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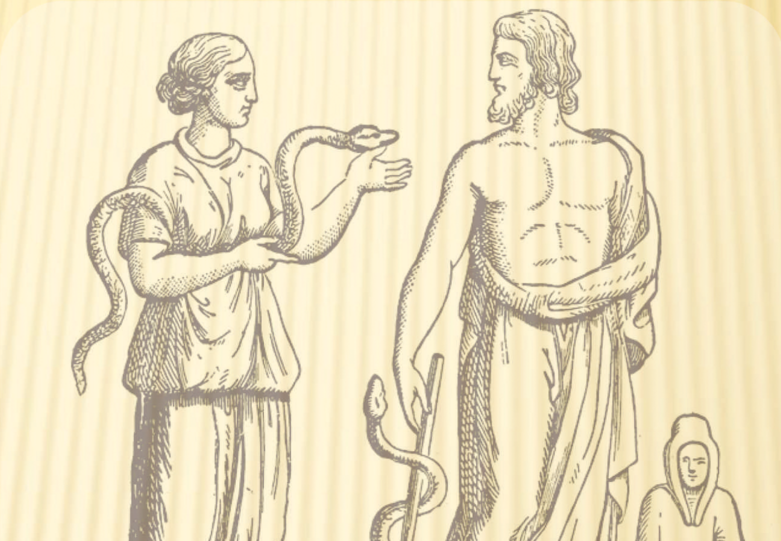
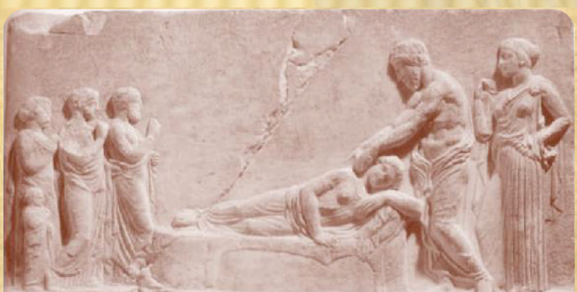
prof. Ivet KOLEVA &
prof. Elena AVRAMESCU

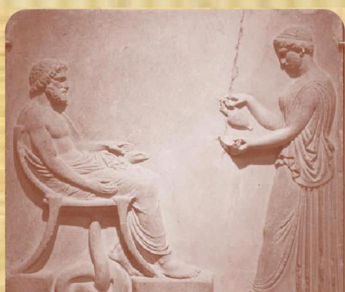
GRASP AND GAIT REHABILITATION

(BASES)



Sofia, 2017





GRASP AND GAIT REHABILITATION

(BASES)

Monograph

Edited by

prof. IB KOLEVA, MD, PhD, DMedSc and prof. ET AVRAMESCU, MD, PhD

Sofia, 2017

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Monograph
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INTRODUCTION

The World Report on Disability defines the **goals of rehabilitation**: prevention of the loss of function; slowing the rate of loss of function; *improvement or restoration of function;* compensation for lost function; maintenance of current function. **Gait** is an important element of the everyday life functionality of our patients in rehabilitation practice, and is crucial for their independence in activities of daily living, respectively for their autonomy.

Our purpose is to emphasize the potential of some contemporary physical modalities for ***balance training, grasp*** and ***gait recovery***, based on best practices and evidence-based research. Principal clinical and instrumental assessment and treatment methods are stated. Special attention is paid to: *functional electrical stimulations* (with low and middle frequency electric currents); *deep oscillation; manual therapy techniques* (tractions, mobilizations and manipulations); *proprioceptive neuro-muscular facilitation* (PNF) methods; *analytic exercises, device-assisted mechano-therapy* (passive, active or combined), etc. We insist on the importance of *technical aids* (wheelchair, canes, or walking sticks) and *weight bearing* (restricted, fractional or total) during the rehabilitation process. Future possibilities are cited, including potential of *internet-based educational courses*.

We explain some **principles of grasp, balance and gait rehabilitation**, dues to our modest clinical experience (of 30 years) and our own results in patients with conditions of the nervous and motor systems. Special attention is paid to ***neurological and neuro-surgical rehabilitation algorithms*** – *in patients with*: *post stroke hemiparesis, multiple sclerosis, Parkinsonism, traumatic brain injury (TBI), brain tumors, spinal cord injuries (SCI) with paraplegia; lumbo-sacral radiculopathy and diabetic polyneuropathy (DPNP) with femoral, peroneal or / and tibial paresis; or radiculopathies and peripheral paresis after neurosurgical intervention (for spinal trauma and discal hernia).*

Authors suggest '*Guidelines of operational standard procedures in **rehabilitation after lower limb orthopedic surgery'***: in patients with *acetabular, inter / trans trochanteric or distal femoral fractures, with* *gamma nail or vis – plaque endoprosthesis; joint replacement of lower extremities (hip and knee arthroplasty); ACL and PCL (anterior and posterior cruciate ligament) alloplasty; total and partial meniscectomy*. Rehabilitation protocols for patients with *trans-femoral and trans-tibial amputations* are proposed.

Our rehabilitation algorithms and guidelines are not intended to be construed or to serve as a standard of care. Standards of care are determined on the basis of all clinical data available for an individual case and are subject to change as scientific knowledge and technology advance and patterns of care evolve.

Typical and atypical clinical cases are presented, including patients with comorbidities, complex or multiple fractures, common or rare complications.

For effective gait rehabilitation the inclusion of a multi-professional therapeutic and **rehabilitation team** is obligatory**.** *Different models of organization of the teamwork* of the staff are applied*:* ***interdisciplinary*** (complex care of the patient from different scientific and professional disciplines); ***multi-disciplinary*** (role of every professional is completely independent from the others); ***transdisciplinary*** (everyone helps the work of the others; role and functions are distributed). We consider that the clinical practice imposes the necessity of transition from a multi-disciplinary to a transdisciplinary model of team work, with a clear definition of the fields of competence and the responsibility of the team members. In Bulgarian rehabilitation practice traditionally a lot of specialists are included: *medical doctors – specialists* in Neurology, Neurosurgery; Rheumatology; Orthopedics and Traumatology and in Physical and Rehabilitation Medicine (PRM); *bachelors and masters* in Physical Therapy and in Occupational therapy (Kinesio-therapy and Ergo-therapy – according nomenclature of some countries, e.g. Bulgaria and Romania).

Part 1.

GRASP AND GAIT:

DEFINITIONS.

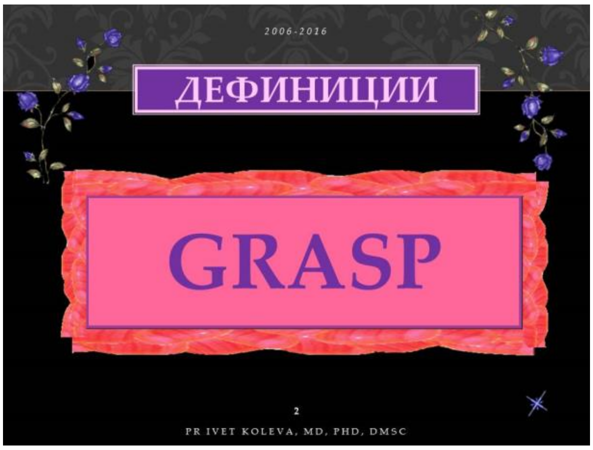
METHODS OF

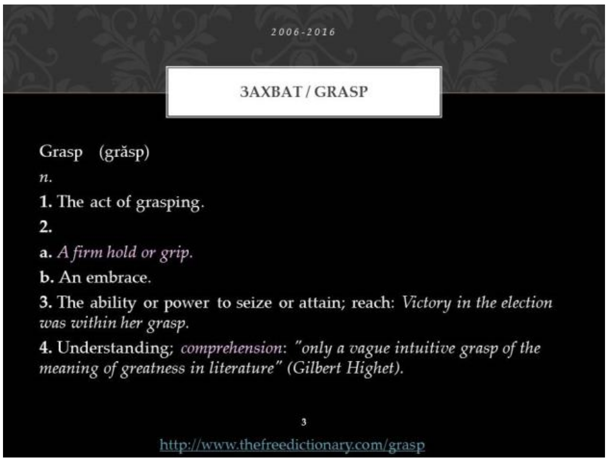
ASSESSMENT AND

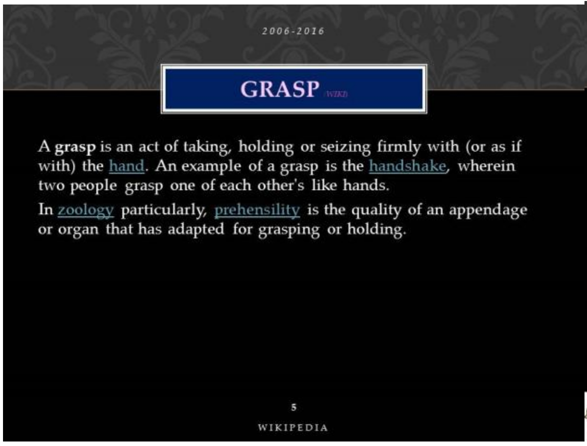
REHABILITATION.

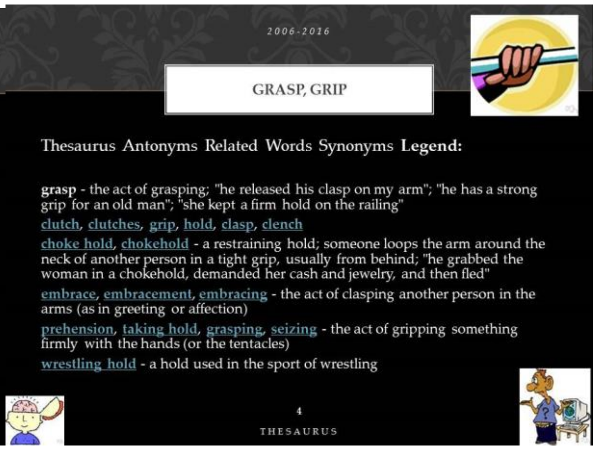
GRASP & GAIT: BASES OF THE ANALYSIS

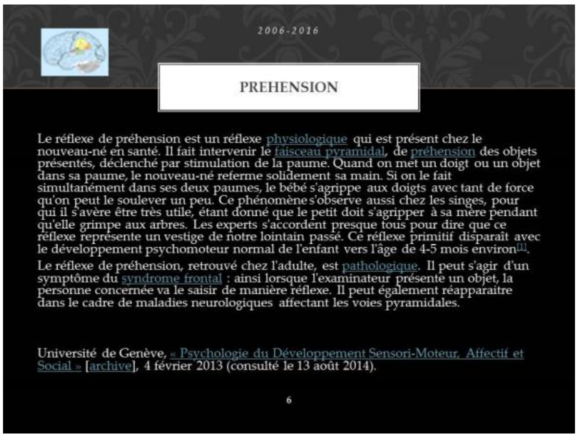
Ivet KOLEVA



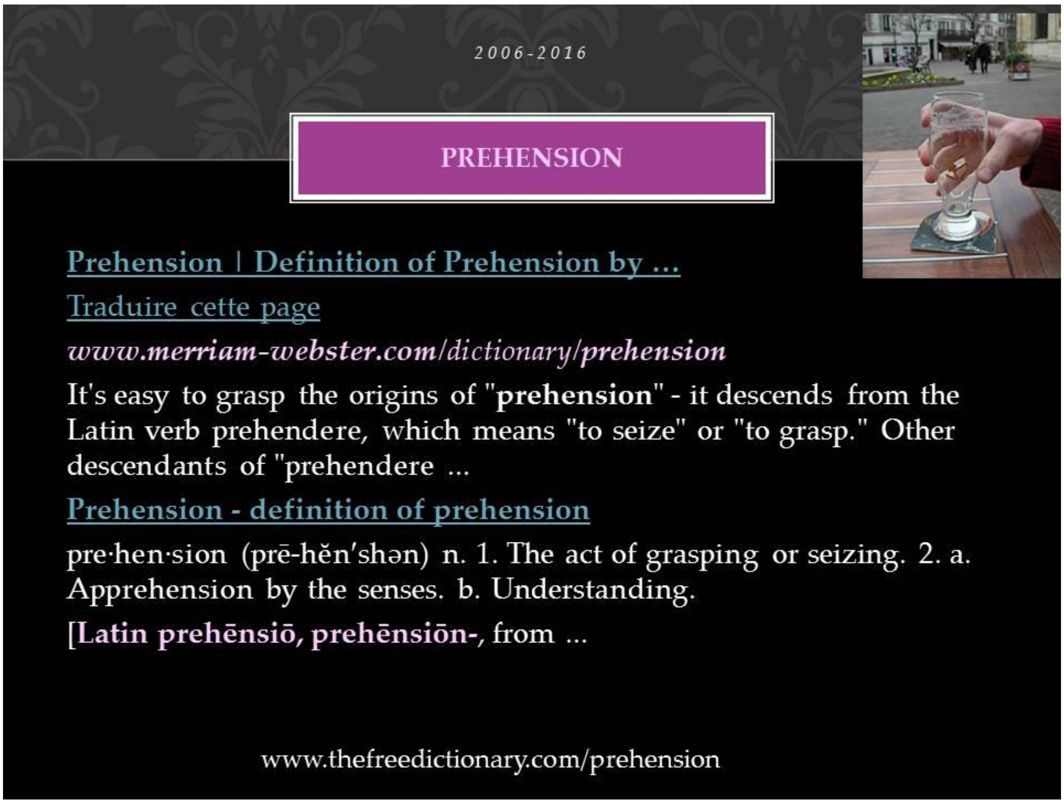


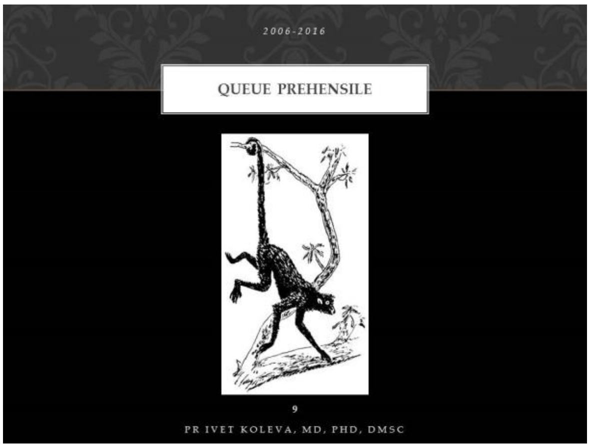





2006-2016
PREHENSION
Le réflexe de préhension est un réflexe physiologique qui est présent chez le nouveau-né en santé. Il fait intervenir le faisceau pyramidal, de préhension des objets présentés, déclenché par stimulation de la paume. Quand on met un doigt ou un objet dans sa paume, le nouveau-né referme solidement sa main. Si on le fait simultanément dans ses deux paumes, le bébé s'agrippe aux doigts avec tant de force qu'on peut le soulever un peu. Ce phénomène s'observe aussi chez les singes, pour qui il s'avère être très utile, étant donné que le petit doit s'agripper à sa mère pendant qu'elle grimpe aux arbres. Les experts s'accordent presque tous pour dire que ce réflexe représente un vestige de notre lointain passé. Ce réflexe primitif disparaît avec le développement psychomoteur normal de l'enfant vers l'âge de 4-5 mois environ[1].
Le réflexe de préhension, retrouvé chez l'adulte, est pathologique. Il peut s'agir d'un symptôme du syndrome frontal : ainsi lorsque l'examinateur présente un objet, la personne concernée va le saisir de manière réflexe. Il peut également réapparaitre dans le cadre de maladies neurologiques affectant les voies pyramidales.
Université de Genève, « Psychologie du Développement Sensori-Moteur, Affectif et Social » [archive], 4 février 2013 (consulté le 13 août 2014).
6


2006-2016
GRIP
grip (grĭp)
n.
1.
a. A tight hold; a firm grasp: a drowning swimmer now safely in the grip of a lifeguard.
b. The pressure or strength of such a grasp: a wrestler with an unmatched grip.
c. A manner of grasping and holding: The crate afforded no comfortable grip.
7
http://www.thefreedictionary.com/grip


2006-2016
PREHENSION
Prehension | Definition of Prehension by ...
Traduire cette page
www.merriam-webster.com/dictionary/prehension
It's easy to grasp the origins of "prehension" - it descends from the Latin verb prehendere, which means "to seize" or "to grasp." Other descendants of "prehendere ...
Prehension - definition of prehension
pre·hen·sion (prē-hĕn′shən) n. 1. The act of grasping or seizing. 2. a. Apprehension by the senses. b. Understanding.
[Latin prehēnsiō, prehēnsiōn-, from ...
www.thefreedictionary.com/prehension


2006-2016
QUEUE PREHENSILE
9
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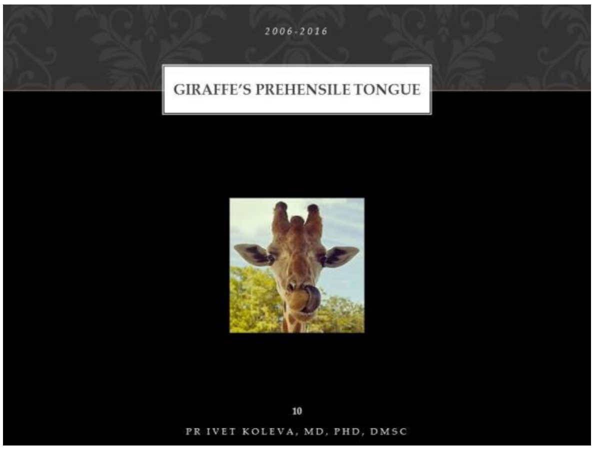
2006-2016
GIRAFFE'S PREHENSILE TONGUE
10
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2006-2016

PREHENSION AND GRASP PATTERNS

- **Fingertip Prehension** ("tip-to-tip pinch")
-
- **Palmar Prehension** ("three claw chunk")
- **Lateral Prehension**
- **Cylindrical Grasp**
- **Spherical Grasp**
- **Hook Grasp**

https://quizlet.com/24833266/prehension-and-grasp-patterns-flash-cards/

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2006-2016

SPECIAL GRASPS

The Dynamic Tripod Grasp

http://www.otplan.com/articles/pencil-grasp-patterns.aspx

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2006-2016

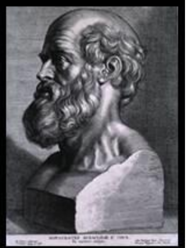
MEDICAL TERMS

grasp : the ability of the digits to seize, often for holding, securing, picking up objects

- synonym: *prehension or grip*
-

conventional classification: based on function

- *power grip (grip)* : for strength
- *prehension grip (pinch)* : for precision



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NEUMANN'S CLASSIFICATION : BASED ON THE NUMBER OF DIGITS INVOLVED AND PURPOSE OF TASK

NEUMANN'S CLASSIFICATION			CONVENTIONAL CLASSIFICATION
by digits involved	by purpose of task	examples	
grip *(all digits are used)*	power grip	*holding a hammer*	power grip
	precision grip	*holding an egg*	
pinch *(primarily use thumb and index)*	power pinch (key pinch)	*holding a key*	prehension grip
	precision pinch	*holding a pin*	
hook grip *(grip without thumb)*	-	*holding a suitcase*	power grip

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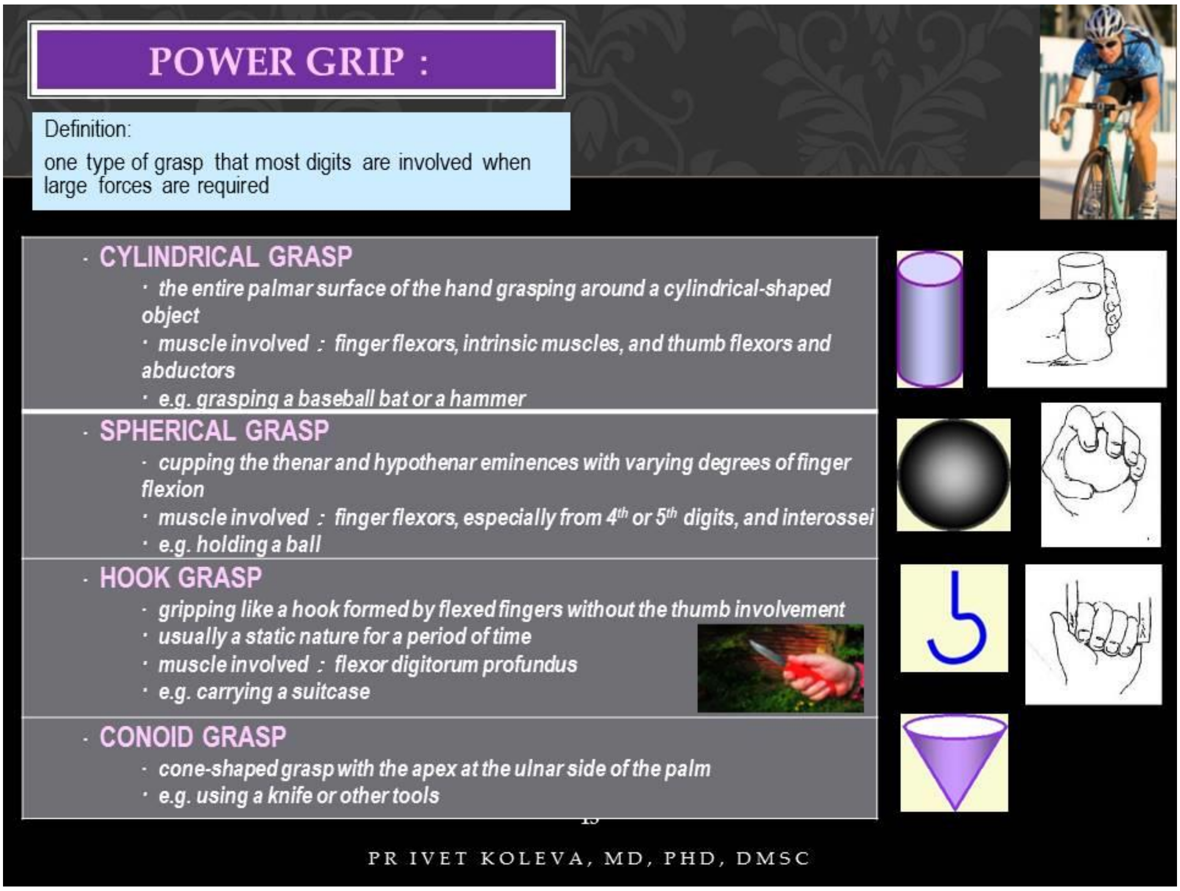
POWER GRIP :
Definition:
one type of grasp that most digits are involved when large forces are required
CYLINDRICAL GRASP
the entire palmar surface of the hand grasping around a cylindrical-shaped object
muscle involved : finger flexors, intrinsic muscles, and thumb flexors and abductors
e.g. grasping a baseball bat or a hammer
SPHERICAL GRASP
cupping the thenar and hypothenar eminences with varying degrees of finger flexion
muscle involved : finger flexors, especially from 4th or 5th digits, and interossei
e.g. holding a ball
HOOK GRASP
gripping like a hook formed by flexed fingers without the thumb involvement
usually a static nature for a period of time
muscle involved : flexor digitorum profundus
e.g. carrying a suitcase
CONOID GRASP
cone-shaped grasp with the apex at the ulnar side of the palm
e.g. using a knife or other tools
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2006-2016
NONPREHENSILE MOVEMENTS
Involve pushing or lifting an object with the fingers or the entire hand.
https://quizlet.com/19922060/grasp-patterns-flash-cards/
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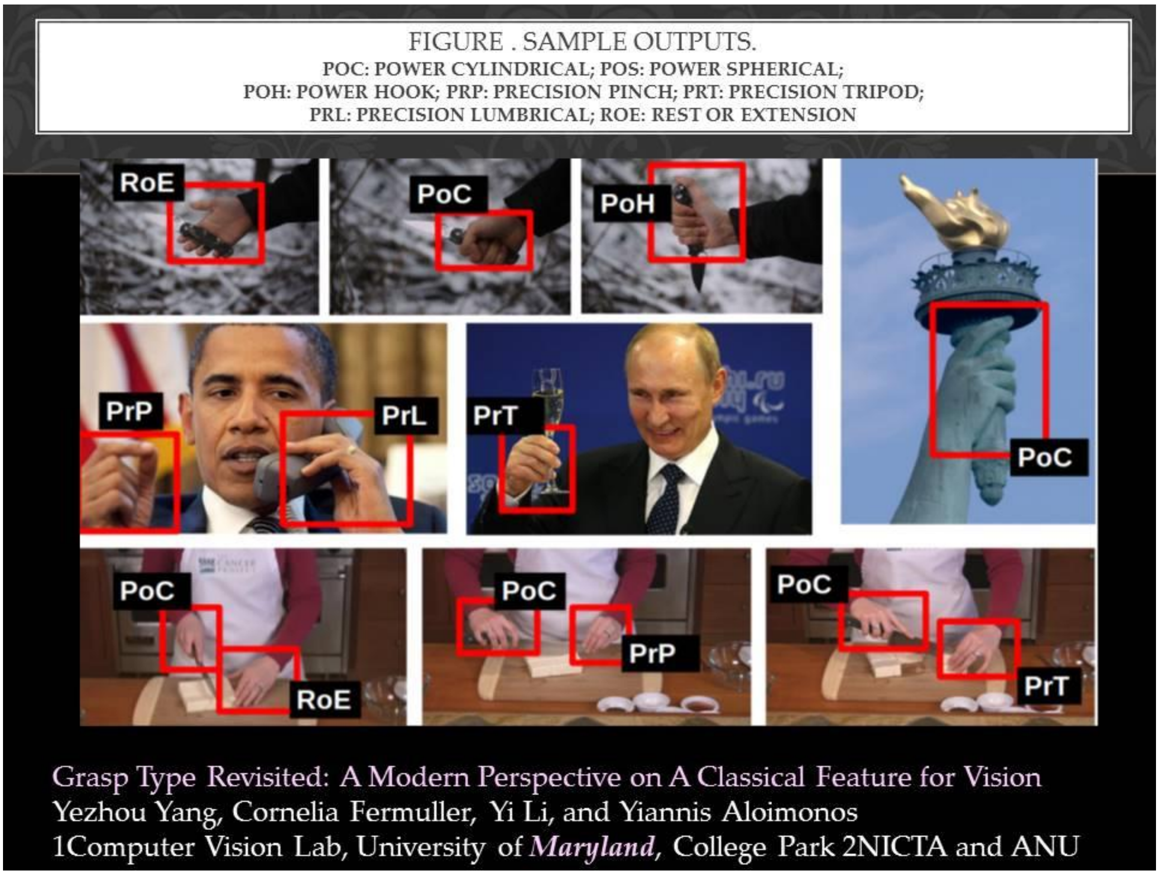
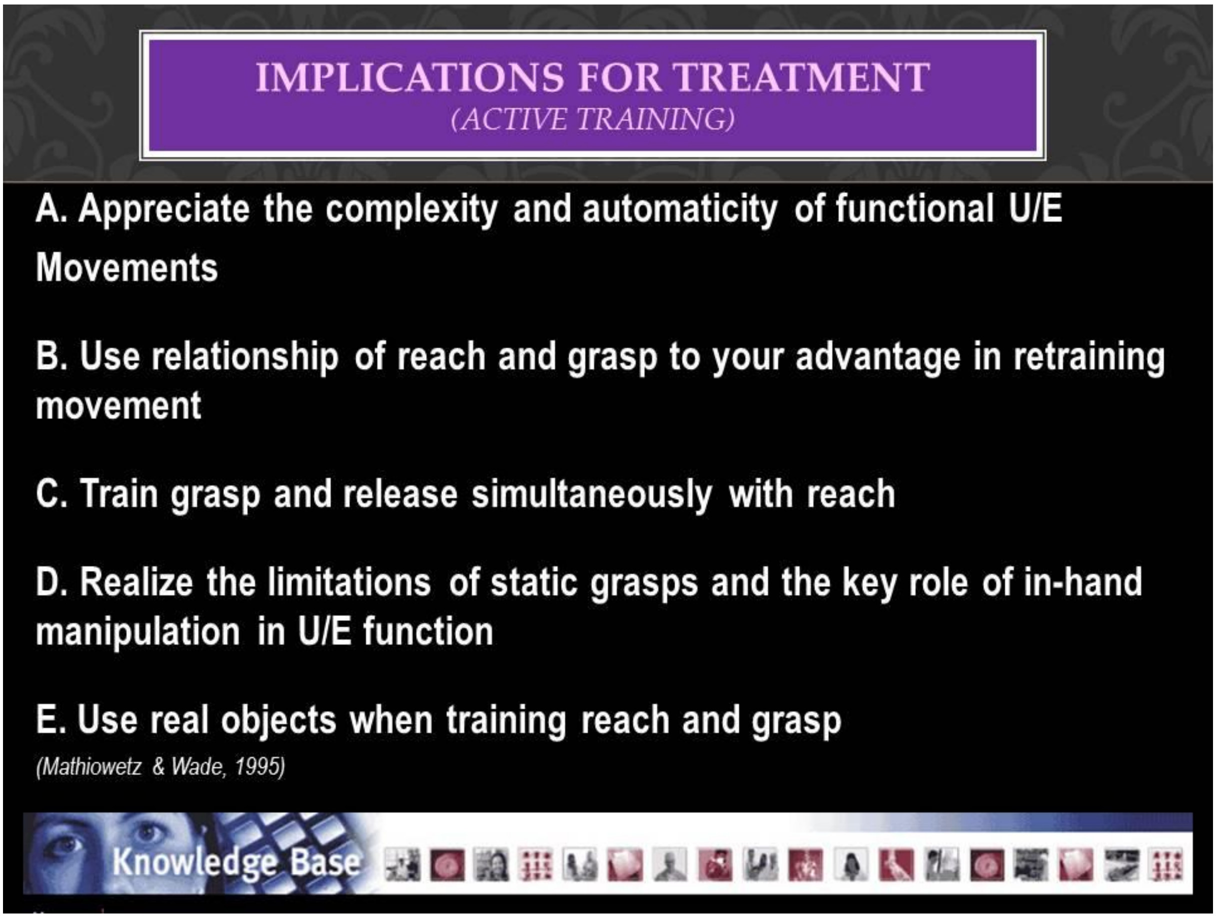


FIGURE . SAMPLE OUTPUTS.
POC: POWER CYLINDRICAL; POS: POWER SPHERICAL;
POH: POWER HOOK; PRP: PRECISION PINCH; PRT: PRECISION TRIPOD;
PRL: PRECISION LUMBRICAL; ROE: REST OR EXTENSION
RoE
PoC
PoH
PoC
PrP
PrL
PrT
PoC
RoE
PoC
PrP
PoC
PrT
Grasp Type Revisited: A Modern Perspective on A Classical Feature for Vision
Yezhou Yang, Cornelia Fermuller, Yi Li, and Yiannis Aloimonos
1Computer Vision Lab, University of *Maryland*, College Park 2NICTA and ANU


THE GRASP TYPES CONSIDERED.
GRASPS WHICH CANNOT BE CATEGORIZED INTO THE SIX TYPES HERE ARE CONSIDERED AS THE "REST AND EXTENSION" (NO GRASPING PERFORMED).
Power
Precision
Cylindrical
Spherical
Hook
Pinch
Tripod
Lumbrical


IMPLICATIONS FOR TREATMENT
(ACTIVE TRAINING)
A. Appreciate the complexity and automaticity of functional U/E Movements
B. Use relationship of reach and grasp to your advantage in retraining movement
C. Train grasp and release simultaneously with reach
D. Realize the limitations of static grasps and the key role of in-hand manipulation in U/E function
E. Use real objects when training reach and grasp
(Mathiowetz & Wade, 1995)
Knowledge Base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2006-2016
GRASP ACTIVITIES
Functional training of:
Pincer Grasp
Bilateral Hand Use
Pre writing
Writing
Hand Dexterity
Grasp
In-hand Manipulation
Thumb Opposition
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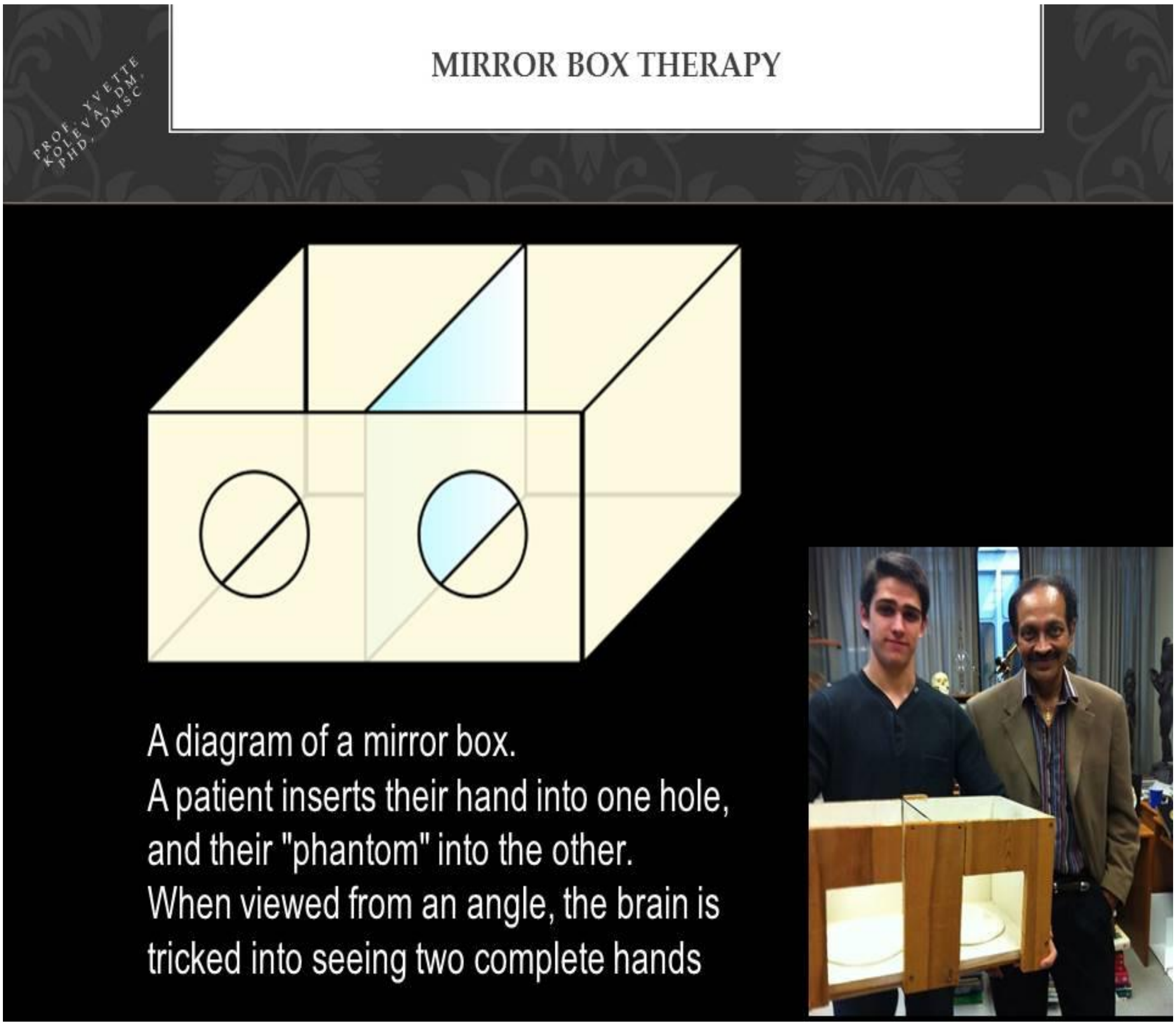
PROF. YVETTE KOLEVA, DM, PHD, DMSC
MIRROR BOX THERAPY
A diagram of a mirror box.
A patient inserts their hand into one hole,
and their "phantom" into the other.
When viewed from an angle, the brain is
tricked into seeing two complete hands


MIRROR BOX
QUANTITY DISCOUNT AVAILABLE ON THIS PRODUCT
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MD, PHD, DMSC


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MIRROR HAND THERAPY
23


2006-2016
GAIT
24
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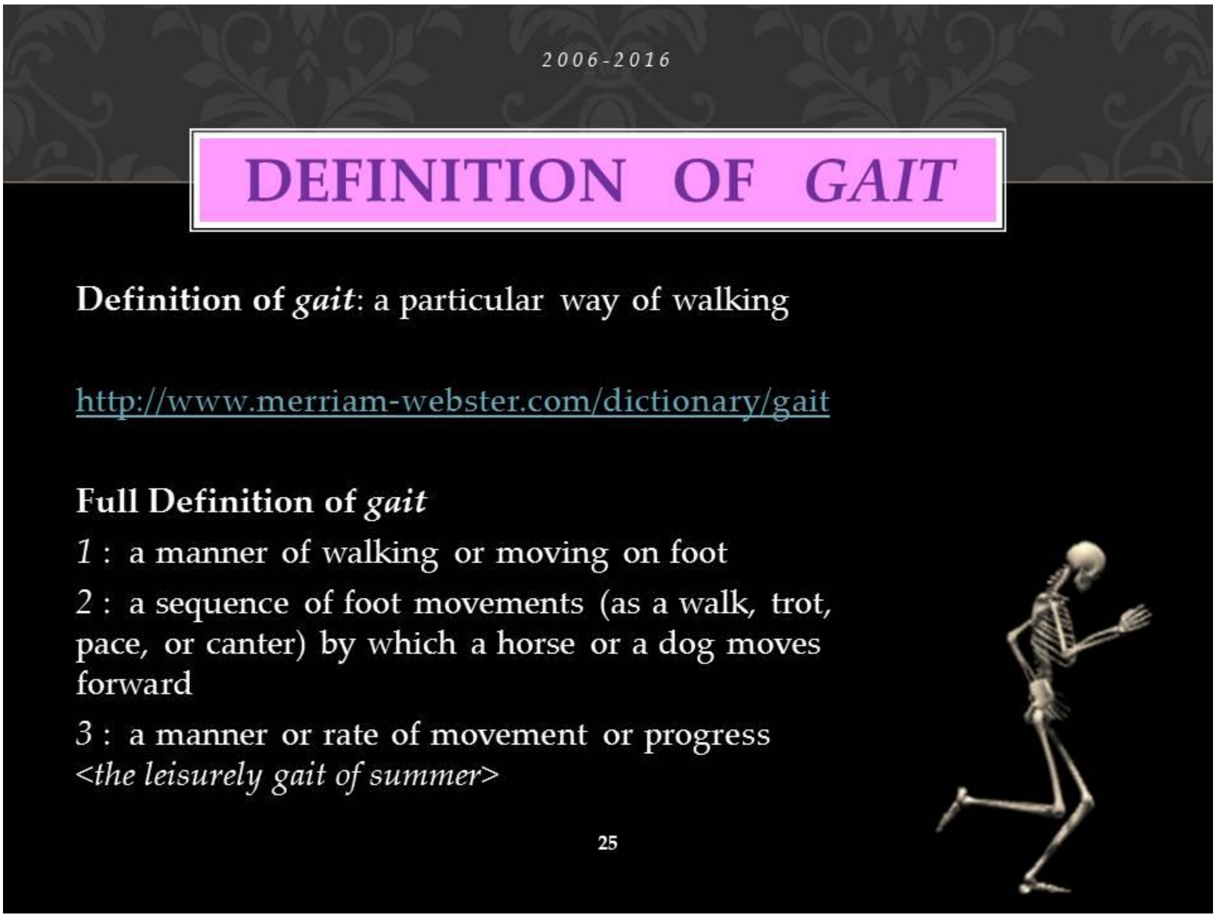
2006-2016
DEFINITION OF *GAIT*
Definition of *gait*: a particular way of walking
http://www.merriam-webster.com/dictionary/gait
Full Definition of *gait*
1 : a manner of walking or moving on foot
2 : a sequence of foot movements (as a walk, trot, pace, or canter) by which a horse or a dog moves forward
3 : a manner or rate of movement or progress
<*the leisurely gait of summer*>
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2006-2016

GAIT ANALYSIS

evaluation of the manner or style of walking, usually done by observing the individual walking naturally in a straight line. The normal forward step consists of two phases: the *stance phase*, during which one leg and foot are bearing most or all of the body weight, and the *swing phase*, during which the foot is not touching the walking surface and the body weight is borne by the other leg and foot. In a complete two-step cycle both feet are in contact with the floor at the same time for about 25 per cent of the time. This part of the cycle is called the *double-support phase*.

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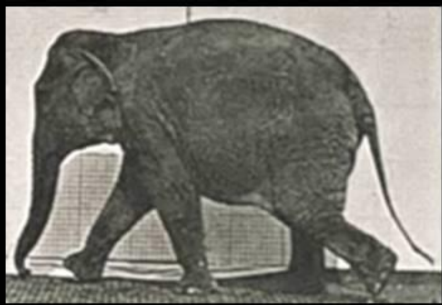

BIPEDAL WALKING

The gait cycle is a repetitive pattern involving steps and strides. A step is one single step, a stride is a whole gait cycle. The step time is the time from one foot hitting the floor to the other foot hitting the floor. Step width can be described as the mediolateral space between the two feet.

There are some differences between the gait and run cycle - the gait cycle is one third longer in time, the ground reaction force is smaller in the gait cycle (so the load is lower), and the velocity is much higher. In running, there is also just one stance phase while in stepping there are two. Shock absorption is also much larger in comparison to walking. This explains why runners have more overload injuries.

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THE GAIT CYCLE

The sequences for walking that occur may be summarized as follows:

- *Registration and activation of the gait command within the central nervous system*
- *Transmission of the gait systems to the peripheral nervous system*
- *Contraction of muscles*
- *Generation of several forces*
- *Regulation of joint forces and moments across synovial joints and skeletal segments*
- *Generation of ground reaction forces*

Classification of the gait cycle involves two main phases:

the stance phase and the swing phase.

The stance phase occupies 60% of the gait cycle while the swing phase occupies only 40% of it. Gait involves a combination of open- and close-chain activities.

A more detailed classification of gait recognizes six phases:

- ✓ *Heel Strike*
- ✓ *Foot Flat*
- ✓ *Mid-Stance*
- ✓ *Heel-Off*
- ✓ *Toe-Off*
- ✓ *Mid-Swing*

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The six phases:
Heel Strike
Foot Flat
Mid-Stance
Heel-Off
Toe-Off
Mid-Swing

2006-2016

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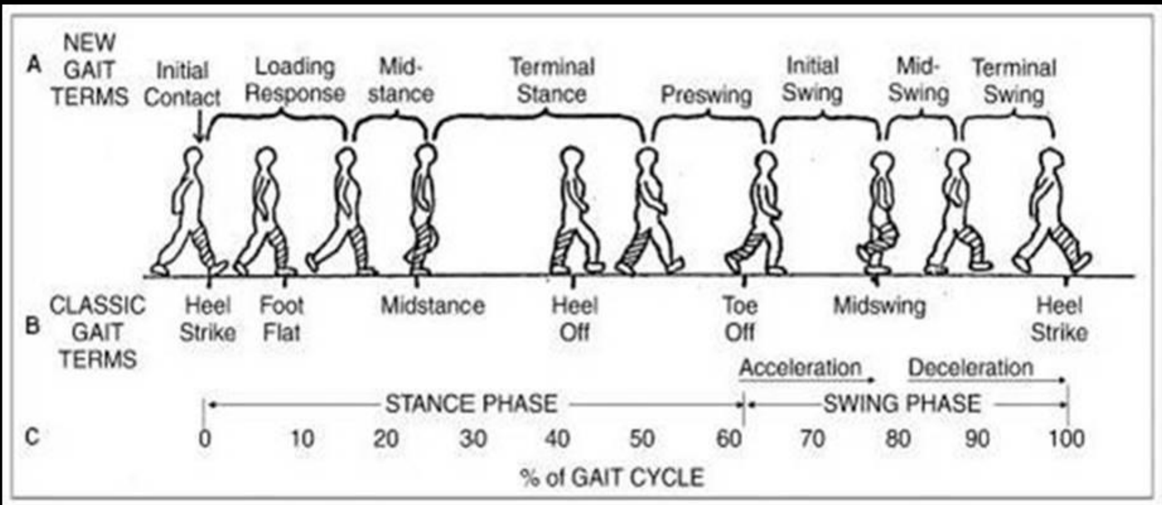
SIX PHASES CLASSIFICATION

Figure : Snijders CJ et al, Het Gaan, (https://eduweb.hhs.nl/~bergwandelen/onderzoek.htm), 1995.

- *Initial Contact*
- *Loading Response*
- *Midstance*
- *Terminal Stance*
- *Pre swing*
- *Initial Swing*
- *Mid Swing*
- *Late Swing*

CLASSIFICATION WITH 8 PHASES



Demos, Gait analysis, (http://www.ncbi.nlm.nih.gov/books/NBK27235/), 2004.

A TYPICAL GAIT CYCLE

- the duration that occurs from the time when the heel of one leg strikes the ground to the time at which the same leg contacts the ground again
- 2 phases
- *stance phase (62%)*
- *swing phase (38%)*
- A typical gait cycle lasts 1-2 sec, depending on speed.

Phases of A Typical Gait Cycle

Source:

Hamilton, N., & Luttgens, K., 2002. Kinesiology, Scientific Basis of Human Motion, 10th ed. Madison, WI, Brown & Benchmark. Chapter 19, pp. 467-494.

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The gait *(walking)* cycle

Phase of the cycle	Period	Comment
Stance phase (60%)	Contact	From heel strike to foot flat Foot unlocks to act as a shock absorber and adapt to irregularities in the ground surface
	Midstance	From foot flat to heel lift The total weight-bearing surface of the foot is in contact with the walking surface
	Propulsion	From heel lift to toe off Foot is a rigid and stable lever
Swing phase (40%)		From toe off limb 1 to heel strike (limb 1) Body mass transfers from limb 1 to limb 2

Source:

Simoneau G.G., 2002. Kinesiology of Walking. - In: Neumann, D.A. (ed). Kinesiology of the Musculoskeletal System: Foundations for Physical Rehabilitation. St. Louis, Missouri: Mosby. pp. 523-569.

2006-2016

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STANCE PHASE (SUPPORT PHASE)

- the duration when the foot in contact with the ground
- the duration from heel strike to toe off
- 3 subphases
- **INITIAL CONTACT PERIOD**: from heel strike to foot flat
- **MIDSTANCE PERIOD**: from foot flat to heel off
- **PROPULSIVE PERIOD**: from heel off to toe off

Source:

Hamilton, N., & Luttgens, K., 2002. Kinesiology, Scientific Basis of Human Motion, 10th ed. Madison, WI, Brown & Benchmark. Chapter 19, pp. 467-494.


2006-2016
TIME VARIABLES
stance time
single support time
double support time
swing time
stride or step time
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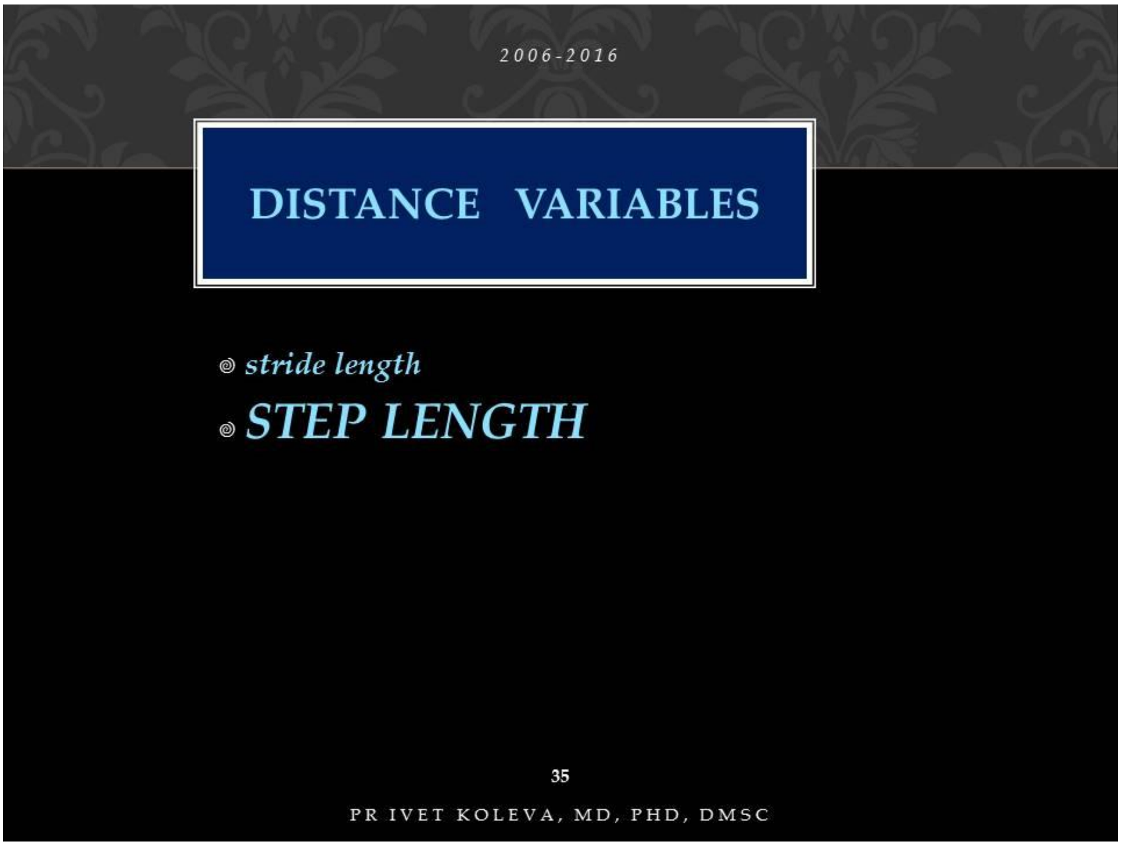
2006-2016
DISTANCE VARIABLES
stride length
STEP LENGTH
35
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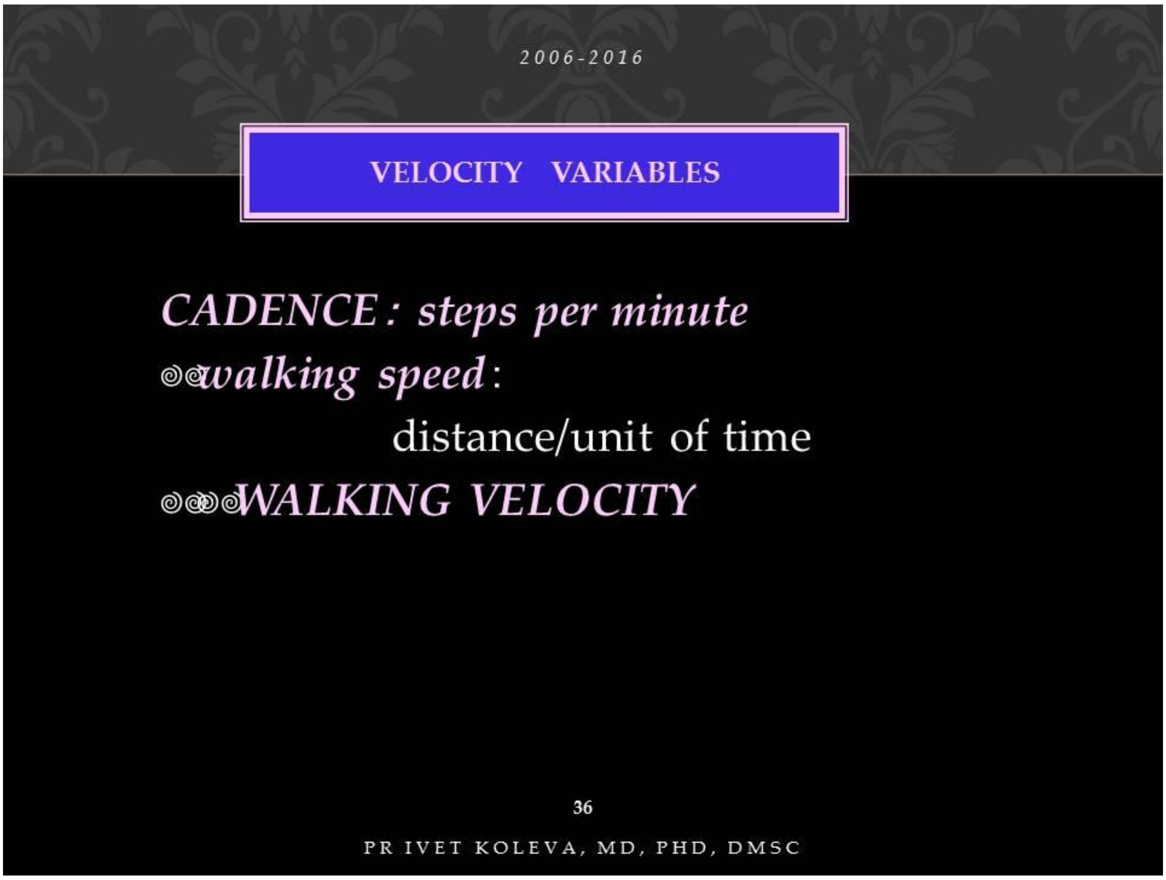
2006-2016
VELOCITY VARIABLES
CADENCE : steps per minute
walking speed :
distance/unit of time
WALKING VELOCITY
36
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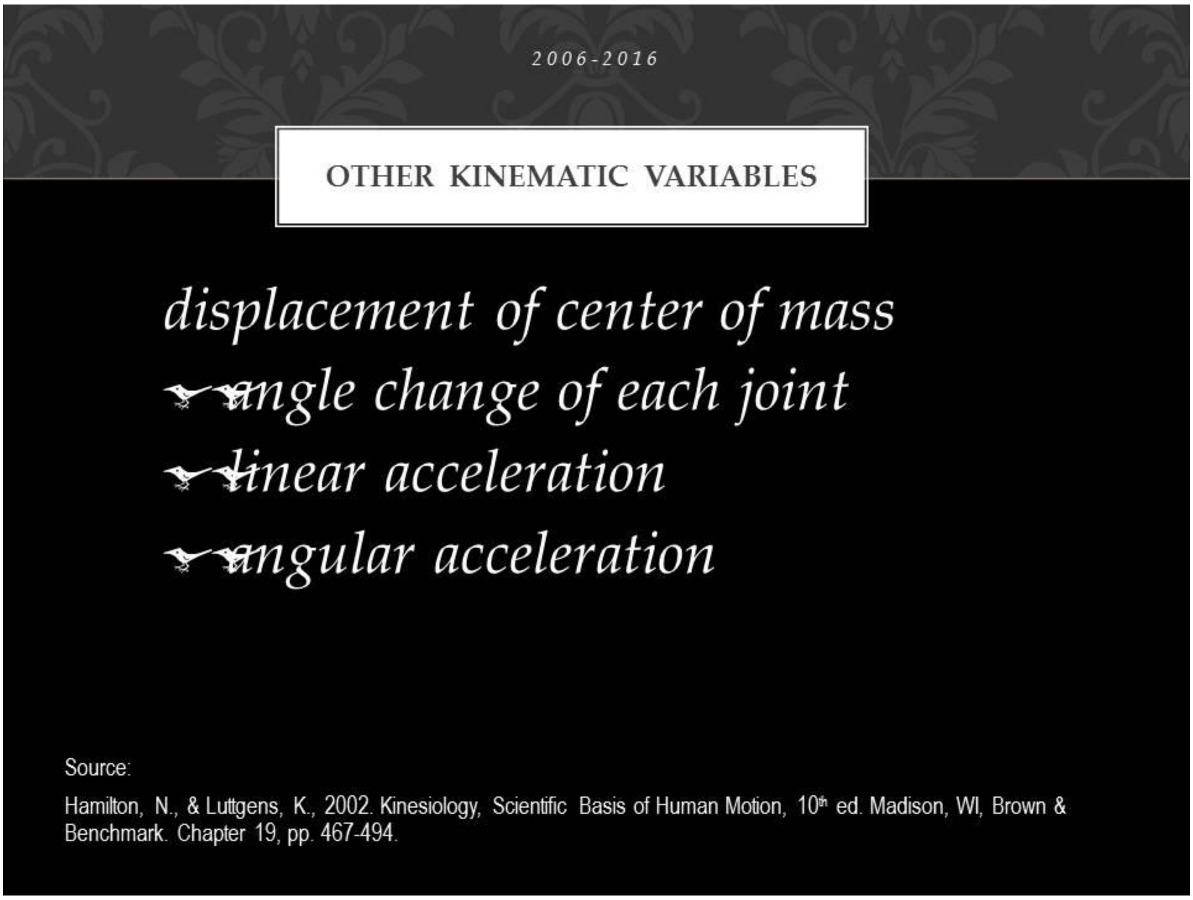
2006-2016
OTHER KINEMATIC VARIABLES
displacement of center of mass
angle change of each joint
linear acceleration
angular acceleration
Source:
Hamilton, N., & Luttgens, K., 2002. Kinesiology, Scientific Basis of Human Motion, 10th ed. Madison, WI, Brown & Benchmark. Chapter 19, pp. 467-494.

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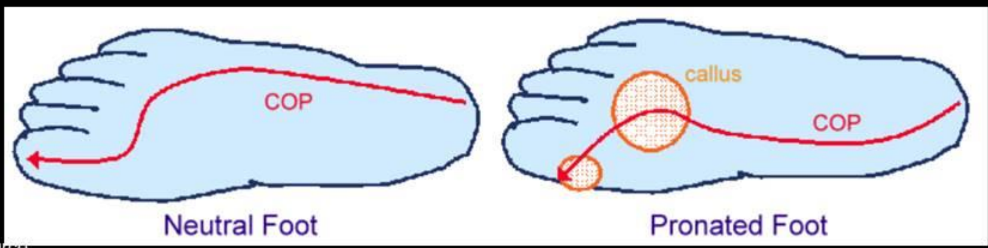
TRAJECTORY OF CENTER OF PRESSURE

- At heel strike, the COP is located lateral to the midpoint of the heel
- At midestance, the COP moves more laterally
- From heel off to toe off, the COP moves medially from the metatarsal heads to the bog toe



Source:

Hamilton, N., & Luttgens, K., 2002. Kinesiology, Scientific Basis of Human Motion, 10th ed. Madison, WI, Brown & Benchmark. Chapter 19, pp. 467-494.

2006-2016

PATHOLOGICAL GAIT

Pathological gait is an altered gait pattern due to deformities, weakness or other impairments, for example, loss of motor control or pain. Alterations can broadly be divided into neurological or musculoskeletal causes .

MUSCULOSKELETAL CAUSES

- *Hip Pathology*
- *Knee pathology*
- *Foot and ankle pathology*
- *Leg length discrepancy*
- *Pain*

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COMMON NEUROLOGICAL CAUSES OF PATHOLOGICAL GAIT

HEMIPLEGIC GAIT,

DIPLEGIC GAIT.

PARKINSONIAN GAIT

ATAXIC GAIT

MYOPATHIC GAIT.

NEUROPATHIC GAITS. HIGH STEPPING GAIT

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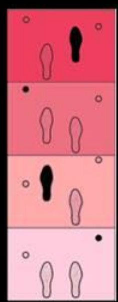
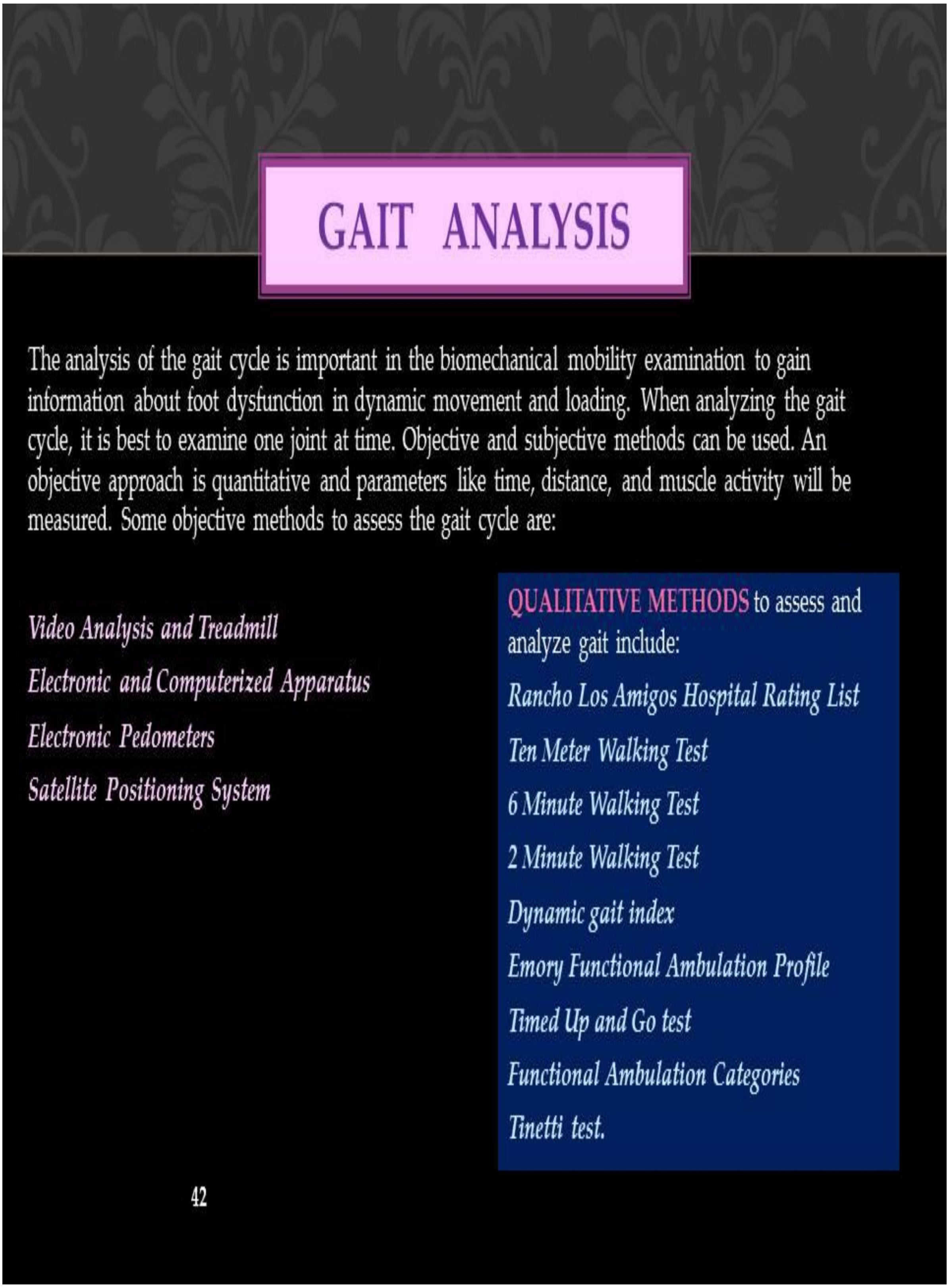
An analysis of each component of the three phases of ambulation is an essential part of the diagnosis of various neurologic disorders and the assessment of patient progress during rehabilitation and recovery from the effects of a neurologic disease, a musculoskeletal injury or disease process, or amputation of a lower limb.

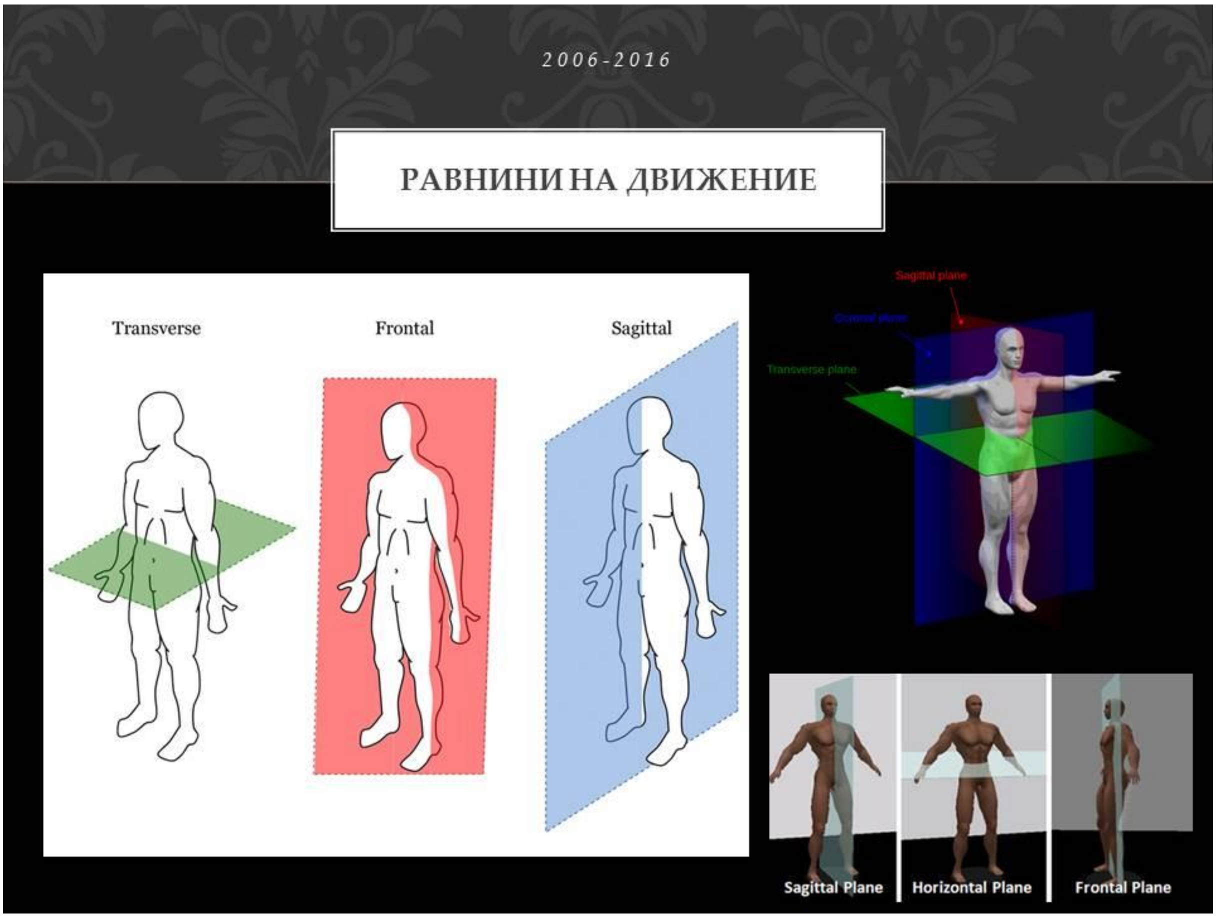
ANTALGIC GAIT ;
ATAXIC GAIT ;
EQUINE GAIT ;.
FESTINATING GAIT (FESTINATION) ;
GLUTEAL GAIT (gluteus medius) ;
HEMIPLEGIC GAIT ;.
OPPENHEIM'S GAIT ;
SCISSORS GAIT ;
SPASTIC GAIT ;
STEPPAGE GAIT ;.
TABETIC GAIT (ataxic gait)

THREE-POINT GAIT
TWO-POINT GAIT ;
WADDLING GAIT
DOUBLE-STEP GAIT ;.
DRAG-TO GAIT ;.
FOUR-POINT GAIT ;
HELICOPOD GAIT
INTERMITTENT DOUBLE-STEP GAIT ;
STUTTERING GAIT ;
SWING-THROUGH GAIT ;.



Miller-Keane Encyclopedia and Dictionary of Medicine, Nursing, and Allied Health, Seventh Edition. © 2003 by Saunders, an imprint of Elsevier, Inc. All rights reserved.


GAIT ANALYSIS
The analysis of the gait cycle is important in the biomechanical mobility examination to gain information about foot dysfunction in dynamic movement and loading. When analyzing the gait cycle, it is best to examine one joint at time. Objective and subjective methods can be used. An objective approach is quantitative and parameters like time, distance, and muscle activity will be measured. Some objective methods to assess the gait cycle are:
Video Analysis and Treadmill
Electronic and Computerized Apparatus
Electronic Pedometers
Satellite Positioning System
QUALITATIVE METHODS to assess and analyze gait include:
Rancho Los Amigos Hospital Rating List
Ten Meter Walking Test
6 Minute Walking Test
2 Minute Walking Test
Dynamic gait index
Emory Functional Ambulation Profile
Timed Up and Go test
Functional Ambulation Categories
Tinetti test.
42


2006-2016
РАВНИНИ НА ДВИЖЕНИЕ
Transverse
Frontal
Sagittal
Sagittal Plane
Horizontal Plane
Frontal Plane


ATLAS
D'ANATOMIE
2006-2016
ОСИ НА ДВИЖЕНИЕ
SAGITTAL PLANE &
SAGITTAL HORIZONTAL AXIS
FRONTAL PLANE &
FRONTAL HORIZONTAL AXIS
TRANSVERSE PLANE &
VERTICAL AXIS
45
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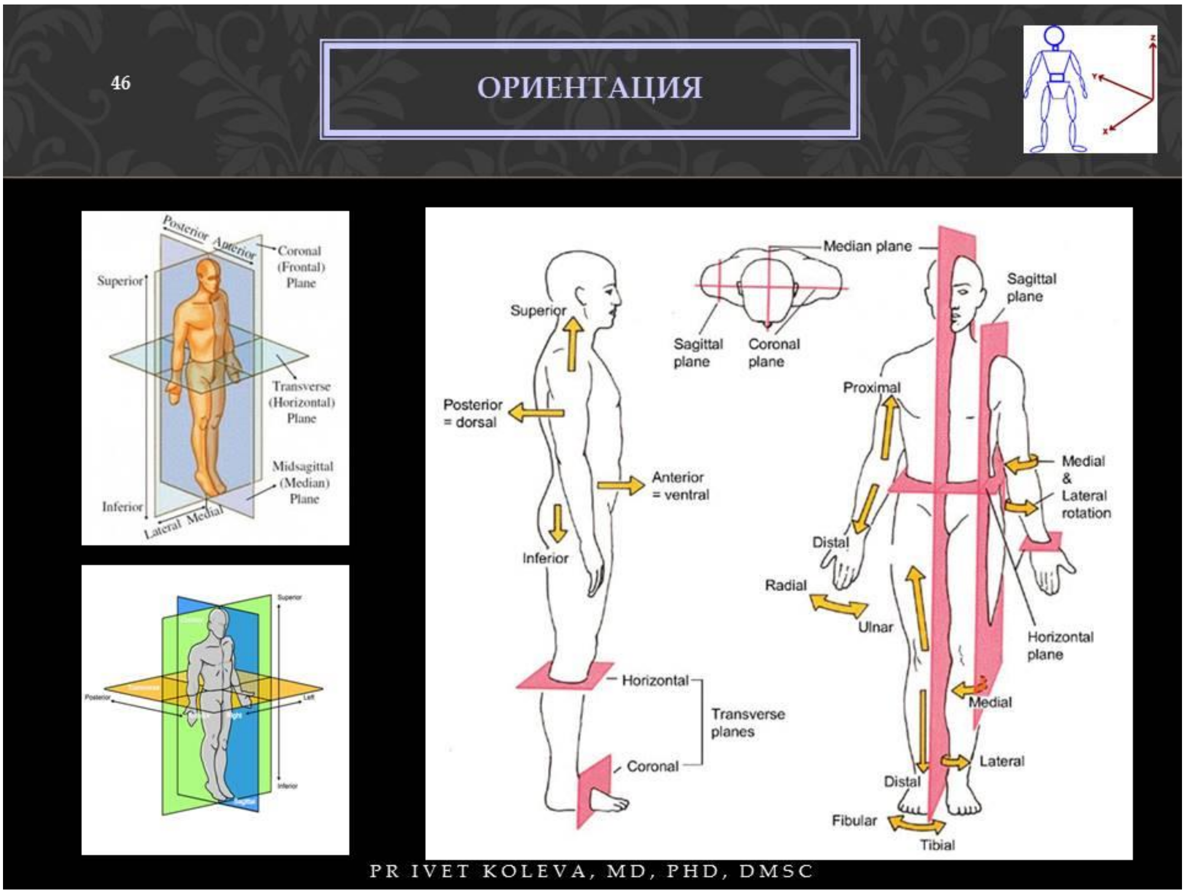
46
ОРИЕНТАЦИЯ
Posterior
Anterior
Coronal (Frontal) Plane
Superior
Transverse (Horizontal) Plane
Midsagittal (Median) Plane
Inferior
Lateral
Medial
Median plane
Sagittal plane
Coronal plane
Superior
Posterior = dorsal
Anterior = ventral
Inferior
Horizontal
Coronal
Transverse planes
Sagittal plane
Proximal
Medial & Lateral rotation
Distal
Radial
Ulnar
Horizontal plane
Medial
Lateral
Distal
Fibular
Tibial
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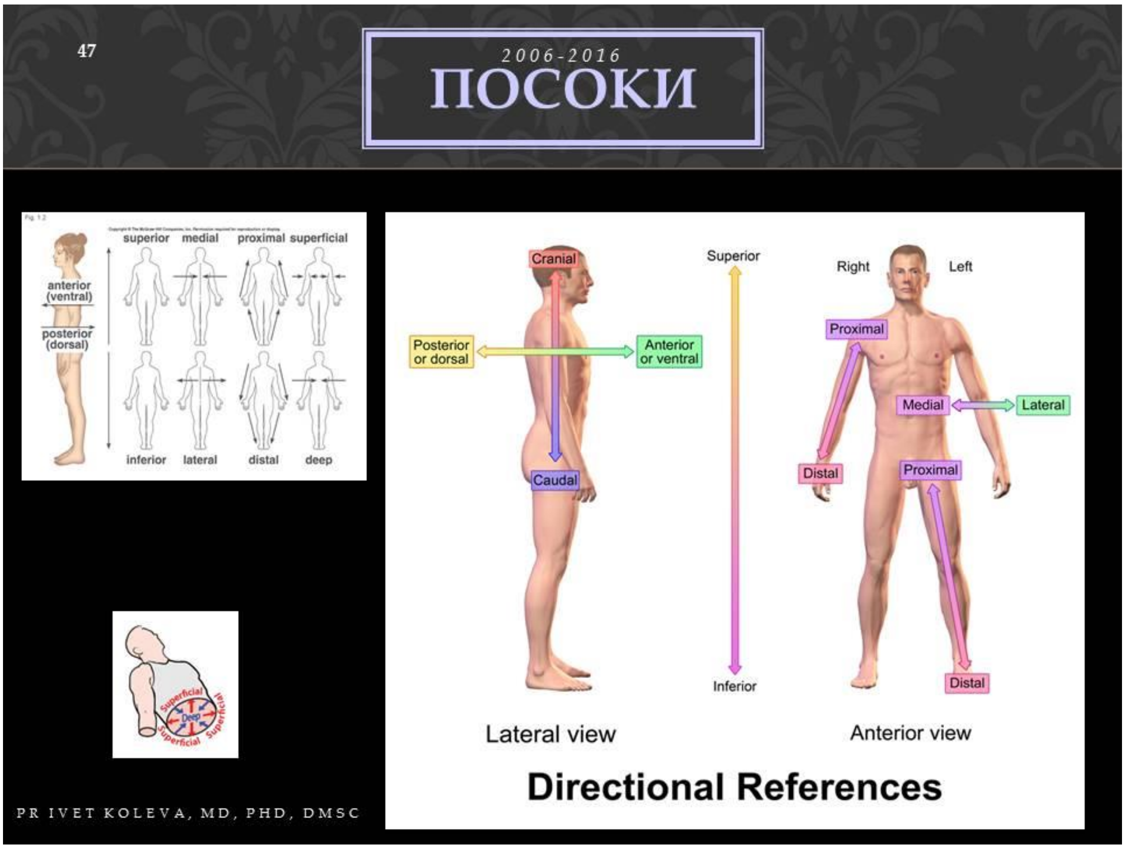
47
2006-2016
ПОСОКИ
anterior (ventral)
posterior (dorsal)
superior
medial
proximal
superficial
inferior
lateral
distal
deep
Superficial
Deep
Cranial
Posterior or dorsal
Anterior or ventral
Caudal
Superior
Inferior
Right
Left
Proximal
Medial
Lateral
Distal
Proximal
Distal
Lateral view
Anterior view
Directional References
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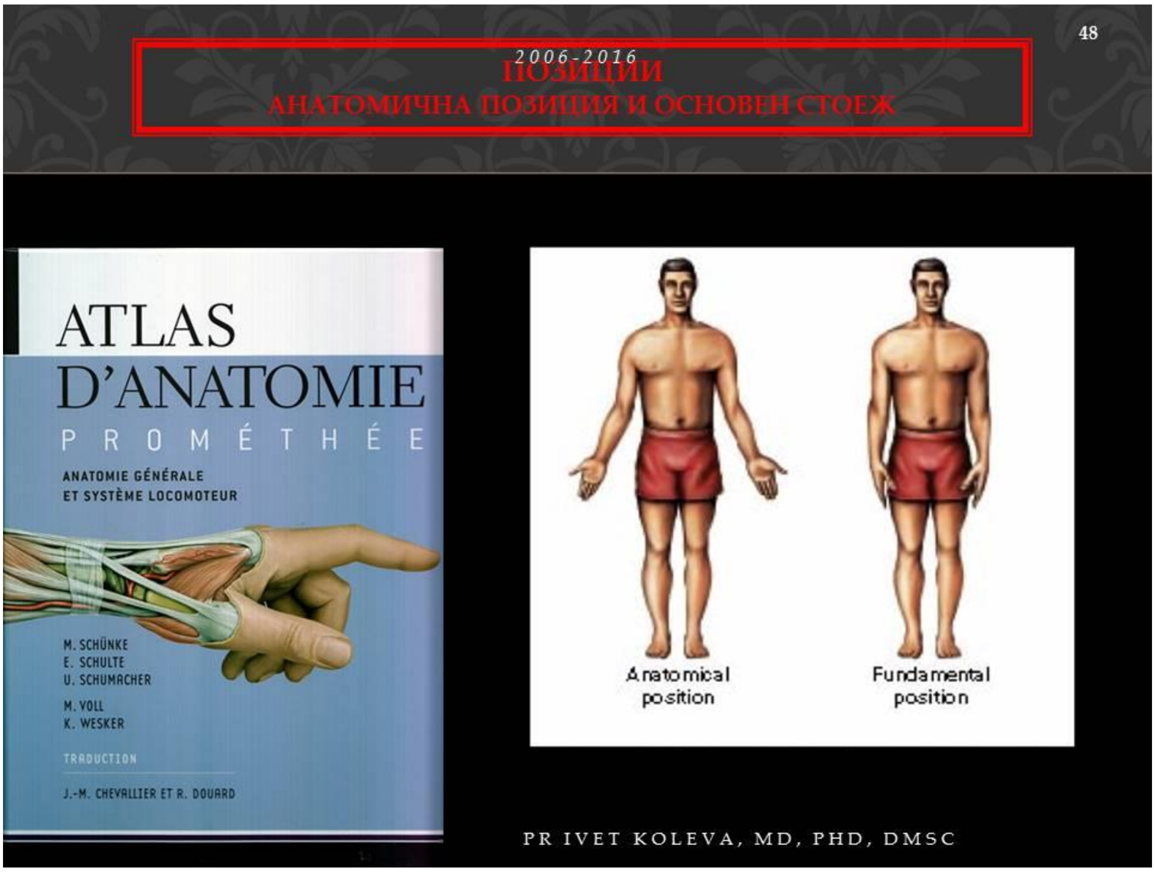
48
2006-2016
ПОЗИЦИИ
АНАТОМИЧНА ПОЗИЦИЯ И ОСНОВЕН СТОЕЖ
ATLAS
D'ANATOMIE
PROMÉTHÉE
ANATOMIE GÉNÉRALE
ET SYSTÈME LOCOMOTEUR
M. SCHÜNKE
E. SCHULTE
U. SCHUMACHER
M. VOLL
K. WESKER
TRADUCTION
J.-M. CHEVALLIER ET R. DOUARD
Anatomical position
Fundamental position
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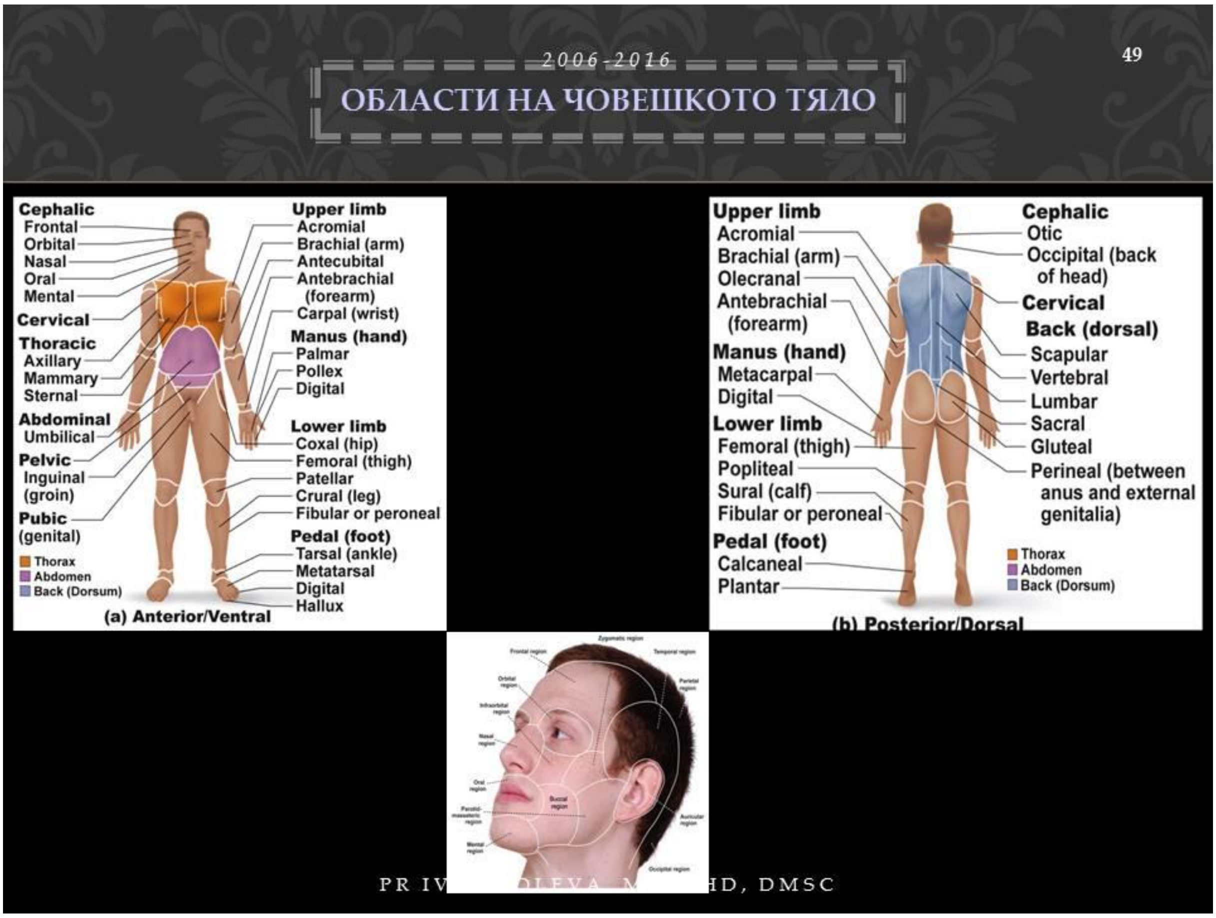
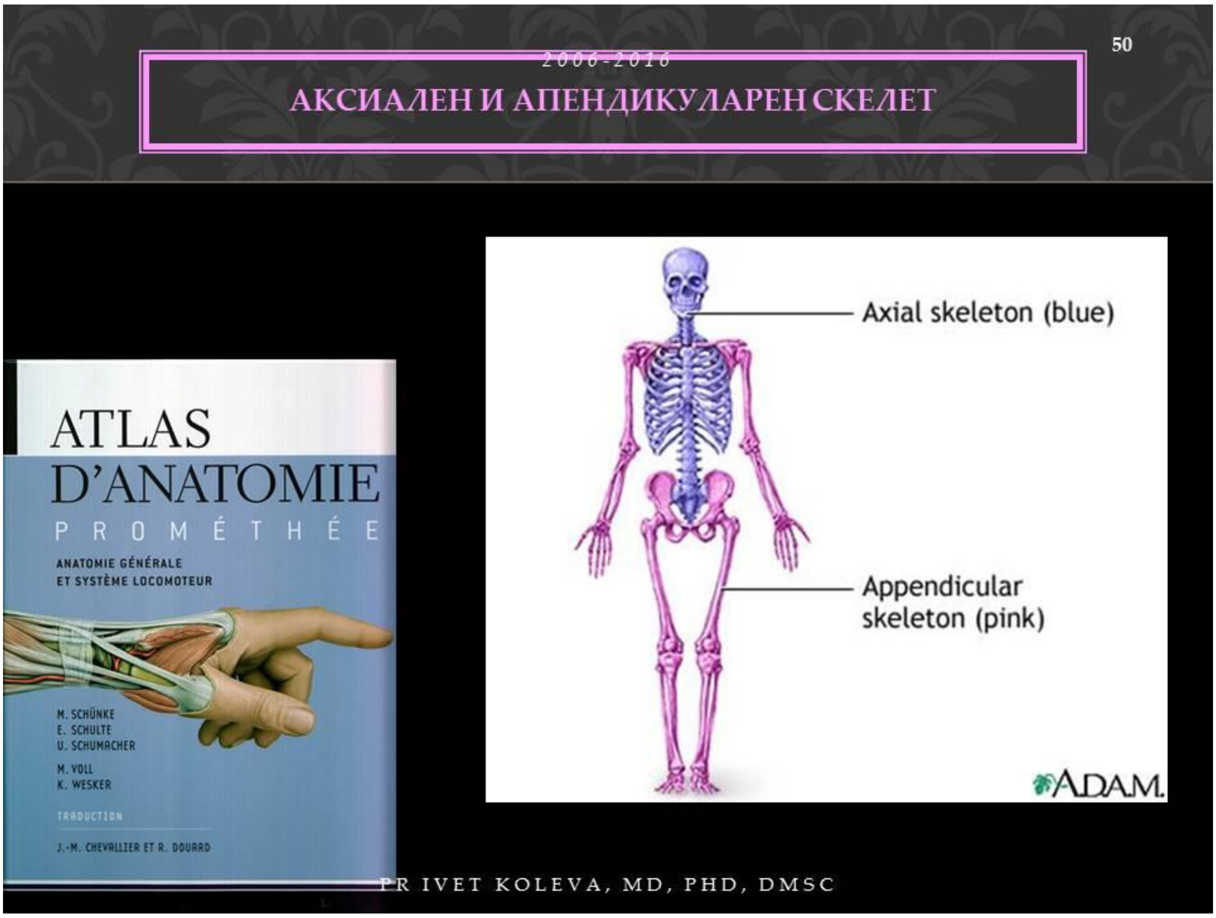
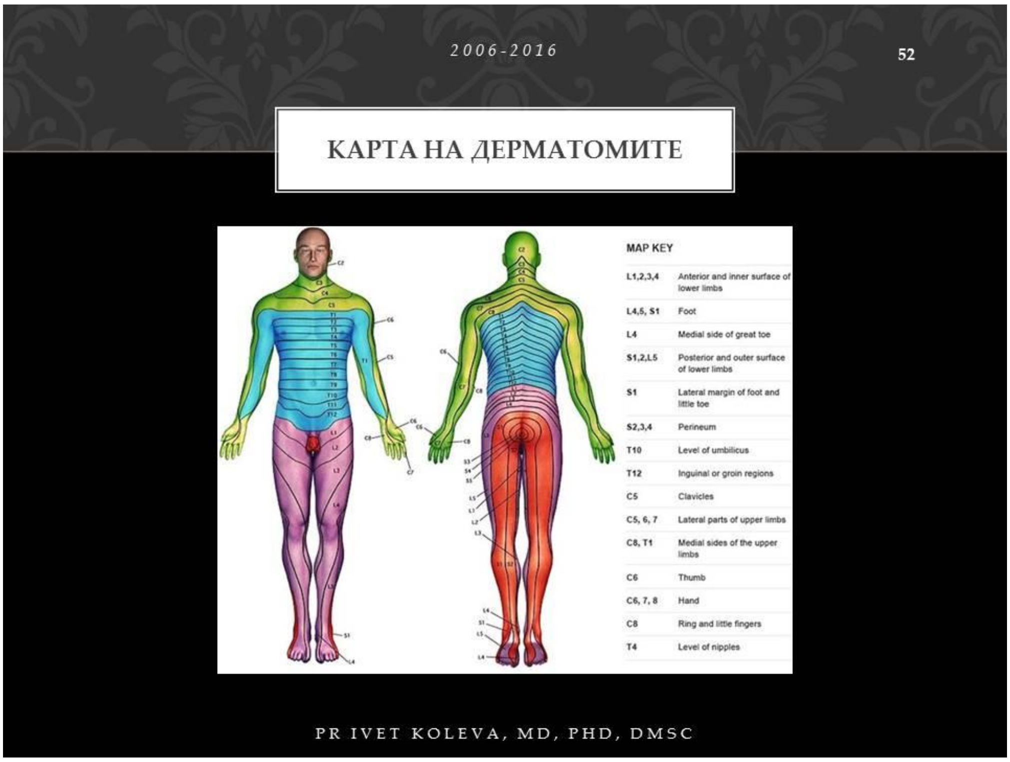
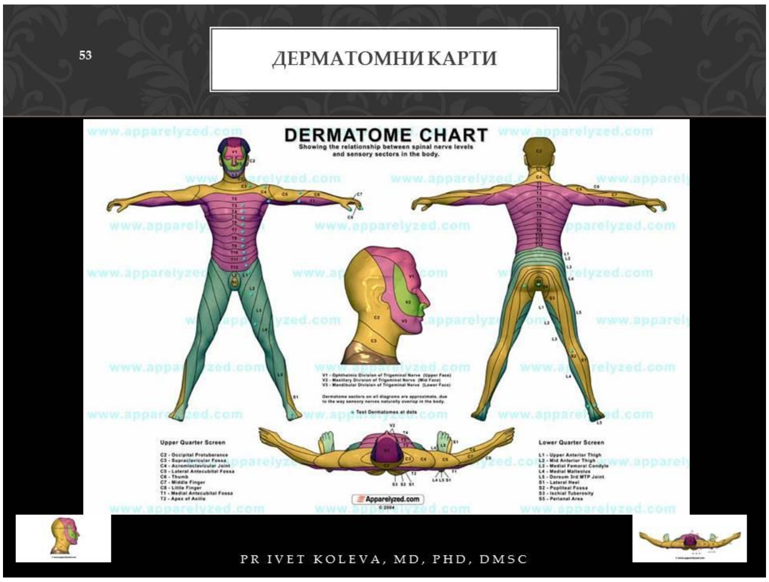
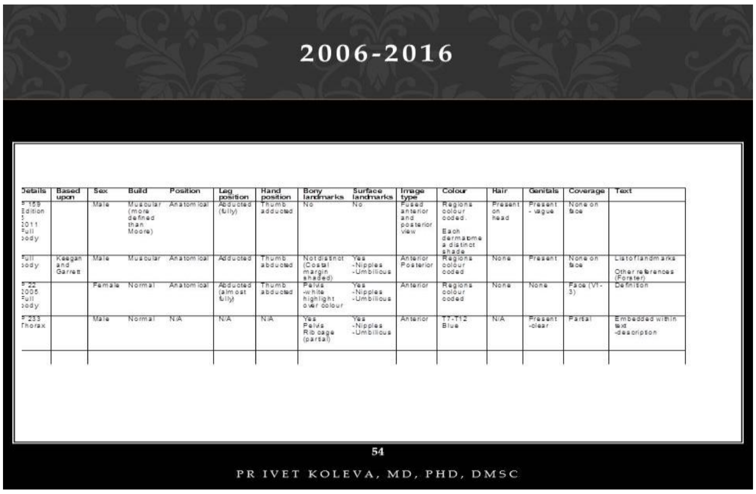

49
2006-2016
ОБЛАСТИ НА ЧОВЕШКОТО ТЯЛО
Cephalic
Frontal
Orbital
Nasal
Oral
Mental
Cervical
Thoracic
Axillary
Mammary
Sternal
Abdominal
Umbilical
Pelvic
Inguinal (groin)
Pubic (genital)
Thorax
Abdomen
Back (Dorsum)
(a) Anterior/Ventral
Upper limb
Acromial
Brachial (arm)
Antecubital
Antebrachial (forearm)
Carpal (wrist)
Manus (hand)
Palmar
Pollex
Digital
Lower limb
Coxal (hip)
Femoral (thigh)
Patellar
Crural (leg)
Fibular or peroneal
Pedal (foot)
Tarsal (ankle)
Metatarsal
Digital
Hallux
Upper limb
Acromial
Brachial (arm)
Olecranal
Antebrachial (forearm)
Manus (hand)
Metacarpal
Digital
Lower limb
Femoral (thigh)
Popliteal
Sural (calf)
Fibular or peroneal
Pedal (foot)
Calcaneal
Plantar
Cephalic
Otic
Occipital (back of head)
Cervical
Back (dorsal)
Scapular
Vertebral
Lumbar
Sacral
Gluteal
Perineal (between anus and external genitalia)
Thorax
Abdomen
Back (Dorsum)
(b) Posterior/Dorsal


50
2006-2016
АКСИАЛЕН И АПЕНДИКУЛАРЕН СКЕЛЕТ
ATLAS
D'ANATOMIE
PROMÉTHÉE
ANATOMIE GÉNÉRALE
ET SYSTÈME LOCOMOTEUR
M. SCHÜNKE
E. SCHULTE
U. SCHUMACHER
M. VOLL
K. WESKER
TRADUCTION
J.-M. CHEVALLIER ET R. DOUARD
Axial skeleton (blue)
Appendicular
skeleton (pink)
ADAM.
PR IVET KOLEVA, MD, PHD, DMSC

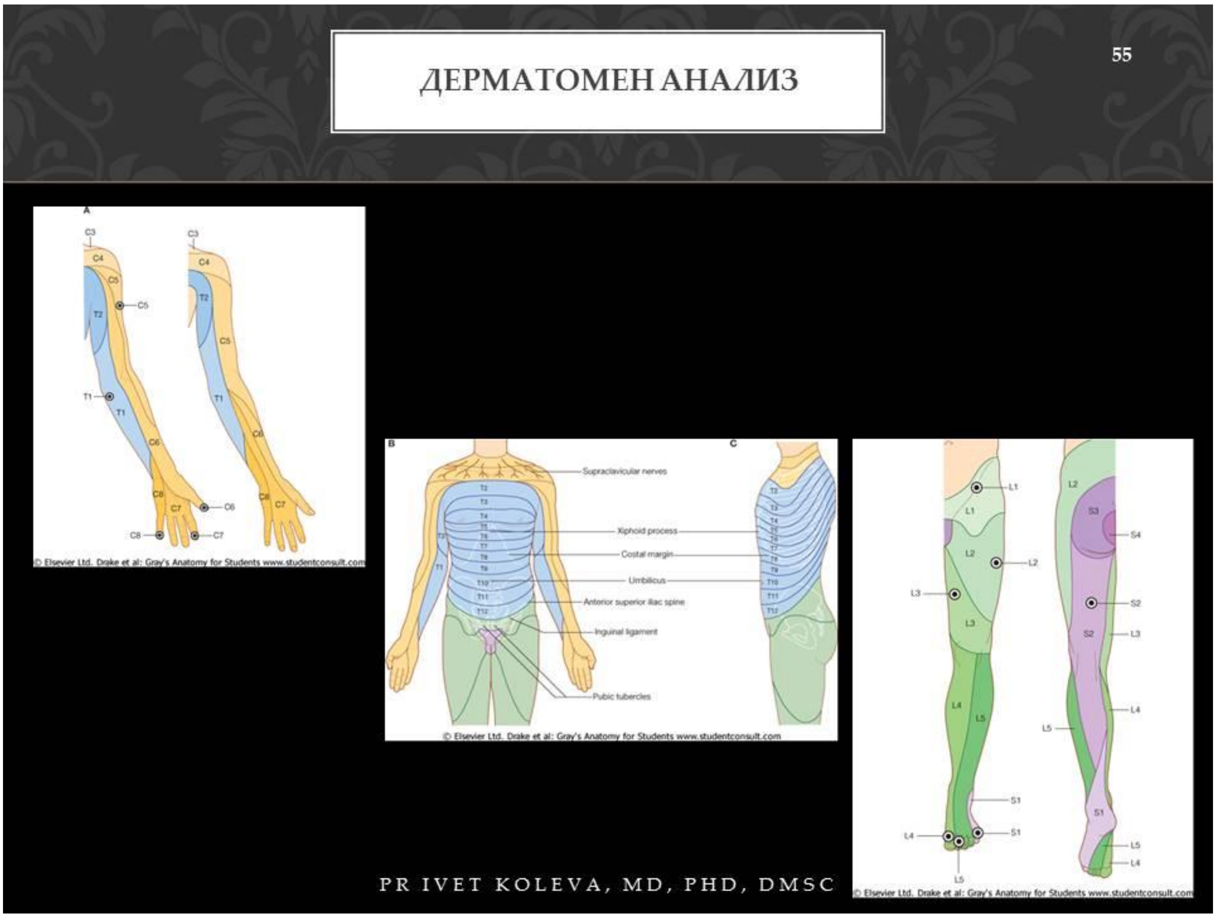

51
УЧЕНИЕ ЗА ДЕРМАТОМИТЕ
Dermatomes
Front View
Spinal
Cord
Segments
Dermatomes
Side View
FOCUSED
PAIN RELIEF
FocusedPainRelief.com
877.648.1951
PR IVET KOLEVA, MD, PHD, DMSC
Interpretations in three dimensions of dermatome diagrams from
Drake RL, Vogl W, Mitchell AWM (2005), Gray's Anatomy for Students.







Details	Based upon	Sex	Build	Position	Leg position	Hand position	Bony landmarks	Surface landmarks	Image type	Colour	Hair	Genitals	Coverage	Text
P 159 Edition 5 2011 Full body		Male	Muscular (more defined than Moore)	Anatomical	Abducted (fully)	Thumb adducted	No	No	Fused anterior and posterior view	Regions colour coded. Each dermatome a distinct shade	Present on head	Present - vague	None on face	
Full body	Keegan and Garrett	Male	Muscular	Anatomical	Adducted	Thumb abducted	Not distinct (Costal margin shaded)	Yes -Nipples -Umbilicus	Anterior Posterior	Regions colour coded	None	Present	None on face	List of landmarks Other references (Forster)
P 22 2005 Full body		Female	Normal	Anatomical	Abducted (almost fully)	Thumb abducted	Pelvis -white highlight over colour	Yes -Nipples -Umbilicus	Anterior	Regions colour coded	None	None	Face (V1-3)	Definition
P 233 Thorax		Male	Normal	N/A	N/A	N/A	Yes Pelvis Rib cage (partial)	Yes -Nipples -Umbilicus	Anterior	T7-T12 Blue	N/A	Present -clear	Partial	Embedded within text -description


ДЕРМАТОМЕН АНАЛИЗ
55
Supraclavicular nerves
Xiphoid process
Costal margin
Umbilicus
Anterior superior iliac spine
Inguinal ligament
Pubic tubercles
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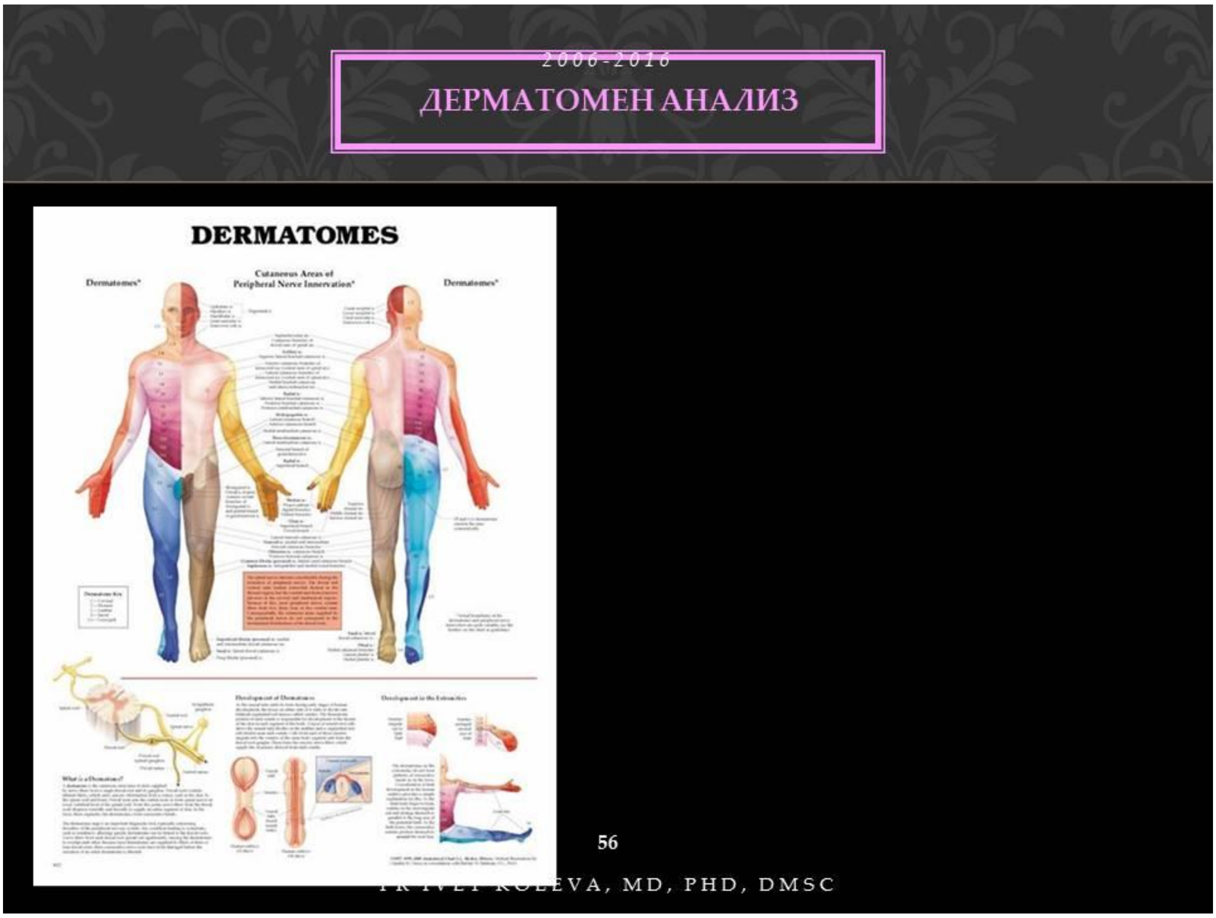
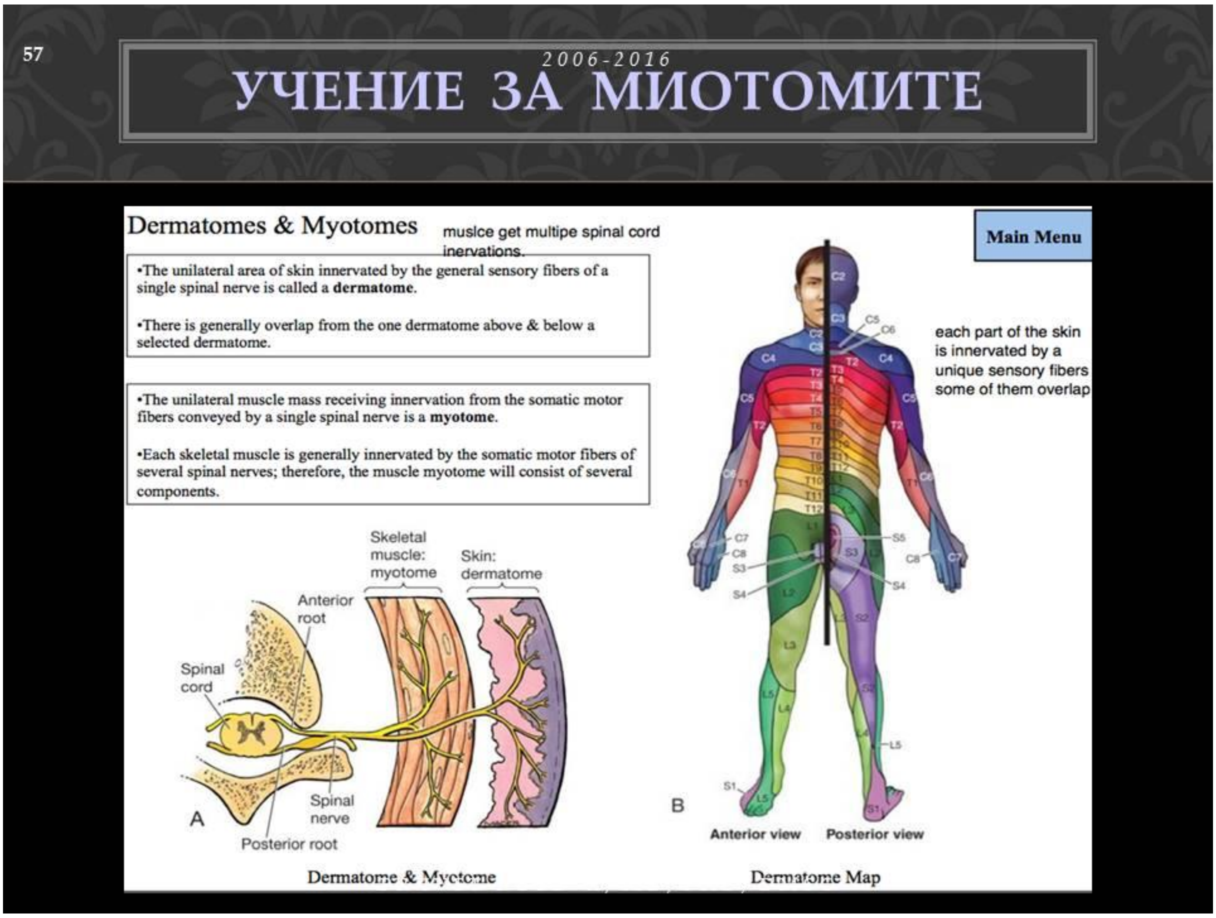
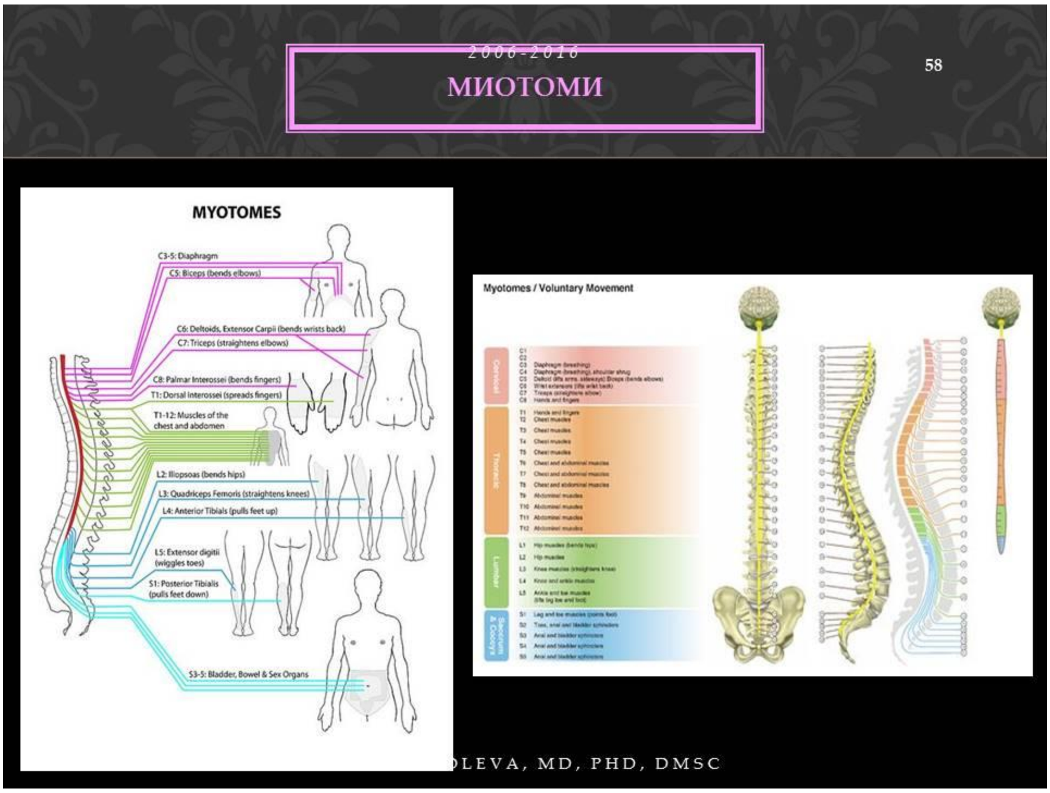

2006-2016
ДЕРМАТОМЕН АНАЛИЗ
DERMATOMES
Dermatomes*
Cutaneous Areas of Peripheral Nerve Innervation*
56
VA, MD, PHD, DMSC


57
2006-2016
УЧЕНИЕ ЗА МИОТОМИТЕ
Dermatomes & Myotomes
musIce get multipe spinal cord inervations.
•The unilateral area of skin innervated by the general sensory fibers of a single spinal nerve is called a dermatome.
•There is generally overlap from the one dermatome above & below a selected dermatome.
•The unilateral muscle mass receiving innervation from the somatic motor fibers conveyed by a single spinal nerve is a myotome.
•Each skeletal muscle is generally innervated by the somatic motor fibers of several spinal nerves; therefore, the muscle myotome will consist of several components.
Main Menu
each part of the skin is innervated by a unique sensory fibers some of them overlap
Skeletal muscle: myotome
Skin: dermatome
Anterior root
Spinal cord
Spinal nerve
Posterior root
A
B
Anterior view
Posterior view
Dermatome & Myotome
Dermatome Map


2006-2016
МИОТОМИ
58
MYOTOMES
C3-5: Diaphragm
C5: Biceps (bends elbows)
C6: Deltoids, Extensor Carpii (bends wrists back)
C7: Triceps (straightens elbows)
C8: Palmar Interossei (bends fingers)
T1: Dorsal Interossei (spreads fingers)
T1-12: Muscles of the chest and abdomen
L2: Iliopsoas (bends hips)
L3: Quadriceps Femoris (straightens knees)
L4: Anterior Tibials (pulls feet up)
L5: Extensor digitii (wiggles toes)
S1: Posterior Tibialis (pulls feet down)
S3-5: Bladder, Bowel & Sex Organs
Myotomes / Voluntary Movement
OLEVA, MD, PHD, DMSC

MYOTOME CHART FOR THE UPPER EXTREMITY

C3 MYOTOME
- Levator scapulae
- Sternocleidomastoid (sometimes)
- Trapezius

C4 MYOTOME
- Trapezius
- Rhomboid major (sometimes)
- Levator scapulae

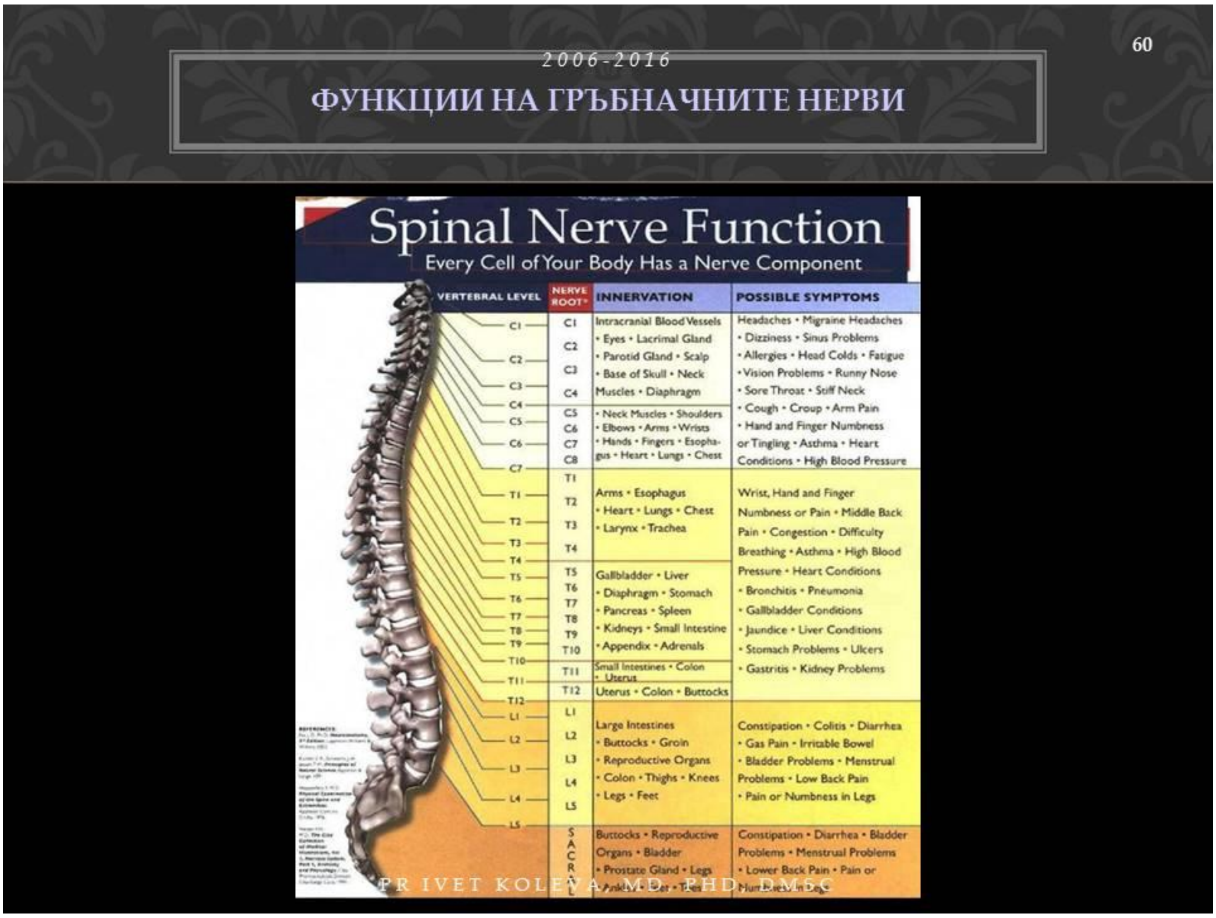
C5 MYOTOME
- Pectoralis major (clavicular head)
- Serratus anterior
- Rhomboid major
- Rhomboid minor
- Deltoid
- Supraspinatus
- Infraspinatus
- Subscapularis
- Teres major
- Teres minor
- Biceps brachii
- Brachialis
- Coracobrachialis
- Brachioradialis
- Supinator

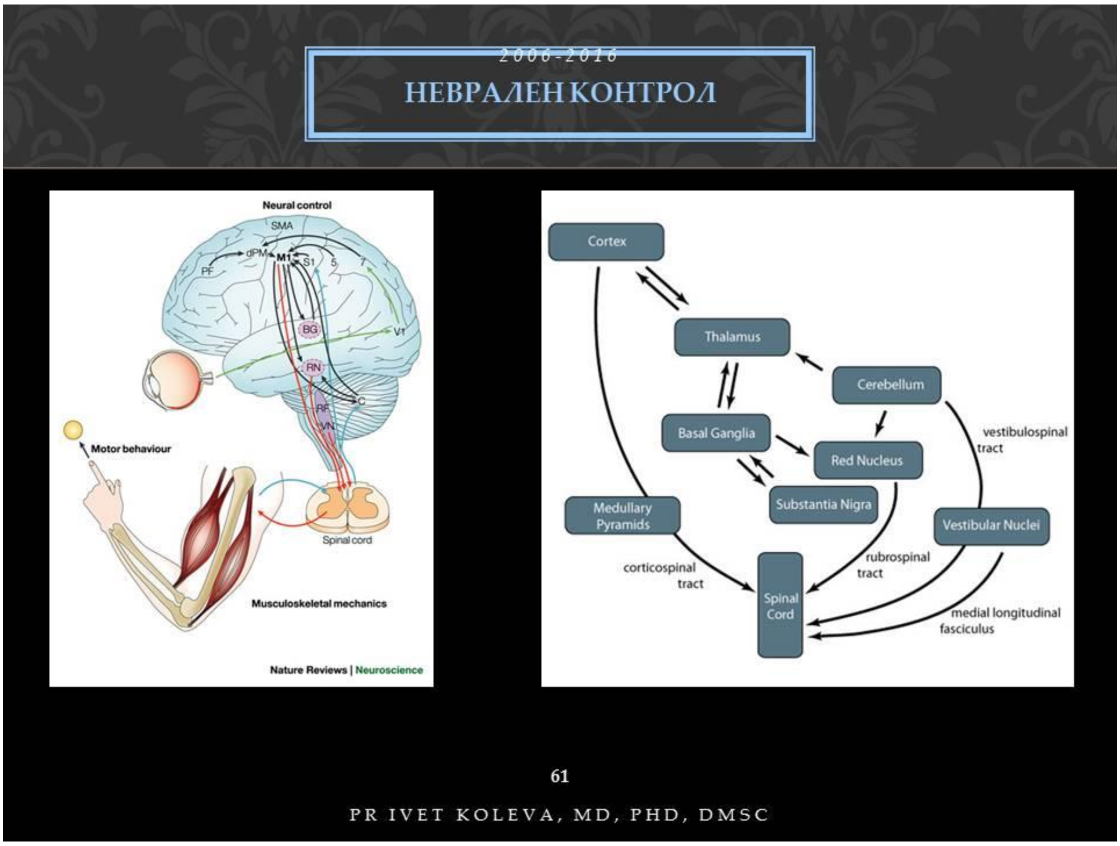
C6 MYOTOME
- Pectorais major (clavicular head)
- Serratus anterior
- Latissimus dorsi
- Deltoid
- Supraspinatus
- Infraspinatus
- Subscapularis
- Teres major
- Teres minor
- Biceps brachii
- Brachialis
- Coracobrachialis
- Triceps brachii
- Pronator teres
- Flexor carpi radialis
- Brachioradialis
- Extensor carpi radialis longus
- Extensor carpi radialis brevis
- Extensor digitorum
- Extensor digiti minimi
- Extensor carpi ulnaris
- Supinator
- Abductor pollicis longus
- Extensor pollicis brevis

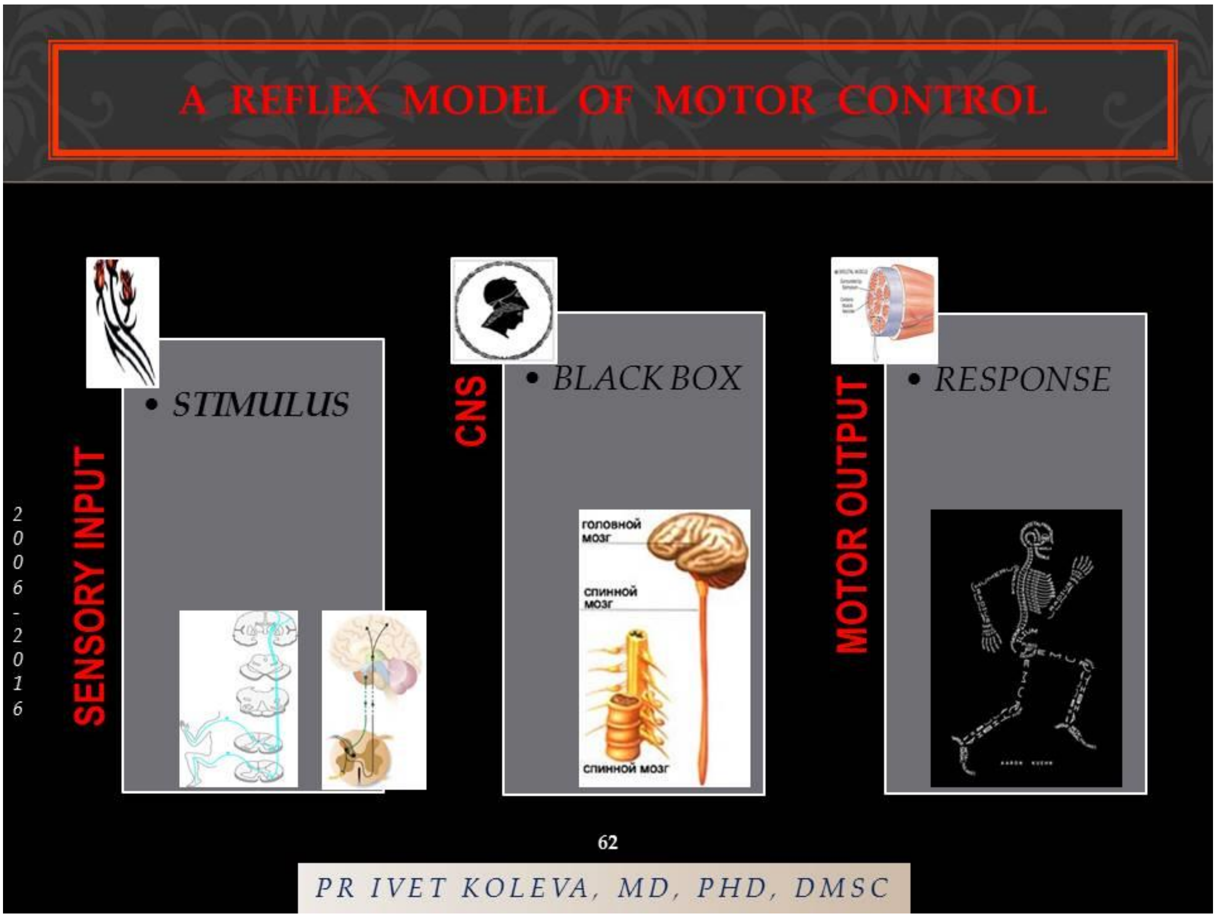
C7 MYOTOME
- Pectoralis major (clavicular head)
- Serratus anterior
- Latissimus dorsi
- Coracobrachialis
- Triceps brachii
- Anconeus
- Pronator teres
- Flexor carpi radialis
- Palmaris longus
- Flexor digitorum superficialis
- Flexor pollicis longus
- Pronator quadratus
- Extensor carpi radialis longus
- Extensor carpi radialis brevis
- Extensor digitorum
- Extensor digiti minimi
- Extensor carpi ulnaris
- Abductor pollicis longus
- Extensor pollicis brevis
- Extensor pollicis longus
- Extensor indicus

C8 MYOTOME
- Pectoralis major (sternal head)
- Pectoralis minor
- Latissimus dorsi
- Triceps brachii
- Anconeus
- Palmaris longus
- Flexor carpi ulnaris
- Flexor digitorum superficialis
- Flexor digitorum profundus
- Flexor pollicis longus
- Pronator quadratus
- Extensor digitorum
- Extensor digiti minimi
- Extensor carpi ulnaris
- Extensor pollicis longus
- Extensor indicus
- **also all wrist/hand muscles that we haven't covered yet**

T1 MYOTOME
- Pectoralis major (sternal head)
- Pectoralis minor
- Flexor carpi ulnaris
- Flexor digitorum superficialis
- Flexor digitorum profundus
- Flexor pollicis longus
- Pronator quadratus
- **also all wrist/hand muscles that we haven't covered yet**




2006-2016
НЕВРАЛЕН КОНТРОЛ
Neural control
SMA
dPM
M1
S1
PF
BG
RN
RF
VN
V1
C
Motor behaviour
Spinal cord
Musculoskeletal mechanics
Nature Reviews | Neuroscience
Cortex
Thalamus
Cerebellum
Basal Ganglia
Red Nucleus
Substantia Nigra
Medullary Pyramids
Vestibular Nuclei
vestibulospinal tract
rubrospinal tract
corticospinal tract
Spinal Cord
medial longitudinal fasciculus
61
PR IVET KOLEVA, MD, PHD, DMSC


A REFLEX MODEL OF MOTOR CONTROL
SENSORY INPUT
• STIMULUS
CNS
• BLACK BOX
головной мозг
спинной мозг
спинной мозг
MOTOR OUTPUT
• RESPONSE
2006-2016
62
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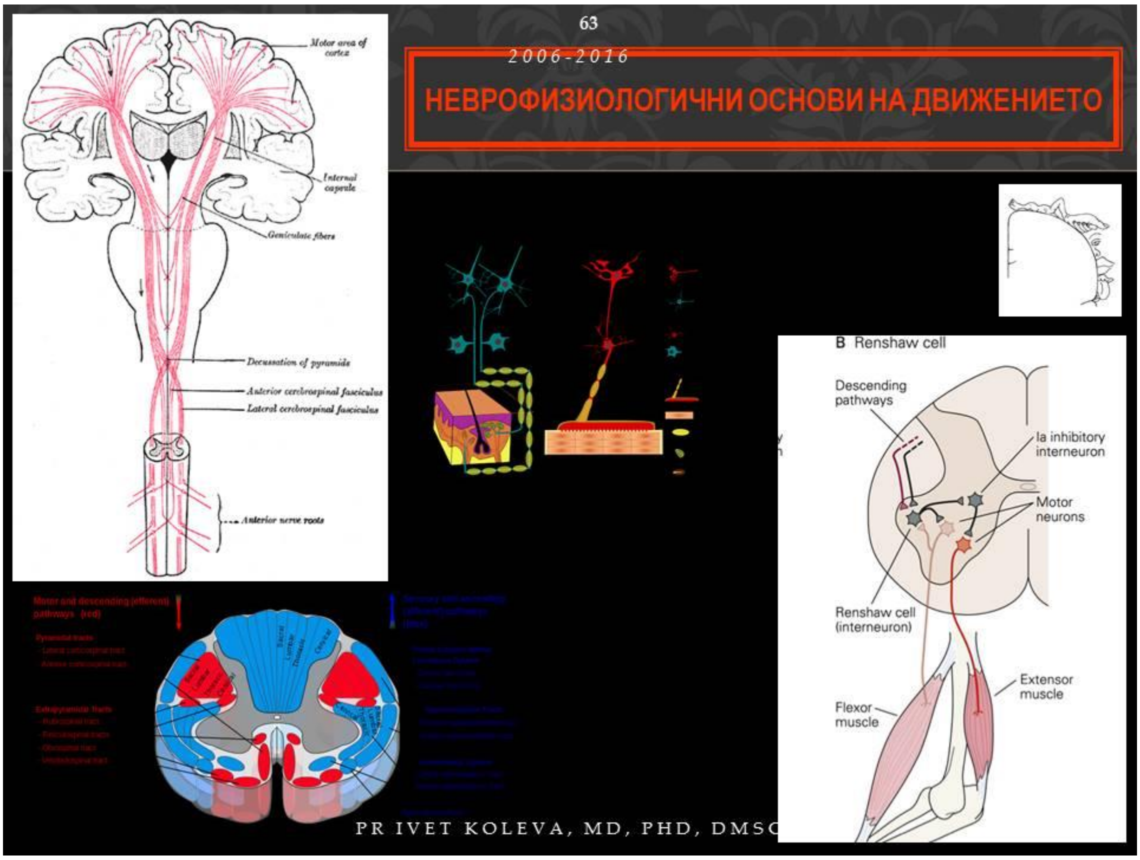

63
2006-2016
НЕВРОФИЗИОЛОГИЧНИ ОСНОВИ НА ДВИЖЕНИЕТО
Motor area of cortex
Internal capsule
Geniculate fibers
Decussation of pyramids
Anterior cerebrospinal fasciculus
Lateral cerebrospinal fasciculus
Anterior nerve roots
B Renshaw cell
Descending pathways
Ia inhibitory interneuron
Motor neurons
Renshaw cell (interneuron)
Extensor muscle
Flexor muscle
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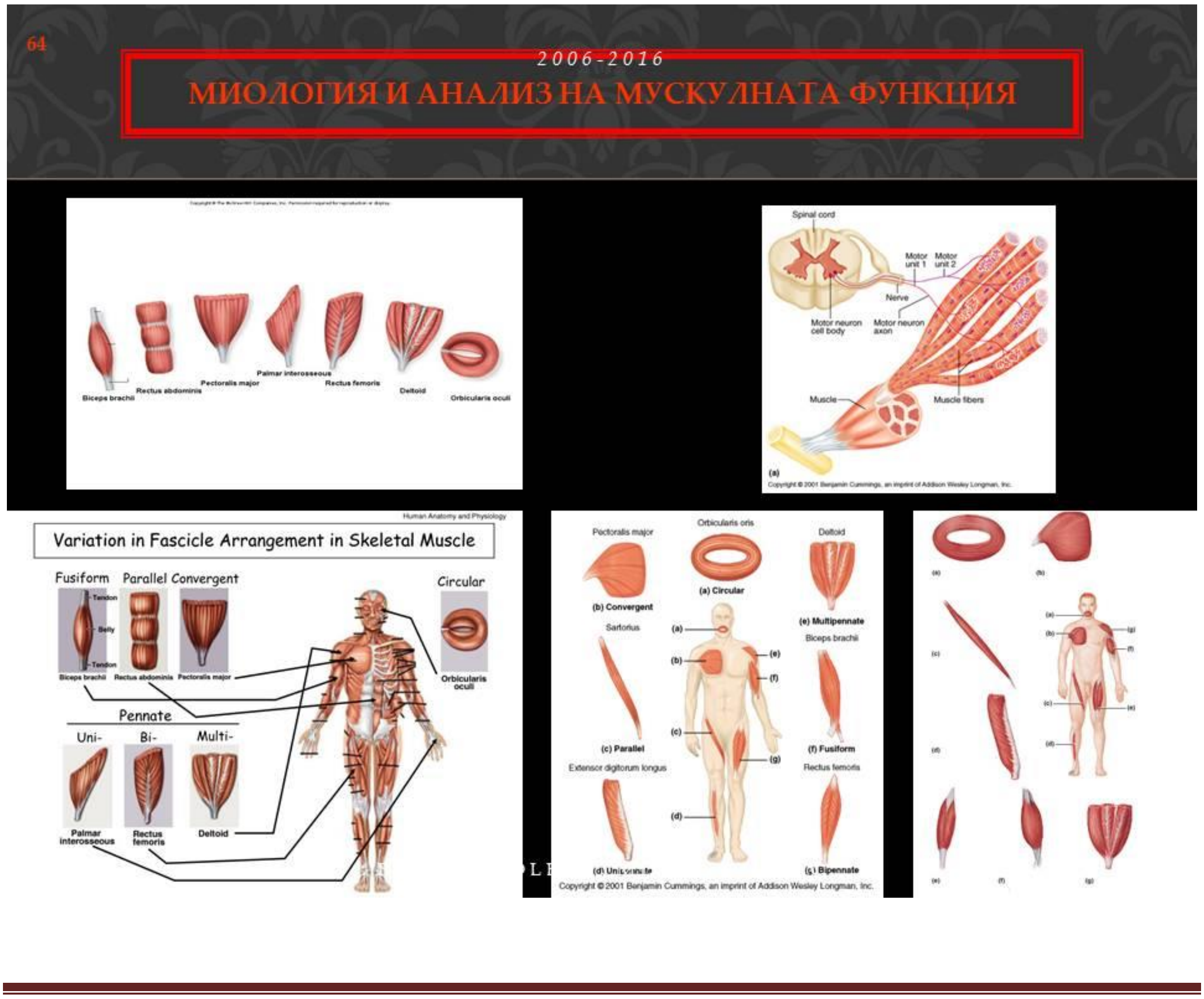

64
2006-2016
МИОЛОГИЯ И АНАЛИЗ НА МУСКУЛНАТА ФУНКЦИЯ
Biceps brachii
Rectus abdominis
Pectoralis major
Palmar interosseous
Rectus femoris
Deltoid
Orbicularis oculi
Spinal cord
Motor unit 1
Motor unit 2
Nerve
Motor neuron cell body
Motor neuron axon
Muscle
Muscle fibers
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Human Anatomy and Physiology
Variation in Fascicle Arrangement in Skeletal Muscle
Fusiform
Parallel
Convergent
Circular
Tendon
Belly
Tendon
Biceps brachii
Rectus abdominis
Pectoralis major
Orbicularis oculi
Pennate
Uni-
Bi-
Multi-
Palmar interosseous
Rectus femoris
Deltoid
Pectoralis major
Orbicularis oris
Deltoid
(a) Circular
(b) Convergent
(e) Multipennate
Sartorius
Biceps brachii
(c) Parallel
(f) Fusiform
Extensor digitorum longus
Rectus femoris
(d) Unipennate
(g) Bipennate
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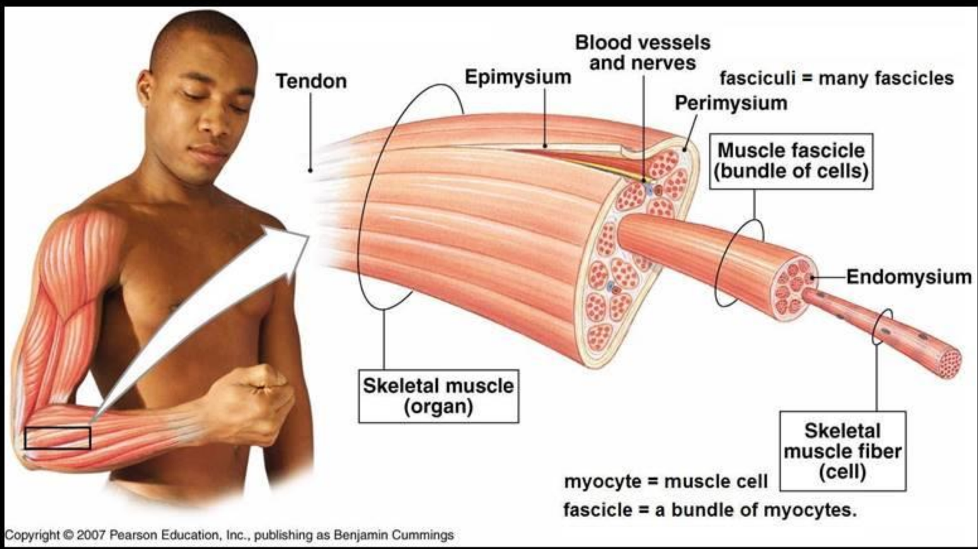
2006-2016

МИОФАСЦИКУЛИ



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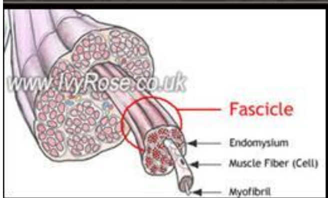
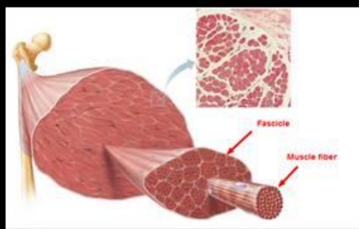
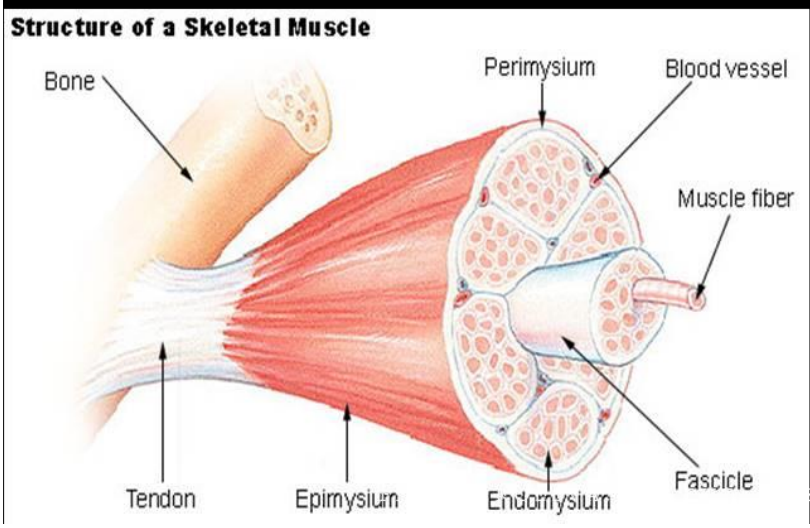
2006-2016

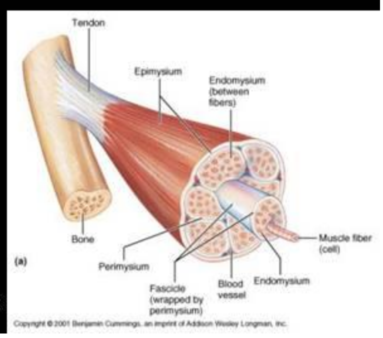
MYOFASCICLES

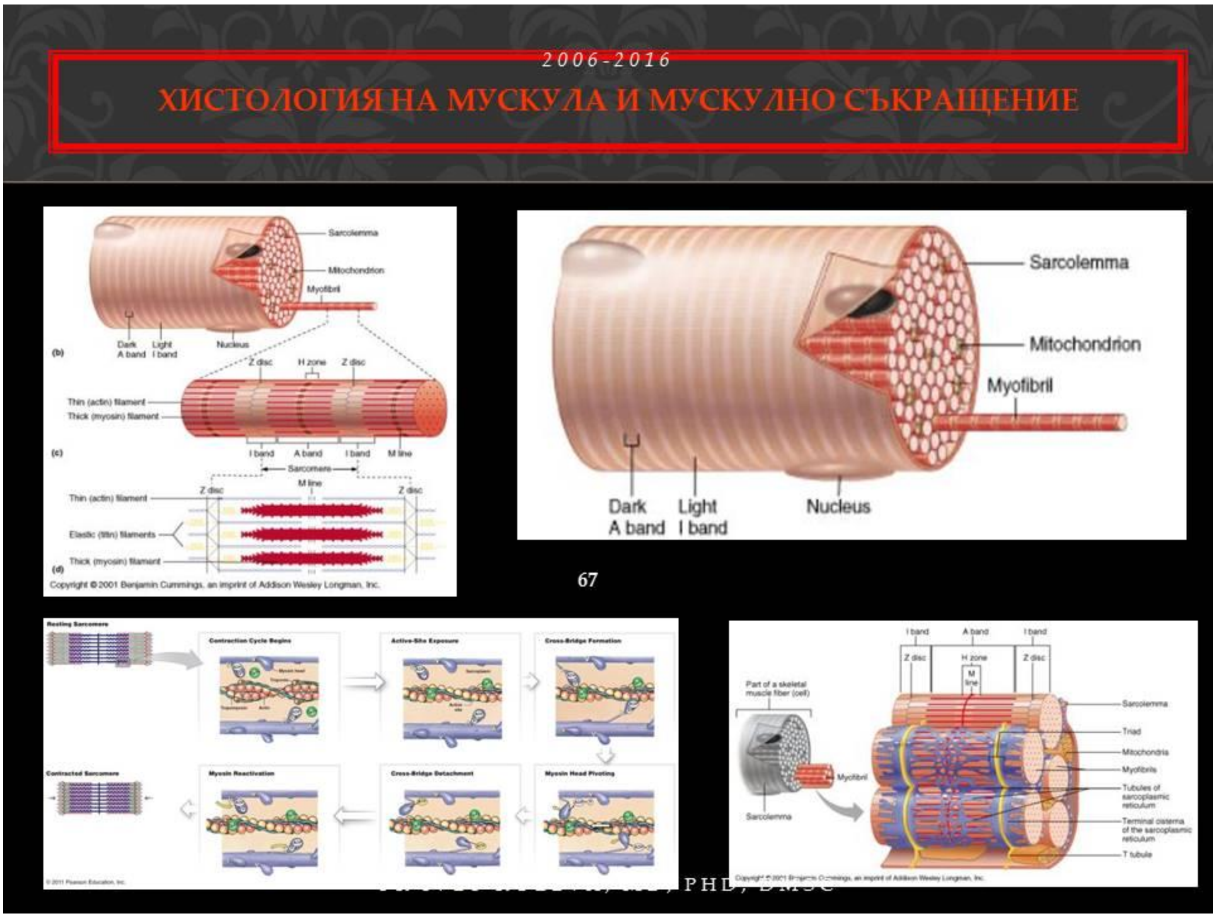
66










2006-2016
ХИСТОЛОГИЯ НА МУСКУЛА И МУСКУЛНО СЪКРАЩЕНИЕ
Sarcolemma
Mitochondrion
Myofibril
Dark
A band
Light
I band
Nucleus
Thin (actin) filament
Thick (myosin) filament
Z disc
H zone
I band
A band
M line
Sarcomere
Elastic (titin) filaments
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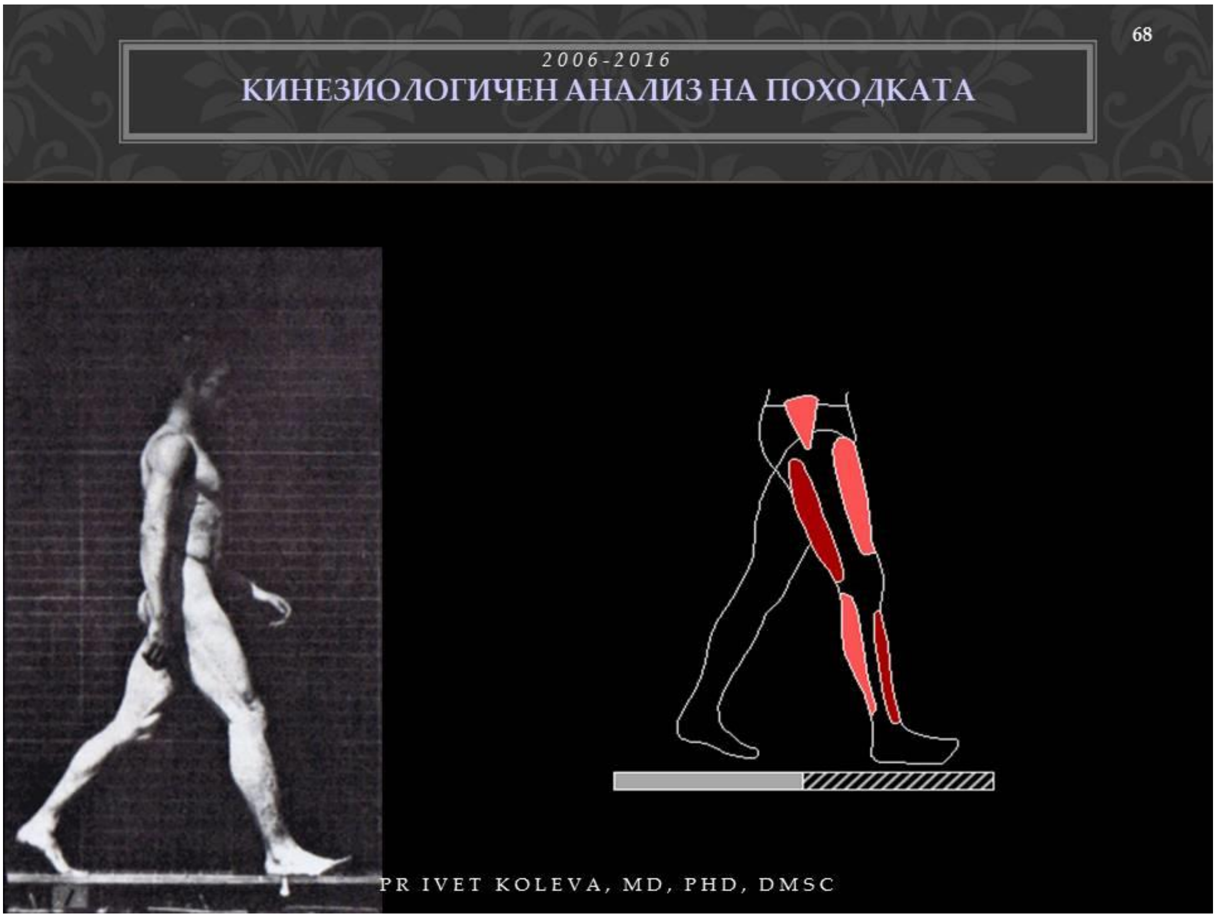
68
2006-2016
КИНЕЗИОЛОГИЧЕН АНАЛИЗ НА ПОХОДКАТА
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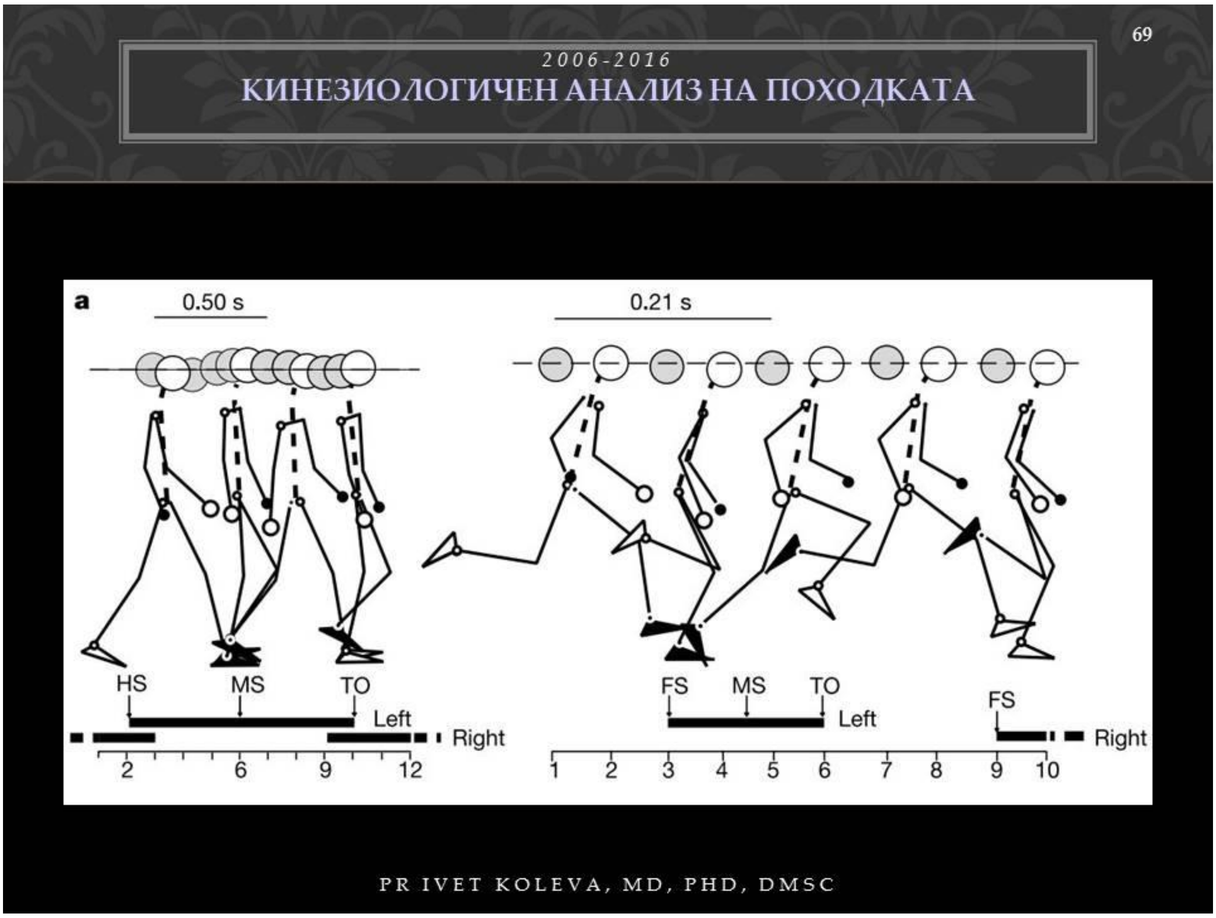
69
2006-2016
КИНЕЗИОЛОГИЧЕН АНАЛИЗ НА ПОХОДКАТА
a
0.50 s
0.21 s
HS
MS
TO
Left
Right
2
6
9
12
FS
MS
TO
Left
FS
Right
1
2
3
4
5
6
7
8
9
10
PR IVET KOLEVA, MD, PHD, DMSC


2006-2016
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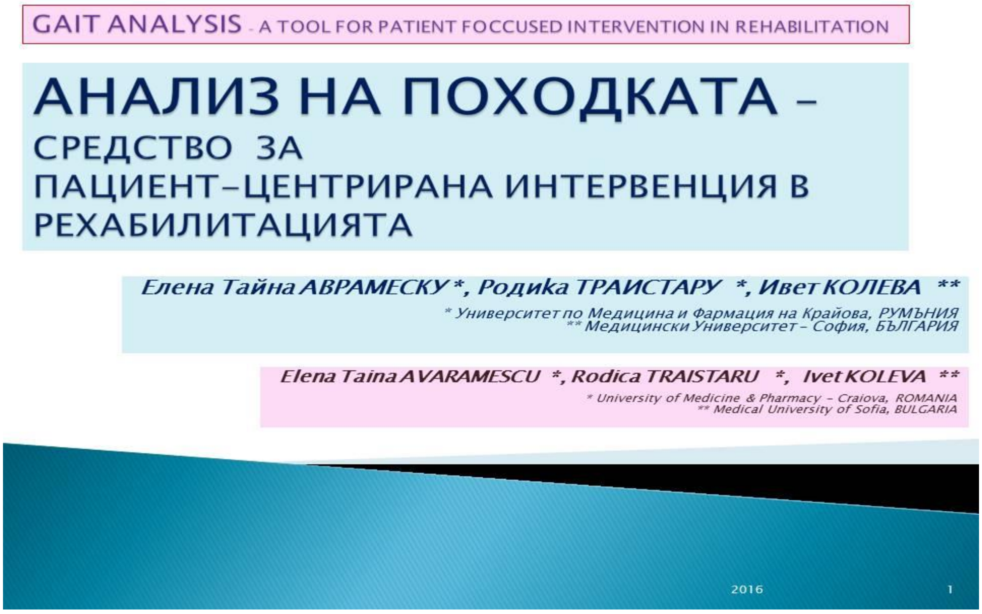
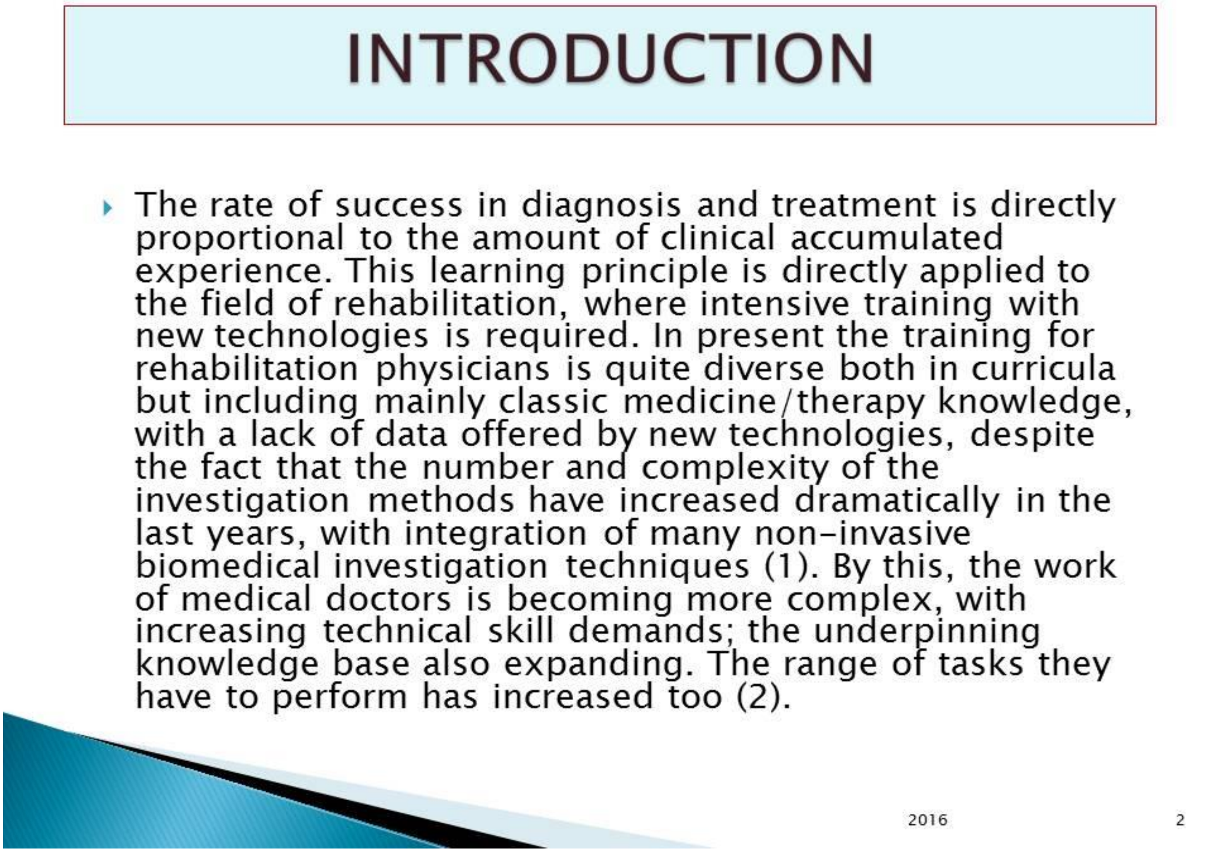
КИНЕЗИОЛОГИЧЕН И ПАТОКИНЕЗИОЛОГИЧЕН АНАЛИЗ
НА РАЗЛИЧНИ ДЕЙНОСТИ
PR IVET KOLEVA, MD, PHD, DMSC

GAIT ANALYSIS

ET Avramescu, R Traistaru, I Koleva





Advanced knowledge in medicine can improve human health through cross-disciplinary activities that integrate the biomedical sciences with clinical practice. EU Commission Communicate on Rethinking Education (2012) underlines that Increasing transversal and basic skills alone is not sufficient for growth and competitiveness and VET must be able to react to the demand for ***advanced vocational skills***.

Normal gait is essential for daily living and the number of ***pathologies that affect gait is increasing*** (accidents, aging). In orthopedics, in particular after surgery, a long and difficult ***rehabilitation process follows in order to regain normal gait and requires interdisciplinary team*** approaches.

Clinical experience showed that each patient has its own particularities, so standard procedures are not all the time effective and need to be adapted (***patient focused intervention***).

Gait analysis is performed within a great range of methods: in Romania at least, none of the hospitals have trained personal for gait analysis and the analyze is based on visual observation, so development of advanced skills for computerized gait assessment becomes a priority.

While most of hospital units use clinical analysis, computational gait analysis has a better advantage in providing an overall stress distribution on the foot level.

The results of several studies indicate that plantar pressures in pathological gait are different not only depending on the pathology but also according to the anatomical and functional particularities of the subjects (3,4). Data analysis of recorded parameters permitted adaptation of standard rehabilitation protocols according to the specificity of each case, with an increase of subjective and objective patient outcomes and a decrease of rehabilitation duration (5,6). This will allow to perform the best decision making in rehabilitation procedures, related to the specificity of each case.

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THE FOOTSCAN SYSTEM

Describing the Foot scan pressure plate and its characteristics

- The Foot scan system is a modular system.
- One module contains 64 sensors' rows.
- The platform has an area of 0.5 m × 0.4 m, containing a total of 4096 pressure sensors (4 sensors per cm 2), that allow vertical pressure measurement in response to ground reaction force, triggered by plantar contact with the supporting surface (Fig. 1).
- Sensors have a size of 5 mm x 7 mm.
- As sensor size is known, pressure will be determined automatically.
- The highest recording speed is 500 frames / sec, which is only possible with the Foot scan 3D-box.
- The system measures 1000 frames, so the user can measure 2 seconds at the highest recording speed.
- This data capturing can help with an in depth analysis of force distribution and pressure and their association with foot biomechanics.

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Table 1. Technical specifications

Footscan® 2D 0,5m plate	Size L x B x H (m)	Active surface L x B (m)	Nr. of sensors	Range (N/cm^2)	Maximal frequency (Hz)
	0,5 x 0,4 x 0,008	0,48 x 0,32	4096	0,27 – 127	500

- The system is connected to a PC via a USB port and can record 500 frames / sec., which allows a close correlation between force / pressure on the one hand and the kinematic parameters on the other hand, if we perform a 2D or 3D video gait recording.

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Fig. 1.
Footscan system (left).
Static measurement with Footscan plate (right).

- The database within the Footscan analysis software gives a clear overview on all patients and the measurements made for each patient. When selecting a patient, all measurements for the patient will be shown, with name and date of measurement.

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WHAT AND HOW WE MEASURE?

- The platform is used to record pressure distribution values for the lower leg on ground contact. By plantar application on the platform, local pressure is measured during the total period of ground contact at a high frequency. The operational principle is represented by measuring total impact force applied to the sensor array on a known surface. On the ground contact area, the developed pressure is measured by the equation: pressure (p) = force (F) exerted on the surface (S); $p = F/S$.
- In this way we can underline that the Footscan system measures:
- – Local pressures or the total impact force applied to the plate
- – During the entire stance phase, but not during the swing phase
- – With a high frequency between 150-500 frames per second.
- The Footscan system consist of a matrix that measure force. This means that sensors are fixed in 64 lines and column, which measure synchronically. Because we know the surface of each sensor it is possible to calculate (and thus not measure) pressure.

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- When we apply a certain force (N) on multiple sensors with a certain surface (cm^2) is possible to calculate the pressure, as in Fig. 2.

Fig. 2

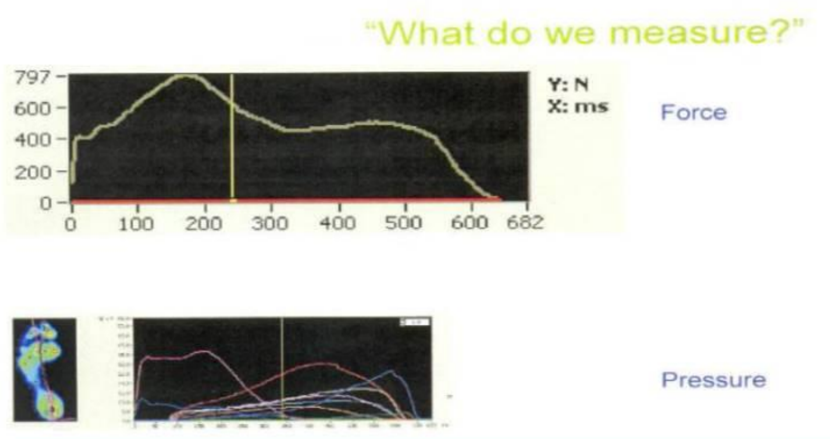

Fig. 2. Main recorded variables – force and pressure.
The top graph is showing the total force in Newtons for the entire foot during the complete contact time. The low graph is showing local pressures for some selected regions (see left) of the foot. [7]

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- When measuring pressure it is not only important to know if a high force is applied, but also the contact surface is relevant. When we apply an amount of weight on a small surface, the pressure will be higher than when we apply the same amount of force on a larger surface.
- A person with a hollow foot type has a smaller contact surface than a person with a flat foot. So, if both persons have the same weight, the person with the hollow foot will have higher overall pressures (Fig.3).

2016 10

"What do we measure?"

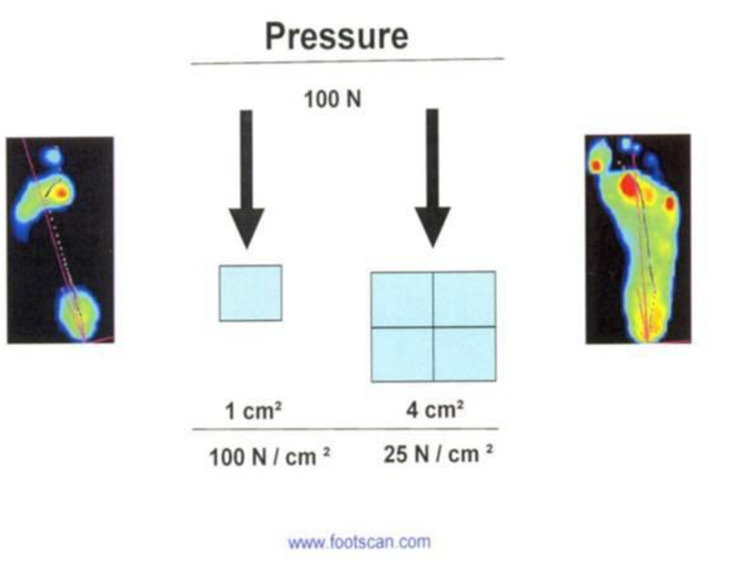

Fig. 3. Main recorded variables – contact surface.
A person with a hollow foot type has a smaller contact surface than a person with a flat foot. So, if both persons have the same weight, the person with the hollow foot will have higher overall pressures. [7]

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- The Footscan system only measures when the foot applies a force on the platform, which is the one possible if the foot has physical contact on it.
- As mentioned in previous courses, a complete step cycle is divided in a stance phase (60%) and a swing phase (40%), as shown in fig.4. A complete gait cycle includes a stance phase (contact) that represents 60% from total duration of the gait cycle and a swing phase (40%).

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"What do we measure?"

"Total contact time off the foot":

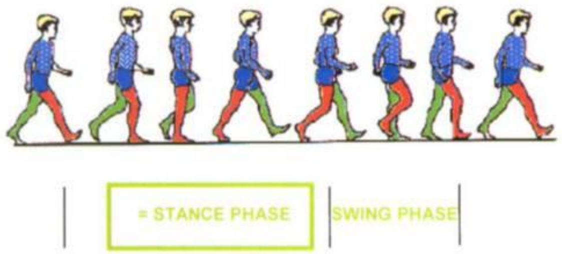

Fig. 4. Main recorded variables - gait cycle. The Footscan system only measures during the stance phase which has duration of approximately 600 to 800 milliseconds (0.6-0.8 seconds). Footscan system measures only the stance phase, lasting from 0.6 to 0.8 s respectively, under a normal gait. [7]

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Each sensor of the Footscan system gives the amount of force applied to the sensor for each measured frame. The highest measured value is colored red and from there the values are scaled downwards to the lowest value which is blue (fig. 5).

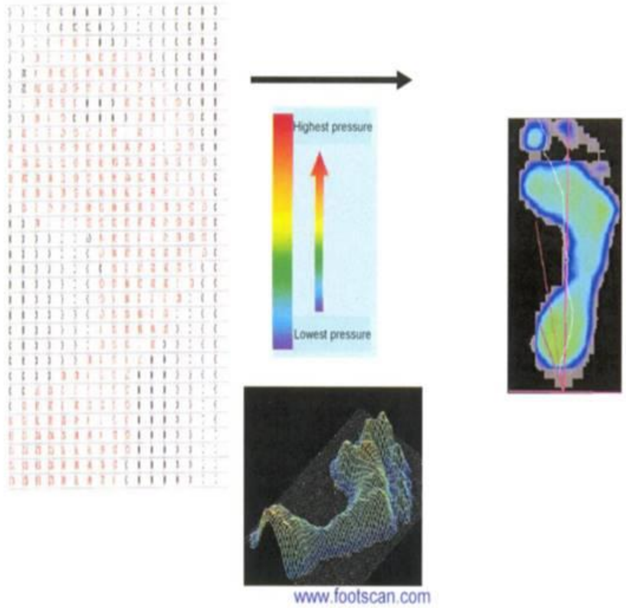

Fig. 5. Pressure color scale [7]

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- For the 2D system used for measurements in our case studies, the speed cannot be adjusted and is dependent on the number of lines/platform. But there is a possibility of increasing the recording time and subquently the frequency will decrease. It should be noted that the 2D system used to record current speed is dependent on the PC. The system has a normal speed when registration is performed at maximum 350 Hz. For this method Hz is the number of frames / second.

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Why do we measure?

- Data from plantar pressure measurement can be used in evaluating and treating patients with neurological and musculoskeletal pathology. Operational motivation of this method is that the new generation of scanning systems and pressure measurement platforms are able to record and analyze plantar load distribution with high accuracy, thus having the potential to achieve prediction of rapid movement characteristics for foot and calf. These aspects allow prediction of effective therapies by developing and validating an algorithm gait analysis with applications in orthopedic pathology, in order to achieve a quick and objective interpretations and the exclusion of human subjectivity.
- The Footscan can provide static and dynamic gait analysis in terms of ground reaction force (ground reaction force) and developed pressure during walking. Expression of measured parameters is in the N for force and N/cm² for pressure. These determinations allow the gait evaluation while the patient is walking with or without assistive means. Data analysis includes: information on plantar pressure distribution versus time, force-time distribution, determine the loading on different anatomical regions, active contact surface, foot axis and subtalar angle, foot balance in frontal and antero-posterior plane, position of the pressure center. Foot shape, foot size, foot movements, the unroll of the foot, quantification of the motion of the foot, temporal and spatial parameters of the unroll and of gait can also be evaluated. The pressure data are automatically calculated by the RSScan plate, and the results can be displayed in various ways.
- Gait analysis can be achieved by the analysis of images included in specific screens or the appropriate numerical correspondence by studying synthetic numerical data included in tables, charts for the evolution and the distribution of forces (dynamic screen, impulse screen, balance screen, compare screen and gait screen). Another important feature is the ability to calculate the average of several measurements, to allow comparison of medial and lateral areas of the same foot, left-right comparisons, comparing measurements made at different time intervals.

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Anatomical terms used in footscan evaluation

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- In fig. 6 you can visualise the 3 anatomical regions commonly used by the footscan software.

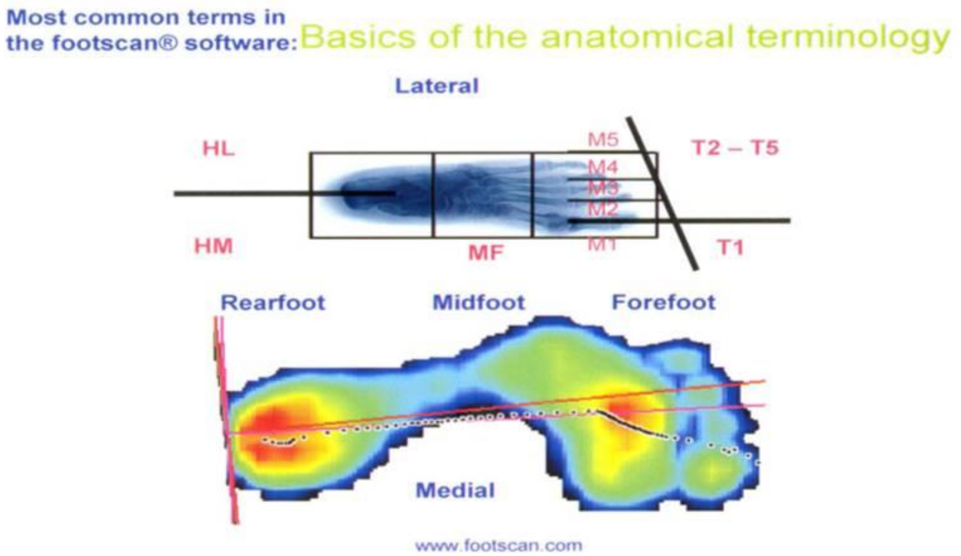

Fig. 6. Lateral and medial term are used to define the inner and outside of the foot. Rear foot, midfoot and forefoot are used to split up the foot. The heel is split into the lateral and medial part of the foot (HM and HL). Meta 1 to 5 are used for naming the metaheads and the joints they form with the 5 toes. T1 is the name for great toe, T2-T5 for the lesser toes. [7]

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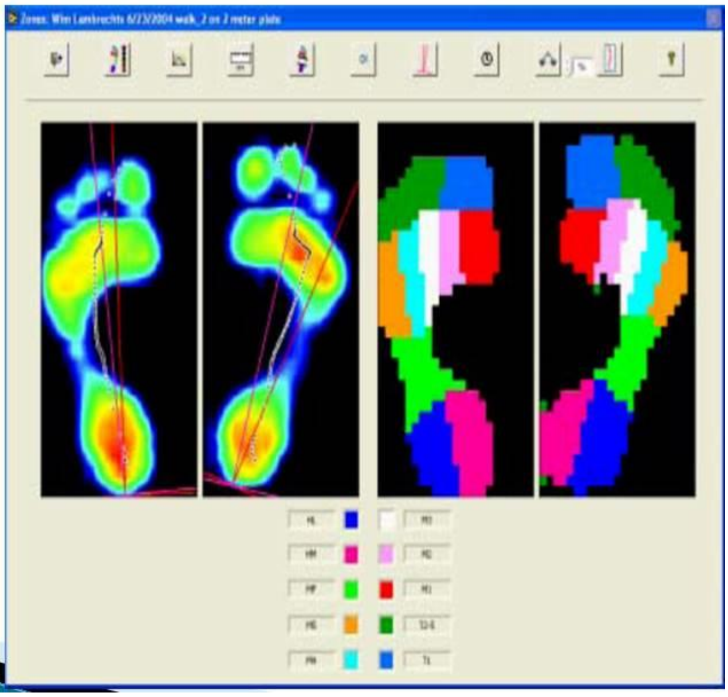
Further on, related to the medial and lateral zone under the rearfoot, midfoot, and forefoot, the foot was splited into 10 relevant anatomical zones, as shown in fig. 7. These zones are very important for further analysing of the measurement. The software gives you also the possibility of manual adjustment of these zones.

HL:	Heel lateral
HM:	Heel medial
MF:	Midfoot
M5:	Metatarsal 1
M4:	Metatarsal 2
M3:	Metatarsal 3
M2:	Metatarsal 4

Fig. 7.
The used plantar anatomical zones.



METHODOLOGY IN RECORDING AND INTERPRETATION OF DATA

- The pressure plate is able to carry out both static and dynamic measurements (walking or running). The system outputs ground reaction force and the developed pressure during stance or walking. During plantar contact the plate automatically detects left and / or right foot, and movement is allowed in both directions on the scanning plate. Identification of initial contact is done when at least 3 sensors are activated by a resultant force of about 5 N. Depending on the size of your plate and step length it might be that only one left or right foot is recorded, but also that two left and two right feet are recorded. The software will handle that for you.
- While the static measurement practically grabs a snapshot of the patient's soles, the dynamic scanning allows analysis more detailed of the aspects of walking, recording the sole pressures throughout walking.
- For each type of recording is necessary to know the requirements and recording procedure, the parameters that can be obtained and the analysis of these parameters. Recorded values must be correlated with the normal biomechanical values corresponding to anthropometric parameters for the studied subject.

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STATIC MEASUREMENTS

- **Procedure.**

Patient has to stand barefooted on the platform for a number of seconds, hands hanging next to the body, looking straight ahead.

- **Recording technique**

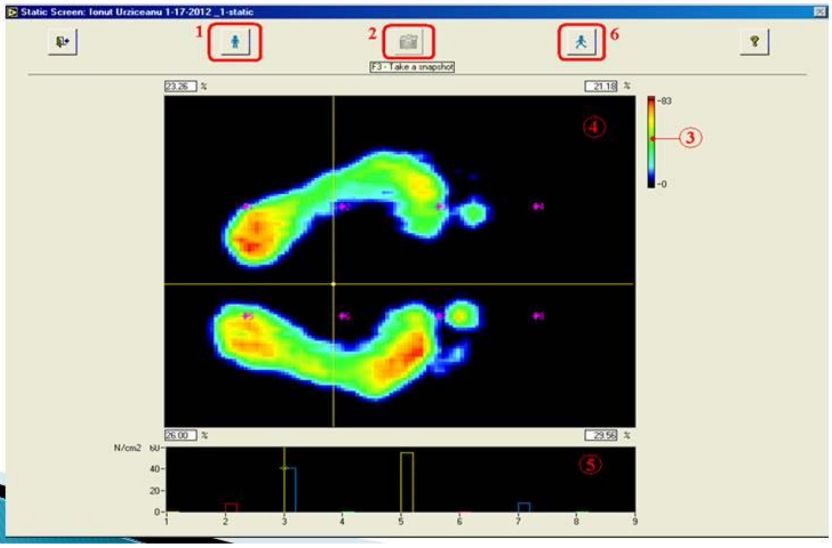

Fig. 8.
Static screen measurement

STATIC MEASUREMENTS

Recorded parameters

- Static measurement represents a momentary recording and gives static maximal pressures. The results of a static measurement are the maximal pressures of the foot contact surface. Other recorded parameters are the percentages of the body weight for 4 quadrants. The red dot in the middle is the patient center of mass. Based on the center of mass the feet are divided in 4 quadrants, also is the percentage of the body weight given for each quadrant.

Static measurement analysis

- The magnitude of the pressure distribution is shown by a color scale *(for details, see Fig. 8, mark 3).* The blue color represents low pressure areas and the red indicates areas of high pressure. Black indicates no pressure and other colors indicate intermediate values of pressure.
- Measurement screen is divided into four quadrants, in the corner of each quadrant is displayed the relevant percentage of body weight distribution on the correspondent surface. Horizontal and vertical yellow lines can be adjusted to change the size quadrants (*Fig. 8, mark 4).*
- Static screen chart below gives the maximum pressure recorded for each of the 8 purple markers on static display. Their position can be changed by repositioning the mouse. (*Fig. 8, mark 5).*
- By analyzing the recorded image and values can be issued conclusions on the left-right body weight dividing and front-backwards differences.

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DYNAMIC MEASUREMENTS

Procedure.

It is important that the current measurement is performed in a manner as close to the physiological activity we want to evaluate (walking or running). Thus, the plate will be placed in a walkway/route length of 6 m (long enough to allow a normal gait). In the optimal solution, the plate is built in into the run way and covered with a thin cover of EVA material. The EVA material will not influence the measurement, the walk way is comfortable for the patient and they can not target for the plate since it is invisible. The procedure depends on the dimension of the platform you are using. With a 2 m platform you aquire multiple steps in 1 trial, while you have to do more trials with a 0,5 m platform.

When the Footscan platform is activated, it will wait until a foot starts to roll off. That has to be configured before measuring:

- – „single step" or „automatic": when single step is being used, only one foot is being measured and you have to appoint it to left or right yourself. With the automatic function this is being done by the software.
- – forefoot landing or heel landing: the software normally is set on heellanding, but when you are measuring a patient whose first contact is with the forefoot you can let the software take this into account.

To achieve dynamic measurements the patient is instructed to walk normally at a rate that does not cause discomfort, taking into account the pathological changes of gait present in most patients. Do not allow walking with support.

- • Choose a fixed starting point for the patient at a distance corresponding to the plate of 2-3m, so the reference foot to land on the surface of the plate;
- • The patient is required to walk normally, starting with the left foot (for example) and from previously assumed starting point. Measurement is performed.
- • Proceed as in the previous case, this time asking the patient to start with the right foot.

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Fig. 9. The use of the Footscan plate:
a) outsite of walking route,
b) included in a walking route of 6 m.

Recording is done for both soles during 2 gait cycles, paying attention to place alternative the feet on the plate. We chose this method of registration because our platform length is 0.5 m, which does not allow recording pressures for both soles in the same gait cycle. Note that this type of measurement is possible due to technical features of the platform.
The platform software allows summarization of information and comparative presentation of images and values recorded for the two plants.

HOW DO WE APPRECIATE IF WE MEASURED CORECTLY?

- In normal gait, the contact time with the plate is of 600-800 ms and no significant variations for the two soles are recorded.

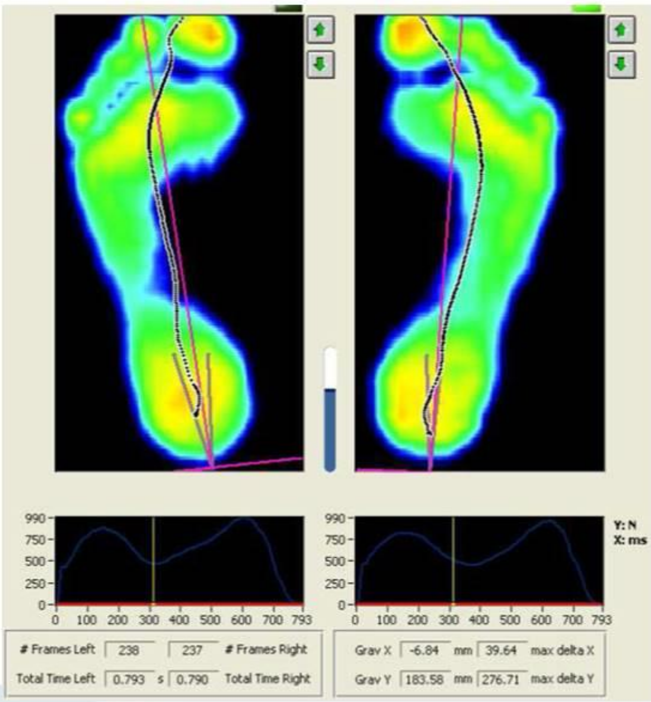

Fig. 10.
Example of a measurement for a patient with no pathology.

- A large difference in contact time between left and right can be caused by a pathology or a complaint of the patient.
- When the contact time is much shorter then 600 ms, it is possible that the patient walked too fast;
- if it is longer than 800 ms, the patient may have walked too slow. Anyway we have to keep in mind the patient age and pathology.

2016 25

Further control: Are the Footscan zones and foot axis correct?

- We must look to the position of the foot axis, which has to start at the center of the heel and go through M2 and M3. When the zones are incorrect it is possible to manualy adjust them.
- It is recommended that for each evaluation to be performed three valid measurements, and to keep for study the optimal registration. Measurements can be considered valid after the patient gets used with the plate and meets the following criteria: (1) a common pattern for heel contact, (2) a constant gait speed.
  Data obtained directly from the measurement and data processed with specific software RSSCAN-time walking, will be stored on the computer in Excel format.
- Gait analysis can be done by studying synthetic numerical data included in tables or image analysis included in specific screens (dynamic screen, impulse screen, balance screen, comparing screen, gait screen).

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CONCLUSIONS

- We need to form specialists with specific expertise related to the assessment, correction or replacement of functions that affect mobility. This can be achieved only by understanding the basic concepts, technological principles and their interdisciplinary application. The ability to make measurements and interpret data from motion analysis should be associated with the ability to identify, formulate and solve problems faced by patients and determining the most appropriate treatment.
- Gait analysis offers an objective, quantifiable tool for gait abnormalities. These aspects allow prediction of effectiveness of rehabilitation therapies by developing and validating an algorithm for gait analysis, in order to achieve a quick and objective interpretations and the exclusion of human subjectivity and to improve early rehabilitation in different pathologies by effectively controlling gait parameters in relation with patient specificities.

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REHABILITATION OF THE GRASP & GAIT: CONTEMPORANEOUS METHODS

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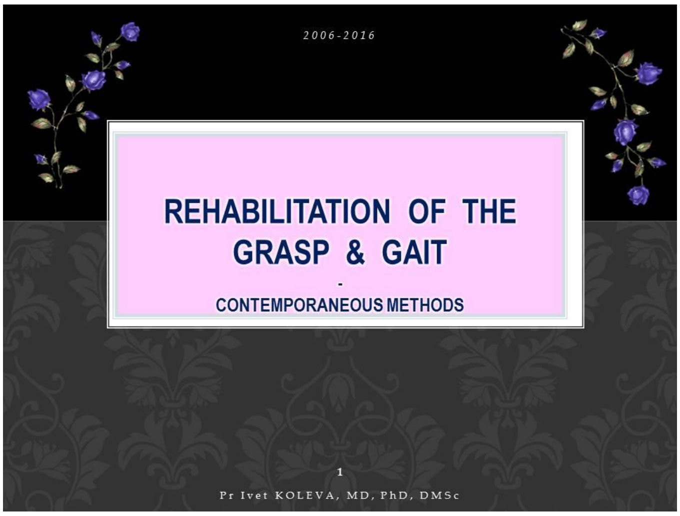

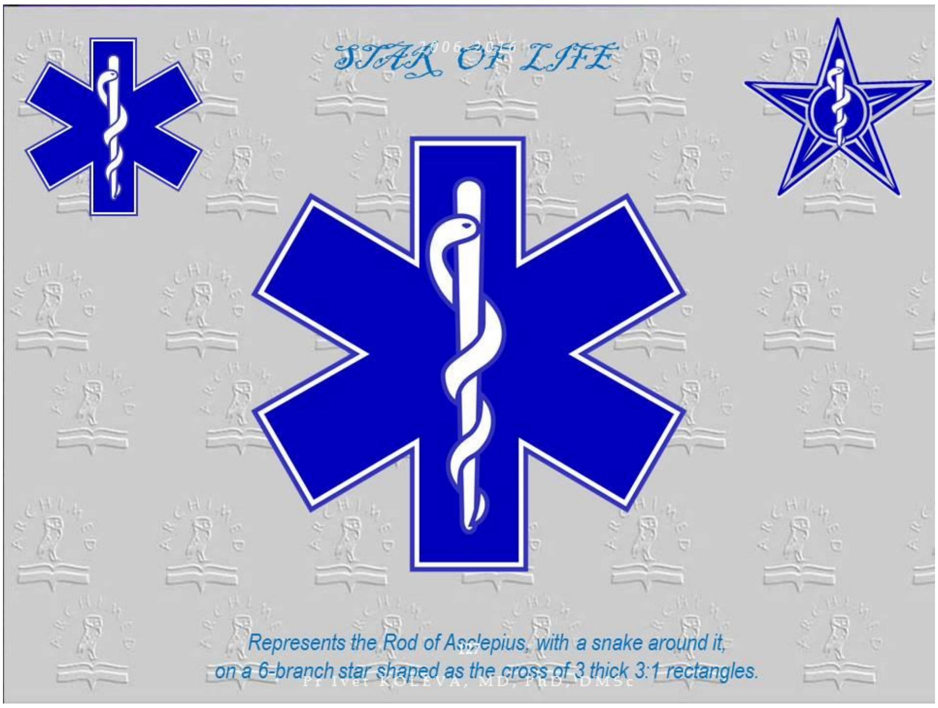
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Represents the Rod of Asclepius, with a snake around it,
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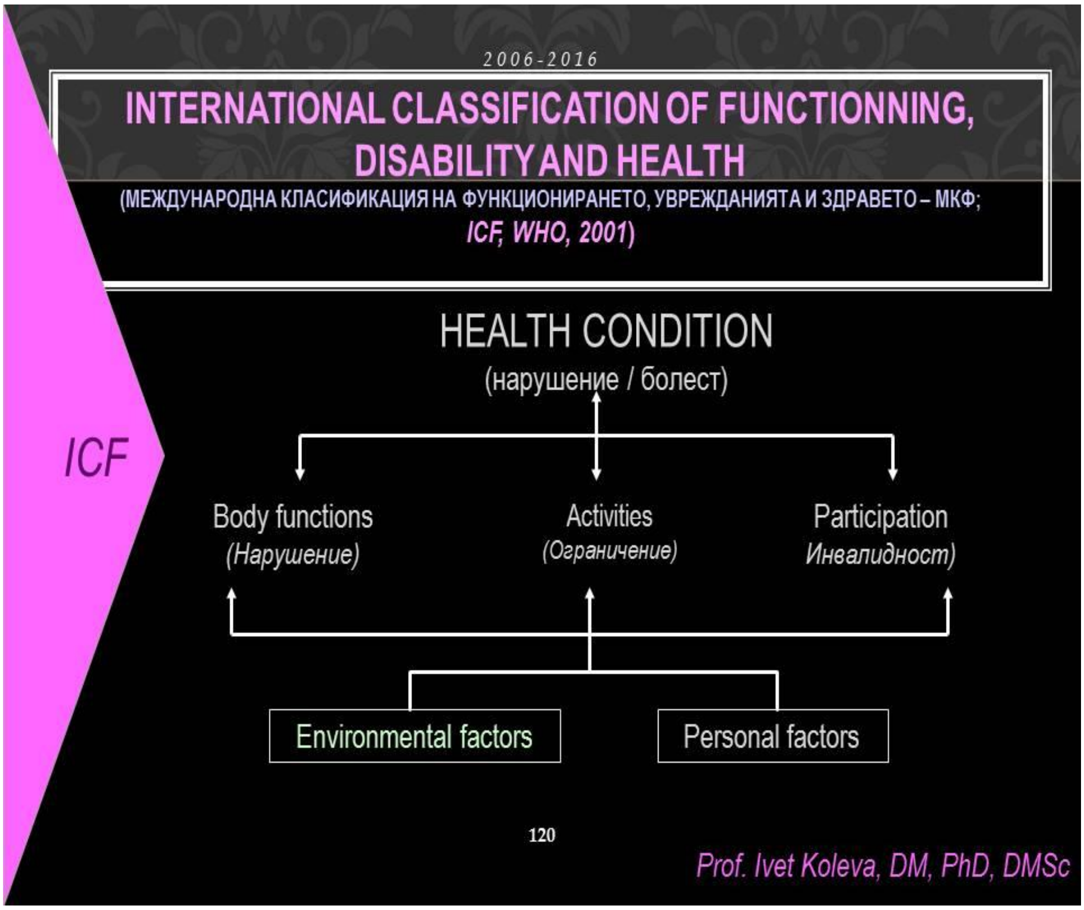
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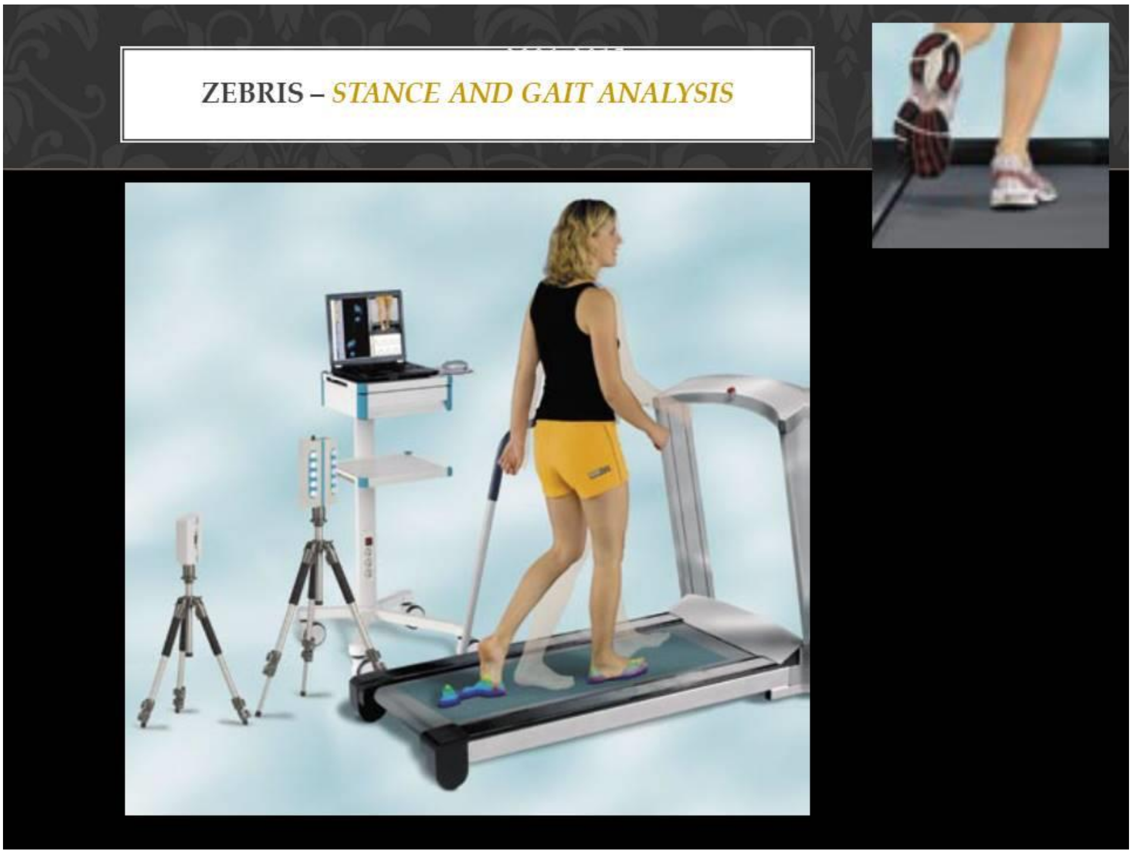
Prof. Ivet Koleva, DM, PhD, DMSc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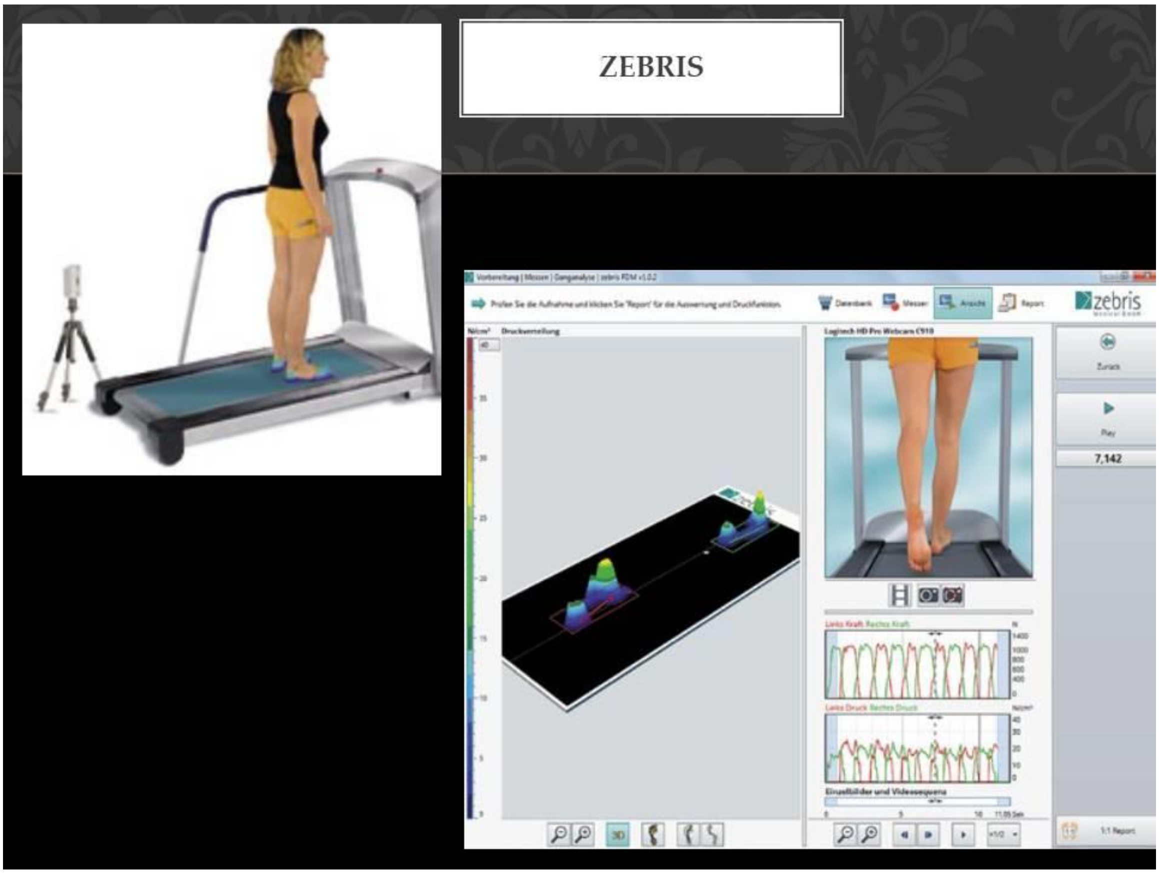
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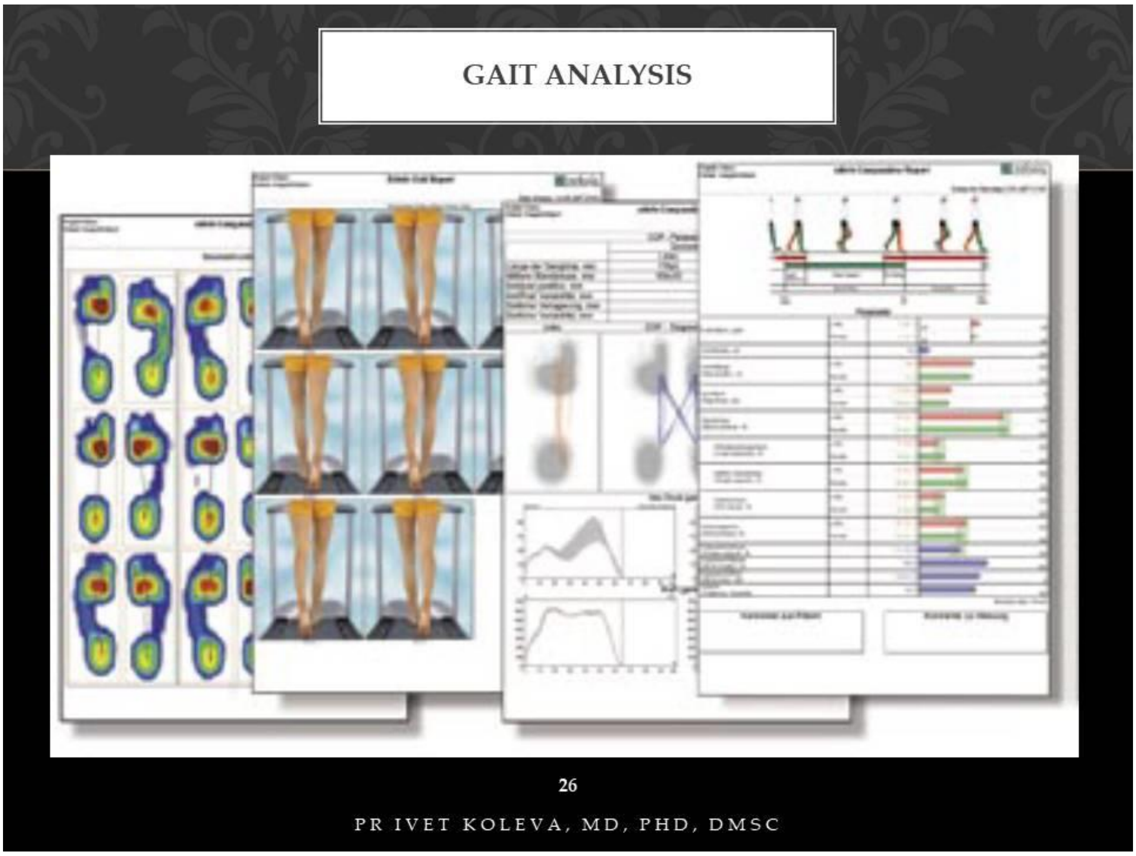
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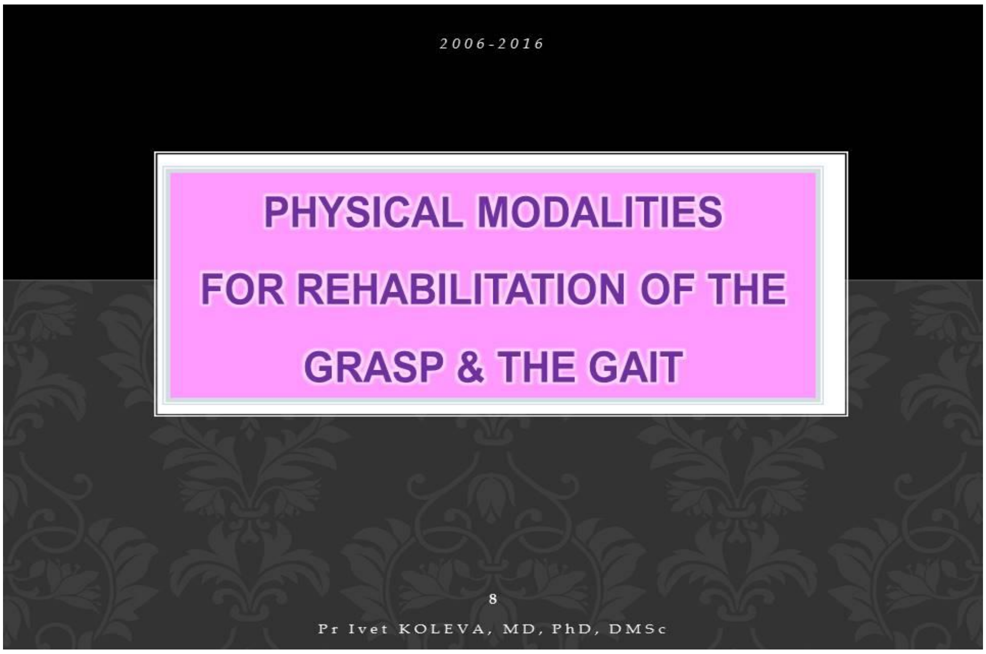
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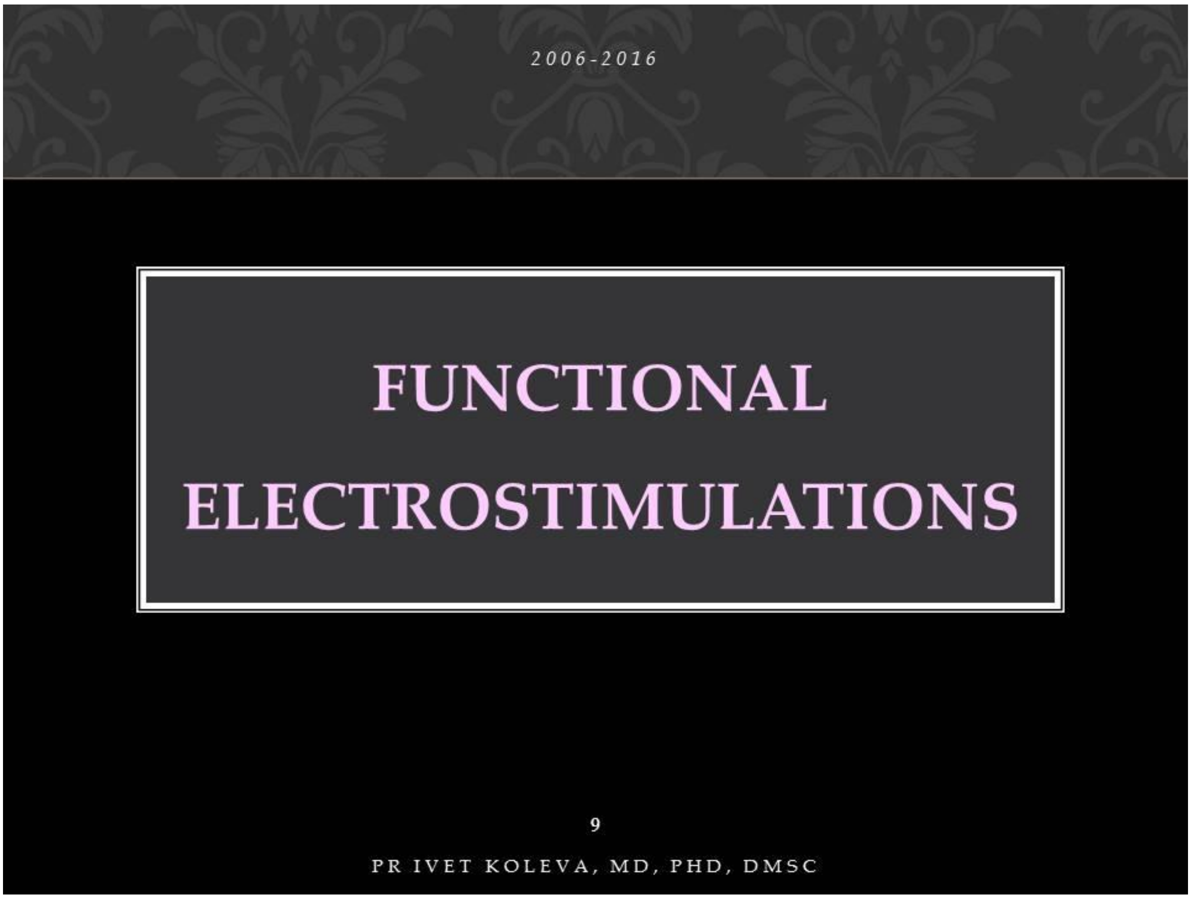
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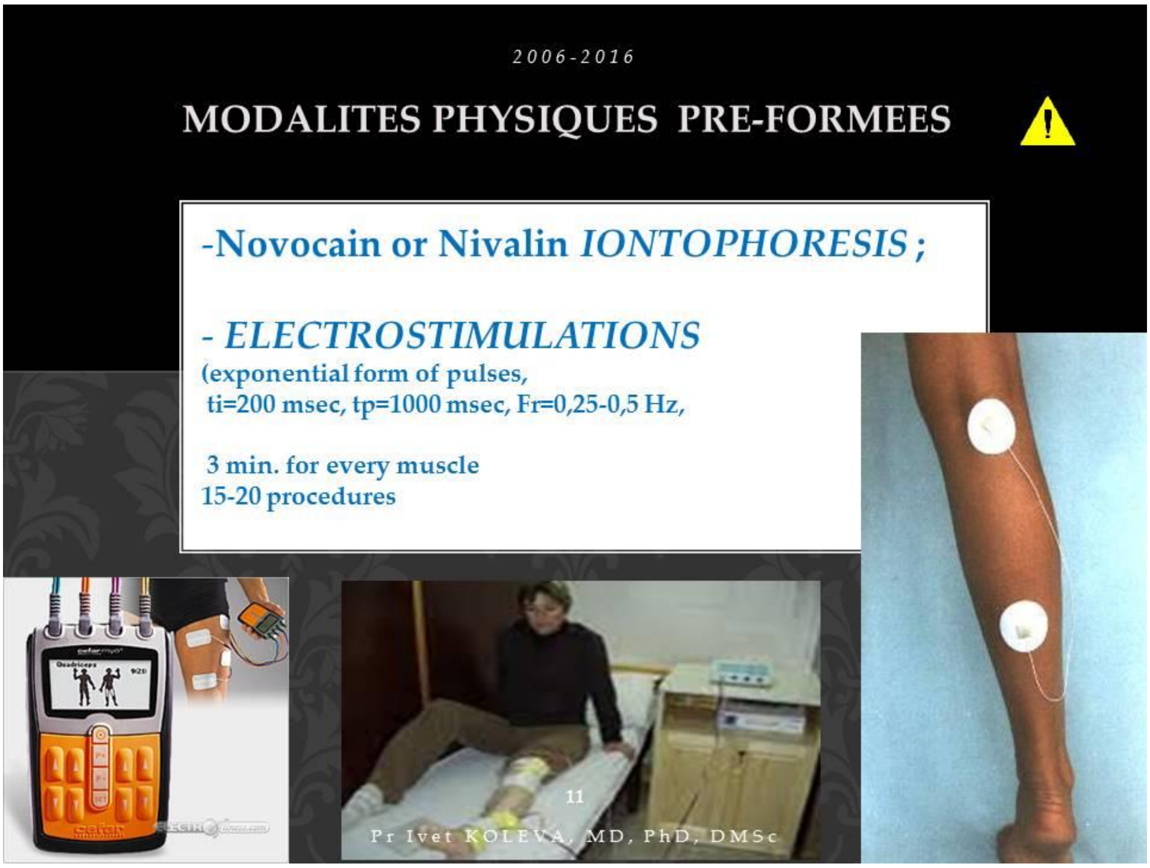
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3 min. for every muscle
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Pr Ivet KOLEVA, MD, PhD, DMSc


Devices for electro-therapy
(low and middle frequency electric currents)
Iontoforesis mod. C-4
4 canales, timer electrónico
Controlado por microprocesador.
12
ALL-STIM


DEVICES
portable
ALL-STIM
Muscle, Nerve & Interferential
Four Channel Stimulator
EMS
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TNS
ENTER
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TIME
1 2 3 4
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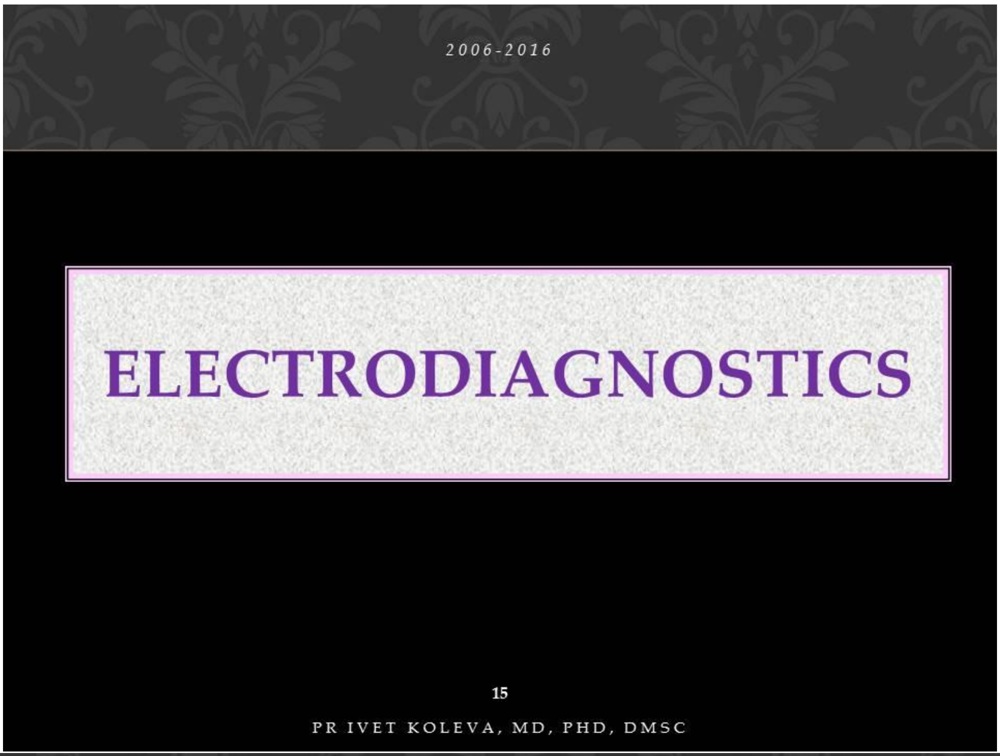
PR IVET KOLE


ELECTRODES
for electrotherapy with
low frequency and middle frequency currents
VITALITYWEB
1.5" x 1.5"
Square
VITALITYWEB
2" Round
VITALITYWEB
3" x 5" Rectangle
SOFIA, BOTA CONGRESS, SEPT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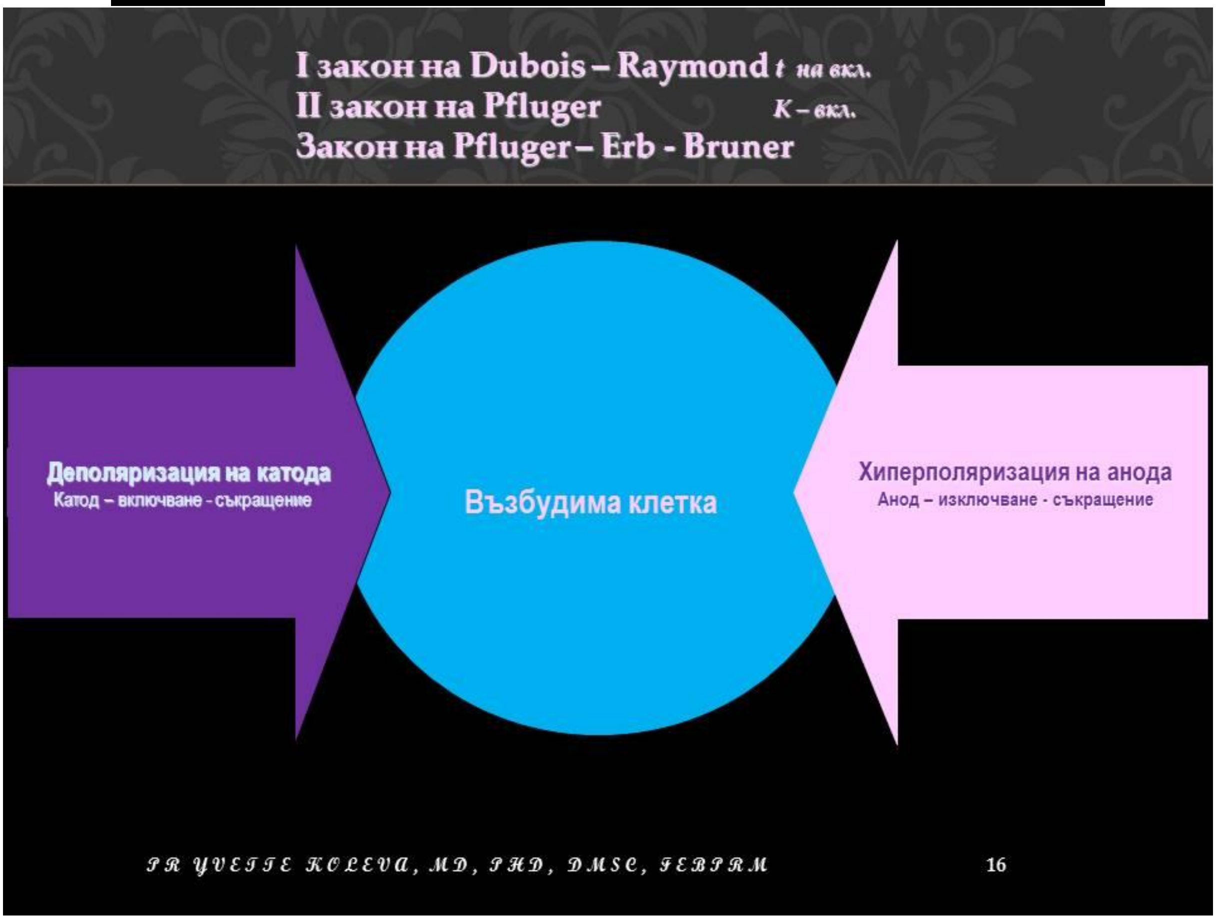
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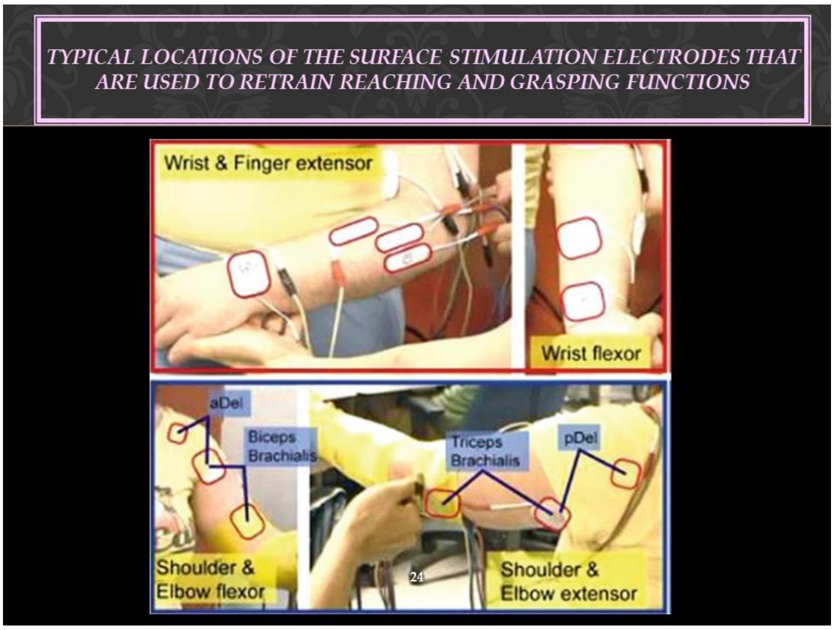
TYPICAL LOCATIONS OF THE SURFACE STIMULATION ELECTRODES THAT ARE USED TO RETRAIN REACHING AND GRASPING FUNCTIONS
Wrist & Finger extensor
Wrist flexor
aDel
Biceps Brachialis
Triceps Brachialis
pDel
Shoulder & Elbow flexor
Shoulder & Elbow extensor
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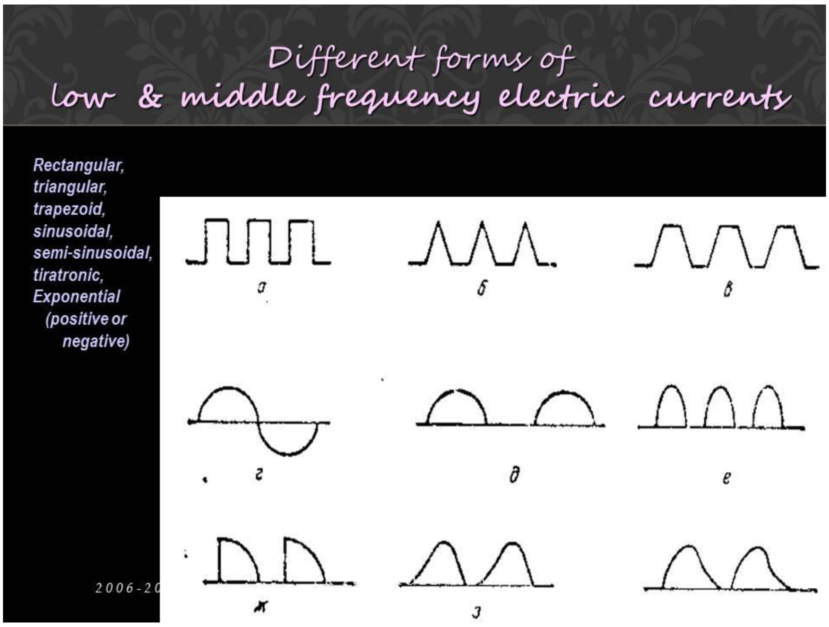
Different forms of low & middle frequency electric currents
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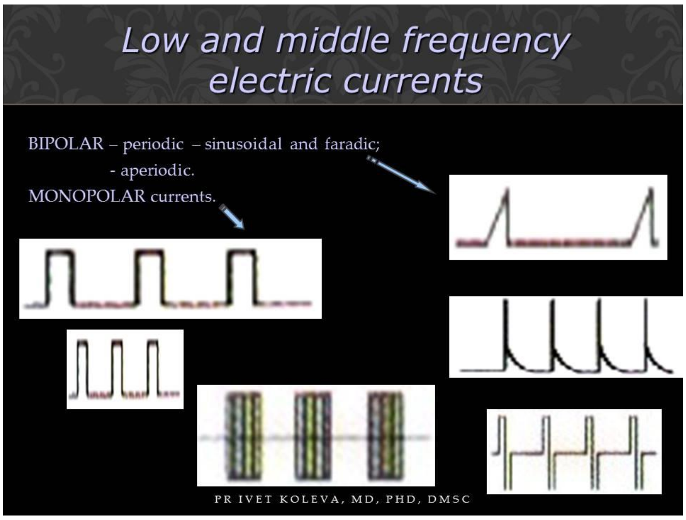
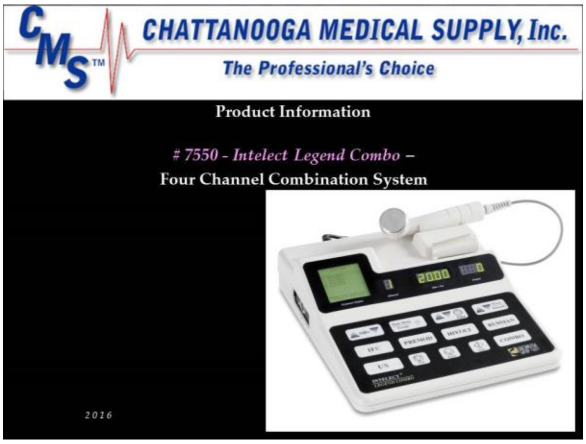
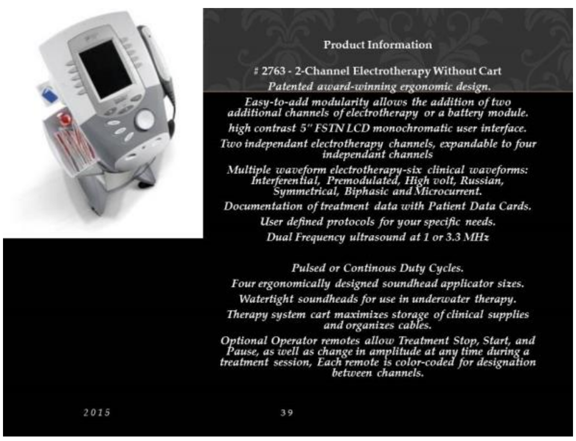

Low and middle frequency electric currents
BIPOLAR – periodic – sinusoidal and faradic;
- aperiodic.
MONOPOLAR currents.
PR IVET KOLEVA, MD, PHD, DMSC

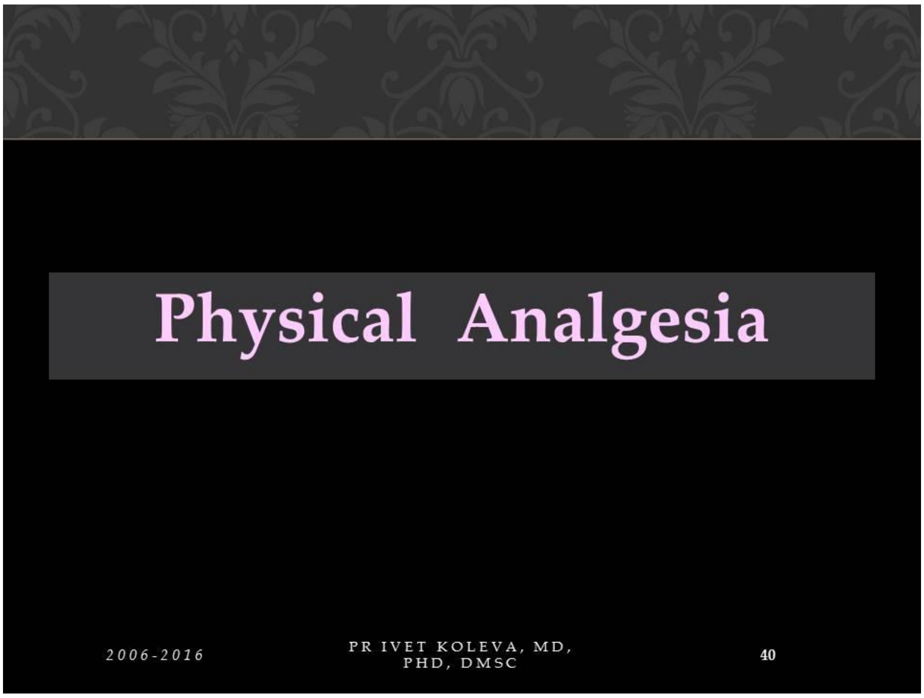

Използват се различни методики: с фиксирани електроди и с един подвижен електрод.
INTELLECT Chattanooga Intelect Legend XT 2 Channel Combo (stim and ultrasound) Unit Without Cart
by INTELLECT
MARCH 2014

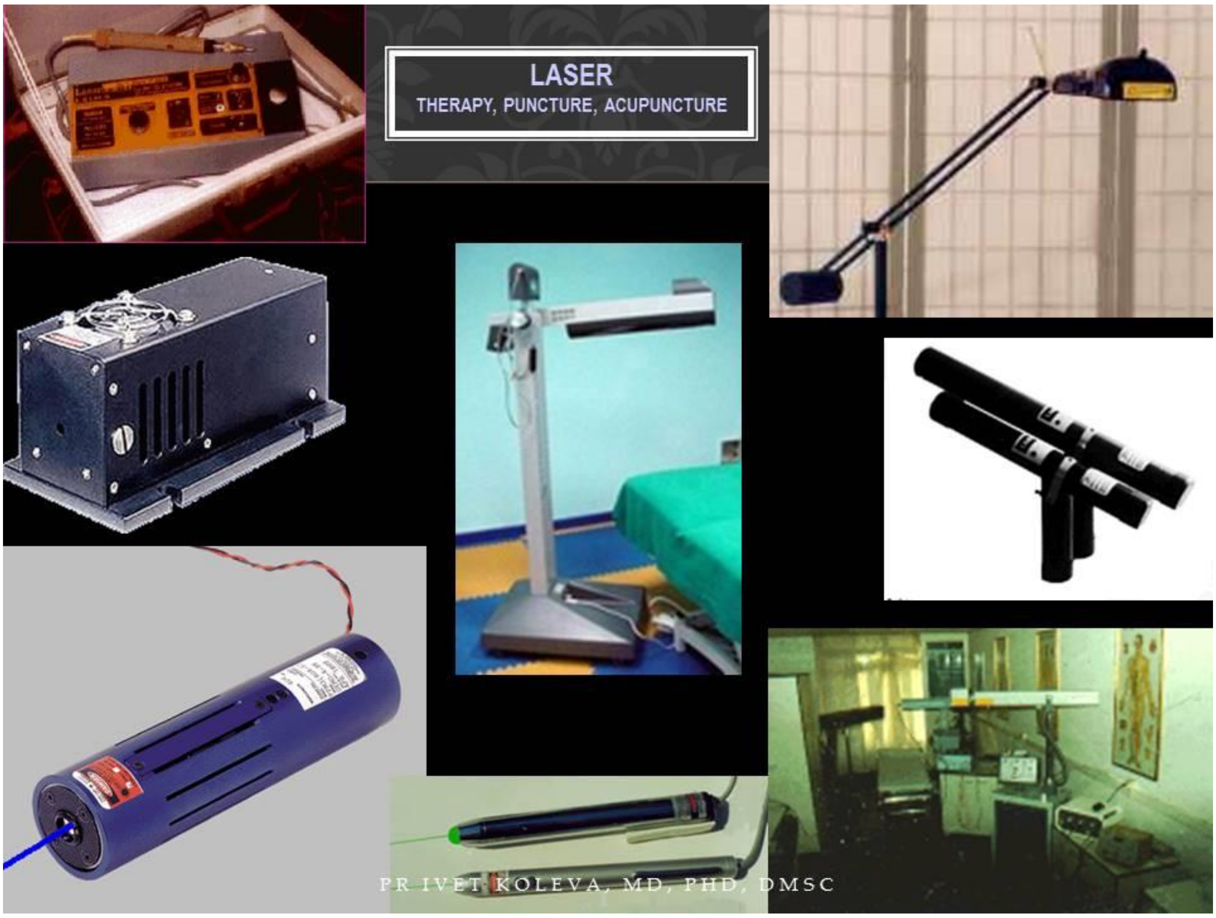

CHATTANOOGA MEDICAL SUPPLY, Inc.
The Professional's Choice
Product Information
7550 - Intelect Legend Combo –
Four Channel Combination System
2016


Intelect Legend XT T
2015
37

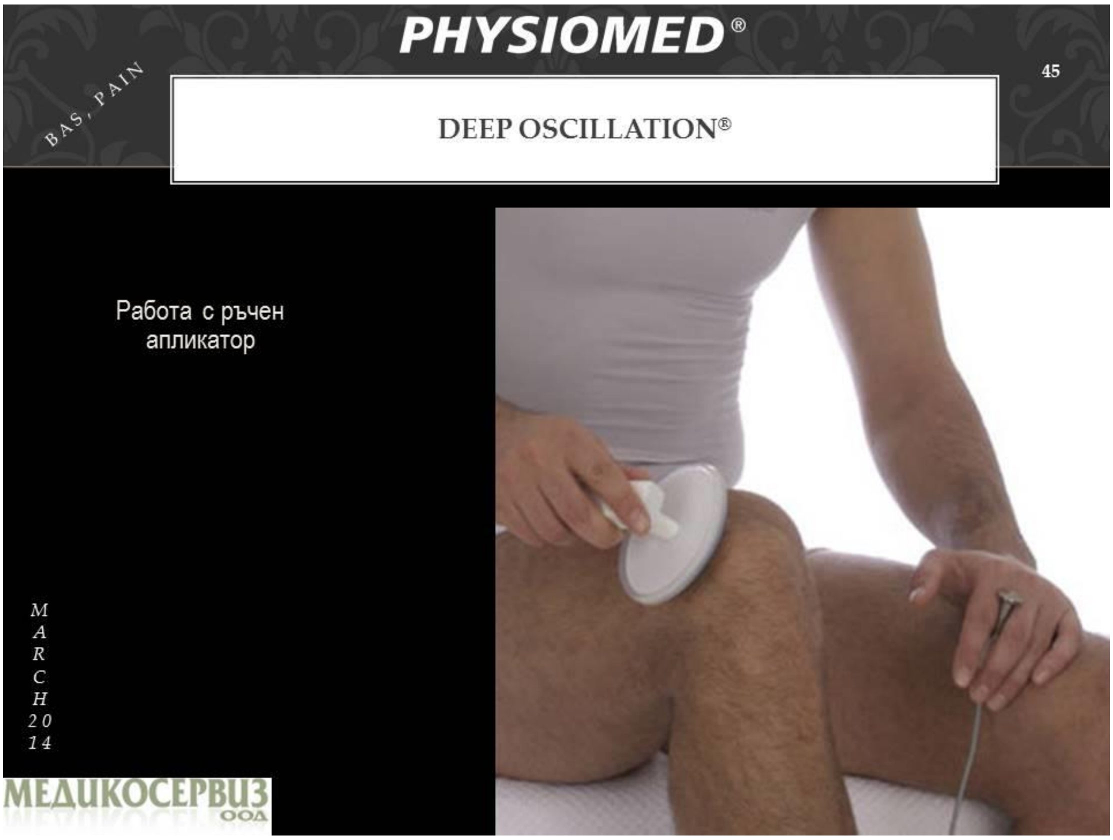

Intelect Legend XT System
Product Information
2797K - 4-Channel Electrotherapy with Cart
Leading Therapy in A New Direction
Clean, award winning modular design
Easy-to-add modularity allows the addition of 2 additional Channels of Electrotherapy or a Battery Module
Mulitple waveform electrotherapy - 6 clinical waveforms: Interferential, Premodulated, High Volt, Russian, Symmetrical Byphasic and Microcurrent
4 independent Electrotherapy channels
User defined protocols for your specific needs
Documentation of treatment outcomes with Patient Data Cards including pain map profile, modality records, electrode placement diagrams and session notes
Includes Therapy System Cart .
38
2015


Product Information
2763 - 2-Channel Electrotherapy Without Cart
Patented award-winning ergonomic design.
Easy-to-add modularity allows the addition of two additional channels of electrotherapy or a battery module.
high contrast 5" FSTN LCD monochromatic user interface.
Two independant electrotherapy channels, expandable to four independant channels
Multiple waveform electrotherapy-six clinical waveforms: Interferential, Premodulated, High volt, Russian, Symmetrical, Biphasic and Microcurrent.
Documentation of treatment data with Patient Data Cards.
User defined protocols for your specific needs.
Dual Frequency ultrasound at 1 or 3.3 MHz
Pulsed or Continous Duty Cycles.
Four ergonomically designed soundhead applicator sizes.
Watertight soundheads for use in underwater therapy.
Therapy system cart maximizes storage of clinical supplies and organizes cables.
Optional Operator remotes allow Treatment Stop, Start, and Pause, as well as change in amplitude at any time during a treatment session, Each remote is color-coded for designation between channels.
2015
39


Physical Analgesia
2006-2016
PR IVET KOLEVA, MD, PHD, DMSC
40


LASER
THERAPY, PUNCTURE, ACUPUNCTURE
PR IVET KOLEVA, MD, PHD, DMSC


PHYSIOMED®
BAS, PAIN
DEEP OSCILLATION®
DEEP OSCILLATION
Evident
Терапевтичната част, разположена върху подвижна стойка, създава мобилност на системата
Подвижният преден панел на стойката дава възможност за съхранение на задължителните и допълнителни аксесоари
Магнитни опорни точки здраво фиксират терапевтичната част към мобилната стойка
Спирачни пластини на колелцата осигуряват стабилност на системата (при нужда)
МЕДИКОСЕРВИЗ ООД


PHYSIOMED®
BAS, PAIN
45
DEEP OSCILLATION®
Работа с ръчен апликатор
MARCH 2014
МЕДИКОСЕРВИЗ ООД

SHOCK WAVE THERAPY

Shockwave is an acoustic wave which carries high energy to painful spots and myoskeletal tissues with subacute, subchronic and chronic conditions. The energy promotes regeneration and reparative processes of the bones, tendons and other soft tissues.
Shockwaves are characterized by jump change in pressure, high amplitude and non-periodicity.
The kinetic energy of the projectile, created by compressed air, is transferred to the transmitter at the end of the applicator and further into the tissue.

Acoustic waves with high energy peak used in Shockwave therapy interact with tissue causing overall medical effects of accelerated tissue repair and cell growth, analgesia and mobility restoration. All the processes mentioned in this section are typically employed simultaneously and are used to treat chronic, sub-acute and acute (advanced users only) conditions.

New Blood Vessel Formation

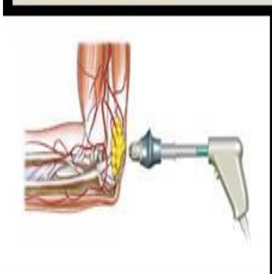
Nutrient blood flow is necessary to start and maintain the repair processes of damaged tissue structure. The application of acoustic waves creates capillary microruptures in tendon and bone. Due to microruptures the expression of growth factors such as eNOS, VEGF, PCNS and BMP is significantly increased.
As a result of these processes arterioles are remodeled, stimulated to grow and new ones are formed. The new blood vessels improve blood supply and oxygenation of the treated area and support faster healing of both the tendon and the bone.

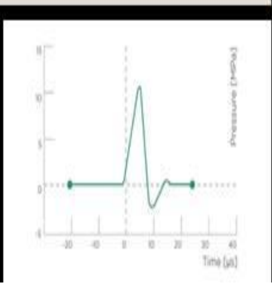
Reversal of Chronic Inflammation

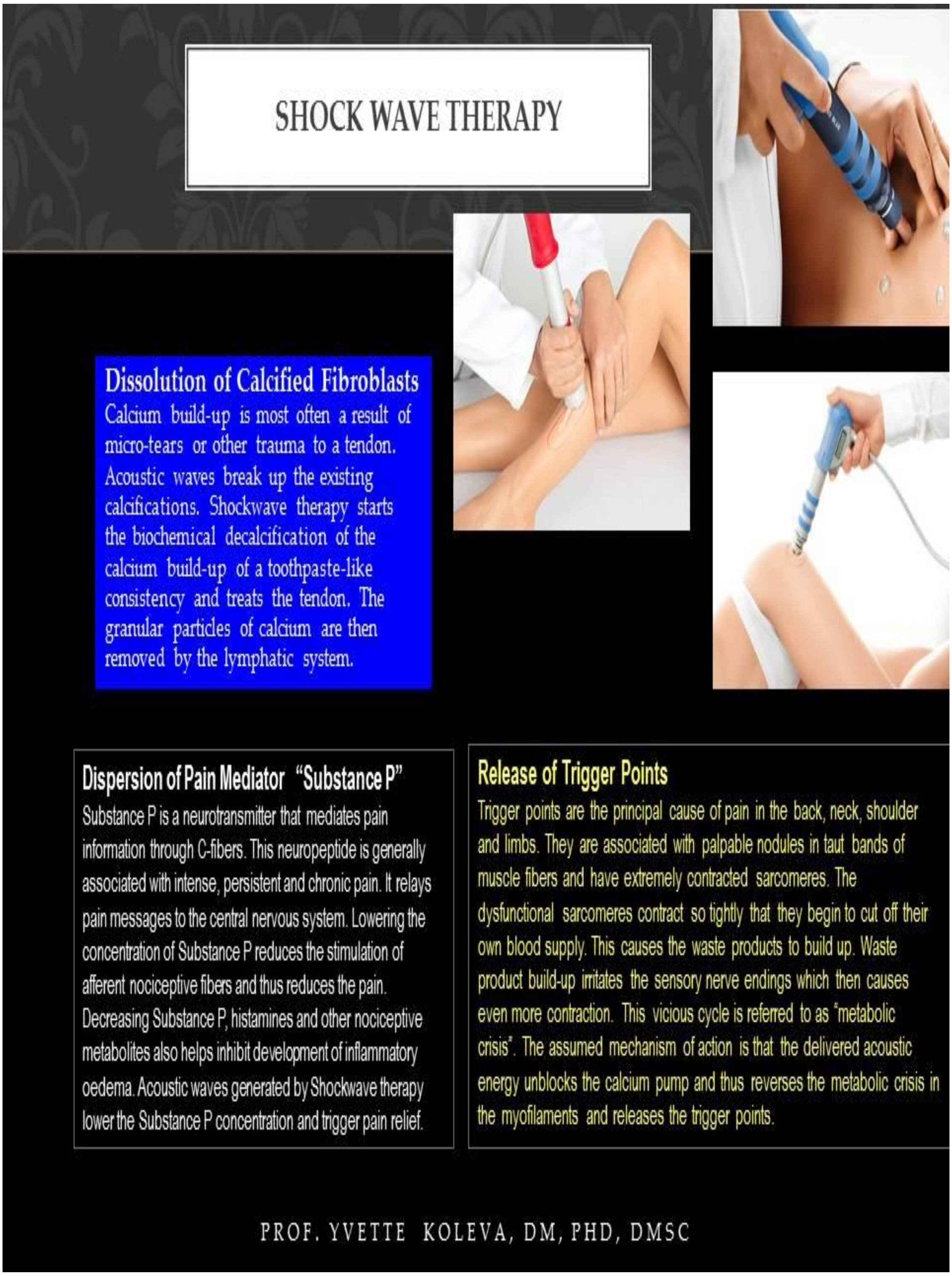
Chronic inflammation occurs when the inflammatory response is not completely halted. It can damage healthy tissue and results in chronic pain. Mast cells are one of the key components of the inflammatory process. Their activity may be increased by using pervasive acoustic waves.
Mast cell activation is followed by the production of chemokines and cytokines. These pro-inflammatory compounds first enhance the inflammatory process and in the next step help restore normal healing and regenerative processes.

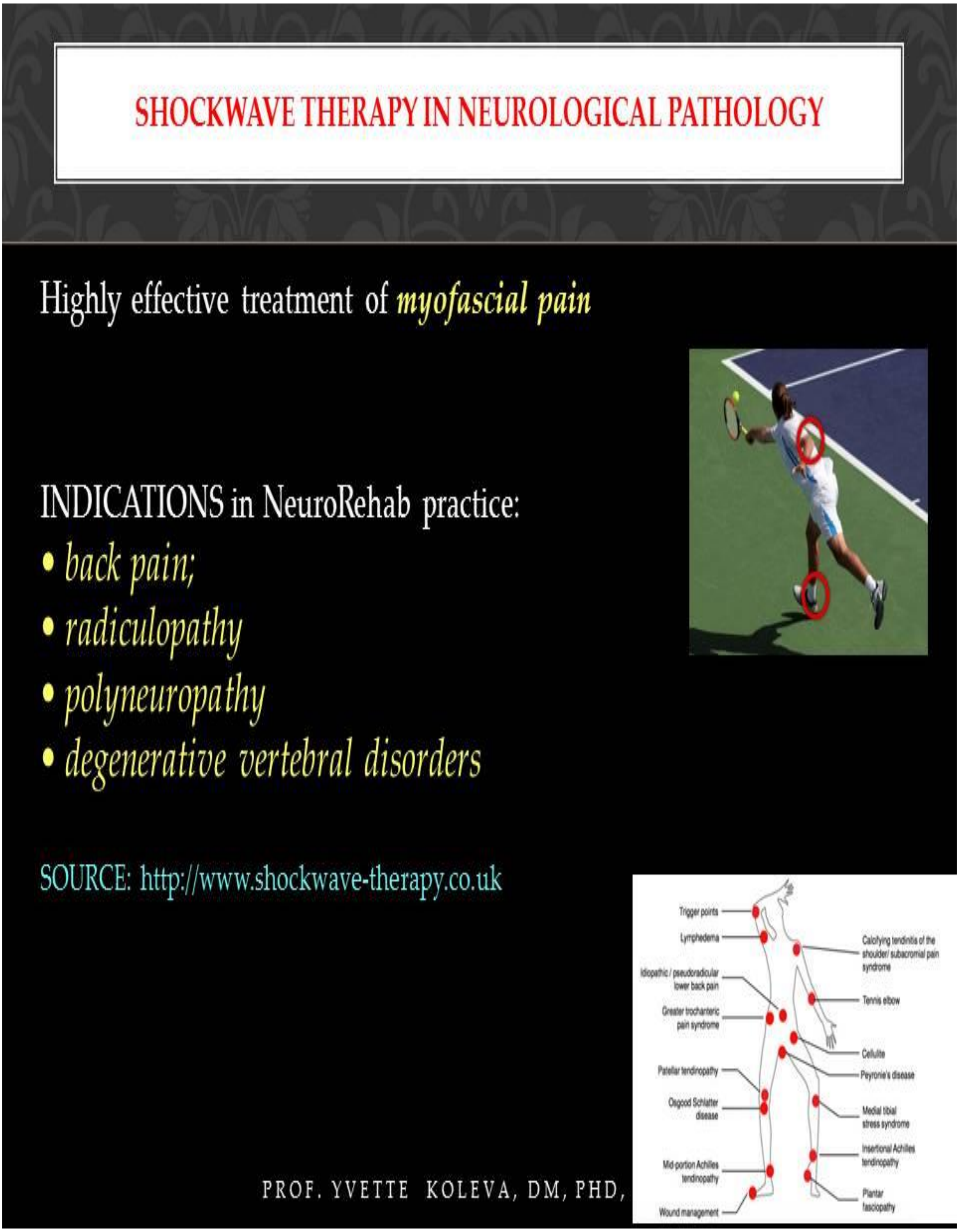
Stimulation of Collagen Production

The production of a sufficient amount of collagen is a necessary precondition for the repair processes of the damaged myoskeletal and ligamentous structures. Shockwave therapy accelerates procollagen synthesis. The therapy forces the newly created collagen fibers into a longitudinal structure which makes the newly formed tendon fibers more dense and stiff and creates a firmer structure.





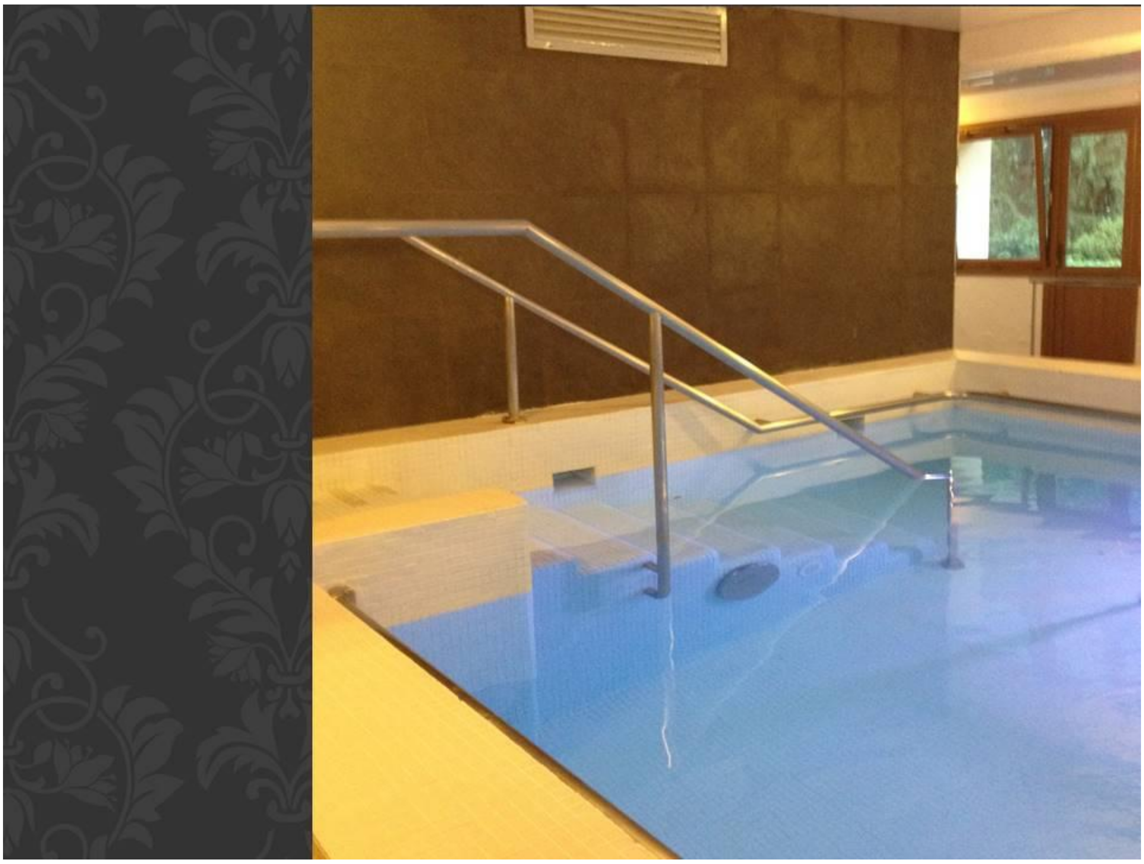

SHOCK WAVE THERAPY
Dissolution of Calcified Fibroblasts
Calcium build-up is most often a result of micro-tears or other trauma to a tendon. Acoustic waves break up the existing calcifications. Shockwave therapy starts the biochemical decalcification of the calcium build-up of a toothpaste-like consistency and treats the tendon. The granular particles of calcium are then removed by the lymphatic system.
Dispersion of Pain Mediator "Substance P"
Substance P is a neurotransmitter that mediates pain information through C-fibers. This neuropeptide is generally associated with intense, persistent and chronic pain. It relays pain messages to the central nervous system. Lowering the concentration of Substance P reduces the stimulation of afferent nociceptive fibers and thus reduces the pain. Decreasing Substance P, histamines and other nociceptive metabolites also helps inhibit development of inflammatory oedema. Acoustic waves generated by Shockwave therapy lower the Substance P concentration and trigger pain relief.
Release of Trigger Points
Trigger points are the principal cause of pain in the back, neck, shoulder and limbs. They are associated with palpable nodules in taut bands of muscle fibers and have extremely contracted sarcomeres. The dysfunctional sarcomeres contract so tightly that they begin to cut off their own blood supply. This causes the waste products to build up. Waste product build-up irritates the sensory nerve endings which then causes even more contraction. This vicious cycle is referred to as "metabolic crisis". The assumed mechanism of action is that the delivered acoustic energy unblocks the calcium pump and thus reverses the metabolic crisis in the myofilaments and releases the trigger points.
PROF. YVETTE KOLEVA, DM, PHD, DMSC

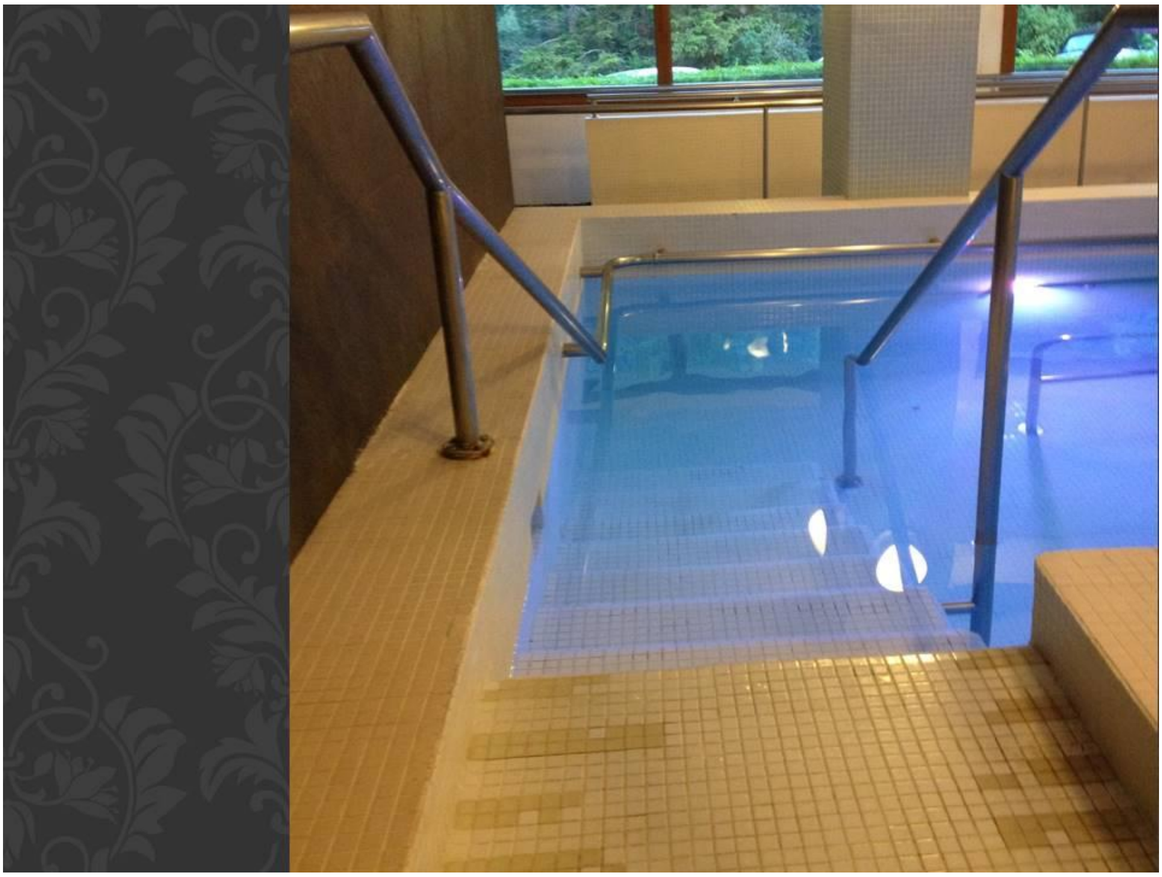

SHOCKWAVE THERAPY IN NEUROLOGICAL PATHOLOGY
Highly effective treatment of *myofascial pain*
INDICATIONS in NeuroRehab practice:
• *back pain;*
• *radiculopathy*
• *polyneuropathy*
• *degenerative vertebral disorders*
SOURCE: http://www.shockwave-therapy.co.uk
PROF. YVETTE KOLEVA, DM, PHD,
Trigger points
Lymphedema
Idiopathic / pseudoradicular lower back pain
Greater trochanteric pain syndrome
Patellar tendinopathy
Osgood Schlatter disease
Mid-portion Achilles tendinopathy
Wound management
Calcifying tendinitis of the shoulder/ subacromial pain syndrome
Tennis elbow
Cellulite
Peyronie's disease
Medial tibial stress syndrome
Insertional Achilles tendinopathy
Plantar fasciopathy

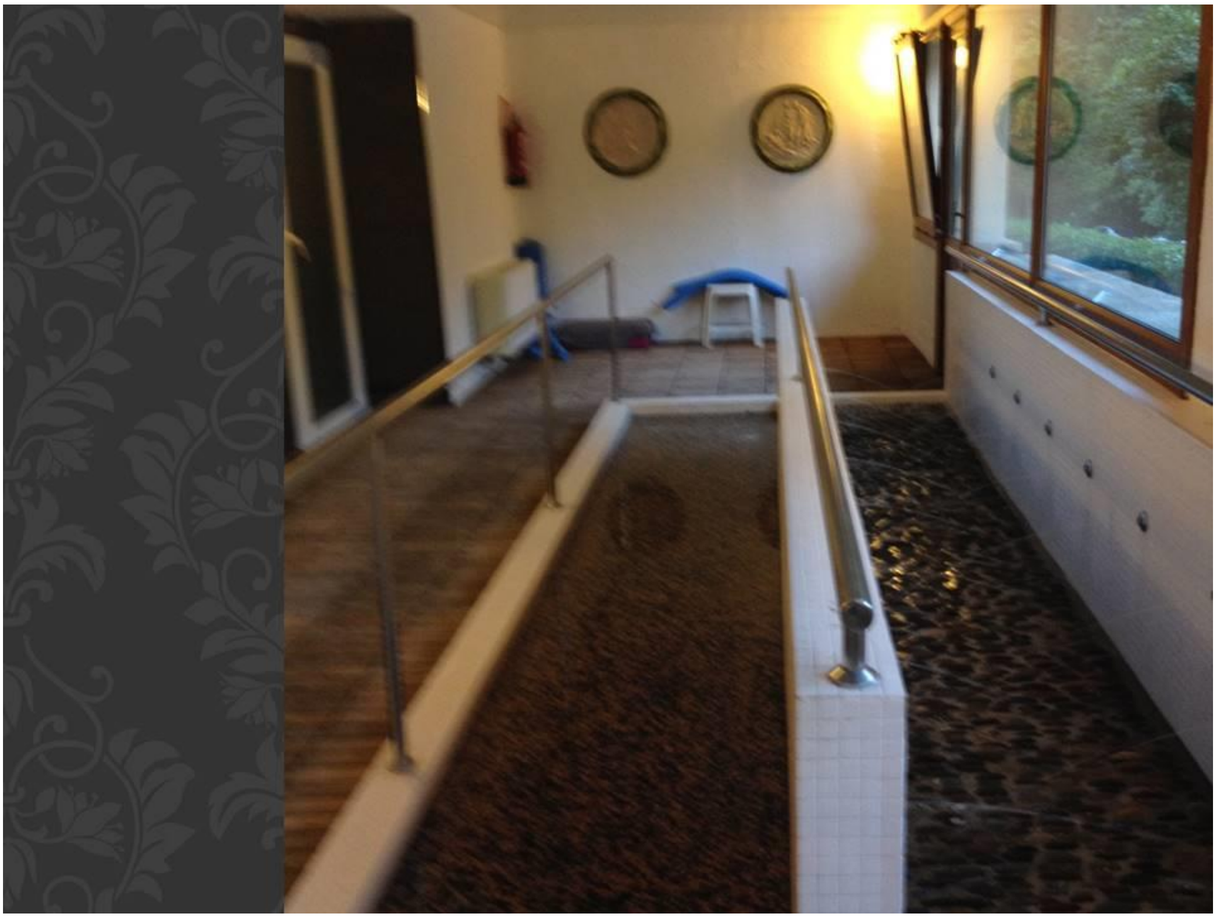

SPA, Wellness,
Medical SPA
проф. д-р Ивет Колева, дмн

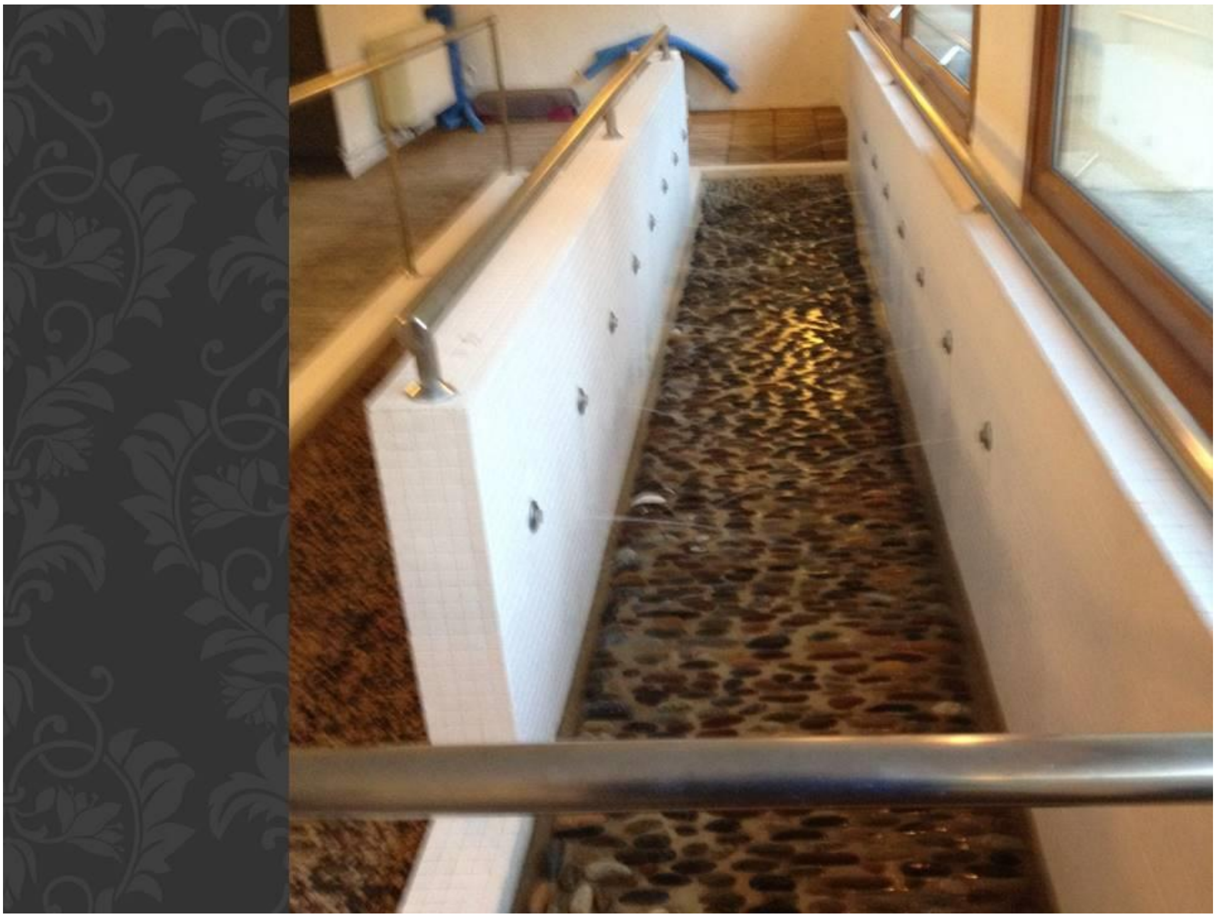

SPA
Sanus Per Aquam
or
health by water
2006-2016
50
Pr Ivet KOLEVA, MD, PhD, DMSc

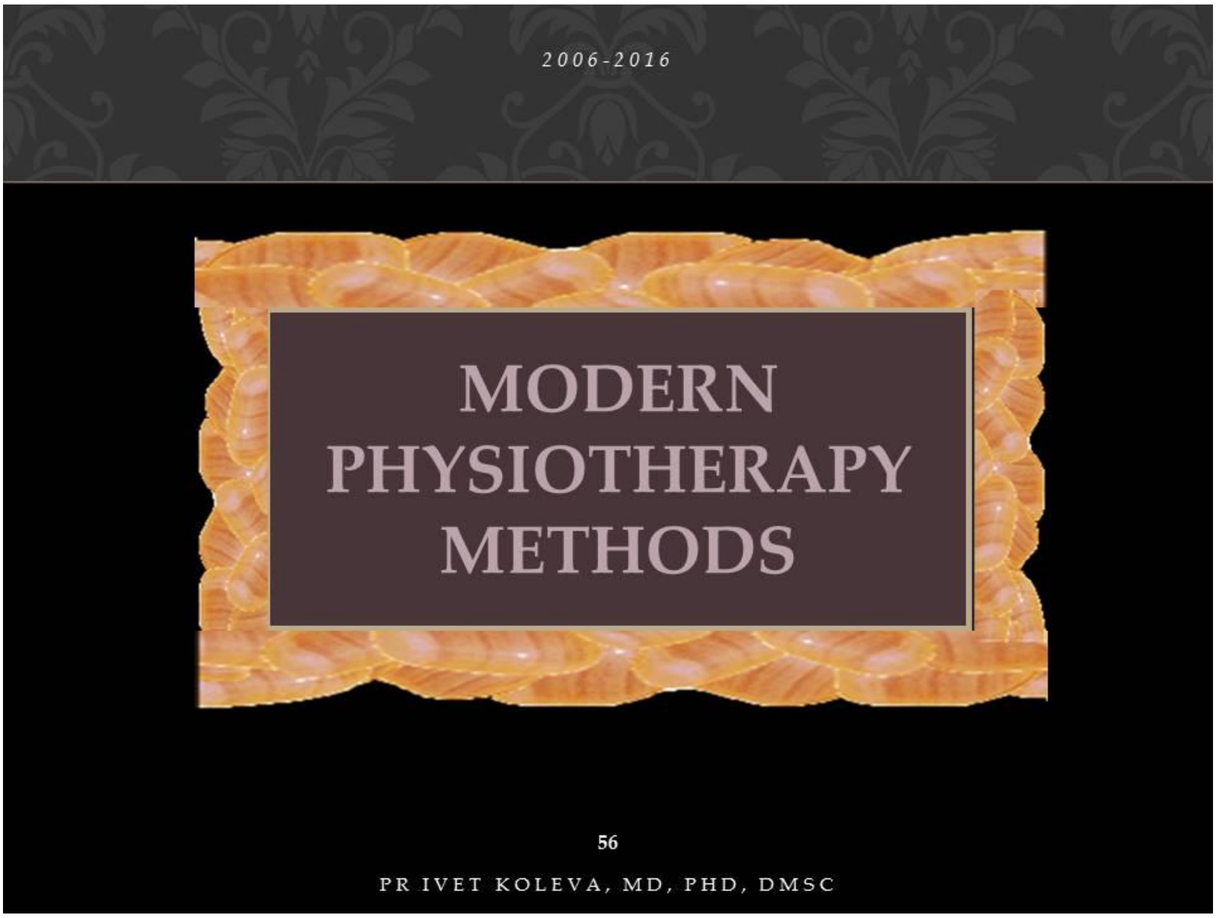

2006-2016
Step 1
Step 2
Step 3
Step 4
51
PR IVET KOLEVA, MD, PHD, DMSC





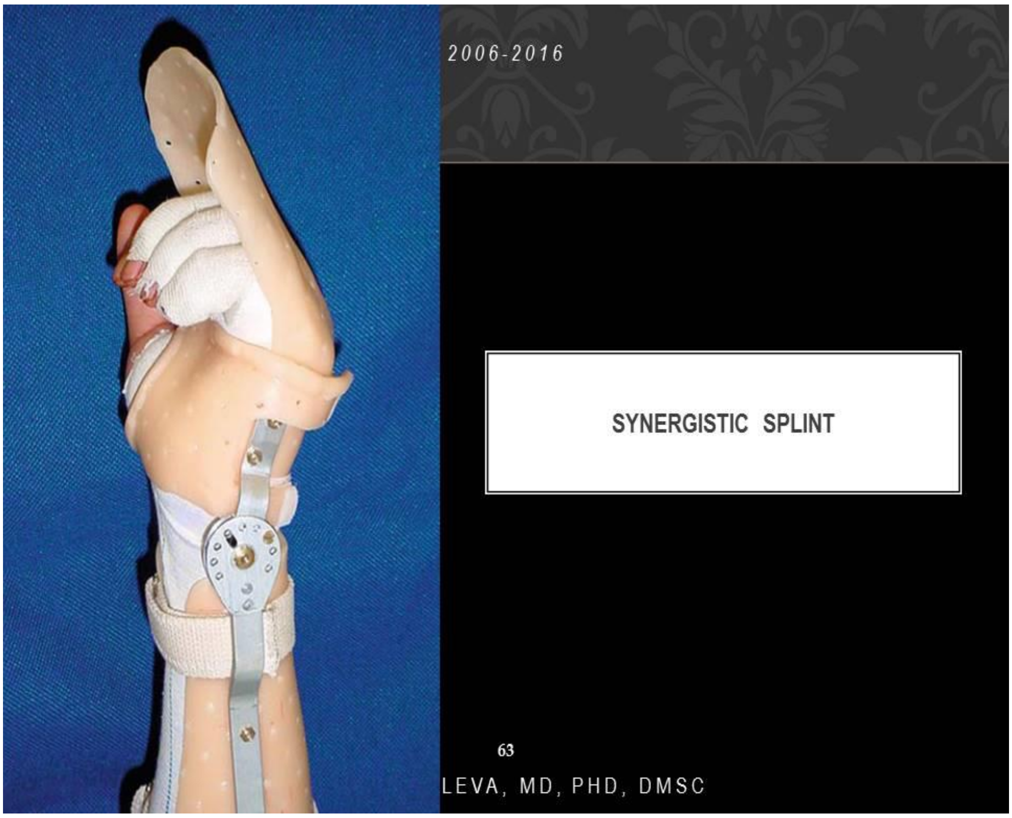




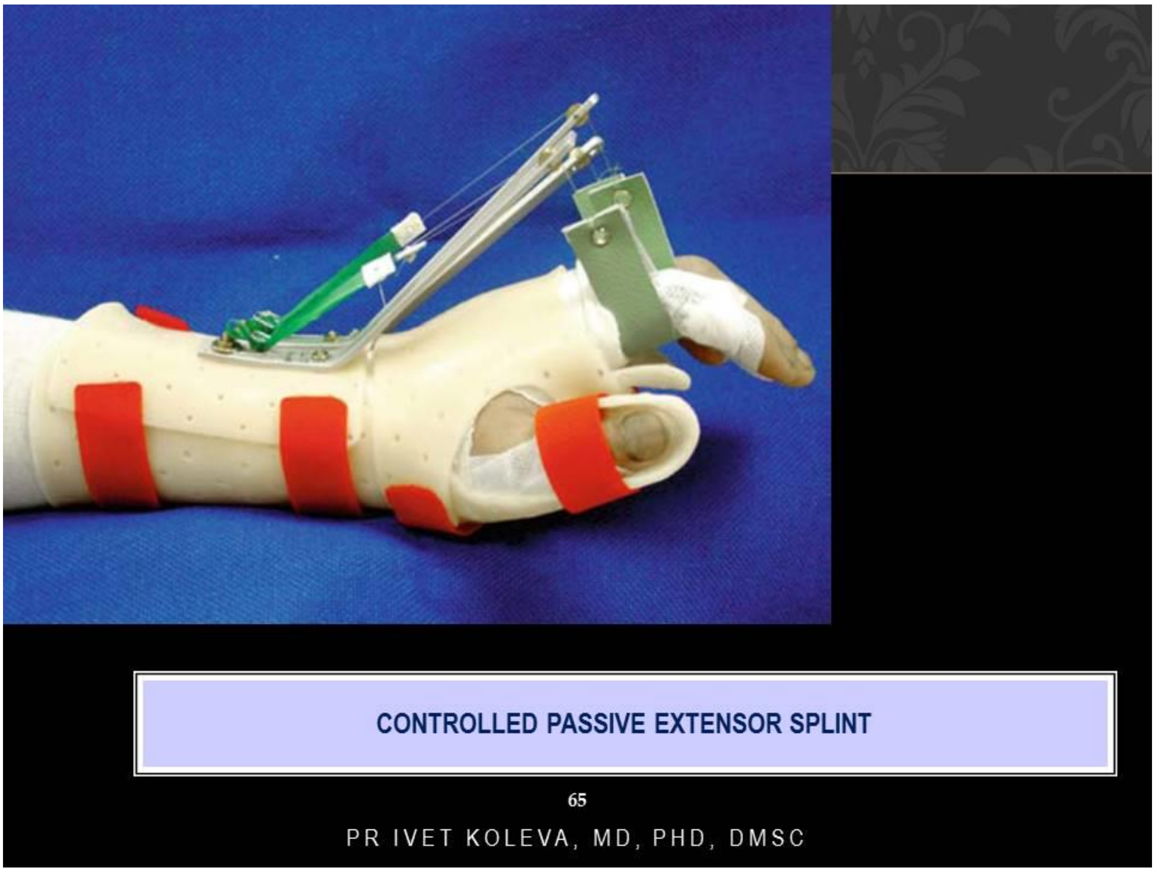

2006-2016
MODERN
PHYSIOTHERAPY
METHODS
56
PR IVET KOLEVA, MD, PHD, DMSC


2006-2016
SPLINTS
FOR ACTIVE GRASP TRAINING
61
PR IVET KOLEVA, MD, PHD, DMSC


CONTROLLED ACTIVE
FLEXOR SPLINT
62
PHD, DMSC

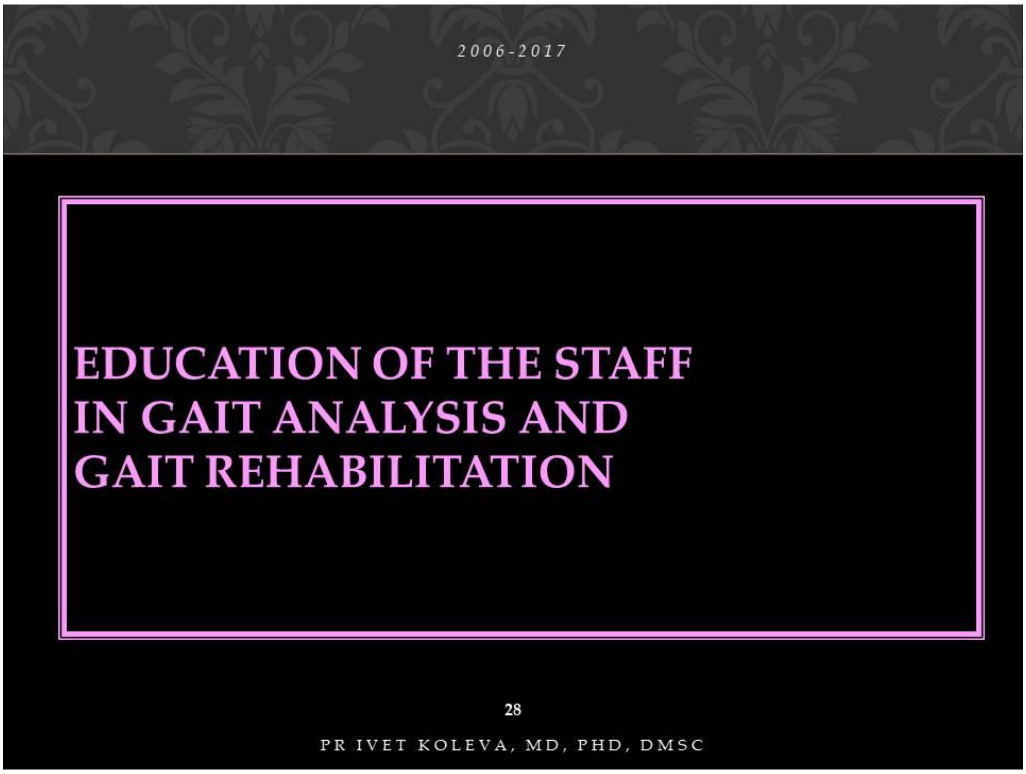

2006-2016
SYNERGISTIC SPLINT
63
LEVA, MD, PHD, DMSC


DIFFERENTIAL
TENDON-GLIDING
SPLINTS
64
PR IVET KOLEVA, MD, PHD, DMSC

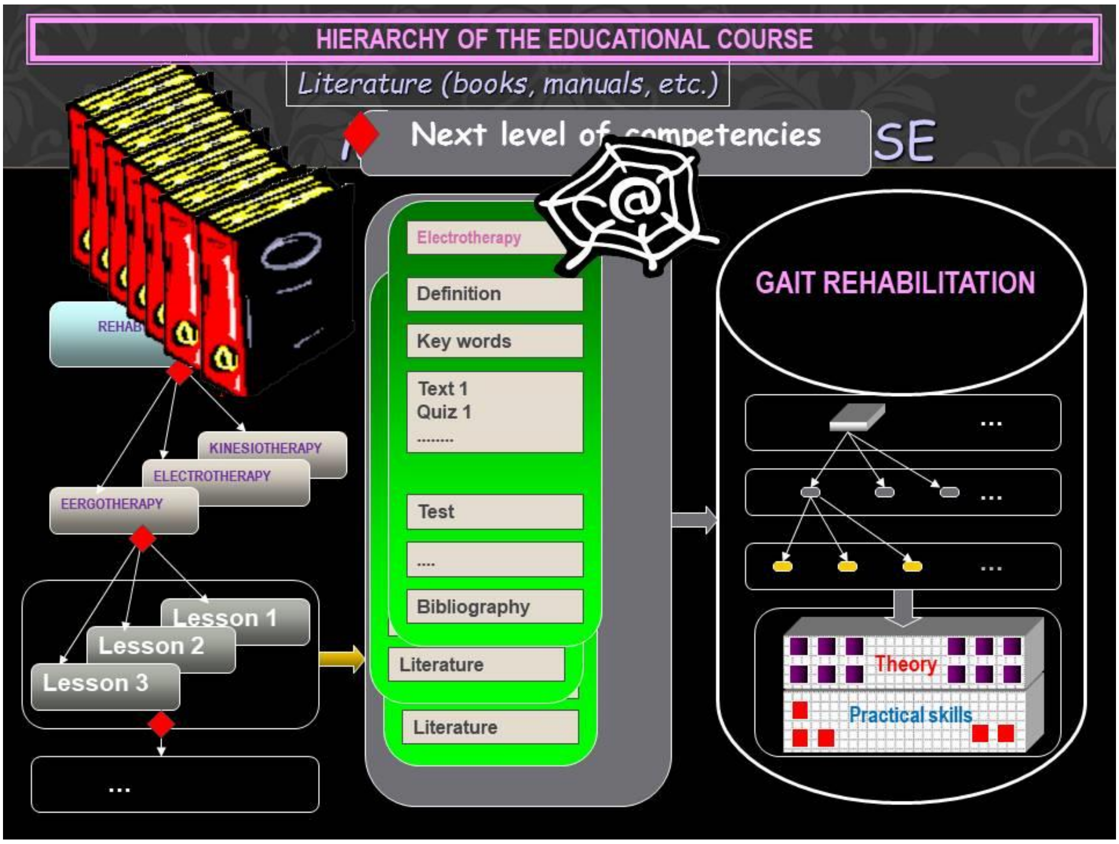

CONTROLLED PASSIVE EXTENSOR SPLINT
65
PR IVET KOLEVA, MD, PHD, DMSC


2006-2016
IMMEDIATE CONTROLLED ACTIVE MOTION SPLINT
66
PR IVET KOLEVA, MD, PHD, DMSC


2006-2016
BUDDY SPLINT AND PROXIMAL PHALANGIAL FRACTURE RESTING SPLINT
67
PR IVET KOLEVA, MD, PHD, DMSC


2006-2017
EDUCATION OF THE STAFF
IN GAIT ANALYSIS AND
GAIT REHABILITATION
28
PR IVET KOLEVA, MD, PHD, DMSC

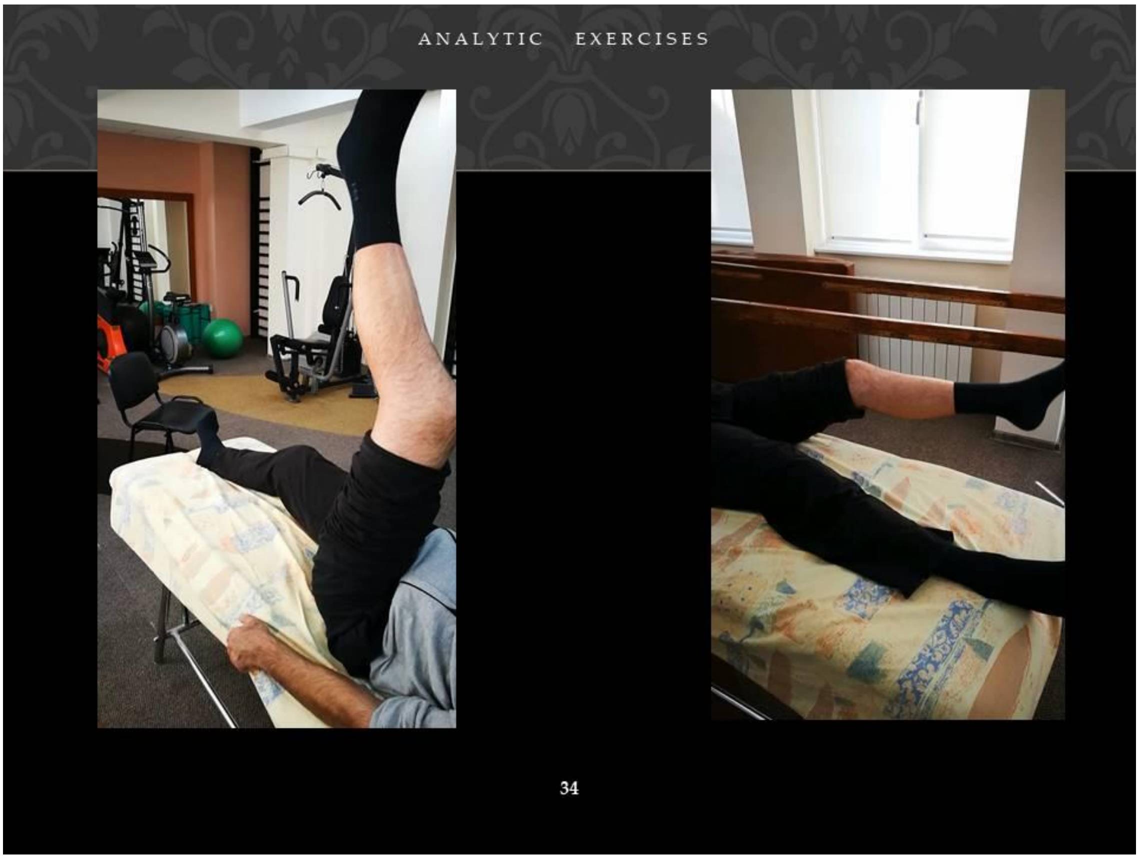

MINIMAL LEVEL
OF COMPETENCES
Minimally required level of competences
2006-2017
29

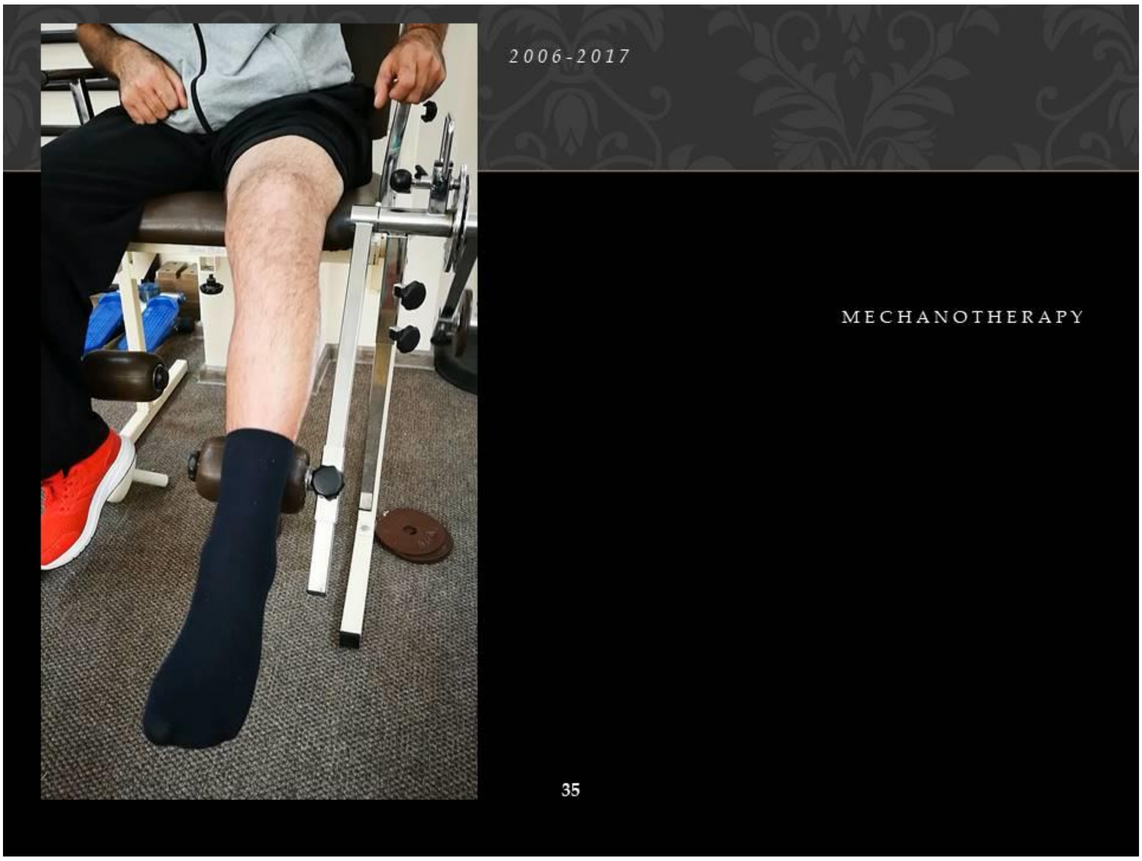

HIERARCHY OF THE EDUCATIONAL COURSE
Literature (books, manuals, etc.)
Next level of competencies
SE
REHAB
KINESIOTHERAPY
ELECTROTHERAPY
EERGOTHERAPY
Lesson 1
Lesson 2
Lesson 3
...
Electrotherapy
Definition
Key words
Text 1
Quiz 1
Test
Bibliography
Literature
Literature
GAIT REHABILITATION
Theory
Practical skills

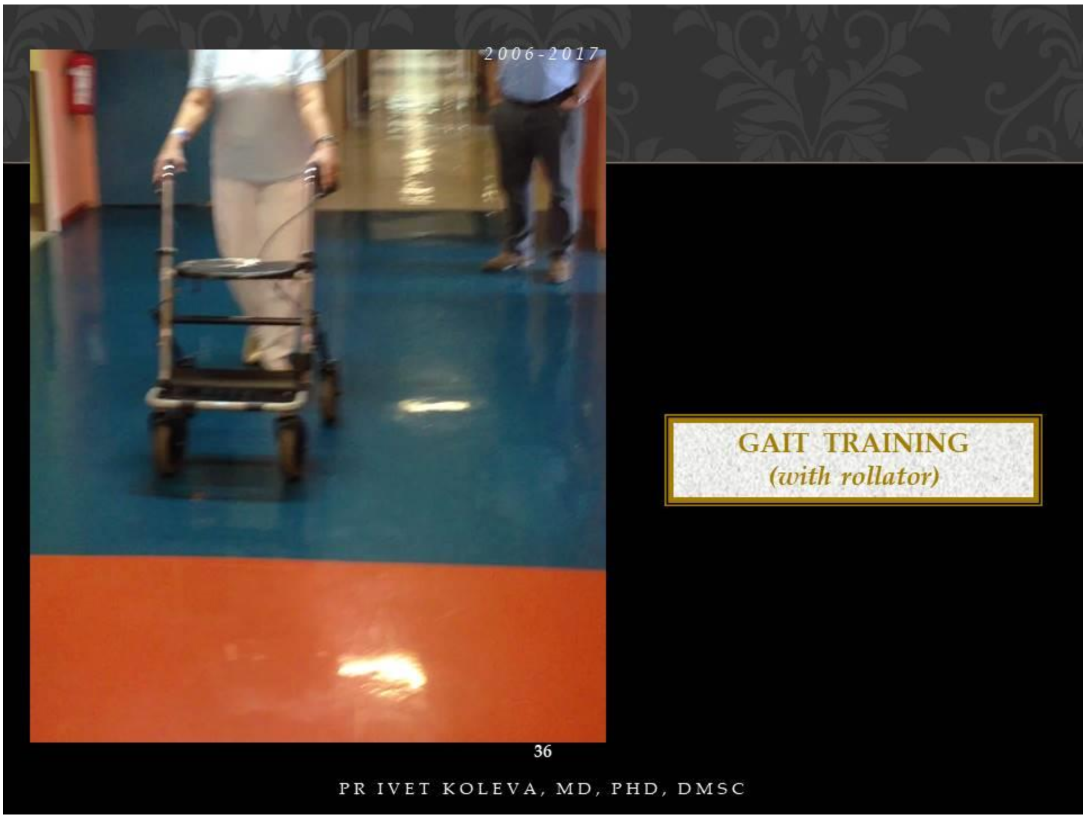

2006-2017
E-LEARNING
WEB-BASED EDUCATION
REHABILITATION OF THE GRASP AND GAIT
ERASMUS PLUS PROJECT
www.cor-skill.org
ERASMUS PLUS PROJECT
31
PR IVET KOLEVA, MD, PHD, DMSC

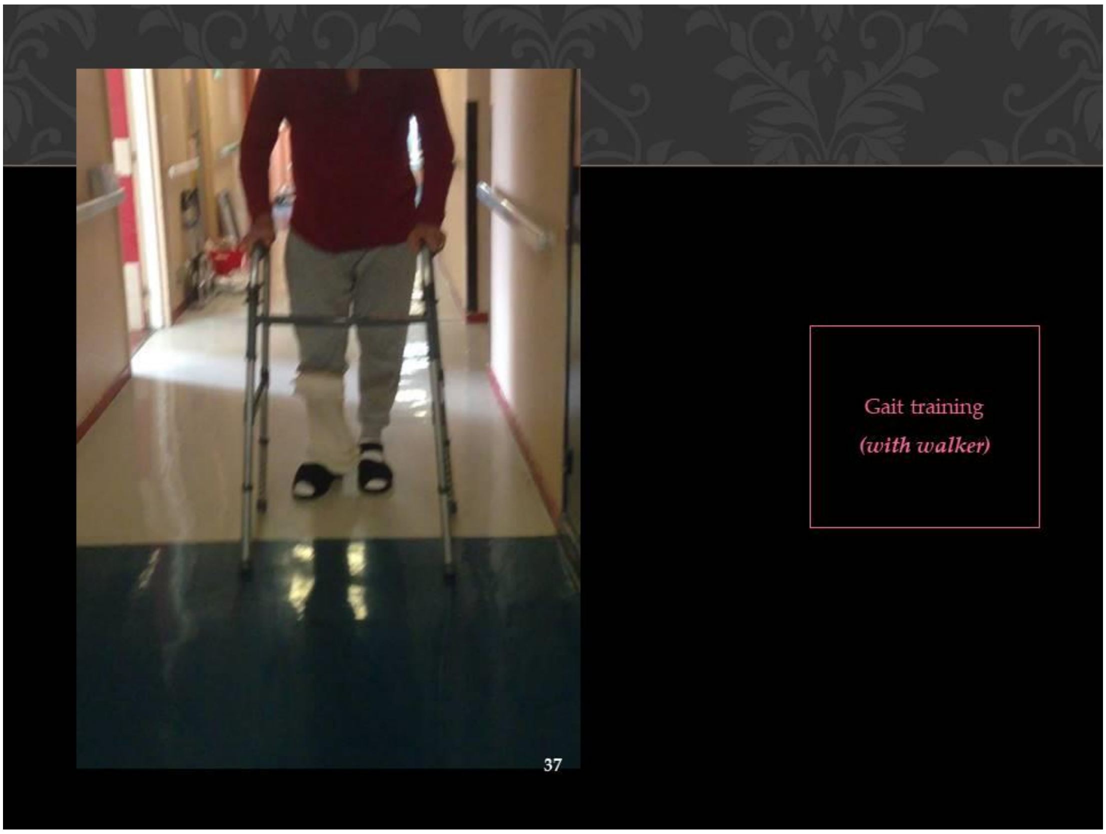

Analytic
exercises
32


2006-2017
VERTICALIZATION
33
PR IVET KOLEVA, MD, PHD, DMSC

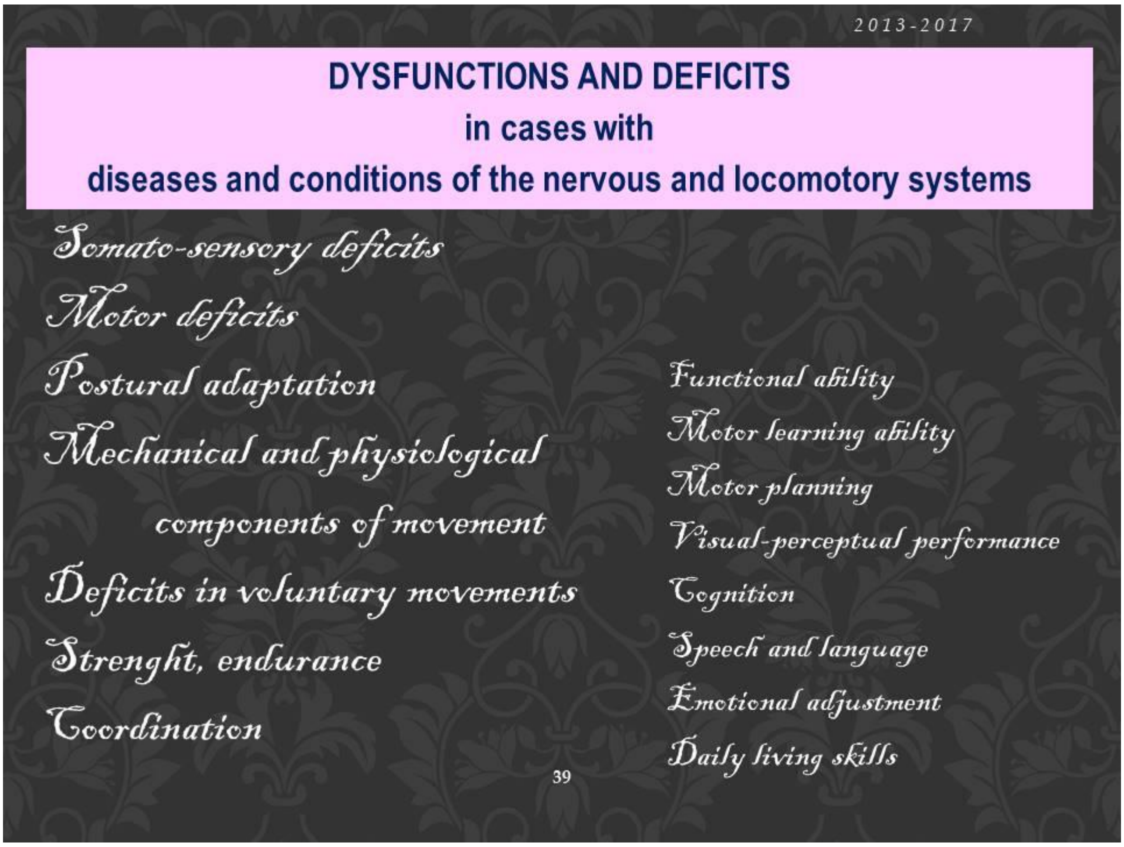

ANALYTIC EXERCISES
34


2006-2017
MECHANOTHERAPY
35

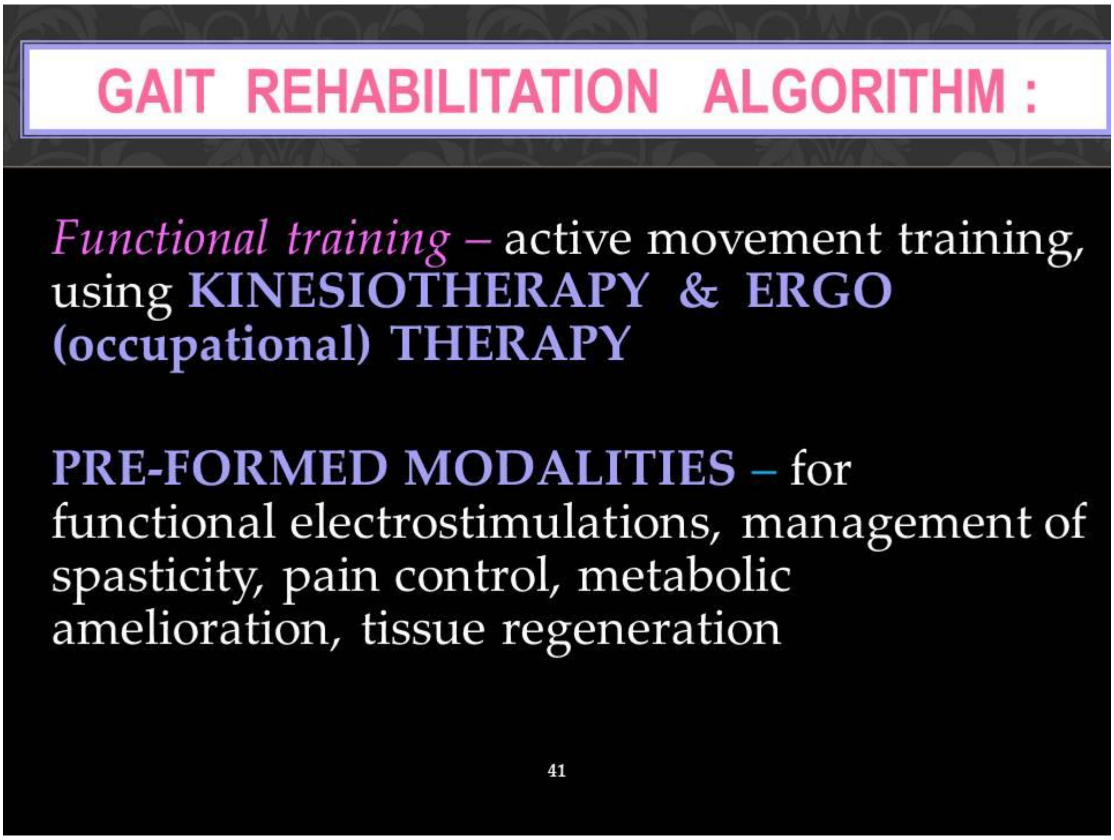

2006-2017
GAIT TRAINING
(with rollator)
36
PR IVET KOLEVA, MD, PHD, DMSC

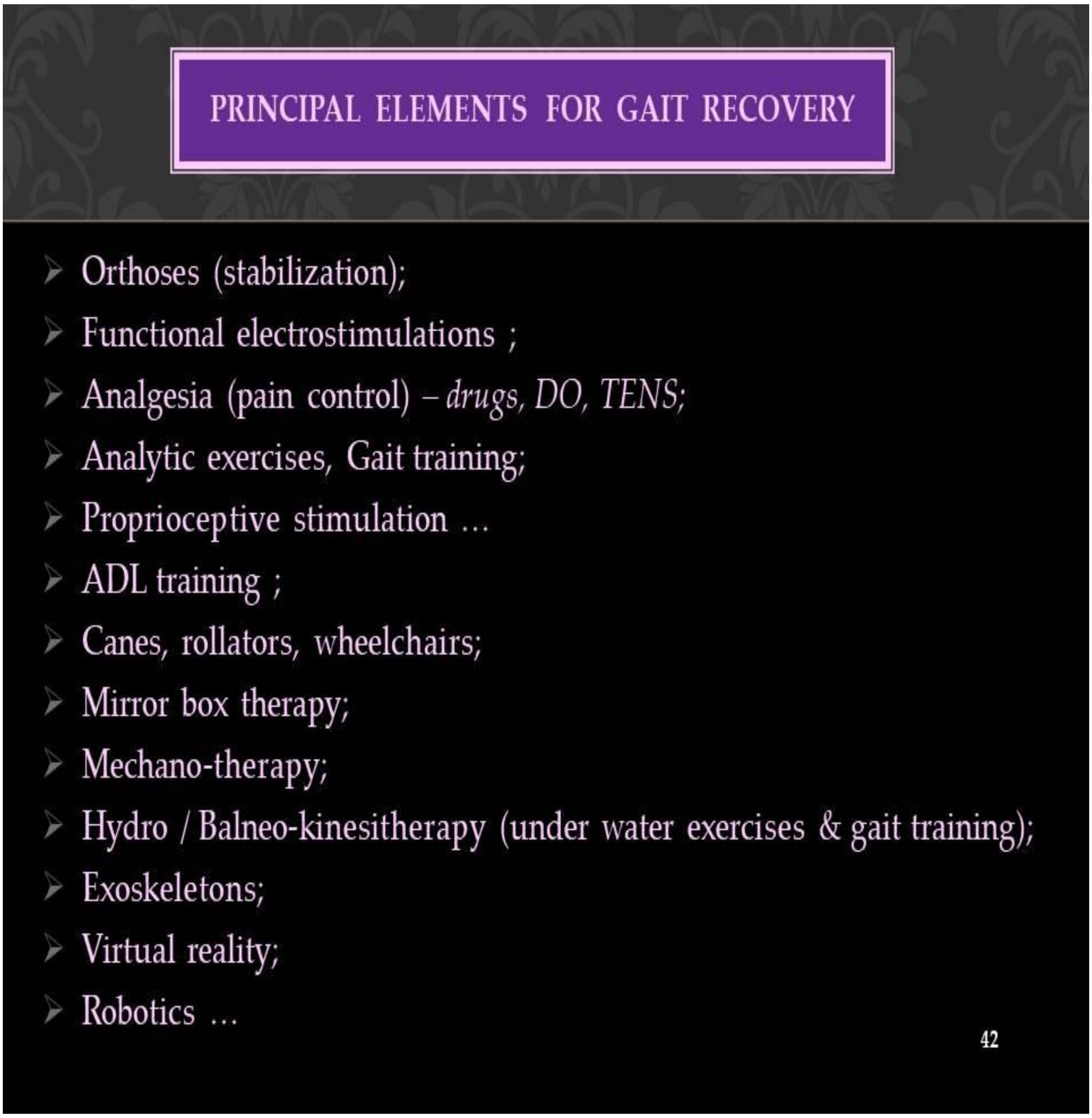

Gait training
(with walker)
37

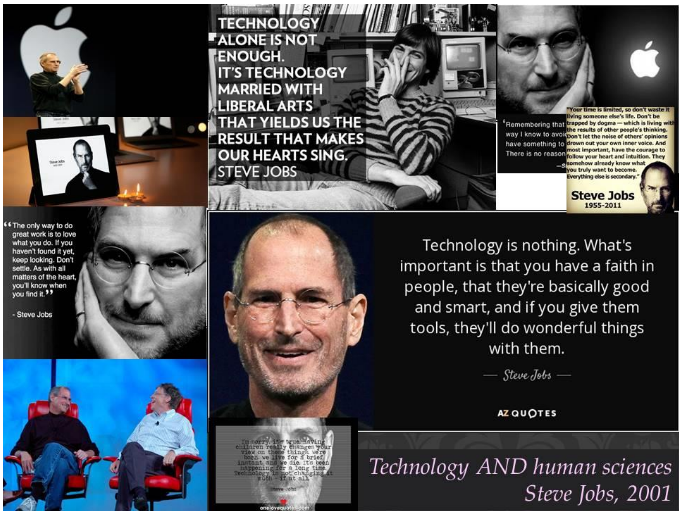

2013-2017
GAIT REHABILITATION
CONTEMPORANEOUS METHODS
38


2013-2017
DYSFUNCTIONS AND DEFICITS
in cases with
diseases and conditions of the nervous and locomotory systems
Somato-sensory deficits
Motor deficits
Postural adaptation
Mechanical and physiological
components of movement
Deficits in voluntary movements
Strenght, endurance
Coordination
Functional ability
Motor learning ability
Motor planning
Visual-perceptual performance
Cognition
Speech and language
Emotional adjustment
Daily living skills
39

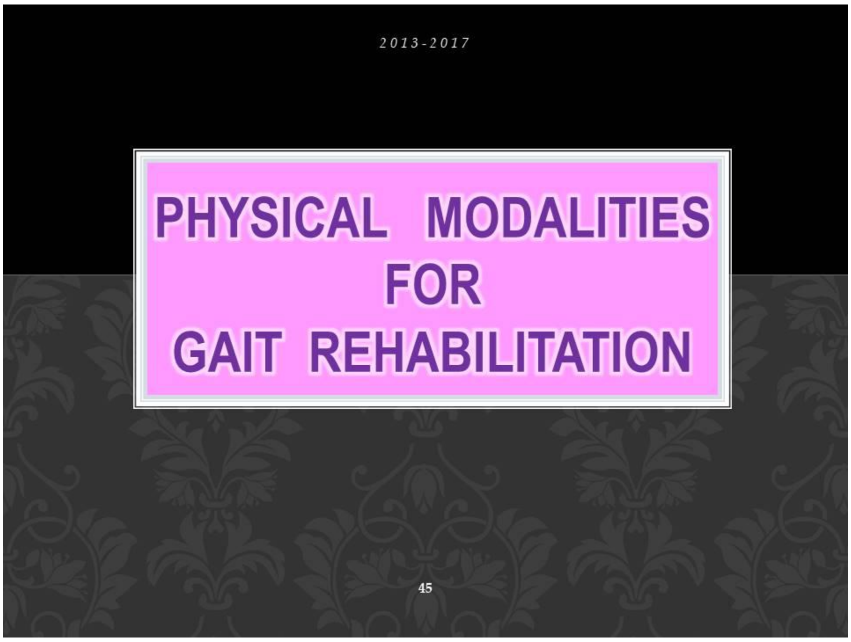

2013-2017
REHABILITATION PROGRAMME
DRUGS
(MEDICATIONS)
KINESIOTHERAPY – ACTIVE AND PASSIVE
OCCUPATIONAL THERAPY
ADL
PROFESSIONAL ORIENTATION AND RE-ORIENTATION
THERMOTHERAPY
CRYOTHERAPY, ICE, COLD-PACKS,
PARAFFIN, HOT-PACKS, ETC.
PRE-FORMED PHYSICAL MODALITIES
PSYCHOLOGICAL ASSISTANCE
SPEECH THERAPY
40

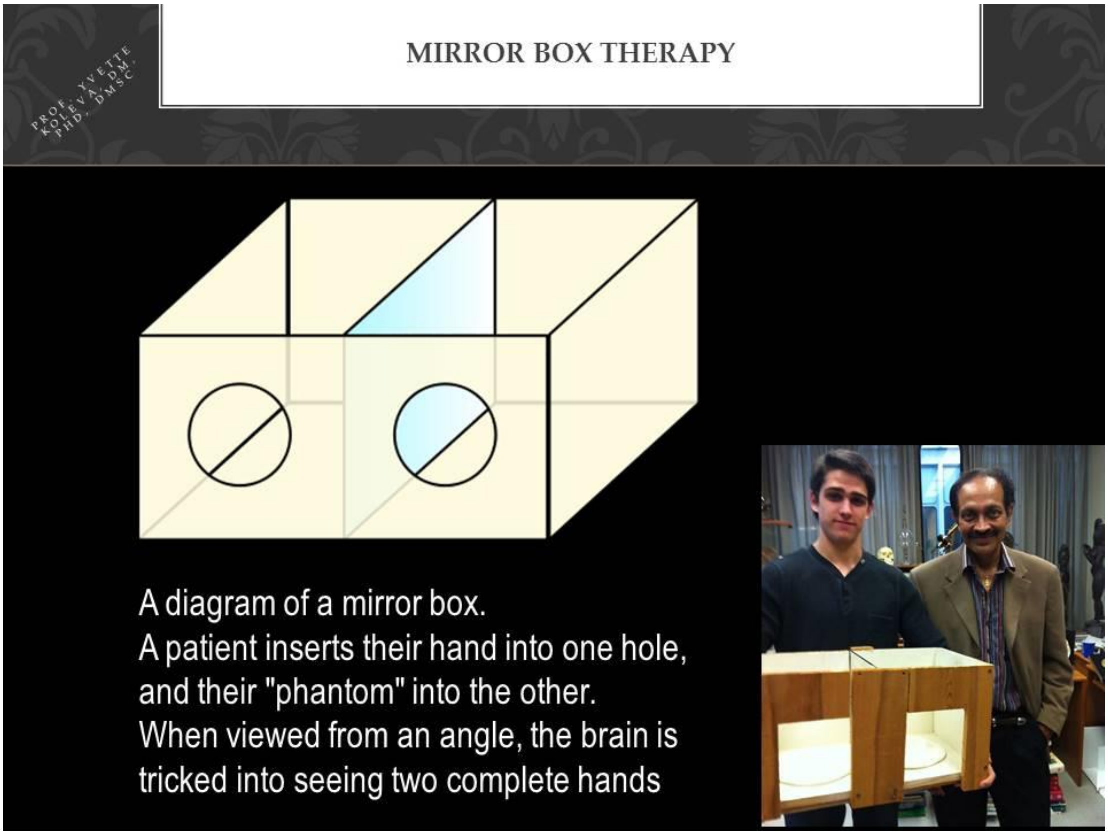

GAIT REHABILITATION ALGORITHM :
Functional training – active movement training, using KINESIOTHERAPY & ERGO (occupational) THERAPY
PRE-FORMED MODALITIES – for functional electrostimulations, management of spasticity, pain control, metabolic amelioration, tissue regeneration
41


PRINCIPAL ELEMENTS FOR GAIT RECOVERY
Orthoses (stabilization);
Functional electrostimulations ;
Analgesia (pain control) – drugs, DO, TENS;
Analytic exercises, Gait training;
Proprioceptive stimulation …
ADL training ;
Canes, rollators, wheelchairs;
Mirror box therapy;
Mechano-therapy;
Hydro / Balneo-kinesitherapy (under water exercises & gait training);
Exoskeletons;
Virtual reality;
Robotics …
42


TECHNOLOGY ALONE IS NOT ENOUGH. IT'S TECHNOLOGY MARRIED WITH LIBERAL ARTS THAT YIELDS US THE RESULT THAT MAKES OUR HEARTS SING.
STEVE JOBS
Steve Jobs
1955-2011
Technology is nothing. What's important is that you have a faith in people, that they're basically good and smart, and if you give them tools, they'll do wonderful things with them.
— Steve Jobs —
AZ QUOTES
Technology AND human sciences
Steve Jobs, 2001

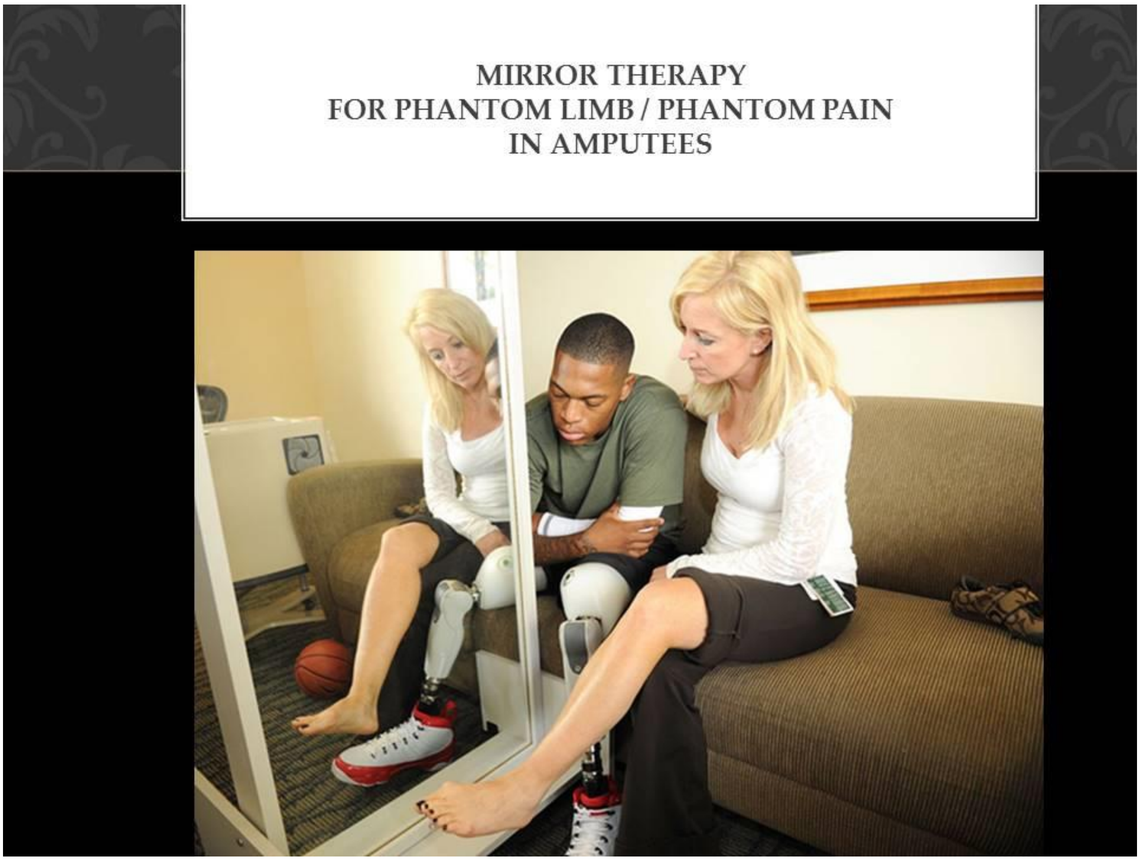

TELE-MEDICINE
TELE-REHABILITATION
Application of information and communication technologies for rehabilitation.
Types - according the World Report on Disability [2011]:
Video and Tele-conference technologies;
Mobile phones and mobile Internet;
Tele-monitoring – e.g. Holter electro-cardiography.
Potential users:
patients, members of the family; members of the rehabilitation team, etc. …
[KD Seelman, LM Hartman, 2009; DM Taylor et al., 2009; A Vainoras et al., 2004]
2013-2017
44


2013-2017
PHYSICAL MODALITIES
FOR
GAIT REHABILITATION
45

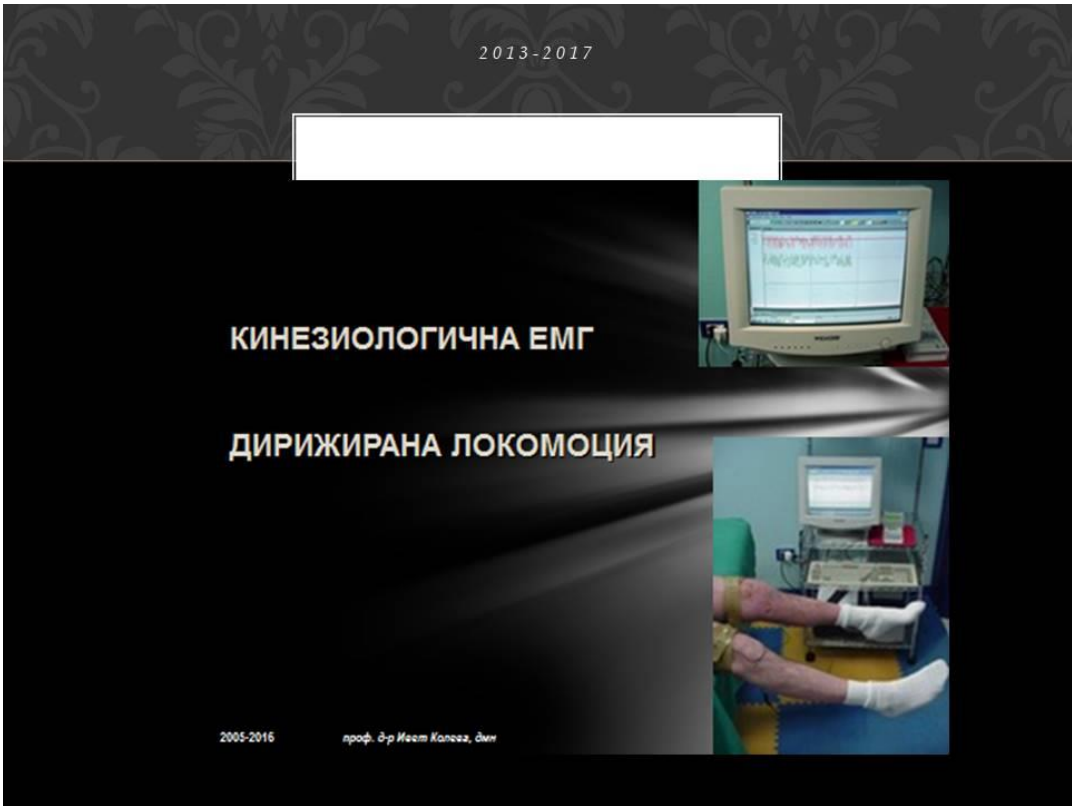

PROF. YVETTE KOLEVA, DM, PHD, DMSC
MIRROR BOX THERAPY
A diagram of a mirror box.
A patient inserts their hand into one hole,
and their "phantom" into the other.
When viewed from an angle, the brain is
tricked into seeing two complete hands


2006-
MIRROR BOX
QUANTITY DISCOUNT AVAILABLE ON THIS PRODUCT
QUANTITY DISCOUNT AVAILABLE ON THIS PRODUCT
8
MD, PHD, DMSC


2006-2016
MIRROR HAND THERAPY
59
PR IVET KOLEVA, MD


MIRROR THERAPY
FOR PHANTOM LIMB / PHANTOM PAIN
IN AMPUTEES


HUBERT Medical
(LPG DEVICE)
69


2013-2017
КИНЕЗИОЛОГИЧНА ЕМГ
ДИРИЖИРАНА ЛОКОМОЦИЯ
2005-2016
проф. д-р Ивет Колева, дмн

EXO-SKELETON

An **exoskeleton** (*from Greek ἔξω, éxō "outer" and σκελετός, skeletos "skeleton"*) is the external skeleton that supports and protects an animal's body, in contrast to the internal skeleton (endo-skeleton) of, for example, a human. In popular usage, some of the larger kinds of exoskeletons are known as "***shells***".

http://forums.wincustomize.com/457853

EXOSKELETONS: EXPANDED HORIZONS.

By DrJBHL on September 20, 2014 9:49:47 AM from JoeUser Forums

I like that Sci Fi 'inventions' become real.

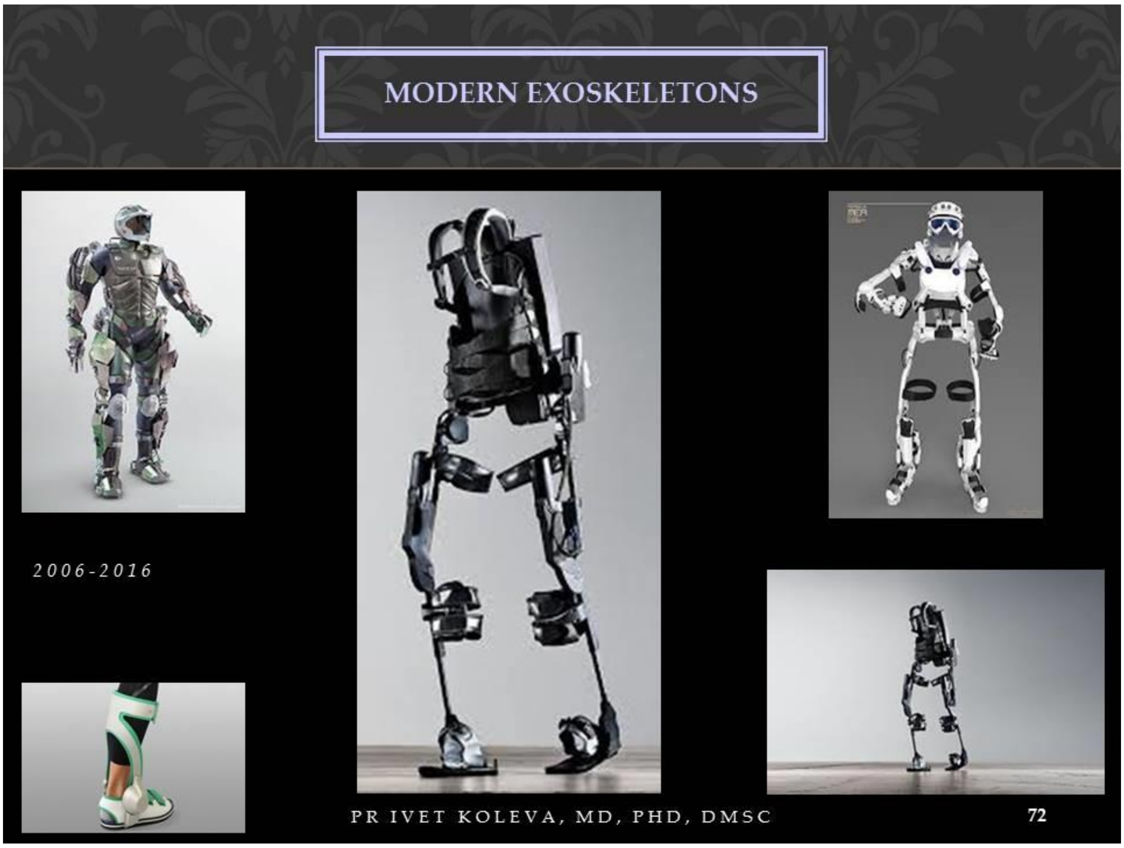
Exoskeletons (a normal attribute for insects and crustaceans) are now finding their way into mankind's world.

They exist…for medical and industrial as well as military uses:

70

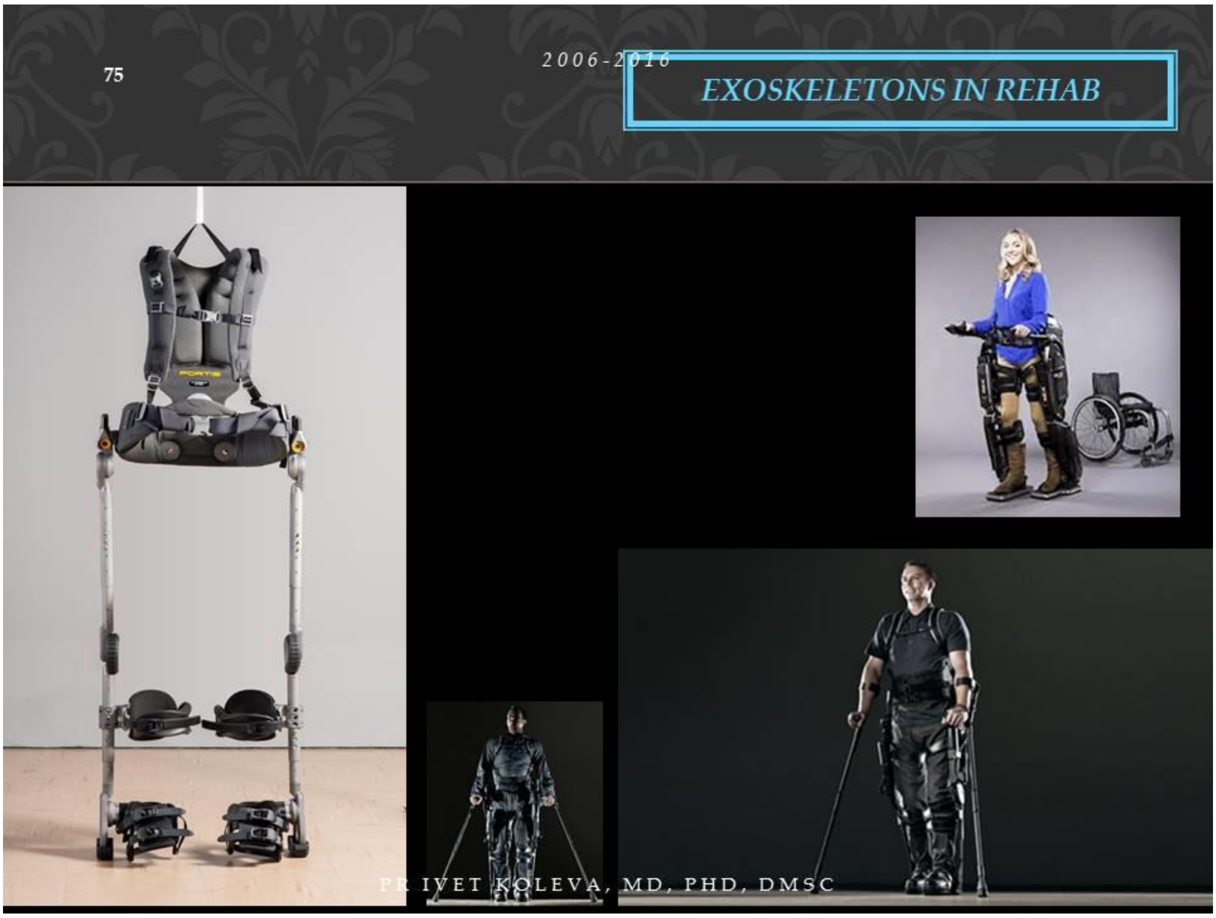
PR IVET KOLEVA, MD, PHD, DMSC

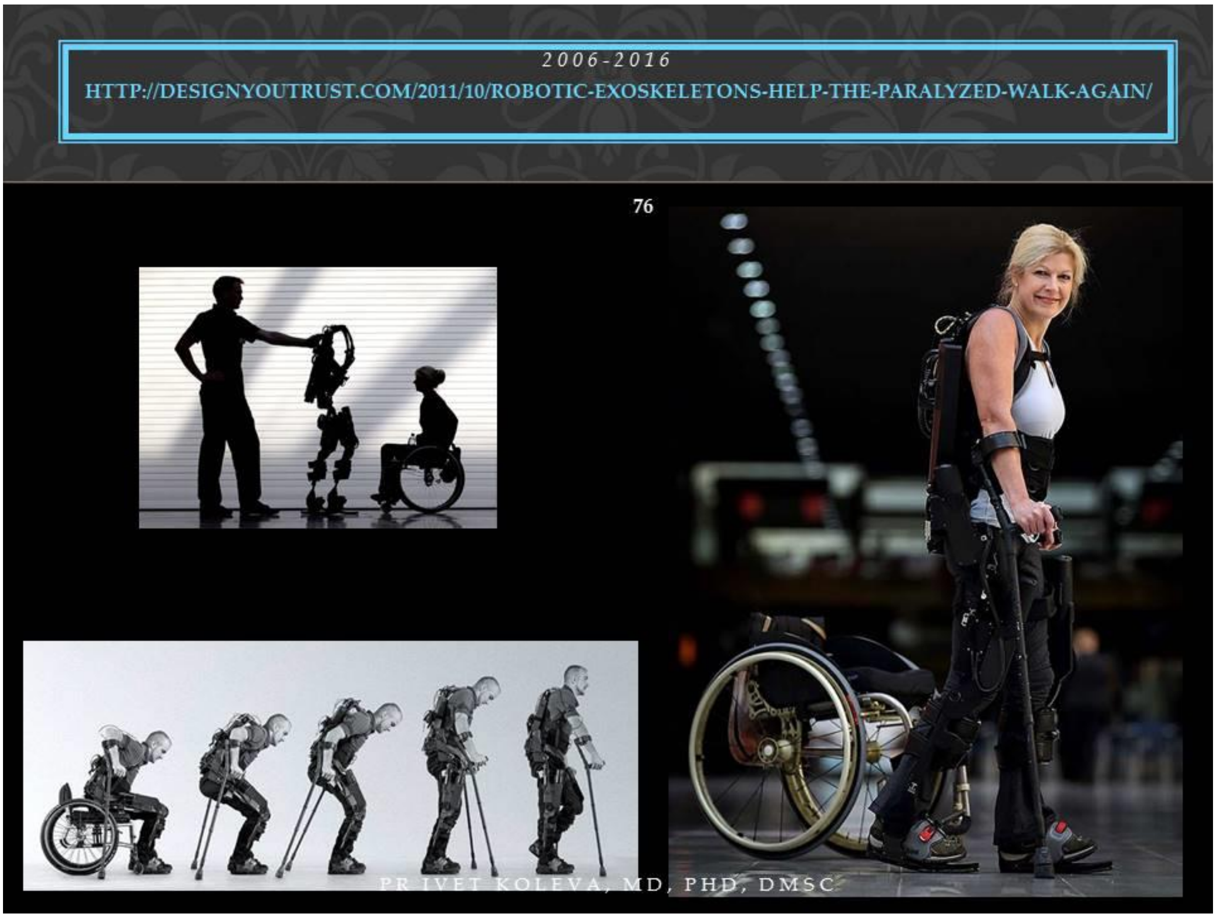
EXOSKELETON

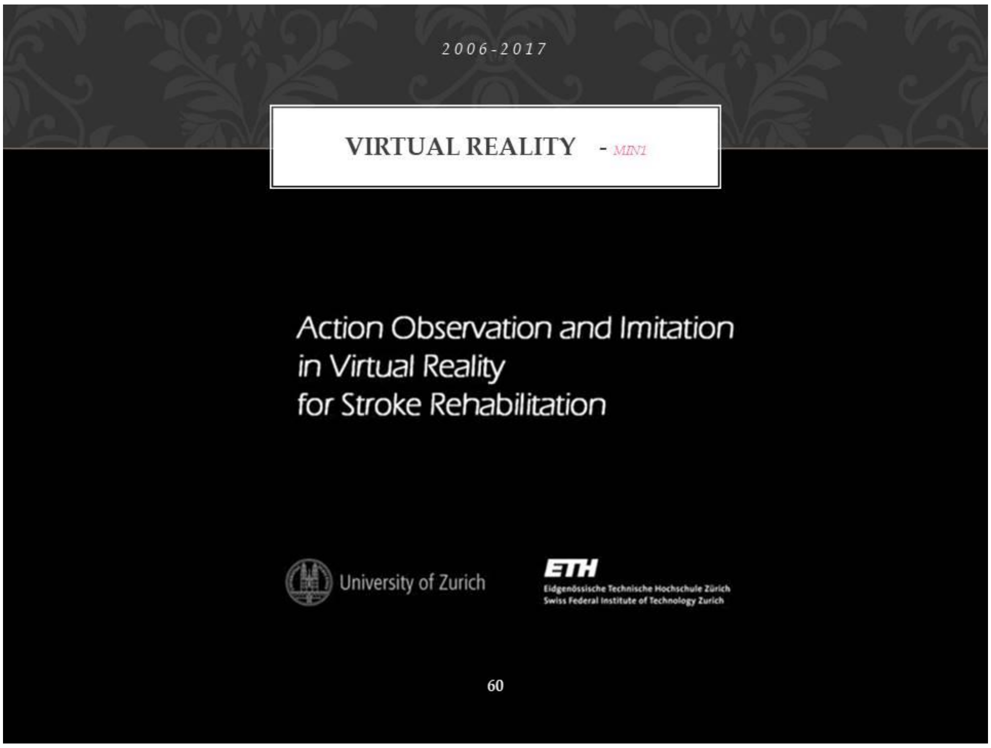

MODERN EXOSKELETONS
2006-2016
PR IVET KOLEVA, MD, PHD, DMSC
72

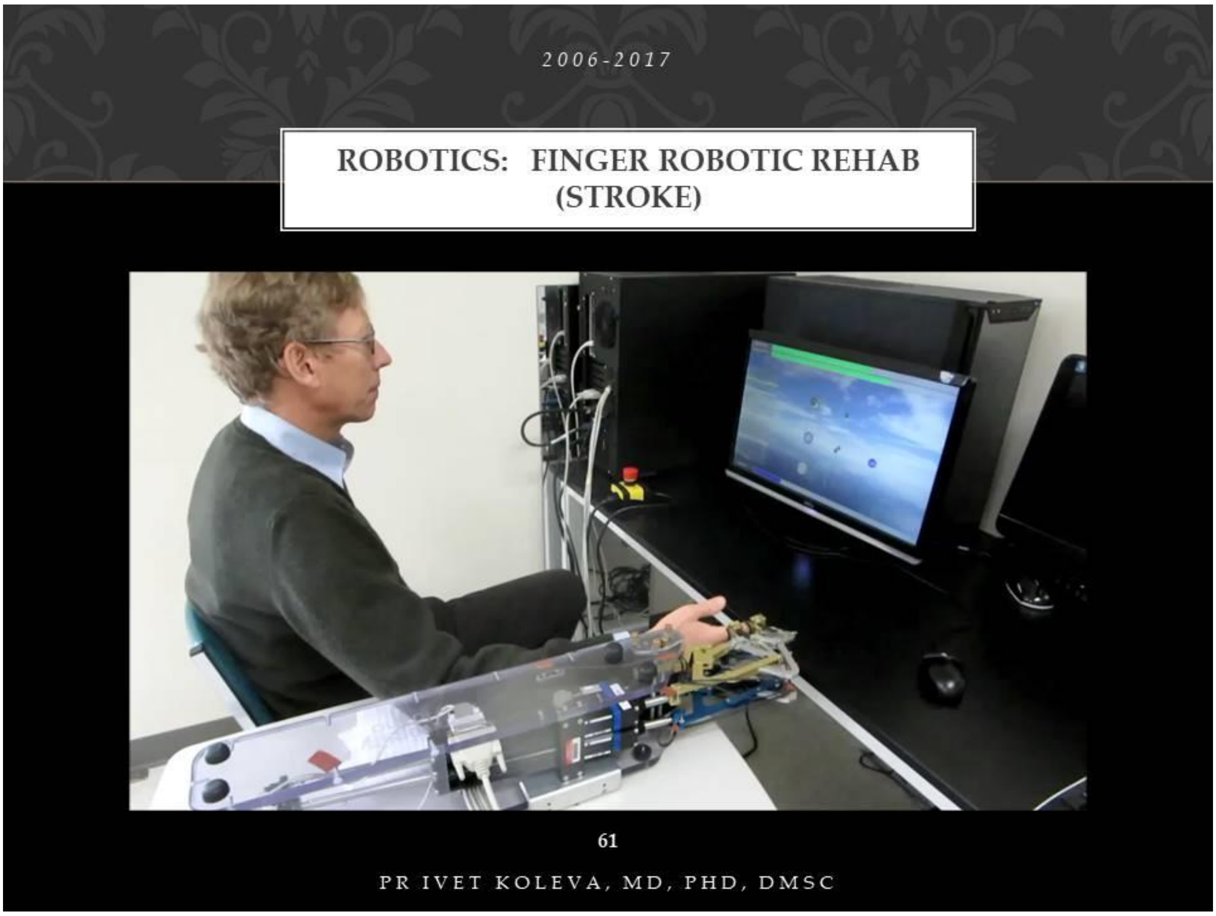

2006-2016
EXOSKELETONS IN INDUSTRY
73
FORTIS exoskeleton
http://www.lockheedmartin.com/us/products/exoskeleton/fortis.html
EXOSKELETON TECHNOLOGIES
STRENGTH
ENDURANCE
PRODUCTIVITY
PR IVET KOLEVA, MD, PHD, DMSC

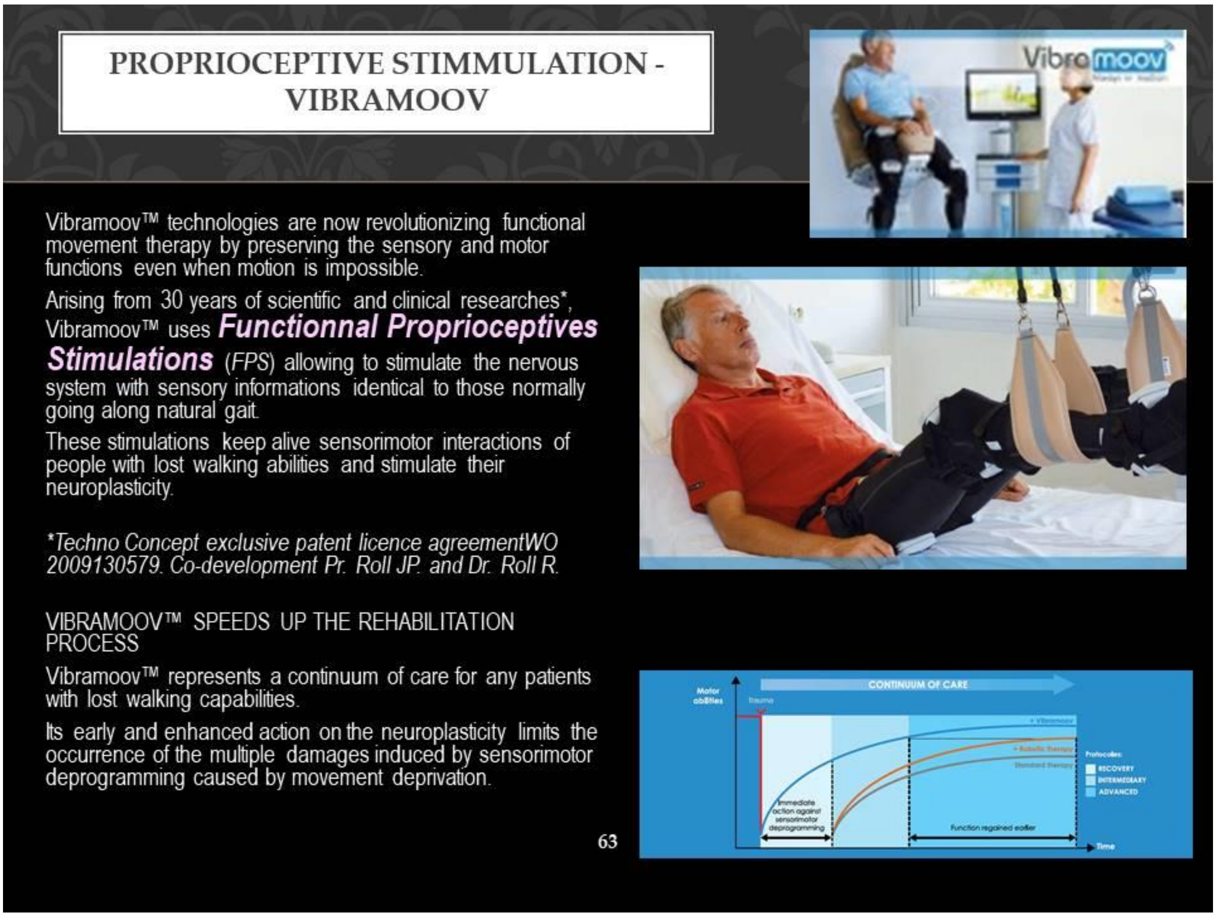

US NAVY
2006-2016
U.S. Navy to Test and Evaluate Lockheed Martin Industrial Exoskeletons
http://aerospace.firetrench.com/2014/08/u-s-navy-to-test-and-evaluate-lockheed-martin-industrial-exoskeletons/
74
PR IVET KOLEVA, MD, PHD, DMSC

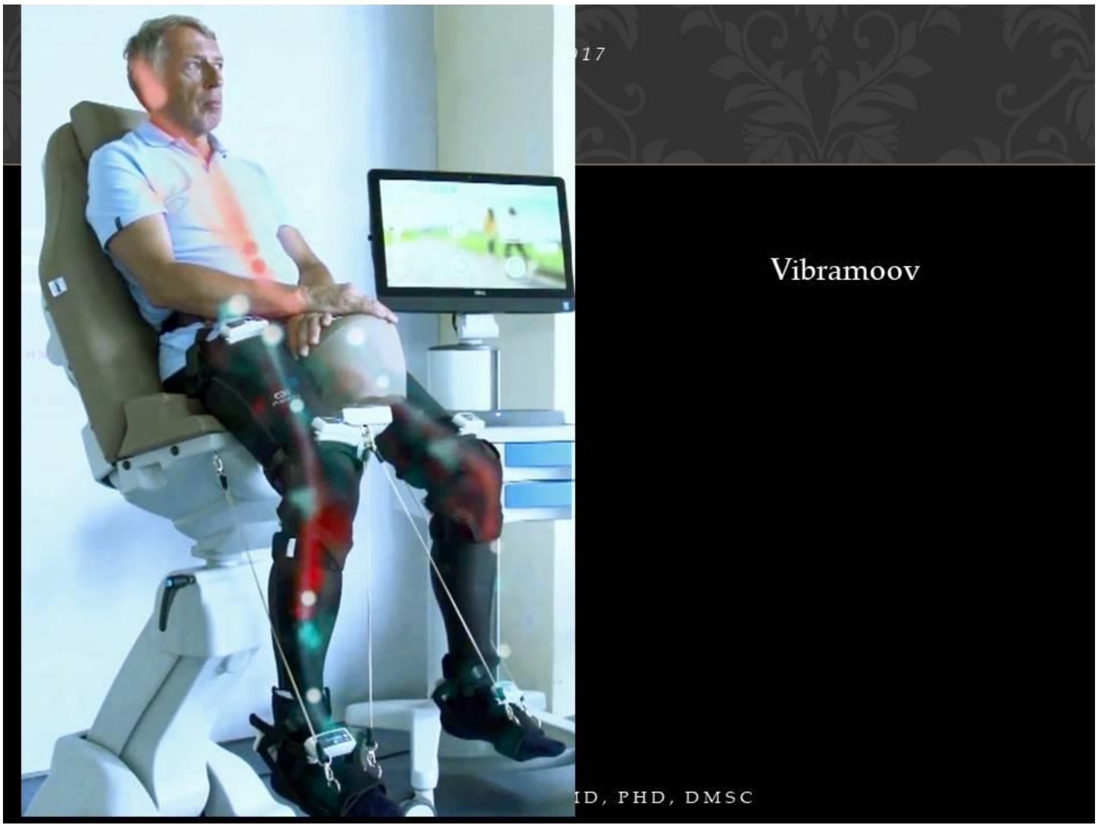

75
2006-2016
EXOSKELETONS IN REHAB
PR IVET KOLEVA, MD, PHD, DMSC


2006-2016
HTTP://DESIGNYOUTRUST.COM/2011/10/ROBOTIC-EXOSKELETONS-HELP-THE-PARALYZED-WALK-AGAIN/
76
PR IVET KOLEVA, MD, PHD, DMSC


2006-2017
VIRTUAL REALITY - MINI
Action Observation and Imitation
in Virtual Reality
for Stroke Rehabilitation
University of Zurich
ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich
60

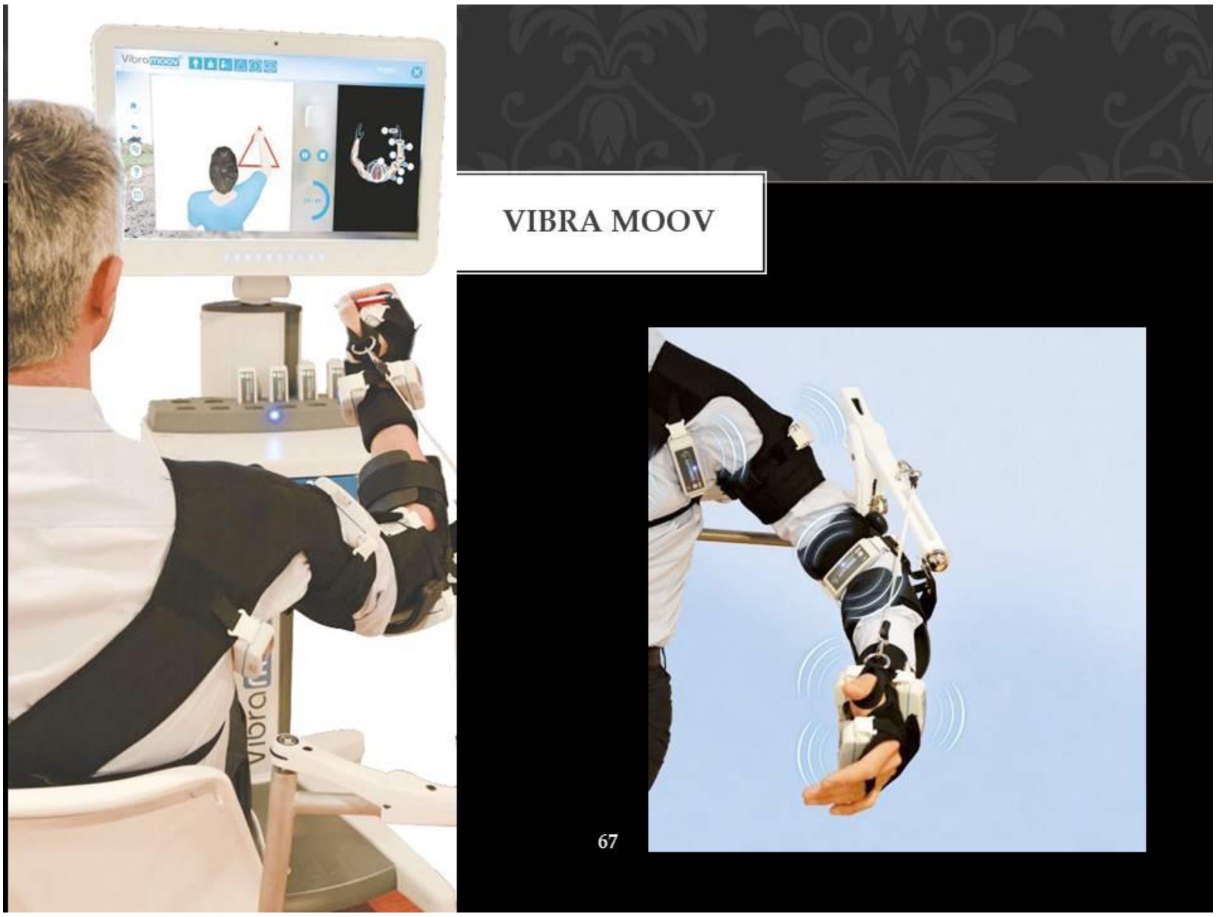

2006-2017
ROBOTICS: FINGER ROBOTIC REHAB (STROKE)
61
PR IVET KOLEVA, MD, PHD, DMSC


PROPRIOCEPTIVE STIMMULATION - VIBRAMOOV
Vibramoov
Vibramoov™ technologies are now revolutionizing functional movement therapy by preserving the sensory and motor functions even when motion is impossible.
Arising from 30 years of scientific and clinical researches*, Vibramoov™ uses Functionnal Proprioceptives Stimulations (FPS) allowing to stimulate the nervous system with sensory informations identical to those normally going along natural gait.
These stimulations keep alive sensorimotor interactions of people with lost walking abilities and stimulate their neuroplasticity.
*Techno Concept exclusive patent licence agreementWO 2009130579. Co-development Pr. Roll JP. and Dr. Roll R.
VIBRAMOOV™ SPEEDS UP THE REHABILITATION PROCESS
Vibramoov™ represents a continuum of care for any patients with lost walking capabilities.
Its early and enhanced action on the neuroplasticity limits the occurrence of the multiple damages induced by sensorimotor deprogramming caused by movement deprivation.
63
Motor abilities
CONTINUUM OF CARE
Trauma
+ Vibramoov
+ Robotic therapy
Standard therapy
Protocoles:
RECOVERY
INTERMEDIARY
ADVANCED
Immediate action against sensorimotor deprogramming
Function regained earlier
Time

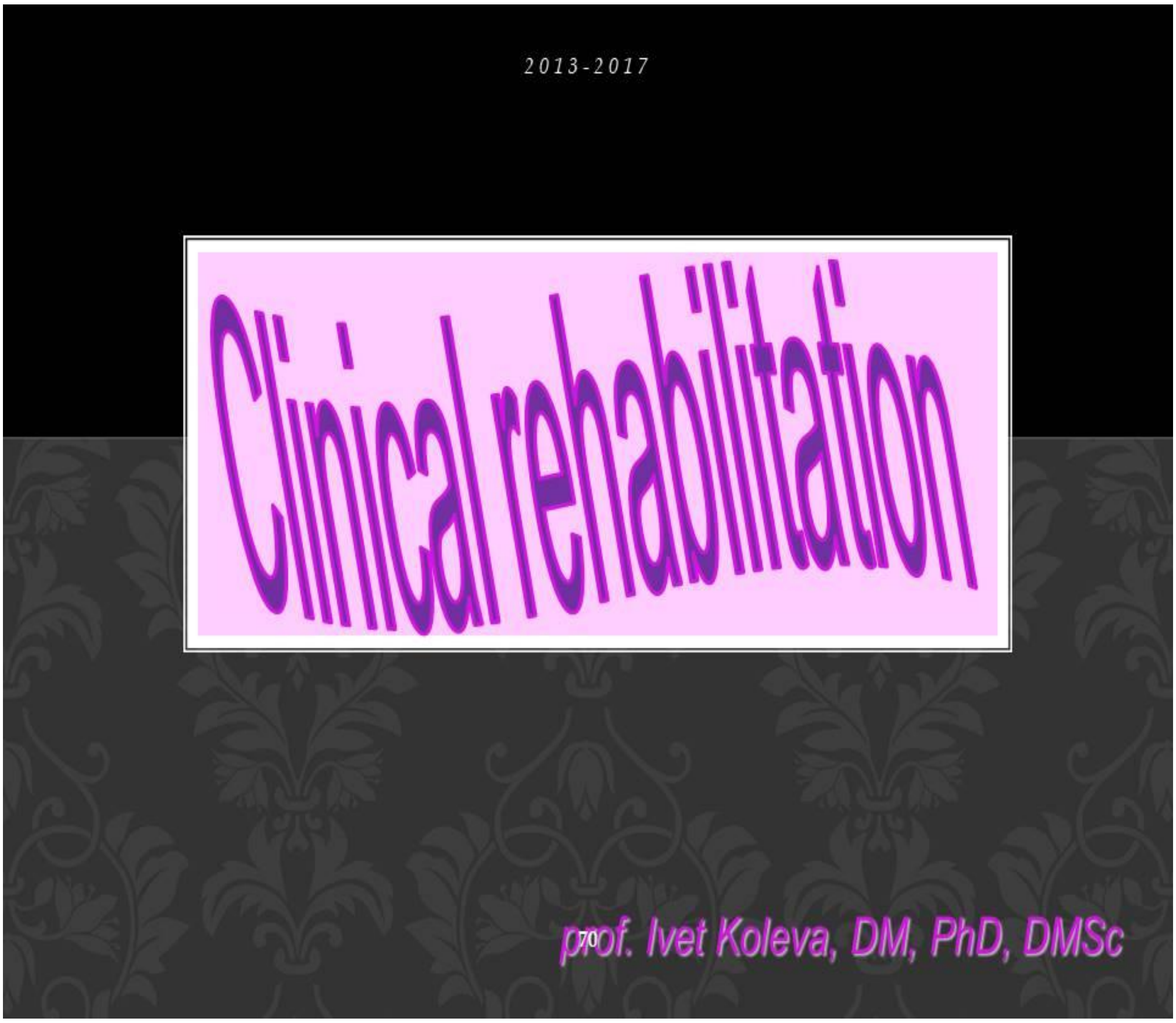

Vibramoov

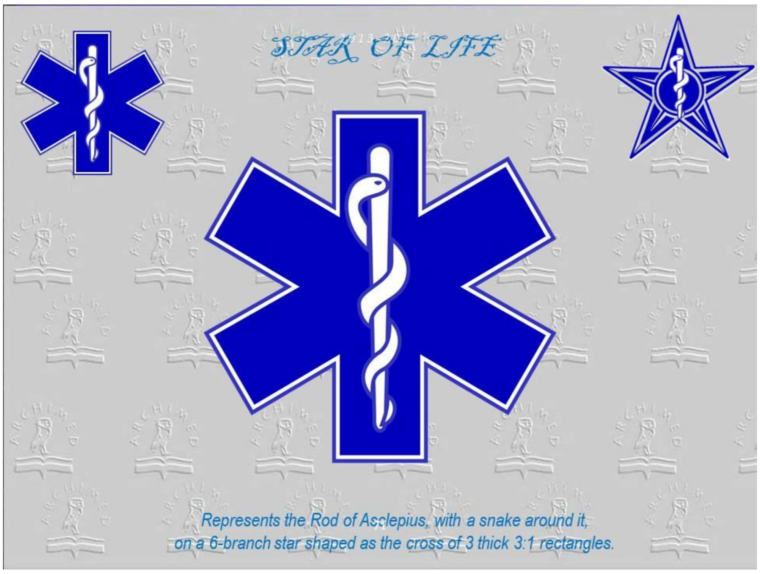
- Early Treatment Encourages Neuroplasticity
- Intensity and Frequency are Important
- Recovery of Mobility
- Bimanual & Bipedal COORDINATION
- COGNITIVE STIMULATION

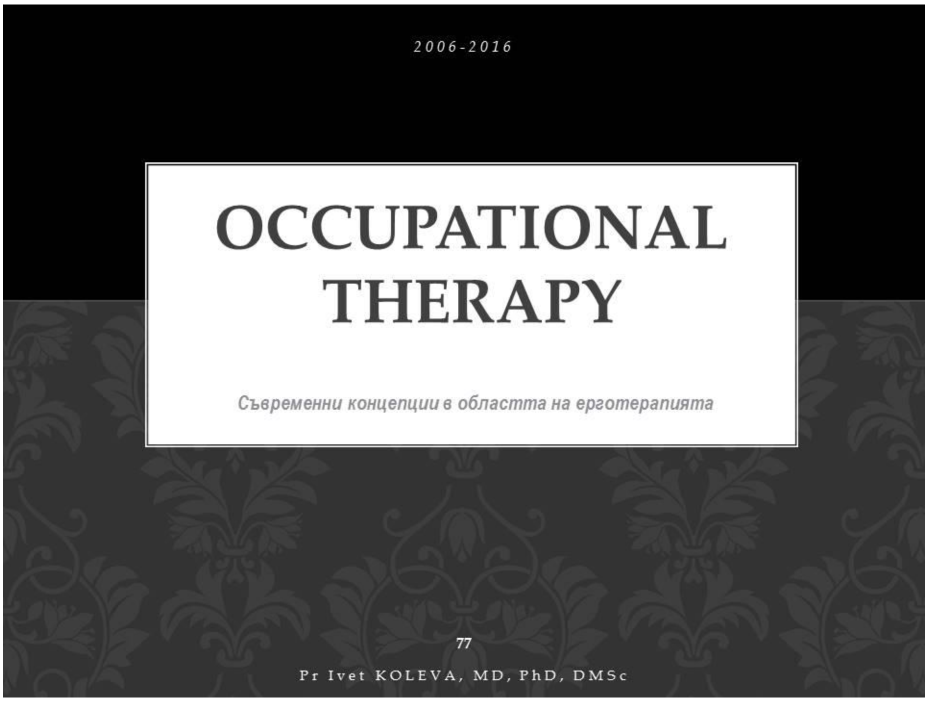
66

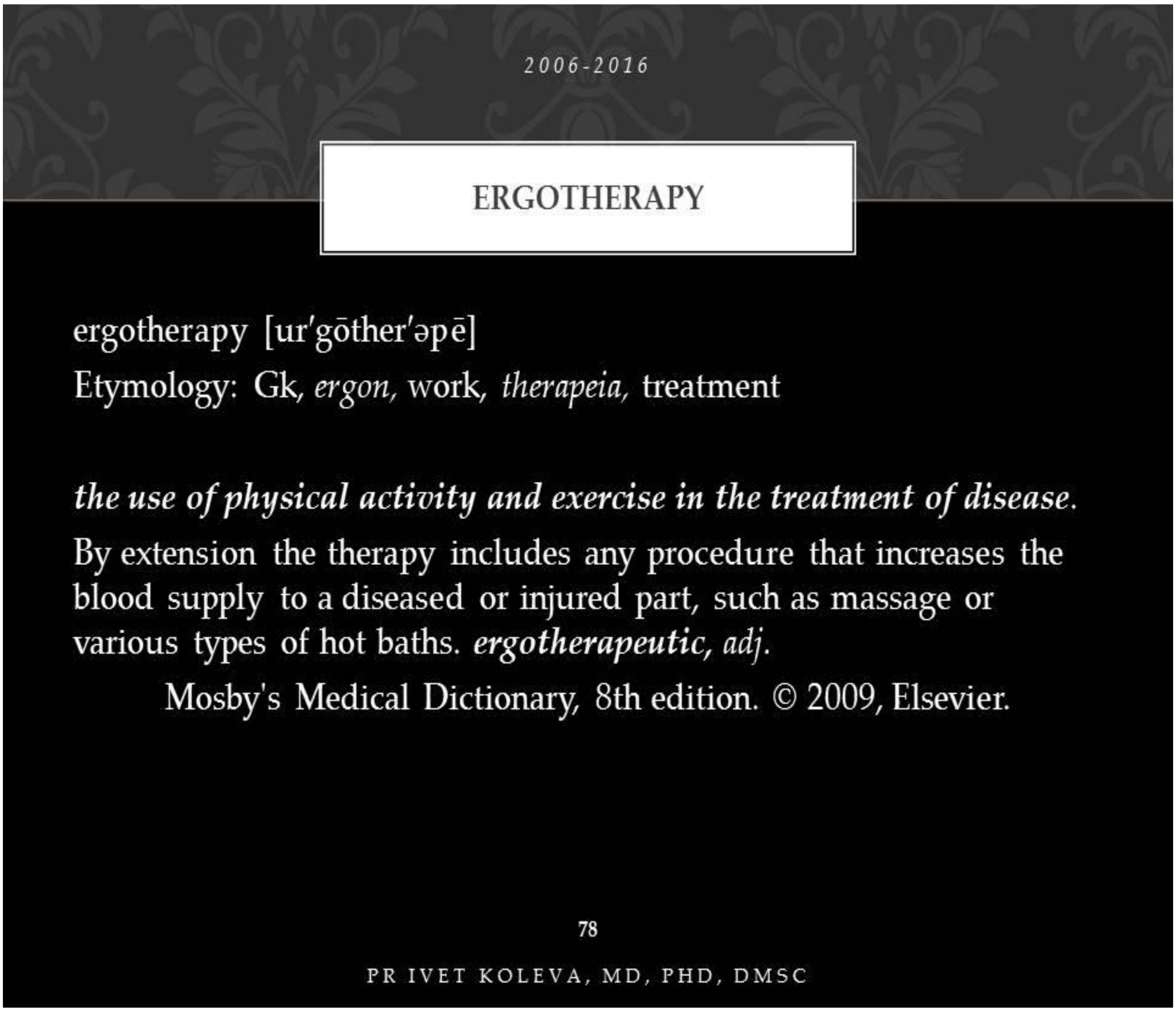

VIBRA MOOV
67


Vibramoov
Always in motion
TECHNO
29 : 45
68


2013-2017
Clinical rehabilitation
prof. Ivet Koleva, DM, PhD, DMSc
70


STAR OF LIFE
Represents the Rod of Asclepius, with a snake around it,
on a 6-branch star shaped as the cross of 3 thick 3:1 rectangles.


2006-2016
OCCUPATIONAL THERAPY
Съвременни концепции в областта на ерготерапията
77
Pr Ivet KOLEVA, MD, PhD, DMSc


2006-2016
ERGOTHERAPY
ergotherapy [ur′gōther′əpē]
Etymology: Gk, *ergon,* work, *therapeia,* treatment
the use of physical activity and exercise in the treatment of disease.
By extension the therapy includes any procedure that increases the blood supply to a diseased or injured part, such as massage or various types of hot baths. ***ergotherapeutic,*** *adj.*
Mosby's Medical Dictionary, 8th edition. © 2009, Elsevier.
78
PR IVET KOLEVA, MD, PHD, DMSC

2006-2016

WFOT

The WORLD FEDERATION OF OCCUPATIONAL THERAPISTS provides the following definition of Occupational Therapy: "Occupational therapy is as a profession concerned with promoting health and well being through occupation. *The primary goal of occupational therapy is to enable people to participate in the activities of everyday life*. Occupational therapists achieve this outcome by enabling people to do things that will enhance their ability to participate or by modifying the environment to better support participation." Occupational therapists use careful analysis of physical, environmental, psychosocial, mental, spiritual, political and cultural factors to identify barriers to occupation. Occupational therapy draws from the fields of medicine, psychology, sociology, anthropology, and many other disciplines in developing its knowledge base. A new discipline of *occupational science* has been developed to enhance the evidence base of the profession.

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PR IVET KOLEVA, MD, PHD, DMSC

2006-2016

DEFINITION OF OT

Occupational therapy is the use of purposeful activity with individuals who are limited by physical injury or illness, psychosocial dysfunction , developmental or learning disabilities, poverty and cultural differences, or the aging process in order to maximize independence, prevent disability, and maintain health.

The practice encompasses *evaluation, treatment and consultation*.

Resolution Q: Definition of occupational therapy for licensure. Minutes of the 1981 AOTA representative Assembly. AJOT, 35, 1981, 35, 798-799.

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PR IVET KOLEVA, MD, PHD, DMSC

2006-2016

MODEL OF HUMAN DEVELOPMENT & OCCUPATION (MOHO) – *GARY KIELHOFNER, 1985*

How did MOHO begin?

First published in 1980, the model of human occupation (MOHO) grew out of Dr. Gary Kielhofner's master's thesis and practice in the mid 1970s. While Dr Kielhofner has remained the primary person working on MOHO, it has always been the result of collaborative efforts. Today, this model reflects the ideas, research, and practice efforts of a large number of people throughout the world. Because so many people are involved in developing MOHO, it has become one of the leading theories in occupational therapy practice worldwide. The contributions so many people have made to MOHO are represented in the substantial resources which can be found and obtained through this website and the MOHO e-store. It is hoped that this website enables individuals to become part of a worldwide community of occupational therapists who use and contribute to the development of MOHO.

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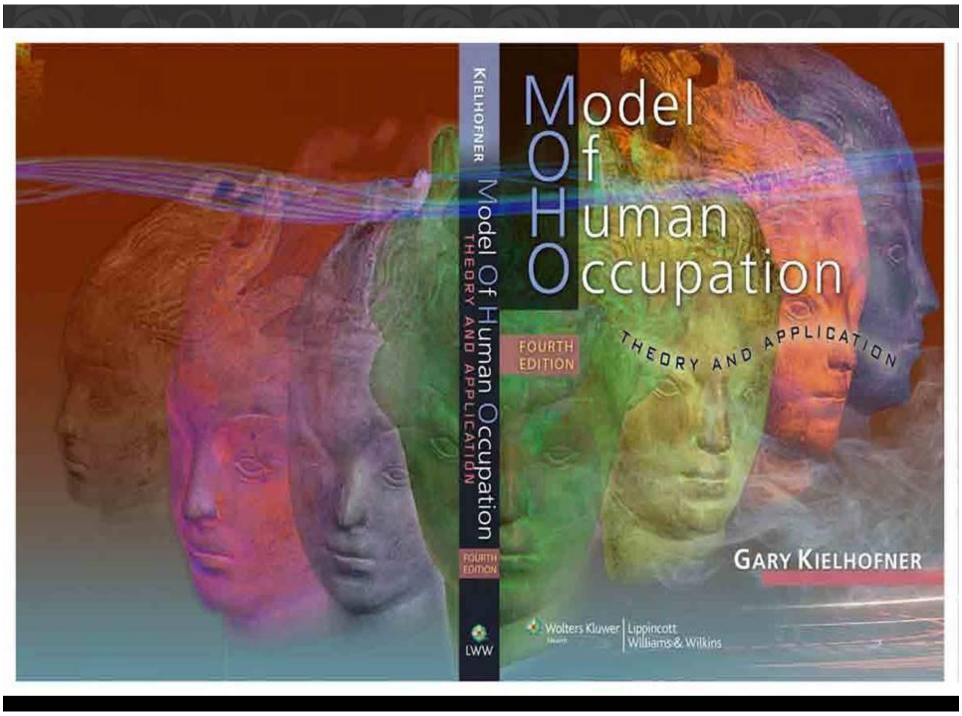
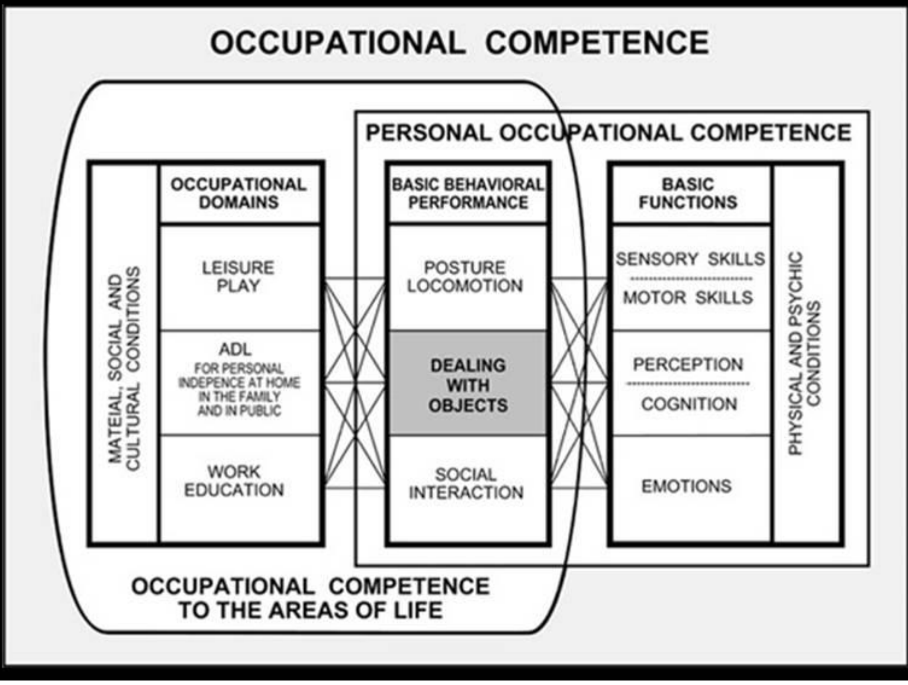
PR IVET KOLEVA, MD, PHD, DMS



2006-2016

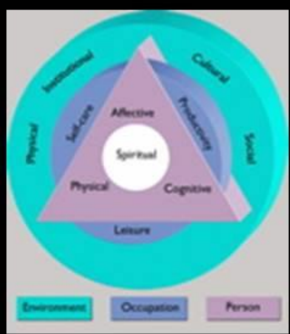
OCCUPATIONAL COMPETENCE



2006-2016

CANADIAN MODEL OF OCCUPATIONAL PERFORMANCE (CMOP)

We also looked at the *Canadian Model of Occupational Performance (CMOP)*, which involves the person, occupation and environment. Each of these sections is then further broken down into smaller components to better understand what is going on and what needs to happen so the issue can be addressed. This model aims to show the relationship between environment and occupation and person.



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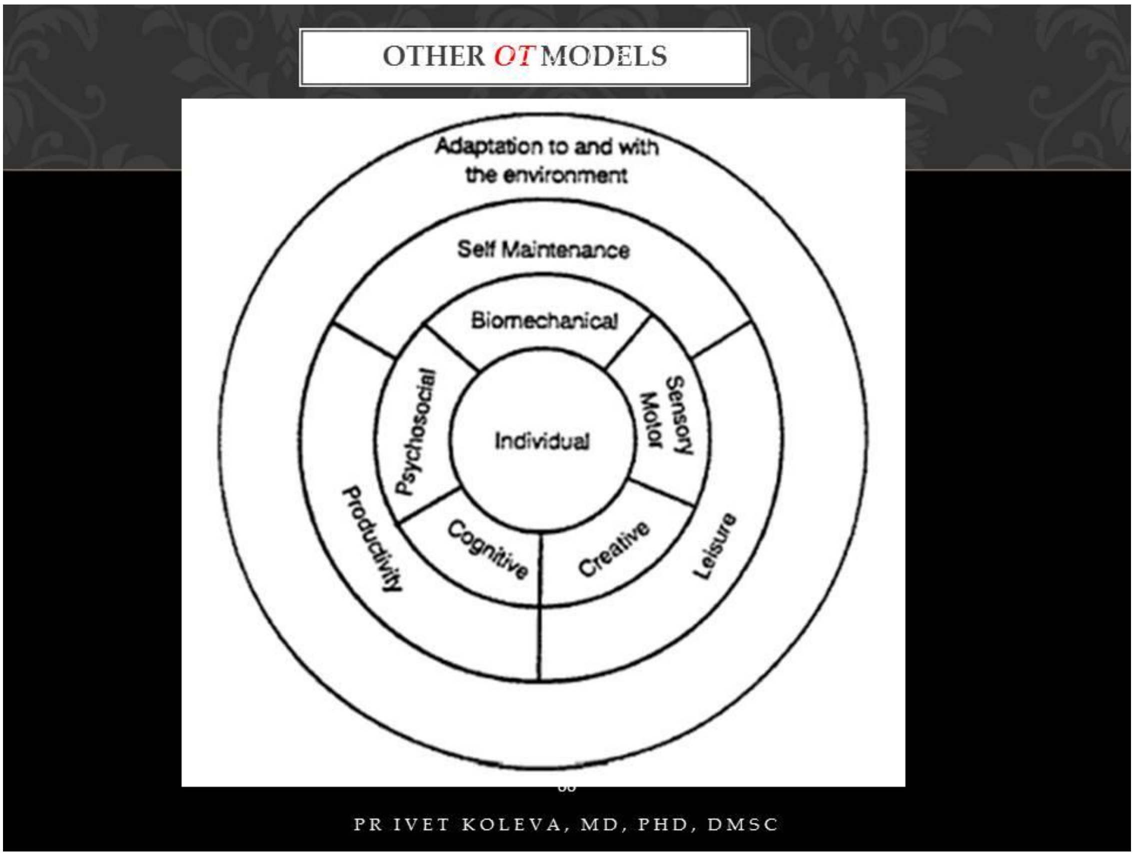
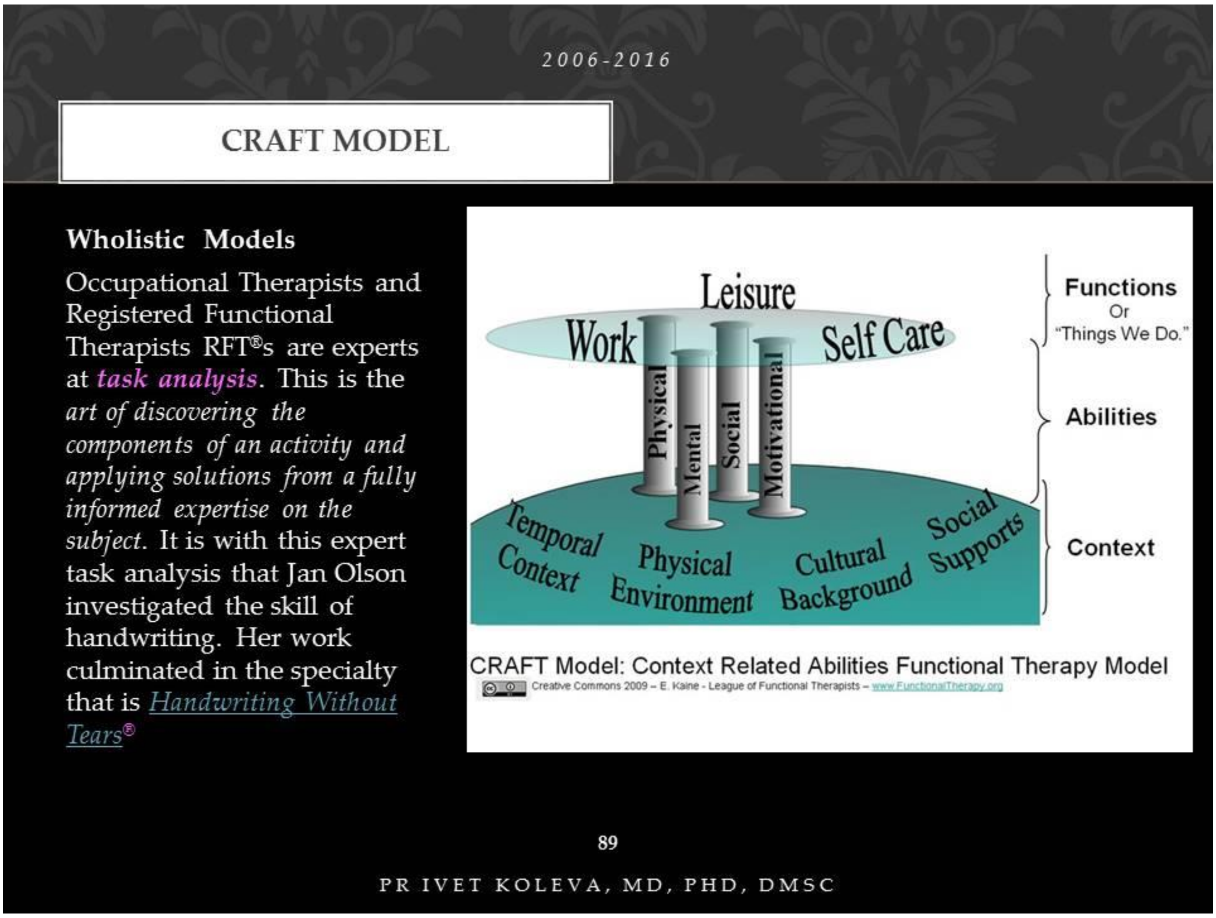
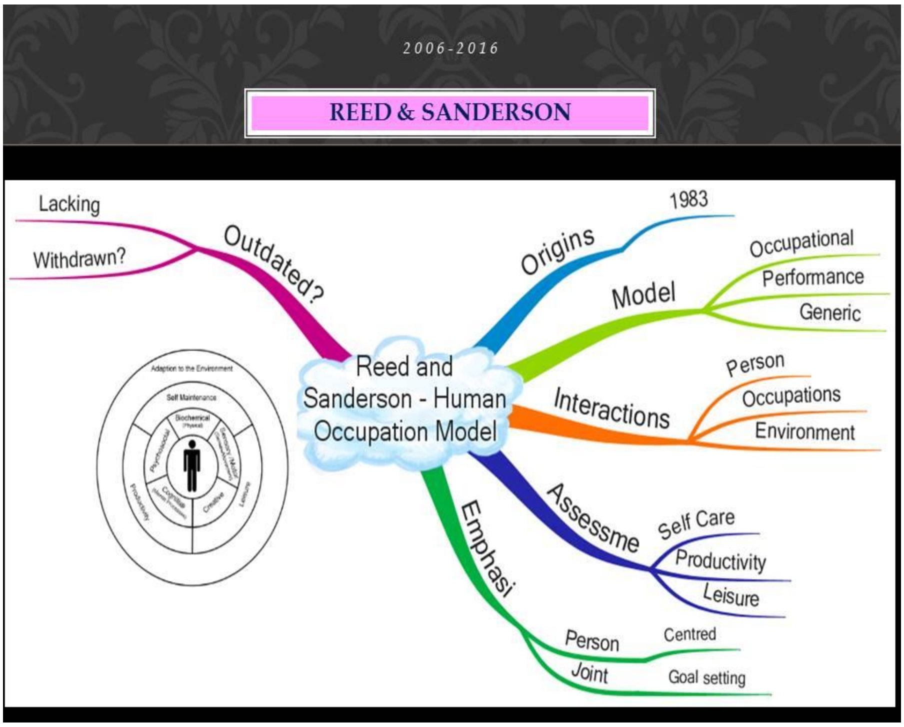
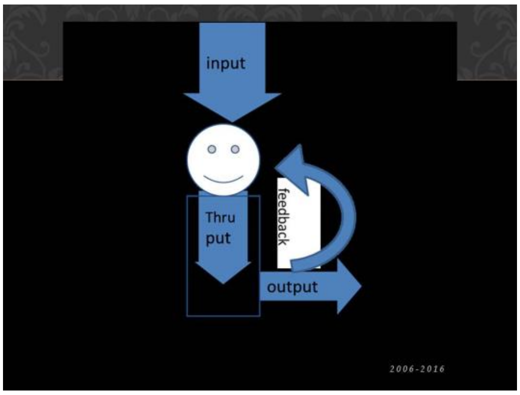
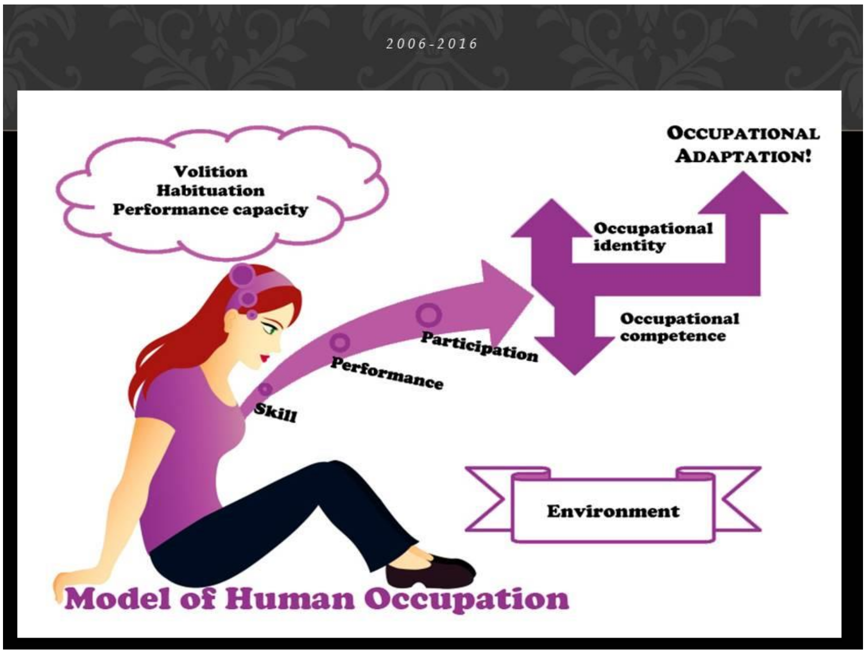
PR IVET KOLEVA, MD, PHD, DMSC

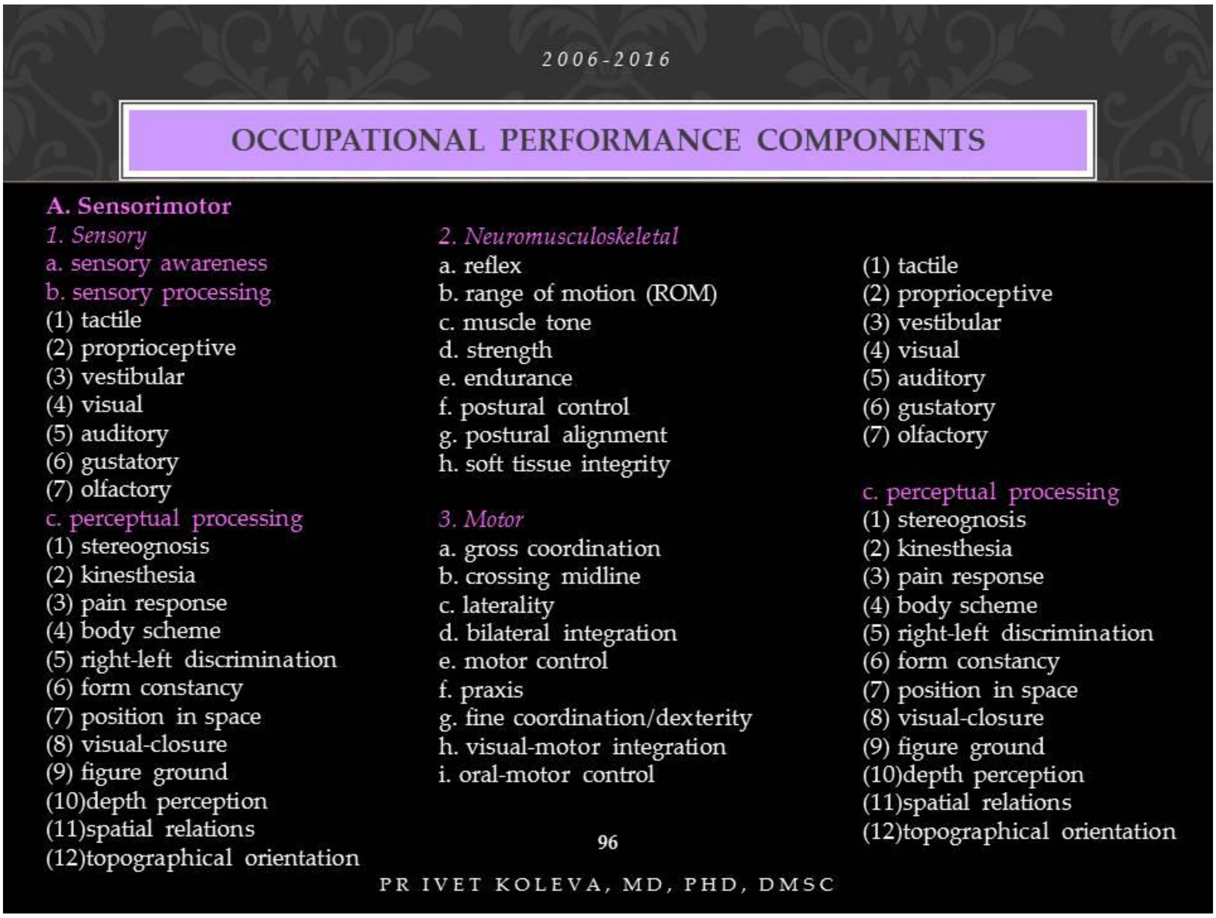

OTHER OT MODELS
Adaptation to and with the environment
Self Maintenance
Biomechanical
Sensory Motor
Individual
Psychosocial
Cognitive
Creative
Productivity
Leisure
PR IVET KOLEVA, MD, PHD, DMSC

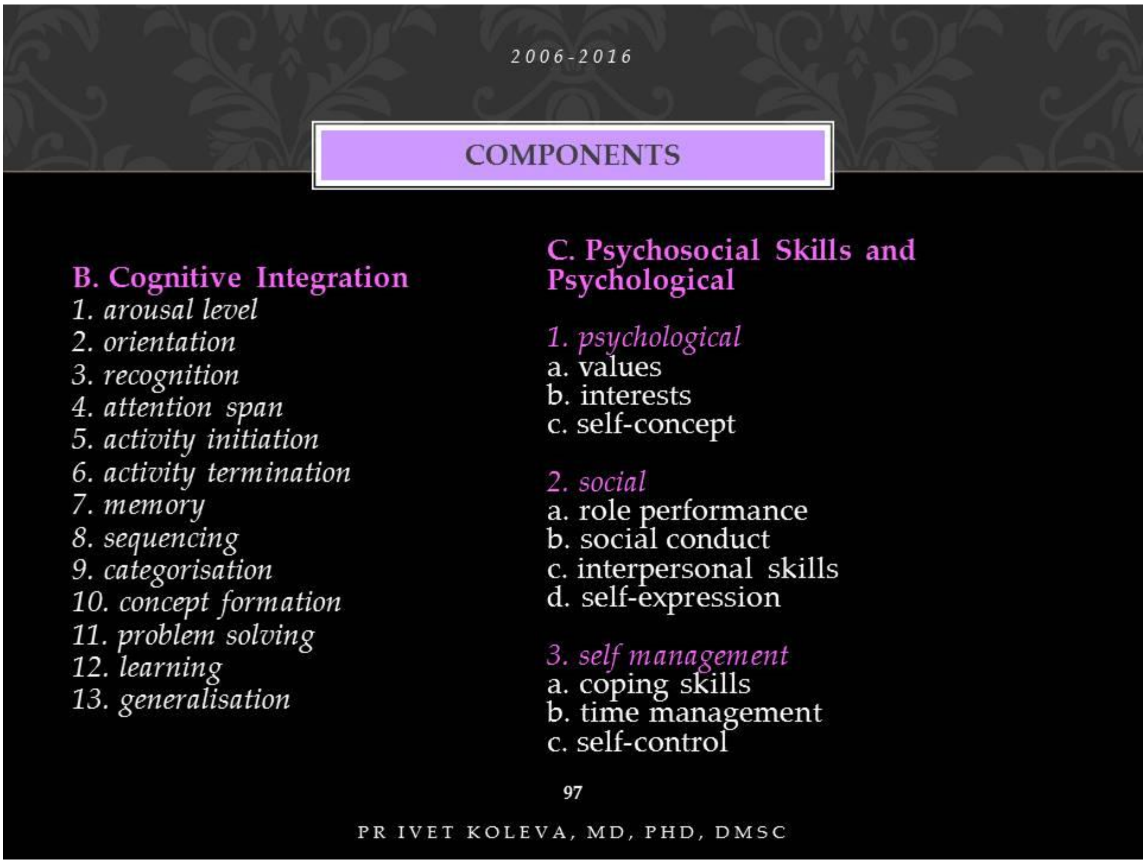

2006-2016
CRAFT MODEL
Wholistic Models
Occupational Therapists and Registered Functional Therapists RFT®s are experts at task analysis. This is the art of discovering the components of an activity and applying solutions from a fully informed expertise on the subject. It is with this expert task analysis that Jan Olson investigated the skill of handwriting. Her work culminated in the specialty that is Handwriting Without Tears®
Leisure
Work
Self Care
Functions
Or
"Things We Do."
Physical
Mental
Social
Motivational
Abilities
Temporal Context
Physical Environment
Cultural Background
Social Supports
Context
CRAFT Model: Context Related Abilities Functional Therapy Model
Creative Commons 2009 – E. Kaine - League of Functional Therapists – www.FunctionalTherapy.org
89
PR IVET KOLEVA, MD, PHD, DMSC

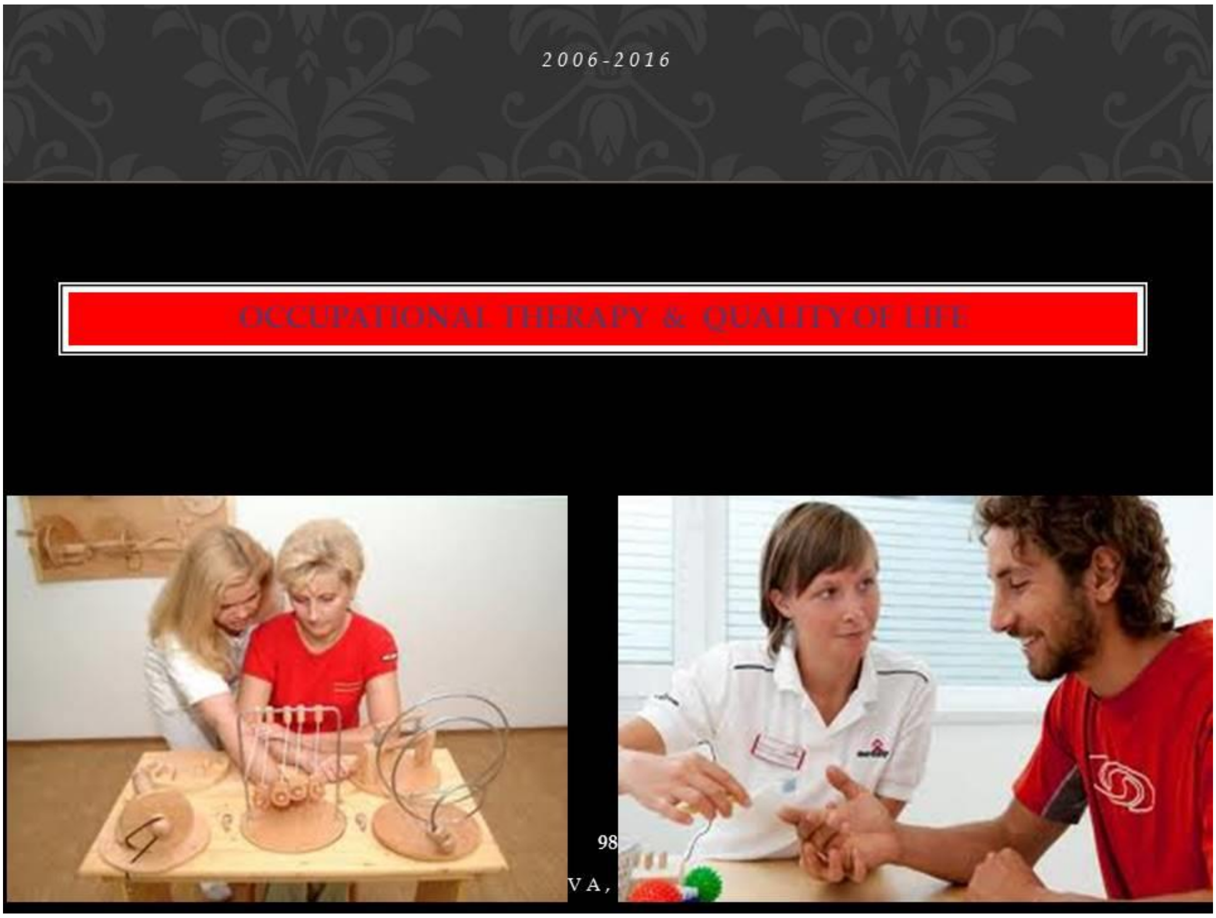

2006-2016
REED & SANDERSON
Lacking
Withdrawn?
Outdated?
Reed and Sanderson - Human Occupation Model
Origins
1983
Model
Occupational
Performance
Generic
Interactions
Person
Occupations
Environment
Assessme
Self Care
Productivity
Leisure
Emphasi
Person
Centred
Joint
Goal setting


input
Thru put
feedback
output
2006-2016

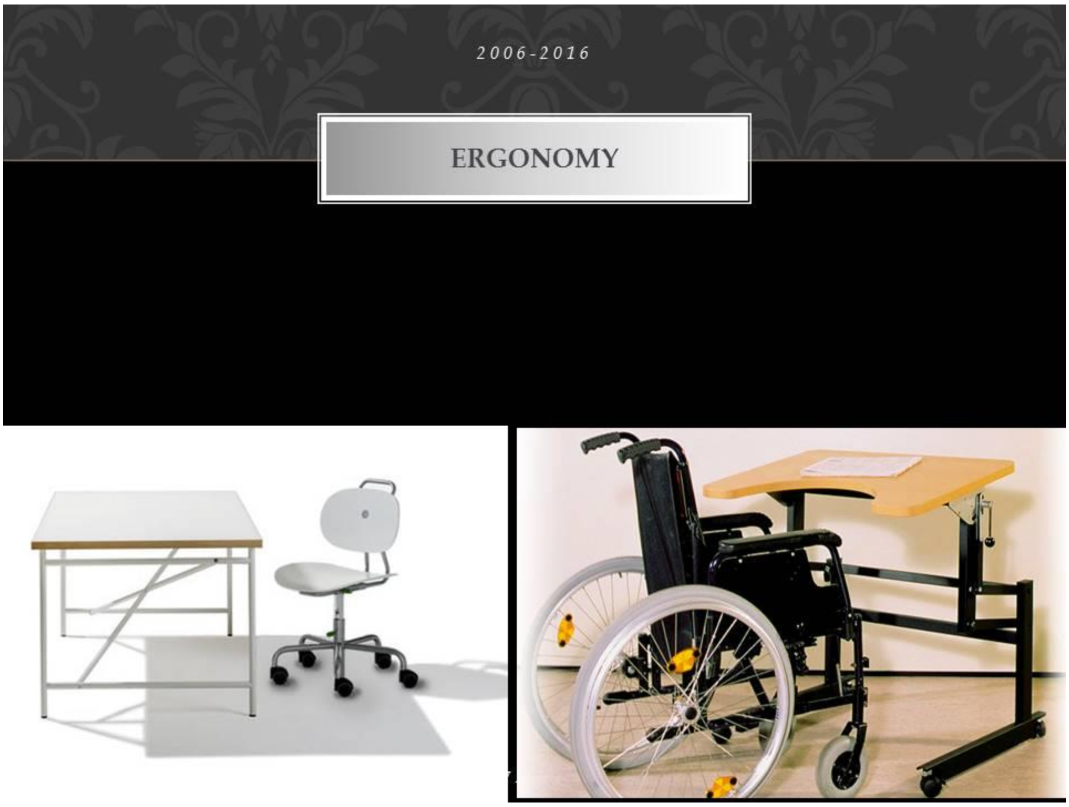

2006-2016
Volition
Habituation
Performance capacity
Occupational Adaptation!
Occupational identity
Occupational competence
Participation
Performance
Skill
Environment
Model of Human Occupation

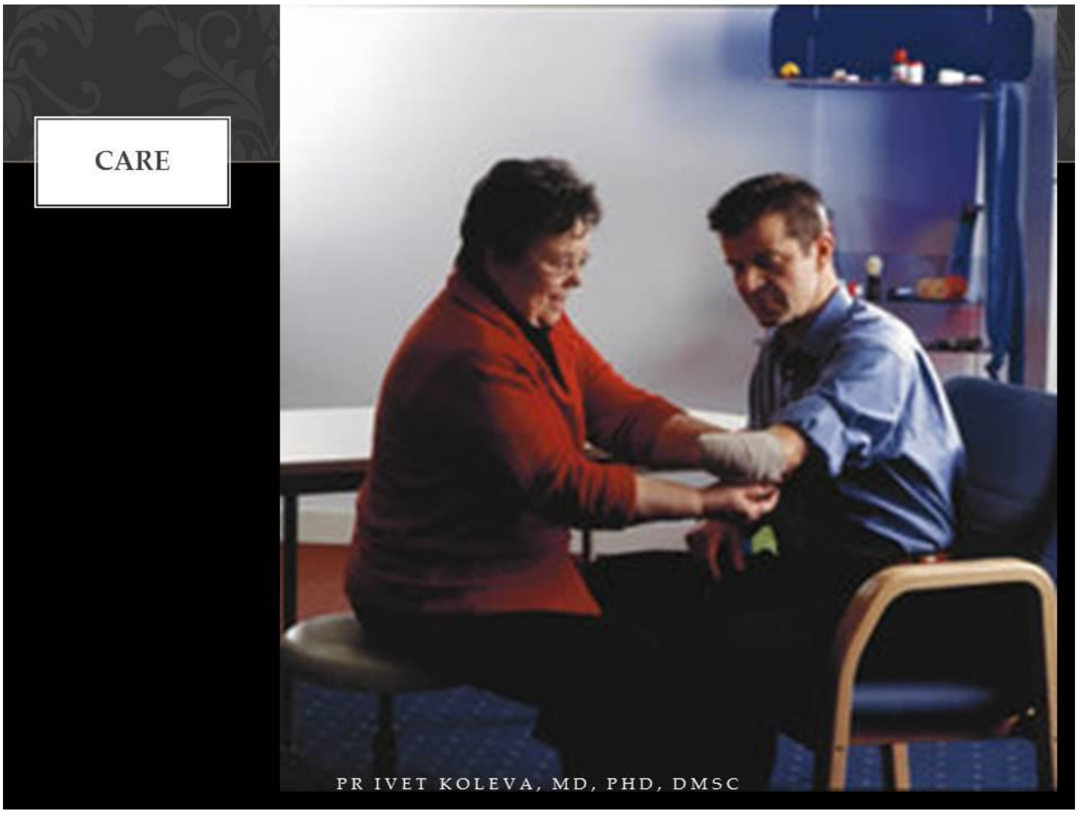

2006-2016
OCCUPATIONAL PERFORMANCE COMPONENTS
A. Sensorimotor
1. Sensory
a. sensory awareness
b. sensory processing
(1) tactile
(2) proprioceptive
(3) vestibular
(4) visual
(5) auditory
(6) gustatory
(7) olfactory
c. perceptual processing
(1) stereognosis
(2) kinesthesia
(3) pain response
(4) body scheme
(5) right-left discrimination
(6) form constancy
(7) position in space
(8) visual-closure
(9) figure ground
(10)depth perception
(11)spatial relations
(12)topographical orientation
2. Neuromusculoskeletal
a. reflex
b. range of motion (ROM)
c. muscle tone
d. strength
e. endurance
f. postural control
g. postural alignment
h. soft tissue integrity
3. Motor
a. gross coordination
b. crossing midline
c. laterality
d. bilateral integration
e. motor control
f. praxis
g. fine coordination/dexterity
h. visual-motor integration
i. oral-motor control
(1) tactile
(2) proprioceptive
(3) vestibular
(4) visual
(5) auditory
(6) gustatory
(7) olfactory
c. perceptual processing
(1) stereognosis
(2) kinesthesia
(3) pain response
(4) body scheme
(5) right-left discrimination
(6) form constancy
(7) position in space
(8) visual-closure
(9) figure ground
(10)depth perception
(11)spatial relations
(12)topographical orientation
96
PR IVET KOLEVA, MD, PHD, DMSC


2006-2016
COMPONENTS
B. Cognitive Integration
1. arousal level
2. orientation
3. recognition
4. attention span
5. activity initiation
6. activity termination
7. memory
8. sequencing
9. categorisation
10. concept formation
11. problem solving
12. learning
13. generalisation
C. Psychosocial Skills and Psychological
1. psychological
a. values
b. interests
c. self-concept
2. social
a. role performance
b. social conduct
c. interpersonal skills
d. self-expression
3. self management
a. coping skills
b. time management
c. self-control
97
PR IVET KOLEVA, MD, PHD, DMSC

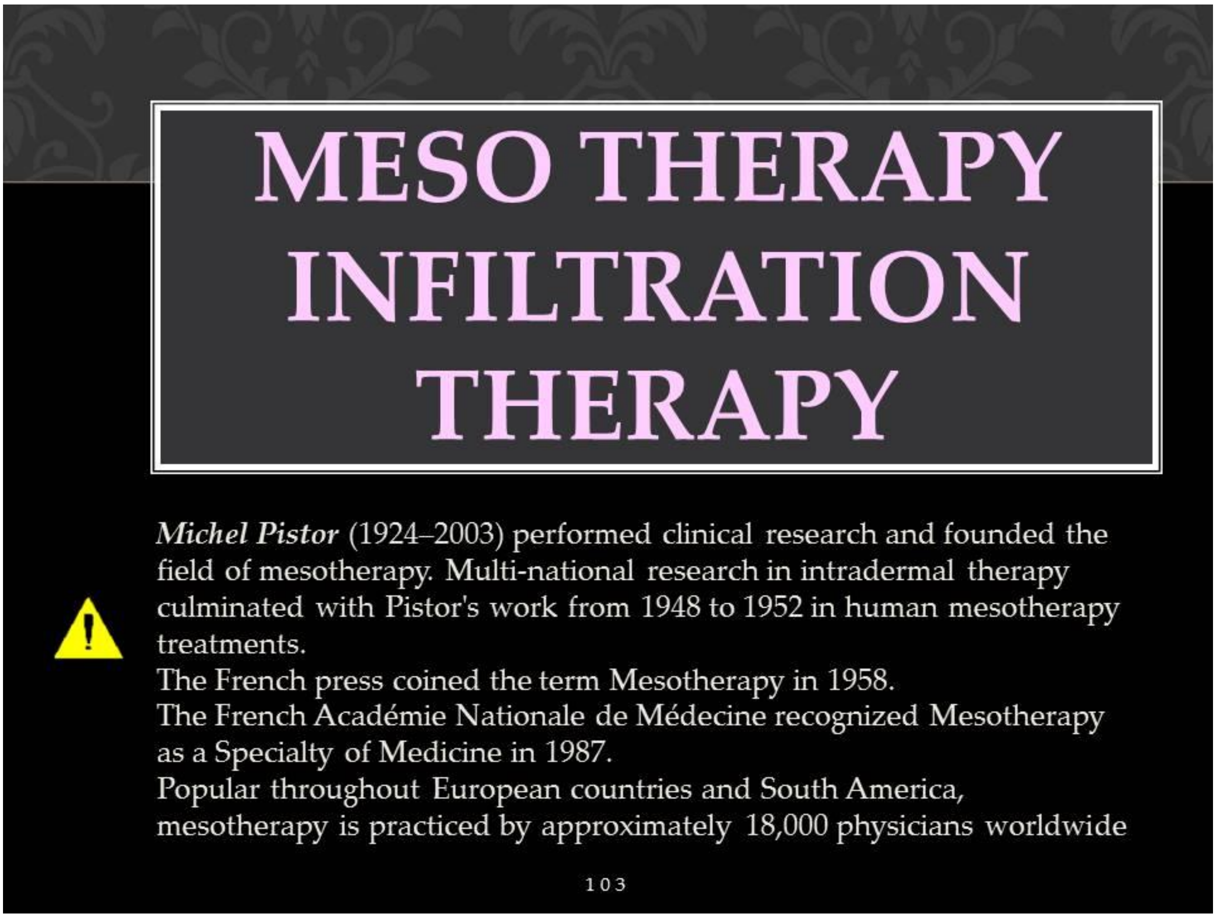

2006-2016
OCCUPATIONAL THERAPY & QUALITY OF LIFE
98

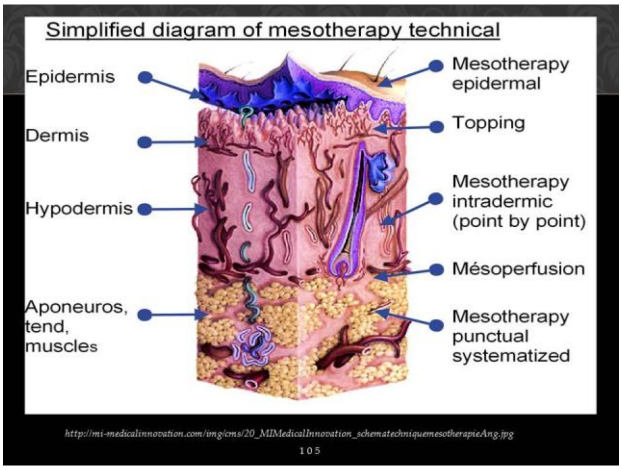

2006-2016
99


2006-2016
ERGONOMY


CARE
PR IVET KOLEVA, MD, PHD, DMSC


In some cases
Drug therapy
Infiltration therapy


MESO THERAPY INFILTRATION THERAPY
Michel Pistor (1924–2003) performed clinical research and founded the field of mesotherapy. Multi-national research in intradermal therapy culminated with Pistor's work from 1948 to 1952 in human mesotherapy treatments.
The French press coined the term Mesotherapy in 1958.
The French Académie Nationale de Médecine recognized Mesotherapy as a Specialty of Medicine in 1987.
Popular throughout European countries and South America, mesotherapy is practiced by approximately 18,000 physicians worldwide
103


Simplified diagram of mesotherapy technical
Epidermis
Dermis
Hypodermis
Aponeuros, tend, muscles
Mesotherapy epidermal
Topping
Mesotherapy intradermic (point by point)
Mésoperfusion
Mesotherapy punctual systematized
http://mi-medicalinnovation.com/img/cms/20_MIMedicalInnovation_schematechniquemesotherapieAng.jpg
105

There are published studies on the clinical treatments and effects of these medications and numerous cocktails of combined chemical compounds on the body have been reported in Europe and South America for several years. There is no conclusive research proof that these chemical compounds work to target adipose (fat cells) specifically. Cell lysis, resulting from the detergent action of deoxycholic, may account for any clinical effect [2]

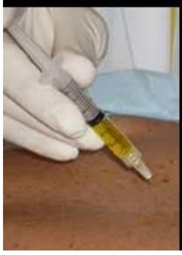
In 2012, a French laboratory invented a way to insert a treatment of Mesotherapy into a liquid podlet. This podlet is then plugged into a facial steamer titled the MTherapy Beauty Pod which applies the treatment to the user's facial pores via steam. This was the first invention of its kind to enable Mesotherapy treatments directly to consumers within their own home.

SUBSTANCES USED INCLUDE:

Phosphatidylcholine
T3-T4 thyroid,
Isoproterenol
Aminophylline
Pentoxifylline
L-carnitine
L-arginine
Hyaluronidase

Collagenase
Yohimbine
Co-enzyme cofactors
Dimethylethanolamine
Gerovital
Glutathione
Tretinoin

Alpha lipoic acid
Vitamin C
Procaine
Lidocaine
Ginkgo biloba
Melilotus
C-adenosine monophosphate
Multiple vitamins
Trace mineral elements
Carbon dioxide
Mesoglycan



INFILTRATION THERAPY
MESOTHERAPY
BEFORE THE PROCEDURE (RESPECTIVE PRE-FORMED MODALITY)

IN LOCO DOLORIS, OR SEGMENTAL APPLICATION

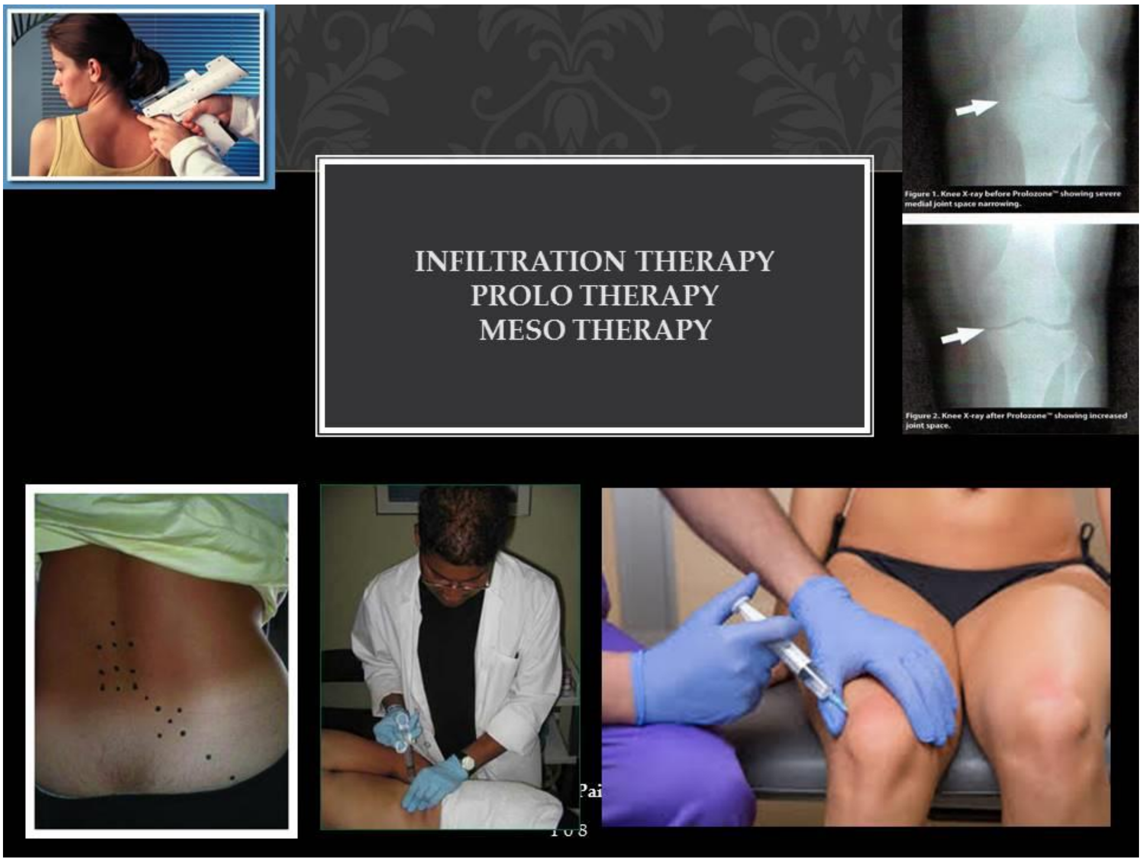
BEFORE THE APPLICATION OF PHYSICAL MODALITIES (ELECTROTHERAPY, MAGNETIC FIELD, VIBRATION, ETC.)

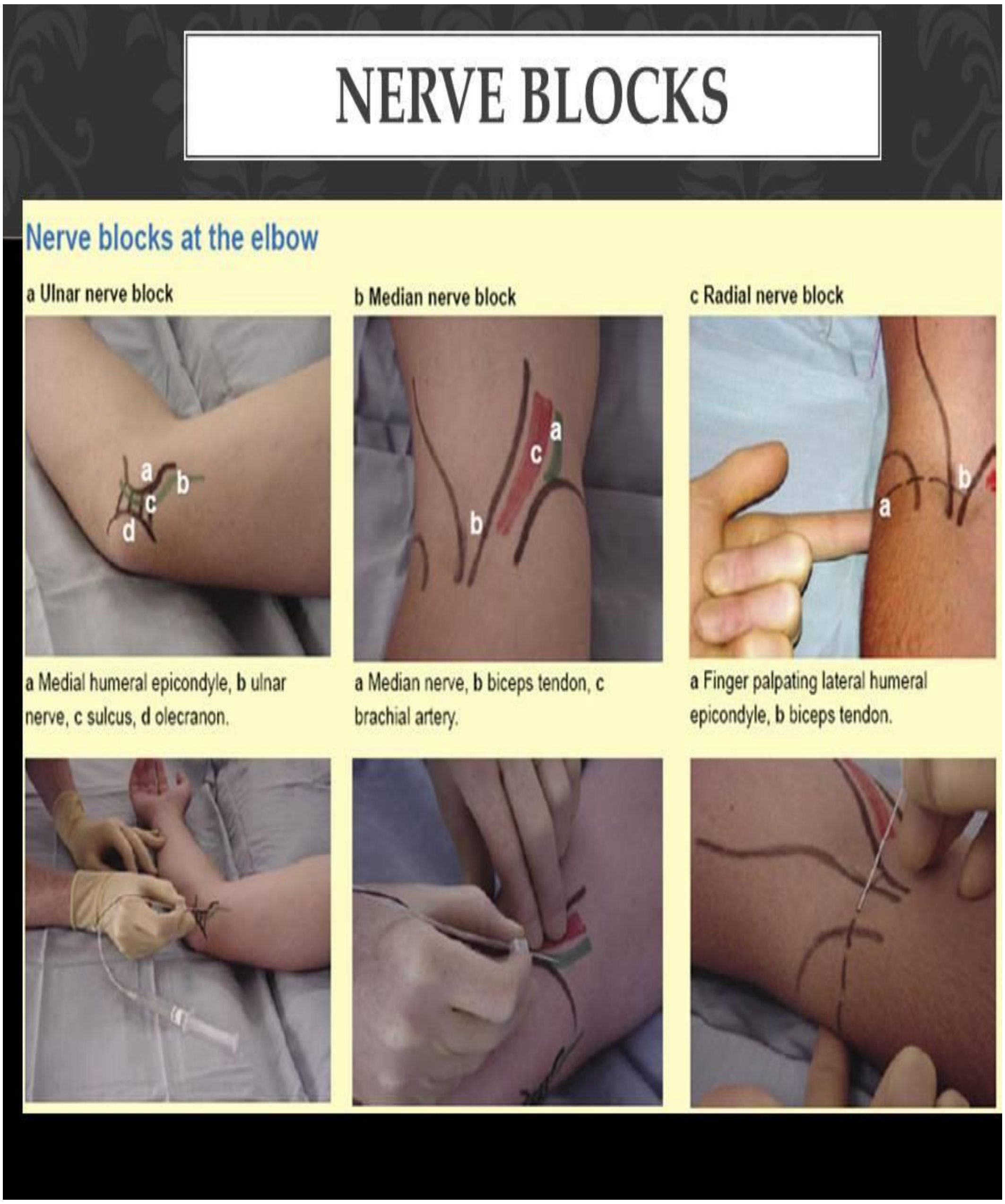
REDUCTION OF PAIN

PADUA L, I APRILE, F CECCHI, ET AL.
PAIN IN POSTSURGICAL ORTHOPEDIC REHABILITATION: A MULTICENTER STUDY.
PAIN MEDICINE, 13, 2012, 769-776.

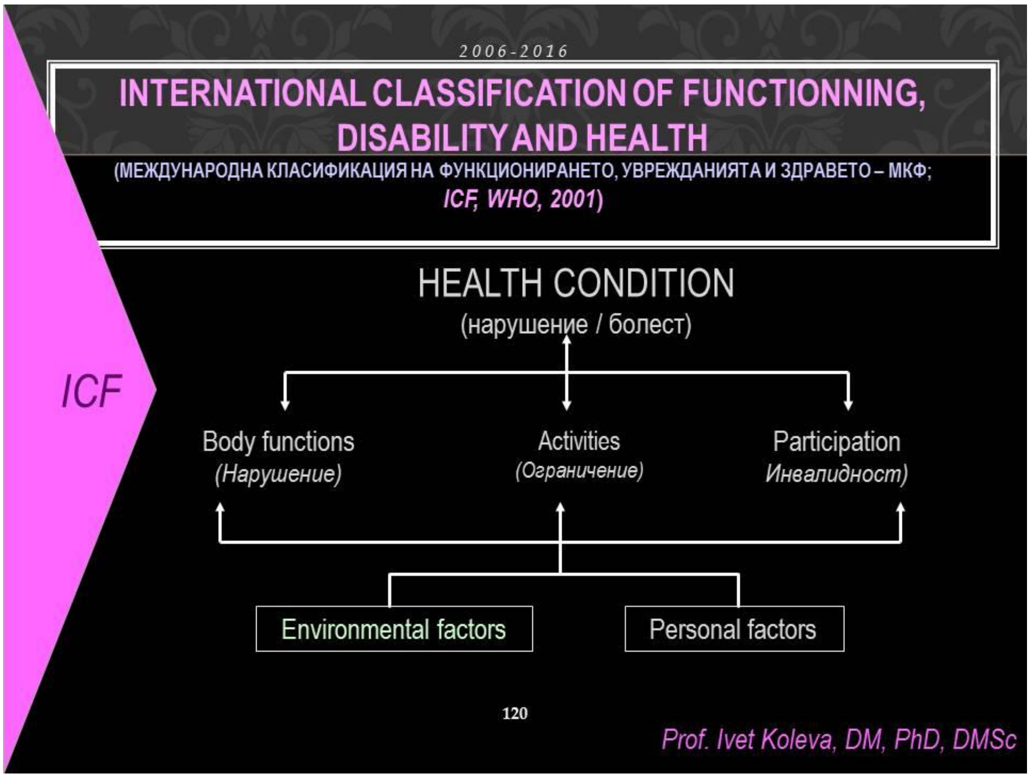
Prof. Yvette Koleva, DM, PhD, DMSc

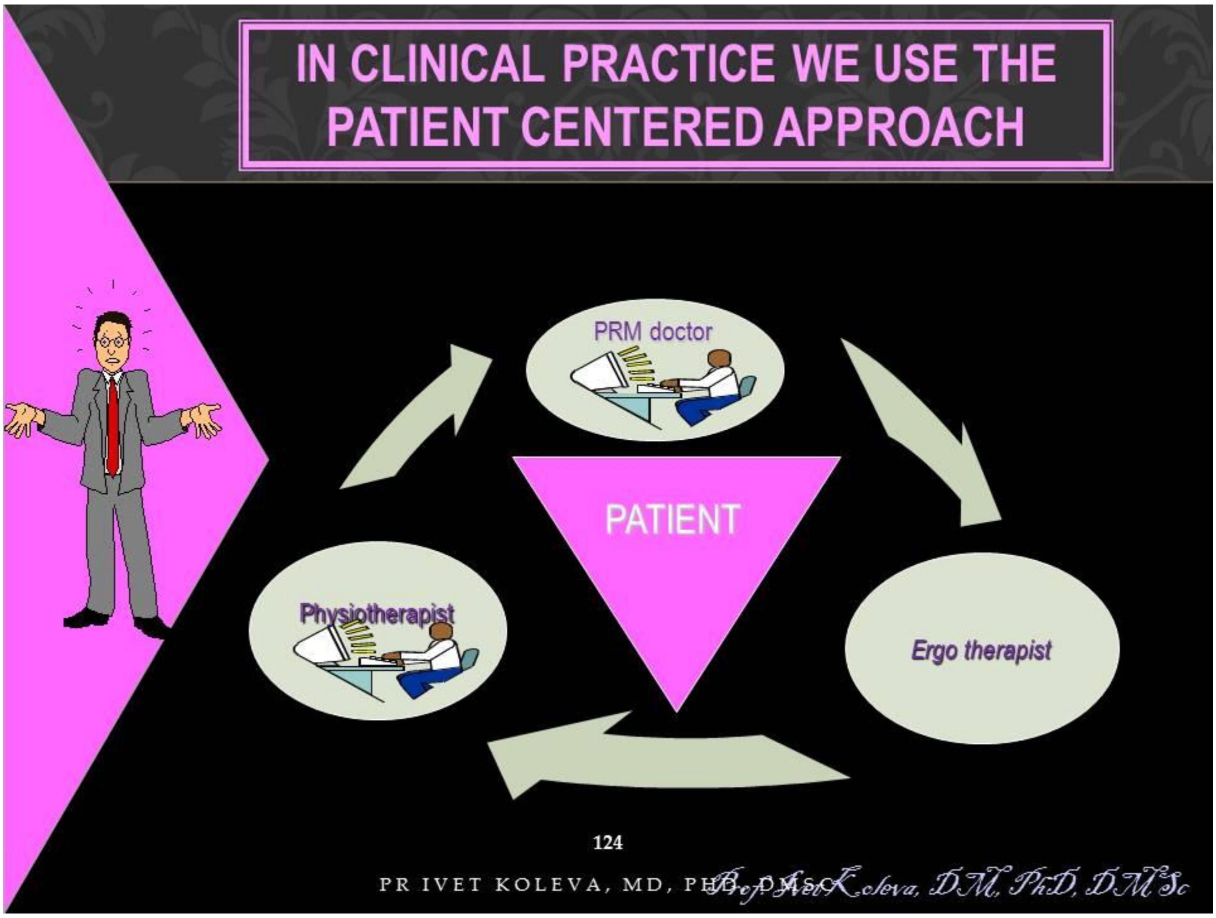

MESOTHERAPY & PAIN
BAS, Pain


INFILTRATION THERAPY
PROLO THERAPY
MESO THERAPY
Figure 1. Knee X-ray before Prolozone™ showing severe medial joint space narrowing.
Figure 2. Knee X-ray after Prolozone™ showing increased joint space.


NERVE BLOCKS
Nerve blocks at the elbow
a Ulnar nerve block
b Median nerve block
c Radial nerve block
a Medial humeral epicondyle, b ulnar nerve, c sulcus, d olecranon.
a Median nerve, b biceps tendon, c brachial artery.
a Finger palpating lateral humeral epicondyle, b biceps tendon.


2006-2016
REHABILITATION
IN
BULGARIA
118
Prof. Ivet Koleva, DM, PhD, DMSc


2006-2016
INTERNATIONAL CLASSIFICATION OF FUNCTIONNING, DISABILITY AND HEALTH
(МЕЖДУНАРОДНА КЛАСИФИКАЦИЯ НА ФУНКЦИОНИРАНЕТО, УВРЕЖДАНИЯТА И ЗДРАВЕТО – МКФ;
ICF, WHO, 2001)
ICF
HEALTH CONDITION
(нарушение / болест)
Body functions
(Нарушение)
Activities
(Ограничение)
Participation
Инвалидност)
Environmental factors
Personal factors
120
Prof. Ivet Koleva, DM, PhD, DMSc



E-mail: yvette@cc.bas.bg; Phone: ++359.888.20.81.61

Part 2.

GRASP AND GAIT REHABILITATION

IN NEUROLOGICAL AND

NEUROSURGICAL

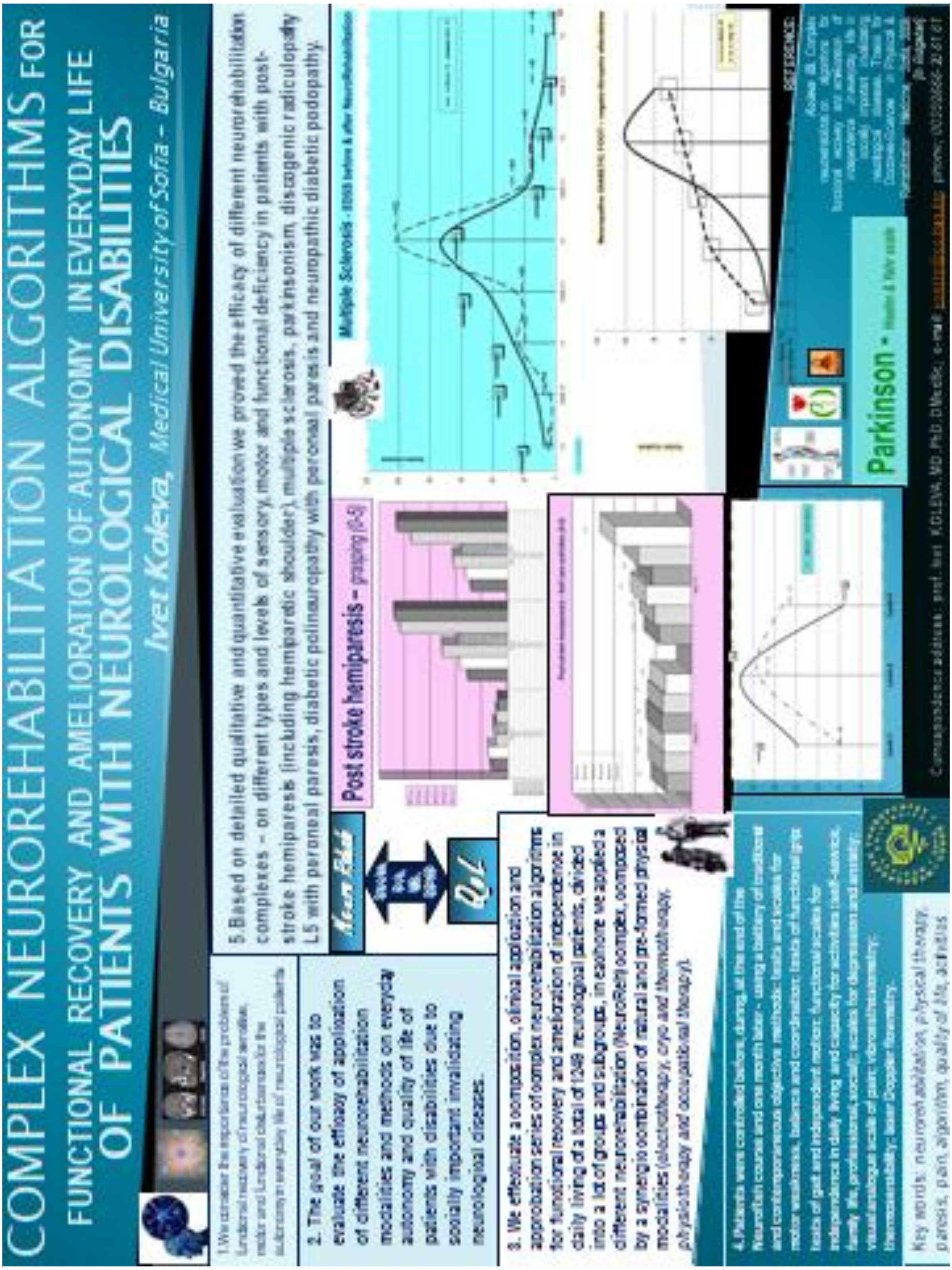
CONDITIONS

COMPLEX NEUROREHABILITATION ALGORITHMS FOR FUNCTIONAL RECOVERY AND AMELIORATION OF AUTONOMY IN EVERYDAY LIFE OF PATIENTS WITH NEUROLOGICAL DISABILITIES

Ivet Koleva

Author discusses the problem of functional recovery of neurological sensitive, motor and functional disturbances. The goal was to evaluate the efficacy of application of different neurorehabilitation modalities and methods on everyday autonomy and quality of life of patients with disabilities due to socially important invalidating neurological diseases.
We effectuate a composition, clinical application and approbation series of complex neurorehabilitation algorithms for functional recovery and amelioration of independence in daily living of a total of 1249 neurological patients, divided into a lot of groups and subgroups, in each one we applied a different neurorehabilitation (NeuroReh) complex, composed by a synergic combination of natural and pre-formed physical modalities (electrotherapy, cryo and thermotherapy, physiotherapy and occupational therapy).
Patients were controlled before, during, at the end of the NeuroReh course and one month later - using a battery of traditional and contemporaneous objective methods: tests and scales for motor weakness, balance and coordination; tests of functional grip; tests of gait and independent motion; functional scales for independence in daily living and capacity for activities (self-service, family life, professional, social); scales for depression and anxiety; visual analogue scale of pain; vibroesthesiometry; thermosensibility; laser Doppler flowmetry.
Based on detailed qualitative and quantitative evaluation we proved the efficacy of different neurorehabilitation complexes – on different types and levels of sensory, motor and functional deficiency in patients with post-stroke hemiparesis (including hemiparetic shoulder), multiple sclerosis, parkinsonism, discogenic radiculopathy L5 with peroneal paresis, diabetic polineuropathy with peroneal paresis and neuropathic diabetic podopathy.

Key words: *neurorehabilitation, physical therapy, paresis, pain, algorithm, quality of life, activities*


COMPLEX NEUROREHABILITATION ALGORITHMS FOR
FUNCTIONAL RECOVERY AND AMELIORATION OF AUTONOMY IN EVERYDAY LIFE
OF PATIENTS WITH NEUROLOGICAL DISABILITIES
Ivet Koleva, Medical University of Sofia – Bulgaria
5.Based on detailed qualitative and quantitative evaluation we proved the efficacy of different neurorehabilitation complexes – on different types and levels of sensory, motor and functional deficiency in patients with post-stroke hemiparesis (including hemiparetic shoulder), multiple sclerosis, parkinsonism, discogenic radiculopathy L5 with peroneal paresis, diabetic polinauropathy with peroneal paresis and neuropathic diabetic podopathy.
Post stroke hemiparesis
Multiple Sclerosis
Parkinson
QoL

COMPARATIVE EVALUATION OF THE EFFICACY OF DIFFERENT NEUROREHABILITATION PROGRAMS ON THE FUNCTIONAL RECOVERY AND THE AUTONOMY OF PATIENTS WITH POST STROKE HEMIPARESIS

Ivet Koleva, Radoslav Yoshinov, Borislav Yoshinov
Medical University of Sofia, Bulgaria

Abstract
Aim: *On the base of systematic review of the literature, clinical observations and investigations, specific complex neurorehabilitation algorithms were structured (including natural and preformed physical modalities).*
GOAL: Comparative evaluation of the efficacy of different physical-therapeutic and rehabilitation programs on the functional recovery, the autonomy in activities of daily living and the capacity for different activities of patients suffering from post-stroke hemiparesis.
Materials and methods: *A total of 366 post-stroke in-patients were observed. The neurorehabilitation complex includes physiotherapy, occupational therapy; thermotherapy or cryotherapy; in some groups we added electrostimulations of hand extensors and mirror therapy (grasp training).*
Patients were investigated before and after therapy, and one month later; according a Protocol with all patients' data (including neurological and functional status, hemiparesis level – Brunnstrom's test; evaluation of capacity of independence in self-care, familiar activities, professional activities; evaluation of prehension).
Statistical evaluation: *t-test (analysis of variances ANOVA) and Wilcoxon rank test (non-parametrical correlation analysis).*
Results and discussion: *Comparative analysis of results proved a statistically significant favorable effect (p<0,001) on some parameters: increase of the muscle force, the range of motion and the functional capacity of the hand (precision grips); stabilization of the balance and the locomotion (test of Brunnstrom); improvement of the autonomy in different activities – self-service and domestic care. The stability of the results one month after the end of neurorehabilitation is satisfactory.*
Conclusion: *In conclusion we must underline the impact of electrostimulations and grasp training before mirror for functional recovery and patients' autonomy.*

Key words
neurorehabilitation, stroke, hemiparesis, algorithm, functional recovery, activities of daily living (ADL)

Introduction

Stroke is considered worldwide as a socially important disease, with high morbidity and mortality, and a significant level of disability of stroke survivors, with necessity of systematic rehabilitation [1-3].
According to the data of the American National Stroke Association: stroke is one of the leading causes of long-term adult disability, affecting approximately 795,000 people each year in the U.S. [1].
According to reports of the National Institute of Neurological Disorders and Stroke (NINDS), a component of the U.S. National Institutes of Health (NIH), approximately two-thirds of the stroke patients in the United States survive and require rehabilitation [3,4].
According to the World Health Organization (WHO), stroke is a condition in which clinical signs of focal or global impairment of cerebral functions develops rapidly, lasts longer than 24 hours unless interrupted by surgery or death, and exhibit no apparent nonvascular cause [1]. From the clinical point of view, the acute neurological deficit is the result of a large area of impaired circulation. So, the stroke is a result of the altered circulation, respectively it can be defined as a vessel-related functional impairment of a specific region of the brain. Strokes can be classified according to the type: ischemic stroke (80-83%); intracerebral hemorrhage (10-12%); subarachnoid hemorrhage (7-8%).

About 88% of the patients with acute stroke have hemiparesis [2], so the motor weakness and the reduced autonomy in everyday life are the main problems of post stroke patients in rehabilitation units.
The World Health Organization's (WHO) definition of rehabilitation is: "The use of all means aimed to reduce the impact of disabling and handicapping conditions, and at enabling people with disabilities to achieve optimal social integration" [5,6].
The definition of Physical and Rehabilitation Medicine (PRM) by the Union Européenne des Médecins Spécialistes (European Union of Medical Specialists) (UEMS) - Section of PRM is: "an independent medical specialty concerned with the promotion of physical and cognitive functioning, activities (including behavior), participation (including quality of life) and modifying personal and environmental factors. It is thus responsible for the prevention, diagnosis, treatments and rehabilitation management of people with disabling medical conditions and co-morbidity across all ages." [5].
There is not a great difference of basic concepts in PRM between both sides of the Atlantic [7].
According to these concepts, the main objective of rehabilitation is to help survivors become as independent as possible and to attain the best possible quality of life [NINDS], and stroke is the second neurological typical condition present in acute PRM wards [6].
Physical and Rehabilitation Medicine (PRM) is an independent medical specialty focusing on the improvement of functioning [8], and the role of International Classification of Functioning, disability and Health [ICF] is crucial [9, 10]. During last two decades we worked on this [11].
Rehabilitation in post-stroke patients traditionally applies different PRM techniques: Proprioceptive neuromuscular facilitation, Kabath and Brunnstrom methods; Neurodevelopmental training (Bobath concept); Sensorimotor therapy (Rood approach). Ultimately some modern modalities were included in the neurorehabilitation process, such as Motor relearning program, Constraint-induced movement therapy, Mirror therapy, Functional electrical stimulation (FES), Electromyographic (EMG) biofeedback, Robotic devices [2,11,12].
Most of the studies analyze the isolated efficacy of one or two rehabilitation methods. But medical doctors – PRM specialists traditionally have a holistic approach to people with acute and chronic conditions [5]. Thus, we decide to combine different physical modalities (natural and pre-formed), with the goal to improve the efficacy of the neurorehabilitation [11]. In our clinical practice, we accentuate on the functional recovery, capacities for different activities and autonomy in everyday life, and we apply a synergic combination of physiotherapy, occupational therapy, thermo- or cryotherapy, electrotherapy, etc.

Goal

The goal of the current article is to effectuate a comparative evaluation of the efficacy of application of different neurorehabilitation programs in patients with post-stroke hemiparesis, and to evaluate the impact of different physical modalities: physiotherapy (proprioceptive neuro-muscular facilitation techniques, passive and active range-of-motion exercises, gait training), mirror therapy for digital prehension training, occupational therapy, cryotherapy or thermotherapy, functional electrostimulations.

Design Of The Study (Material And Methods)

The current investigation was realized during last 15 years in 5 university departments / clinics of PRM in two Bulgarian cities (the capital Sofia and one city at the north part of the country – Pleven).

The investigations were carried out considering patients' rights (according to the Declaration of Helsinki), and were approved by the respective Institutional review boards and Ethic commissions.

All patients signed informed consent concerning their participation in the scientific research, and before undergoing every investigation or procedure.

In the investigation we include a total of 366 in-patients, treated using 6 different neurorehabilitation complexes. For controls we used data of patients without PRM (included in the list of potential in-patients, during the interval between the initial examination and their entry in the Neurorehabilitation Clinic). All patients were examined by us, during our work or consultation.

Inclusion criteria: The clinical diagnosis of all patients was post-stroke hemiparesis; proved by clinical, functional and imagery examinations.

Exclusion criteria: All patients with a severe cardiac, respiratory or renal insufficiency were excluded, general contraindications for rehabilitation were considered. We excluded patients with correction of the medicaments during the last 1 month before the beginning of our study.

Characteristics of the material: Our patients were in a subacute or chronic stage after a supra-tentorial stroke; presenting a spastic hemiparesis (including central paresis of the ipsilateral facial and the hypoglossal nerve), with significant motor weakness, hyperreflexia, pathologic reflexes of the groups of Babinski and Rossolimo, superficial hemi-hypoesthesia; with difficulties in the functional grasping and transfers, and with reduced autonomy in everyday activities.

A total of 366 patients were treated, the distribution men: women = 151 : 215 (41,26% : 58.74%). The middle age of our patients was 57 years (from 34 to 68 y, standard deviation /SD/ = 13,8); in a period of 1 to 8 months (average 4,5 months, SD 3,8) after an ischemic stroke (cerebral infarctus) in the irrigation territory of the medial cerebral artery (left arteria cerebri media /ACM/ in 149 patients, right ACM – in 117 patients). The Brunnstrom score before the neurorehabilitation was on a middle level III - IV, the evaluated functional capacity was 13 / 20 points (Barthel ADL index).

Previously, all patients were hospitalized in an University Clinic/Department of Neurology.

Our intervention began during the first months after the acute event (1.5 to 8 months); and was realized on a total of 366 post-stroke in-patients of a Clinic/Department of Physical and Rehabilitation Medicine (Neurorehabilitation/neuroreh/sector).
Every patient received a complex PRM program of four weeks (20 procedures, 5 times weekly).

Periods of evaluation: Patients were controlled before and at the end of the neuroreh course, and one month later; according a Protocol with all data - using a battery of traditional and contemporaneous objective methods (including neurological and functional status): level of the hemiparesis – Brunnstrom's test; tests and scales for motor weakness, balance and coordination; tests for spasticity and prehension (functional grip); tests for gait and independent motion; functional scales for capacity and autonomy in daily living activities (self-service, family life, professional, social); scales for depression and anxiety (tests of Zung); etc.
Here we analyze results from all patients, which passed this program and who were presented to the control examination one month after the end of the rehabilitation.

Randomization of patients: In the investigation we included a total of 366 in-patients, divided in 7 groups: three experimental groups of a total of 285 patients treated by innovative physiotherapy methods (E-1, E-2, E-3), and 81 patients for the control groups: three of them treated by standard rehabilitation methods (K-1, K-2, K-3) and a control group patients without PRM (K-0). Patients were randomized into seven treatment groups (approximatively 95 patients per group – for the experimental groups; about 20 patients per group – for the control groups).

Functional assessment methods: The evaluation protocol consists of: the history of the condition, the clinical patterns of the central hemiparesis and the autonomy in everyday activities, and functional assessment, including: the level of the hemiparesis (Brunnstrom's test) [13], the functional score (Barthel ADL index – score of 20 points) [14], the evaluation of spasticity (0-4), the goniometry of the range of motion of the wrist and the evaluation of the functional capacities of the paretic upper limb in activities (test of E.Michel), evaluation of the autonomy in activities of daily living (0-5) – concerning self-care (bed activities, toilet, dressing, eating, transfers), domestic activities (fixing the bed, food preparation, doing the clothing, cleaning); professional activities (for the upper and lower extremities; professional activities connected with travelling); and evaluation (0-5) of the digital prehension or terminal opposition (precision grips – tip-to-tip pinch) [11].

Treatment methods

The neurorehabilitation program was focused on the following tasks: functional recovery, restoration of functional independence; reduction of muscle weakness and spasticity; training of transfers, grasp and gait; management of co-morbid conditions; prevention of complications (e.g. muscle and joint contractures, position and gait type Wernicke-Mann, humero-scapular sub-luxation); increase of the quality of life of patient and his / her family; social re-integration.

The duration of the PRM-program was 20 procedures, 5 days a week, for 4 weeks.

All patients received a detailed physiotherapeutic program, including proprioceptive neuro-muscular facilitation (PNF - method of Kabath), education and training of some activities for the self-care. Family members were included in the neurorehabilitation team and participated in the sessions of patients' education.

For all patients of the experimental groups the PRM programs included:

- Physiotherapy: individualized movement program (PNF by Kabath) with soft tissue massages (proprioceptive neuro-muscular facilitation techniques, analytic exercises for the paretic limbs, balance training, training of transfers and gait, exercises to stabilize the gait on flat terrain and on stairs); duration 45 minutes, twice a day;
- cryotherapy with ice block – distally in upper and lower extremities, duration 2-3 minutes per field, twice daily;
- occupational therapy (OT), including training in activities of daily living (ADL) - 30 minutes, twice a day;
- patient education.

In the second group (E-2) we added:

- functional electrical stimulations (FES) – a stable method of application, for the extensors of the paretic upper and lower limbs (with special attention to the wrist and ankle) and for the flexors of the fingers; with tetanic pulses, procedure of 10-20 minutes, once a day;

In the third group (E-3) we added too:

- analytic exercises and manipulative activities (grasp training with peanuts, beans, lego) with a mirror box (mirror therapy) – 10-20 minutes a day.

In the control groups (K) we included a total of 81 patients (with comparable clinical characteristics), part of them – control zero group (K-0) were observed without rehabilitation (between the initial examination before the entrance in the PRM clinic and the official entry like in-patients). The rest of patients of the control groups were randomized into three control groups (K-1, K-2, K-3) and they received a standard physiotherapy program (once daily) and a standard (group) education in some ADL.

- **K-1** sub-group received only these procedures;
- In patients of **K-2** sub-group we added too thermotherapy (paraffin applications distally (wrist and ankle);
- **K-3** sub-group received additionally electrostimulations – once a day.

All patients received detailed instructions for the treatment strategy and concerning the rehabilitation process. Patient education includes information about the lesion and the main risk factors for stroke, possible therapy and interventions, potential of the physical and rehabilitation medicine (PRM); and principal recommendations for everyday life during the first 6 months (position therapy, control of spasticity, grasp and gait training;

hypolipid and hypoglucid diet; ending of smoking and alcohol abuse; control of lipid profile and arterial hypertension, stress control).

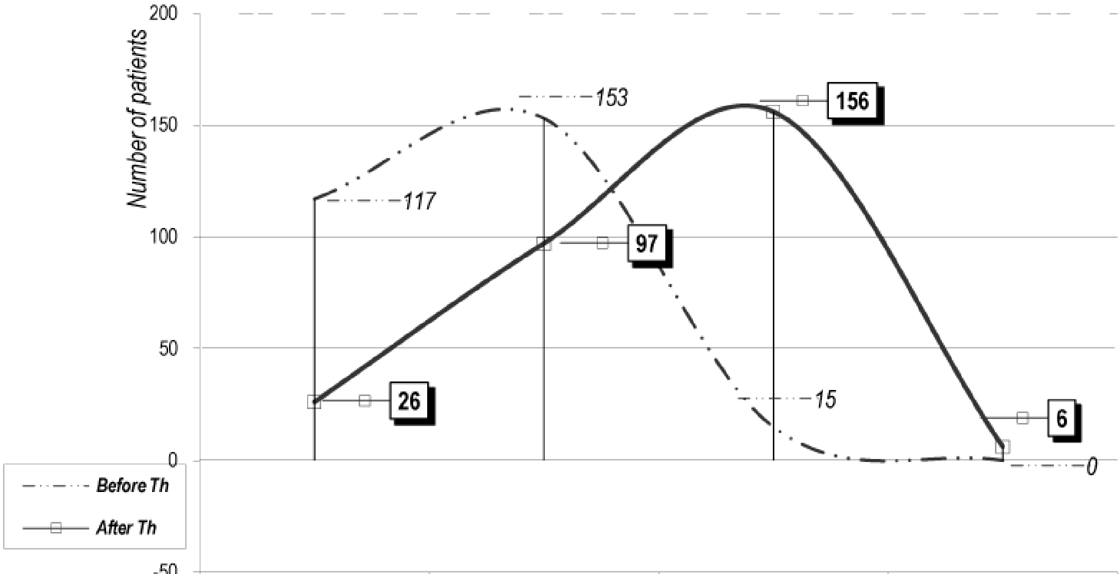
Statistical analysis
Statistical analysis was performed with SPSS electronic package, version 17. We applied options for two samples comparison with parametrical analysis of variances ANOVA and non-parametrical distribution and correlation analysis: t-test (t-criteria, p value), Signed test, Signed rank test, Kolmogorov – Smirnov test, Mann – Whitney (Wilcoxon) W test (W median).
The treatment difference was considered to be statistically significant if the p value was < 0.05. In some cases we received lower results of the p-value (p<0.01 and even p<0.001).

Results
Comparative analysis of results of neurological and functional exams proved a statistically significant favorable effect (p<0,05) on a lot of parameters: reduction of muscle weakness, increase of the range of motion and the functional capacity of the hand (including grip); stabilization of the balance and locomotion (tests of Brunnstrom); improvement of capacity of hemiparetics to effectuate different activities – self-care, domestic care. The stability of the results one month after the end of neurorehabilitation was satisfactory.
Functional capacities
The evaluation using the Brunnstrom's test [13] presents an increase of functional capacities. Table 1 compares the score before and after therapy (B.Th./A.Th.).

Table 1. *Evaluation with the test of Signe Brunnstrom*

Moment of the test	**Before Neurorehabilitation**		**After Neurorehabilitation**	
Brunnstrom's score	***Number of patients***	Value per cent	***Number of patients***	Value per cent
Level 2	**117**	41,06	**26**	9,12
Level 3	**153**	53,68	**97**	34,03
Level 4	**15**	5,26	**156**	54,74
Level 5	**0**	0	**6**	2,11
TOTAL	**285**	**100.00**	**285**	**100.00**

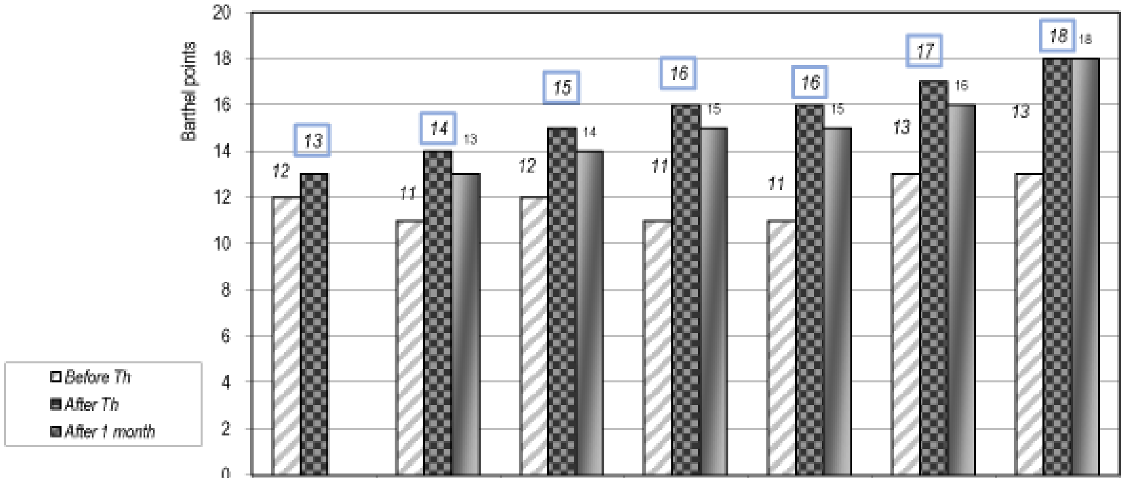
The statistical analysis of the total distribution of patients according the score of S Brunnstrom is presented on Figure 1. Using the method of Mann - Whitney we don't receive significant difference (p>0.05), because of the gravity of the hemiparesis and the relatively short duration of the rehabilitation (according actual situation in our country). But we observed a translation of the curve of distribution (Gaus distribution) after rehabilitation to the left side (translation to the mild levels of alteration) – in comparison with the levels before therapy (B.Th.), especially for the patients of levels 3 and 4.



	Level 2	Level 3	Level 4	Level 5
Before Th	117	153	15	0
After Th	26	97	156	6

***Figure 1.** Functional evaluation (test of S Brunnstrom) (for the 285 patients of the experimental groups)*

The statistical analysis (t-test) of the results concerning the functional evaluation by the ADL scale of Barthel (Figure 2) and the test of Michels for the upper extremity (Figure 3) demonstrates a significant difference ($p<0.05$) for the patients of the experimental groups (E-1, E-2 & E-3), especially for the group E-3.



	K-0	K-1	K-2	K-3	E-1	E-2	E-3
Before Th	12	11	12	11	11	13	13
After Th	13	14	15	16	16	17	18
After 1 month		13	14	15	15	16	18

***Figure 2.** Functional evaluation of Barthel ADL index (0-20) (For control and experimental groups)*

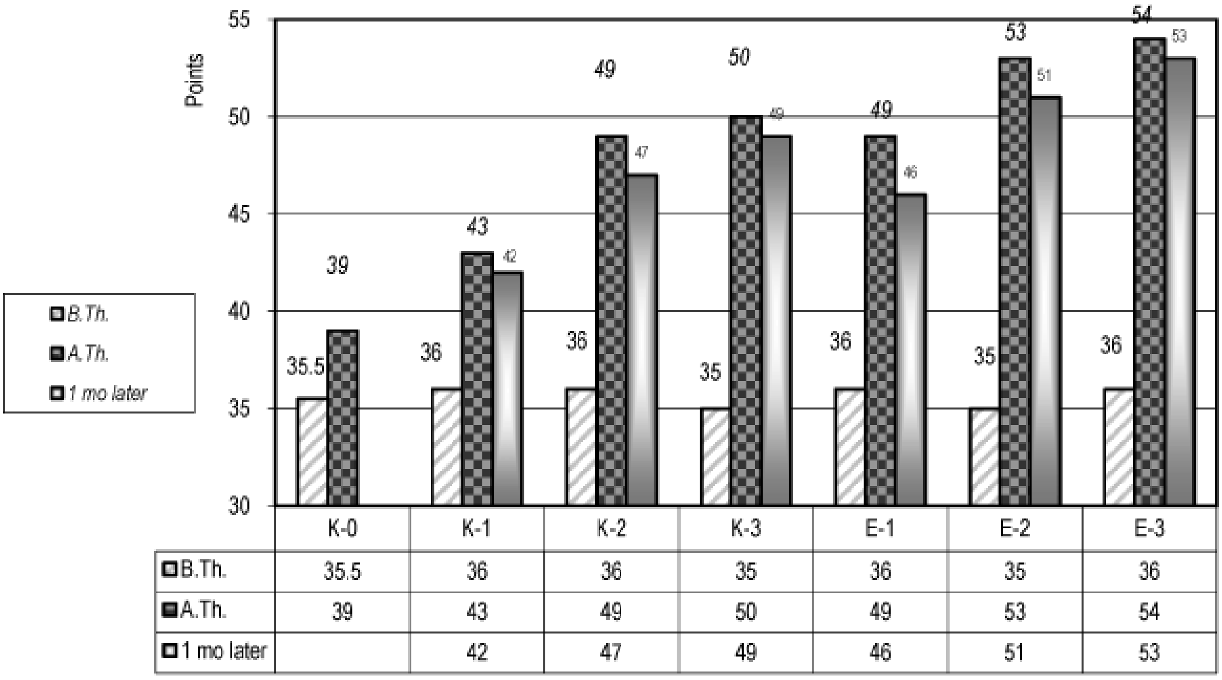


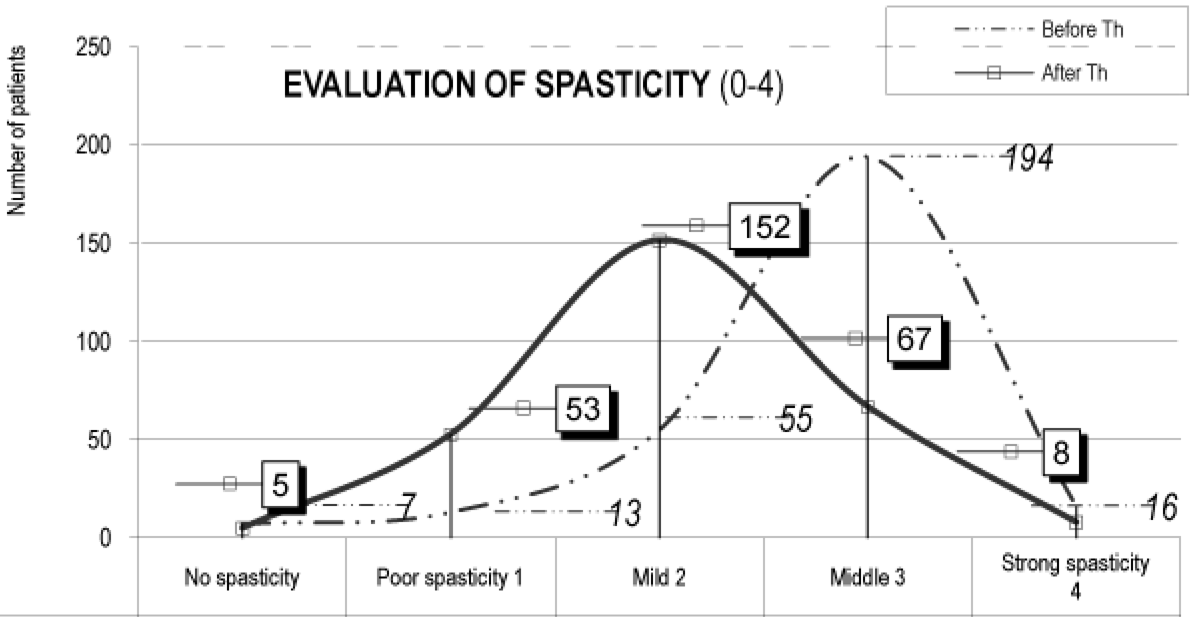
Figure 3. *Evaluation of the autonomy of the paretic upper limb in ADL (test of E Michel) – (for the control and the experimental groups)*

We must highlight that the results are more important for the patients with a mild level of dysfunction.

Spasticity
The evaluation of spasticity presents a favorable effect – reduction of spasticity (values A.Th. in comparison with the values before Th - Table 2 and Figure 4).

Table 2. *Evaluation of spasticity (0-4)*

Moment of testing	**Before Th**		**After Th**	
SPASTICITY	**Number of patients**	*Per cents*	**Number of patients**	*Per cents*
0 – no spasticity	**7**	2,45	**5**	1,75
1 – poor spasticity	**13**	4,56	**53**	18,6
2 – mild spasticity	**55**	19,30	**152**	53,33
3 – middle spasticity	**194**	68,08	**67**	23,51
4 – strong spasticity	**16**	5,61	**8**	2,81
TOTAL	285	100,00	285	100,00

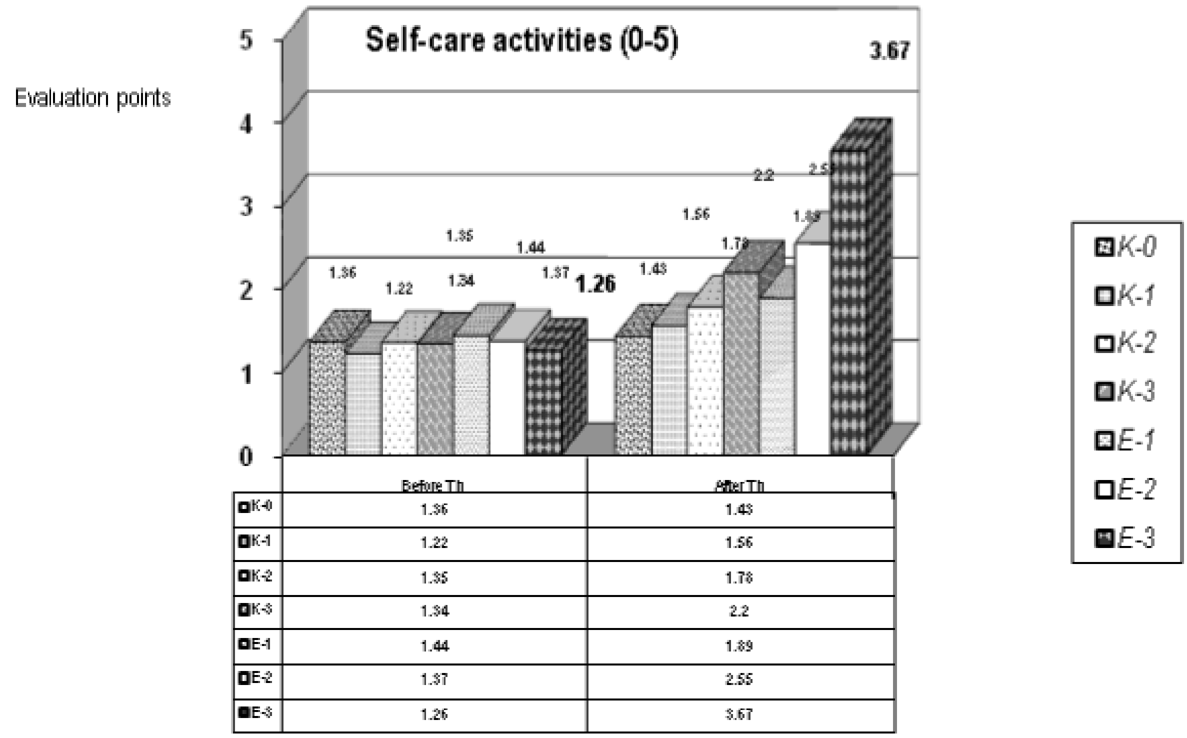


	No spasticity	Poor spasticity 1	Mild 2	Middle 3	Strong spasticity 4
Before Th	7	13	55	194	16
After Th	5	53	152	67	8

Figure 4. *Evaluation of the spasticity (0-4)*
(in all 285 patients of the experimental groups)

Independence in activities of daily living (ADL)

We observed significant amelioration in autonomy of patients in ADL (0-5) – concerning self-care and some domestic activities (Figure 5): bed activities, sitting, standing, balance; transfers – using or not a wheelchair; personal hygiene, dressing; eating). Our patients didn’t present significant performance in home and professional activities – probably due to the level of motor weakness, the short duration of neurorehabilitation and the early period after the acute onset of the vascular event.



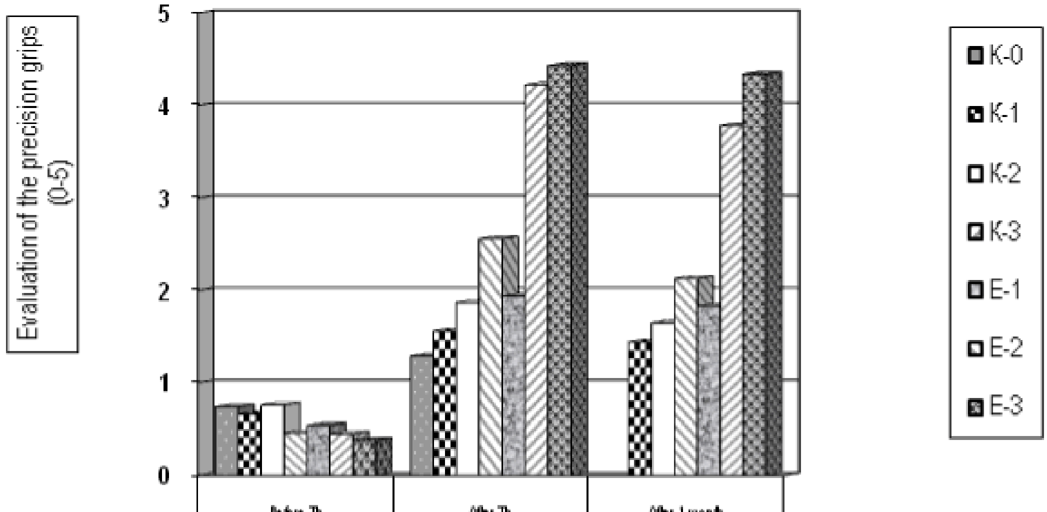
	Before Th	After Th
K-0	1.36	1.43
K-1	1.22	1.56
K-2	1.35	1.78
K-3	1.34	2.2
E-1	1.44	1.89
E-2	1.37	2.55
E-3	1.26	3.67

Figure 5. *Evaluation of autonomy in self-care activities (0-5)*
(for the control and the experimental groups)

During the statistical analysis (t-test) of self-care activities (0-5) we observed median values: before therapy (B.Th.) = 1,33 +/- SD 0,072; and after therapy (A.Th.) = 2,15 +/- SD 0,768; p=0,016, so we have a statistical significance with a p<0.05. The statistical significance is most pronounced for the patients of the experimental groups: E-1, E-2 and E-3. Applying the method of Mann-Whitney we received values for the W-medians B.Th. and A.Th.: 1,35 versus 1,89.

Digital prehension (precision grips)

Figure 6 presents the results concerning the precision handling (0-5) – tip prehension (tip-to-tip pinch). The statistical evaluation demonstrates a significant difference B.Th versus A.Th. in patients of the experimental groups (E-2 and E-3).



	Before Th	After Th	After 1 month
K-0	0.74	1.29	
K-1	0.66	1.56	1.44
K-2	0.76	1.87	1.65
K-3	0.46	2.56	2.13
E-1	0.54	1.94	1.83
E-2	0.45	4.22	3.78
E-3	0.38	4.43	4.34

Figure 6. *Evaluation of the tip prehension - precision grips (tip-to-tip pinch, scale 0-5) (for the control and the experimental groups)*

Applying the t-test – the median value of patients before Th is 0,57 (SD 0,15) and A.Th. is 2,55 (SD 1,27), the t-criterion is = -4,09 and the p value = 0,001, so we have an important statistical significance. Using the method of Mann-Whitney we received a median of Wilcoxon = 49,0 and p-value p=0,001, so statistical significance (p<0.01).

If we compare the results of the experimental groups after therapy and one month later – we don't receive statistical significance [t=0,19; p=0,85], so we have a stability of the efficacy of the rehabilitation during the first 4 weeks. This stability of the effects is most expressed in the groups with mirror therapy (with grasp training). Our conclusion is that the application of functional electrical stimulations for the wrist extensors is effective (for the spasticity and for the precision grips), but is relatively instable; and for stability of the results is necessary to apply a grasp training, better with the method of mirror therapy.

The comparison of results for the experimental groups before therapy and one month after the end of the therapy demonstrates too a statistical significance [t=-3,75; p=0,02, so p<0,05].

Discussion

Our results proved the significant efficacy of complex neurorehabilitation on a lot of parameters: reduction of muscle weakness, increase of functional capacity of the hand (tip prehension); stabilization of the balance and locomotion (tests of Brunnstrom); improvement of the capacity of hemiparetic patients to realize main activities of self-care and some activities of domestic care.

Results of experimental groups are the most favorable, and we can emphasize the impact of electrostimulations (group E-2) and of mirror therapy for grasp training (group E-3) for acceleration of the functional recovery.

It's necessary to underline the stability of the results one month after the end of neurorehabilitation.

We agree with authors who highlight the importance of neurologic sensory-motor dysfunctions and deficits for everyday autonomy of post-stroke patients and discuss the impact of occupational therapy [2,3,11]. Training of basic activities of daily living (ADL - bathing, dressing, feeding, toileting, transfers) is considered as obligatory and in most reports, 47-76% of patients achieve partial or total independence in the performance of ADL, evaluated with disability rating scales. The maximal improvement is measured during the first 6 months post onset [2,11].

Ultimately, the impact of mirror therapy is discussed in the literature. In a systematic review H Thieme et al. (2013) summarizes the effectiveness of mirror therapy for improving motor function, activities of daily living, pain, and visuospatial neglect in patients after stroke. They included randomized controlled trials and randomized crossover trials comparing mirror therapy with different interventions for patients after stroke, using relevant data of Cochrane Registers, Medline, Embase, etc. Authors analyze 14 studies with a total of 567 participants, which compared mirror therapy with other interventions. Mirror therapy was found to have a significant effect on motor function and on activities of daily living [12].

Evidence from clinical trials supports the premise that the early initiation of neurorehabilitation is crucial for the functional recovery from stroke [2,11,14]. When the beginning of the rehabilitation is delayed, patients may develop a lot of complications, such as muscular or joint contractures, pressure ulcers; pneumonia; urinary infections; heterotopic ossifications; depression; falls; malnutrition; deep venous thrombosis; pulmonary embolism; encephalopathy, vascular dementia [2-4,11].

Mechanisms of functional recovery are discussed by a lot of authors [2-4,11]. Without doubt, the reduction of the extent of neurologic impairment can result from spontaneous, natural neurologic recovery (via the effects of drug treatments that limit the extent of the stroke) and from neurorehabilitation interventions that enhance neurologic functioning [2,11]. The training of activities of daily living (ADL), of gait and grasp can improve the quality of life of post-stroke survivors.

During the first 3 to 6 months the principal recovery mechanism is the resolution of harmful local factors: reduction of local edema, resorption of local toxins, improvement of local circulation, and recovery of partially damaged ischemic neurons. This is the cause for the early spontaneous improvement after stroke [2].

We consider that the efficacy of neurorehabilitation is due to the other mechanism of recovery – the neuroplasticity, which may continue for many months, and which can take place early or late. By definition, the brain plasticity is the ability of the nervous system to modify its structural and functional organization – principally by collateral sprouting of new synaptic connections, and by stimulation of previously latent functional pathways [2,15]. Other discussed mechanisms of neuroplasticity are assumption of function by undamaged, redundant neural pathways, reversibility from diaschisis, and regenerative proximal sprouting of transected neuronal axons [15]. Experimental evidence indicates that plasticity can be altered by several external factors, including pharmacologic agents, electrical stimulation, and environmental stimulation [2,15].

A key aspect of neuroplasticity, very important for neurorehabilitation, is the dependence of synaptic plasticity from the functional activity [2,16].

Our work demonstrates that active regular and prolonged physiotherapy and training of everyday activities (accentuating on grasp training with a mirror) promote the functional recovery and the autonomy of post-stroke hemi paretic patients, probably stimulating the brain plasticity and its functional reorganization.

Probably the stability of the effects on motor function and on autonomy in ADL (at follow-up assessment - one month after the end of rehabilitation) is due to this use-dependent neuroplasticity.

Conclusion

The brain has significant capacity to recover from the loss of function following a cerebral vascular accident. PRM training stimulates brain reorganization and improves functional recovery and autonomy of post-stroke patients. Systematic neurorehabilitation reduces risks of complications during the post-acute and the chronic phase, such as contractures and deconditioning [2].

The organization of neurorehabilitation is a key consideration in stroke management [17].

We agree with the White Book of PRM in Europe (2006) that the future goals for the specialty PRM cover the development of a “culture of rehabilitation” as a fundamental right for people with disabilities and one of the roles of PRM specialists is to realize that [5].

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COMPARATIVE STUDY OF FOUR NEUROREHABILITATION COMPLEXES IN PATIENTS WITH DIABETIC POLYNEUROPATHY AND DIABETIC FOOT

Introduction: Most of patients with Diabetes mellitus /DM/ develop neurological complications, including diabetic polyneuropathy /DPNP/ and neuropathic diabetic foot /DF/.

Objective: The goal of current study was to effectuate a comparative evaluation of different neurorehabilitation /NR/ complexes in patients with DM, DPNP and DF; with detailed evaluation of the impact of some pre-formed modalities: low frequency electric currents, functional electrical stimulations /FES/ and Deep Oscillation /DO/.

Material and methods: During last years a total of 144 patients with non-insulino-dependent DM, DPNP and neuropathic DF were observed and investigated. The investigation was conducted with consideration for the protection of patients, as outlined in the Declaration of Helsinki, and was approved by the appropriate institutional review boards and ethic commissions. All patients gave written informed consent before undergoing any examination or study procedure. Patients were randomized into four treatment groups of 36 each one.

All patients received a complex NR programme including physical therapy and patients' education. Patients of group /gr/ 1 received only these procedures. In other groups we added some preformed physical modality: gr 2 – low frequency electric currents (iontophoresis and functional electrical stimulations /FES/), gr 3 - DO. Patients of group 4 received complex NR, including combination of procedures of groups 2 and 3.

For statistical evaluation we used t-test (ANOVA) and Wilcoxon rank test (non-parametrical correlation analysis), performed using SPSS package. The treatment difference was considered to be statistically significant if the *P value* was < *0.05*.

Results: The comparative *analysis of results* shows a significant improvement: pain relief (visualized by the Visual analogue scale, and evaluation of muscle tenderness), increase of muscle force (Manual muscle test), reduction of dystrophic foot signs, and amelioration of quality of life (McGill QoL questionnaire). We received best results in group 4.

Discussion and conclusion: The combination of iontophoresis and FES is the most effective complex in cases with peripheral paresis. Deep Oscillation is the most analgesic agent. We suggest a conception of mechanisms of physical analgesia.

We could recommend the complex program for treatment of DPNP and DF.

Keywords: *DM, DPNP, DF, analgesia, physical modalities, deep oscillation*

IMPACT OF FUNCTIONAL ELECTRICAL STIMULATIONS IN THE EARLY NEUROSURGICAL REHABILITATION OF PATIENTS WITH CEREBRAL TUMORS
(a comparative study)

Ivet B. Koleva , Radoslav D. Yoshinov, Borislav R.Yoshinov

Introduction: Most of patients with brain tumors require a complex neurorehabilitation program after surgical intervention.

Our purpose was to evaluate the impact of pre-formed physical modality functional electro-stimulation in the post-operative management of hemiparesis.

Objective: Our goal was to effectuate a comparative evaluation of two neurorehabilitation complexes in patients with brain tumors after neurosurgical intervention, and to check the significance of functional electrical stimulations on the level of hemiparesis.

Material and methods: During last years a total of 46 hemiparetic patients after neurosurgical intervention for cerebral glioma and glioblastoma were observed and investigated. The investigation was conducted with consideration for the protection of patients, as outlined in the Declaration of Helsinki, and was approved by the appropriate institutional review boards and ethic commissions. All patients gave written informed consent before undergoing any examination or study procedure.

Patients were randomized into two treatment groups of 23 each one.

All patients received a complex neurorehabilitation programme including physical therapy, ergotherapy and patients' education. In group 1 we applied only these physical modalities. Patients of groups 2 received too functional electrical stimulations for shoulder abductors, for hand and foot extensors.

For statistical evaluation we used t-test (ANOVA) and Wilcoxon rank test (non-parametrical correlation analysis), performed using SPSS package. The treatment difference was considered to be statistically significant if the *P value* was < *0.05*.

Results: The comparative ANALYSIS of RESULTS shows a significant improvement of the symptoms of the patients, concerning: active and passive range of motion (ROM) of the hemiparetic shoulder, hand and foot; reduction of muscle weakness, increase of the grasp, stabilization of the balance and the gait, amelioration of independence in activities of daily living and of quality of life. We received best results in the second group.

Discussion and conclusion: The functional electrical stimulations stimulate the cortical neuroplasticity; and this way support the muscle function and assist the functional restoration of hemiparetic patients. We could recommend the complex program for treatment of patients after neurosurgical intervention.

Keywords: *functional electrical stimulation, brain tumor, glioma, glioblastoma, neurorehabilitation, neurosurgical intervention,*

Impact of functional electrical stimulations in the early neurosurgical rehabilitation of patients with cerebral tumors

(a comparative study)

Ivet Koleva [1], Radoslav Yoshinov [2], Borislav Yoshinov [1]

1 Medical University of Sofia, Bulgaria
2 Bulgarian Academy of Sciences, Laboratory of Telematics - Sofia

INTRODUCTION:

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Fig. 1. Evaluation of autonomy in self service activities (ADL 0-5) in groups 1 & 2

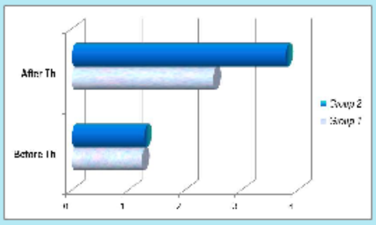
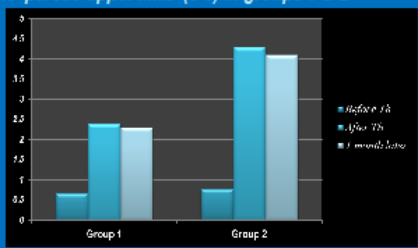
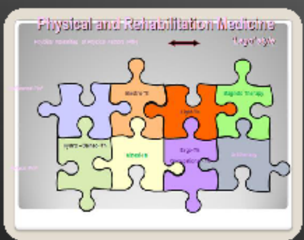


Fig. 2. Evaluation of the functional precise grasp of the paretic upper limb (0-5) in groups 1 & 2





DISCUSSION AND CONCLUSION:

The functional electrical stimulations stimulate the cortical neuroplasticity; and this way support the muscle function and assist the functional restoration of hemiparetic patients.

We could recommend the complex program for treatment of patients after neurosurgical intervention.

P 088

ePoster Session 6
Disease specific rehabilitation 1

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Prof. Ivet KOLEVA, MD, PhD, DMedSc
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NEUROREHABILITATION ALGORITHMS FOR PAIN MANAGEMENT
(Physical analgesia – methods & Mechanisms)

Ivet KOLEVA, Borislav YOSHINOV, Radoslav YOSHINOV

Pain management is an important part of rehabilitation algorithms in clinical practice.

Pain is one of the most frequent sensations, formed in the nervous system. By definition, pain is an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage.

The Declaration of Montréal of the International Pain Summit of the International Association for the *Study of Pain* (IASP) identifies that chronic pain is a serious chronic health problem and access to pain management is considered as a fundamental human right.

We proposed the notion ***physical analgesia*** for the application of physical factors for pain management. By our opinion the anti-pain effect of physical modalities is very important, with a high level of efficacy. Physical analgesia has not side consequences and may be applied in combination with other therapeutic factors.

In physical analgesia a lot of **physical modalities** are applied:

- ***Preformed modalities***: Low frequency currents and low frequency modulated middle frequency currents (sinusoidal-modulated, interferential, Kots currents); Transcutaneous electroneurostimulation (TENS); High frequency currents (*diathermy, ultra-high frequency currents, decimeter and centimeter waves);* Ultra-sound and phonophoresis with NSAIDs; Low frequency magnetic field; Deep Oscillation;
- ***Natural modalities***: Kryo-factors *(ice, cold packs, cold compresses);* Thermo-agents *(hot packs, hot compresses),* Hydro- and balneo-techniques (*douches, baths, piscine);* hydro and balneo-physiotherapy techniques (*underwater massage, under water exercises, etc.);* Peloidotherapy (*fango therapy, thermal mud, sea lye compresses*); Physiotherapy techniques - stretching, post-isometric relaxation, manual therapy (traction, mobilization, manipulation); massages (manual and with devices; periostal, connective tissue massage, etc.);
- ***Reflectory methods***: electrotherapy, thermotherapy and physiotherapy in reflectory points and zones; acupuncture, laserpuncture, acupressure, etc

We propose our own theory for explanation of **pathogenetic mechanisms** of action of physical modalities on the nociceptive and neuropathic pain:

- *By influence on the cause for irritation of pain receptors* - consequence of stimulation of circulation, metabolism and trophy of tissues (by low and medium frequency electric currents, magnetic field, ultrasound, He-Ne laser; massages; manual techniques);
- *By blocking of nociception* (low frequency currents, including transcutaneous electrical nerve stimulation or TENS; lasertherapy);
- *By inhibition of peripheral senzitization* (low and middle frequency currents, TENS; magnetic field; lasertherapy);
- *By peripheral sympaticolysis* (low frequency currents like dyadinamic currents, peloids);
- *By stopping the neural transmission (by C and Aδ delta - fibers) to the body of the first neuron of the general sensibility* (iontophoresis with Novocain in the receptive zone – the region of neuro-terminals);
- *By input of the gate-control mechanism* (TENS with frequency 90-130 Hz and interferential currents with high resulting frequency - 90-150 Hz);
- *By activation of the reflectory connections: cutaneous – visceral, subcutaneous-connective tissue-visceral, proprio-visceral, periostal-visceral and motor-visceral* (classic manual, connective tissue and periostal massage, post-isometric relaxation and stretching-techniques);

- ❖ *By influence on the pain-translation in the level of posterior horn of the spinal medulla – using the root of activation of encephalic blocking system in the central nervous system* (increasing the peripheral afferentation) and *influence on the descending systems for pain – control* (TENS with frequency 2-5 Hz and interferential currents with low resulting frequency 1-5 Hz, acupuncture and laserpuncture; reflectory and periostal massage, zonotherapy, acupressure, su-dgok massage; preformed factors in reflectory zones /palms of hands, plants of feet, paravertebral points; zones of Head, of Mackenzie, of Leube-Dicke, of Vogler-Krauss/);
- ❖ *By inhibition of central sensitization* (lasertherapy; peloidotherapy; physiotherapy);
- ❖ *By influence on the psychic state of the patient* – the drug «doctor» and the drug «procedure».

The influence of physical modalities on the interstitium ('milieu interieur' of Claude Bernard) is the theoretical base for a *combined pain management programme.*

We present our own **experience and results** in patients with conditions of the nervous and motor systems.

The goal of current work is to prove and evaluate the efficacy of application of different modalities and methods of the physical and rehabilitation medicine (PRM) on independence and quality of life of neurological patients.

We effectuate a composition, clinical application and approbation series of complex neurorehabilitation algorithms for functional recovery and amelioration of independence in activities of daily living (ADL) of 1029 patients with neurological diseases, and 516 patients with neurosurgical conditions. The total of 1545 patients was divided into a lot of groups and subgroups, in each one we applied a different neurorehabilitation complex, composed by a synergic combination of natural and pre-formed physical modalities (electrical currents, laser; cryo / thermo-agents, hydro-/ balneo-/ peloido-therapy; physiotherapy and occupational therapy).

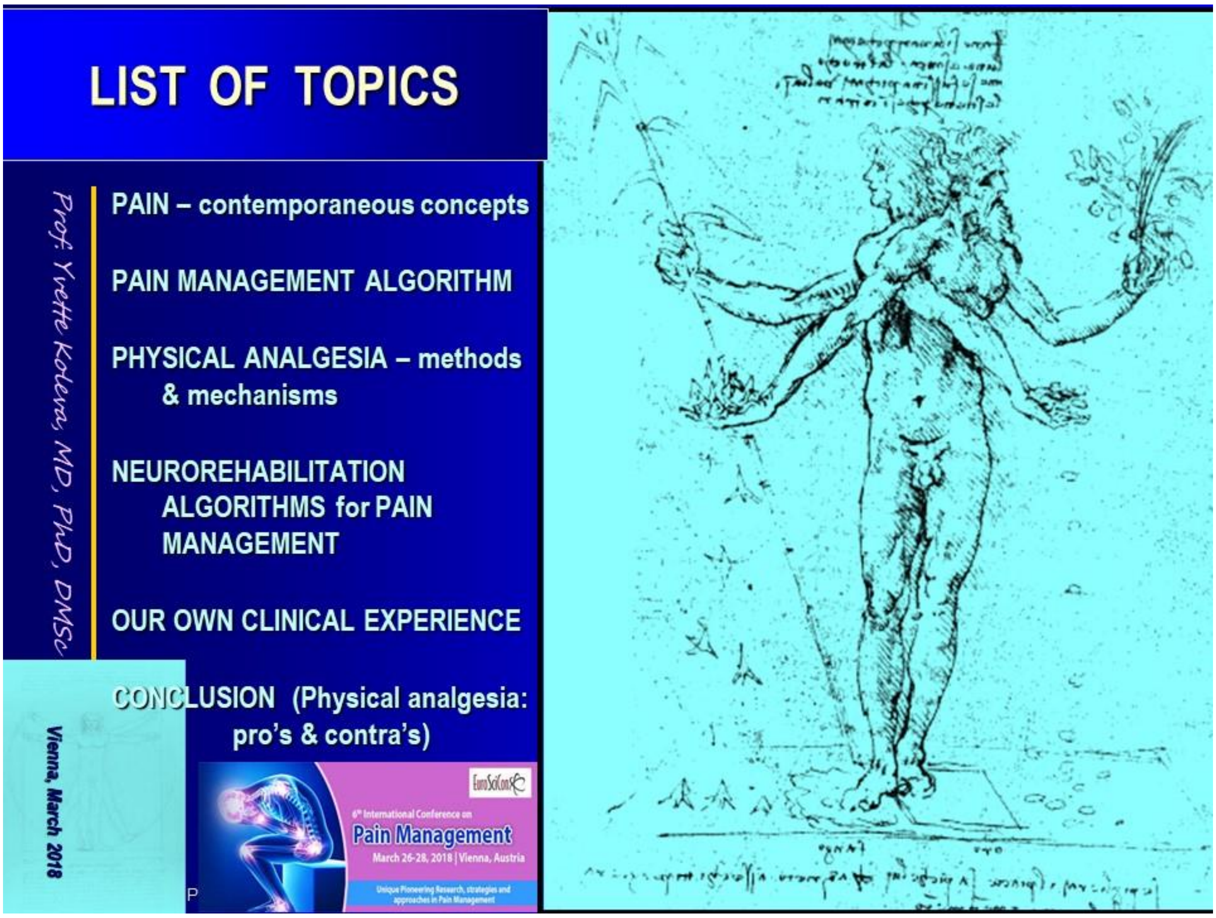
Patients were controlled before, during and at the end of the neurorehabilitation course and one month after its end - using a battery of traditional and contemporaneous objective methods (including for pain assessment): tests and scales for motor deficiency, balance and coordination; tests of functional grip of the upper limb; tests of gait and independent motion; complex functional scales for independence in ADL (self service, family, professional & social life); scales for depression and anxiety; visual analogue scale of pain; vibroesthesiometry; thermosensibility; laser Doppler flowmetry; ICF asessment.

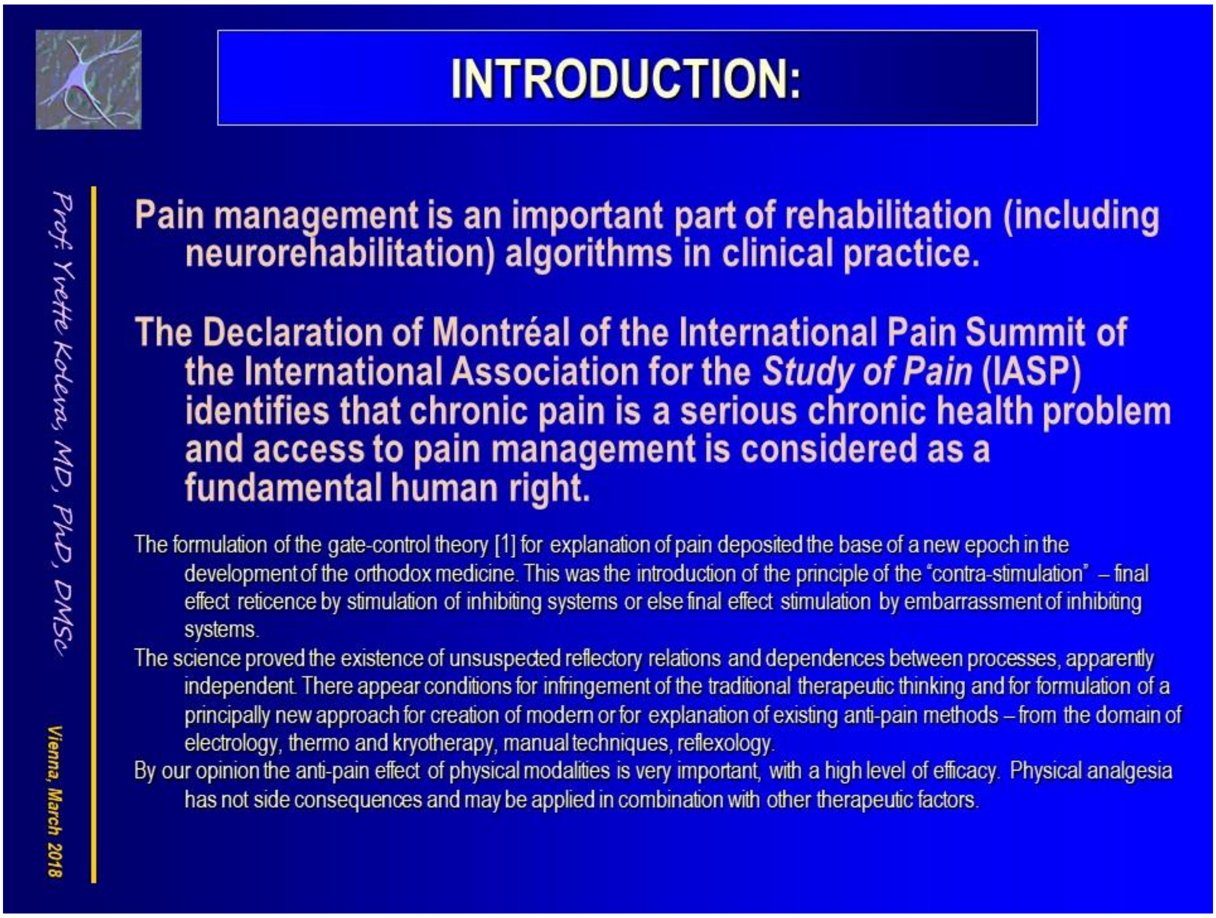
Based on detailed qualitative and quantitative evaluation we proved the efficacy of application of different PhThReh complexes and programs – on different types and levels of sensory, motor and functional deficiency in patients with diseases and conditions of the nervous systems.

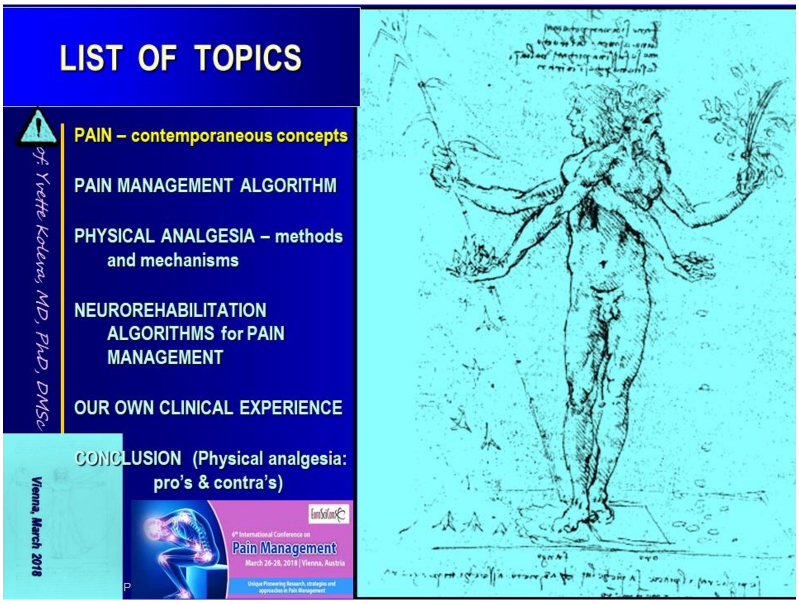
Mechanisms of physical analgesia are discuted.

In conclusion we must say that physical modalities improve significantly the quality of life of patients with diseases and conditions of the nervous systems.


Leonardo da Vinci:
Dolore & Piacere
The Notebooks of
Leonardo da Vinci, 676 :
Allegorical
representations
Allegory of
Pleasure and Pain
1480
"Pleasure and pain are
represented as twins, they are
joined together as there is not
the one without the other"
Leonardo da Vinci :
PAIN and PLEASURE


LIST OF TOPICS
Prof. Yvette Koleva, MD, PhD, DMSc
PAIN – contemporaneous concepts
PAIN MANAGEMENT ALGORITHM
PHYSICAL ANALGESIA – methods
& mechanisms
NEUROREHABILITATION
ALGORITHMS for PAIN
MANAGEMENT
OUR OWN CLINICAL EXPERIENCE
CONCLUSION (Physical analgesia:
pro's & contra's)
Vienna, March 2018
Pain Management
March 26-28, 2018 | Vienna, Austria


INTRODUCTION:
Prof. Yvette Koleva, MD, PhD, DMSc
Vienna, March 2018
Pain management is an important part of rehabilitation (including neurorehabilitation) algorithms in clinical practice.
The Declaration of Montréal of the International Pain Summit of the International Association for the Study of Pain (IASP) identifies that chronic pain is a serious chronic health problem and access to pain management is considered as a fundamental human right.
The formulation of the gate-control theory [1] for explanation of pain deposited the base of a new epoch in the development of the orthodox medicine. This was the introduction of the principle of the "contra-stimulation" – final effect reticence by stimulation of inhibiting systems or else final effect stimulation by embarrassment of inhibiting systems.
The science proved the existence of unsuspected reflectory relations and dependences between processes, apparently independent. There appear conditions for infringement of the traditional therapeutic thinking and for formulation of a principally new approach for creation of modern or for explanation of existing anti-pain methods – from the domain of electrology, thermo and kryotherapy, manual techniques, reflexology.
By our opinion the anti-pain effect of physical modalities is very important, with a high level of efficacy. Physical analgesia has not side consequences and may be applied in combination with other therapeutic factors.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OUR OWN CLINICAL EXPERIENCE
CONCLUSION (Physical analgesia: pro's & contra's)
Vienna, March 2018
Pain Management

PAIN

Prof. Yvette Koleva, MD, PhD, DMSc

PAIN is one of the most frequent sensations, formed in the nervous system, with different functional characteristics.

Pain is a subjective experience, provoked by nociceptive activation, by changes in sensory nerves and roads, or by cerebral centres – regulating of the stress, the affects and the motivation.

Different factors (physical, chemical, psychological) can influence on the pain perception.

Pain is an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage.

International Association for the Study of Pain (IASP)
www.iasp-pain.org
www.painbooks.org

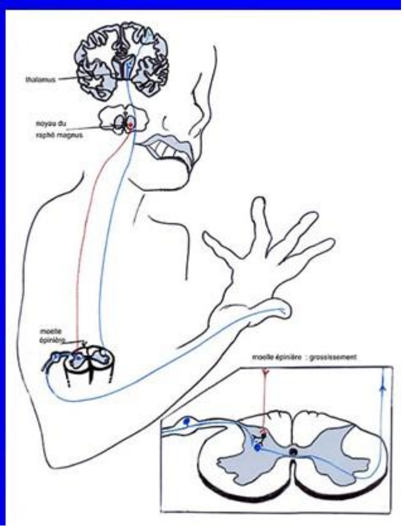
PAIN

Prof. Yvette Koleva, MD, PhD, DMSc

Vienna, March 2018

The ***biological significance*** of pain perception is the protection of the organism from negative external influences *(signal attention)*.

The pain informs the organism and provokes a ***reflectory defensive reaction*** *of the individual.*



René Descartes

idea for the defensive character of pain (baby fire, boy fire) (1662, 1664)

*The French philosopher **René Descartes** explains the idea for the defensive character of pain (baby fire, boy fire) and the capacity to unchain a reflectory reaction "pulling on a thread" (1662, 1664).*

Prof. Yvette Koleva, MD, Ph

René Descartes.
L'homme de René Descartes.
Paris: Charles Angot, 1664

René Descartes.
Renatus Des Cartes de homine.
Lvgdvni Batavorvm: Petrvm
Leffen & Fransciscvm
Moyardvm, 1662

PAIN

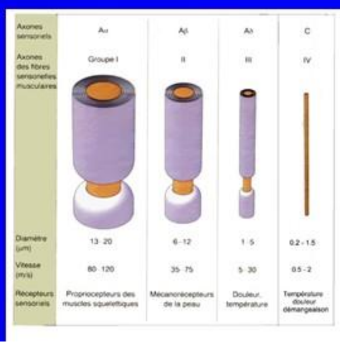
Prof. Yvette Koleva, MD, PhD, DMSc

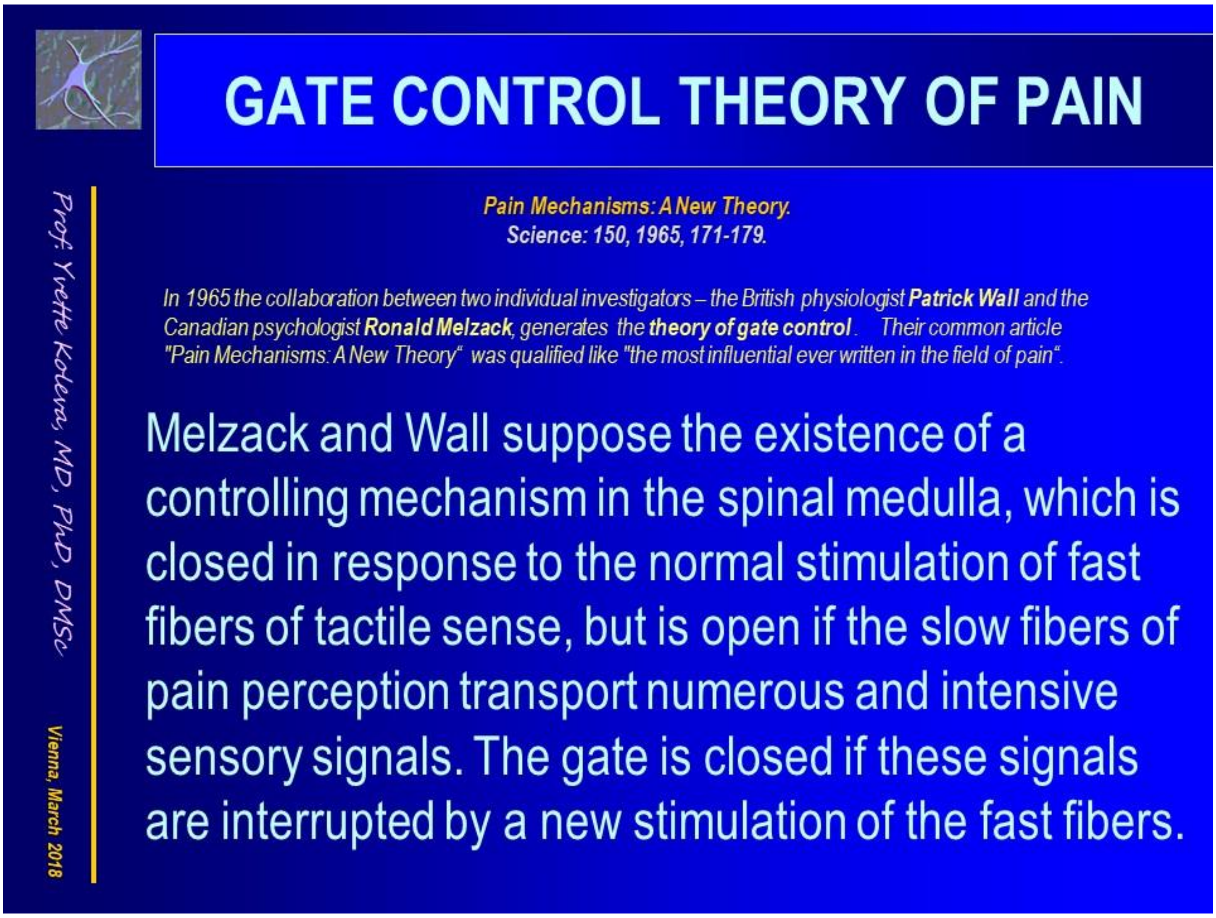
Vienna, March 2018

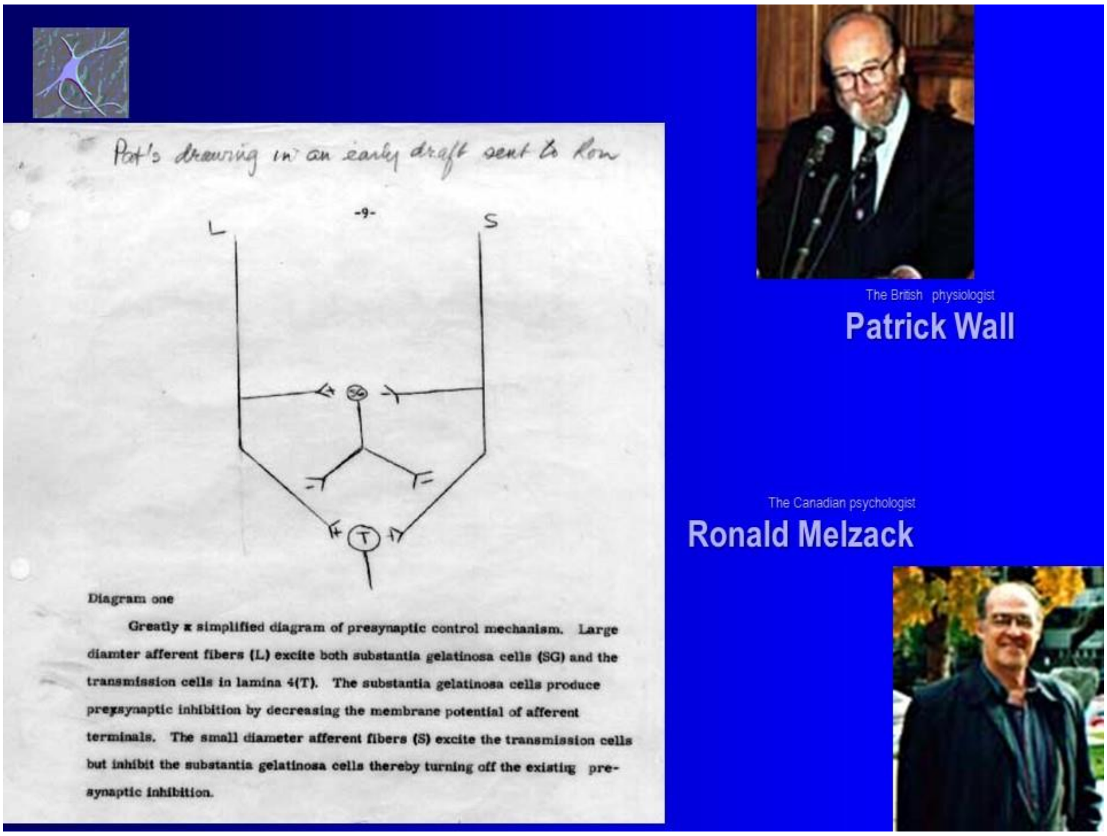
***Willem Noordenbos (1959)* - HYPOTHESIS FOR THE MULTI-SYNAPTIC TRANSMISSION OF PAIN-SIGNAL**

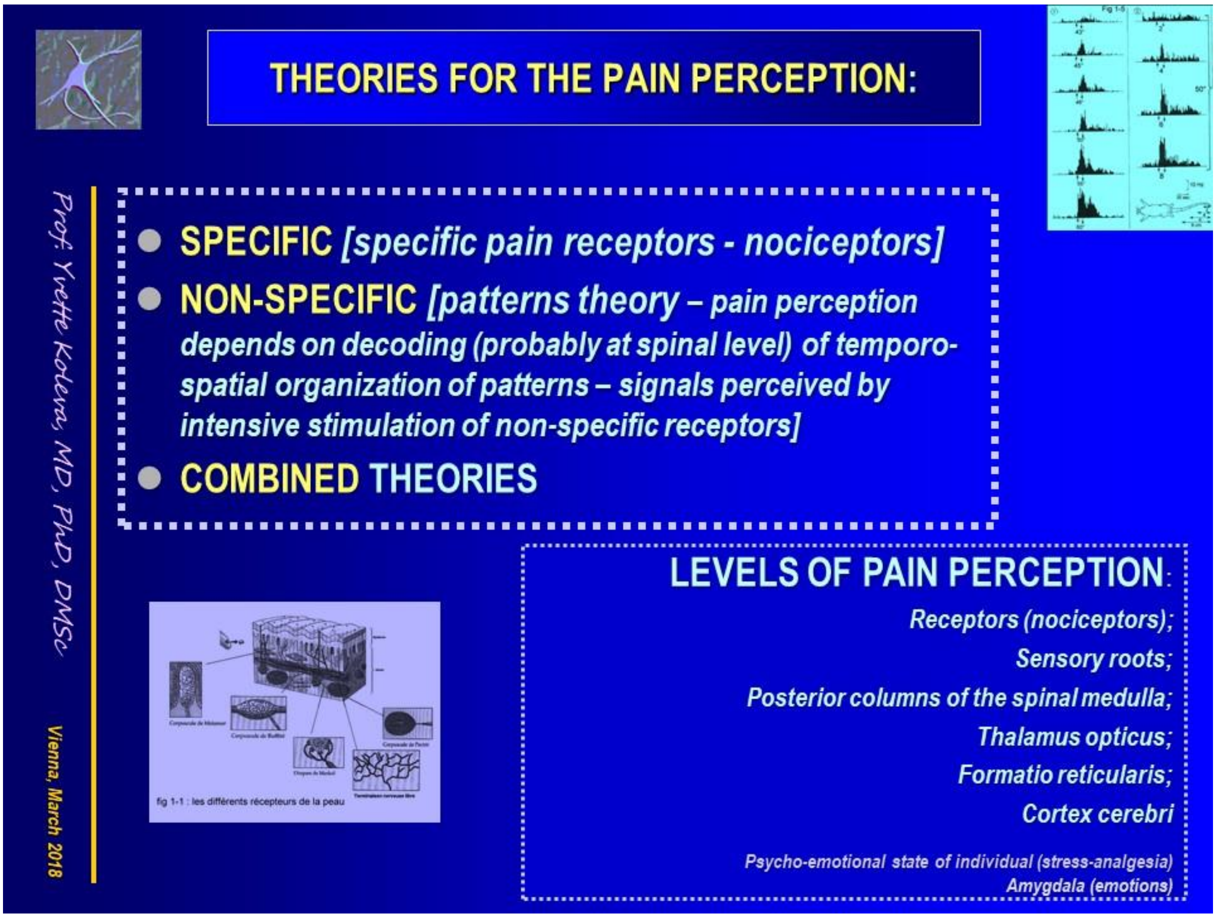
"One-one synaptic transmission must be the exception *rather than the rule in the nervous system. Any nerve cell located in the anterior horn. . . could hardly be expected to synapse at higher level with one such similar cell only. It will probably send ramifications to many other locations, and in turn be acted upon by the ramifications of many other cells. . . Far from being a continuous chain of short neurons, these fibers must constitute links in an extremely complicated nerve net in which, within limits, everything synapses more or less with everything else."*

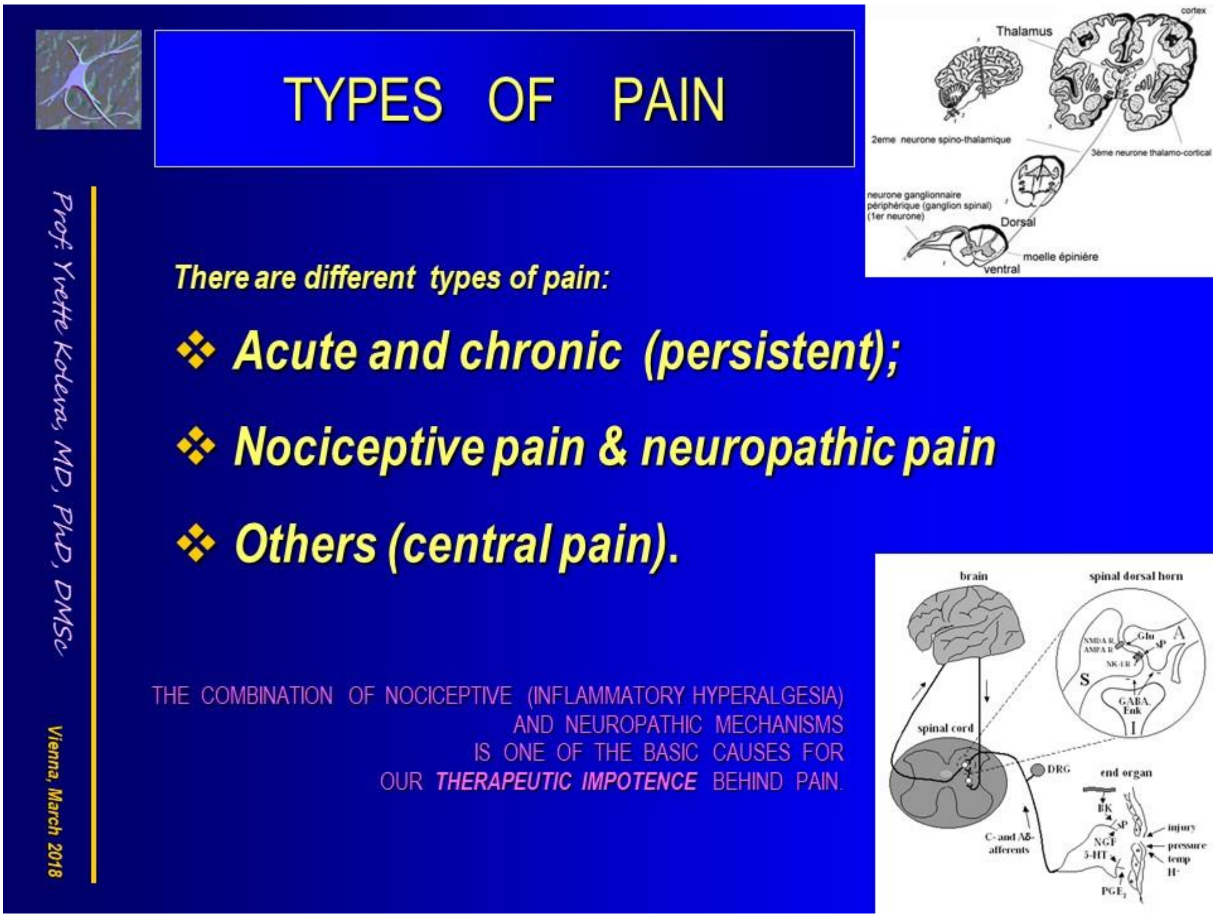
***Noordenbos**, Willem.*
Pain: Problems Pertaining to the Transmission of Nerve Impulses Which Give Rise to Pain.
Amsterdam: Elsevier, 1959.

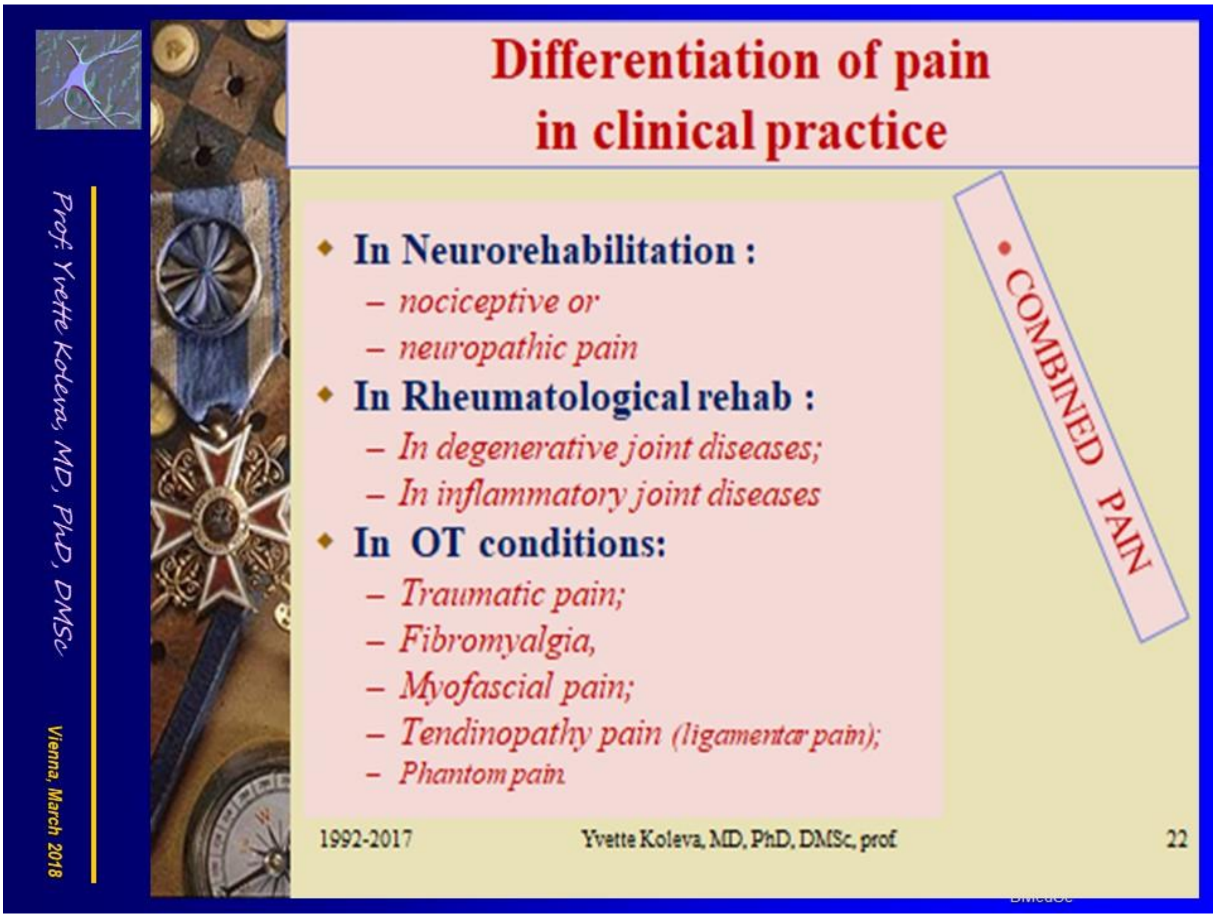



GATE CONTROL THEORY OF PAIN
Prof. Yvette Koleva, MD, PhD, DMSc
Vienna, March 2018
Pain Mechanisms: A New Theory.
Science: 150, 1965, 171-179.
In 1965 the collaboration between two individual investigators – the British physiologist Patrick Wall and the Canadian psychologist Ronald Melzack, generates the theory of gate control. Their common article "Pain Mechanisms: A New Theory" was qualified like "the most influential ever written in the field of pain".
Melzack and Wall suppose the existence of a controlling mechanism in the spinal medulla, which is closed in response to the normal stimulation of fast fibers of tactile sense, but is open if the slow fibers of pain perception transport numerous and intensive sensory signals. The gate is closed if these signals are interrupted by a new stimulation of the fast fibers.


Pat's drawing in an early draft sent to Ron
-9-
L
S
SG
T
Diagram one
Greatly x simplified diagram of presynaptic control mechanism. Large diamter afferent fibers (L) excite both substantia gelatinosa cells (SG) and the transmission cells in lamina 4(T). The substantia gelatinosa cells produce prepsynaptic inhibition by decreasing the membrane potential of afferent terminals. The small diameter afferent fibers (S) excite the transmission cells but inhibit the substantia gelatinosa cells thereby turning off the existing pre-synaptic inhibition.
The British physiologist
Patrick Wall
The Canadian psychologist
Ronald Melzack


THEORIES FOR THE PAIN PERCEPTION:
Prof. Yvette Koleva, MD, PhD, DMSc
Vienna, March 2018
SPECIFIC [specific pain receptors - nociceptors]
NON-SPECIFIC [patterns theory – pain perception depends on decoding (probably at spinal level) of temporo-spatial organization of patterns – signals perceived by intensive stimulation of non-specific receptors]
COMBINED THEORIES
fig 1-1 : les différents récepteurs de la peau
LEVELS OF PAIN PERCEPTION:
Receptors (nociceptors);
Sensory roots;
Posterior columns of the spinal medulla;
Thalamus opticus;
Formatio reticularis;
Cortex cerebri
Psycho-emotional state of individual (stress-analgesia)
Amygdala (emotions)


TYPES OF PAIN
Prof. Yvette Koleva, MD, PhD, DMSc
Vienna, March 2018
Thalamus
cortex
2eme neurone spino-thalamique
3ème neurone thalamo-cortical
neurone ganglionnaire périphérique (ganglion spinal) (1er neurone)
Dorsal
moelle épinière
ventral
There are different types of pain:
Acute and chronic (persistent);
Nociceptive pain & neuropathic pain
Others (central pain).
THE COMBINATION OF NOCICEPTIVE (INFLAMMATORY HYPERALGESIA) AND NEUROPATHIC MECHANISMS IS ONE OF THE BASIC CAUSES FOR OUR THERAPEUTIC IMPOTENCE BEHIND PAIN.
brain
spinal dorsal horn
spinal cord
DRG
end organ
C- and Aδ- afferents
injury
pressure
temp


Differentiation of pain in clinical practice
In Neurorehabilitation :
– nociceptive or
– neuropathic pain
In Rheumatological rehab :
– In degenerative joint diseases;
– In inflammatory joint diseases
In OT conditions:
– Traumatic pain;
– Fibromyalgia,
– Myofascial pain;
– Tendinopathy pain (ligamentar pain);
– Phantom pain
COMBINED PAIN
1992-2017
Yvette Koleva, MD, PhD, DMSc, prof
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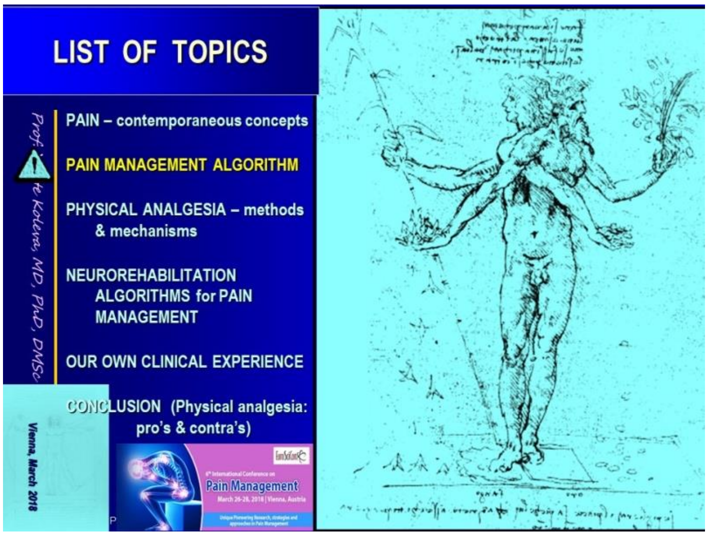
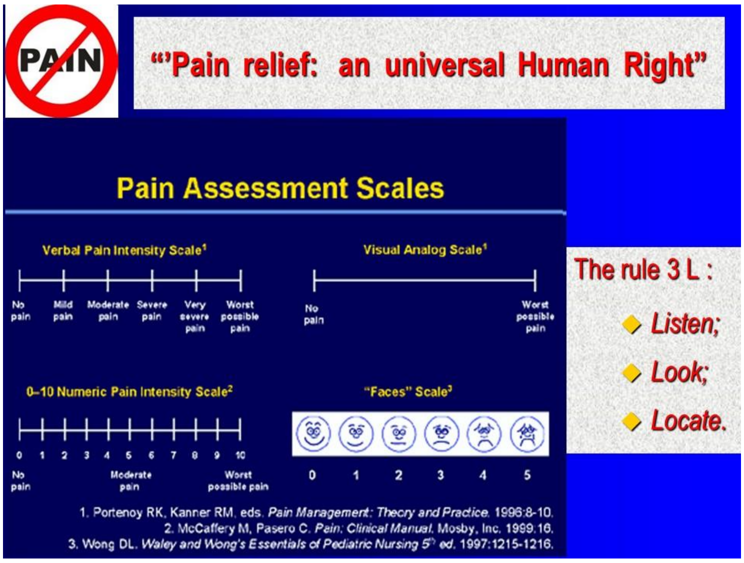
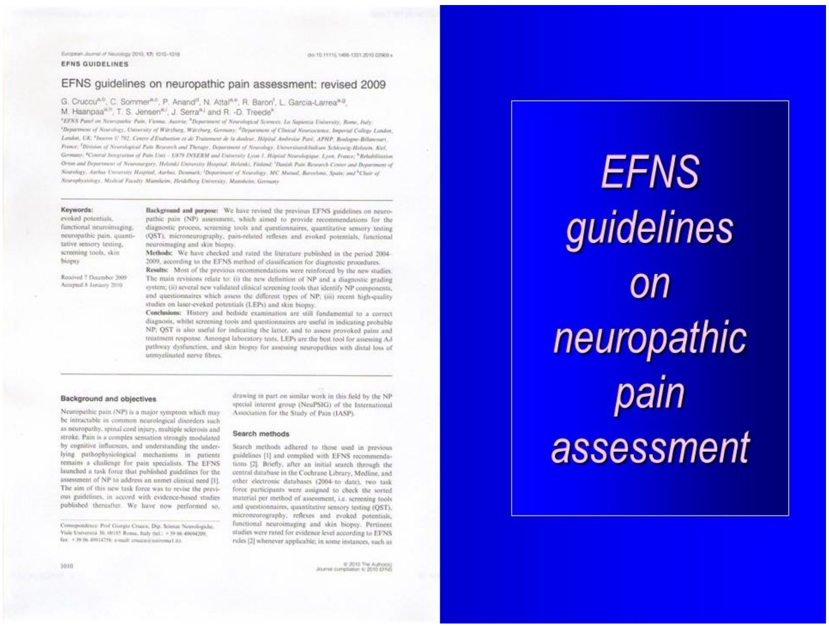
Prof. Yvette Koleva, MD, PhD, DMSc
Vienna, March 2018


PAIN COMPONENTS
(CLINICAL ELEMENTS OF PAIN)
SENSORY DISCRIMINATIVE COMPONENT: Physiological element , analysed in the brain according to site, intensity, duration and nature. Assessed by different scales, e.g. VAS.
AUTONOMIC COMPONENT: Pain leads to reactions of the autonomic nervous system, such as increase in blood pressure and heart rate, or nausea.
MOTOR COMPONENT: Reflectory element, e.g. protective reflexes (for example withdrawing the hand), relieving defensive muscle spasm or posture, muscle tension, myofascial pain, fibromyalgia, etc.
COGNITIVE COMPONENT: Pain is classified and evaluated on the basis of previous experience, observations or information.
EMOTIONAL COMPONENT: Pain is associated to a greater or lesser degree with emotions, such as anxiety, aversion or helplessness. (clinical translation - depression, anxiety).
Psychological elements of pain imposes the necessity of psychologists in the pain rehabilitation team.
Impact on the patient's quality of life (QoL)
Prof. Yvette Koleva, MD, PhD, DMSc
Vienna, March 2018






European Journal of Neurology 2010, 17: 1010–1018 doi:10.1111/j.1468-1331.2010.02969.x

EFNS GUIDELINES

EFNS guidelines on neuropathic pain assessment: revised 2009

G. Cruccu[a,b], C. Sommer[a,c], P. Anand[d], N. Attal[a,e], R. Baron[f], L. Garcia-Larrea[a,g], M. Haanpaa[a,h], T. S. Jensen[a,i], J. Serra[a,j] and R.-D. Treede[k]

Keywords: evoked potentials, functional neuroimaging, neuropathic pain, quantitative sensory testing, screening tools, skin biopsy

Received 7 December 2009
Accepted 8 January 2010

Background and purpose: We have revised the previous EFNS guidelines on neuropathic pain (NP) assessment, which aimed to provide recommendations for the diagnostic process, screening tools and questionnaires, quantitative sensory testing (QST), microneurography, pain-related reflexes and evoked potentials, functional neuroimaging and skin biopsy.
Methods: We have checked and rated the literature published in the period 2004–2009, according to the EFNS method of classification for diagnostic procedures.
Results: Most of the previous recommendations were reinforced by the new studies. The main revisions relate to: (i) the new definition of NP and a diagnostic grading system; (ii) several new validated clinical screening tools that identify NP components, and questionnaires which assess the different types of NP; (iii) recent high-quality studies on laser-evoked potentials (LEPs) and skin biopsy.
Conclusions: History and bedside examination are still fundamental to a correct diagnosis, whilst screening tools and questionnaires are useful in indicating probable NP; QST is also useful for indicating the latter, and to assess provoked pains and treatment response. Amongst laboratory tests, LEPs are the best tool for assessing Aδ pathway dysfunction, and skin biopsy for assessing neuropathies with distal loss of unmyelinated nerve fibres.

Background and objectives

Neuropathic pain (NP) is a major symptom which may be intractable in common neurological disorders such as neuropathy, spinal cord injury, multiple sclerosis and stroke. Pain is a complex sensation strongly modulated by cognitive influences, and understanding the underlying pathophysiological mechanisms in patients remains a challenge for pain specialists. The EFNS launched a task force that published guidelines for the assessment of NP to address an unmet clinical need [1]. The aim of this new task force was to revise the previous guidelines, in accord with evidence-based studies published thereafter. We have now performed so, drawing in part on similar work in this field by the NP special interest group (NeuPSIG) of the International Association for the Study of Pain (IASP).

Search methods

Search methods adhered to those used in previous guidelines [1] and complied with EFNS recommendations [2]. Briefly, after an initial search through the central database in the Cochrane Library, Medline, and other electronic databases (2004–to date), two task force participants were assigned to check the sorted material per method of assessment, i.e. screening tools and questionnaires, quantitative sensory testing (QST), microneurography, reflexes and evoked potentials, functional neuroimaging and skin biopsy. Pertinent studies were rated for evidence level according to EFNS rules [2] whenever applicable; in some instances, such as

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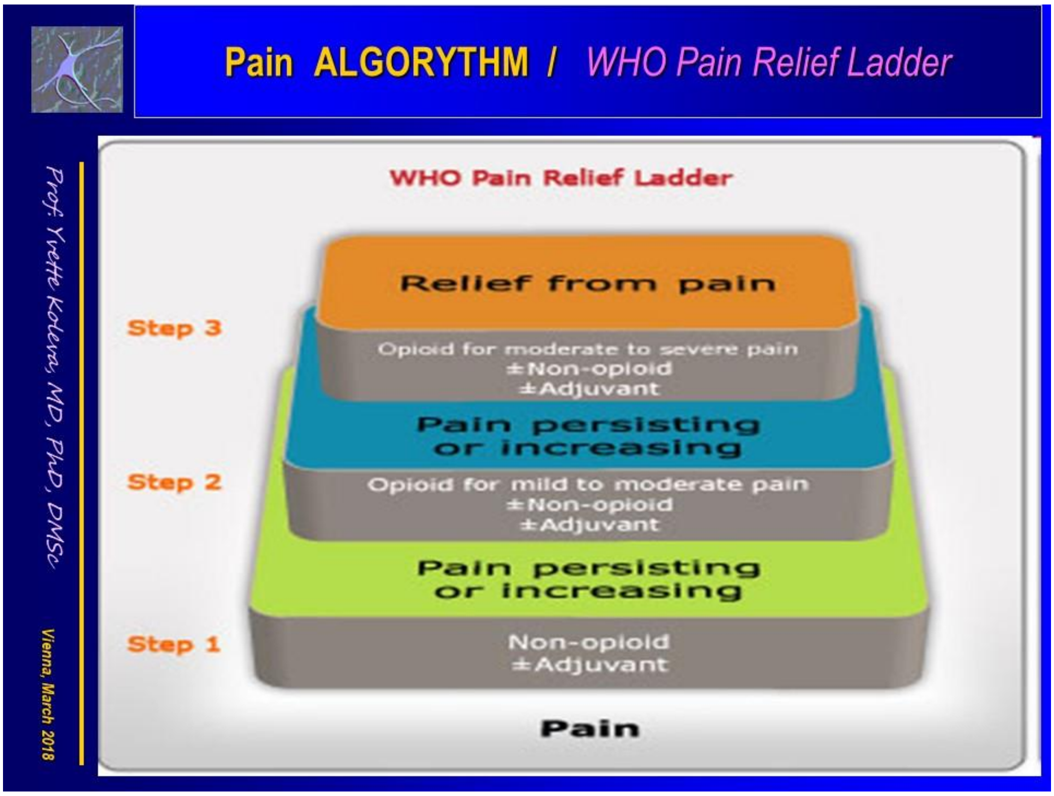

European Journal of Neurology 2010, 17: 1113–1123 doi:10.1111/j.1468-1331.2010.02999.x

EFNS GUIDELINES

EFNS guidelines on the pharmacological treatment of neuropathic pain: 2010 revision

N. Attal[a,b], G. Cruccu[a,c], R. Baron[a,d], M. Haanpää[a,e], P. Hansson[a,f], T. S. Jensen[a,g] and T. Nurmikko[a,h]

[a]EFNS Panel Neuropathic Pain; [b]INSERM U987, Centre d'Evaluation et de Traitement de la Douleur, Hôpital Ambroise Paré, APHP, Boulogne-Billancourt, and Université Versailles-Saint-Quentin, Versailles, France; [c]Department of Neurological Sciences, La Sapienza University, Rome, Italy; [d]Division of Neurological Pain Research and Therapy, Department of Neurology, Universitätsklinikum Schleswig-Holstein, Kiel, Germany; [e]Rehabilitation ORTON and Department of Neurosurgery, Helsinki University Hospital, Helsinki, Finland; [f]Department of Molecular Medicine and Surgery, Clinical Pain Research and Pain Center, Department of Neurosurgery, Karolinska Institutet/University Hospital, Stockholm, Sweden; [g]Department of Neurology and Danish Pain Research Center, Aarhus University Hospital, Aarhus, Denmark; and [h]Pain Research Institute, Neuroscience Research Unit, School of Clinical Sciences, University of Liverpool, Liverpool, UK

Keywords: neuropathic pain, painful diabetic polyneuropathy, post-herpetic neuralgia, trigeminal neuralgia, central neuropathic pain, evidence-based recommendations, pharmacological treatment, randomized clinical trials

Received 13 October 2009
Accepted 2 February 2010

Background and objectives: This second European Federation of Neurological Societies Task Force aimed at updating the existing evidence about the pharmacological treatment of neuropathic pain since 2005.
Methods: Studies were identified using the Cochrane Database and Medline. Trials were classified according to the aetiological condition. All class I and II randomized controlled trials (RCTs) were assessed; lower class studies were considered only in conditions that had no top-level studies. Treatments administered using repeated or single administrations were considered, provided they are feasible in an outpatient setting.
Results: Most large RCTs included patients with diabetic polyneuropathies and post-herpetic neuralgia, while an increasing number of smaller studies explored other conditions. Drugs generally have similar efficacy in various conditions, except in trigeminal neuralgia, chronic radiculopathy and HIV neuropathy, with level A evidence in support of tricyclic antidepressants (TCA), pregabalin, gabapentin, tramadol and opioids (in various conditions), duloxetine, venlafaxine, topical lidocaine and capsaicin patches (in restricted conditions). Combination therapy appears useful for TCA-gabapentin and gabapentin-opioids (level A).
Conclusions: There are still too few large-scale comparative studies. For future trials, we recommend to assess comorbidities, quality of life, symptoms and signs with standardized tools and attempt to better define responder profiles to specific drug treatments.

Background and objectives

Neuropathic pain (NP) may be caused by a lesion or a disease of the somatosensory system [1] and is estimated to afflict as high as 7–8% of the general population in Europe [2,3]. The management of NP is challenging because the response to most drugs remains unpredictable [4] despite attempts to develop a more rationale therapeutic approach [5,6]. In 2006, the European Federation of Neurological Societies (EFNS) produced the first guidelines on pharmacological treatment of NP [7]. Since 2006, new randomized controlled trials (RCTs) have appeared in various NP conditions, justifying an update.

The objectives of our revised Task Force were (i) to examine all the RCTs performed in various NP conditions since 2005, (ii) to propose recommendations aiming at helping clinicians in their treatment choice for most NP conditions, and (iii) to propose studies that may clarify unresolved issues.

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Methods

We conducted an initial search of the Cochrane Library from 2005. Whenever the Cochrane search failed to

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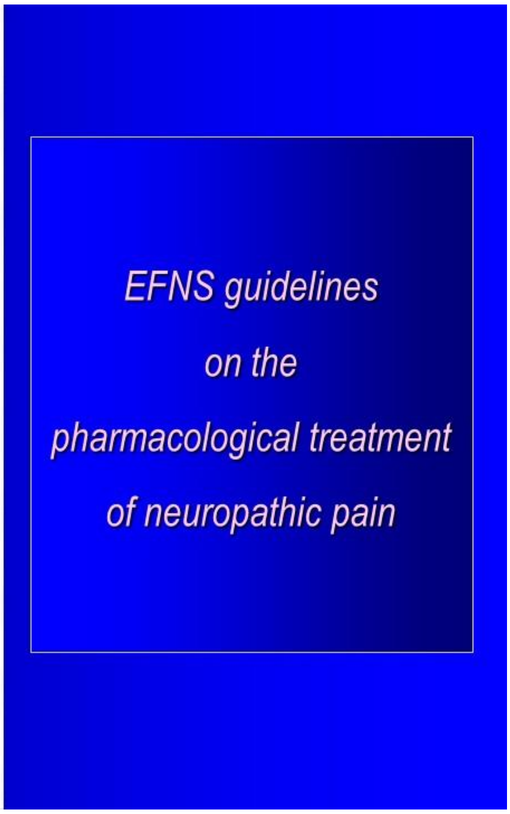

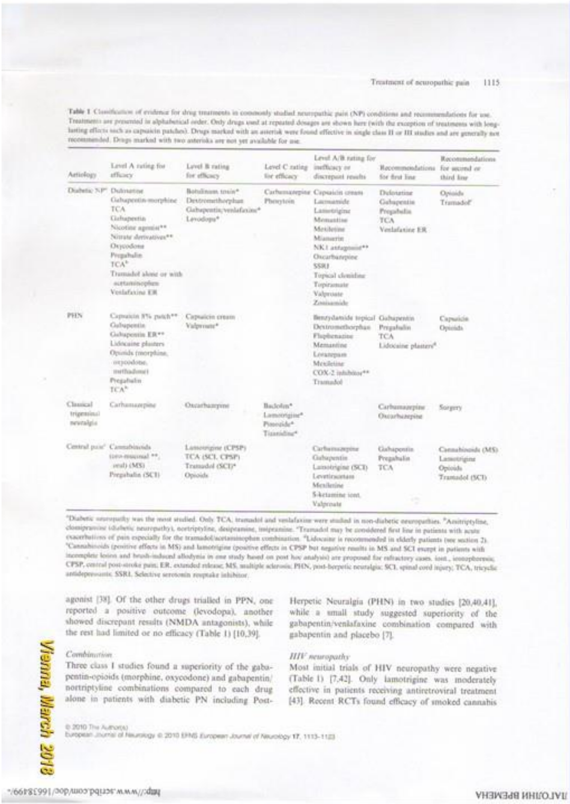

Treatment of neuropathic pain 1115

Table 1 Classification of evidence for drug treatments in commonly studied neuropathic pain (NP) conditions and recommendations for use. Treatments are presented in alphabetical order. Only drugs used at repeated dosages are shown here (with the exception of treatments with long-lasting effects such as capsaicin patches). Drugs marked with an asterisk were found effective in single class II or III studies and are generally not recommended. Drugs marked with two asterisks are not yet available for use.

Aetiology	Level A rating for efficacy	Level B rating for efficacy	Level C rating for efficacy	Level A/B rating for inefficacy or discrepant results	Recommendations for first line	Recommendations for second or third line
Diabetic NP[a]	Duloxetine Gabapentin-morphine TCA Gabapentin Nicotine agonist** Nitrate derivatives** Oxycodone Pregabalin TCA[b] Tramadol alone or with acetaminophen Venlafaxine ER	Botulinum toxin* Dextromethorphan Gabapentin/venlafaxine* Levodopa*	Carbamazepine Phenytoin	Capsaicin cream Lacosamide Lamotrigine Memantine Mexiletine Mianserin NK1 antagonist** Oxcarbazepine SSRI Topical clonidine Topiramate Valproate Zonisamide	Duloxetine Gabapentin Pregabalin TCA Venlafaxine ER	Opioids Tramadol[c]
PHN	Capsaicin 8% patch** Gabapentin Gabapentin ER** Lidocaine plasters Opioids (morphine, oxycodone, methadone) Pregabalin TCA[b]	Capsaicin cream Valproate*		Benzydamide topical Dextromethorphan Fluphenazine Memantine Lorazepam Mexiletine COX-2 inhibitor** Tramadol	Gabapentin Pregabalin TCA Lidocaine plasters[d]	Capsaicin Opioids
Classical trigeminal neuralgia	Carbamazepine	Oxcarbazepine	Baclofen* Lamotrigine* Pimozide* Tizanidine*		Carbamazepine Oxcarbazepine	Surgery
Central pain[e]	Cannabinoids (oro-mucosal **, oral) (MS) Pregabalin (SCI)	Lamotrigine (CPSP) TCA (SCI, CPSP) Tramadol (SCI)* Opioids		Carbamazepine Gabapentin Lamotrigine (SCI) Levetiracetam Mexiletine S-ketamine iont. Valproate	Gabapentin Pregabalin TCA	Cannabinoids (MS) Lamotrigine Opioids Tramadol (SCI)

[a]Diabetic neuropathy was the most studied. Only TCA, tramadol and venlafaxine were studied in non-diabetic neuropathies. [b]Amitriptyline, clomipramine (diabetic neuropathy), nortriptyline, desipramine, imipramine. [c]Tramadol may be considered first line in patients with acute exacerbations of pain especially for the tramadol/acetaminophen combination. [d]Lidocaine is recommended in elderly patients (see section 2). [e]Cannabinoids (positive effects in MS) and lamotrigine (positive effects in CPSP but negative results in MS and SCI except in patients with incomplete lesion and brush-induced allodynia in one study based on post hoc analysis) are proposed for refractory cases. iont., iontophoresis; CPSP, central post-stroke pain; ER, extended release; MS, multiple sclerosis; PHN, post-herpetic neuralgia; SCI, spinal cord injury; TCA, tricyclic antidepressants; SSRI, Selective serotonin reuptake inhibitor.

agonist [38]. Of the other drugs trialled in PPN, one reported a positive outcome (levodopa), another showed discrepant results (NMDA antagonists), while the rest had limited or no efficacy (Table 1) [10,39].

Combination

Three class I studies found a superiority of the gabapentin-opioids (morphine, oxycodone) and gabapentin/nortriptyline combinations compared to each drug alone in patients with diabetic PN including Post-Herpetic Neuralgia (PHN) in two studies [20,40,41], while a small study suggested superiority of the gabapentin/venlafaxine combination compared with gabapentin and placebo [7].

HIV neuropathy

Most initial trials of HIV neuropathy were negative (Table 1) [7,42]. Only lamotrigine was moderately effective in patients receiving antiretroviral treatment [43]. Recent RCTs found efficacy of smoked cannabis

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Table 2 Classification of evidence for drug treatments in less commonly studied neuropathic pain (NP) conditions. Treatments are presented in alphabetical order. Drugs marked with an asterisk were found effective in single class II studies

Aetiology of NP	Level A rating for efficacy	Level B rating for efficacy	Level A/B rating for inefficacy/poor efficacy or discrepant results
HIV neuropathy	Capsaicin 8% patch Smoked cannabis	Lamotrigine	Amitriptyline Capsaicin cream Gabapentin Lidocaine plasters Memantine
Post-traumatic or post-surgical NP		Amitriptyline* Botulinum toxin-A*	Cannabinoids Capsaicin Gabapentin Levetiracetam Propranolol Venlafaxine ER
Chronic radiculo-pathy			Morphine* Nortriptyline* Nortriptyline-morphine * Pregabalin (unpublished) Topiramate Valproate
Cancer NP	Gabapentin	Amitriptyline* Tramadol*	
Phantom pain	Morphine Tramadol		Amitriptyline Gabapentin Memantine Mexiletine
Multi-aetiology NP	Bupropion Cannabinoids (oromucosal, synthetic analogue) Levorphanol	Methadone TCA (nortriptyline, clomipramine)	Amitriptyline/ketamine topical CCK2 antagonists Dextromethorphan Dihydrocodeine Gabapentin[a] Venlafaxine ER[a] Lidocaine plasters Lamotrigine Lidocaine plasters Mexiletine[a] Nabilone Riluzole

[a]These drugs were found effective in some spontaneous NP symptoms (gabapentin) or only on brush-induced or static mechanical allodynia (mexiletine, venlafaxine) in single trials. ER, extended release; TCA, tricyclic antidepressants.

on the primary outcome in a large multicentre trial but improved several secondary outcomes and may be beneficial in a subgroup of patients (level A) although predictors of the response need to be identified [78]; antidepressants have level B evidence, good results were reported for botulinum toxin A, and discrepant or negative results were obtained with other drugs [79,80]. *Radiculopathy*: Pregabalin (level A), TCA and opioids and their combination (level B) are ineffective or slightly effective (the combination TCA/opioids was effective on maximal pain only in one study) [81–83]. *Phantom pain*: Efficacy of tramadol and morphine was reported (level A), while gabapentin induced discrepant results [84,85]. Results in *multi-aetiology NP* are positive mainly for antidepressants (bupropion, TCA), opioids (levorphanol, methadone) and cannabinoids [7,86–92].

Effects on pain symptoms and signs and predictors of the response

Randomized controlled trials increasingly assess symptoms and signs [60] and suggest that drugs (gabapentin, oxycodone, topical lidocaine, cannabinoids) have differential effects on the quality of NP (i.e., burning, deep, paroxysmal) [7,93,94] and that some may alleviate brush-induced and/or static mechanical allodynia based on single trials (TCA, pregabalin, cannabinoids, topical lidocaine, venlafaxine, NMDA antagonists but not lamotrigine) [7,50,87,88,95].

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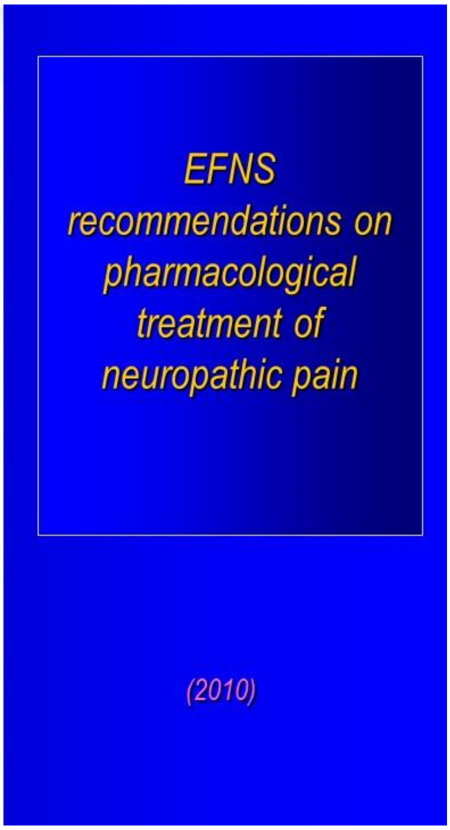


Prof. Yvette Koleva, MD, PhD, DMSc

Vienna, March 2018

ANALGESICS / *OPIOIDS ANALGETICS*

DRUGs		
Morphine		
Codeine		
Fentanyl		
Meperidine		
Methadone		
Propoxyphene		
Levorphanol		
Hydromorphone		
Oxycodone		
Oxymorphone		
Pentazocine		

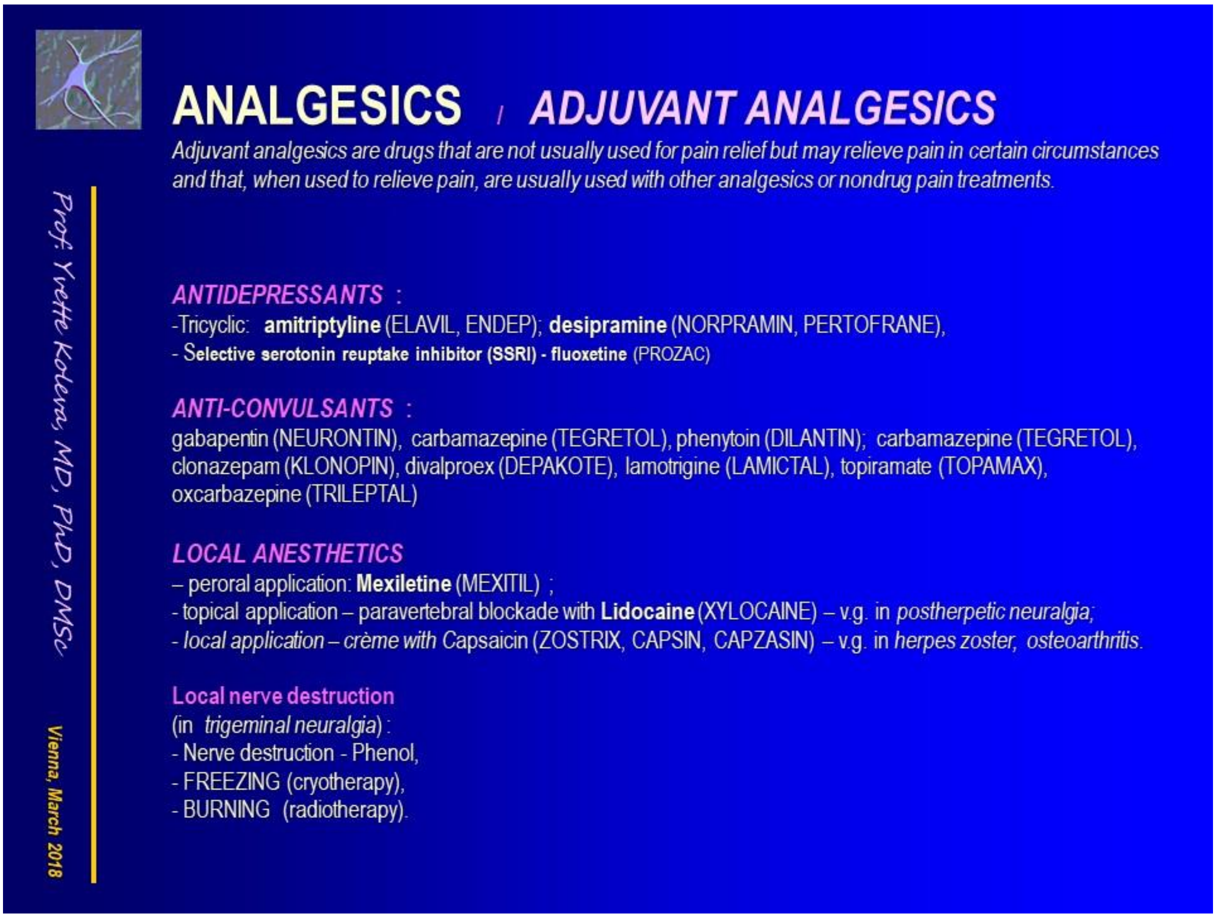
Prof. Yvette Koleva, MD, PhD, DMSc

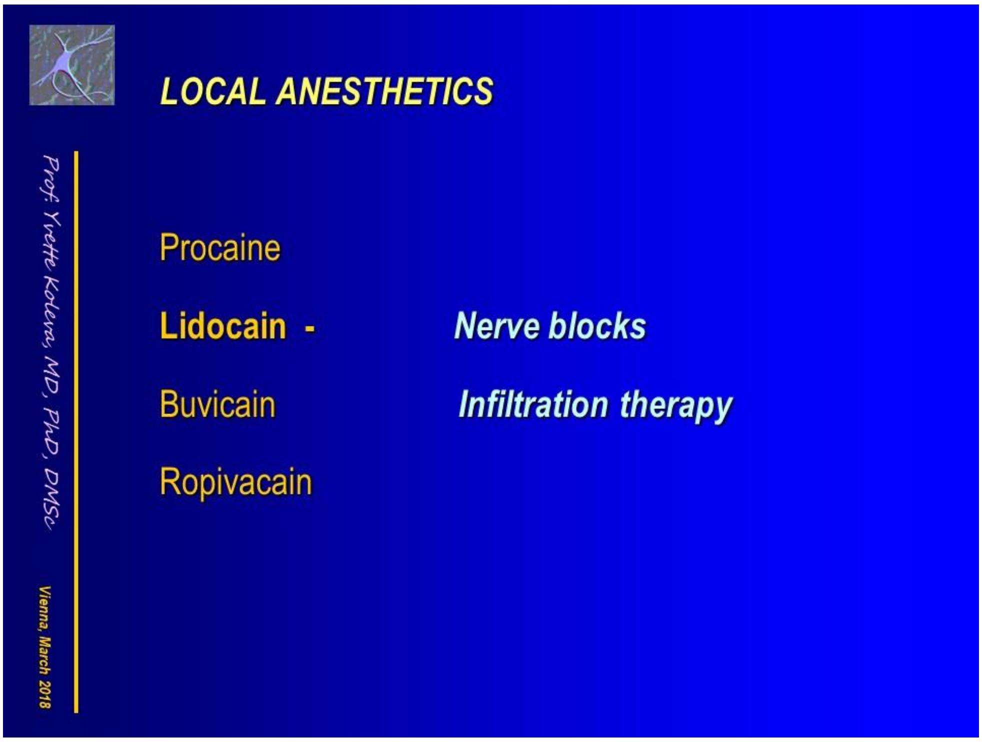
Vienna, March 2018

ANALGESICS / NONOPIOID ANALGESICS

NON-STEROIDE ANTI-INFLAMMATORY DRUGS

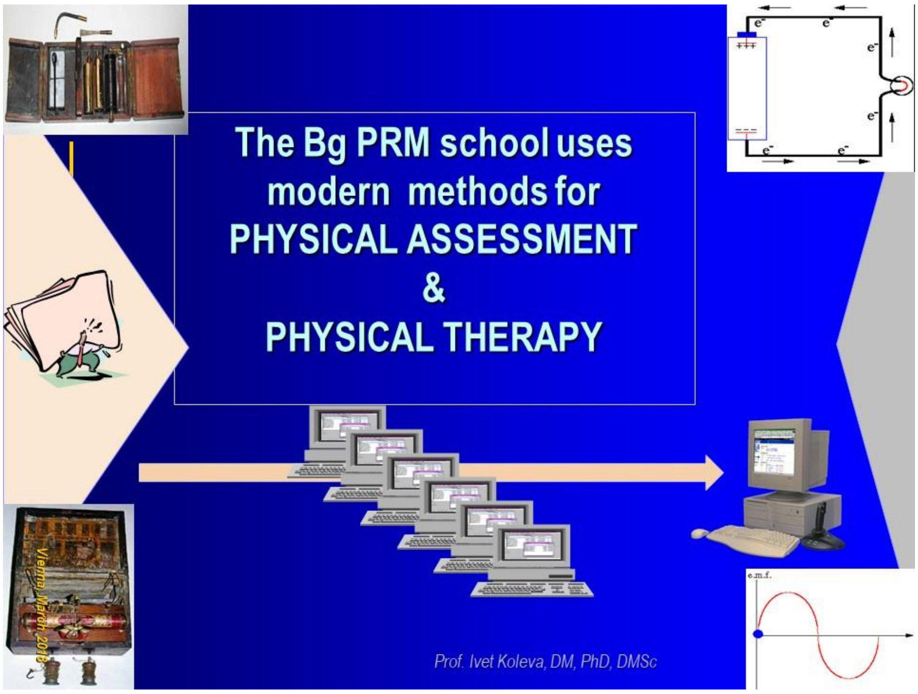
GROUPS	MEDICAMENTS *(commercial name)*
Salycilats	Aspirin Choline magnesium trisalicylate Diflunisal Salsalate
COX-2 inhibitors *Coxibs*	Celecoxib Valdecoxib
Classical drugs *(DICLOFENAC, IBUPROFEN, NAPROXENIC ACID)*	Diclofenac Etodolac Fenoprofen Flurbiprofen Ibuprofen Indomethacin Ketoprofen Ketorolac Meclofenamate Mefenamic acid Meloxicam Nabumetone Naproxen Oxaprozin Piroxicam Sulindac Tolmetin

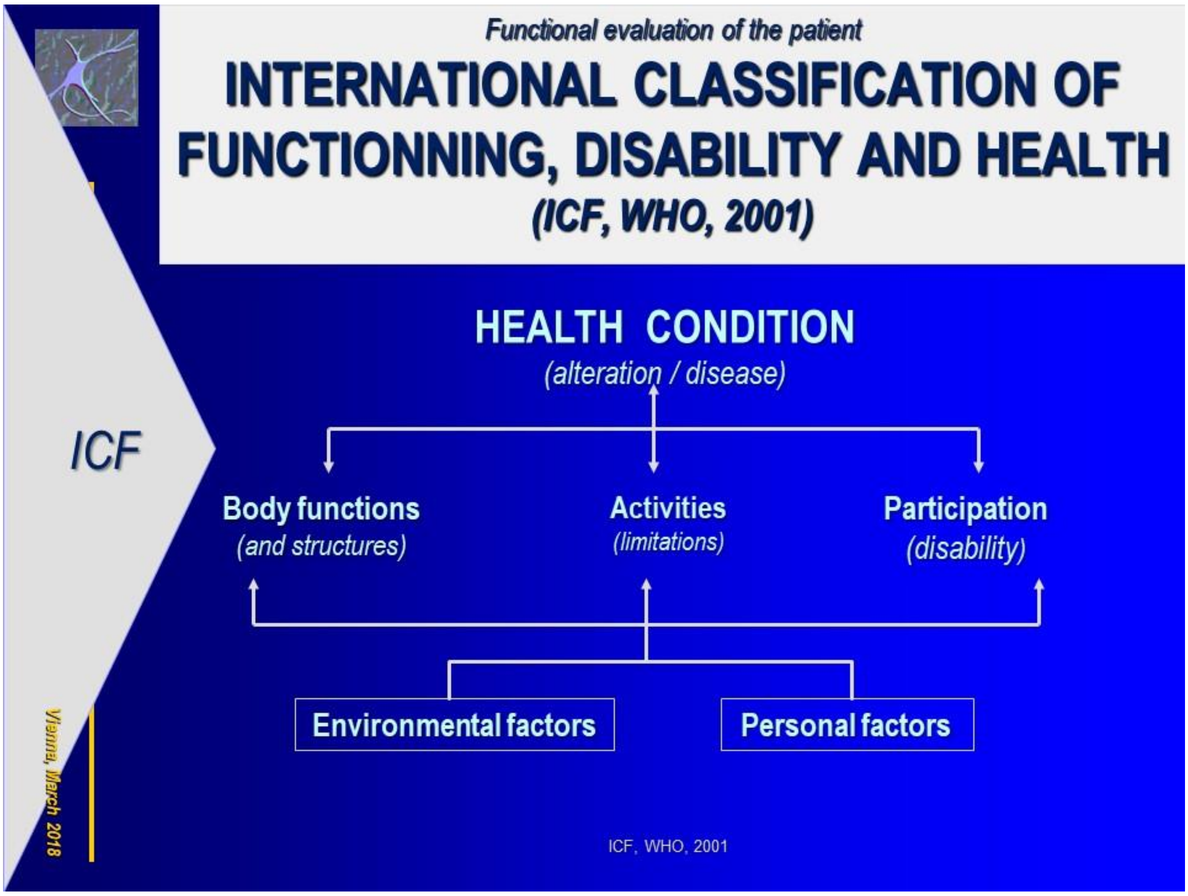

ANALGESICS / ADJUVANT ANALGESICS
Adjuvant analgesics are drugs that are not usually used for pain relief but may relieve pain in certain circumstances and that, when used to relieve pain, are usually used with other analgesics or nondrug pain treatments.
ANTIDEPRESSANTS :
-Tricyclic: amitriptyline (ELAVIL, ENDEP); desipramine (NORPRAMIN, PERTOFRANE),
- Selective serotonin reuptake inhibitor (SSRI) - fluoxetine (PROZAC)
ANTI-CONVULSANTS :
gabapentin (NEURONTIN), carbamazepine (TEGRETOL), phenytoin (DILANTIN); carbamazepine (TEGRETOL), clonazepam (KLONOPIN), divalproex (DEPAKOTE), lamotrigine (LAMICTAL), topiramate (TOPAMAX), oxcarbazepine (TRILEPTAL)
LOCAL ANESTHETICS
– peroral application: Mexiletine (MEXITIL) ;
- topical application – paravertebral blockade with Lidocaine (XYLOCAINE) – v.g. in postherpetic neuralgia;
- local application – crème with Capsaicin (ZOSTRIX, CAPSIN, CAPZASIN) – v.g. in herpes zoster, osteoarthritis.
Local nerve destruction
(in trigeminal neuralgia) :
- Nerve destruction - Phenol,
- FREEZING (cryotherapy),
- BURNING (radiotherapy).
Prof. Yvette Koleva, MD, PhD, DMSc
Vienna, March 2018


LOCAL ANESTHETICS
Procaine
Lidocain - Nerve blocks
Buvicain Infiltration therapy
Ropivacain
Prof. Yvette Koleva, MD, PhD, DMSc
Vienna, March 2018

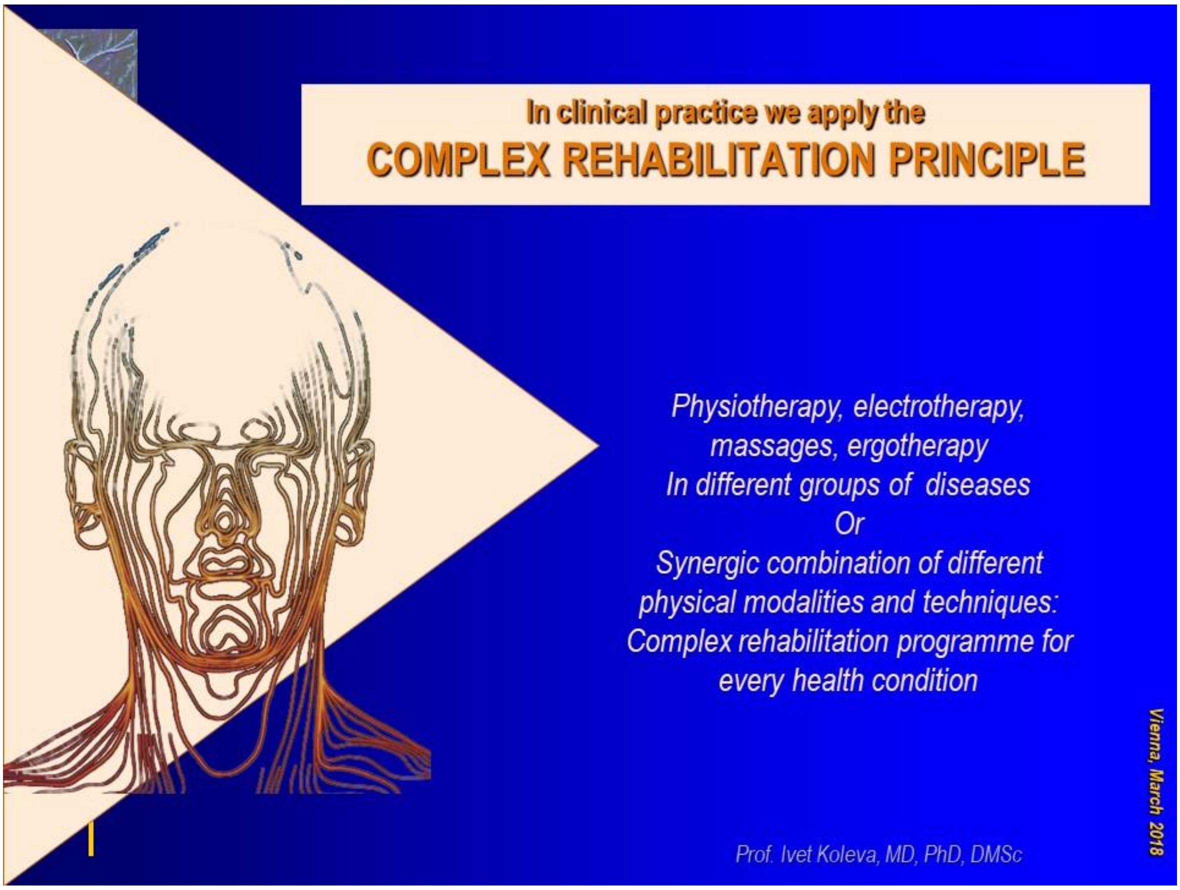

PAIN
MANAGEMENT
Treatment of pain
Clinical approach - to treat the reason, the source for pain
Prof. Yvette Koleva, MD, PhD, DMSc
Vienna, March 2018
1992-2018,
Prof. Ivet Koleva, MD, PhD, DMedSc

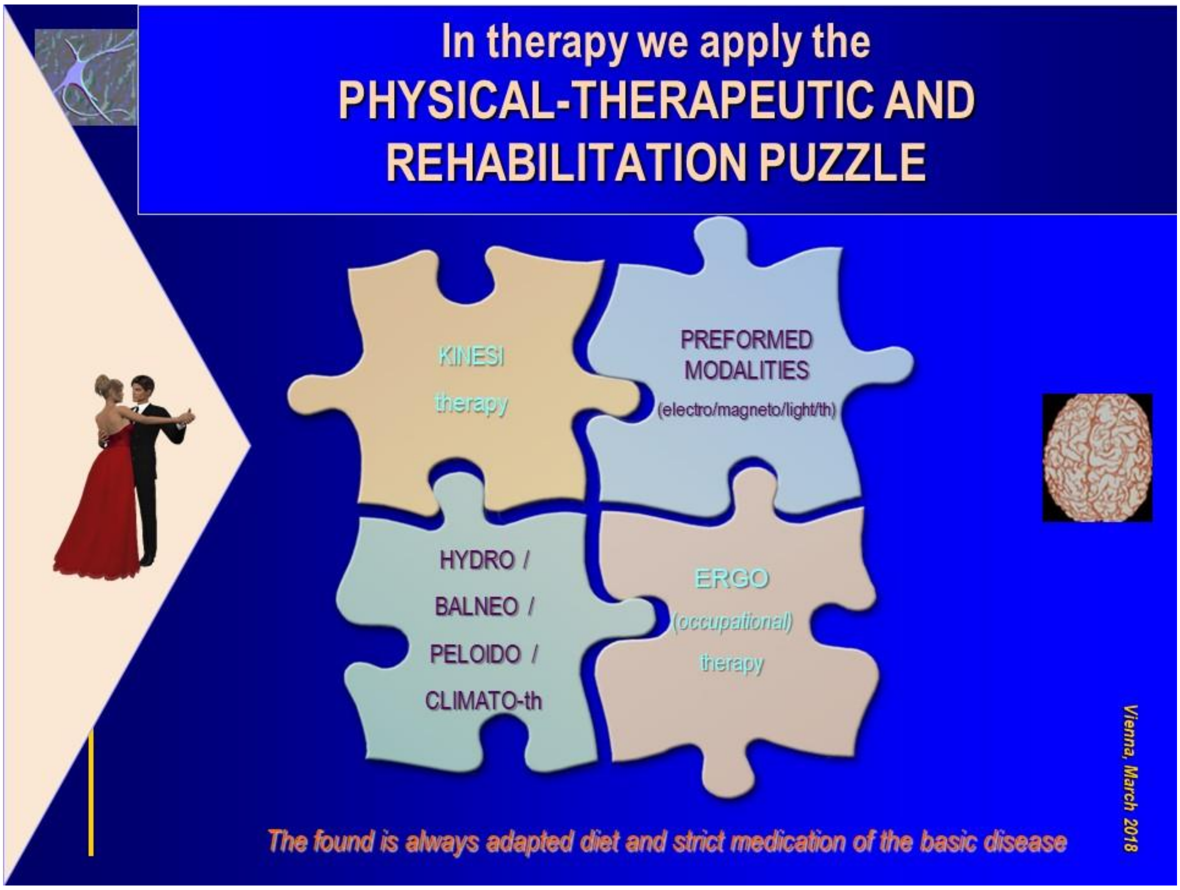

2018
Basic
principles
of
Physical and
Rehabilitation
Medicine
in
Bulgaria
Prof. Ivet Koleva, DM, PhD, DMSc

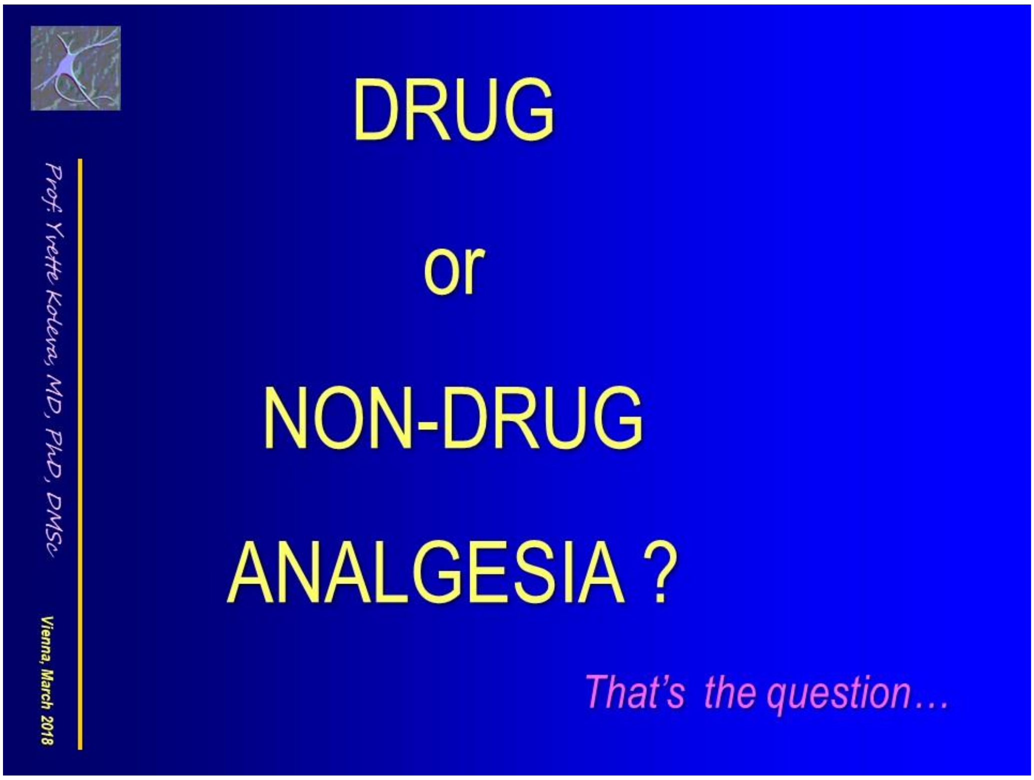

The Bg PRM school uses
modern methods for
PHYSICAL ASSESSMENT
&
PHYSICAL THERAPY
Vienna, March 2018
Prof. Ivet Koleva, DM, PhD, DMSc
e.m.f.

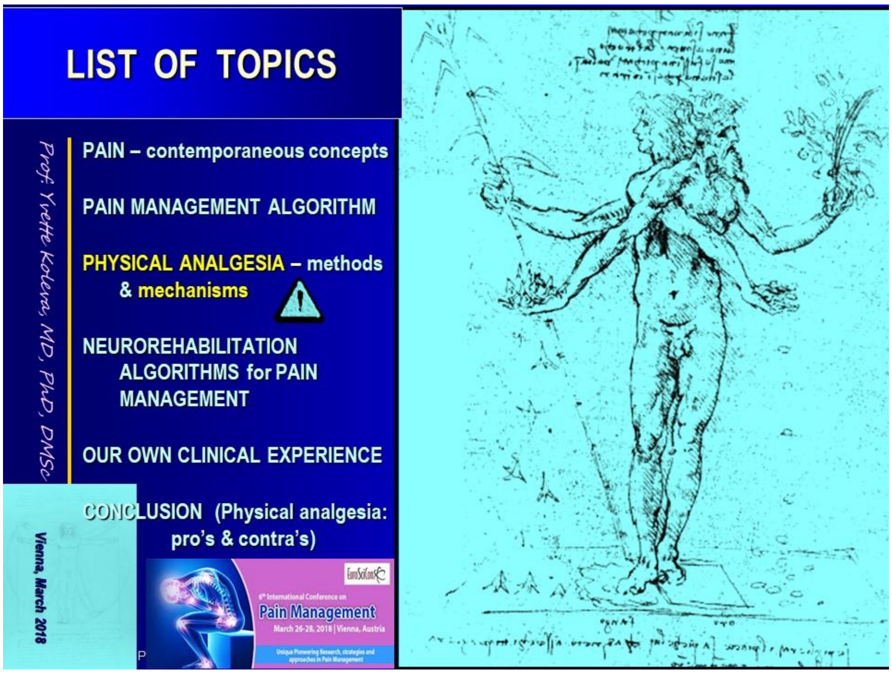

Functional evaluation of the patient
INTERNATIONAL CLASSIFICATION OF
FUNCTIONNING, DISABILITY AND HEALTH
(ICF, WHO, 2001)
ICF
HEALTH CONDITION
(alteration / disease)
Body functions
(and structures)
Activities
(limitations)
Participation
(disability)
Environmental factors
Personal factors
Vienna, March 2018
ICF, WHO, 2001

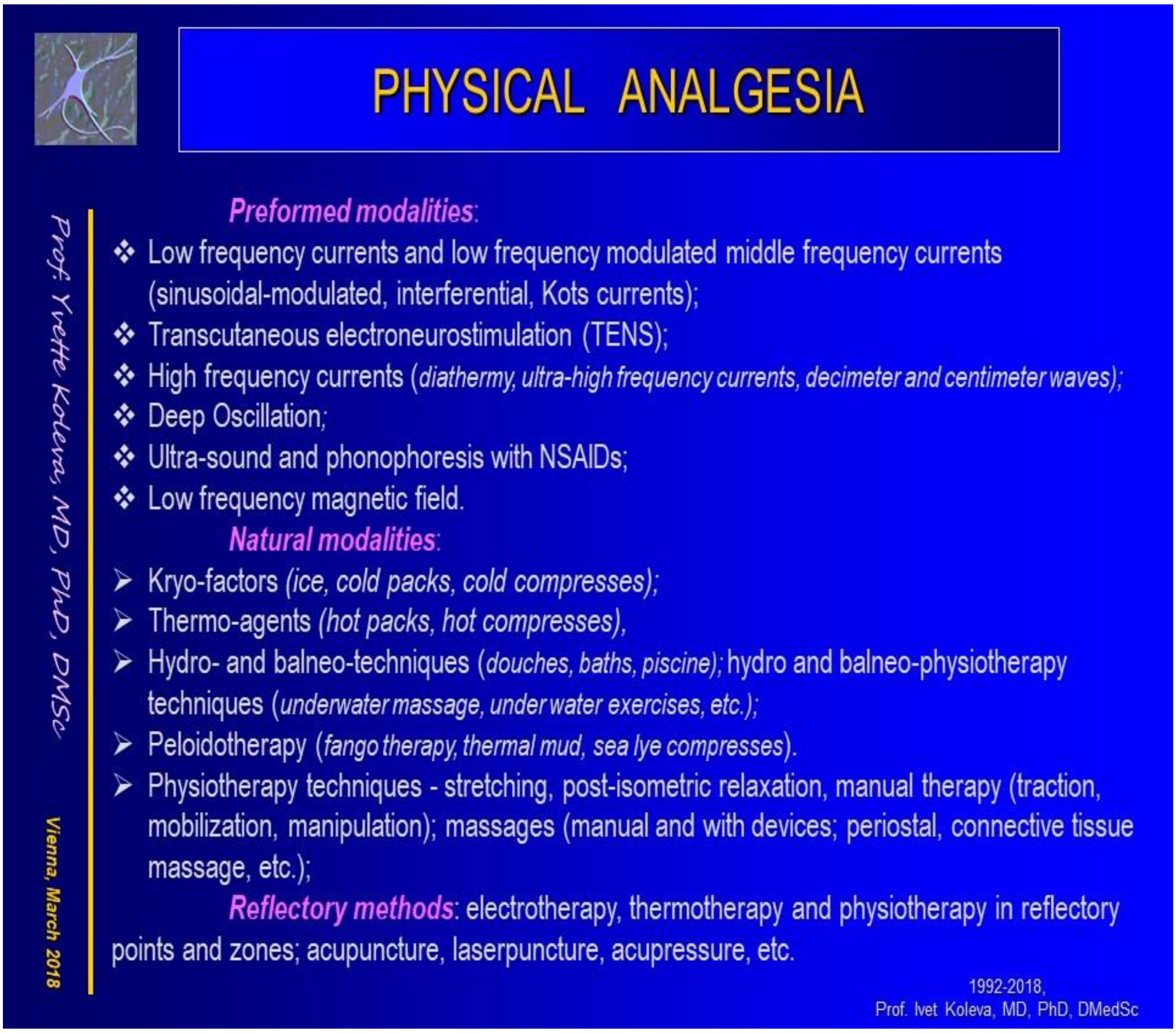

Rehabilitation
principles

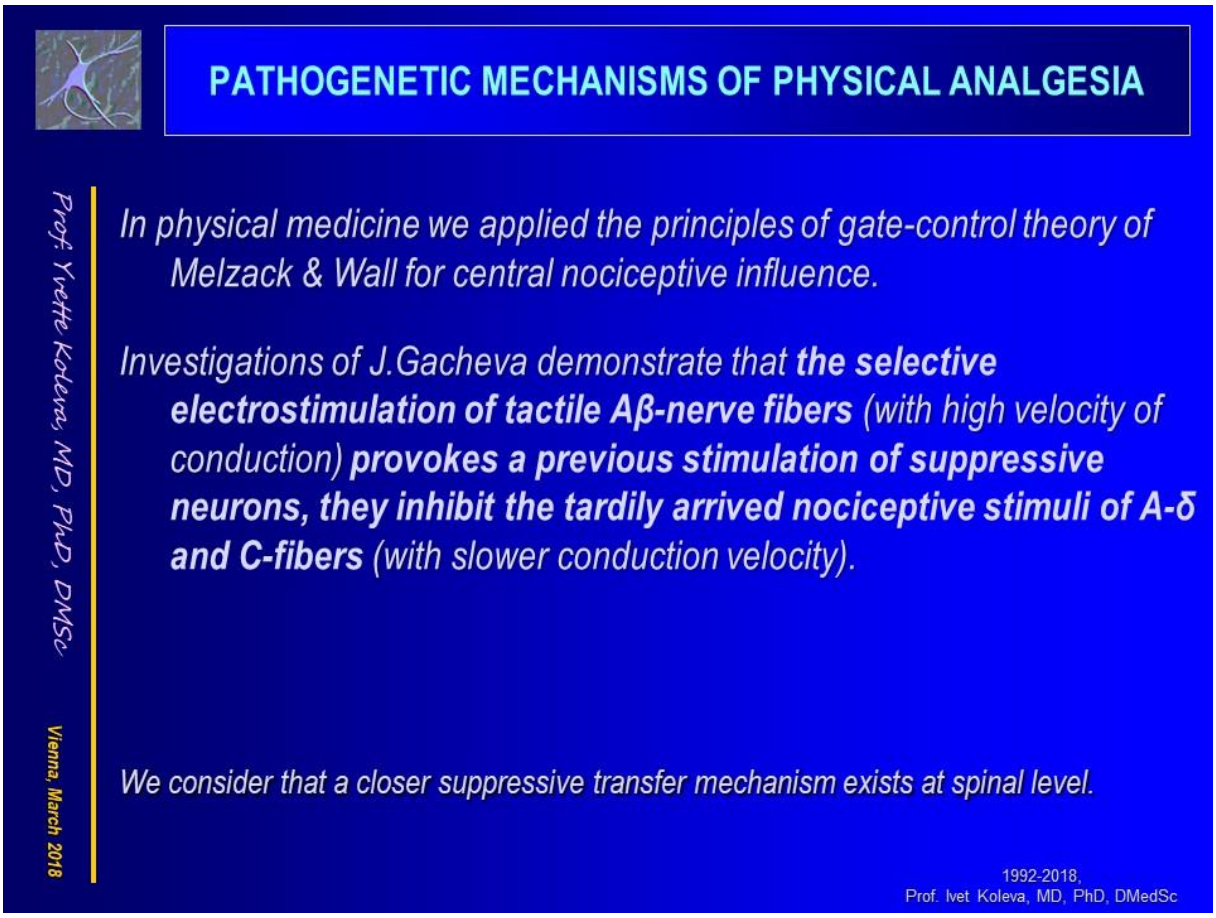

In clinical practice we apply the
COMPLEX REHABILITATION PRINCIPLE
Physiotherapy, electrotherapy,
massages, ergotherapy
In different groups of diseases
Or
Synergic combination of different
physical modalities and techniques:
Complex rehabilitation programme for
every health condition
Vienna, March 2018
Prof. Ivet Koleva, MD, PhD, DMSc

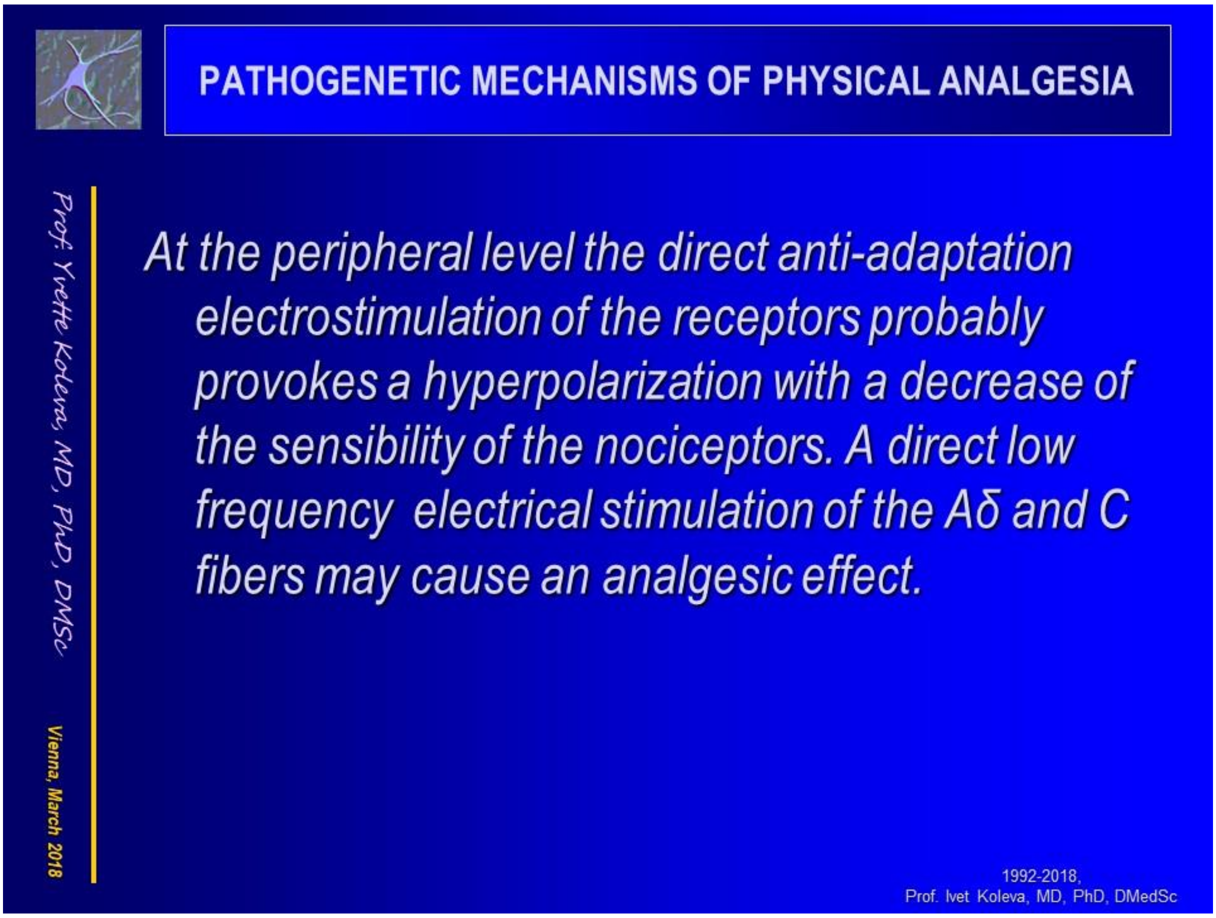

In therapy we apply the
PHYSICAL-THERAPEUTIC AND
REHABILITATION PUZZLE
KINESI
therapy
PREFORMED
MODALITIES
(electro/magneto/light/th)
HYDRO /
BALNEO /
PELOIDO /
CLIMATO-th
ERGO
(occupational)
therapy
The found is always adapted diet and strict medication of the basic disease
Vienna, March 2018


DRUG
or
NON-DRUG
ANALGESIA ?
That's the question…
Prof. Yvette Koleva, MD, PhD, DMSc
Vienna, March 2018

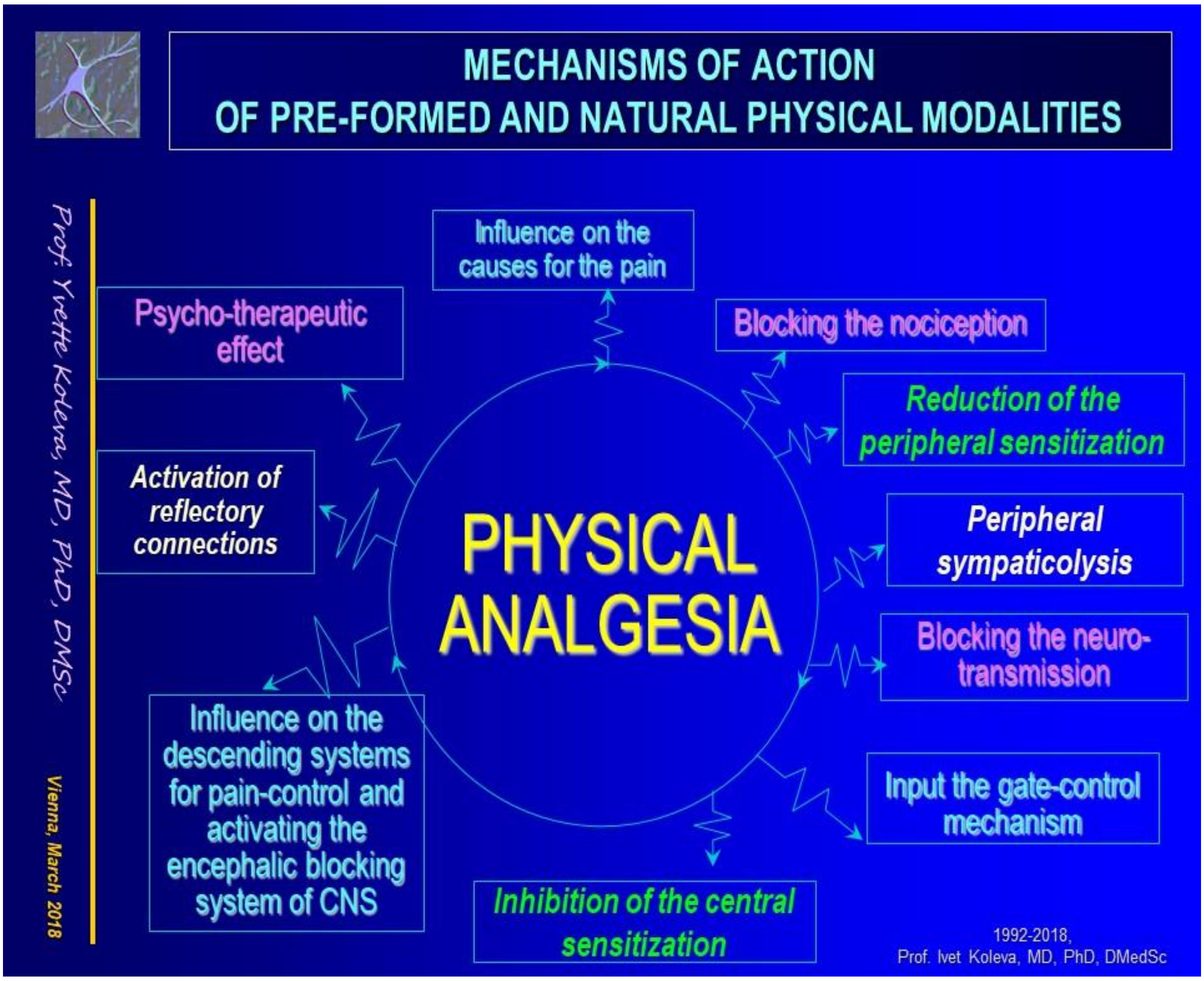

LIST OF TOPICS
Prof. Yvette Koleva, MD, PhD, DMSc
PAIN – contemporaneous concepts
PAIN MANAGEMENT ALGORITHM
PHYSICAL ANALGESIA – methods & mechanisms
NEUROREHABILITATION ALGORITHMS for PAIN MANAGEMENT
OUR OWN CLINICAL EXPERIENCE
CONCLUSION (Physical analgesia: pro's & contra's)
Vienna, March 2018
Pain Management
March 26-28, 2018 | Vienna, Austria

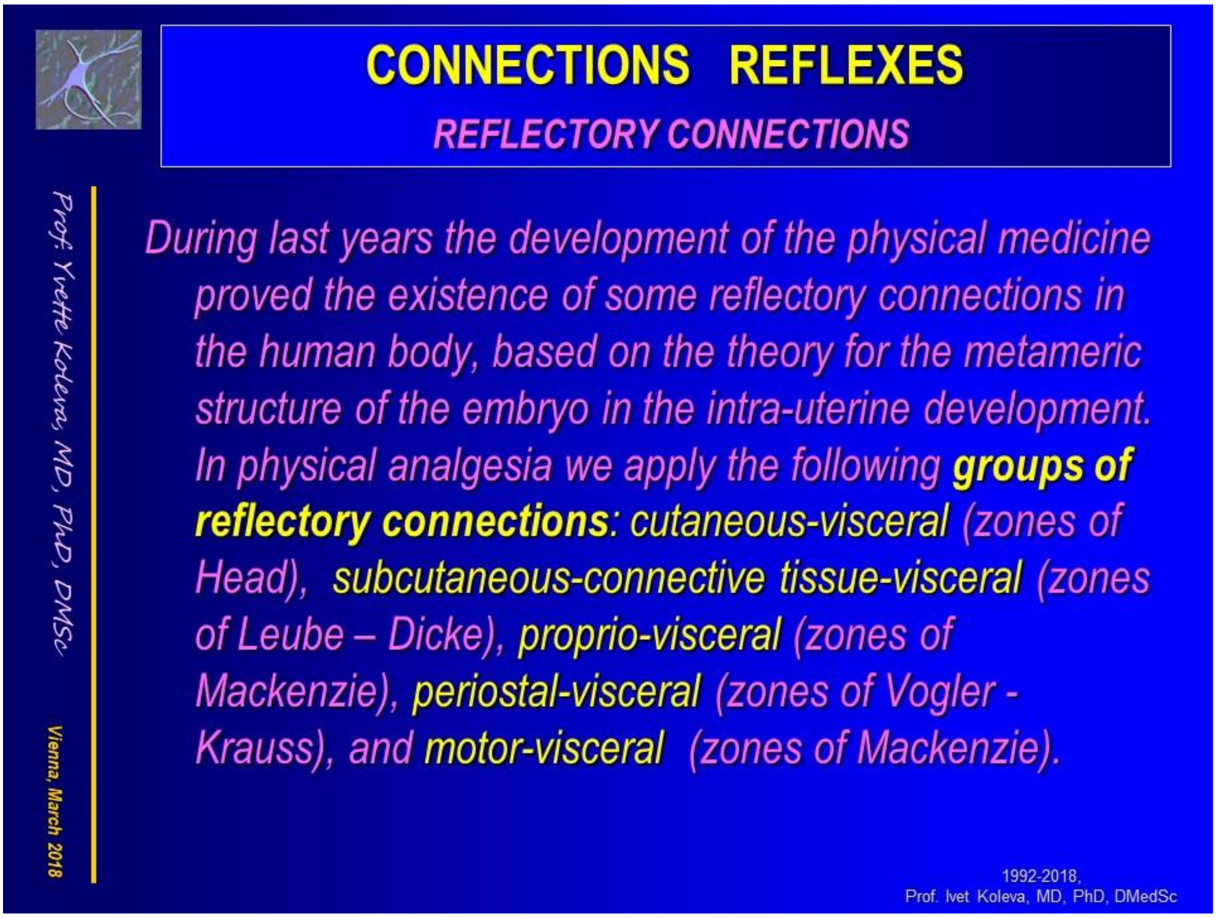

PHYSICAL ANALGESIA
Prof. Yvette Koleva, MD, PhD, DMSc
Preformed modalities:
❖ Low frequency currents and low frequency modulated middle frequency currents (sinusoidal-modulated, interferential, Kots currents);
❖ Transcutaneous electroneurostimulation (TENS);
❖ High frequency currents (diathermy, ultra-high frequency currents, decimeter and centimeter waves);
❖ Deep Oscillation;
❖ Ultra-sound and phonophoresis with NSAIDs;
❖ Low frequency magnetic field.
Natural modalities:
➢ Kryo-factors (ice, cold packs, cold compresses);
➢ Thermo-agents (hot packs, hot compresses),
➢ Hydro- and balneo-techniques (douches, baths, piscine); hydro and balneo-physiotherapy techniques (underwater massage, under water exercises, etc.);
➢ Peloidotherapy (fango therapy, thermal mud, sea lye compresses).
➢ Physiotherapy techniques - stretching, post-isometric relaxation, manual therapy (traction, mobilization, manipulation); massages (manual and with devices; periostal, connective tissue massage, etc.);
Reflectory methods: electrotherapy, thermotherapy and physiotherapy in reflectory points and zones; acupuncture, laserpuncture, acupressure, etc.
Vienna, March 2018
1992-2018,
Prof. Ivet Koleva, MD, PhD, DMedSc

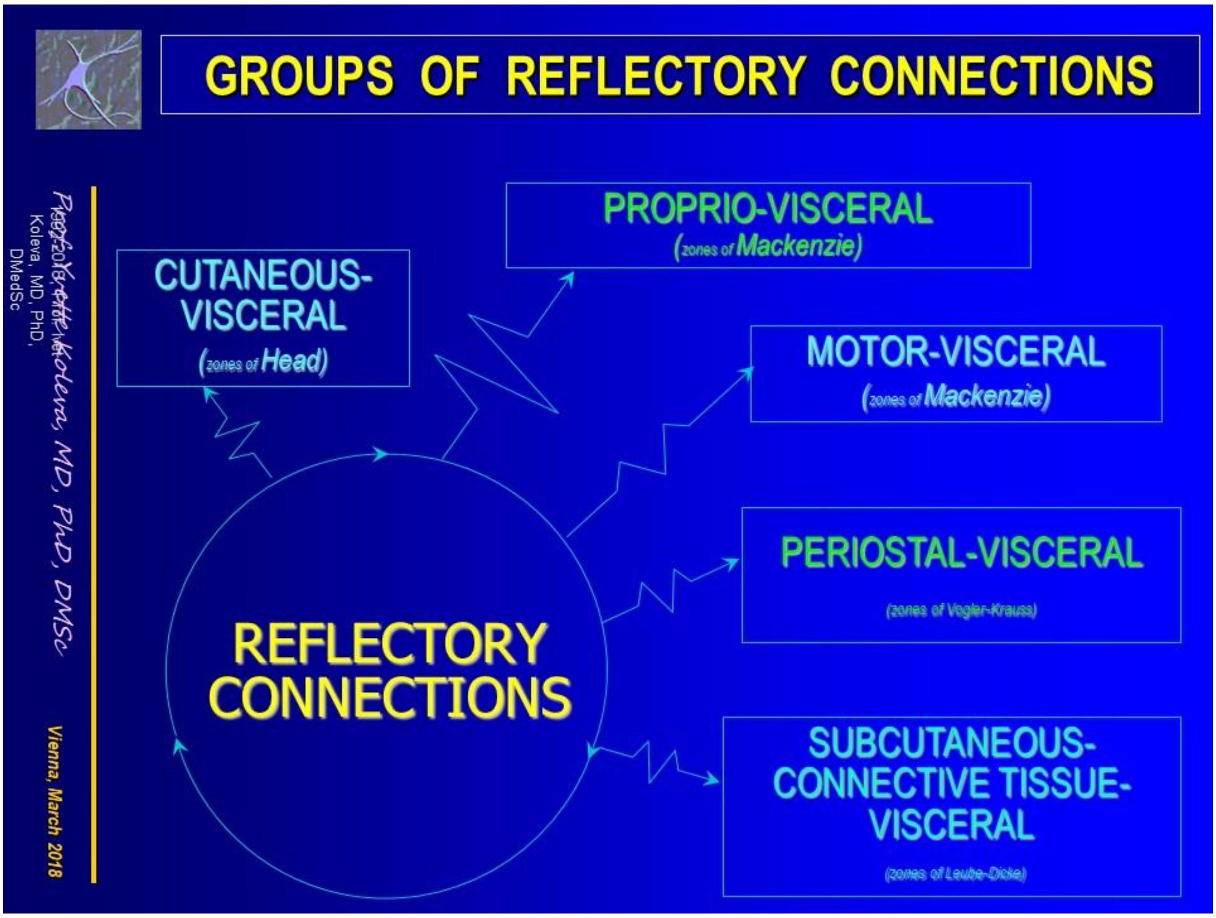

PATHOGENETIC MECHANISMS OF PHYSICAL ANALGESIA
Prof. Yvette Koleva, MD, PhD, DMSc
Vienna, March 2018
In physical medicine we applied the principles of gate-control theory of Melzack & Wall for central nociceptive influence.
Investigations of J.Gacheva demonstrate that the selective electrostimulation of tactile Aβ-nerve fibers (with high velocity of conduction) provokes a previous stimulation of suppressive neurons, they inhibit the tardily arrived nociceptive stimuli of A-δ and C-fibers (with slower conduction velocity).
We consider that a closer suppressive transfer mechanism exists at spinal level.
1992-2018,
Prof. Ivet Koleva, MD, PhD, DMedSc

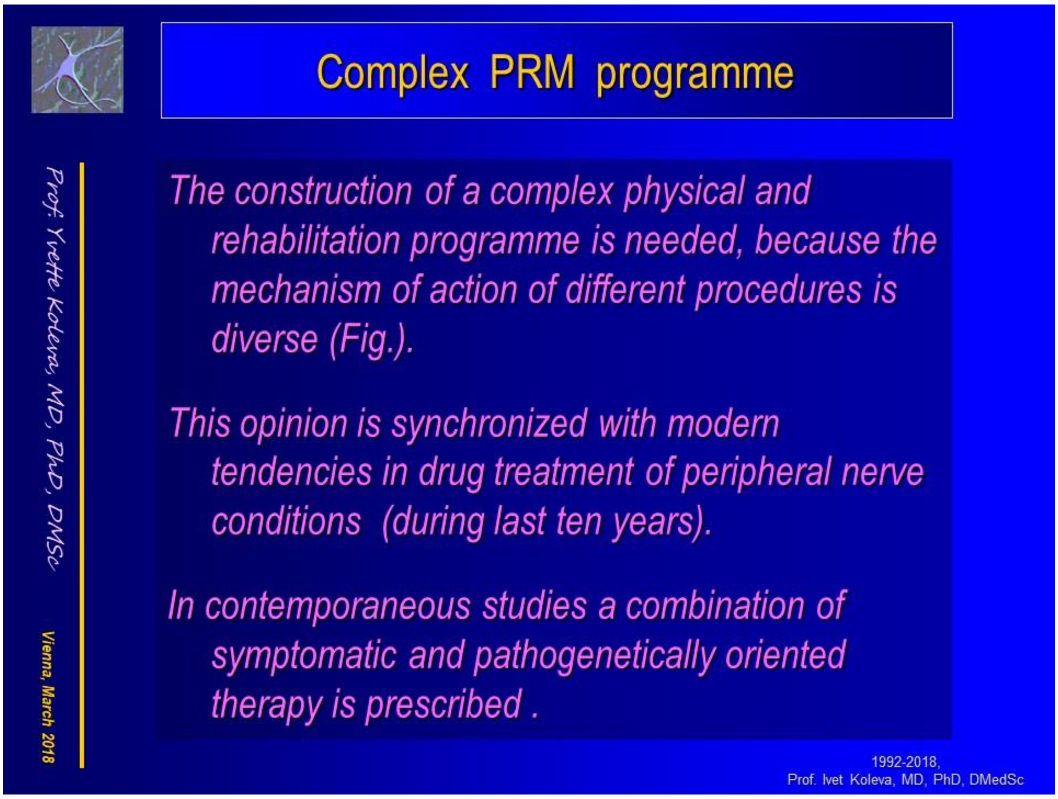

PATHOGENETIC MECHANISMS OF PHYSICAL ANALGESIA
Prof. Yvette Koleva, MD, PhD, DMSc
Vienna, March 2018
At the peripheral level the direct anti-adaptation electrostimulation of the receptors probably provokes a hyperpolarization with a decrease of the sensibility of the nociceptors. A direct low frequency electrical stimulation of the Aδ and C fibers may cause an analgesic effect.
1992-2018,
Prof. Ivet Koleva, MD, PhD, DMedSc

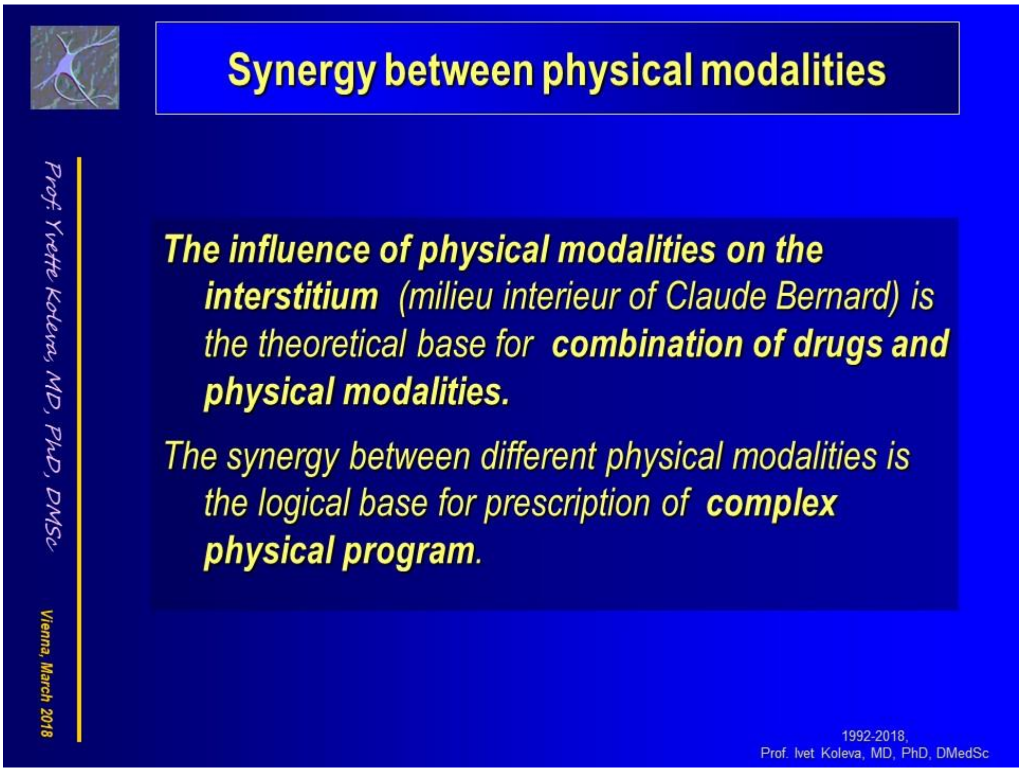

PATHOGENETIC MECHANISMS OF PHYSICAL ANALGESIA
We propose our own theory for explanation of mechanisms of action of physical modalities on the nociceptive and neuropathic pain
[we introduce the notion physical analgesia or anti-pain effect of physical modalities]:
Prof. Yvette Koleva, MD, PhD, DMSc
Vienna, March 2018
1992-2018,
Prof. Ivet Koleva, MD, PhD, DMedSc

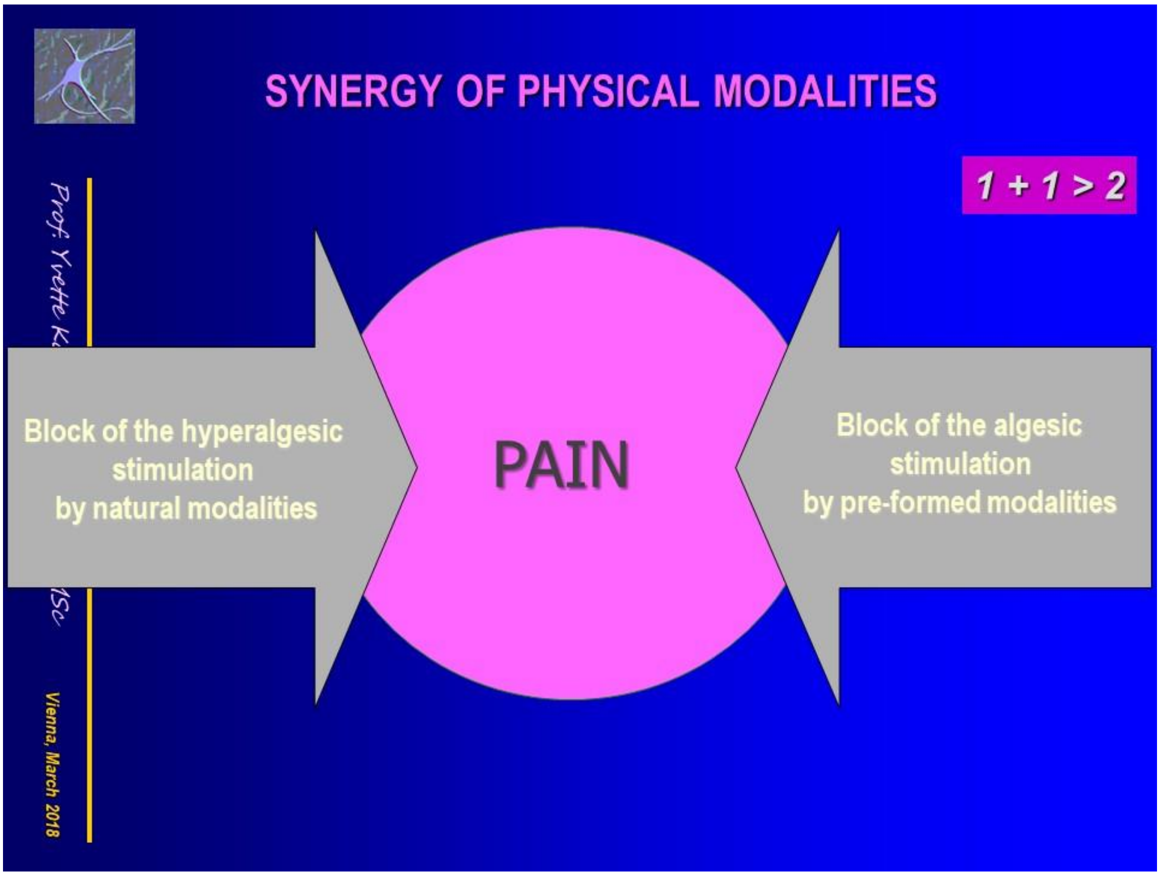

MECHANISMS OF ACTION
OF PRE-FORMED AND NATURAL PHYSICAL MODALITIES
PHYSICAL ANALGESIA
Influence on the causes for the pain
Blocking the nociception
Reduction of the peripheral sensitization
Peripheral sympaticolysis
Blocking the neuro-transmission
Input the gate-control mechanism
Inhibition of the central sensitization
Influence on the descending systems for pain-control and activating the encephalic blocking system of CNS
Activation of reflectory connections
Psycho-therapeutic effect
Prof. Yvette Koleva, MD, PhD, DMSc
Vienna, March 2018
1992-2018,
Prof. Ivet Koleva, MD, PhD, DMedSc

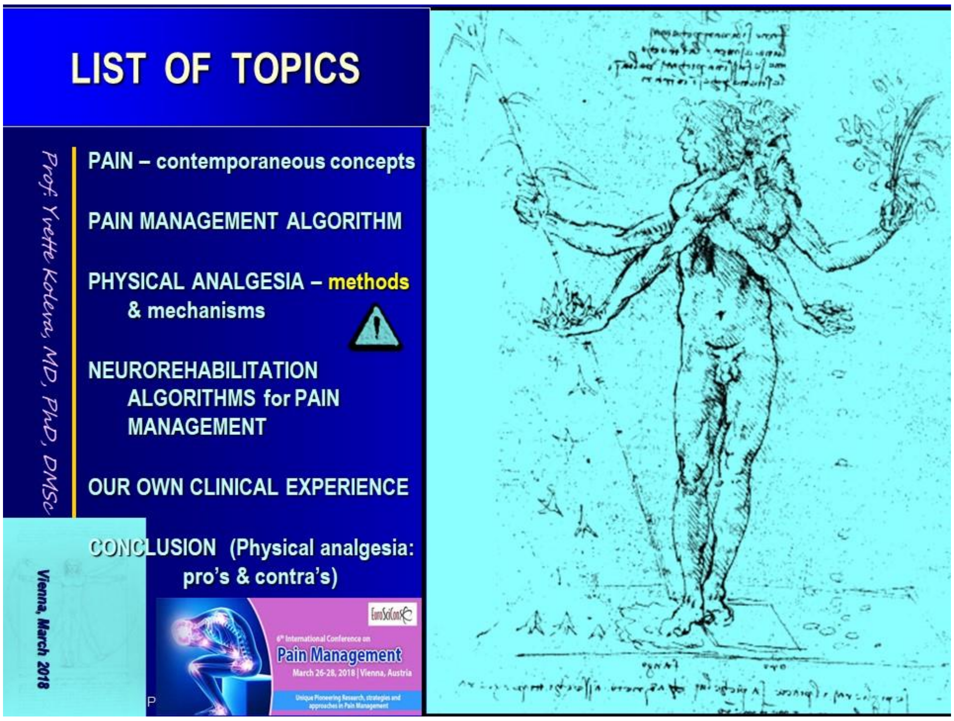

CONNECTIONS REFLEXES
REFLECTORY CONNECTIONS
During last years the development of the physical medicine proved the existence of some reflectory connections in the human body, based on the theory for the metameric structure of the embryo in the intra-uterine development. In physical analgesia we apply the following **groups of reflectory connections**: cutaneous-visceral (zones of Head), subcutaneous-connective tissue-visceral (zones of Leube – Dicke), proprio-visceral (zones of Mackenzie), periostal-visceral (zones of Vogler - Krauss), and motor-visceral (zones of Mackenzie).
Prof. Yvette Koleva, MD, PhD, DMSc
Vienna, March 2018
1992-2018,
Prof. Ivet Koleva, MD, PhD, DMedSc


GROUPS OF REFLECTORY CONNECTIONS
CUTANEOUS-VISCERAL
(zones of Head)
PROPRIO-VISCERAL
(zones of Mackenzie)
MOTOR-VISCERAL
(zones of Mackenzie)
PERIOSTAL-VISCERAL
(zones of Vogler-Krauss)
SUBCUTANEOUS-CONNECTIVE TISSUE-VISCERAL
(zones of Leube-Dicke)
REFLECTORY CONNECTIONS
Prof. Yvette Koleva, MD, PhD, DMSc
Vienna, March 2018


Complex PRM programme
The construction of a complex physical and rehabilitation programme is needed, because the mechanism of action of different procedures is diverse (Fig.).
This opinion is synchronized with modern tendencies in drug treatment of peripheral nerve conditions (during last ten years).
In contemporaneous studies a combination of symptomatic and pathogenetically oriented therapy is prescribed .
Prof. Yvette Koleva, MD, PhD, DMSc
Vienna, March 2018
1992-2018,
Prof. Ivet Koleva, MD, PhD, DMedSc


Synergy between physical modalities
The influence of physical modalities on the interstitium (milieu interieur of Claude Bernard) is the theoretical base for combination of drugs and physical modalities.
The synergy between different physical modalities is the logical base for prescription of complex physical program.
Prof. Yvette Koleva, MD, PhD, DMSc
Vienna, March 2018
1992-2018,
Prof. Ivet Koleva, MD, PhD, DMedSc


SYNERGY OF PHYSICAL MODALITIES
1 + 1 > 2
Block of the hyperalgesic stimulation by natural modalities
PAIN
Block of the algesic stimulation by pre-formed modalities
Vienna, March 2018


LIST OF TOPICS
PAIN – contemporaneous concepts
PAIN MANAGEMENT ALGORITHM
PHYSICAL ANALGESIA – methods & mechanisms
NEUROREHABILITATION ALGORITHMS for PAIN MANAGEMENT
OUR OWN CLINICAL EXPERIENCE
CONCLUSION (Physical analgesia: pro's & contra's)
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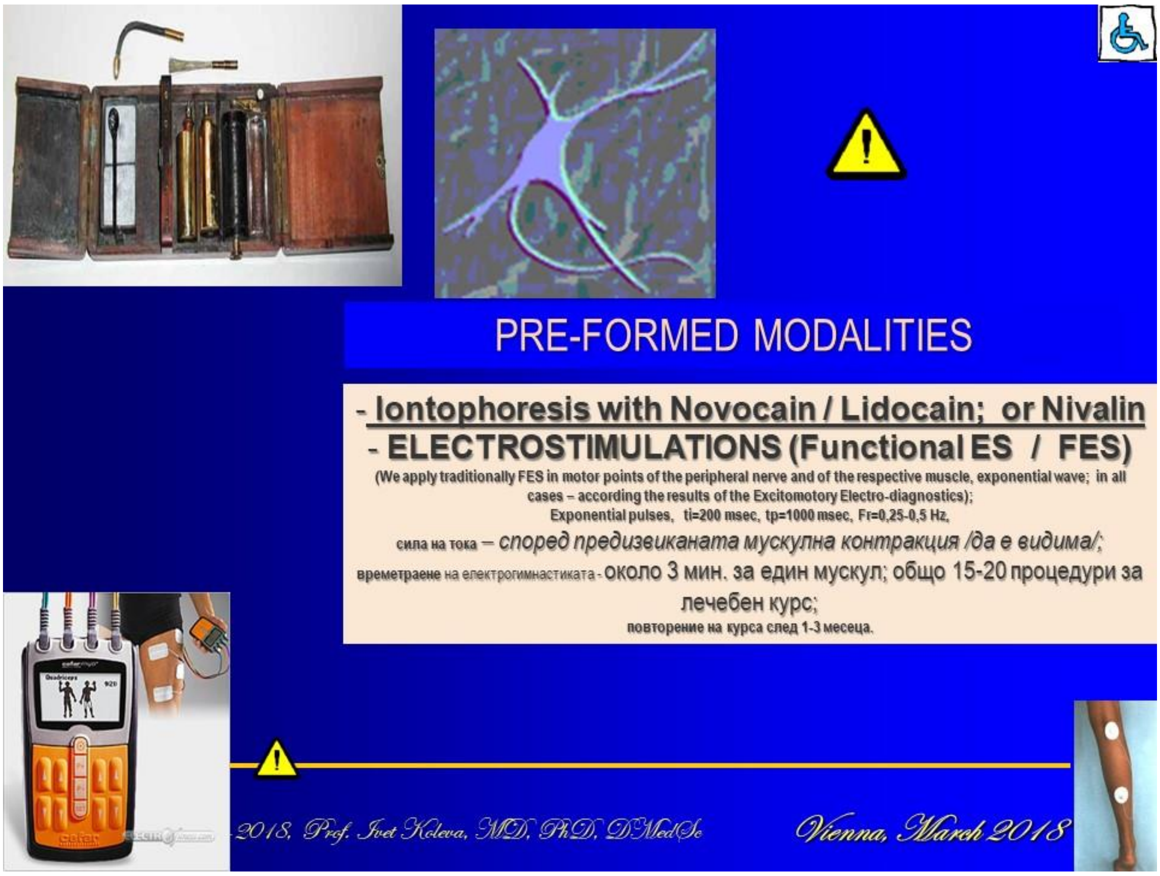
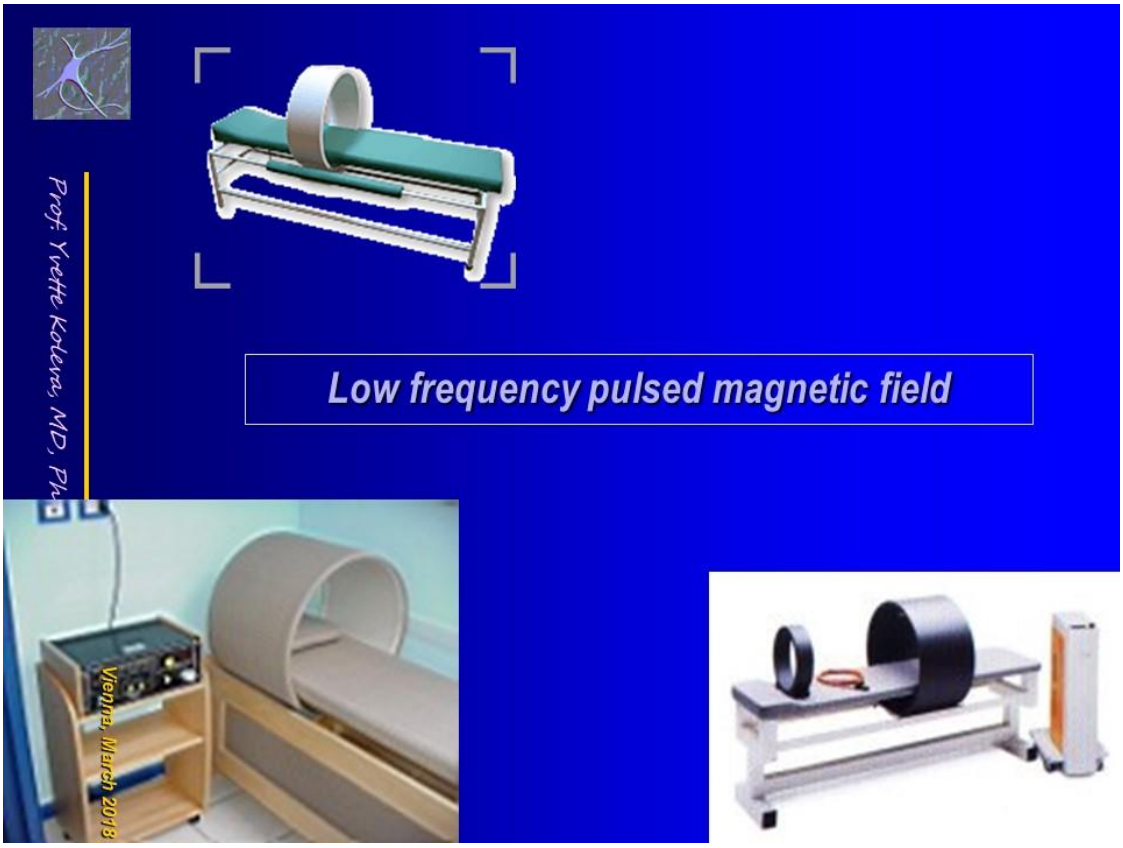
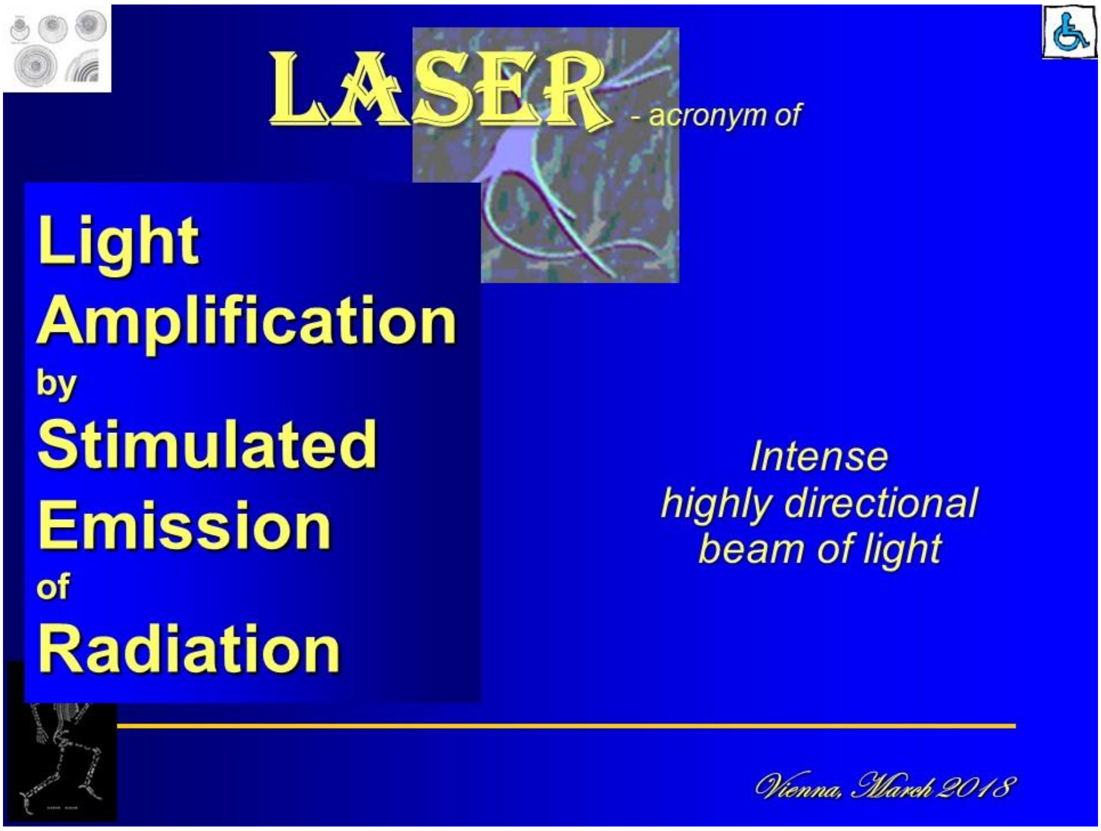
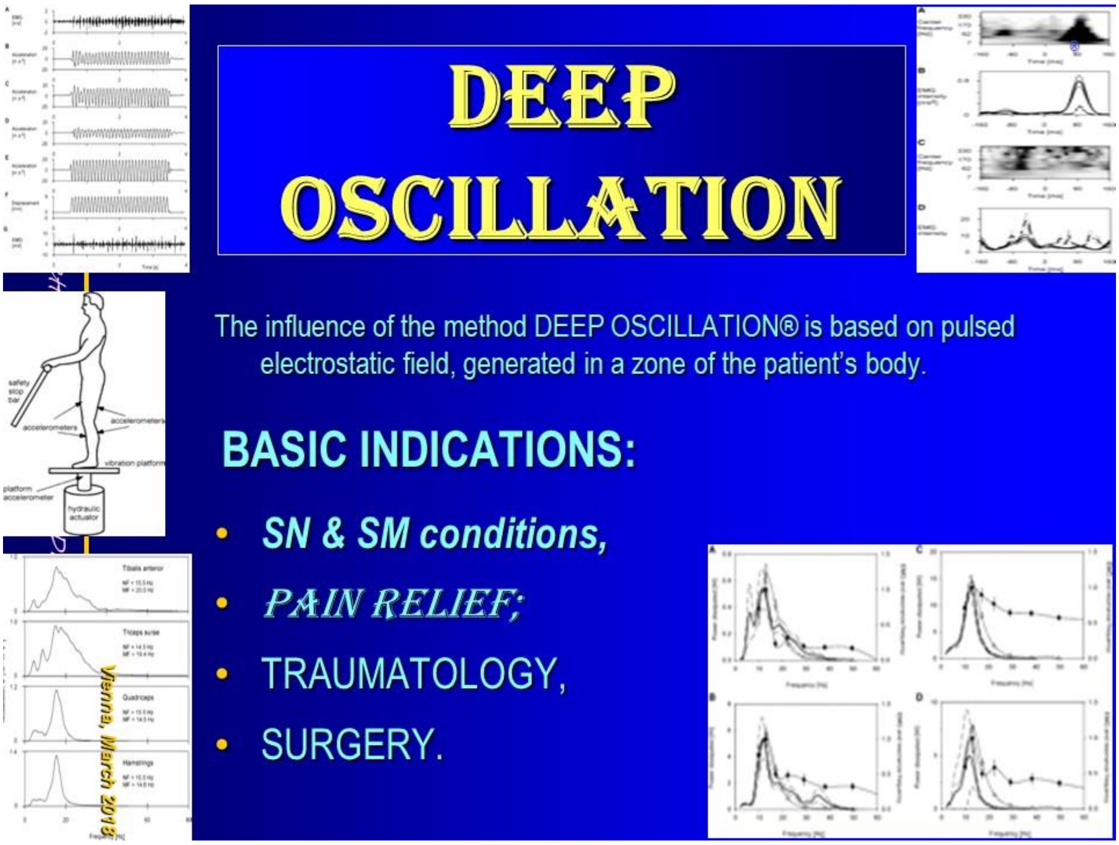
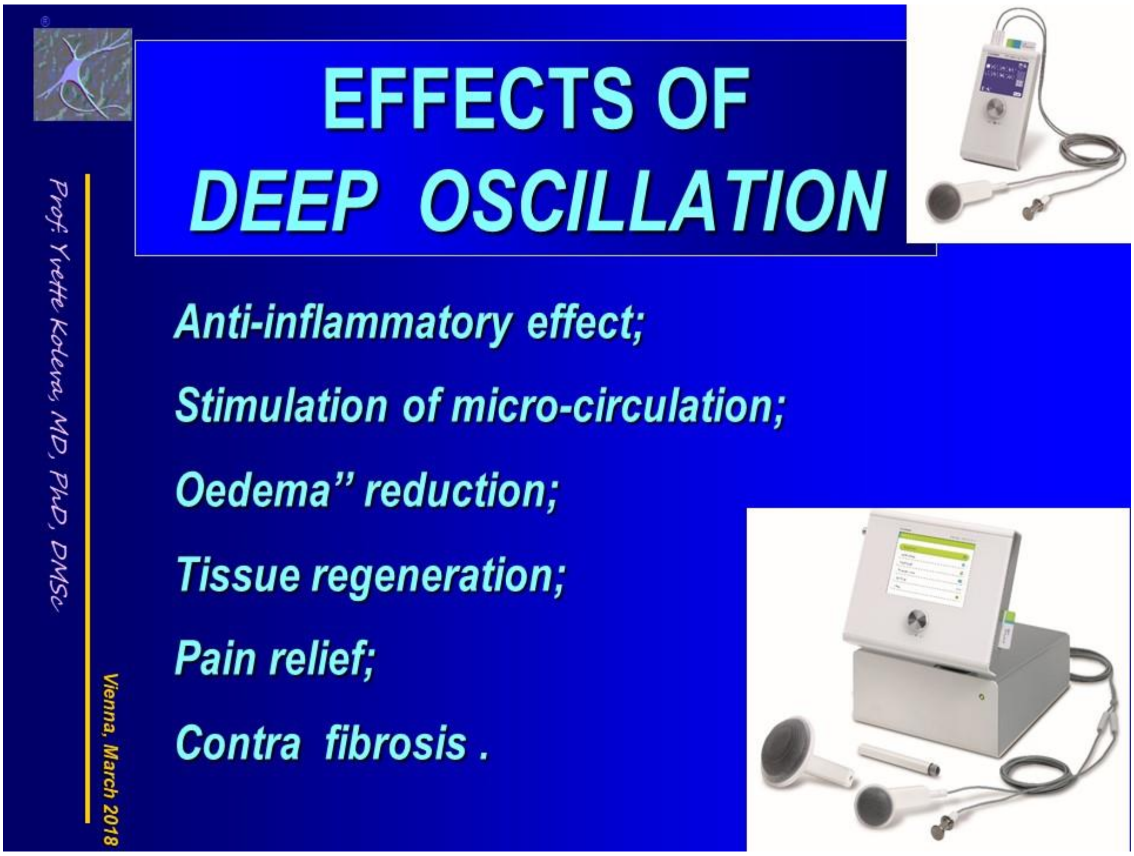

PRE-FORMED MODALITIES
- Iontophoresis with Novocain / Lidocain; or Nivalin
- ELECTROSTIMULATIONS (Functional ES / FES)
(We apply traditionally FES in motor points of the peripheral nerve and of the respective muscle, exponential wave; in all cases – according the results of the Excitomotory Electro-diagnostics);
Exponential pulses, ti=200 msec, tp=1000 msec, Fr=0,25-0,5 Hz,
сила на тока – според предизвиканата мускулна контракция /да е видима/;
времетраене на електрогимнастиката - около 3 мин. за един мускул; общо 15-20 процедури за лечебен курс;
повторение на курса след 1-3 месеца.
2018, Prof. Ivet Koleva, MD, PhD, DMedSc
Vienna, March 2018


TENS
Transcutaneous electrical Nerve stimulation (TENS)
- device BTL-06, program 1617, надлъжно разположение на електродите – по хода на дерматома; сила на тока 10-20 mA, продължителност на процедурата 10-20 min., общо XV процедури;
- device Intelect 340 Combo Electrotherapy Unit (Intelect, Chattanooga group, 2004), програма TENS (асиметрични бифазни правоъгълни пулсиращи токове, модулирани 40%, с продължителност на фазите 20-400 msec., честота 1-250 Hz), сила на тока 15-20 mA, 15 - 20 min., курс от XV процедури.


Low frequency pulsed magnetic field
Vienna, March 2018

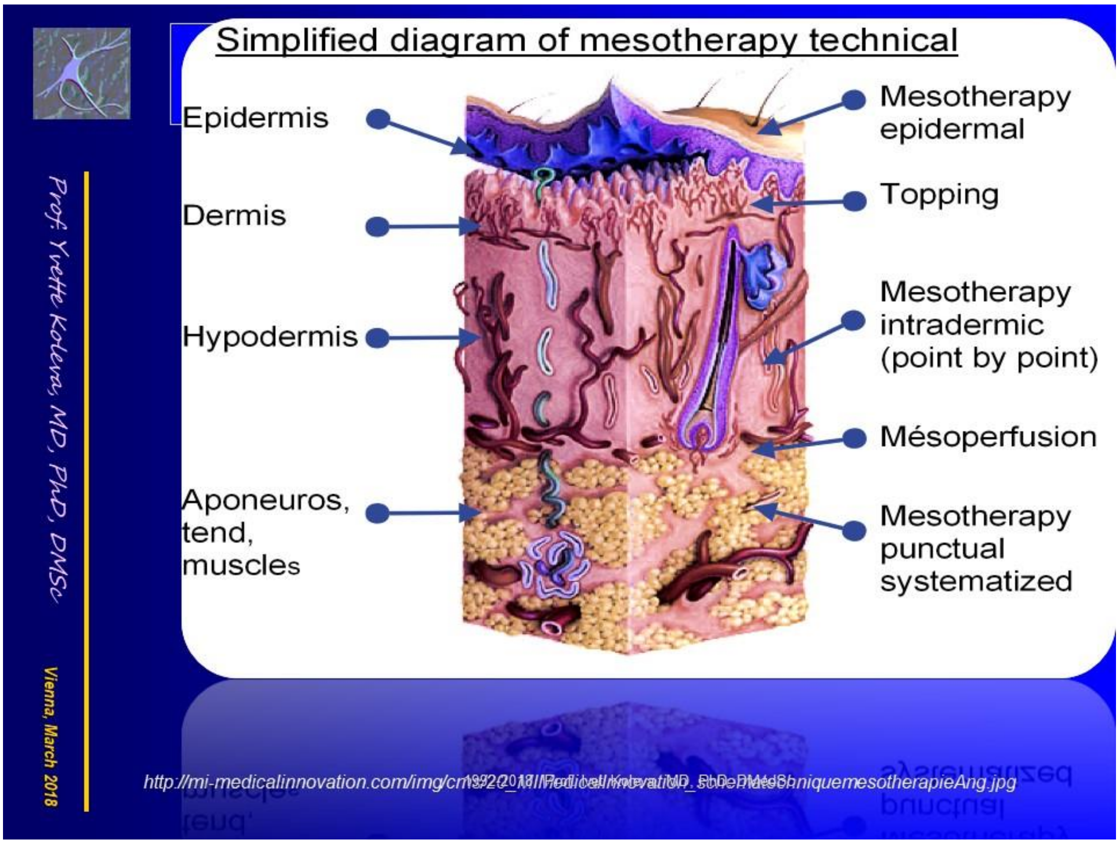

LASER - acronym of
Light
Amplification
by
Stimulated
Emission
of
Radiation
Intense
highly directional
beam of light
Vienna, March 2018


DEEP
OSCILLATION
The influence of the method DEEP OSCILLATION® is based on pulsed electrostatic field, generated in a zone of the patient's body.
BASIC INDICATIONS:
SN & SM conditions,
PAIN RELIEF;
TRAUMATOLOGY,
SURGERY.
Vienna, March 2018


EFFECTS OF
DEEP OSCILLATION
Anti-inflammatory effect;
Stimulation of micro-circulation;
Oedema" reduction;
Tissue regeneration;
Pain relief;
Contra fibrosis .
Prof. Yvette Koleva, MD, PhD, DMSc
Vienna, March 2018

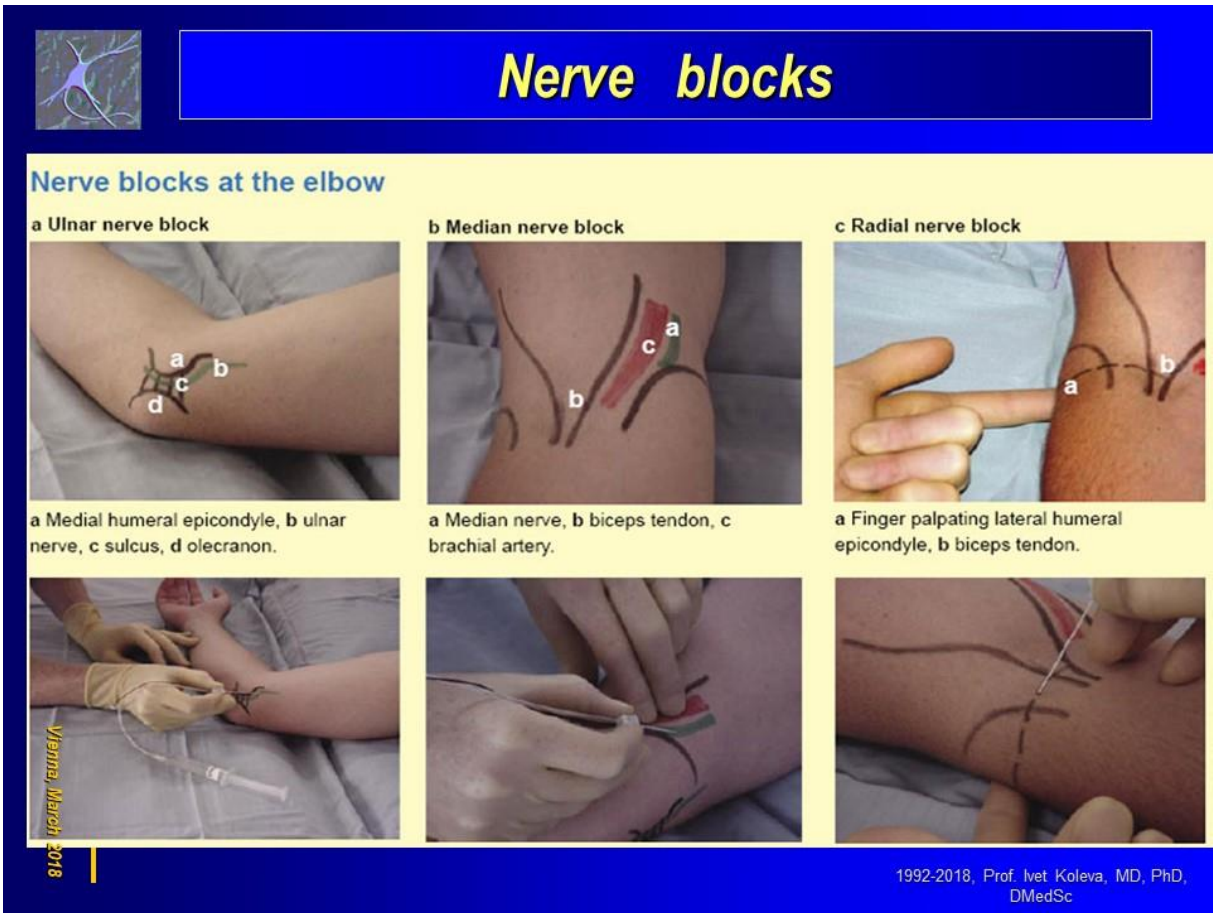

EXTRACORPOREAL
SHOCK WAVE
THERAPY
ESWT
RADIAL SHOCK WAVE THERAPY – RSWT
FOCUSED SHOCK WAVE THERAPY – FSWT
Onose G, Chendreanu CD, Haras M, Spinu A, Andone I. Extracorporeal shock wave therapy – a new «wave» also in Physiatry. Practica Medica 2011; 1 (21):35-42.
Rompe JD, Kirpatrick CJ, Kulmer k, Swittale M, Krischek O. Dose related effect of shock waves on rabit tendo Achilles. J Bone J Surg (Br) 1998; 80: 546-52.
Seil R, Wilmes P, Nuhrenborger C. Extracorporeal shock wave therapy for tendinopathies. Expert Rev Med Devices 2006: 3 (4); 463-70.
Prof. Yvette Koleva, MD, PhD, DMSc
Vienna, March 2018
VETRON-200
1234
5.17
EMS Swiss DolorClast

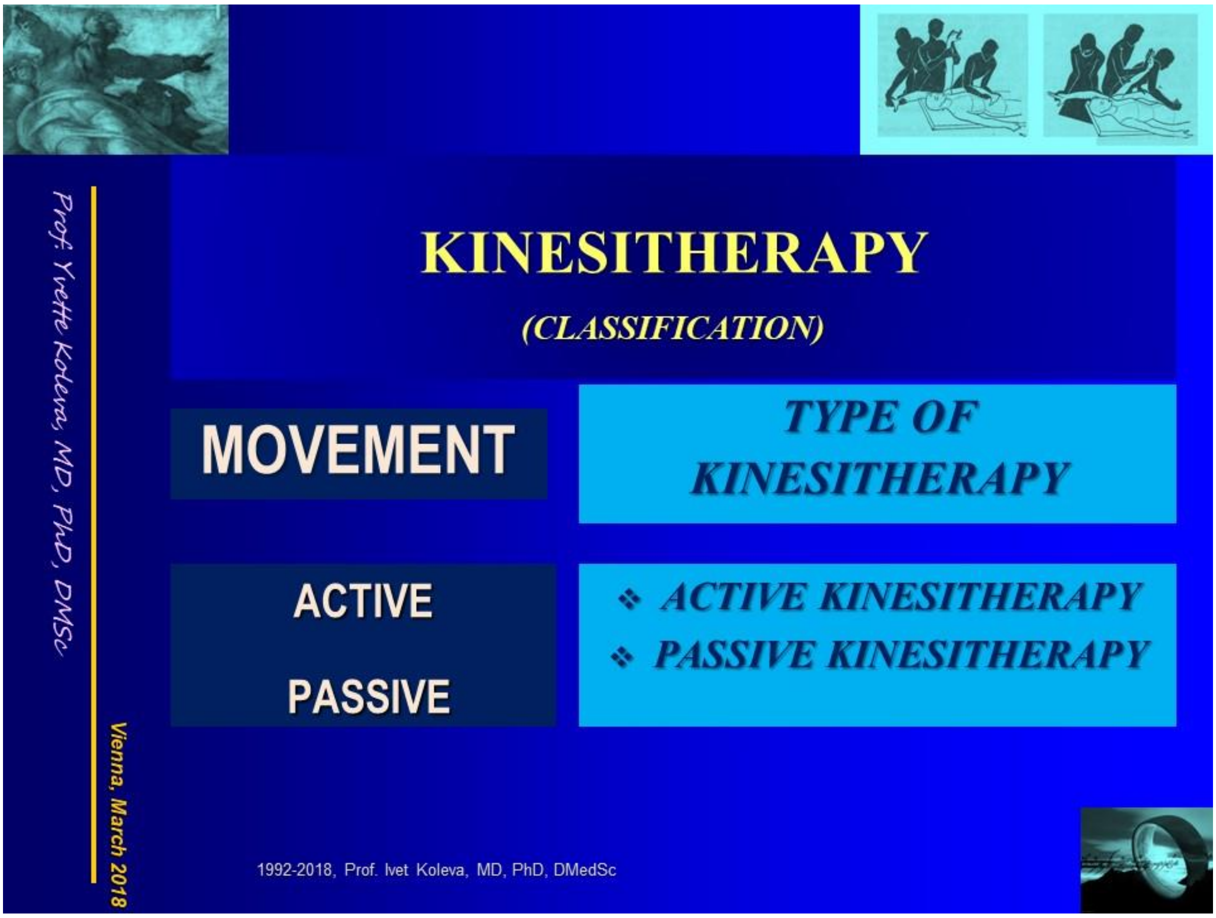

INFILTRATION THERAPY
MESOTHERAPY
BEFORE THE PROCEDURE OF THE RESPECTIVE PRE-FORMED MODALITY
in loco doloris, or segmental application
before the application of physical modalities (electrotherapy, magnetic field, vibration, etc.)
REDUCTION OF PAIN
Padua L, I Aprile, F Cecchi, et al.
Pain in postsurgical Orthopedic Rehabilitation:
A multicenter study.
Pain Medicine, 13, 2012, 769-776.
Prof. Yvette Koleva, MD, PhD, DMSc
Vienna, March 2018

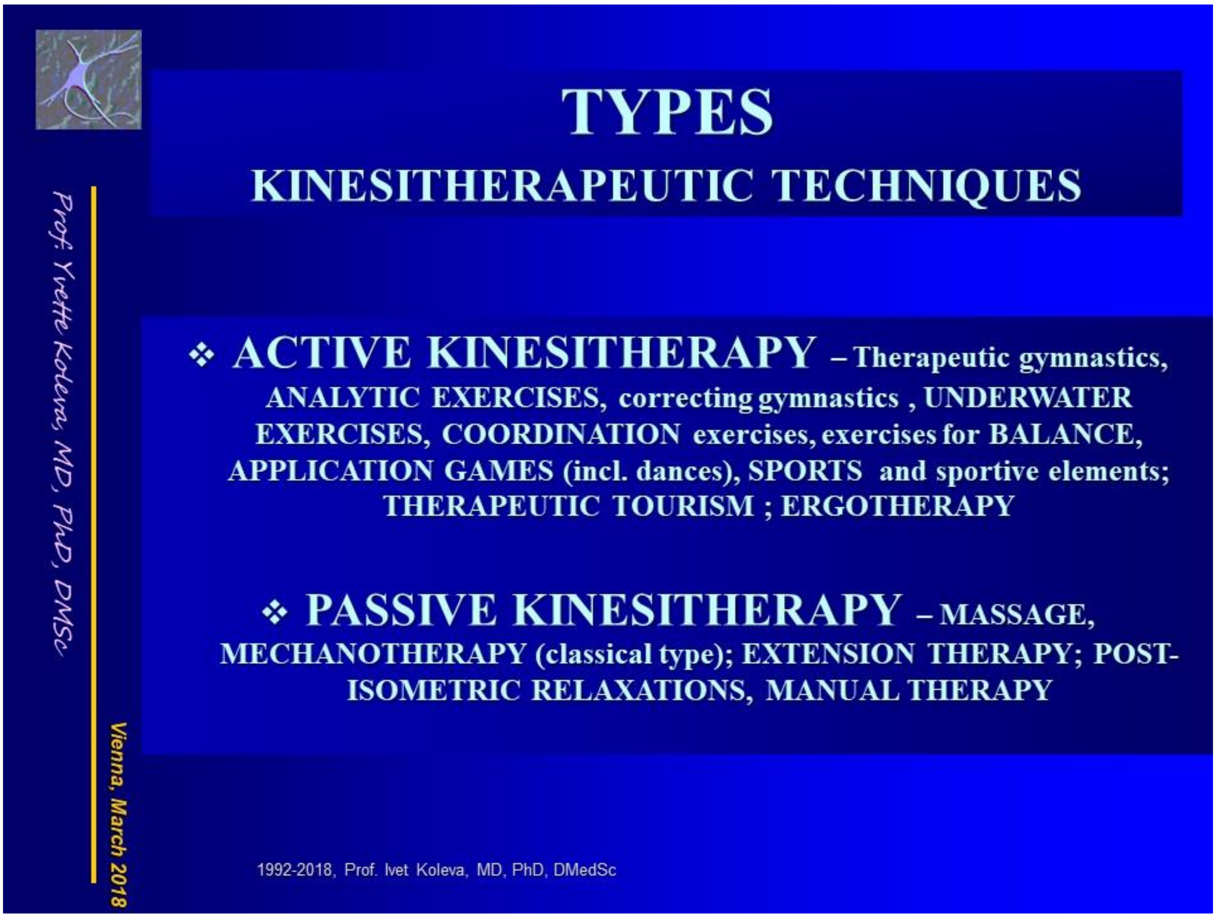

Simplified diagram of mesotherapy technical
Epidermis
Dermis
Hypodermis
Aponeuros, tend, muscles
Mesotherapy epidermal
Topping
Mesotherapy intradermic (point by point)
Mésoperfusion
Mesotherapy punctual systematized
Prof. Yvette Koleva, MD, PhD, DMSc
Vienna, March 2018
http://mi-medicalinnovation.com/img/cms/2-_MI_medical_innovation_schemaTechniquemesotherapieAng.jpg

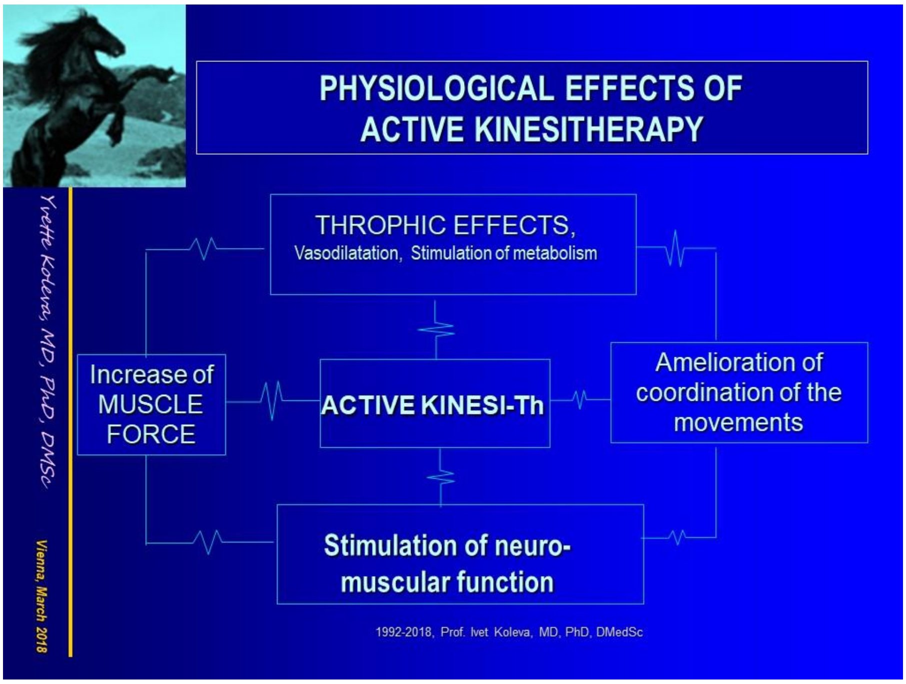

Mesotherapy & Pain
Prof. Yvette Koleva, MD, PhD, DMSc

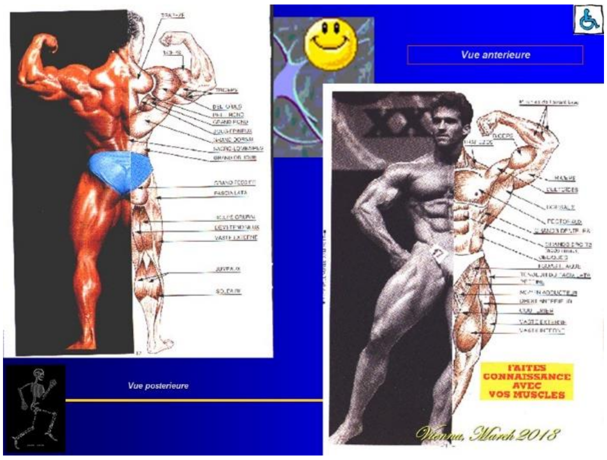

Infiltration therapy
Prolo therapy
Meso therapy
Prof. Yvette Koleva, MD,
Figure 1. Knee X-ray before Prolozone™ showing severe medial joint space narrowing.
Figure 2. Knee X-ray after Prolozone™ showing increased joint space.

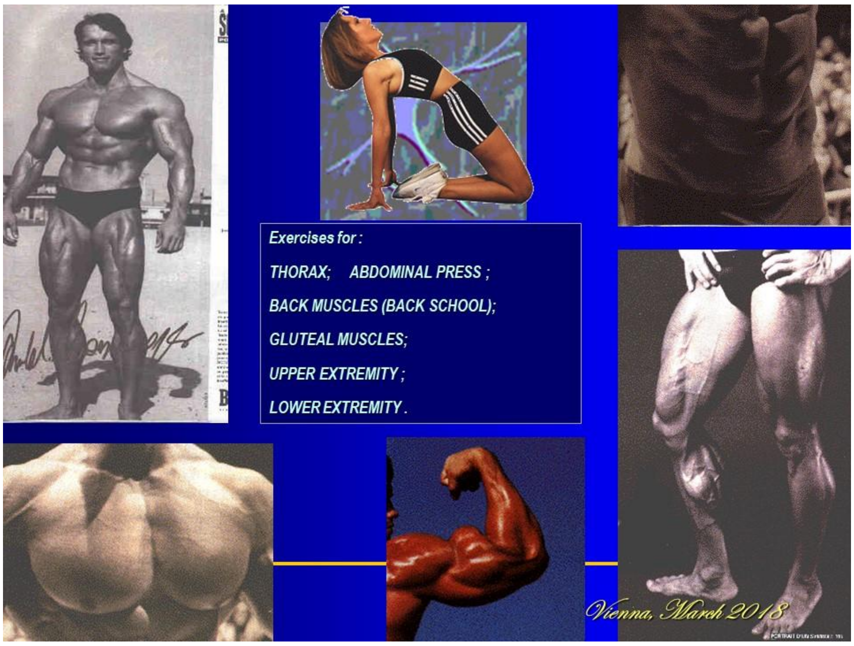

Nerve blocks
Nerve blocks at the elbow
a Ulnar nerve block
b Median nerve block
c Radial nerve block
a Medial humeral epicondyle, b ulnar nerve, c sulcus, d olecranon.
a Median nerve, b biceps tendon, c brachial artery.
a Finger palpating lateral humeral epicondyle, b biceps tendon.
Vienna, March 2018
1992-2018, Prof. Ivet Koleva, MD, PhD, DMedSc

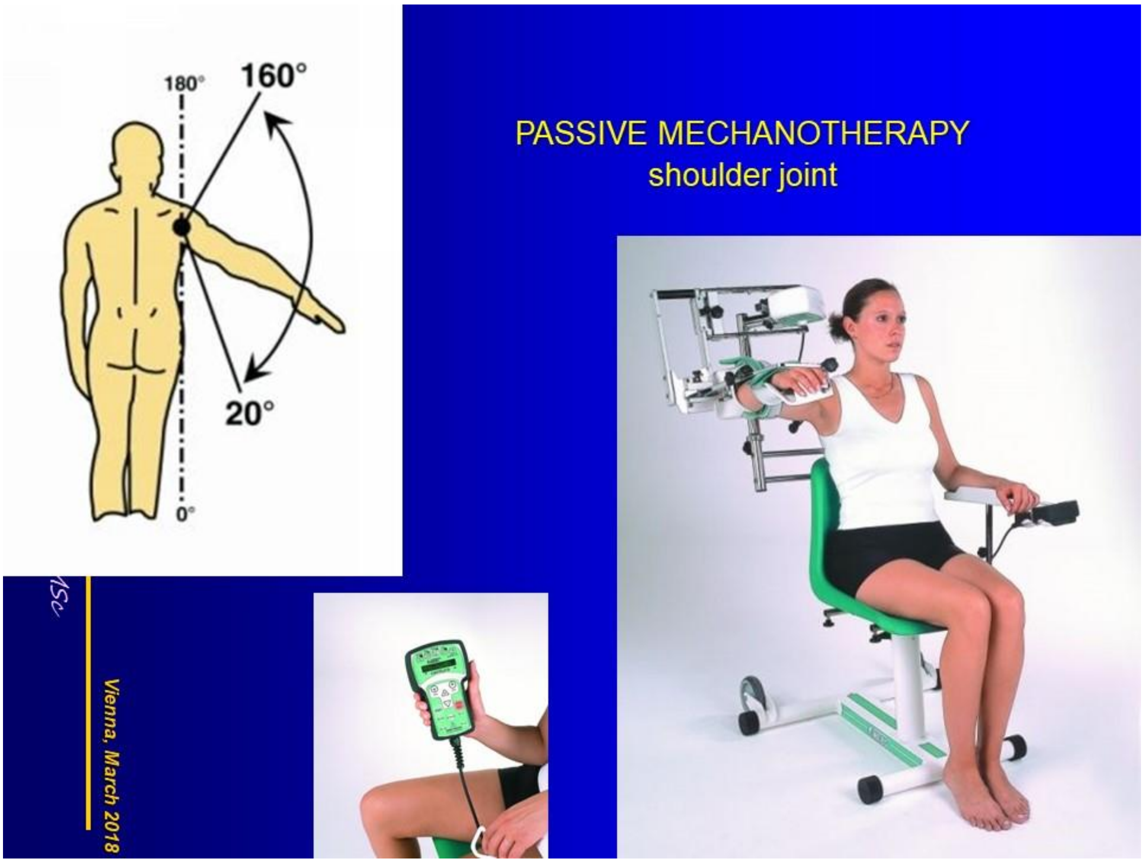

Prof. Yvette Koleva, MD, PhD, DMSc
KINESITHERAPY
(CLASSIFICATION)
MOVEMENT
TYPE OF KINESITHERAPY
ACTIVE
PASSIVE
❖ ACTIVE KINESITHERAPY
❖ PASSIVE KINESITHERAPY
Vienna, March 2018
1992-2018, Prof. Ivet Koleva, MD, PhD, DMedSc

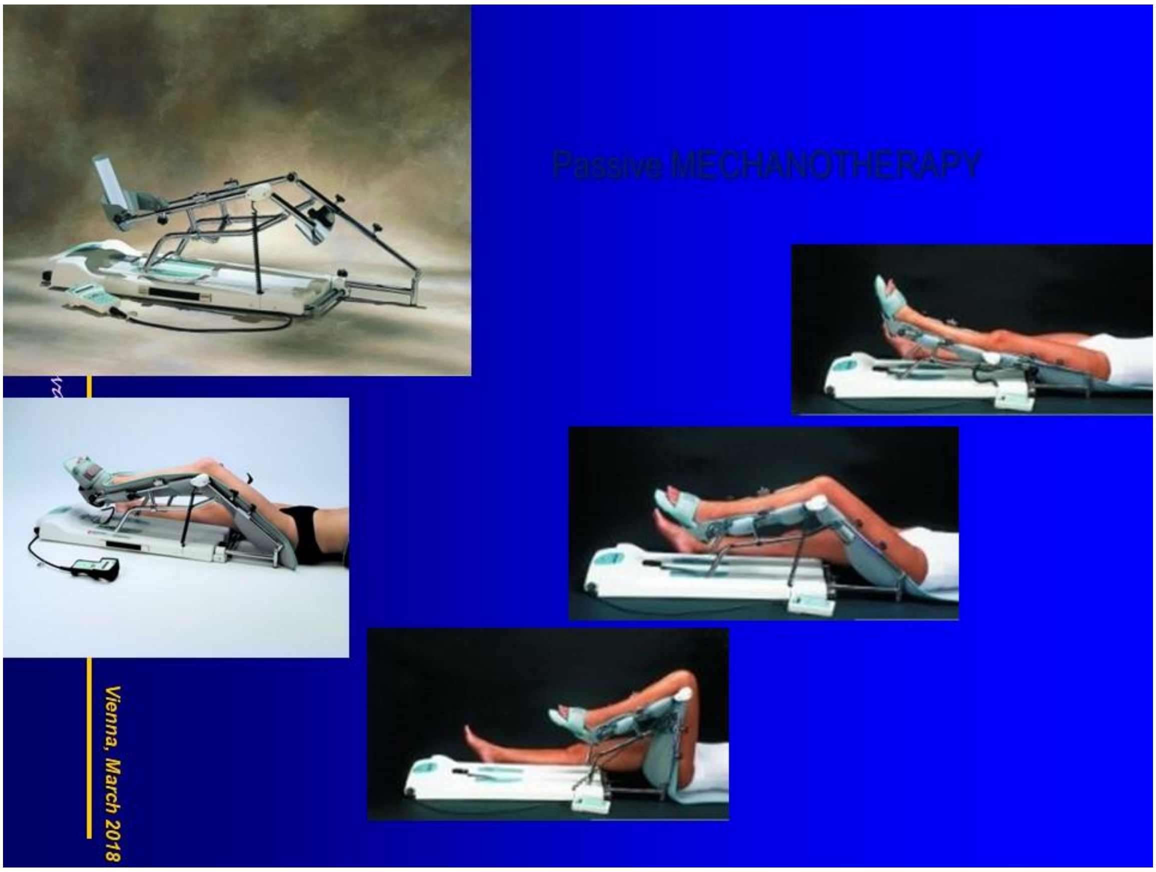

Prof. Yvette Koleva, MD, PhD, DMSc
TYPES
KINESITHERAPEUTIC TECHNIQUES
❖ ACTIVE KINESITHERAPY – Therapeutic gymnastics, ANALYTIC EXERCISES, correcting gymnastics , UNDERWATER EXERCISES, COORDINATION exercises, exercises for BALANCE, APPLICATION GAMES (incl. dances), SPORTS and sportive elements; THERAPEUTIC TOURISM ; ERGOTHERAPY
❖ PASSIVE KINESITHERAPY – MASSAGE, MECHANOTHERAPY (classical type); EXTENSION THERAPY; POST-ISOMETRIC RELAXATIONS, MANUAL THERAPY
Vienna, March 2018
1992-2018, Prof. Ivet Koleva, MD, PhD, DMedSc


PHYSIOLOGICAL EFFECTS OF
ACTIVE KINESITHERAPY
Yvette Koleva, MD, PhD, DMSc
Vienna, March 2018
THROPHIC EFFECTS,
Vasodilatation, Stimulation of metabolism
Increase of MUSCLE FORCE
ACTIVE KINESI-Th
Amelioration of coordination of the movements
Stimulation of neuro-muscular function
1992-2018, Prof. Ivet Koleva, MD, PhD, DMedSc


Vue anterieure
Vue posterieure
FAITES CONNAISSANCE AVEC VOS MUSCLES
Vienna, March 2018

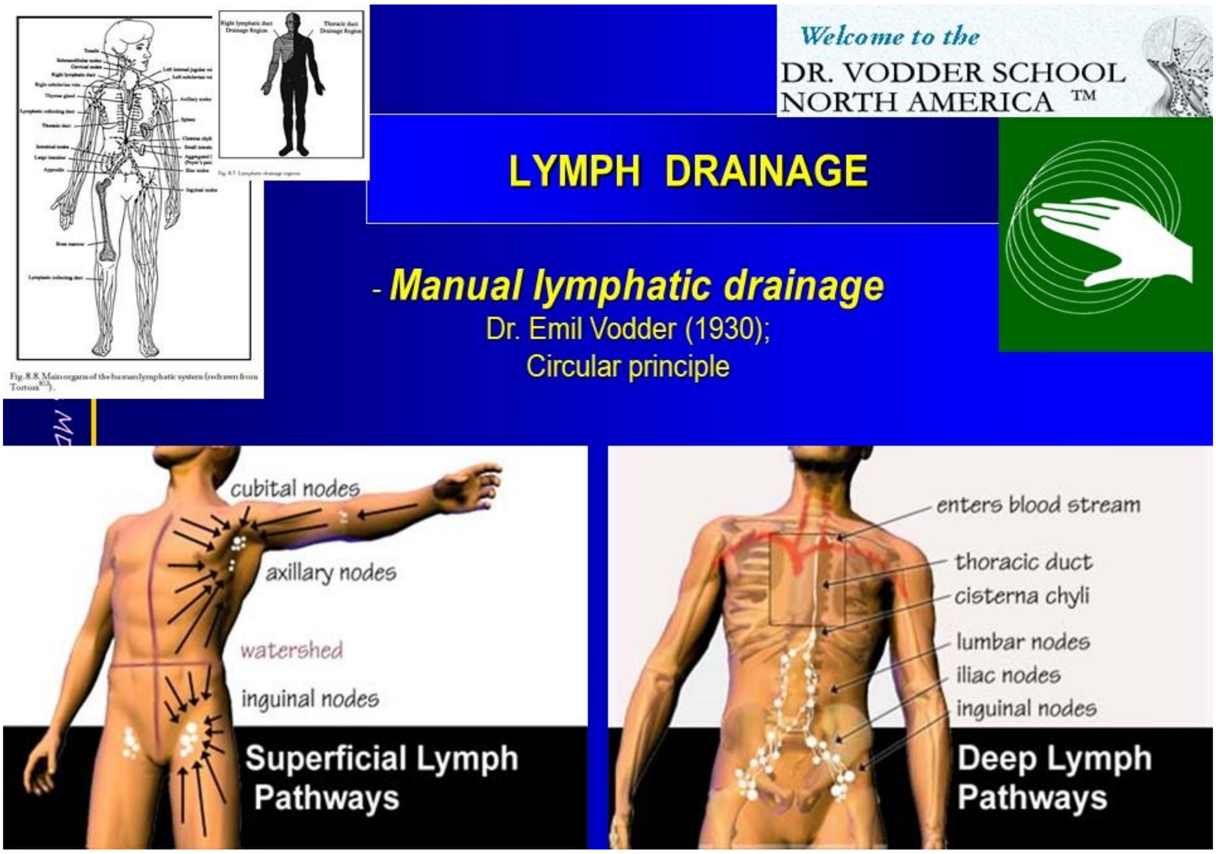

Exercises for :
THORAX; ABDOMINAL PRESS ;
BACK MUSCLES (BACK SCHOOL);
GLUTEAL MUSCLES;
UPPER EXTREMITY ;
LOWER EXTREMITY .
Vienna, March 2018


180°
160°
20°
0°
PASSIVE MECHANOTHERAPY
shoulder joint
Vienna, March 2018


Passive MECHANOTHERAPY
Vienna, March 2018


Active mechanotherapy
D, PhD, DMSc
Vienna, March 2018
JAN 29 2005


Massage
- КЛАСИЧЕСКИ МАНУАЛЕН МАСАЖ за долни крайници, с продължителност около 15-20 min., общо XV процедури); предпочитана изходна позиция – тилен лег;
стандартни техники – поглаждане, разтриване, омачкване, ударни и вибрационни похвати, пасивни движения на глезенната става и пръстите; с акцент върху обработването на ахилесовото сухожилие, m.triceps surae, mm. interossei, плантарната повърхност на стъпалата; често се налага включване и на ПРИЙОМИ ОТ ПЕРИОСТАЛЕН МАСАЖ И ЗОНОТЕРАПИЯ ЗА СТЪПАЛАТА, ТЕХНИКИ ОТ МАНУАЛНИЯ ЛИМФЕН ДРЕНАЖ.
При мускулна хипотрофия с паретични явления в основата на съответния мускул се прилагат по-енергично разтриване, омесване, потупване и вибрация (за активиране на нервната регулация на мускула и стимулиране на метаболизма); след масажната процедура се отделя достатъчно време за упражнения с помощ и срещу съпротивление за флексори и екстензори на стъпалото и пръстите.
- обучение на пациента в самомасаж (акцент върху стъпалата) и автоПИР;
- АПАРАТЕН – ХИДРОМАСАЖ, ПОДВОДЕН ДУШОВ МАСАЖ, ЛИМФАПРЕС.


Welcome to the
DR. VODDER SCHOOL
NORTH AMERICA ™
LYMPH DRAINAGE
- Manual lymphatic drainage
Dr. Emil Vodder (1930);
Circular principle
cubital nodes
axillary nodes
watershed
inguinal nodes
Superficial Lymph Pathways
enters blood stream
thoracic duct
cisterna chyli
lumbar nodes
iliac nodes
inguinal nodes
Deep Lymph Pathways


Lymphatic massage – with device
LYMPHO PRESSO THERAPY


EXTENSION
THERAPY
Cervical tractions
Vienna, March 2018

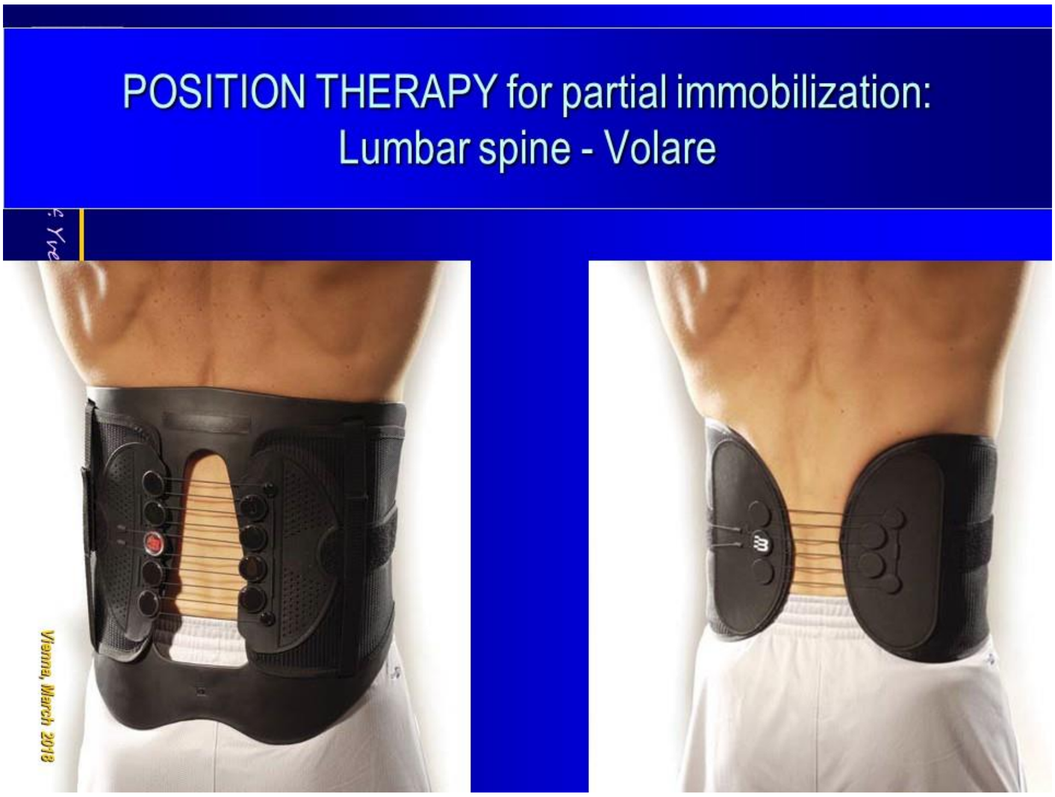

Extension vertebrotherapy –
Lumbar tractions
Vienna, March 2018


POSITION THERAPY
for partial immobilization
Walker boot
Brace
Vienna, March 2018


Arm sling
Shoulder brace
Vienna, March 2018

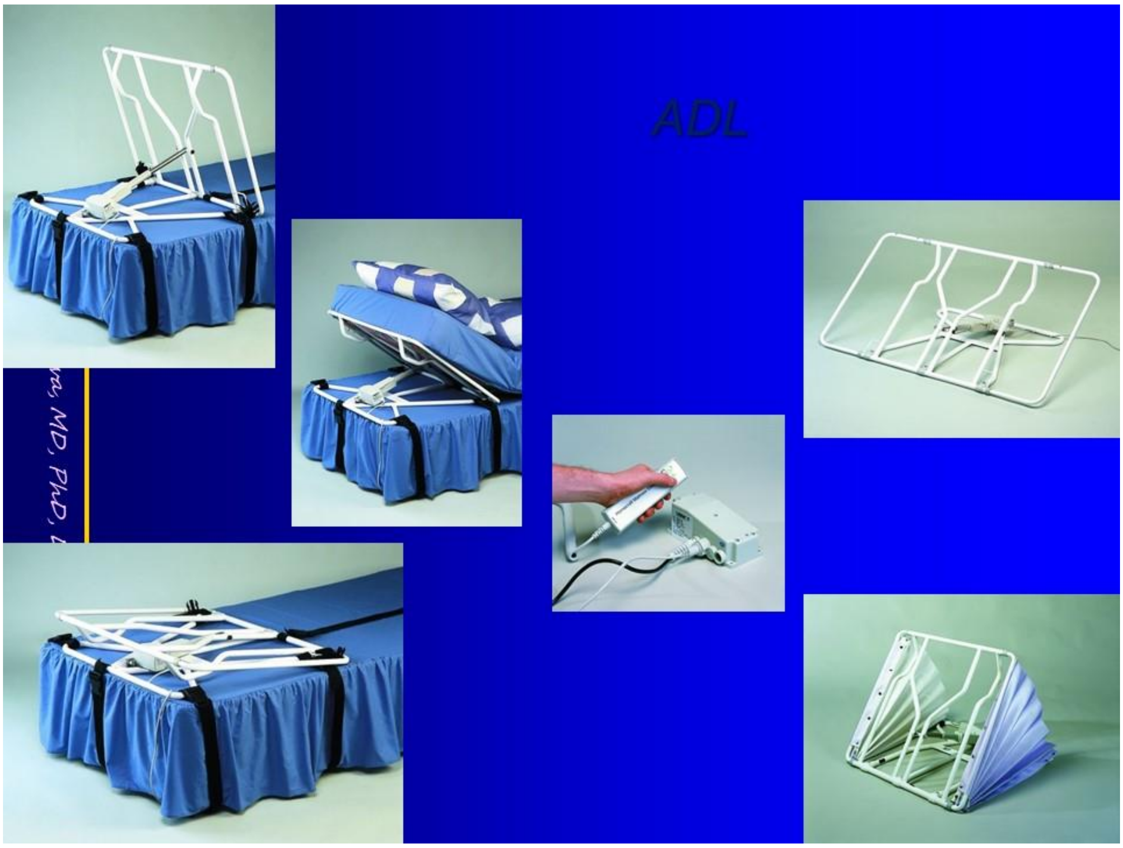

Universal
arm
sling
Vienna, March 2018


Shoulder wrap - Cryotherapy
Prof. Yvette Koleva, MD, PhD, DMSc
Vienna, March 2018

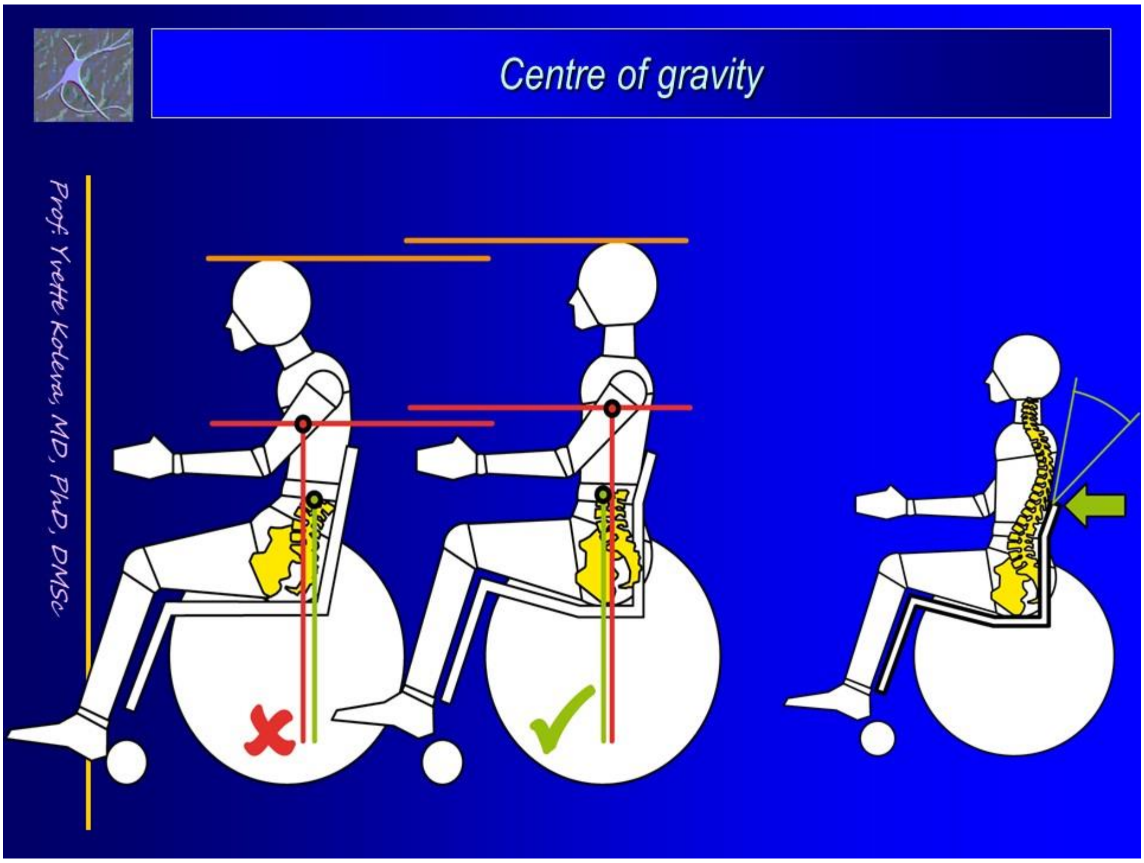

POSITION THERAPY for partial immobilization:
Lumbar spine - Volare
Vienna, March 2018


Modular system
Prof. Yvette Koleva, MD, PhD, DMSc
Vienna, March 2018


OCCUPATIONAL
THERAPY
Adapting the environment for ADL

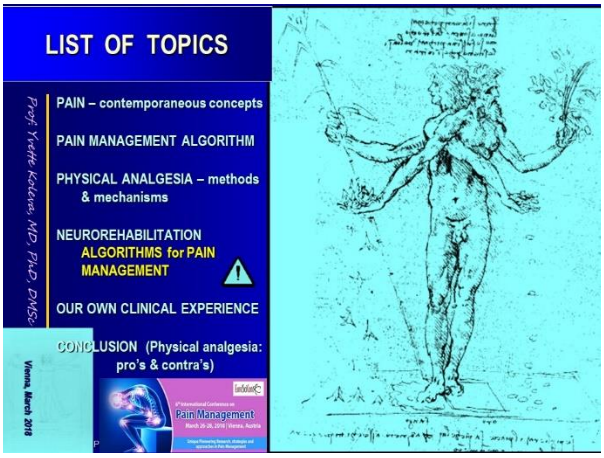

ADL


ADL

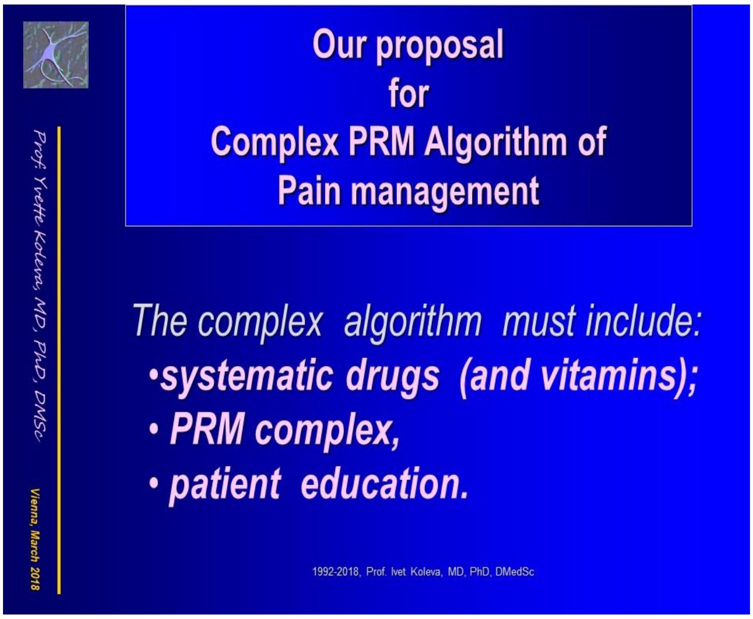

Centre of gravity
Prof. Yvette Koleva, MD, PhD, DMSc

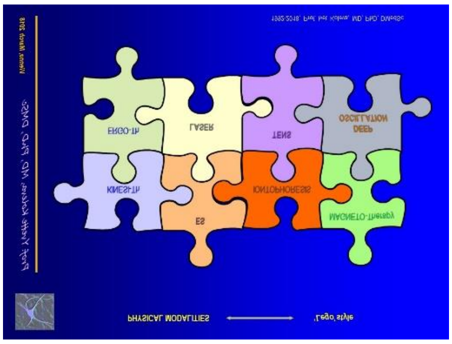

Hydro / Balneo - Therapy
Vienna, March 2018

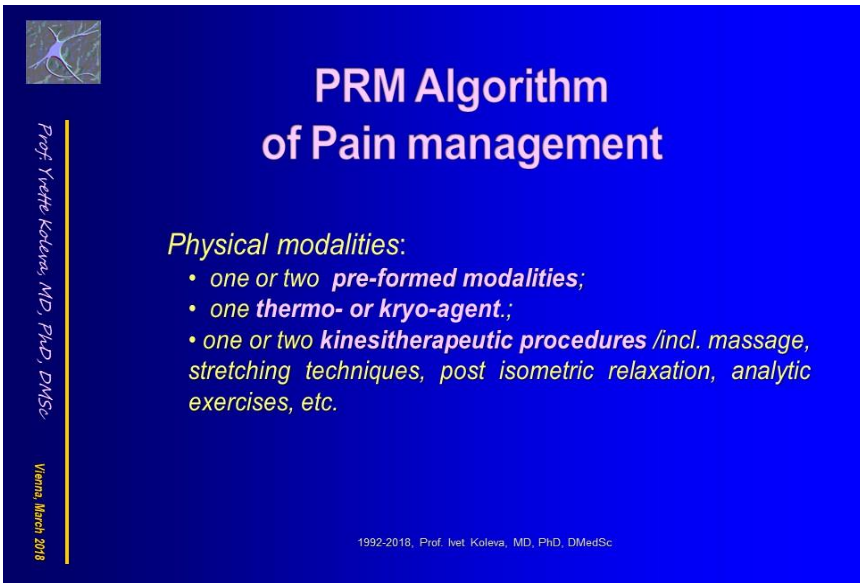

SPA
Salus Per Aquam
or
health by water
Vienna, March 2018

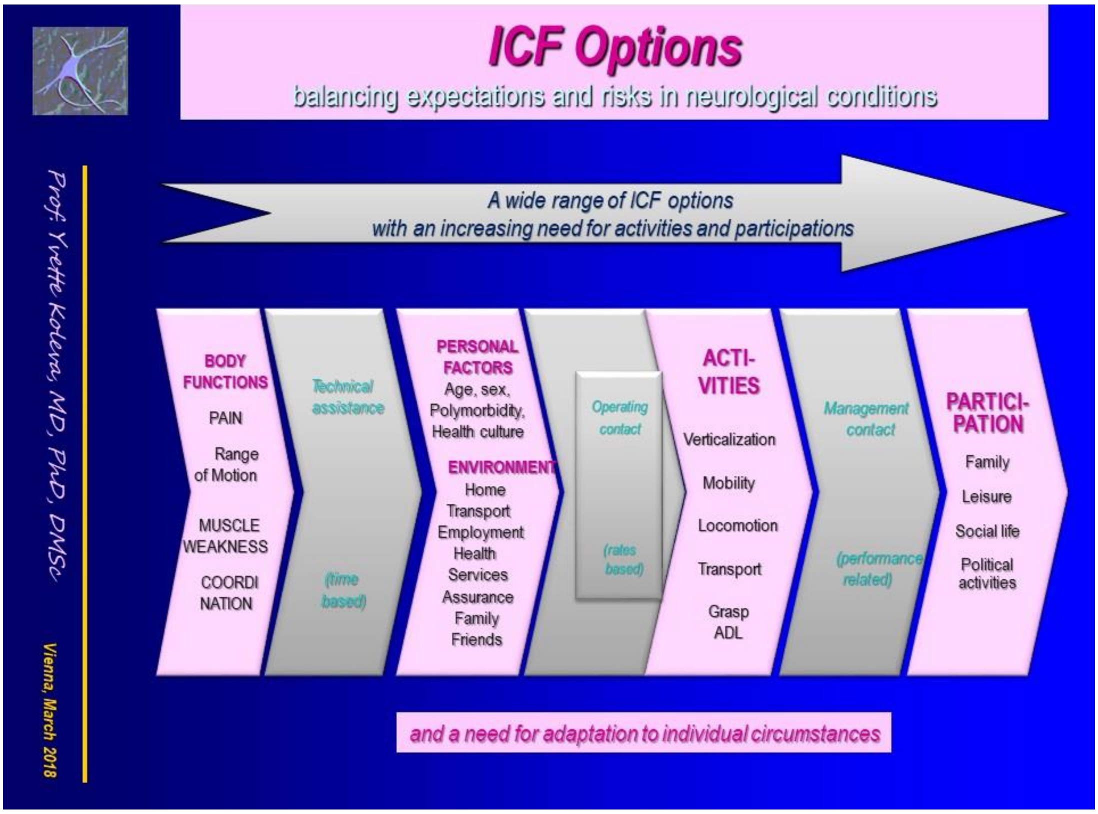

LIST OF TOPICS
PAIN – contemporaneous concepts
PAIN MANAGEMENT ALGORITHM
PHYSICAL ANALGESIA – methods & mechanisms
NEUROREHABILITATION
ALGORITHMS for PAIN MANAGEMENT
OUR OWN CLINICAL EXPERIENCE
CONCLUSION (Physical analgesia: pro's & contra's)
Prof. Yvette Koleva, MD, PhD, DMSc
Vienna, March 2018
Pain Management

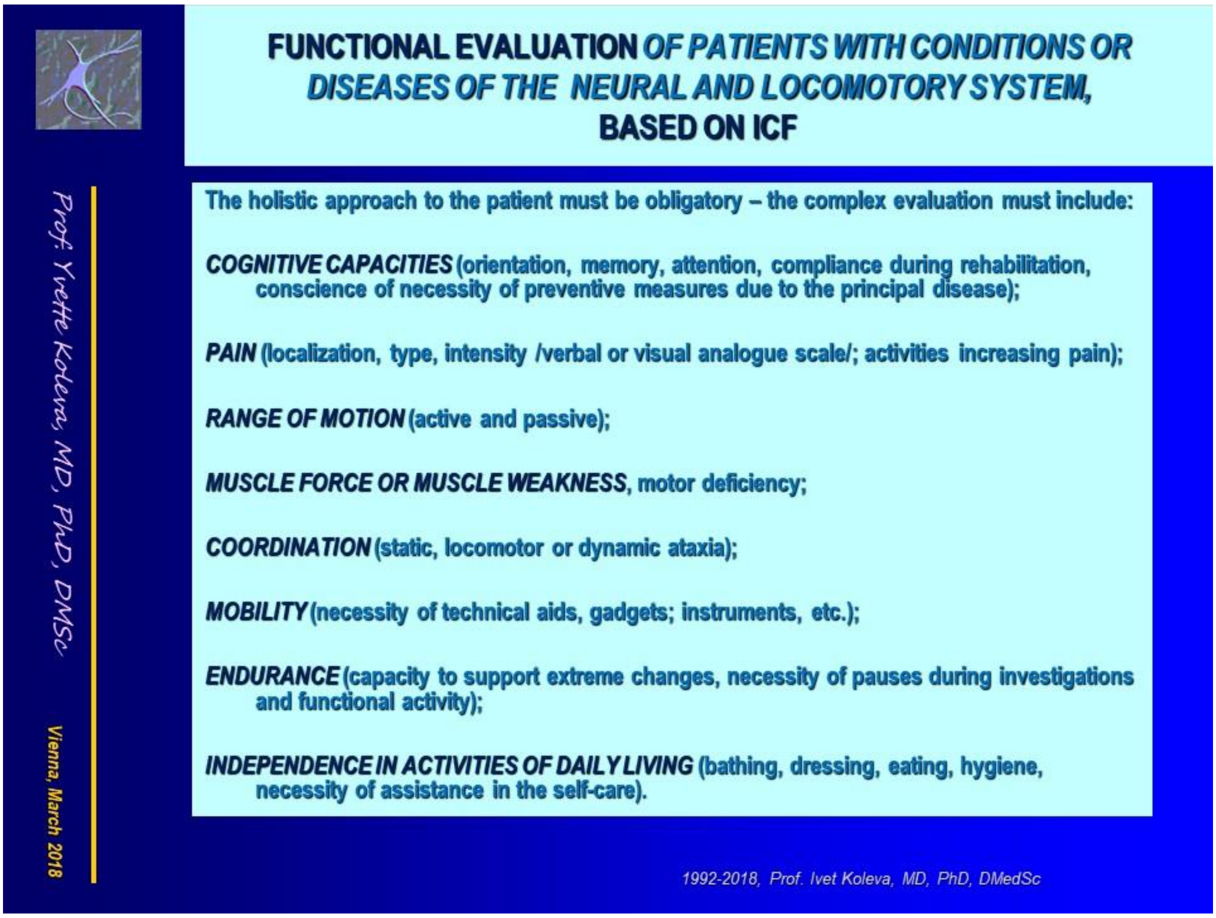

Algorithm of Pain PRM management
Bg rehabilitation school have evolved from 'Diagnose and Adios' to a comprehensive care of the patient's pain.
We consider that the emphasis on early diagnosis and pain management is obligatory.
Actually PRM in Bulgaria is not yet viewed with skepticism. Rehabilitation procedures are well accepted like a first line therapy with proven safety and benefit profile.
Prof. Yvette Koleva, MD, PhD, DMSc
Vienna, March 2018
1992-2018, Prof. Ivet Koleva, MD, PhD, DMedSc

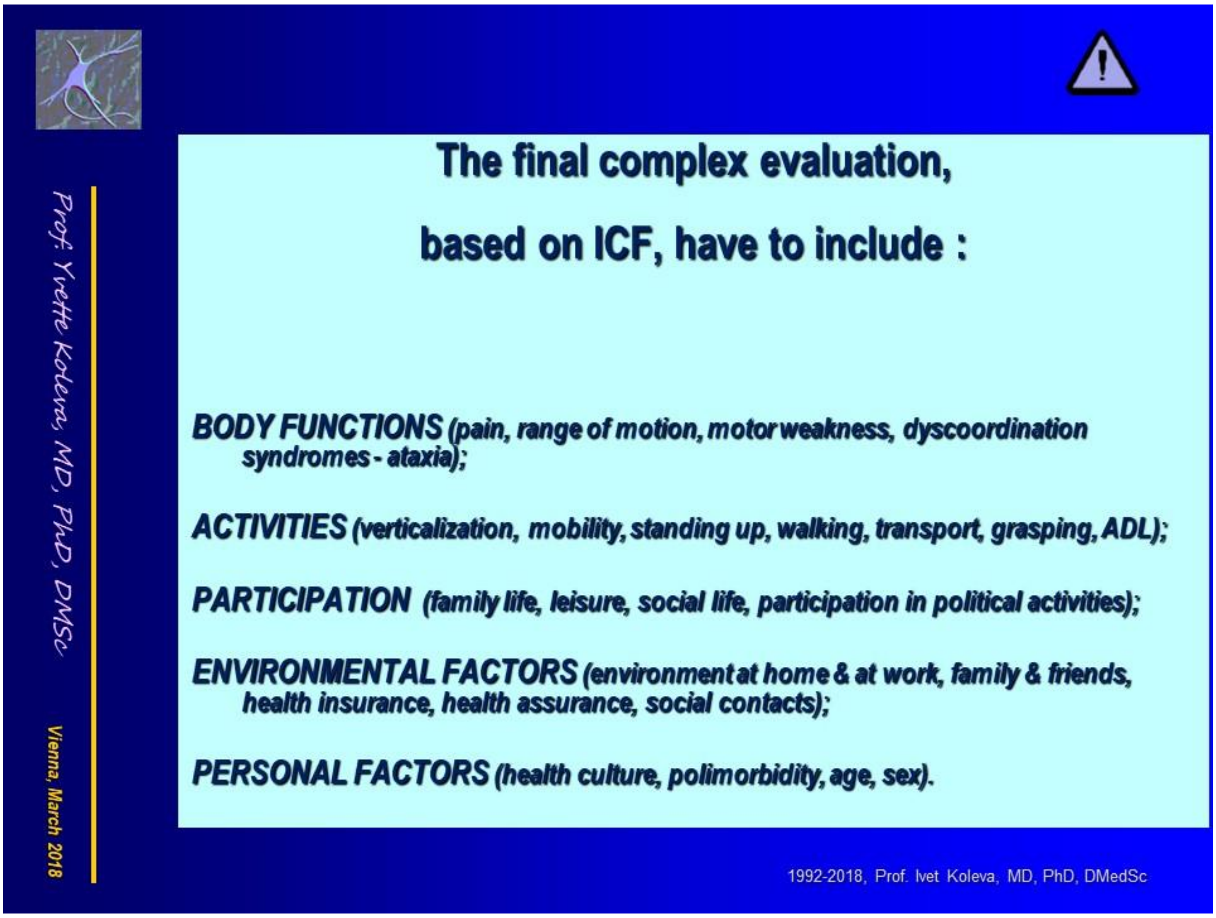

Our proposal for Complex PRM Algorithm of Pain management
The complex algorithm must include:
•systematic drugs (and vitamins);
• PRM complex,
• patient education.
Prof. Yvette Koleva, MD, PhD, DMSc
Vienna, March 2018
1992-2018, Prof. Ivet Koleva, MD, PhD, DMedSc

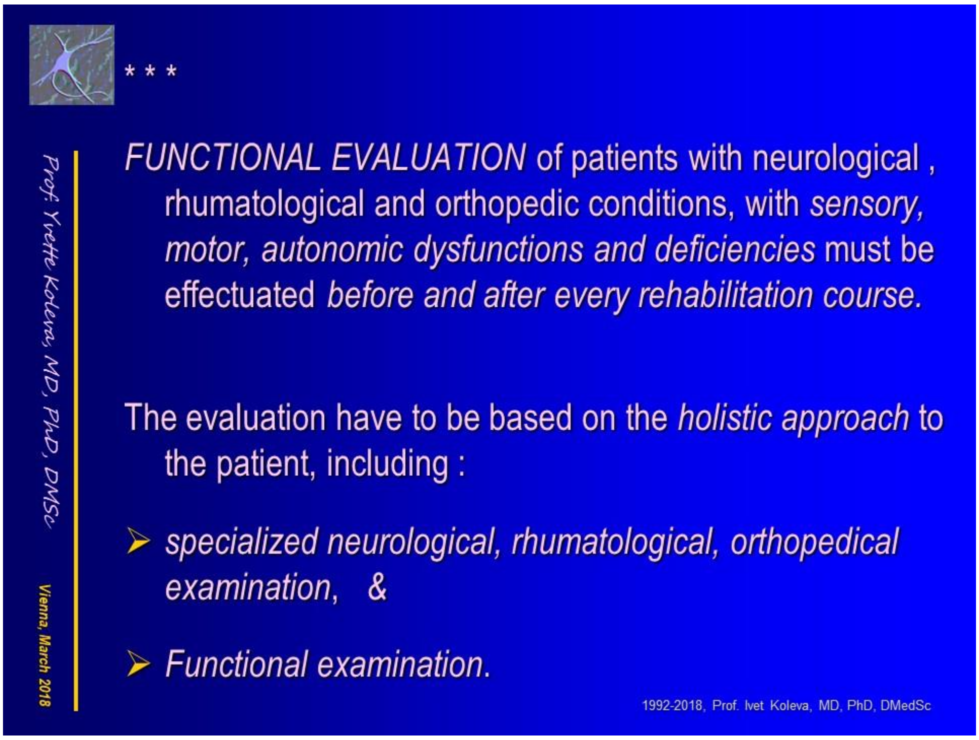

LASER
TENS
ES
IONTOPHORESIS
PHYSICAL MODALITIES

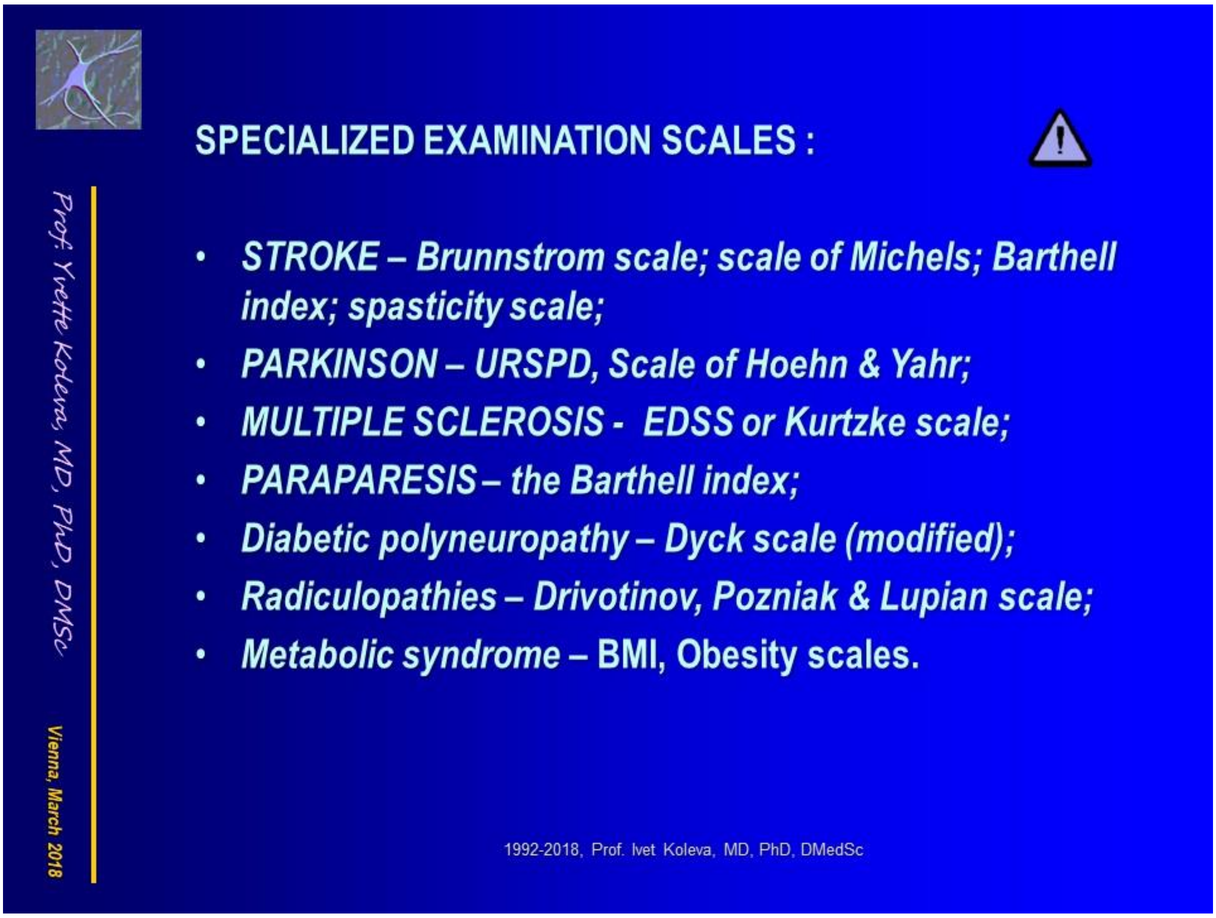

PRM Algorithm
of Pain management
Physical modalities:
• one or two pre-formed modalities;
• one thermo- or kryo-agent.;
• one or two kinesitherapeutic procedures /incl. massage, stretching techniques, post isometric relaxation, analytic exercises, etc.
1992-2018, Prof. Ivet Koleva, MD, PhD, DMedSc
Prof. Yvette Koleva, MD, PhD, DMSc
Vienna, March 2018

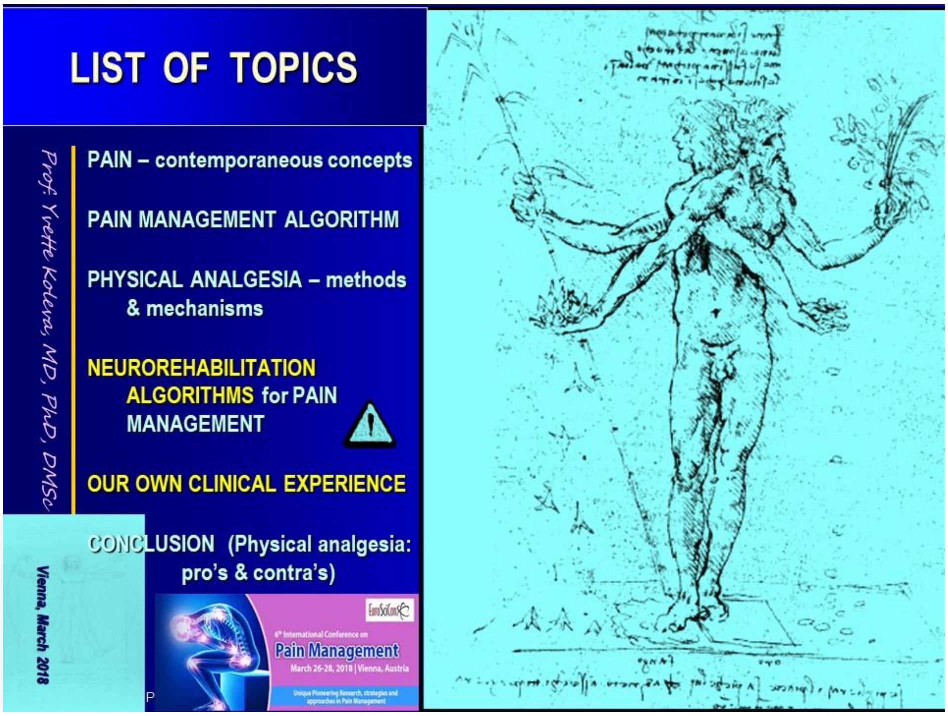

ICF Options
balancing expectations and risks in neurological conditions
A wide range of ICF options
with an increasing need for activities and participations
BODY FUNCTIONS
PAIN
Range of Motion
MUSCLE WEAKNESS
COORDI NATION
Technical assistance
(time based)
PERSONAL FACTORS
Age, sex, Polymorbidity, Health culture
ENVIRONMENT
Home
Transport
Employment
Health Services
Assurance
Family
Friends
Operating contact
(rates based)
ACTI-VITIES
Verticalization
Mobility
Locomotion
Transport
Grasp
ADL
Management contact
(performance related)
PARTICI-PATION
Family
Leisure
Social life
Political activities
and a need for adaptation to individual circumstances
Prof. Yvette Koleva, MD, PhD, DMSc
Vienna, March 2018

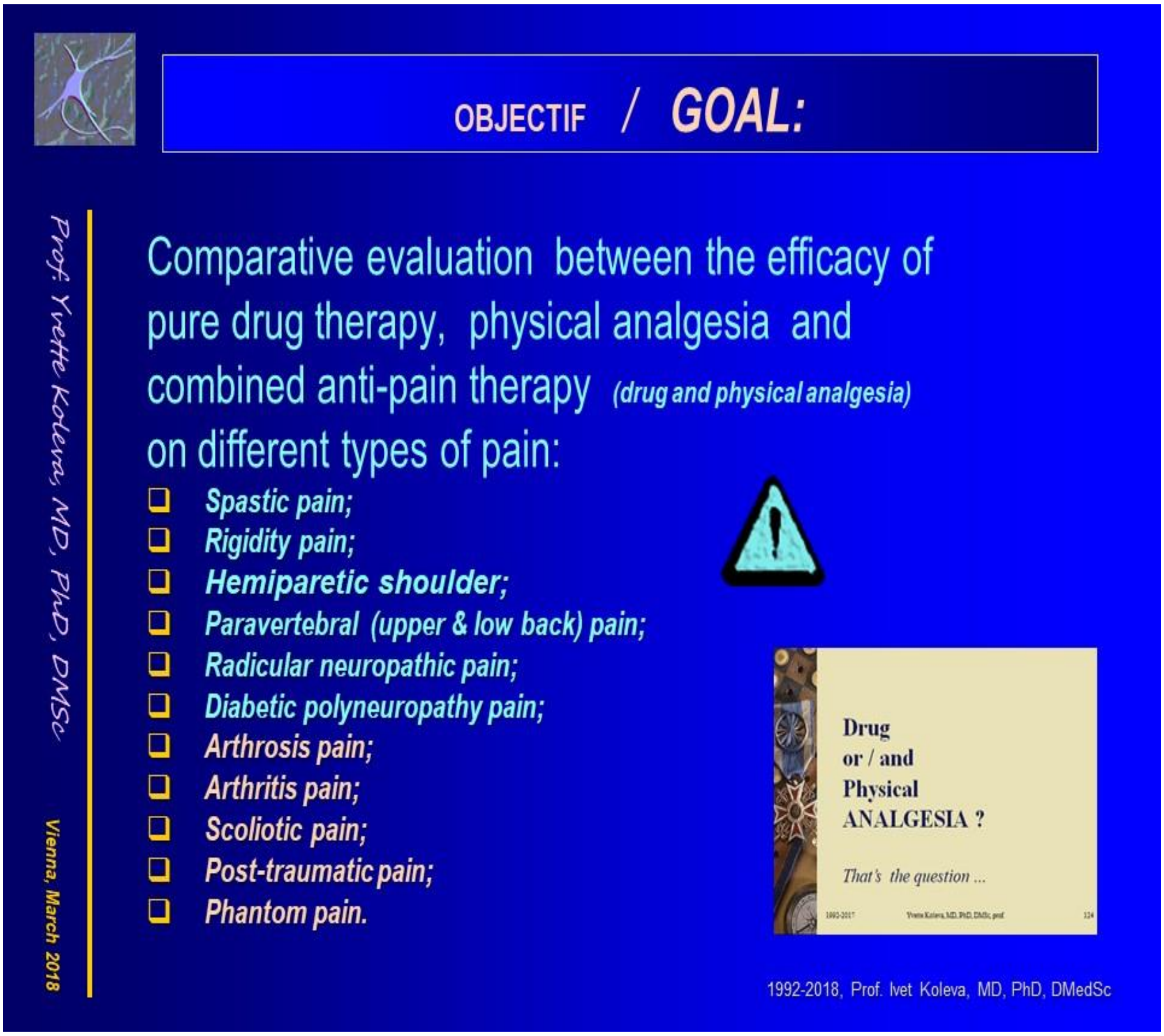

FUNCTIONAL EVALUATION OF PATIENTS WITH CONDITIONS OR DISEASES OF THE NEURAL AND LOCOMOTORY SYSTEM, BASED ON ICF
The holistic approach to the patient must be obligatory – the complex evaluation must include:
COGNITIVE CAPACITIES (orientation, memory, attention, compliance during rehabilitation, conscience of necessity of preventive measures due to the principal disease);
PAIN (localization, type, intensity /verbal or visual analogue scale/; activities increasing pain);
RANGE OF MOTION (active and passive);
MUSCLE FORCE OR MUSCLE WEAKNESS, motor deficiency;
COORDINATION (static, locomotor or dynamic ataxia);
MOBILITY (necessity of technical aids, gadgets; instruments, etc.);
ENDURANCE (capacity to support extreme changes, necessity of pauses during investigations and functional activity);
INDEPENDENCE IN ACTIVITIES OF DAILY LIVING (bathing, dressing, eating, hygiene, necessity of assistance in the self-care).
Prof. Yvette Koleva, MD, PhD, DMSc
Vienna, March 2018
1992-2018, Prof. Ivet Koleva, MD, PhD, DMedSc

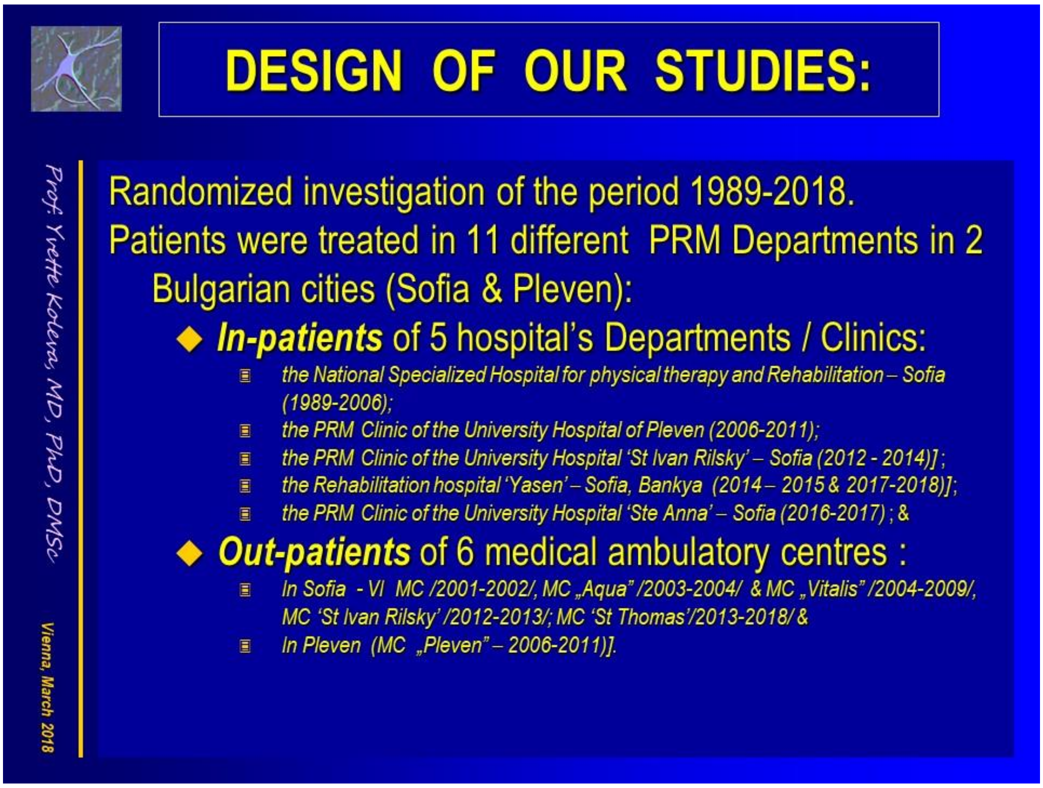

The final complex evaluation,
based on ICF, have to include :
BODY FUNCTIONS (pain, range of motion, motor weakness, dyscoordination syndromes - ataxia);
ACTIVITIES (verticalization, mobility, standing up, walking, transport, grasping, ADL);
PARTICIPATION (family life, leisure, social life, participation in political activities);
ENVIRONMENTAL FACTORS (environment at home & at work, family & friends, health insurance, health assurance, social contacts);
PERSONAL FACTORS (health culture, polimorbidity, age, sex).
Prof. Yvette Koleva, MD, PhD, DMSc
Vienna, March 2018
1992-2018, Prof. Ivet Koleva, MD, PhD, DMedSc

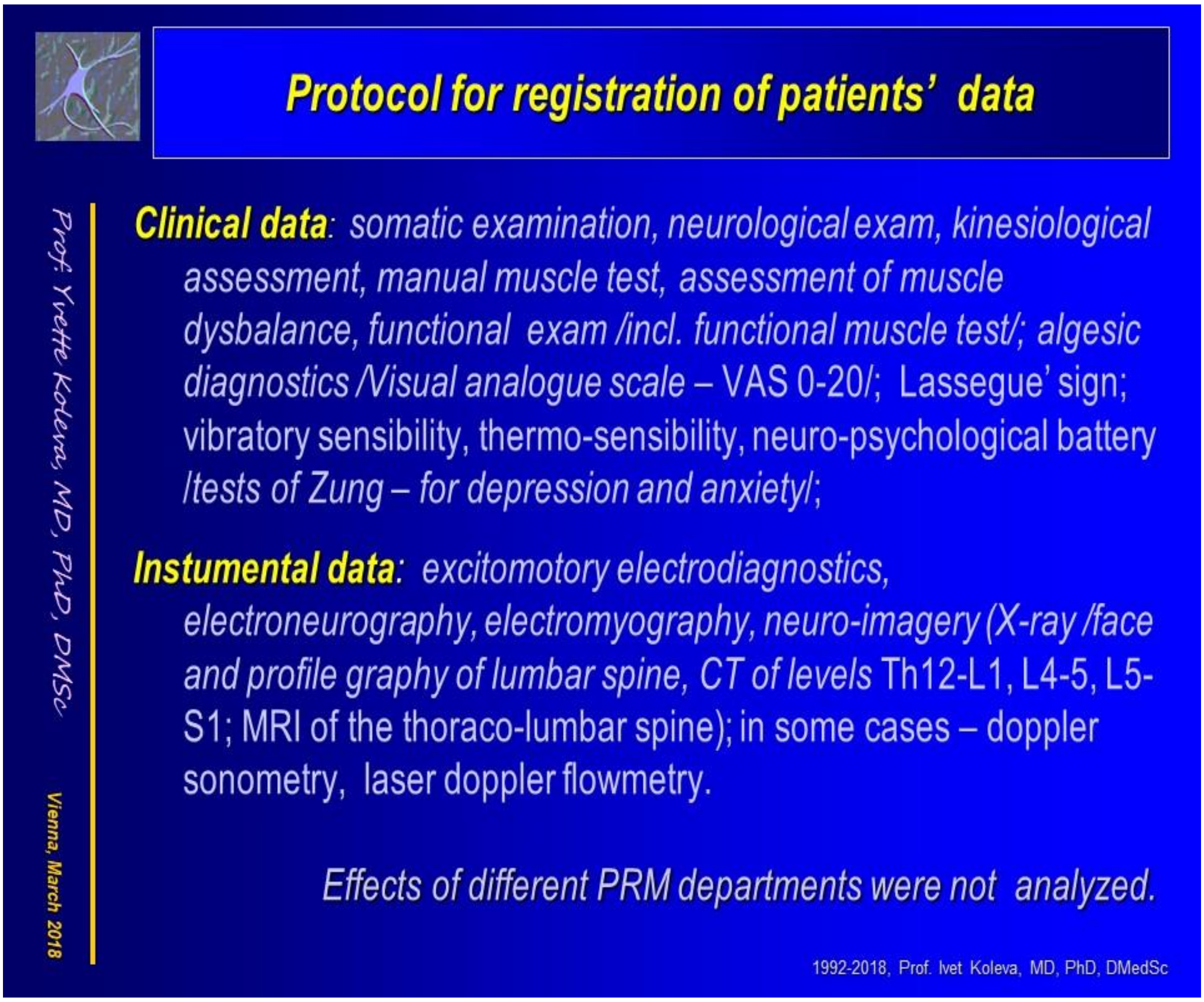

* * *
FUNCTIONAL EVALUATION of patients with neurological , rhumatological and orthopedic conditions, with sensory, motor, autonomic dysfunctions and deficiencies must be effectuated before and after every rehabilitation course.
The evaluation have to be based on the holistic approach to the patient, including :
specialized neurological, rhumatological, orthopedical examination, &
Functional examination.
Prof. Yvette Koleva, MD, PhD, DMSc
Vienna, March 2018
1992-2018, Prof. Ivet Koleva, MD, PhD, DMedSc

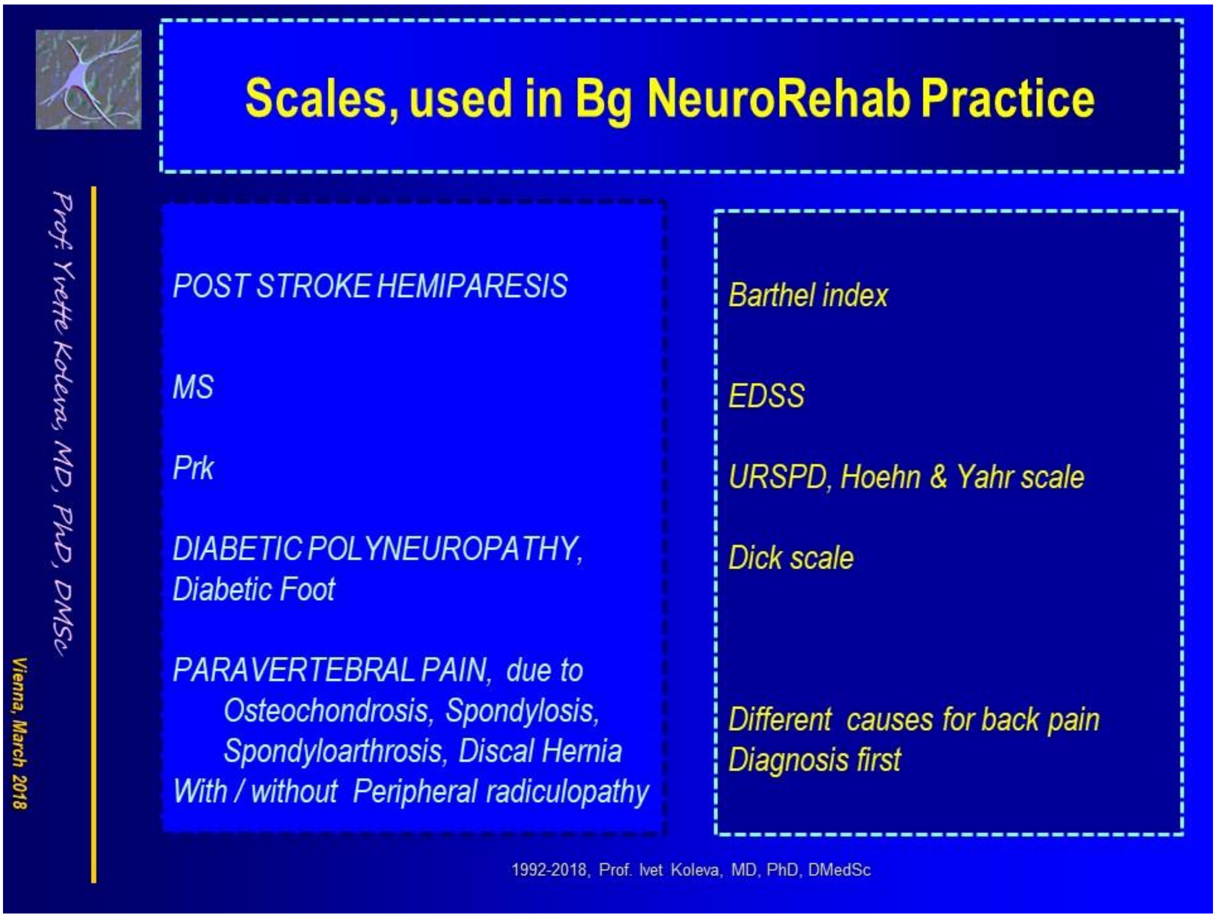

SPECIALIZED EXAMINATION SCALES :
STROKE – Brunnstrom scale; scale of Michels; Barthell index; spasticity scale;
PARKINSON – URSPD, Scale of Hoehn & Yahr;
MULTIPLE SCLEROSIS - EDSS or Kurtzke scale;
PARAPARESIS – the Barthell index;
Diabetic polyneuropathy – Dyck scale (modified);
Radiculopathies – Drivotinov, Pozniak & Lupian scale;
Metabolic syndrome – BMI, Obesity scales.
Prof. Yvette Koleva, MD, PhD, DMSc
Vienna, March 2018
1992-2018, Prof. Ivet Koleva, MD, PhD, DMedSc


LIST OF TOPICS
Prof. Yvette Koleva, MD, PhD, DMSc
PAIN – contemporaneous concepts
PAIN MANAGEMENT ALGORITHM
PHYSICAL ANALGESIA – methods & mechanisms
NEUROREHABILITATION ALGORITHMS for PAIN MANAGEMENT
OUR OWN CLINICAL EXPERIENCE
CONCLUSION (Physical analgesia: pro's & contra's)
Vienna, March 2018
Pain Management

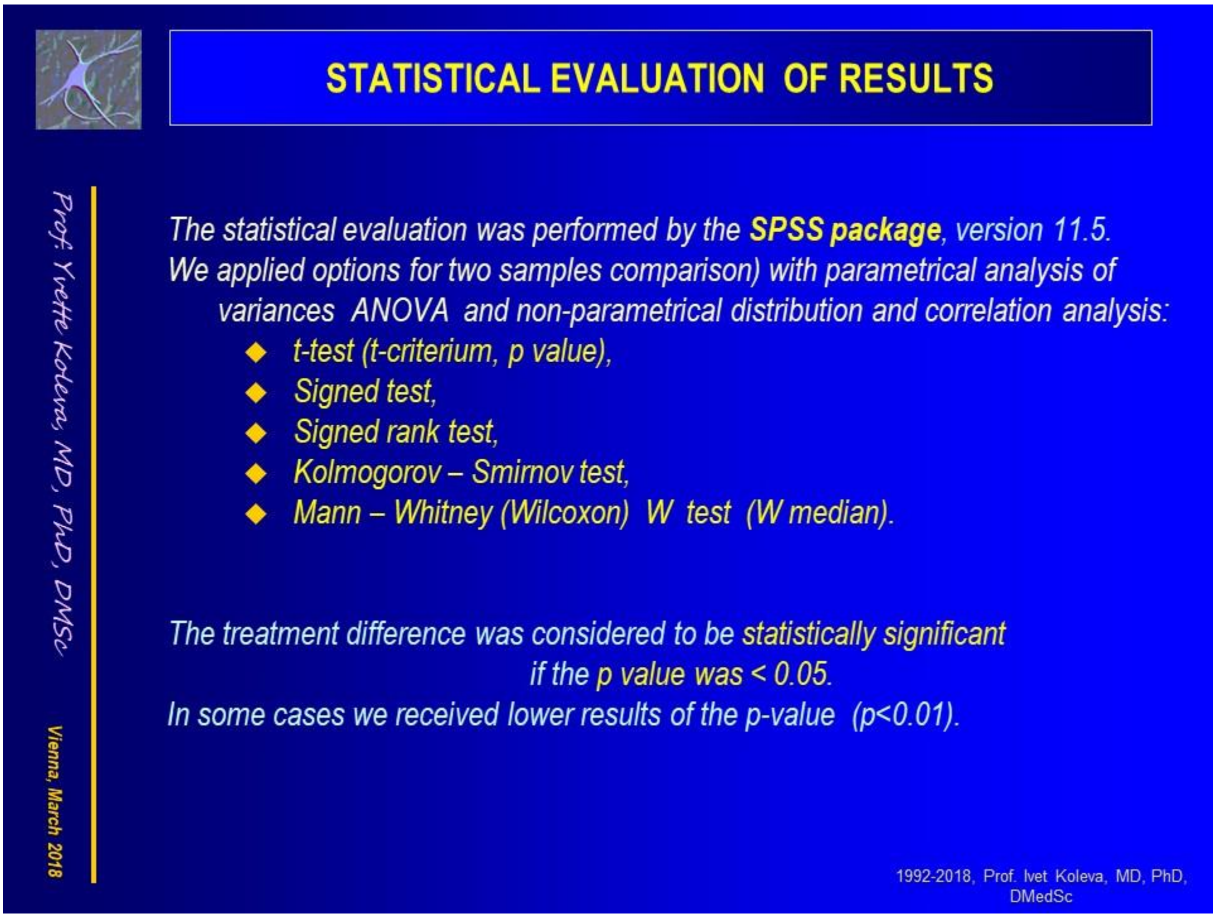

OBJECTIF / GOAL:
Prof. Yvette Koleva, MD, PhD, DMSc
Comparative evaluation between the efficacy of pure drug therapy, physical analgesia and combined anti-pain therapy (drug and physical analgesia) on different types of pain:
Spastic pain;
Rigidity pain;
Hemiparetic shoulder;
Paravertebral (upper & low back) pain;
Radicular neuropathic pain;
Diabetic polyneuropathy pain;
Arthrosis pain;
Arthritis pain;
Scoliotic pain;
Post-traumatic pain;
Phantom pain.
Drug or / and Physical ANALGESIA ?
That's the question ...
Vienna, March 2018
1992-2018, Prof. Ivet Koleva, MD, PhD, DMedSc

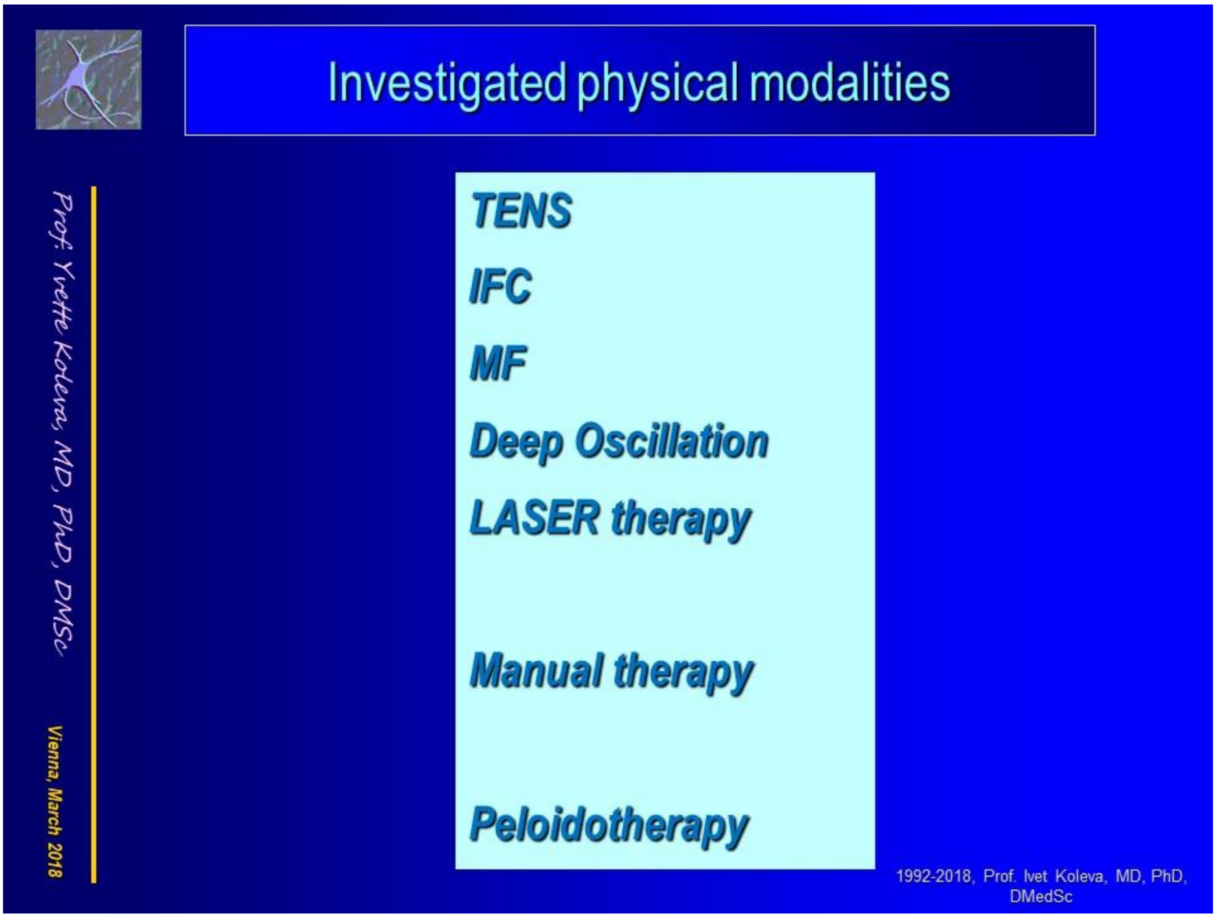

DESIGN OF OUR STUDIES:
Randomized investigation of the period 1989-2018.
Patients were treated in 11 different PRM Departments in 2 Bulgarian cities (Sofia & Pleven):
In-patients of 5 hospital's Departments / Clinics:
the National Specialized Hospital for physical therapy and Rehabilitation – Sofia (1989-2006);
the PRM Clinic of the University Hospital of Pleven (2006-2011);
the PRM Clinic of the University Hospital 'St Ivan Rilsky' – Sofia (2012 - 2014)];
the Rehabilitation hospital 'Yasen' – Sofia, Bankya (2014 – 2015 & 2017-2018)];
the PRM Clinic of the University Hospital 'Ste Anna' – Sofia (2016-2017) ; &
Out-patients of 6 medical ambulatory centres :
In Sofia - VI MC /2001-2002/, MC „Aqua" /2003-2004/ & MC „Vitalis" /2004-2009/, MC 'St Ivan Rilsky' /2012-2013/; MC 'St Thomas'/2013-2018/ &
In Pleven (MC „Pleven" – 2006-2011)].
Prof. Yvette Koleva, MD, PhD, DMSc
Vienna, March 2018

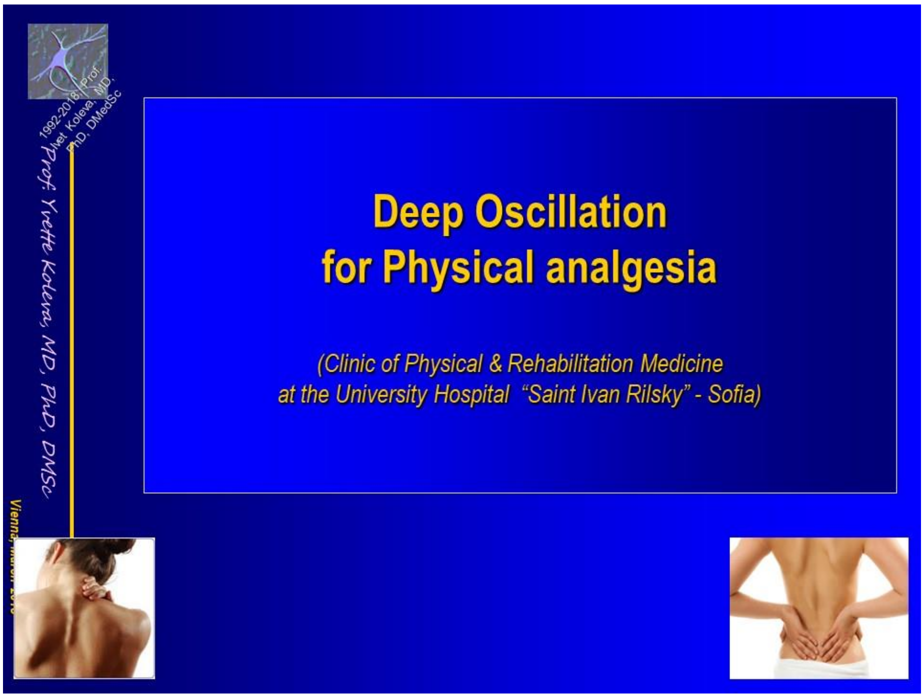

Protocol for registration of patients' data
Clinical data: somatic examination, neurological exam, kinesiological assessment, manual muscle test, assessment of muscle dysbalance, functional exam /incl. functional muscle test/; algesic diagnostics /Visual analogue scale – VAS 0-20/; Lassegue' sign; vibratory sensibility, thermo-sensibility, neuro-psychological battery /tests of Zung – for depression and anxiety/;
Instumental data: excitomotory electrodiagnostics, electroneurography, electromyography, neuro-imagery (X-ray /face and profile graphy of lumbar spine, CT of levels Th12-L1, L4-5, L5-S1; MRI of the thoraco-lumbar spine); in some cases – doppler sonometry, laser doppler flowmetry.
Effects of different PRM departments were not analyzed.
1992-2018, Prof. Ivet Koleva, MD, PhD, DMedSc
Prof. Yvette Koleva, MD, PhD, DMSc
Vienna, March 2018

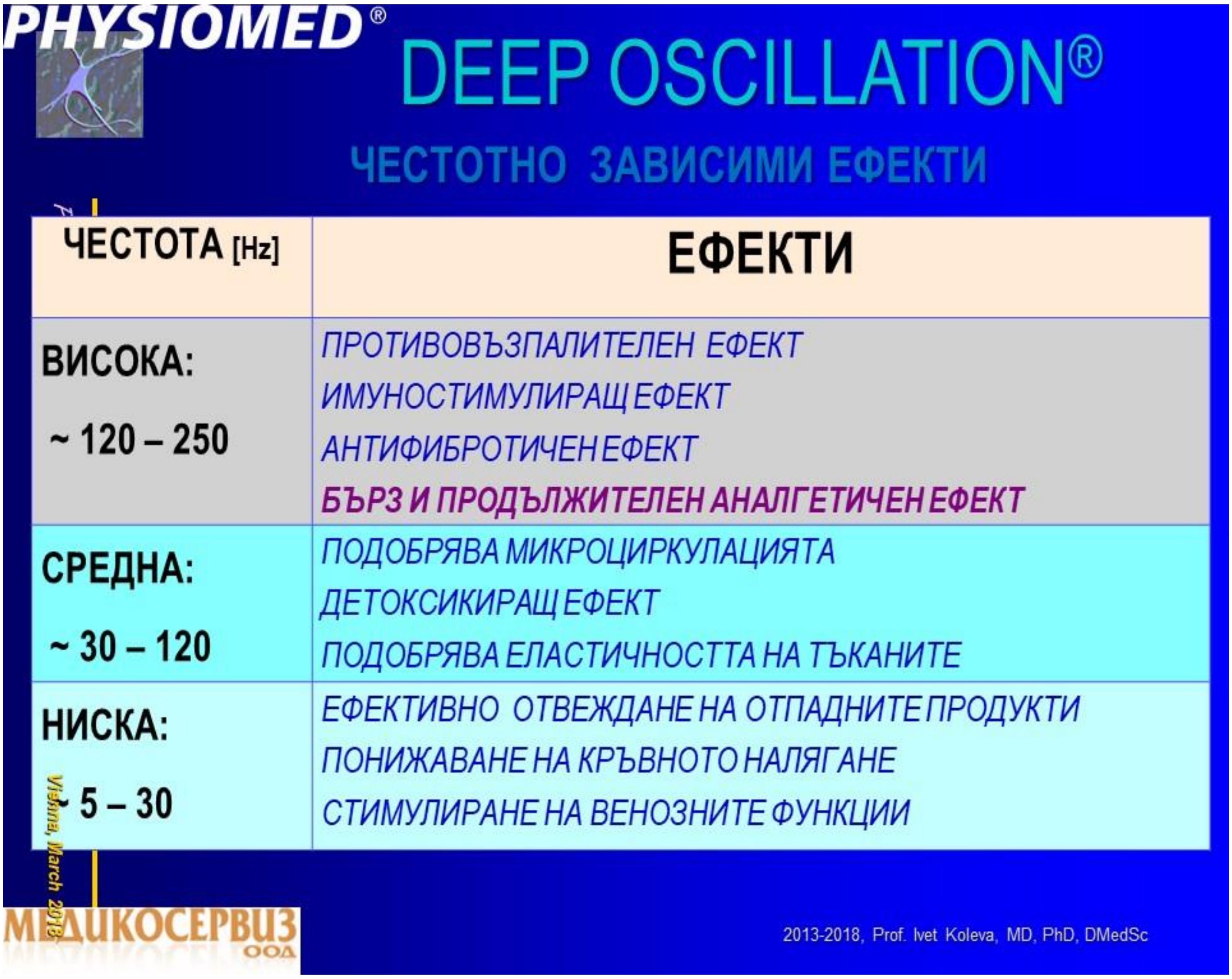

Scales, used in Bg NeuroRehab Practice
POST STROKE HEMIPARESIS
MS
Prk
DIABETIC POLYNEUROPATHY, Diabetic Foot
PARAVERTEBRAL PAIN, due to Osteochondrosis, Spondylosis, Spondyloarthrosis, Discal Hernia With / without Peripheral radiculopathy
Barthel index
EDSS
URSPD, Hoehn & Yahr scale
Dick scale
Different causes for back pain Diagnosis first
Prof. Yvette Koleva, MD, PhD, DMSc
Vienna, March 2018
1992-2018, Prof. Ivet Koleva, MD, PhD, DMedSc

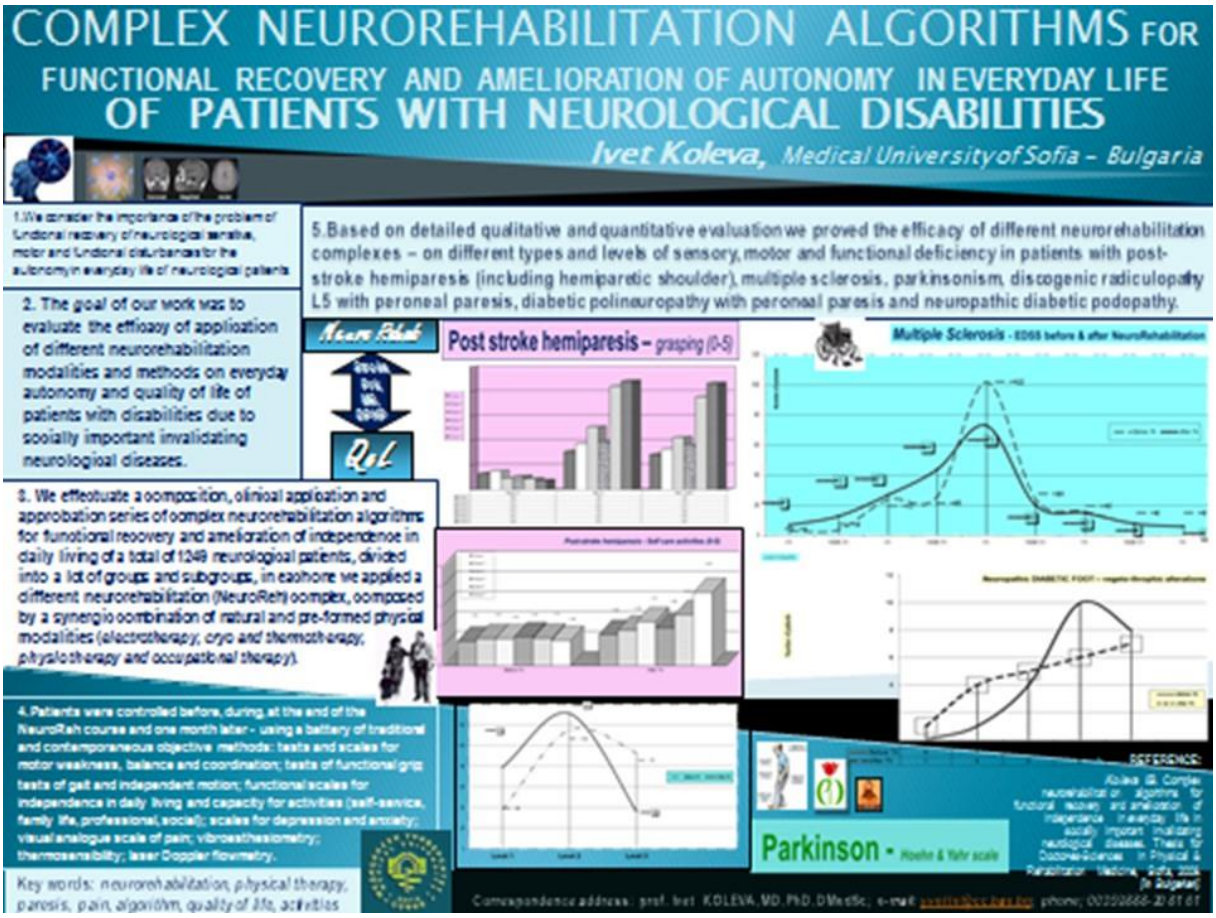

1992-2018, Prof. Ivet Koleva, MD, PhD, DMedSc
During our investigations,
we examined our patients
before and after treatment and one month later :
according the respective PROTOCOL.
Prof. Yvette Koleva, MD, PhD, DMSc
Vienna, March 2018

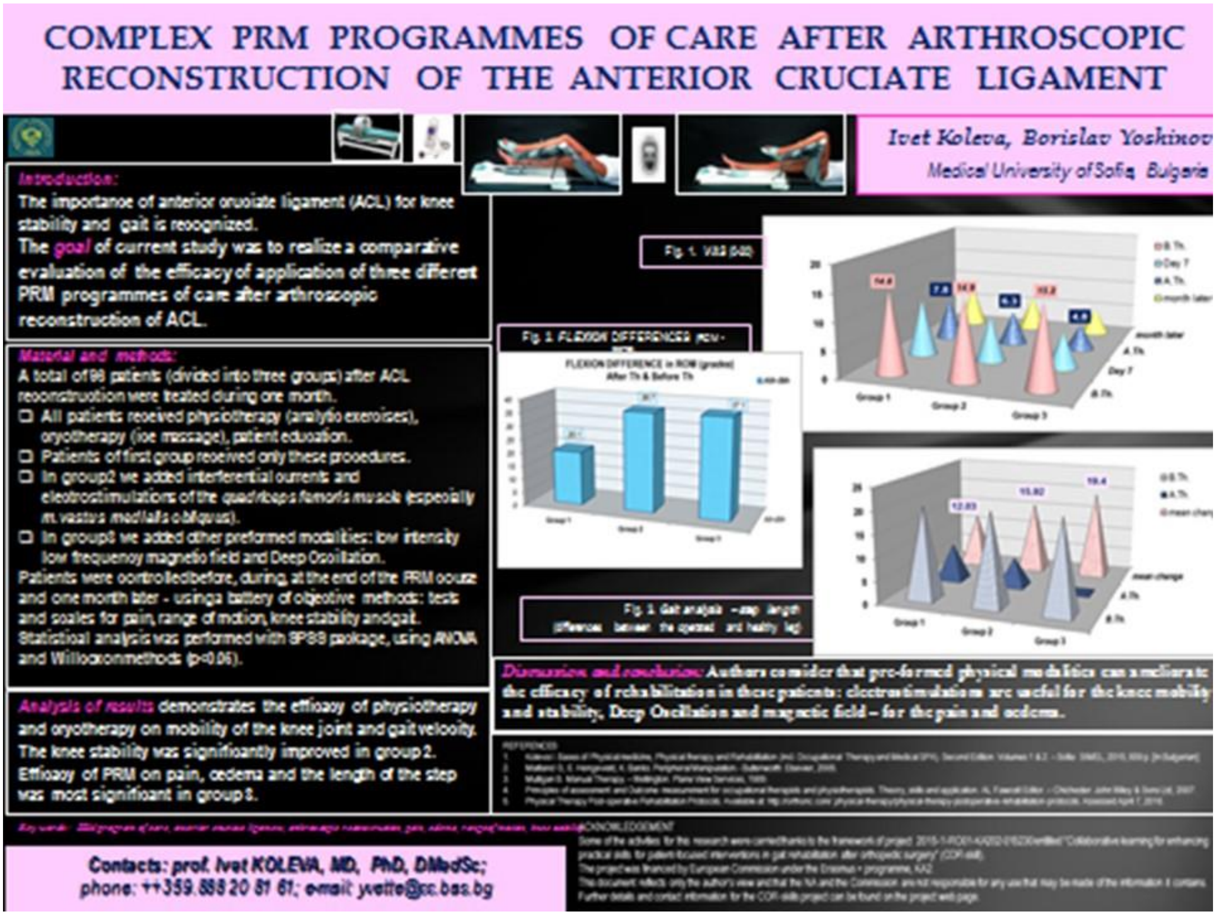

STATISTICAL EVALUATION OF RESULTS
The statistical evaluation was performed by the SPSS package, version 11.5.
We applied options for two samples comparison) with parametrical analysis of variances ANOVA and non-parametrical distribution and correlation analysis:
t-test (t-criterium, p value),
Signed test,
Signed rank test,
Kolmogorov – Smirnov test,
Mann – Whitney (Wilcoxon) W test (W median).
The treatment difference was considered to be statistically significant if the p value was < 0.05.
In some cases we received lower results of the p-value (p<0.01).
Prof. Yvette Koleva, MD, PhD, DMSc
Vienna, March 2018
1992-2018, Prof. Ivet Koleva, MD, PhD, DMedSc

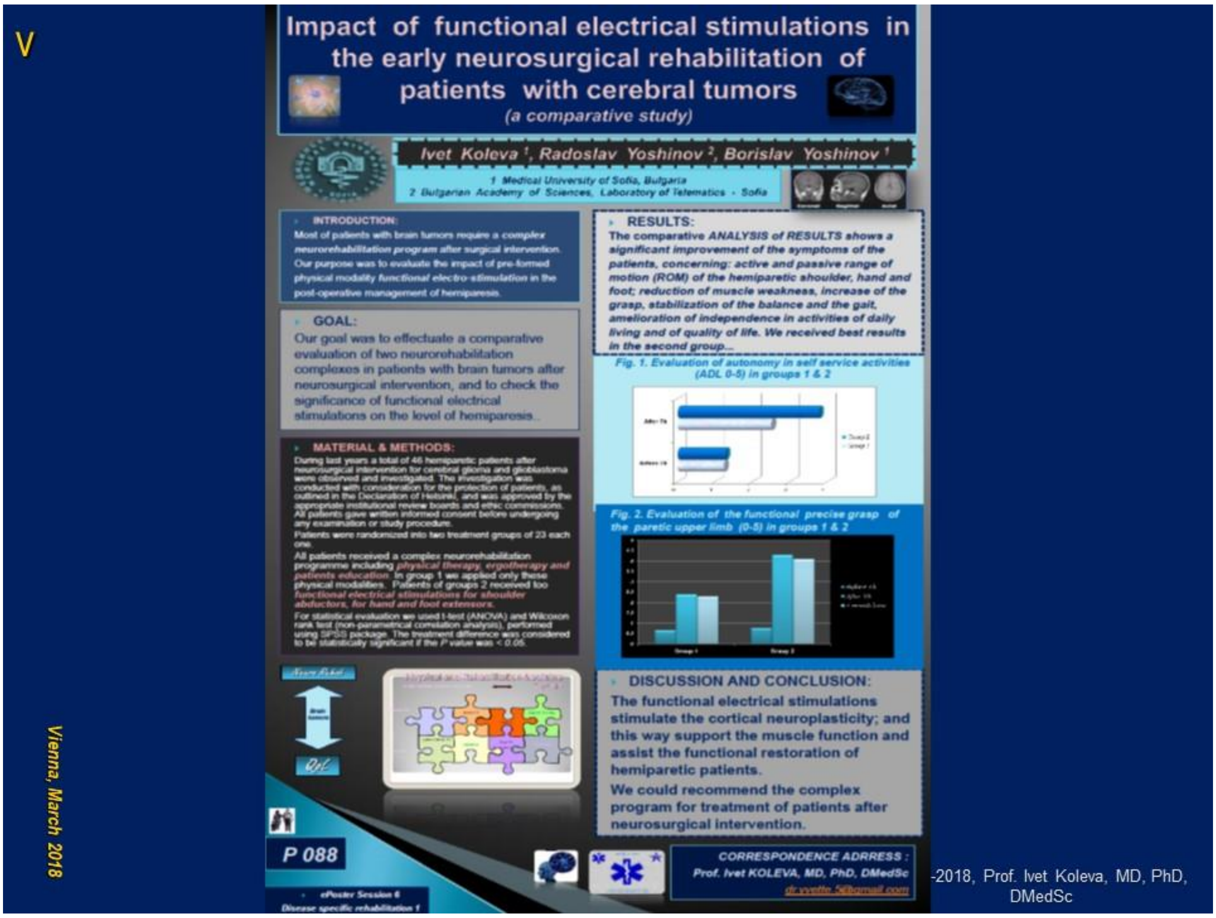

Investigated physical modalities
TENS
IFC
MF
Deep Oscillation
LASER therapy
Manual therapy
Peloidotherapy
Prof. Yvette Koleva, MD, PhD, DMSc
Vienna, March 2018
1992-2018, Prof. Ivet Koleva, MD, PhD, DMedSc

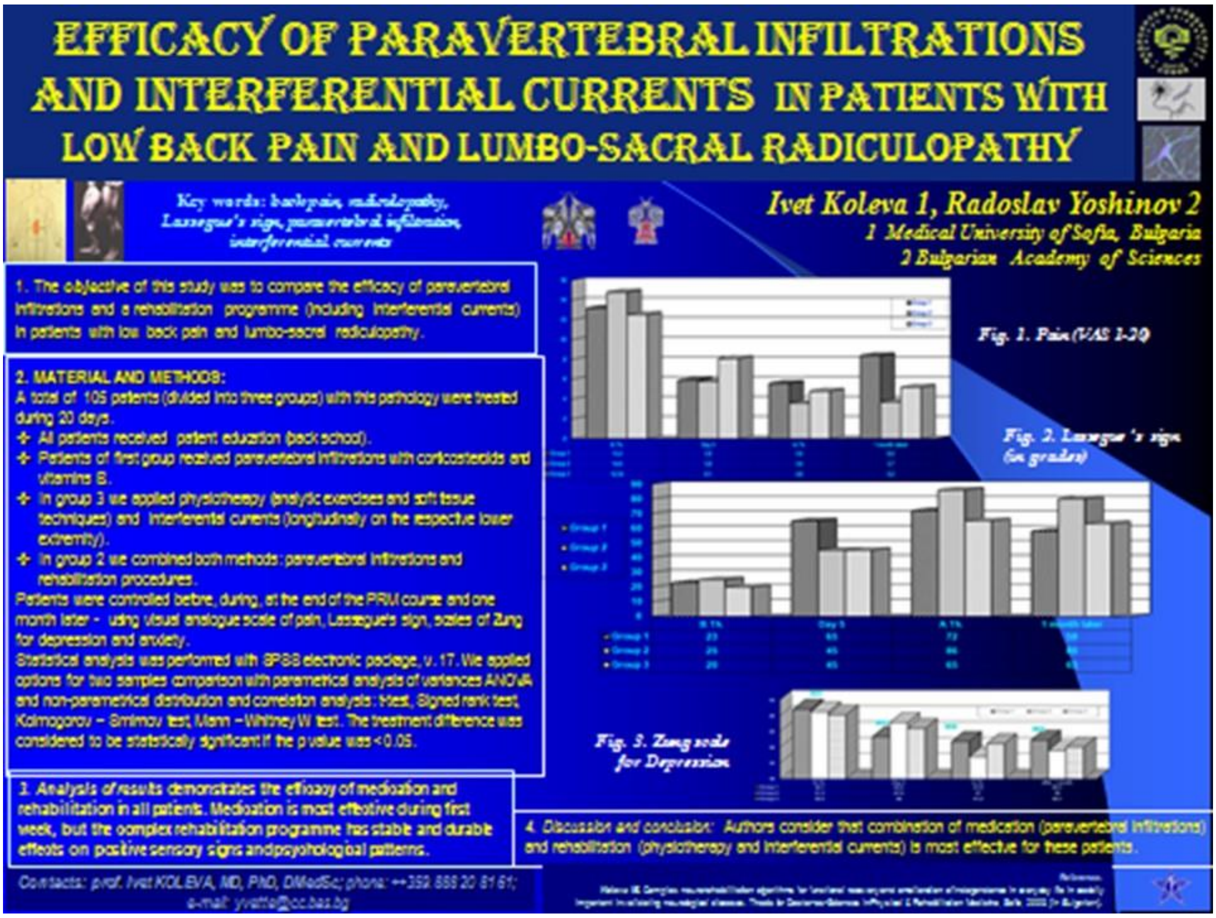

1992-2018, Prof. Ivet Koleva, MD, PhD, DMedSc
Prof. Yvette Koleva, MD, PhD, DMSc
Deep Oscillation
for Physical analgesia
(Clinic of Physical & Rehabilitation Medicine
at the University Hospital "Saint Ivan Rilsky" - Sofia)

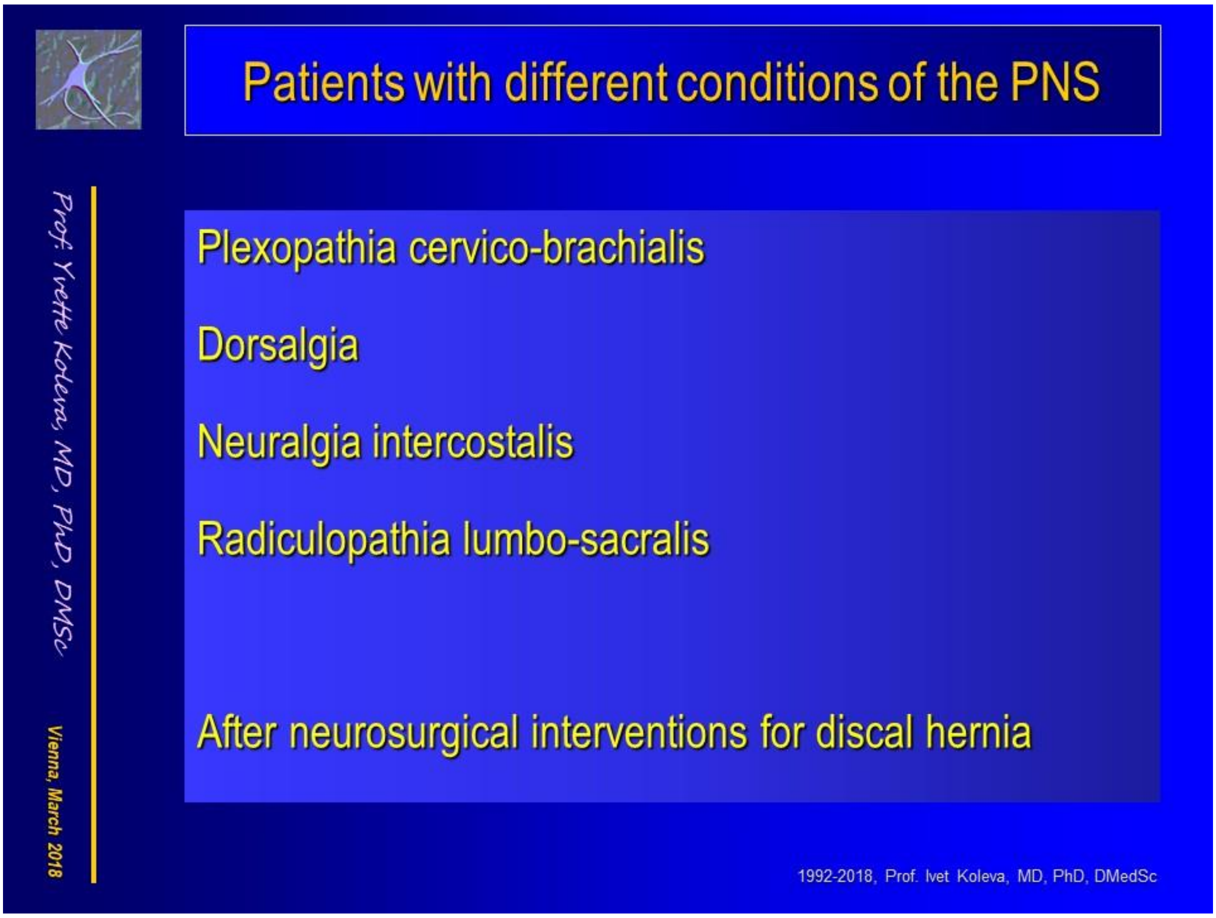

PHYSIOMED®
DEEP OSCILLATION®
ЧЕСТОТНО ЗАВИСИМИ ЕФЕКТИ
ЧЕСТОТА [Hz]
ЕФЕКТИ
ВИСОКА:
~ 120 – 250
ПРОТИВОВЪЗПАЛИТЕЛЕН ЕФЕКТ
ИМУНОСТИМУЛИРАЩ ЕФЕКТ
АНТИФИБРОТИЧЕН ЕФЕКТ
БЪРЗ И ПРОДЪЛЖИТЕЛЕН АНАЛГЕТИЧЕН ЕФЕКТ
СРЕДНА:
~ 30 – 120
ПОДОБРЯВА МИКРОЦИРКУЛАЦИЯТА
ДЕТОКСИКИРАЩ ЕФЕКТ
ПОДОБРЯВА ЕЛАСТИЧНОСТТА НА ТЪКАНИТЕ
НИСКА:
~ 5 – 30
ЕФЕКТИВНО ОТВЕЖДАНЕ НА ОТПАДНИТЕ ПРОДУКТИ
ПОНИЖАВАНЕ НА КРЪВНОТО НАЛЯГАНЕ
СТИМУЛИРАНЕ НА ВЕНОЗНИТЕ ФУНКЦИИ
Vienna, March 2018
МЕДИКОСЕРВИЗ ООД
2013-2018, Prof. Ivet Koleva, MD, PhD, DMedSc


COMPLEX NEUROREHABILITATION ALGORITHMS FOR FUNCTIONAL RECOVERY AND AMELIORATION OF AUTONOMY IN EVERYDAY LIFE OF PATIENTS WITH NEUROLOGICAL DISABILITIES
Ivet Koleva, Medical University of Sofia - Bulgaria
5. Based on detailed qualitative and quantitative evaluation we proved the efficacy of different neurorehabilitation complexes – on different types and levels of sensory, motor and functional deficiency in patients with post-stroke hemiparesis (including hemiparetic shoulder), multiple sclerosis, parkinsonism, discogenic radiculopathy L5 with peroneal paresis, diabetic polineuropathy with peroneal paresis and neuropathic diabetic podopathy.
2. The goal of our work was to evaluate the efficacy of application of different neurorehabilitation modalities and methods on everyday autonomy and quality of life of patients with disabilities due to socially important invalidating neurological diseases.
Post stroke hemiparesis – grasping (0-5)
Multiple Sclerosis
QoL
3. We effectuate a composition, clinical application and approbation series of complex neurorehabilitation algorithms for functional recovery and amelioration of independence in daily living of a total of 1249 neurological patients, divided into a lot of groups and subgroups, in each one we applied a different neurorehabilitation (NeuroReh) complex, composed by a synergic combination of natural and pre-formed physical modalities (electrotherapy; cryo and thermotherapy; physiotherapy and occupational therapy).
Parkinson - Hoehn & Yahr scale
REFERENCE:
Key words: neurorehabilitation, physical therapy, paresis, pain, algorithm, quality of life, activities


COMPLEX PRM PROGRAMMES OF CARE AFTER ARTHROSCOPIC RECONSTRUCTION OF THE ANTERIOR CRUCIATE LIGAMENT
Ivet Koleva, Borislav Yoshinov
Medical University of Sofia, Bulgaria
Introduction:
The importance of anterior cruciate ligament (ACL) for knee stability and gait is recognized.
The goal of current study was to realize a comparative evaluation of the efficacy of application of three different PRM programmes of care after arthroscopic reconstruction of ACL.
Material and methods:
A total of 96 patients (divided into three groups) after ACL reconstruction were treated during one month.
All patients received physiotherapy (analytic exercises), cryotherapy (ice massage), patient education.
Patients of first group received only these procedures.
In group2 we added interferential currents and electrostimulations of the quadriceps femoris muscle (especially m. vastus medialis obliquus).
In group3 we added other preformed modalities: low intensity low frequency magnetic field and Deep Oscillation.
Patients were controlled before, during, at the end of the PRM course and one month later - using a battery of objective methods: tests and scales for pain, range of motion, knee stability and gait.
Statistical analysis was performed with SPSS package, using ANOVA and Willcoxon methods (p<0.05).
Analysis of results demonstrates the efficacy of physiotherapy and cryotherapy on mobility of the knee joint and gait velocity.
The knee stability was significantly improved in group 2.
Efficacy of PRM on pain, oedema and the length of the step was most significant in group 3.
Fig. 1. VAS (0-10)
Fig. 2. FLEXION DIFFERENCES
Discussion and conclusion: Authors consider that pre-formed physical modalities can ameliorate the efficacy of rehabilitation in these patients: electrostimulations are useful for the knee mobility and stability, Deep Oscillation and magnetic field – for the pain and oedema.
Contacts: prof. Ivet KOLEVA, MD, PhD, DMedSc; phone: ++359 888 20 81 61; e-mail: yvette@cc.bas.bg


V
Impact of functional electrical stimulations in the early neurosurgical rehabilitation of patients with cerebral tumors
(a comparative study)
Ivet Koleva 1, Radoslav Yoshinov 2, Borislav Yoshinov 1
1 Medical University of Sofia, Bulgaria
2 Bulgarian Academy of Sciences, Laboratory of Telematics - Sofia
INTRODUCTION:
Most of patients with brain tumors require a complex neurorehabilitation program after surgical intervention. Our purpose was to evaluate the impact of pre-formed physical modality functional electro-stimulation in the post-operative management of hemiparesis.
GOAL:
Our goal was to effectuate a comparative evaluation of two neurorehabilitation complexes in patients with brain tumors after neurosurgical intervention, and to check the significance of functional electrical stimulations on the level of hemiparesis.
MATERIAL & METHODS:
RESULTS:
The comparative ANALYSIS of RESULTS shows a significant improvement of the symptoms of the patients, concerning: active and passive range of motion (ROM) of the hemiparetic shoulder, hand and foot; reduction of muscle weakness, increase of the grasp, stabilization of the balance and the gait, amelioration of independence in activities of daily living and of quality of life. We received best results in the second group...
Fig. 1. Evaluation of autonomy in self service activities (ADL 0-5) in groups 1 & 2
Fig. 2. Evaluation of the functional precise grasp of the paretic upper limb (0-5) in groups 1 & 2
DISCUSSION AND CONCLUSION:
The functional electrical stimulations stimulate the cortical neuroplasticity; and this way support the muscle function and assist the functional restoration of hemiparetic patients.
We could recommend the complex program for treatment of patients after neurosurgical intervention.
Vienna, March 2018
P 088
CORRESPONDENCE ADRRESS :
Prof. Ivet KOLEVA, MD, PhD, DMedSc
-2018, Prof. Ivet Koleva, MD, PhD, DMedSc

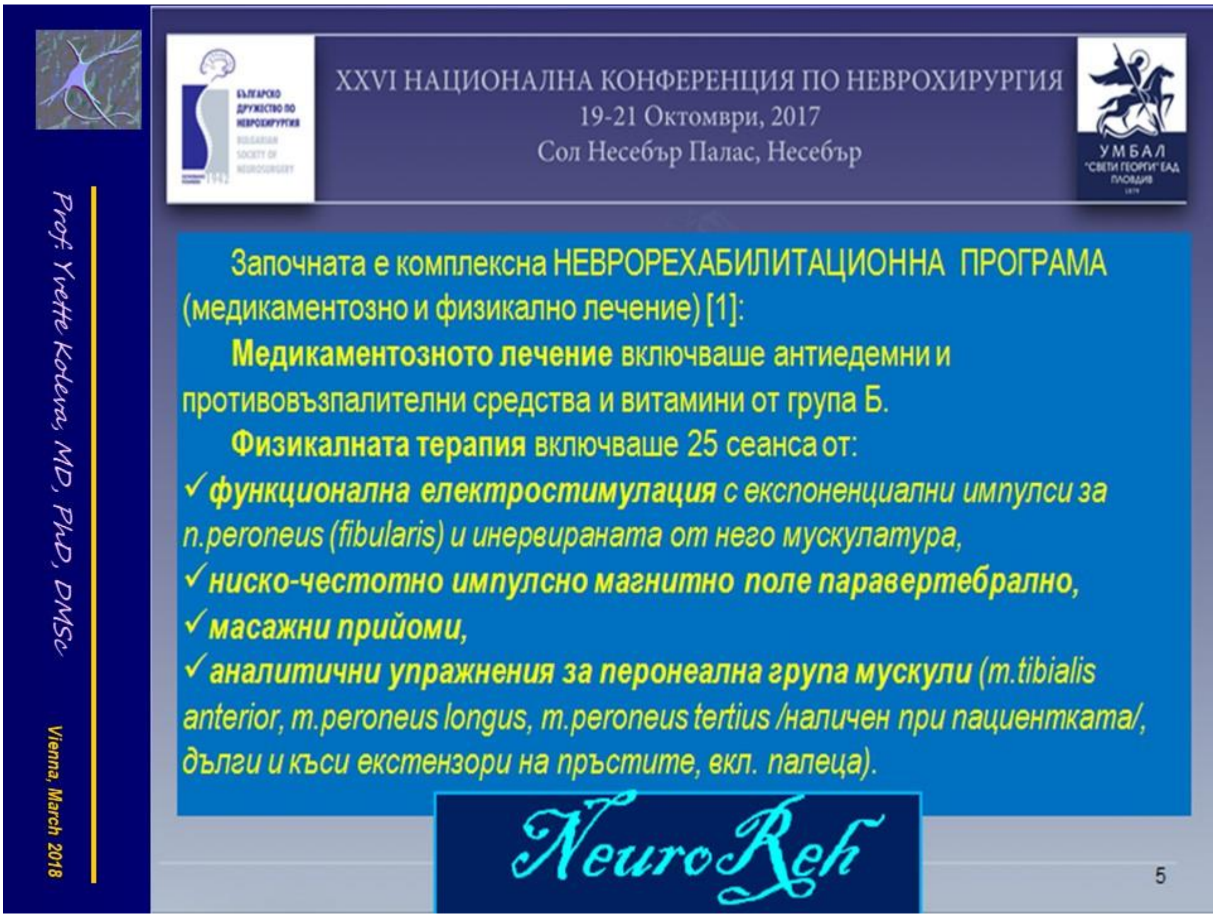

EFFICACY OF PARAVERTEBRAL INFILTRATIONS AND INTERFERENTIAL CURRENTS IN PATIENTS WITH LOW BACK PAIN AND LUMBO-SACRAL RADICULOPATHY
Key words: backpain, radiculopathy, Lasegue's sign, paravertebral infiltration, interferential currents
Ivet Koleva 1, Radoslav Yoshinov 2
1 Medical University of Sofia, Bulgaria
2 Bulgarian Academy of Sciences
1. The objective of this study was to compare the efficacy of paravertebral infiltrations and a rehabilitation programme (including interferential currents) in patients with low back pain and lumbo-sacral radiculopathy.
2. MATERIAL AND METHODS:
A total of 105 patients (divided into three groups) with this pathology were treated during 20 days.
All patients received patient education (back school).
Patients of first group received paravertebral infiltrations with corticosteroids and vitamins B.
In group 3 we applied physiotherapy (analytic exercises and soft tissue techniques) and interferential currents (longitudinally on the respective lower extremity).
In group 2 we combined both methods: paravertebral infiltrations and rehabilitation procedures.
Patients were controlled before, during, at the end of the PRM course and one month later - using visual analogue scale of pain, Lasegue's sign, scales of Zung for depression and anxiety.
Statistical analysis was performed with SPSS electronic package, v. 17. We applied options for two samples comparison with parametrical analysis of variances ANOVA and non-parametrical distribution and correlation analysis: t-test, Signed rank test, Kolmogorov – Smirnov test, Mann –Whitney W test. The treatment difference was considered to be statistically significant if the p value was < 0.05.
3. Analysis of results demonstrates the efficacy of medication and rehabilitation in all patients. Medication is most effective during first week, but the complex rehabilitation programme has stable and durable effects on positive sensory signs and psychological patterns.
Fig. 1. Pain (VAS 1-20)
Fig. 2. Lasegue's sign (in grades)
Fig. 3. Zung scale for Depression
4. Discussion and conclusion: Authors consider that combination of medication (paravertebral infiltrations) and rehabilitation (physiotherapy and interferential currents) is most effective for these patients.
Contacts: prof. Ivet KOLEVA, MD, PhD, DMedSc; phone: ++359 888 20 81 61;
e-mail: yvette@cc.bas.bg

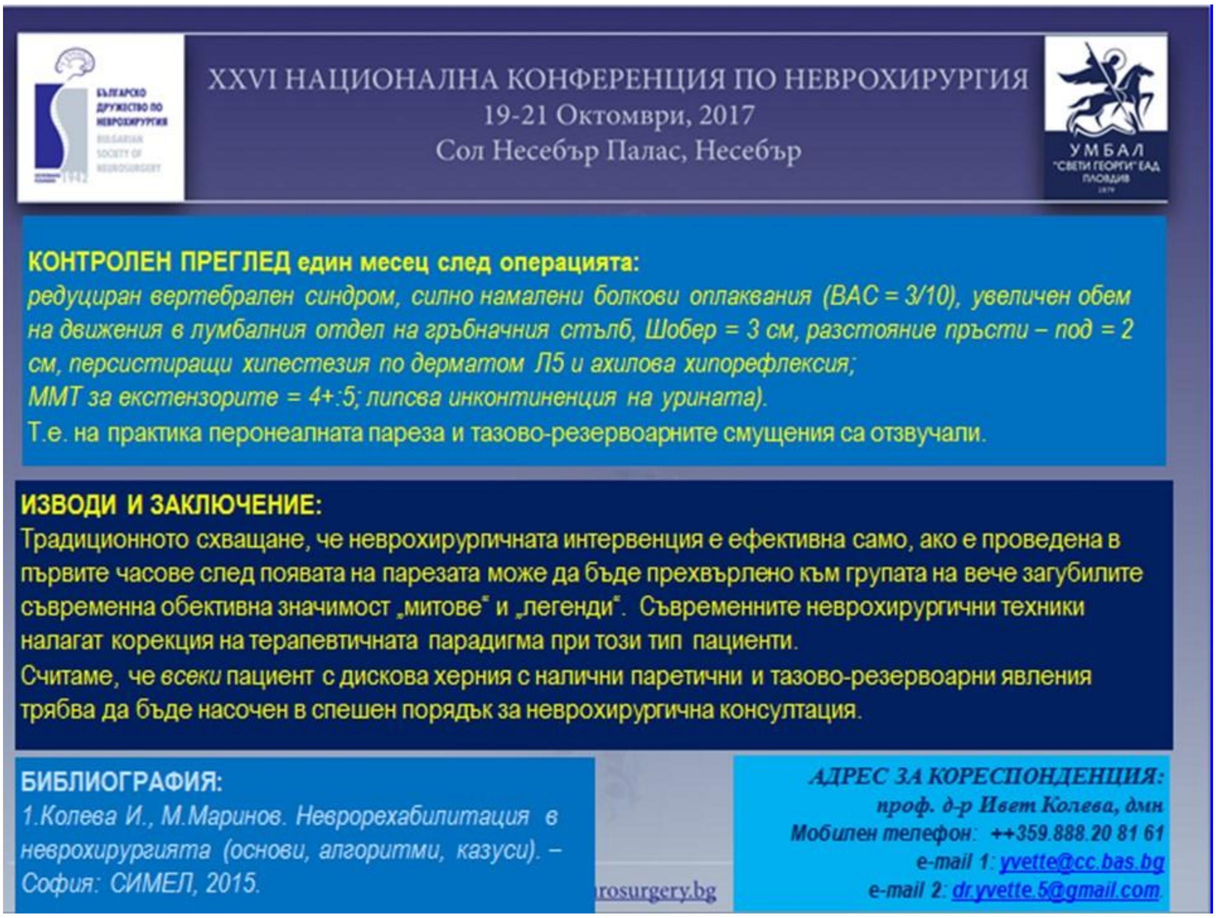

Patients with different conditions of the PNS
Plexopathia cervico-brachialis
Dorsalgia
Neuralgia intercostalis
Radiculopathia lumbo-sacralis
After neurosurgical interventions for discal hernia
Prof. Yvette Koleva, MD, PhD, DMSc
Vienna, March 2018
1992-2018, Prof. Ivet Koleva, MD, PhD, DMedSc

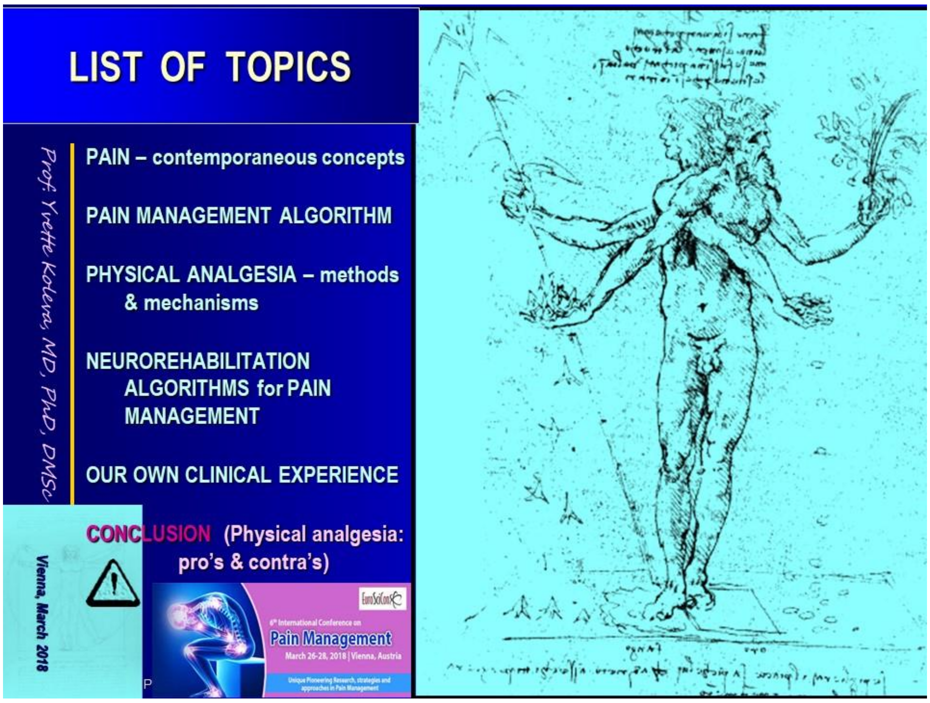

DPNP + DF
Polyneuropathia diabetica – Marchal de Calvi type
Diabetic foot
Prof. Yvette Koleva, MD, PhD, DMSc
Vienna, March 2018
1992-2018, Prof. Ivet Koleva, MD, PhD, DMedSc

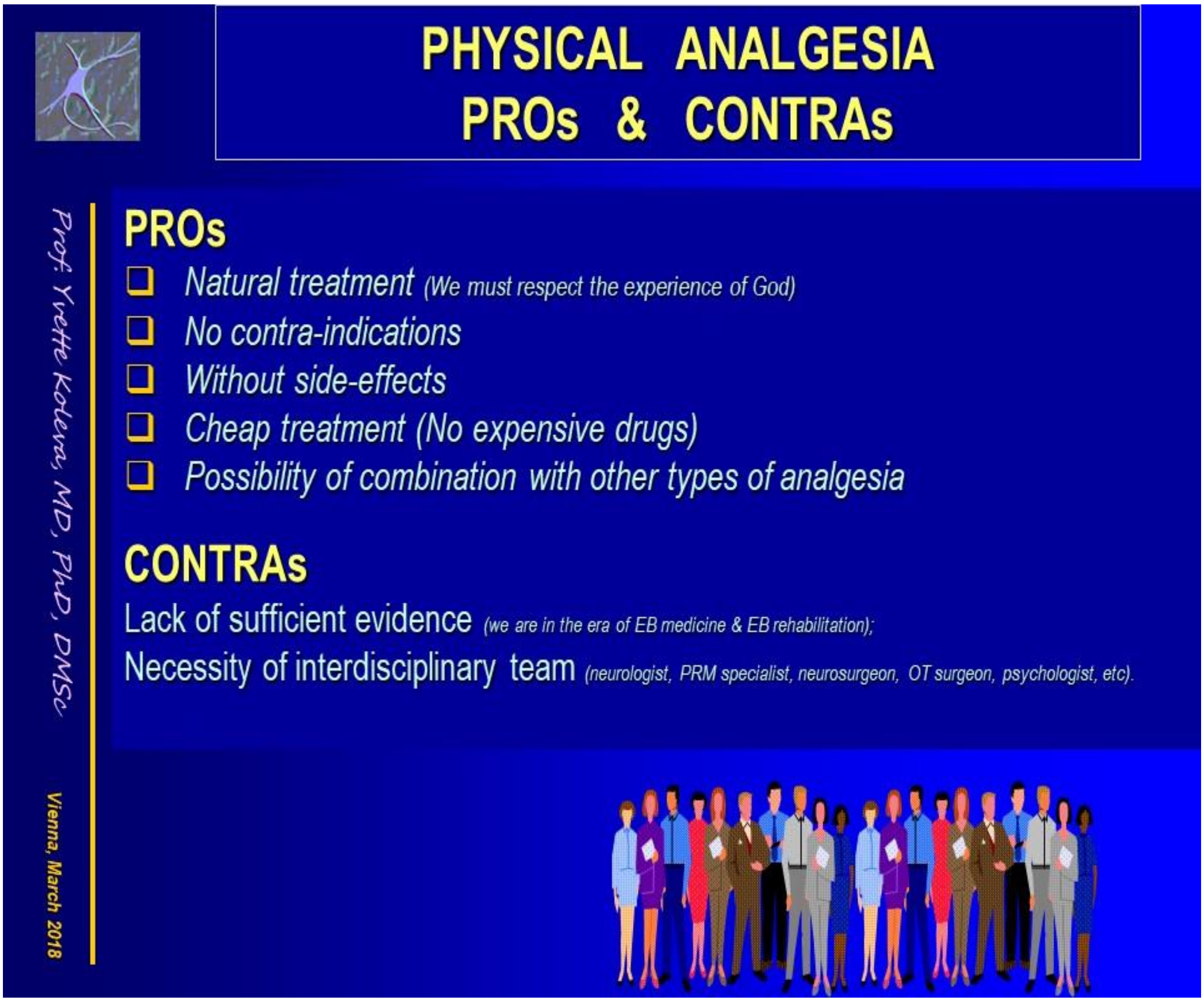

After neurosurgical intervention for a discal hernia
Prof. Yvette Koleva, MD, PhD, DMSc
Vienna, March 2018
XXVI НАЦИОНАЛНА КОНФЕРЕНЦИЯ ПО НЕВРОХИРУРГИЯ
19-21 Октомври, 2017
Сол Несебър Палас, Несебър
УМБАЛ "СВЕТИ ГЕОРГИ" ЕАД ПЛОВДИВ
Представяме клиничен случай: 35-годишна пациентка с диагностицирана дискова херния на ниво L5-S1, с перонеална пареза и императивни позиви за уриниране, консултирана от неврохирург седмица след появата на парезата.
Проведена е оперативна интервенция (cage) в спешен порядък. На фигури 1 и 2 са показани невроизобразяващите изследвания на пациентката преди интервенцията (КАТ и ЯМР), а на фигури 3 и 4 – следоперативните рентгенографии – в легнало и в изправено положение.
Before the operation
Computer tomography
Fig. 1
Before the operation
MRI
Fig. 2
bns2017.neurosurgery.bg
3


Prof. Yvette Koleva, MD, PhD, DMSc
Vienna, March 2018
XXVI НАЦИОНАЛНА КОНФЕРЕНЦИЯ ПО НЕВРОХИРУРГИЯ
19-21 Октомври, 2017
Сол Несебър Палас, Несебър
УМБАЛ
AFTER SURGERY
X-ray
Fig. 3
AFTER SURGERY
X-ray
Fig. 4
На втория следоперативен ден е проведена консултация с невролог и специалист по Физикална и рехабилитационна медицина.
ОБЕКТИВНО:
➤ Вертебрален синдром – тълен, умерено изразен, в лумбалния дял на гръбначния стълб (налични: паравертебрален мускулен спазъм, изгладена лумбална лордоза, набелязана S-образна сколиоза, силно ограничен обем на движения в лумбален дял, тест на Шобер – 0 см, разстояние пръсти – под = 32 см); Нарушена статика на торакален отдел;
➤ Монорадикулерен синдром по L5 коренче вдясно – с възбудна сетивна и отпадна сетивна, рефлексна и двигателна симптоматика (болка – оценка по Визуално-аналогова скала /ВАС/ = 7/10, изтръпване и мравучкане по задно-страничната повърхност на десния долен крайник с ирацация по палеца, хипестезия по L5-дерматом вдясно, ахилова хипорефлексия към арефлексия вдясно, слабост на екстензията на дясно стъпало и пръсти, Мануално мускулно тестуване за екстензорите на стъпалото и пръстите = 3/5).
➤ Тазово-резервоарни смущения по типа на инконтиненцията (по анамнестични данни предоперативно налична incontinentio urinae) - с остатъчни императивни позиви за уриниране.
bns2017.neurosurgery.bg
4


XXVI НАЦИОНАЛНА КОНФЕРЕНЦИЯ ПО НЕВРОХИРУРГИЯ
19-21 Октомври, 2017
Сол Несебър Палас, Несебър
Prof. Yvette Koleva, MD, PhD, DMSc
Vienna, March 2018
УМБАЛ "СВЕТИ ГЕОРГИ" ЕАД ПЛОВДИВ
Започната е комплексна НЕВРОРЕХАБИЛИТАЦИОННА ПРОГРАМА (медикаментозно и физикално лечение) [1]:
Медикаментозното лечение включваше антиедемни и противовъзпалителни средства и витамини от група Б.
Физикалната терапия включваше 25 сеанса от:
✓функционална електростимулация с експоненциални импулси за n.peroneus (fibularis) и инервираната от него мускулатура,
✓ниско-честотно импулсно магнитно поле паравертебрално,
✓масажни прийоми,
✓аналитични упражнения за перонеална група мускули (m.tibialis anterior, m.peroneus longus, m.peroneus tertius /наличен при пациентката/, дълги и къси екстензори на пръстите, вкл. палеца).
NeuroReh
5


XXVI НАЦИОНАЛНА КОНФЕРЕНЦИЯ ПО НЕВРОХИРУРГИЯ
19-21 Октомври, 2017
Сол Несебър Палас, Несебър
УМБАЛ "СВЕТИ ГЕОРГИ" ЕАД ПЛОВДИВ
КОНТРОЛЕН ПРЕГЛЕД един месец след операцията:
редуциран вертебрален синдром, силно намалени болкови оплаквания (ВАС = 3/10), увеличен обем на движения в лумбалния отдел на гръбначния стълб, Шобер = 3 см, разстояние пръсти – под = 2 см, персистиращи хипестезия по дерматом Л5 и ахилова хипорефлексия;
ММТ за екстензорите = 4+:5; липсва инконтиненция на урината).
Т.е. на практика перонеалната пареза и тазово-резервоарните смущения са отзвучали.
ИЗВОДИ И ЗАКЛЮЧЕНИЕ:
Традиционното схващане, че неврохирургичната интервенция е ефективна само, ако е проведена в първите часове след появата на парезата може да бъде прехвърлено към групата на вече загубилите съвременна обективна значимост „митове" и „легенди". Съвременните неврохирургични техники налагат корекция на терапевтичната парадигма при този тип пациенти.
Считаме, че всеки пациент с дискова херния с налични паретични и тазово-резервоарни явления трябва да бъде насочен в спешен порядък за неврохирургична консултация.
БИБЛИОГРАФИЯ:
1.Колева И., М.Маринов. Неврорехабилитация в неврохирургията (основи, алгоритми, казуси). – София: СИМЕЛ, 2015.
АДРЕС ЗА КОРЕСПОНДЕНЦИЯ:
проф. д-р Ивет Колева, дмн
Мобилен телефон: ++359.888.20 81 61
e-mail 1: yvette@cc.bas.bg
e-mail 2: dr.yvette.5@gmail.com

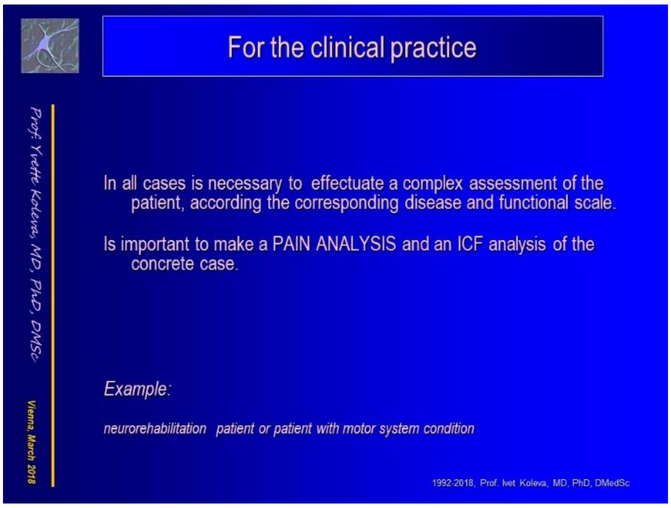

LIST OF TOPICS
PAIN – contemporaneous concepts
PAIN MANAGEMENT ALGORITHM
PHYSICAL ANALGESIA – methods & mechanisms
NEUROREHABILITATION ALGORITHMS for PAIN MANAGEMENT
OUR OWN CLINICAL EXPERIENCE
CONCLUSION (Physical analgesia: pro's & contra's)
Prof. Yvette Koleva, MD, PhD, DMSc
Vienna, March 2018
Pain Management

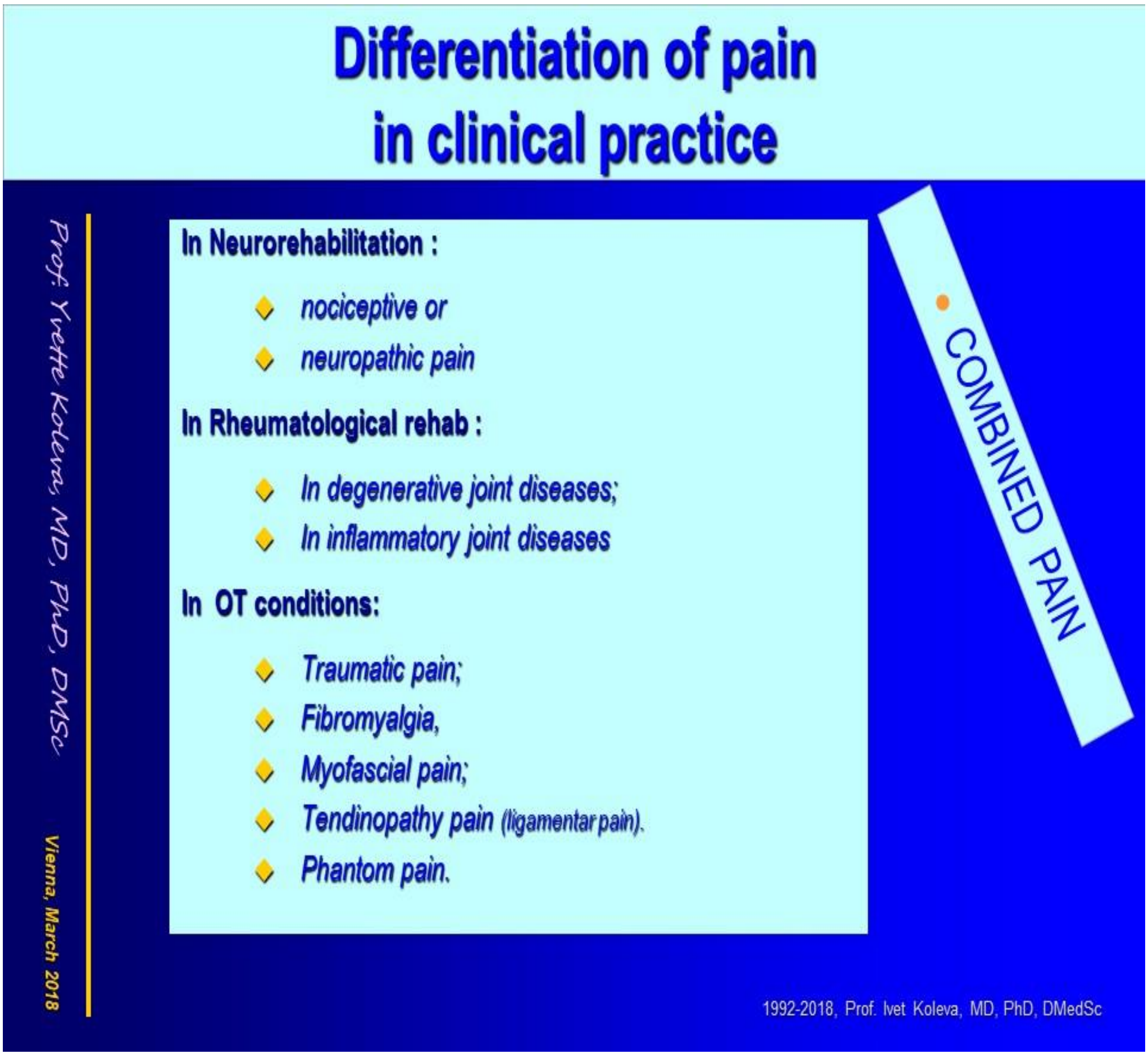

PHYSICAL ANALGESIA
PROs & CONTRAs
PROs
Natural treatment (We must respect the experience of God)
No contra-indications
Without side-effects
Cheap treatment (No expensive drugs)
Possibility of combination with other types of analgesia
CONTRAs
Lack of sufficient evidence (we are in the era of EB medicine & EB rehabilitation);
Necessity of interdisciplinary team (neurologist, PRM specialist, neurosurgeon, OT surgeon, psychologist, etc).
Prof. Yvette Koleva, MD, PhD, DMSc
Vienna, March 2018

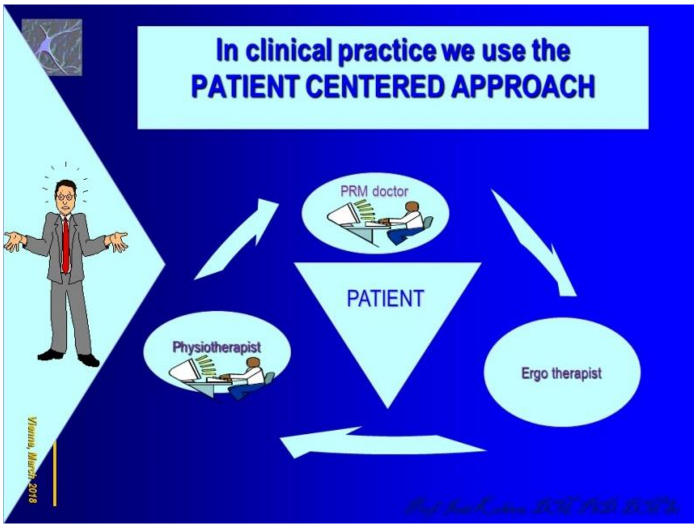

CONCLUSION & HOME MESSAGES:
We could recommend our complex pain algorithm programme.
Prof. Yvette Koleva, MD, PhD, DMSc
Vienna, March 2018
1992-2018, Prof. Ivet Koleva, MD, PhD, DMedSc


In clinical rehabilitation practice we must apply the CHOLISTIC APPROACH to the patient
Prof. Yvette Koleva, MD, PhD, DMSc
Vienna, March 2018


Pain management
'a la carte'
Necessity of individualization of the approach
'Every patient is unique'
Prof. Yvette Koleva, MD, PhD, DMSc
Vienna, March 2018


For the clinical practice
In all cases is necessary to effectuate a complex assessment of the patient, according the corresponding disease and functional scale.
Is important to make a PAIN ANALYSIS and an ICF analysis of the concrete case.
Example:
neurorehabilitation patient or patient with motor system condition
Prof. Yvette Koleva, MD, PhD, DMSc
Vienna, March 2018
1992-2018, Prof. Ivet Koleva, MD, PhD, DMedSc


Differentiation of pain in clinical practice
In Neurorehabilitation :
nociceptive or
neuropathic pain
In Rheumatological rehab :
In degenerative joint diseases;
In inflammatory joint diseases
In OT conditions:
Traumatic pain;
Fibromyalgia,
Myofascial pain;
Tendinopathy pain (ligamentar pain).
Phantom pain.
COMBINED PAIN
Prof. Yvette Koleva, MD, PhD, DMSc
Vienna, March 2018
1992-2018, Prof. Ivet Koleva, MD, PhD, DMedSc


In clinical practice we use the
PATIENT CENTERED APPROACH
PRM doctor
PATIENT
Physiotherapist
Ergo therapist
Vienna, March 2018


We apply the
TEAM REHABILITATION PRINCIPLE
MULTI-DISCIPLINARY
&
MULTI-PROFESSIONAL
REHABILITATION TEAM
Prof. Yvette Koleva, MD, PhD, DMSc
Vienna, March 2018


QUALITY OF
PAIN REHABILITATION
FUNCTIONAL EVALUATION & NEW ASSESSMENT METHODS
ICF
MODERN THERAPEUTIC METHODS
MODERN DEVICES
QUALIFICATION OF THE STAFF
Vienna, March 2018
1992-2018. Prof. Ivet Koleva, MD, PhD, DMedSc

Part 3.

GUIDELINES OF

OPERATIONAL STANDARD PROCEDURES

IN REHABILITATION

AFTER LOWER LIMB

ORTHOPEDIC SURGERY

ACKNOWLEDGEMENTS

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The project is financed by the European Commission under the Erasmus Plus program, KA2.

This document reflects only the authors’ view. The National Agency and the Commission are not responsible for any use that may be made of the information it contains.

REHABILITATION GUIDELINES AFTER LOWER LIMB ORTHOPEDIC SURGERY
A web-based manual for vocational education and training (long life learning)

Ivet B. Koleva, Elena Taina Avramescu, Diana Kamal, Kamal Constantin Kamal, Magdalena Rodica Trăistaru

Abstract
Rehabilitation (Rehab) Guidelines are an online information resource providing up-to-date treatment principles and standard procedures, designed to medical doctors – trainees and specialists in Physical and rehabilitation medicine (PRM) and to rehabilitation professionals. We decided to develop the operational Rehab Guidelines of standard PRM programmes of care with rehab procedures after lower limb orthopedic surgery, as one of the major outputs of COR-skills project, funded by ERASMUS Plus and focused on Vocational Education and Training (VET) at the higher education level. Designed to help therapists to provide post-surgical rehabilitation, based on best practices and evidence-based research, this comprehensive reference presents effective guidelines for rehabilitation after surgical interventions. This guideline introduces a brief picture of 12 selected standard rehabilitation operational procedures after lower limb orthopedic surgery for hip, knee and ankle, aiming to develop basic skills for medical specialists in rehabilitation (theoretical and practical skills for assessment, decision making, and rehabilitation in different pathologies). For each procedure, there are correspondent videos, capturing real practice maneuvers presented in the guide that will create support for autonomous learning practical skills for the trainees. This summary of recommendations can be developed in the future and the database of case studies can be extended.

Keywords: *Vocational training, rehabilitation, guidelines, procedures, lower limb*

1. INTRODUCTION

The Recommendations of the European Parliament and of the Council of Establishment of the European Credit system for Vocational Education and Training (ECVET) are taking place in a framework in which there is a serious necessity of complementarity between vocational training and higher education. Increasing the quality of vocational skills requires the development of world-class *Vocational Education and Training (VET)* systems. A well-known fact is that the harmonization across Europe requires the development of an unitary system in medical education with common standard procedures.

In orthopedics, in particular after surgery, a long and difficult rehabilitation process follows in order to regain normal gait and requires ***interdisciplinary & transdisciplinary team*** approaches (Yoshinov, Koleva, Paskaleva et al., 2011), with the close collaboration of medical doctors – specialists in Orthopedics & Traumatology (OT), and specialists in Physical & Rehabilitation Medicine (PRM); nurses, physiotherapists and occupational therapists, and other rehabilitation professionals. Rehabilitation should be initiated as early as possible – with the goal to stimulate the functional recovery (mobility, balance, gait, active movements).

The initial emphasis should be on restauration of autonomy in activities of daily living (ADL), exempli gratia: transferring, walking, washing, dressing, toileting. Balance and gait are essential components of mobility and are useful predictors in the assessment of functional independence (White Book on Physical and Rehabilitation Medicine in Europe, 2007).

The collaboration between orthopedic surgeons and rehabilitation professionals should be sought to assist in management and medical rehabilitation. The benefits of shared postoperative management by orthopedic surgeons, medical doctors PRM specialists and rehabilitation professionals include trends towards earlier functional independence, reduced length of hospitalization stay, improved management of medical conditions and reduced future need for institutional care, including nursing home care.

Thanks to the development of educational technologies and to the Internet, the number of available e-learning resources has dramatically increased (Dochev, Pavlov & Yoshinov, 2000).

A great number of educational institutions provide a form of web-based learning starting from as early as comprehensive schools and getting as far as university programmes for undergraduate and postgraduate students (Dochev, Pavlov & Yoshinov, 1999, 2000; Yoshinov, Koleva & Garnizov, 2011; Vatchkov, Spassov, Trifonov, Manolov, Yoshinov, Blagoev, 2015). The number of participating countries is increasing, more aspects of higher education are included and the number of activities and projects is growing.

Traditionally, the medical education is considered as one of the most conservative education providers in terms of applied methods. Although in other specialties (especially technical education) computer assisted education has long been integrated into educational curriculum, in medical education this happens sporadically. A growing number of reports draw attention to the need of adjustment of the offer in medical education to labor market needs and the knowledge-based society

In these circumstances we decided to develop the COR-skills project that addresses to Vocational Education on higher education level. Our Strategic Partnership is supporting a project-based collaboration between hospitals and HEIs (Higher Education Institutions), to develop, test and adapt a continuous VET program, based on an exhaustive needs analysis and focusing on a “real-life” transnational approach.

We aim to stimulate the learning and specialization of trainees by contemporaneous approaches, as the development of an innovative e-training method which is able to provide theoretical knowledge and practical skills, including case studies. This modern training curriculum is functioning in a virtual medical environment, similar with the work place and will equip the specialists with the skills required by the labor market. For this, we need an active cooperation between HEI and partners from outside academia: hospitals, medical centers, research centers.

We are committed to provide the highest possible quality research products to aid in both education and applied clinical decision making. In addition, we hope to stimulate interest in solving clinical problems in the post-op rehabilitation field and to offer personalized support - both to the learners but also to the patients.

Implementation of individualized health care approaches is one of the major innovations of this project, encouraging critical thinking of the trainees, reinforced quality of medical services, increasing the level of health care, reducing the rehabilitation time and health costs, stimulating the development of inter-sectorial and international collaborative cultures by sharing knowledge and ideas from the teachers to the rehabilitation professionals in their work-place.

2. BACKGROUND

2.1. Objectives

Our objectives were:

- ***Development and implementation of innovative practices in Physical and Rehabilitation Medicine,***
- ***Improvement of basic skills in the field of Physical and Rehabilitation Medicine- both theoretical and practical, for assessment, decision, treatment protocols in different surgical pathologies of the lower limb after orthopedic interventions,***
- ***Gaining knowledge regarding the indications, utility and limitation of rehabilitation procedures in different pathologies and individualisation of treatment according to the patient characteristics***
- ***Development of new skills as requested by the labor market- computerized gait analysis,***
- ***Development of transversal skills in the field of language, ICT, team work decision,***
- ***Advancing the physician-patient communications process and enhance the diagnosis and treatment of musculoskeletal conditions,***
- ***A better corelation between theoretical knowledge and practical skils. Offering support for autonomous leaning by inovative on line education and strategic use of ICT-based teaching and assessment practices.***

2.2. Participants of our project

Our Strategic Partnership involves a diverse range of partners in order to benefit from their diverse experience, profiles and specific expertise to produce relevant and high quality project results.

The consortium includes hospitals and higher education institutions well known in the field, with consistent experience and strong networks with their target groups from three countries (Romania, Bulgaria and Turkey) with high qualified specialists in Orthopedics & Traumatology (OT) and in Physical & rehabilitation medicine (PRM) with a long-standing reputation for providing student-focused programs for health education.

2.3. Structure of the web-based programme.

The major output in our project is the development of the Guidelines of operational standard procedures in rehabilitation after lower limb orthopedic surgery.

Rehab Guidelines is an online information resource providing up-to-date treatment guidelines to medical doctors – specialists (in Orthopedics & Traumatology /OT/, and in Physical and Rehabilitation Medicine /PRM/), and to professionals (physiotherapists, physiotherapists, ergotherapists).

The guidelines contain 12 standard procedures for post-surgery rehabilitation in selected pathologies of hip, knee and ankle which will be proposed for implementation in the medical world of work from participant countries.

The innovation consists in development of procedures, designated to promote the physician - patient communications process, to enhance the diagnosis and to precise the treatment of musculoskeletal conditions.

Each presented PRM programme of care includes: role of diagnosis, preliminary recommendations, rehabilitation timing and methodology, early post-operative exercises and prevention of complications, complex PRM program, the rationale of procedures, frequently applied natural and pre-formed physical modalities, early and intermediate exercise program, advanced exercises and activities, and communication with patients. The easy-to-follow guidelines support practitioners to look up pathology and quickly see the recommended rehabilitation programme. Phases of treatment are defined to clearly show goals, precautions, treatment strategies and criteria for rehabilitation procedures.

3. DESIGN

3.1. Methods

The present clinical guidelines are created as an educational tool and were developed by a Work Group within the COR-skills partnership. After a detailed bibliographic search we effectuated an analysis of the current scientific and clinical information and accepted approaches in orthopedic surgery and in post-operative rehabilitation.

The result was the creation of a *prototype Protocol*, not intended to be a fixed protocol as some patients may require more or less treatment. Patients' care and treatment should always be based on a clinician's independent medical judgment given according actual and individual clinical circumstances.

Our Strategic Partnership involves a diverse range of partners in order to benefit from their different experiences, profiles and specific expertise to produce relevant and high quality project results.

The consortium includes hospitals, and higher education institutions well known in the field, with extended experience and strong networks with their target groups from 3 countries with high qualified specialists in Orthopedics and Traumatology (OT), and in Physical and Rehabilitation medicine (PRM), with a longstanding reputation for providing student-focused programs of health education. Issues taking into consideration were: competence and thematic expertise in the field, relevant experience in working in transnational context, specific interest in the development of medical skills for health professionals in the fields of OT, PRM and post-operative rehabilitation..

The structure of the partnership based on the complementary of HEIs and hospitals helps to ensure the necessary competence and adequacy of the skills developed but also aiming to contribute in this way to the development of inter-sectorial and international collaborative cultures by sharing of knowledge and ideas from teaching to work-place, helping medical vocational education to meet the current and future labor market needs.

This partnership between education and employment will stimulate the flow exchange of knowledge between higher education and hospitals/medical clinics (world of work) and lead to the development of high quality VET with a strong work-based learning component.

The present material represents the best practice of experts – representatives of correspondent rehabilitation schools of Romania and Bulgaria; using the clinical bases in respected rehabilitation departments in correspondent countries: *Clinical Hospital Filantropia* in Craiova (Romania) and *Sainte Anna University Hospital* in Sofia (Bulgaria).

During elaboration of the guidelines, we applied principles, defined by the American psychological association: standardization across guidelines, clear structure and instructions. We used some practice guidelines attributes: respect for human rights and dignity, delineation of scope, avoidance of bias, educational value, internal consistency, flexibility, basis, feasibility, aspirational language, clarity, and compatibility (American Psychological Association, 2002).

The didactic team began working on guidelines by constructing a set of preliminary recommendations. These recommendations specify [what] should be done in [whom], [when], [where], and [how often or how long]. In the development of the present guidelines we used the WHO criteria (World Health Organization, 2017) (Table 1.)

Table 1.
WHO criteria for technical guidelines development [5].

WHO recommended steps in technical guideline development
Define the specific issues to be addressed by the guidelines
Undertake a systematic search for evidence
Review the evidence available
Develop recommendations linked to the strength of the evidence
Draft guidelines
Discuss and incorporate, where relevant, comments of the external reviewers
Draft final version of the guidelines
Make recommendations on dissemination strategy
Document the process of guideline development
Test the guidelines through pilot evaluations

First step in the process included reviewing the results of the evidence analysis.

The result of the literature research was a report for the current state of art in the field of protocols for orthopedic surgical procedures and rehabilitation procedures after surgery, aiming to:

- *select the most common surgical protocols in all participant countries and the correspondent rehabilitation procedures;*
- *make first steps in standardization of protocols;*
- *develop interdisciplinary and multi-professional approach (OT – PRM).*

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In order to attain these objectives the partnership reviewed different abstracts, recalled pertinent full articles for review and evaluate the studies meeting the inclusion criteria. They also abstract analyzed, interpreted and/or summarized the relevant evidence for each standard procedure.

Upon completion of the systematic reviews, each medical partner registered 30 examples of orthopedic surgical procedures in lower limb pathologies and 30 examples of rehabilitation procedures after surgery in lower limb pathologies.

From these procedures, twelve orthopedic surgical procedures in lower limb pathologies and twelve correspondent rehabilitation procedures were proposed to be negotiated in the partnership as eligible procedures for the Guide of operational standards.

Evidence-based information, in conjunction with the clinical expertise of physicians from multiple medical specialties, was used to develop the criteria in order to improve patient care and obtain the best outcomes while considering the subtleties and distinctions necessary in making clinical decisions.

The Rehabilitation guidelines contain 12 (twelve) standard procedures for post-surgery rehabilitation in selected pathologies of hip, knee and ankle which will be proposed for implementation in the medical world of work from participant countries. The innovation consists in development of procedures that will stimulate the physician-patient communications process and enhance the diagnosis and treatment of musculoskeletal conditions.

The recommendations associated with each procedural step are aligned to the existent medical evidence, as for each procedure there are correspondent videos, capturing in real practice the maneuvers presented in the guide, enabling the user to watch the procedure that is presented in the text and ensuring a better connection between knowledge and skills development. Also the video material will create support for autonomous leaning practical skills for the trainees.

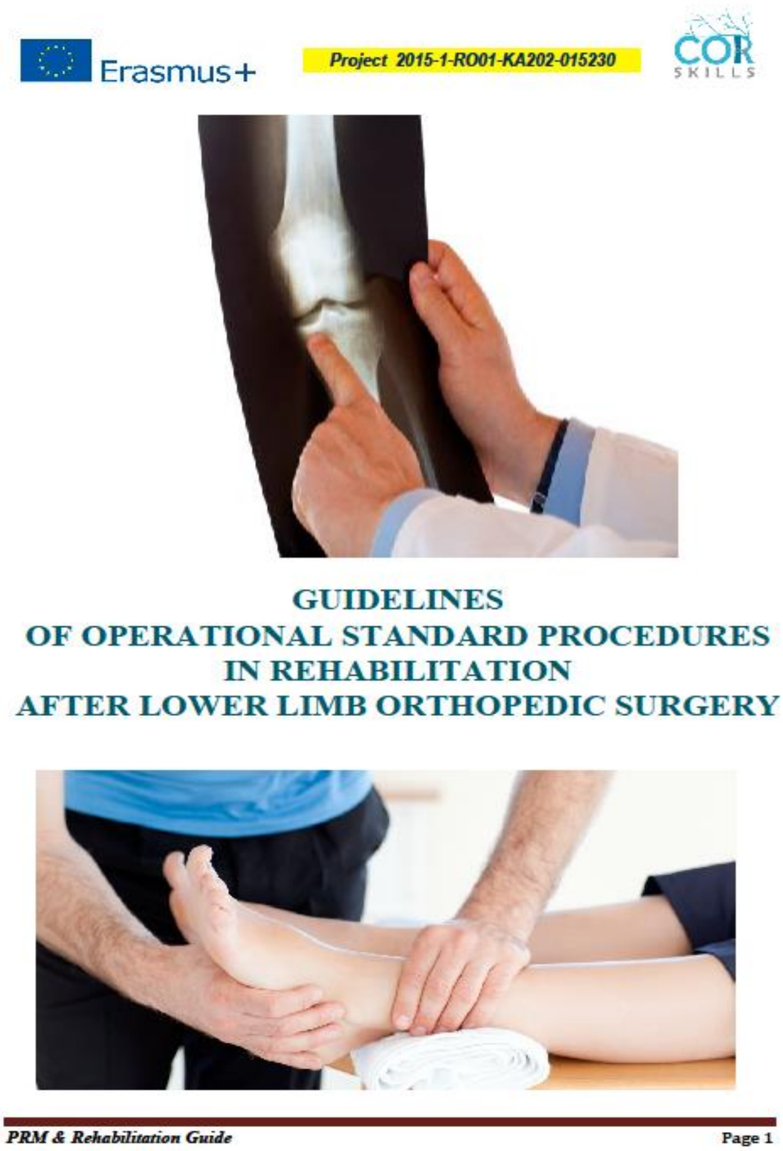
The easy to follow guidelines enable practitioners to look up pathology and quickly see the recommended rehabilitation strategy. Phases of treatment are defined to clearly show goals, precautions, treatment strategies and criteria for rehabilitation.

3.2.Results

Our ***Guidelines of operational standard procedures in rehabilitation after lower limb orthopedic surgery*** contain twelve standard procedures for rehabilitation after hip, knee and ankle surgery and correspondent videos in English.

The text is in form of a book of 117 pages (figures 1, 2 & 3), in which the recommendations associated with each procedural step are aligned to the existent medical evidence and are available on the project web site https://www.cor-skills.org/.

Figure 1.
The Cover of our Guidelines of operational standard procedures
in rehabilitation after lower limb orthopedic surgery



Each presented procedure includes some principal elements:

- *the rationale for the procedure,*
- *role of medical diagnosis and functional assessment,*
- *preliminary recommendations,*
- *rehabilitation timing and methodology (steps),*
- *early postoperative exercises and prevention of complications,*
- *intermediate exercise program,*
- *advanced exercises and activities,*
- *communication with patients.*

Figure 2.
The contents of our Guidelines of operational standard procedures in rehabilitation after lower limb orthopedic surgery

Erasmus+ **Project 2015-1-RO01-KA202-015230** COR SKILLS

CONTENTS

PRM & Rehabilitation Guide **Page 1**

Figure 3.
The first page of the text of our Guidelines of operational standard procedures in rehabilitation after lower limb orthopedic surgery

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3. PROCEDURES

3.1. ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION

3.1.1.PRINCIPLE BASES OF THE TREATMENT IN CASES OF ACL TEAR

3.1.1.1.The Injury:
The anterior cruciate ligament (ACL) is an important stabilizing ligament of the knee. It is located deep inside the knee joint and provides almost 90% of the stability to forward force on the joint. Injuries to this ligament are very common in aggressive sports such as skiing and basketball. Injury to the ACL usually occurs with a sudden hyperextension or rotational force to the joint. The exact mechanism differs for different sports. Typically the injured athlete will hear or feel a "pop", and will have sudden onset of pain, instability and swelling. If this scenario occurs, the athlete should not attempt to continue playing, and should seek medical attention. Because the ACL is such an important stabilizer of the knee, injury to the ligament makes it difficult to participate in aggressive twisting sports.
It should be emphasized that certain sports can continue to be performed quite well without an ACL. These are "straight ahead" sports such as bicycling, rollerblading, light jogging and swimming. Twisting, cutting and jumping sports are not recommended however due to the risk of the knee giving way. The knee is designed to work as a hinge, moving in one plane. With a torn ACL, there is increased play in the joint allowing shearing forces across the cartilage surface, and leading to progressive tearing of the cartilage discs (menisci) and breakdown of the joint surface. Over time, this breakdown leads to degenerative arthritis.

3.1.1.2.Treatment Options:
Treatment of ACL injuries has come a long way in the past ten years. Today athletes have greater than a 90% chance of returning to their pre-injury level of sports participation.
Non-Surgical: Conservative care is recommended for minor and partial tears of the ACL, or tears in which the knee is still within the accepted limits of stability (less than 3 mm of laxity). Non surgical treatment is also recommended for the patient who is willing to modify their activity to non twisting less aggressive sports. In these athletes, we begin an immediate specialized rehabilitation program, and provide a custom fitted knee brace for use during sports activity.
Surgical Options: Surgery for ACL injuries is extremely specialized and should only be performed by a surgeon who specializes in this type of injury. The techniques continue to change and only someone on the cutting edge can hope to stay up with all of the latest changes.
Surgical Technique

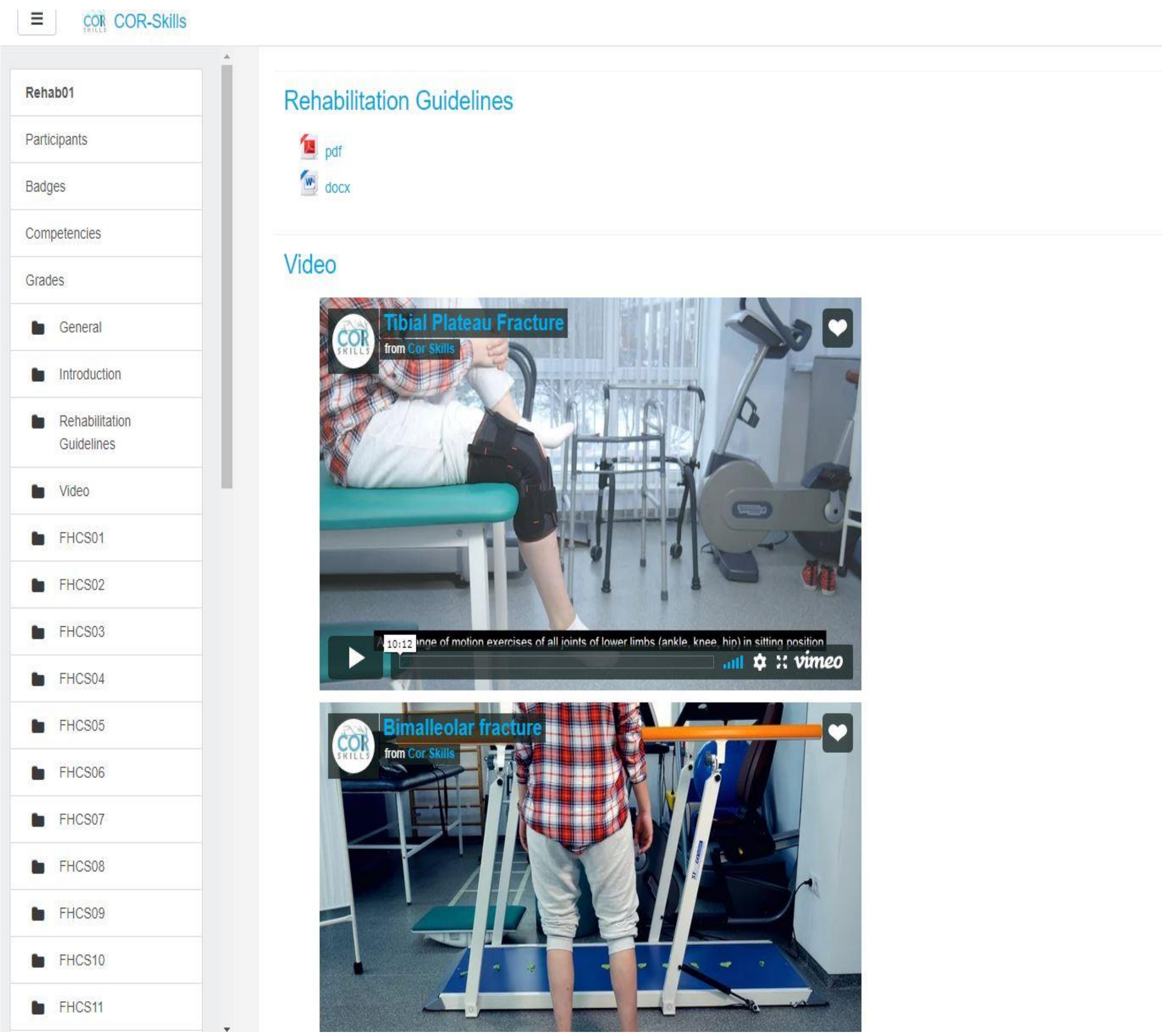
PRM & Rehabilitation GUIDE Page 22

For each rehabilitation procedure we prepared correspondent videos, capturing in real practice the maneuvers presented in the guide, enabling the user to watch the procedure that is presented in the text and ensuring a better connection between theoretical knowledge and practical skills development.

A specific video accompanies every procedure, featuring over 200 minutes of video of patients demonstrating various therapeutic exercises spanning the different phases of postsurgical rehabilitation (fig.4). Also the video material will create support for autonomous leaning practical skills for the trainees. The videos are available on the COR-skills e-learning platform where access is restricted by password.

The videos are composed of a full rehabilitation program. The raw footage is obtained by recording the rehabilitation program from the beginning to the end. The video is edited to discard redundant, focus loosing, scenes and the important steps are joined to form a shortened but demonstrative video. The steps of the rehabilitation program are gathered from several widely accepted text books and are organized as subtitles to the video. The subtitles are embedded into the corresponding time images.

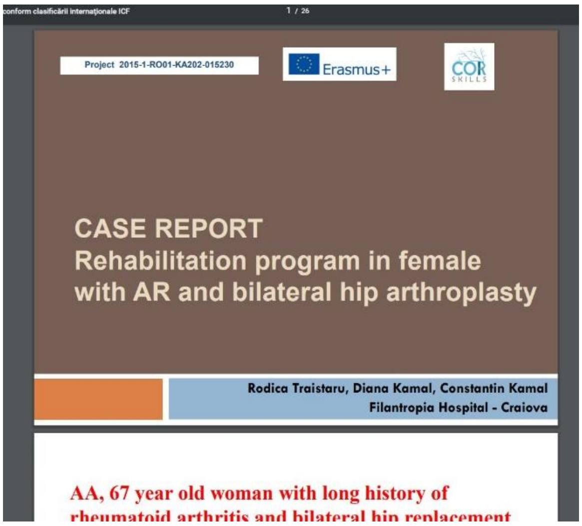
Figure 4.
One page with videos of the Guidelines of operational standard procedures in rehabilitation after lower limb orthopedic surgery - video

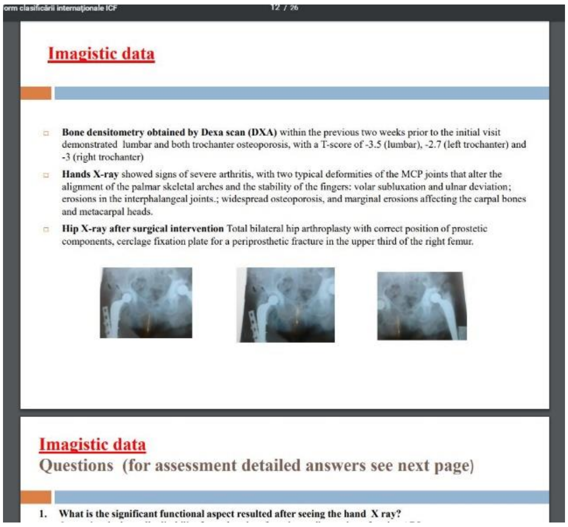


On the **COR-skills e-learning platform** will also be available **30 case studies** *(fig.5)* **and an online course for students** (medical professionals involved in Physical and Rehabilitation Medicine- specialists, trainees, residents, kinesitherapists, physiotherapists, ergotherapists). **Case studies** are in form of full reports on patients in rehabilitation department (medical history, clinical signs, paraclinical evaluations), associated with one or more visual content objects (i.e. 2D, 3D images as acquisition outputs of Ultrasound, Magnetic Resonance Imaging, Tomography), starting with preoperative radiological images, description of rehabilitation procedure, and the outcome of the procedure (postoperative and further follow-up X-rays, MRIs, physical findings. Some cases will include gait assessment and related data: plantar pressure graphs and numerical data.

The system will provide a feedback by showing students the correct diagnosis and how to arrive at it with minimal cost by detailed explanations for the right and wrong answers.

Figure 5.
A case study of the Guidelines of operational standard procedures in rehabilitation after lower limb orthopedic surgery





The estimated required study time will be 46 hours (Guidelines of operational standard procedures in rehabilitation after lower limb orthopedic surgery - 117 pages = 30 hours, 30 min video x 12 topics = 360 min = 6 hours, 30 case studies x 20 min = 600 min = 10 hours).

On the ***e-learning platform*** of the project, there will be available an **assessment system** that will include case studies (*assessment case studies*) meant to be solved by the trainees and witch follows the same structure as the explained case studies with multiple choice test (20 case studies for skills assessment). It will also be available a multiple-response quiz test that will allow access for up to two attempts, and will contain a minimum of 30 questions with a fair promotion threshold of at least 75% of the questions.

The project WEB site can be viewed without restrictions, but the e-learning platform is password protected and pre-registration required. Registration is free and provides access to all educational materials (**Guidelines of operational standard procedures in rehabilitation after lower limb orthopedic surgery, e-learning COR-skills platform-video database, case study database and quizzes database**). All materials are available in English and will be translated in Romanian, Bulgarian and Turkish languages.

Content is structured in the best way to build graduate skills. A special section will allow chatting, content sharing and tutoring by the course provider. Curricula, Curriculum Courses, and Educational Materials (WWW-based) will be provided also for an online course. An e-learning platform user guide is available online.

Our project provides a **free access** to an **innovative guideline** on fundamental **rehabilitation protocols for the lower limb pathologies** with correspondent videos for each procedure, and beside that to:

- ✓ *a more attractive training program, in line with individuals' and labor market needs,*
- ✓ *an innovative multimedia case studies database,*
- ✓ *online **accredited** courses in medical education,*
- ✓ *a validation of training by CME (Continuous Medical Education) credits,*
- ✓ *practical skills development in a simulated environment.*

Interactivity allows trainees to test their knowledge and provides immediate feedback using images and cases that they could encounter in clinical practice. This will function as a virtual medical environment, similar with the work place.

After completion of this task the students (medical professionals involved in Physical and Rehabilitation Medicine – medical doctors specialists or trainees / residents, kinesitherapists, physiotherapists, ergotherapists) will have gained competences such as:

- *Cognitive competence involving the use of theory and concepts for basic principles in rehabilitation, as well as informal practical knowledge gained experientially,*
- *Professional competence by motivating the procedure selection, evaluation and treatment algorithm / alternative treatment, indications and contraindications in the related pathology, short and long term complications,*

After achievement of the training course the respective medical professionals **should be able**:

- *To choose the best rehabilitation procedure for a given problem;*
- *To motivate procedure selection, evaluation and treatment algorithm / alternative treatment, indications and contraindications in related pathology, short and long term complications;*
- *To describe step by step the specific rehabilitation procedure;*
- *To communicate with the patient before and after surgery;*
- *To solve case studies in accordance to the explained pathologies.*

3.3. Discussion

Designed to help medical doctors and therapists to provide post-surgical rehabilitation based on best practices and evidence-based research, this comprehensive reference presents effective guidelines for postsurgical rehabilitation interventions. Its authoritative material is drawn from the most current literature in the field as well as contributions from expert physical therapists, occupational therapists. A specific video accompanies every procedure, featuring over 200 minutes of video of patients demonstrating various therapeutic exercises spanning the different phases of postsurgical rehabilitation.

This guideline is not intended to be construed or to serve as a standard of care. Standards of care are determined on the basis of all clinical data available for an individual case and are subject to change as scientific knowledge and technology advance and patterns of care evolve.

Adherence to guideline recommendations will not ensure a successful outcome in every case, nor should they be construed as including all proper methods of care or excluding other acceptable methods of care aimed at the same results. The ultimate judgment must be made by the appropriate healthcare professional(s), responsible for clinical decisions regarding a particular clinical procedure or treatment plan. This judgment should only be arrived at following discussion of the options with the patient, covering the diagnostic and treatment choices available.

This summary of recommendations is not intended to stand alone. Treatment decisions should be made in light of all circumstances presented by the patient. Treatments and procedures applicable to the individual patient rely on mutual communication between patient, physician and other healthcare practitioners.

4. FUTURE RESEARCH DIRECTIONS

The web-site offers a summary of recommendations and a database of clinical cases, concerning post-op rehabilitation after lower limb surgery.

This is an open system of references and case studies that can be extended and developed in the future.

We aim that this partnership between education and employment will stimulate the flow exchange of knowledge between higher education and hospitals (OT and PRM clinics & Departments) and will lead to the development of a high quality VET with a strong work-based learning component.

In the future we can expand this idea for other type of patients in the clinical rehabilitation practice, e.g. for gait rehabilitation of patients with neurological and neurosurgical conditions.

We hope that our web-site will be useful in the clinical practice of PRM specialists, PRM trainees and therapists, and our work will be beneficial for our patients.

5. CONCLUSION

Our e-book is an online information resource providing up-to-date treatment guidelines to medical doctors – residents and specialists in physical and rehabilitation medicine and to rehabilitation professionals.

The easy-to-follow guidelines enable practitioners to look up pathology and quickly see the recommended rehabilitation strategy.

Designed to help medical doctors – specialists in PRM and therapists to provide post-surgical rehabilitation based on best practices and evidence-based research, this comprehensive reference presents effective guidelines for rehabilitation after lower extremity orthopedic surgery.

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GUIDELINES OF OPERATIONAL STANDARD PROCEDURES IN REHABILITATION AFTER LOWER LIMB ORTHOPEDIC SURGERY

Summary

The current guidelines aim to develop common OT rehabilitation protocols after orthopedic surgery for vocational education & training (VET).
The Document introduces a brief picture of selected standard rehabilitation operational procedures after lower limb orthopaedic surgery aiming to develop basics skills for medical specialists in rehabilitation (theoretical and practical skills for assessment, decision, treatment in different pathologies).
The goal of these protocols is to provide the clinician with a guideline to establish and progress a patient through post-op rehabilitation. It is not intended to be a substitute for one's clinical decision making. The plan of care should be based upon the patients clinical exam and individual goals.
We must take into consideration multiple variables, including: mechanism of injury, fracture type, fixation method, fixation stability, bone and tissue quality, patient's characteristics (including comorbidities, age, goals and expectations) and surgeon specific philosophy preferences.
Based upon these variables, wide variations of progressions and patient outcomes may exist, however the following is a basic guideline that can be used in reference.
In every clinical case physiotherapists must notify the PRM & OT medical doctors immediately of any concern for DVT, infection, excessive oedema, or significant variation in expected progression / outcomes.

1.INTRODUCTION

Scope

The Recommendation of the EU Parliament and of the Council of the Establishment of ECVET is taking place in a framework in which there is a serious need of complementarity between vocational training and higher education. Increasing the quality of vocational skills requires the development of world-class VET systems. The need for harmonization development of an unitary system in medical education across Europe with common standard procedures is a well known fact.

In orthopedics, in particular after surgery, a long and difficult rehabilitation process follows in order to regain normal gait and requires INTERDISCIPLINARY TEAM approaches. Rehabilitation should be commenced early to promote independent mobility and function. The initial emphasis should be on walking and activities of daily living (ADI), for example, transferring, washing, dressing, and toileting. Balance and gait are essential components of mobility and are useful predictors in the assessment of functional independence.

Collaboration between orthopaedic surgeons, PHYSIATRISTS and rehabilitation professionals should be sought to assist in medical management and rehabilitation. The benefits of shared postoperative management by orthopaedic surgeons and rehabilitation professionals include trends towards earlier functional independence, reduced length of stay, improved management of medical conditions and decreased future need for institutional care, including nursing home care.

In these circumstances we decided to develop the COR-skills project that adresses to Vocational Education on higher education level. Our Strategic Partnership is supporting a project-based collaboration between hospitals and HEIs, to develop, test and adapt a continuous VET programme, based on an exhaustive needs analysis and focusing on a “real-life” transnational approach. We aim to stimulate resident learning by new approaches, as the development of an innovative e-training method which is able to provide the trainees with a range of case studies and an advanced training curriculum. This will function as a virtual medical environment, similar with the work place and help attune curricula to current and emerging labor market needs and equip the specialists with required skills, by developing active cooperation between HEI and partners from outside academia: hospitals, medical centers, research centers.

We are committed to providing the highest possible quality research products to aid in both education and applied clinical decision making. In addition, we hope to stimulate interest in solving clinical problems in the field of OT rehabilitation and to offer personalized support both for the learners but also for the clients (patients). Implementation of individualized health care approaches is one of the major innovations of the current project, encouraging critical thinking of the trainees, reinforcing the quality of rehabilitation services, increasing the level of health care, decreasing the rehabilitation time and health costs, stimulating the development of inter-sectorial and international collaborative cultures by sharing of knowledge and ideas from teaching to work-place.

One major output in our project is the development of the Guidelines of operational standard procedures in rehabilitation after lower limb orthopedic surgery. Rehabilitation Guidelines present an online information resource providing up-to-date treatment principals to orthopedic surgeons, to physiatrists and rehabilitation professionals. The guidelines contains 12 standard procedures for post surgery rehabilitation in selected pathologies and corresponding OT procedures of the three principal joints, included in gait, which will be proposed for implementation in the medical society from participant countries. The innovation consists in development of procedures that will allow to advance the physician-patient communication process and enhance the diagnosis and treatment of musculoskeletal conditions, especially after a OT intervention. The recommendations, associated with each procedural step, are aligned to the actual medical evidence, as for each procedure there are correspondent videos, capturing in real practice the manoeuvres presented in the guide, **enabling the user to watch the procedure that is presented in the text and ensuring** a better connection between knowledge and practical skills' development. Also the video material will create support for autonomous leaning practical skills for the OT & PRM trainees.

The easy to follow guidelines enable practitioners to look up a pathology and quickly see the reccomended rehabilitation strategy. Phases of treatment are defined to clearly show goals and tasks, methods and precautions, strategies and criteria for rehabilitation.

Each presented procedure includes:

- *the rationale for the procedure*
- *role of diagnosis*
- *preliminary recommendations*
- *rehabilitation timing and methodology (steps)*
- *Early Postoperative Exercises and Profilaxy of complications,*
- *Intermediate Exercise Program*
- *Advanced Exercises and Activities*
- *Communication with patients*

Methodology

The present clinical guidelines were developed by a Work Group within the COR-skills partnership and is provided as an educational tool based on an assessment of the current scientific and clinical information and accepted approaches to orthopeadic surgery. It is not intended to be a fixed protocol as some patients may require more or less treatment. Patient care and treatment should always be based on a clinician's independent medical judgment given the individual clinical circumstances.

Our Strategic Partnership involves a diverse range of partners in order to benefit from their different experiences, profiles and specific expertise to produce relevant and high quality project results. The consortium includes hospitals and higher education institutions well known in the field, with consistent experience and strong networks with their target groups from 2 countries with high qualified specialists in orthopedics and traumatology (OT) and physical and rehabilitation medicine (PRM) with a long standing reputation for providing student-centered programmes of health education. Issues taking into consideration were: competence and thematic expertise in the field, relevant experience in working in transnational context, specific interest in the development of medical skills for health professionals in the orthopedic and rehabilitation field.

The structure of the partnership based on the complementary of HEIs and hospitals helps to ensure the necessary competence and adequacy of the skills developed, but also aiming to contribute in this way to the development of inter-sectorial and international collaborative cultures by sharing of knowledge and ideas from teaching to work-place, helping medical vocational education to meet the current and future labour market needs.

This partnership between education and employment will stimulate the flow exchange of knowledge between higher education and hospitals / medical clinics (world of work) and lead to the development of high quality VET with a strong work-based learning component.

The present material represents the best practice of experts with the Clinical Hospital Filantropia from Craiova, Romania and Sainte Anna Hospital from Sofia, Bulgaria, one of the best known and most respected rehabilitation hospitals in the correspondent countries.

The didactic team began working on these guidelines by constructing a set of preliminary recommendations. These recommendations specify [what] should be done in [whom], [when],[where], and [how often or how long].

In the development of the present guidelines we used the WHO criteria

WHO recommended steps in technical guideline development	**Action Taken**
Define the specific issues to be addressed by the guidelines	Completed
Undertake a systematic search for evidence	Completed
Review the evidence available	Completed
Develop recommendations linked to the strength of the evidence	Completed
Draft guidelines	Completed
Discuss and incorporate, where relevant, comments of external reviewers	Completed
Draft final version of the guidelines	Completed
Make recommendations on dissemination strategy	Completed
Document the process of guideline development	Completed
Test the guidelines through pilot evaluations	Completed

First step in the process included reviewing the results of the evidence analysis.

The result of the literature research was a report for the current state of art in the field of protocols for orthopedic surgical procedures and rehabilitation procedures after surgery, aiming to:

- *select the most common surgical protocols in all participant countries and the correspondent rehabilitation procedures;*
- *make first steps in standardization of protocols;*
- *develop an interdisciplinary approach (orthopedics-rehabilitation);*

In order to attain these objectives the partnership reviewed different abstracts, recalled pertinent full articles for review and evaluate the studies meeting the inclusion criteria. They also abstract analyzed, interpreted and/or summarized the relevant evidence for each standard procedure.

Upon completion of the systematic reviews, each medical partner registered 30 examples of orthopedic surgical procedures in lower limb pathologies and 30 examples of rehabilitation procedures after surgery in lower limb pathologies. From these procedures, we select the most common in the clinical practice 12 orthopedic surgical procedures in lower limb pathologies and 12 correspondent rehabilitation procedures were proposed to be negotiated in the partnership as eligible procedures for the Guide of operational standards.

Evidence-based information, in conjunction with the clinical expertise of physicians from multiple medical specialties, was used to develop the criteria in order to improve patient care and obtain the best outcomes while considering the subtleties and distinctions necessary in making clinical decisions.

Recommendations

Designed to help therapists provide post-surgical rehabilitation based on best practices and evidence-based research, this comprehensive reference presents effective guidelines for postsurgical rehabilitation interventions. Its authoritative material is drawn from the most current literature in the field as well as contributions from expert physical therapists, occupational therapists. A specific video accompanies every procedure, featuring minutes of video of patients demonstrating various therapeutic exercises spanning the different phases of postsurgical rehabilitation.

This guideline is not intended to be construed or to serve as a standard of care. Standards of care are determined on the basis of all clinical data available for an individual case and are subject to change as scientific knowledge and technology advance and patterns of care evolve.

Adherence to guideline recommendations will not ensure a successful outcome in every case, nor should they be construed as including all proper methods of care or excluding other acceptable methods of care aimed at the same results. The ultimate judgement must be made by the appropriate healthcare professional(s) responsible for clinical decisions regarding a particular clinical procedure or treatment plan. This judgement should only be arrived at following discussion of the options with the patient, covering the diagnostic and treatment choices available.

This summary of recommendations is not intended to stand alone. Treatment decisions should be made in light of all circumstances presented by the patient. Treatments and procedures applicable to the individual patient rely on mutual communication between patient, physician and other healthcare practitioners.

2.PRINCIPAL BASES OF THE REHABILITATION IN ORTHOPEDIC AND TRAUMATIC CONDITIONS

INTRODUCTION

According the definition of the European Union of Medical Specialists – PRM Section [46] **Physical and Rehabilitation Medicine (PRM)** is an „independent medical specialty, oriented to the promotion of physical and cognitive functioning, activities (including environment), participation (including quality of life) and changes in personal factors and environment. The specialty PRM is responsible for the management of the prevention, diagnostics, treatment and rehabilitation of patients with health-related disability and co-morbidity of all ages. According the World Report on Disability of the World Health Organization and World Bank [48] rehabilitation measures are divided into three categories: rehabilitation medicine, therapy and assistive technologies.

According the White Book on Physical and Rehabilitation Medicine [46] **the basic objective of PRM** is the optimization of social participation and the amelioration of the quality of life of patients. This includes the aid of the patient to reach possible levels and patterns of autonomy and independence, including participation in professional, social and leisure activities, part of his human rights [29, 36].

Tasks of PRM are: treatment of existing pathology; reduction of disability; prevention and therapy of complications; amelioration of functioning and activity; stimulation of patient's participation in different types of activities [33, 43, 46].

The World Report on Disability [48] defines the **goals of rehabilitation**: *prevention of the loss of function; slowing the rate of loss of function; improvement or restoration of function; compensation for lost function; maintenance of current function.*

Modern rehabilitation has an ***integrative and holistic approach to the patient,*** based on the *International Classification, disability and Health (ICF)* and on clinical principles [23, 45, 47]. Current book presents the author's opinion about the necessity of structuration of complex rehabilitation algorithms (PRM programmes of care), including not only different natural and pre-formed physical modalities, but too a detailed functional evaluation at the beginning (baseline) and at the end of every rehab course – in all patients with orthopedic and traumatic conditions.

FUNCTIONAL EVALUATION

The first step of our algorithms is the ***qualitative and quantitative*** functional evaluation, including ICF assessment (ICF, 2001), and evaluation scales, applied commonly in the clinical practice of OT and rehabilitation [8, 10, 12, 18, 31, 35].

According ICF principles the complex functional assessment must include (figures 1, 2 & 3): *body functions* (pain, range of motion, muscle force or motor deficiency, alterations of coordination); *activities* (mobility, grasp, gait, activities of daily living /ADL/, transport); *participation* (family relationship, relaxing activities, social life, political activity); *environmental factors* (conditions of life and work, transport, family and friends, health insurance, social relationship); *personal factors* (life style, co-morbidities, age, sex) [26, 30, 32, 40].

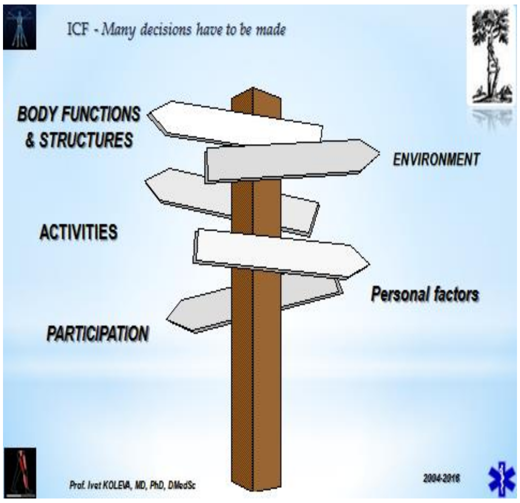
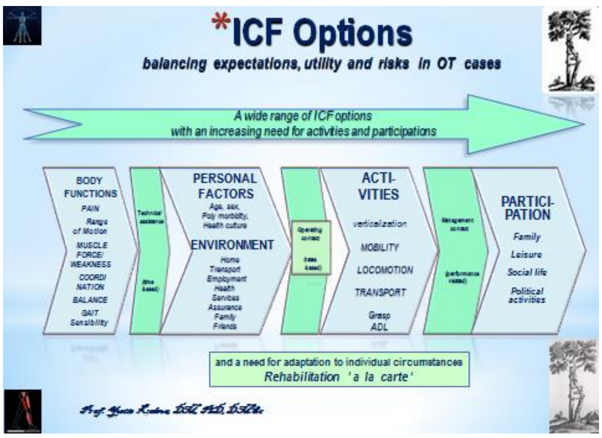


Fig. 1-2. International Classification of Functioning, disability and Health (ICF), 2001 [47]



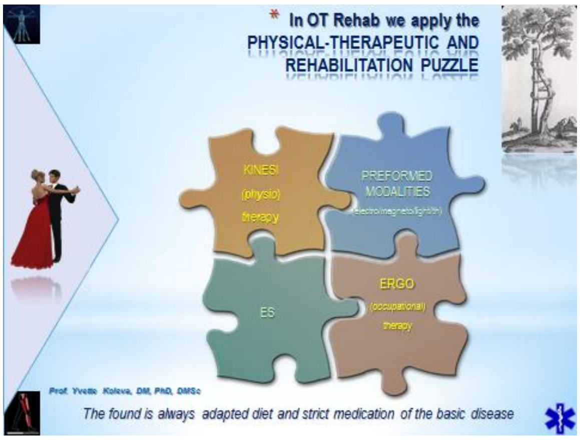


Fig.3. ICF options

Fig. 4. Rehabilitation puzzle

During clinical assessment we accentuate on some analyses: *pain* (localization, type, intensity – verbal or visual analogue scale; modifying pain activities); *joint stability* (including joint position sense) *and range of motion* (active and passive); presence of oedema, muscle or joint *contractures*; *evaluation of the muscle force / muscle insufficiency, motor deficit; analysis of the grasp and gait; mobility* (necessity of technical aids - canes, walking sticks, crutches, walkers, wheelchairs and other devices); *fatigue* (physical endurance, necessity of rest during the examination or the functional activity); *autonomy in everyday activities (*bathing, dressing, eating, putting shoes on, personal hygiene, need of help in ADL). Evaluation of problems must be qualitative and quantitative, including: fatigue, motor deficiency, coordination problems (body position, gait, grasp); pain; conscience for the necessity of technical aids; difficulties in ADL; limitations in functional mobility [2, 8, 12, 15, 38, 40].

The control before and after rehabilitation is obligatory. At the end of every course we realize a detailed clinical, para-clinical and functional (including instrumental) revision of the obtained results, and we prescribe a periodical control and periodical PRM courses. We consider that the functional evaluation is very important not only for control of the quality of rehabilitation, but too for amelioration of independence in everyday activities and of health-related quality of life of patients.

REHABILITATION PROGRAMME

The complexity of rehabilitation in OT cases imposes the necessity of a holistic approach to the patient – detailed functional analysis before and after the rehabilitation courses; application of therapeutic methods of different medical specialties (principally orthopedics and traumatology; neurology and neurosurgery; rheumatology; PRM) and from non-medical fields (kinesitherapy, sociology, psychology, occupational therapy). We apply basic principles of the specialty Physical and Rehabilitation medicine [8, 9, 11, 18, 23]. Depending on the results of the assessment of the rehabilitation potential of the concrete patient, we use different physical modalities and methods in different combination – the rehabilitation puzzle (figure 4). In every stage of the rehabilitation processus we must define precisely the goal, tasks and algorithms of rehabilitation. In every case our goal is to assure a high quality of the rehabilitation, optimal for the clinical form of the principal disease or condition, adapted to the age, co-morbidities, capacity and desire of the concrete patient; with the strategic goal to receive the best result for his quality of life.

The complex rehabilitation programme includes physical and drug therapy, diet, patient education (table 1).

Table 1: Parts of the complex rehabilitation programme

KINESI- and ERGO-therapy (exercises, activities, massage, manual therapy)	PREFORMED physical modalities (electric currents, magnetic field, light, LASER, ultra-sound)	CRYO-/THERMO-/ BALNEO-/PELOIDO-therapy (ice, mineral waters, therapeutic mud, paraffin)	DIET (proteins /amino-acids/ , hypolipidic, hypo-glucidic)	PATIENT EDUCATION (medicaments; diet; basic physical activity; weight control)

In our clinical practice we apply a synergic combination) of two (2-3) procedures with pre-formed modalities (electro- and photo-therapy, LASER; magnetic field; ultra-sound, etc.); one (1-2) cryo-/ hydro- / balneo- / thermo-therapeutic procedure with three (3-4) kinesi-therapeutic methods and one (1-2) ergo-therapeutic activity [3, 24, 25, 28, 37, 44]. The functional recovery depends principally from the training of grasp and gait, and the education in activities of daily life [1, 5, 6, 7, 11, 27, 28, 34, 41]. **For the structuration of the individualized for every patient PRM programme** we used everywhere capacities of different traditional and contemporaneous natural and pre-formed factors, accentuating on the potential of modern methods, e.g.: transcutaneous electro-neurostimulation (TENS), functional electrostimulations (FES), Lasertherapy and Laserpuncture, Deep Oscillation; proprioceptive neuro-muscular facilitation, analytic exercises, post-isometric relaxation, stretch techniques; and ergo-therapeutic methods [5, 9, 13, 14, 39, 42].

The control after the rehabilitation course and the prescription of periodical ambulatory PRM courses are very important. We consider necessary the continuity of PRM-care: in-patients in acute care hospitals and in PRM clinics (Departments), in-patients in long-term specialized hospitals; out-patients in ambulatory medical and PRM centres; balneo-kinesitherapy in resorts.

CONCRETIZATION AND CLINICAL APPROBATION OF ALGORITHMS

The presented PRM algorithm can be concretized and we used it during our own clinical investigations and observations (including clinical case studies) of rehabilitation of patients with different OT conditions: shoulder instability and rotator cuff injuries; distal radius fractures & Zudeck's algoneurodystrophy; hip replacement, partial and total knee arthroplasty, periprosthetic fractures; intertrochanteric & femur shaft fractures; after anterior and posterior cruciate ligament reconstruction; after partial and total meniscectomy; patella (knee cap) dislocation and fracture; tibial plateau and tibial plafond fractures; ankle fractures, Lisfranc and Chopart's injuries (fracture–dislocation); upper or lower limb amputation with phantom pain and prosthesis. [8, 9, 14, 15, 16, 17, 19, 39, 42].

The on-time initiation of rehabilitation procedures in OT management (especially after OT interventions) has a lot of positive consequences: amelioration of the clinical status of patients and prevention of complications; augmentation of muscle force and range of motion, decrease of pain, намаляване на болката, oedema reduction, regulation of the statics and equilibrium; normalization of the scapula-humeral and the pelvi-femoral rhythm; functional recovery of the grasp and the gait; amelioration of autonomy and quality of life of patients; acceleration of the resocialization and inclusion in functional activity, economic effect.

SUMMARY

In our clinical practice we apply systematically our structured rehabilitation algorithms, individualized and adapted to the concrete patient. We published periodically our results, proving the amelioration of the quality of life of significant number of patients (age > 18 years) with different OT conditions: orthopedic dysfunctions (scoliosis, spondylolisthesis, spina bifida, lumbalisatio S1, sacralisatio L5), traumatic injuries (incl. sports' traumas), after alloplastic surgery (hip and knee joint), after arthroscopic surgery (shoulder and knee joints), etc. In case of synergic combination of procedures we received statistically significant favorable effects on the range of motion, muscle force and muscle weakness, neuro-muscular coordination, grasp and gait, independence in ADL, quality of life of patients [1, 4, 9, 10, 14, 15, 16, 17, 19, 20, 21, 22, 39, 42].

The complex rehabilitation stimulates the functional recovery of patients with invalidating diseases and conditions of the locomotory system, ameliorating their independence and the health-related quality of life.

3.PROCEDURES

3.1.ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION

3.1.1.PRINCIPLE BASES OF THE TREATMENT IN CASES OF ACL TEAR

3.1.1.1.The Injury:

The anterior cruciate ligament (ACL) is an important stabilizing ligament of the knee. It is located deep inside the knee joint and provides almost 90% of the stability to forward force on the joint. Injuries to this ligament are very common in aggressive sports such as skiing and basketball. Injury to the ACL usually occurs with a sudden hyperextension or rotational force to the joint. The exact mechanism differs for different sports. Typically the injured athlete will hear or feel a "pop", and will have sudden onset of pain, instability and swelling. If this scenario occurs, the athlete should not attempt to continue playing, and should seek medical attention. Because the ACL is such an important stabilizer of the knee, injury to the ligament makes it difficult to participate in aggressive twisting sports.
It should be emphasized that certain sports can continue to be performed quite well without an ACL. These are "straight ahead" sports such as bicycling, rollerblading, light jogging and swimming. Twisting, cutting and jumping sports are not recommended however due to the risk of the knee giving way. The knee is designed to work as a hinge, moving in one plane. With a torn ACL, there is increased play in the joint allowing shearing forces across the cartilage surface, and leading to progressive tearing of the cartilage discs (menisci) and breakdown of the joint surface. Over time, this breakdown leads to degenerative arthritis.

3.1.1.2.Treatment Options:

Treatment of ACL injuries has come a long way in the past ten years. Today athletes have greater than a 90% chance of returning to their pre-injury level of sports participation.
Non-Surgical : Conservative care is recommended for minor and partial tears of the ACL, or tears in which the knee is still within the accepted limits of stability (less than 3 mm of laxity). Non surgical treatment is also recommended for the patient who is willing to modify their activity to non twisting less aggressive sports. In these athletes, we begin an immediate specialized rehabilitation program, and provide a custom fitted knee brace for use during sports activity.
Surgical Options: Surgery for ACL injuries is extremely specialized and should only be performed by a surgeon who specializes in this type of injury. The techniques continue to change and only someone on the cutting edge can hope to stay up with all of the latest changes.
Surgical Technique

- Suture Repair of the ACL.

- Reconstruction: creating a new ligament out of a tendon from another location in the patient's knee or using cadaver tissue. There are three popular choices for the choice of tissue:

Patella Tendon (Autograft)

- This means taking a strip of the tendon from the front of the athlete's own knee (autograft), and is the most popular choice for this surgery. This technique has been utilized for the longest period of time in the largest number of patients, and is considered the gold standard for ACL reconstruction.
- *Advantages*: Strong graft, with bone attachments at each end, which allows the graft to be fixed very solidly at the time of surgery and which allows healing to the body in the shortest period of time (bone to bone healing) of 4-6 weeks.
- *Disadvantages*: Requires taking tissue from the body. This may cause donor site soreness in a small percentage of patients. To avoid this we utilize a unique method for harvesting the patella tendon graft. This method utilizes a round oscillating tool, which takes a circular graft and leaves the patella with a smooth defect. This makes the patella much less prone to any post surgical problems, and we have not found this to be a problem in many hundreds of patients.

New Frontiers - ACL Tightening (Shrinkage): Currently a study utilizing a new technique which tightens the partially torn or stretched ACL is performed. This is not applicable to the completely torn ligament. Surgery is done ***arthroscopically*** with no incisions. Recovery time is dramatically faster than with a reconstruction.

3.1.1.3.AFTER-CARE REHABILITATION:

In a lot of OT clinics in USA and Europe the patients are sent home with a *knee brace* for the first day. Range of motion is started as soon as the wound is checked. Early goals are to obtain range of motion and to reeducate the muscles. Weight bearing is begun immediately with crutches. The brace is utilized for three weeks or until the quadriceps are strong enough to support the limb. Crutches are discontinued after 1-2 weeks. Stationary bicycling is begun as soon as the patient can achieve 100 degrees of flexion and can get around on the pedal (usually 2 weeks). Outdoor bicycling and jogging are allowed at 3 months. Return to twisting cutting and jumping sports is delayed for 6 months since this is how long it takes for the graft to biologically heal. Prior to returning to sports, the patient is expected to have regained 90-95% of their muscular strength.

3.1.2.REHABILITATION AFTER ACL RECONSTRUCTION

3.1.2.1.In all traumatic knee conditions with a knee surgery the PRM Algorithm includes:

Functional evaluation of the knee mobility and stability and a **Complex PRM programme of care**, including natural and pre-formed physical modalities. The pre-defined PRM protocol includes only ***physiotherapy (analytic exercises) combined with cryotherapy.***
We consider that the traditions of some rehabilitation schools (including Bulgarian, Romanian, etc.) can be used too: we apply preformed physical modalities - ***electrostimulations of the quadriceps femoris muscle*** *(accentuating on m.vastus lateralis and musculus vastus medialis, especially on m.vastus medialis obliquus);* ***interferential currents; low intensity low frequency magnetic field; ultraphonoforesis with NSAIDs***.

3.1.2.2.SCHEMA FOR A PATIENT AFTER ACL RECONSTRUCTION

3.1.2.2.1.FUNCTIONAL EVALUATION:

- Post-operative day No …
- Active range of motion (A-ROM)
- Manual muscle test
- Dynamometry
- Centimetry – of the thigh 10 cm & 20 cm over the patella - for evaluation of the muscular hypotrophy due to the inactivity
- Centimetry of the knee joint – for evaluation of the oedema
- Pain – Visual analogue scale (VAS 0-10 or 0-20)
- Negative sensitive patterns
- Vibroesthesiometry
- Joint Position Sense (JPS)
- Gait assessment (with the orthesis)- SUG test (stand up and go), 5 meters test
- ICF assessment

3.1.2.2.2.PRM PROGRAMME

We effectuate 3-4 PRM courses of 15-20 procedures during the first 4-6 months.

A. Immobilization

Application of ***orthesis*** (with possibility of fixation and regulation of the flexion/extension), ***tape, elastic bandage*** or ***brace***
During the first 2-3 weeks the ***orthesis is locked*** in full extension (if necessary – in 5-10 degrees of flexion) – except during the active exercises.
During the first month the patient will receive a prescription for a lying or sitting position for a minimum 2 hours daily (afternoon) and 8 hours (at night). During the first post-operative period we prescribe the strict execution of the RICE algorithms (Rest, Ice, Compression, Elevation).

B.Pre-formed modalities:

Functional electrical stimulations – for QF, especially for m.VMO

Interferential currents (resulting frequency 90-140 Hz) – 10-20 min., for the knee joint

Low frequency pulsed magnetic field – 16 000 A / m, 10-20 min. – for the knee joint

Ultra-sound or ultra-phonophoresis with NSAID – 0.4-0.8 W/cm^2, 4-8 min.

C.Cryotherapy

Ice massage for 5-10 minutes, 3-5 sessions daily

D.Kinesitherapy

We apply a standard kinesitherapy programme, adapted to the level of pain and functional disability.
We begin with passive mobilizations (under the level of pain) for augmentation of the A ROM of the knee joint; after that we introduce (gradually) active exercises for the range of motion and strengthening exercises – from a lying position (after – in sitting position, in a few days – from standing position – with locked orthesis or brace). Gradually we increase the range of motion (of the orthesis and of the exercise).
We accentuate on analytic exercises for m.quadriceps femoris (especially for m.castus medialis and m.vastus lateralis) and for the hip abductors (especially for m.gluteus medius). At the beginning we use isometric exercises; gradually we include isotonic exercises, with a progressive increase of the applied resistance during exercises.
We apply post-isometric relaxation for the m.rectus femoris, patellar mobilizations, training of the locomotion (with gradually increase of the weight bearing and progressive transition from the crutches to gait without aids).

Passive and mixt exercises:
Initiating with ***passive mobilizations***

Post isometric relaxations *for the m.rectus femoris*
Mobilizations of the patella – only in medial – lateral and proximal-distal directions.

Active exercises – from isometric to isotonic, and contra-resistance:
For muscles around the knee joint (bilaterally): *analytic exercises for the knee dynamic stabilizers and for knee mobility* – strengthening exercises for the muscles quadriceps femoris, m.triceps surae; m.semitendinosus, m.semimembranosus, etc.
Training of muscles of the hip joint and of the ankle joint – bilaterally
Stretching and Theraband exercises for QF, TS, hamstring muscles - training of proprioception

E.ERGO-Th - Sport and other Activities:

Stationary bicycle

Swimming

Training of gait:

with ***progressive weight bearing*** – from non-weight bearing during the first 2-4 weeks, 50 % to full weight bearing and normalization of the gait at the 6th month (at the beginning – with crutches, after that – with cane, after that – without technical aids)

3.1.2.2.3. CLINICAL ALGORITHM

Table – Rehabilitation Algorithm after ACL Reconstruction

PERIOD *(post-op day / week / month)*	Localization of the rehab	GOAL & *Tasks*	Weight bearing	Technical aids ***(brace, orthosis)***	CRYO-Th *(Ice)*	KINESI-Th ***(active exercises, passive mobilizations, soft tissue techniques)***	Training of everyday activities ***(ADL)***	PREFORMED MODALITIES	Notes
Post-operative Day 0-3	**In-patient** ***OT Depart-ment***	*Functional recovery:* *First mobilization of the knee joint – in bed;* *Reduction of pain, oedema;* *First steps*	Partial weight-bearing (25 %), gait – using crutches	Crutches *(or cane – in the altered side);* Locked orthosis or brace *(Flexion 75-80°)*	10 min, 3-7 sessions per day	**Range of motion exercises:** ➢ ***Flexion*** : heel slides; ➢ ***Extension :*** Passive – using towel rolls; **Strengthening exercises:** ➢ *Quadriceps isometry;* ➢ *Begin ankle strengthening exercises:* plantar / dorsal flexion.		Magnetic field Deep Oscillation (DO)	*Active exercises – to patient tolerance;* *Gradually increase of ROM and strength;*
Post-op Days 4-15	**In-patient** ***PRM & Rehab Depart-ment of the Hospi-tal***	**Mobilization of the knee joint – in sitting & in standing position;** **Obtain full knee extension (0°) & 90° of the knee flexion;** **Gait training**	Partial weight-bearing (***50-75 %),*** Gait – with crutches (or cane)	Crutches *(or cane);* Locked orthosis or brace (Extension 0°)	15 min, 3 x daily	**Range of motion exercises:** ➢ ***Flexion*** : knee bends, wall slides, heel slides ➢ ***Extension :*** Passive – using prone hangs and towel rolls **Strengthening exercises:** ➢ *Quadriceps sets with knee support;* ➢ *Hamstring digs with knee support;* ➢ *Ankle strengthening exercises:* plantar /	*Getting up from a seated position* (with support on crutches)	Magnetic field Interferential currents (IFC) Deep Oscillation (DO)	*Observation for eventual post-operative complications* *(deep vein thrombosis, pulmonary thromboembolism)*

				dorsiflexion, inversion / eversion **VERTICALIZATION** **BALANCE TRAINING** **GAIT TRAINING**			
Post-op Weeks 3-6	**Out-patient** ***PRM Depart of*** ***the Medical Center***	Gait training	Partial weight-bearing - WB ***(75 – 100 %),*** Gait – with crutches (or cane)	**Stretching exercises:** ➢ ***For Flexors*** : of the ankle and hip joints *(especially for soleus and ilio-psoas muscles);* ➢ ***For Extensors :*** of the ankle and hip joints *(especially for m.tibialis anterior and gluteal muscles);* **Strengthening exercises:** ➢ *Quadriceps sets with knee support;* ➢ *Hamstring digs with knee support;* ➢ *Ankle strengthening exercises:* plantar / dorsiflexion, inversion / eversion **Range of motion exercises:** ➢ ***Flexion*** : knee bends, wall slides, heel slides ➢ ***Extension :*** Passive – using prone hangs and towel rolls	*Walking uphill or downhill* (with support, but gradually eliminate the support)	FES for m.vastus medialis obliquus Magnetic field (MF) IFC DO	NB! Without pressing on the popliteal fossa

Post-op Weeks 7-8	**Out-patient** ***PRM Depart of*** ***the Medical Center*** ***or*** ***AT HOME Rehab***	Gait training Goal – to obtain normal ROM & Normal walking	TWB Gait – with cane or ***without technical aids***	**Manual therapy:** ***Mobilizations of the patella*** (in proximal, distal; lateral and medial directions) **Stretching exercises:** ➢ ***For Flexors*** : of the ankle and hip joints *(especially for soleus and ilio-psoas muscles);* ➢ ***For Extensors :*** of the ankle and hip joints *(especially for m.tibialis anterior and gluteal muscles);* **Strengthening exercises:** ➢ *Quadriceps sets with knee support;* ➢ *Hamstring digs with knee support;* ➢ *Ankle strengthening exercises:* plantar / dorsiflexion, inversion / eversion	*Getting up from a seated position* (without support); *Going up or down stairs*	FES for m.vastus medialis obliquus or Ultra-sound of the knee or MF or IFC	
Post-op Months 2 - 4	**Out-patient** ***PRM Depart of*** ***the Medical Center*** ***or***	Participation in all ADL Training of working activities		**MANUAL therapy:** *tibio-femoral distraction,* *anterior tibial glide,* *posterior glide;* *Techniques of Maitland and Mulligan* **Stretching exercises:** ➢ ***For Flexors*** : of the ankle and hip joints	*Kneeling, squatting* Some sports training – swimming, sitting bicycle; Training of working	FES for m.vastus medialis obliquus or MF	**PRM Control**

	AT HOME Rehab		*(especially for soleus and ilio-psoas muscles);* ➢ ***For Extensors :*** of the ankle and hip joints *(especially for m.tibialis anterior and gluteal muscles);* **Strengthening exercises:** ➢ *Quadriceps sets with knee support;* ➢ *Hamstring digs with knee support;* *Ankle strengthening exercises:* plantar / dorsiflexion, inversion / eversion **ERGO-Therapy**	activities	
Post-op Months 5-6	***AT HOME Rehab***	Every day	**Stretching exercises** **Exercising Muscles that Surround The Knee** **Working the Hip Stabilizers** **Increasing Muscle Endurance** **CARDIO-RESPIRATORY FITNESS –**		OT control

			including stationary bicycle, swimming, etc.			
Longlife maintenance rehabilitation programme	***AT HOME Rehab***	3 seances weekly	**Stretching exercises** **Exercising Muscles that Surround The Knee** **Working the Hip Stabilizers** **Increasing Muscle Endurance** **CARDIO-RESPIRATORY FITNESS – i*ncluding stationary bicycle, swimming, etc.***	***Sports*** ***Working activities*** ***Leisure activities***	***Periodically*** ***(monthly or every 2 months):*** **10-15 seances DO or** **MF or** **IFC**	
Control *PRM & OT*						

3.1.2.2.4. Prevention of complications

In every period of the rehabilitation process, the patient is observed for possible complications: deep vein thrombosis, pulmonary thromboembolism, muscle or joint contracture, etc.

3.1.2.2.5. Prognosis:

ACL reconstruction is a highly successful operation. 90-95% of patients can be expected to return to full sports participation with 6 months and with aggressive (but well dosed) rehabilitation.

3.2. REHABILITATION PROGRAMME AFTER TOTAL HIP ARTHROPLASTY

REHABILITATION AFTER JOINT REPLACEMENT (ENDOPROSTHESIS)

Endoprosthesis is the reconstruction of joints with mobile artificial joint models, consisting of metal alloys and synthetic materials. These reconstructions are performed on the shoulder, elbow, hip and knee joints. The achievement obtained on the knee and hip reconstructions could not be obtained in upper extremity reconstructions.

Endoprosthesis is a good option for: knee calcifications that do not respond to intra-articular injection or physiotherapy; for patients who are considered not to benefit from knee arthroscopy and directing operations; in those who had such operations but have persistent complaints; for calcifications which do not respond to drug injection or physiotherapy applications in the hip joint.

REHAB:

Patients with hip or knee endoprosthesis are transferred from acute to subacute or outpatient rehab at an ever earlier stage. In rehab, major goals are the improvement of range of motion of the knee or hip. In addition to individual physiotherapy, it is inevitable that the patient participates in accompanying measures.

In the early stage of rehab, a motor splint is usually utilized. Further on in the rehab process, it is important that the patient starts to become active and to apply his/her own strength. Often, the transition from continuous passive motion with the motor splint to active training

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on an ergometer turns out to be problematic. Due to a small range of motion, pain or hematoma, the application of a cycle ergometer is not yet possible in many cases.

Training goals:

- *Improvement of motor skills, cardiovascular conditions and strength*
- *Prevention of contractures (mobilization of joints, muscles and tendons)*
- *Prevention of thrombosis (improvement of the venous backflow from the legs)*
- *Rapid muscle build-up: Particularly in patients with a non-cemented endoprosthesis, who usually tend to have larger deficits in the area of quadriceps and gluteal muscles, enforced muscle gain can regularly be observed after additional training with a mechanotherapy device, v.g. the MOTOmed leg trainer.*
- *Early start of active training (less muscle loss, less stiffening). Particularly for weaker and older patients, the combination of passive-assistive and active training has proven to be of great value: In order to initiate movement, the legs are being moved and loosened up by the motor without any strain on the patient. After that, the patient can start cycling him/herself against a minimal resistance, even if putting in very little impulses. The motor supports the movement (assistive training). A further progression of the training is the active cycling against finely adjustable resistances.*
- *Improvement of circulation and therefore increased sensation of warmth*
- *Improvement of the general patient condition: Psychologically, a transition to an active form of training is of great importance for many patients. Thus, it can be quite valuable for post surgery patients to be able to perform movements without pain or tension after a long time of great pain and relieving postures.*
- *Support of the process to restore a correct gait pattern: Usually, physiotherapy training is only provided during the first two months after surgery. However, studies show that the largest increase of muscle strength only happens after those two months. Therefore, it is important that the patients continue with muscle strength training after the period of physiotherapy.*

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Rehabilitation program in a patient with *total hip arthroplasty (after coxarthrosis)*

Patient Complaints

- *Excessive pain and stiffness in the left hip and muscles around it ,*
- *Difficulties in standing up, transfers and mobility,*
- *Reduction of autonomy in activities of daily living (ADL).*
- *Gait with walker or crutches, if possible; with or without assistant.*

CLINICAL EXAM:

- ✓ *Limited range of motion of the correspondent lower extremity.*
- ✓ *Post-operative cicatrix – without complications.*

FUNCTIONAL ASSESSMENT

KINESIOLOGICAL ANALYSIS:

- *Goniometry of the operated hip joint*
- difficulty in transfers, normal gait impossible, the patient can or can't effectuate 10 meters walk test – with walker, 1-2 crutches and an assistant PT.
- evaluation of the *rehabilitation potential*

ICF assessment:

- impairments of body functions – hip pain, muscle weakness, and restricted hip ROM;
- changes in body structures;
- activity limitation - limited walking ability and problems with putting on socks;
- participation restrictions - reduced participation in leisure activities;
- decrease of the patient's level of autonomy.

EVALUATION TESTS:

- ***10 meters walk test (10mWT) – seconds* before & after rehab ;**
- ***Timed Up and Go test (TUG) -* seconds before intervention;**
- ***6 Minutes Walk Test (6 MWT)*** - impossible before rehabilitation; … meters after rehabilitation (one week inpatient rehab cycle)

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REHABILITATION PROGRAMME

GOAL – *functional reeducation*

TASKS:

- *recovery of the stability and mobility of the lower limb joints,*
- *restoration of the muscle and ligament balance, accentuating on muscles around the hip joint; keeping the hip in the economic limb biomechanics;*
- *pain control;*
- *control of the cicatrix;*
- *control of joint ROM;*
- *control of possible complications;*
- *education of transfers,*
- *normal gait recovery with correction of eventual abnormal walking scheme;*
- *ADL (activities of daily living) training;*
- *amelioration of autonomy in everyday life;*
- *psycho-emotional stimulation ,*
- *amelioration of the health-related quality of life.*

METHODS :

- ✓ ***drugs* – Fraxiparine ; analgesics.**
- ✓ ***patient's education;***
- ✓ ***posture* (activity modification),**
- ✓ ***electrotherapy* – magnetic field, interferential currents.**
- ✓ ***paraffinotherapy* -** for the hip joint (before the massage and the kinesitherapy);
- ✓ ***massage*** – classic massage (relaxing for the anterior group of muscles of the hip; stimulating for gluteal muscles),
- ✓ ***Individualized kinesitherapeutic programme* - correct posture of lower limb, analytic exercises for gluteal muscles especially for *gluteus medius* muscle, lower limb joint mobilization (active range of motion), post-isometric relaxation /PIR/ for *iliopsoas muscle*; gait training with supporting walker or two crutches, education in mobility up and down the stairs.**
- ✓ ***Occupational therapy & ADL training*.**

FUNCTIONAL ASSESSMENT at the end of the rehab:

- o *Goniometry* of the operated hip:
- o *6 Minutes Walk Test (6 MWT)* - in meters.

RESULTS OF THE REHABILITATION PROGRAMME

- ➢ *Amelioration of the range of motion of the left hip;*
- ➢ *Amelioration of the functional capacity ;*
- ➢ *Independent stand up and transfers*
- ➢ *Independent gait with crutches – in the room and the corridor*
- ➢ *Balance & Gait stabilization;*
- ➢ *Decrease of dysesthesiae and pain in distal parts of lower limbs;*
- ➢ *Stabilization of the metabolic patterns;*

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- *Amelioration of the autonomy in ADL.*

RECOMMENDATIONS:
Treatment plan after the dehospitalization:
Auto-PT at home: kinesiotherapy every day at the 3-th month after the operation
Gait – with walker, one or two crutches
Next rehabilitation course at hospital – after 3 months

General HIP CONDITIONING PROGRAM – *for longlife protection after surgery*

Aim: *to stimulate the patient to return to daily activities, to sport and other recreational activities.*

Methods:
- *Strengthening exercises*
- *Flexibility exercises – stretching the muscles for restoration of ROM and prevention of future injuries*

Target muscles:
- ✓ Gluteus maximus (buttocks);
- ✓ Gluteus medius (buttocks);
- ✓ Hamstrings (back of the thigh);
- ✓ Piriformis (buttocks);
- ✓ Adductors (inner thigh);
- ✓ Abductors (outer thigh);
- ✓ Tensor fasciae latae (outer thigh).

Length of the program - 4-6 weeks
After that – maintenance program for lifelong protection of knees (2 – 3 days a week)

Structure of the procedure:
- *Warm-up (5-10 minutes);*
- *Stretch,*
- *Strengthening exercises,*
- *Stretching exercises.*

***Stretching exercises* -** Standing ilio-tibial stretch, Seated rotation stretch , Knee to chest, Supine hamstring stretch

***Strengthening exercises* -** Hip Abduction, Hip Adduction, Hip extension (prone), Internal hip rotation, External hip rotation

Recommendations:
Exercises must be done without pain (or increase of current pain)
Patient can realize exercises at home, only if the therapist is sure that the application of exercises is correct!

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3.3. TOTAL KNEE ARTHROPLASTY

DEGENERATIVE JOINT DISEASE OF THE KNEE – REHABILITATION PROGRAM IN A PATIENT WITH KNEE ARTHROPLASTY

3.3.1.Degenerative joint disease of the knee

Osteoarthritis is the most common musculoskeletal affliction, representing a significant health problem worldwide.

The knee joint (the largest joint in the human body is intensely stressed in both locomotion and repose, with the rapid deterioration of its elements) is one of the most common sites of osteoarthritis (even the most frequent in some studies) with major dysfunctional impact on the body. Presently, knee osteoarthritis is a major social and health problem and a cause of disability among the aging population, generating an increasingly heavy financial burden on the social society and health care systems in modern societies.

Osteoarthritis of the knee is one of the five leading causes of physical disability in non-institutionalized elderly men and women. Knee osteoarthritis significantly contributes to functional limitations and disability in the elderly, affecting the ability to walk and climb the stairs more than any other disease.

Like hip osteoarthritis, it might be seen as the primary disease or develop secondary to developmental knee dysplasia, arthritis, etc.

3.3.2. Role of complete diagnosis / assessment (etiopathogenical, clinic, laboratory - screening laboratory, imaging examination and functional assessment):

a. The **etiopathogenical and clinical assessment** included:

- careful patient history to determine: the parameters of pain, accompanying symptoms;
- general physical state examination (system examination including sensory evaluation);

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- musculoskeletal examination – somatoscopic exam, appreciation of the range of motion and manual muscle testing of the leg muscles, especially the knee, the patellar shock assessment;
- exam in loaded/charged bipod, unipodal and sitting, when surgical status permitted;
- gait exam, pace and dynamics, analyze pain when walking (on flat ground and stairs), when surgical status permitted.

b. <u>Imaging examination</u>

- Radiographs: Plain radiographs are usually satisfactory for diagnosis; lateral or medial joint space narrowing, subchondral sclerosis, subchondral cysts, osteophytes may be seen.
- Ultrasound exam: is useful pre – and post surgical, we can monitor the all periarticular structures.
- Magnetic resonance imaging: Useful in determining early stages of the disease, preoperative.

c. <u>Functional assessment</u>

- the VAS - Visual Analogue Scale (from 0 to 10, 0 = absence of pain and 10 = maximum pain score, other values between 0 and 10 is directly proportional with the intensity of pain, depending on the individual pain threshold);
- the WOMAC scale for assessing the impact of osteoarthritis on lower limbs for completing usual activities of daily living (total score = 0 = maximum functional status and functional status 96 = minimum, with maximum disruption of daily activities).

3.3.3. Rehabilitation program (RP)

3.3.3.1. Preoperative period

<u>Objectives</u> of RP:

- painful status control;
- controlling the inflammatory process;

- regaining stability and mobility of the knee, muscle and ligament balance, restoring balance to the muscle groups serving the entire "knees" complex;
- correcting abnormal walking scheme, with recovery of normal walking;
- keeping the knee in the economy of the limb biomechanics;
- regaining motor control, optimal knee function.

Methods of RP:

- non-pharmacological and non-surgical modalities:
  - educational, dietary (weight reduction) and hygienic, posture (activity modification),
  - physical (thermotherapy - paraffin knee and electrotherapy - magnetodiaflux, TENS, ultrasound) - decreased joint swelling and pain will reduce chances of developing complications during the rehabilitation process;
  - massage – classic and special massage (Cyriax),
  - kinetic – correct posture of lower limb (nothing should be placed behind the operative knee, to promote maximal knee extension and prevent knee flexion contracture), disto-proximal lower limb joint mobilization (assistive active and active range of motion, early patellar mobilization), stretching and strengthening in all muscles (early quadriceps retraining and strength training), gait training with supporting cane in the opposite hand;
  - knee orthoses;
- pharmacological modalities - analgesics, chondroprotective medicine, anti-inflammatory drugs;
- surgical modalities – total knee arthroplasty is the procedure of choice in most cases of knee osteoarthritis.

3.3.3.2. Postperative period

3.3.3.2.1. First interval. See table 1.

1 – 7 days (week 1) = Before rehabilitation department (inpatient orthopedic department).

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Table 1. Components of the kinetic program applied for patients with knee arthroplasty during the first week after surgical intervention

Objective		Rehabilitation components / Early Postoperative Exercises
1	Control postoperative knee swelling	1. Cryotherapy (at least 4 times/day, 3 – 7 days after surgery). 2. Physical therapy – TENS, reflex ultrasound (in plantar foot).
2	Increase range of motion (ROM) in the knee ≥ 80° flexion ≤ 10° extension	1. Lower extremity passive range of motion (PAROM) exercises (supine and seated positions). 2. Patella femoral and tibial femoral joint mobilization. 3. Straight leg raises (SLR) exercise. 4. Correct postures in bed (a towel roll should be placed at the ankle to promote knee extension when patient is supine; heel slides in supine or sitting to increase knee flexion)
3	Enhance muscle control and strength in the involved lower extremity	1. Soft tissue massage. 2. Gentle stretches for the hamstrings, calf, and iliotibial band. 3. Independently perform extremity SLR exercise and ankle pumps. 4. Lower extremity strengthening - isometric quadriceps, hamstring, and gluteal isometric exercises. !! No exercises with weights or resistance. !! Avoid torque or twisting forces across the knee joint. 5. Closed chain exercises (if patient demonstrates good pain control, muscle strength and balance) performed with bilateral upper extremity support while maintaining appropriate assistive device (weight bearing). 6. Transfer training (supine in bed ↔ sit down ↔ stand up) 7. Gait training on flat surfaces with assistive device (cane maintained in opposite hand).
4	Maximize patients' mobility and functional independence	1. Bed mobility and transfers with the least amount of assistance while maintaining appropriate weight bearing (WB) precautions. 2. Ambulate with an assistive device for 200 meters to allow for independence activities while maintaining appropriate WB. 3. Verbalize understanding of post-operative activity recommendations/precautions including use of proper positioning of the lower extremity, range of motion and strengthening exercises.
5	Profilaxy of complications	Observe for any signs of deep vein thrombosis (increased swelling, calf pain, erthymia), pulmonary embolism, loss of peripheral nerve integrity.

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3.3.3.2.2. Second interval. See table 2.

8 - 21 days (weeks 2 - 3).

Inpatient rehabilitation department - patient has minimal knee pain and inflammation, active knee range of motion (10°-80°) and is able to: ascend/descend stairs performs quadriceps contraction and/or perform a straight leg raise, independent transfers and walks at least 250 meters with appropriate assistive device (cane).

Table 2. Components of the kinetic program applied for patients with knee arthroplasty during weeks 2 and 3 after surgical intervention

Objective		**Rehabilitation components /** Intermediate Exercise Program
1	Minimize pain	Pain modulation modalities – cryotherapy, medication
2	Increase knee range of motion (0-90°)	1. Heel slides in supine or sitting to increase knee flexion 2. Lower extremity range of motion (ROM) → active assisted active (AA/AROM) exercises (supine and seated positions) for ankle dorsiflexion mobilization knee flexion / extension, hip extension. 3. Patellar mobilizations in all directions
3	Enhance muscle control and muscle strength 3/5-4/5 in the involved lower extremity	1. Active straight-leg raises in supine, prone, and sidelying positions. 2. Progressive passive stretching for the hamstrings, calf, and iliotibial band within a pain-free range 3. Muscle-setting exercises of the quadriceps, hamstrings, and hip adductors. 4. Neuromuscular electrical stimulation (NMES) for quads if poor quad contraction is present. 5. Gravity-assisted knee extension in supine (placing a towel roll under the ankle and leaving the knee unsupported) and in sitting 6. Agonist-contraction and Kabat techniques to decrease muscle guarding, particularly in the quadriceps, and increase knee flexion
4	Maximize patients' mobility and functional independence	1. Ambulation with use of an assistive device 2. Ascend and descend stairs, with assistive device 3. Training the transfers and sitting and standing balance

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3.3.3.2.3. Third interval. See table 3.

22 – 42 days (weeks 4 - 6).

Outpatient rehabilitation department.

Table 3. Components of the kinetic program applied for patients with knee arthroplasty during weeks 4 - 6 after surgical intervention

Objective		**Rehabilitation components /** Intermediate Exercise Program
1	Diminish swelling and inflammation	1. Pain modulation modalities – cryotherapy, medication 2. Cyriax massage
2	Increase knee range of motion (0-115°)	1.Lower extremity range of motion (ROM) → active assisted active (AA/AROM) exercises (supine and seated positions). 2. Patellar and tibiofemoral joints mobilizations. 3. Stationary bike without resistance to increase flexion ROM !! Sustain mobilization after suture removal, when incision is clean, dry
3	Increased dynamic joint stability Muscle strength 4/5-5/5 Full weight bearing per implant status	1. Soft tissue mobilization to quadriceps or hamstrings myofascia (apply to restricted tissue to break up adhesions caused by swelling and inflammation). 2. Progressive passive stretches to hamstrings, gastrocnemius, soleus, quadriceps within a pain-free range 3. Active straight-leg raises in flexion, abduction, adduction, extension 4. Gravity-assisted knee extension in supine (placing a towel roll under the ankle and leaving the knee unsupported) and in sitting 5. Continue isometric quadriceps, hamstring, gluteal isometric exercises, than Include concentric and eccentric quadriceps exercises. 6. Initiate isokinetic exercise to challenge the quadriceps and hamstrings throughout the range of motion. Work in concentric and eccentric modes. 7. NMES for quads if poor quad contraction is present. 8. Pain-free progressive resisted exercises using ankle weights 9. Neuromuscular proprioception techniques (Kabat, Frenkel) to decrease muscle guarding, and increase balance. 10. Closed-kinetic chain strengthening, such as ¼ squats, ¼ front lunges
4	Return to functional activities (appropriate balance and proprioception)	1.Ascend and descend stairs, with / without assistive device Gait training on stairs to engage the knee through 0-110° of motion, the ROM optimal to ambulate on stairs without compensations. Focus on eccentric quad control and stabilization in stance phase. 2. Complex gait training - weight shifting, tandem walking, lateral stepping over / around objects, obstacle courses, front and lateral step-ups closed-kinetic chain activities 3. Protected, progressive aerobic exercise, such as cycling without resistance, walking, or swimming !!! Assistive devices are discontinued when the patient demonstrates adequate lower extremity strength and balance during functional activities (usually 1-4 weeks)
5	Adhere to home exercise program	Postural cues/ reeducation during all functional activities as indicated.

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3.3.3.2.4. Fourth interval. See table 4.

After 6 weeks. Home-training.

Patient has minimal to no pain and inflammation, an optimal clinical and functional status – knee ROM 0-115°, strength and endurance and motor control of the involved limb (good voluntary quadriceps control, 4+/5 muscular performance based on MMT of all lower extremity musculature), normal age appropriate balance, properly cardiovascular fitness, independent, non-antalgic gait (≥ 500 meters) and independent step over step stair climbing without assistive device, deviations or antalgia.

So, previous exercises must continued with progression (including resistance and repetitions) and performed to functional tasks, such as transferring from sit-to-stand, lifting, carrying, push/pulling, squat/crouching, and return to work and sport tasks. Activities such as bicycling, walking, or aquatic programs are recommended to improve and maintain cardio-respiratory and muscle endurance.

Until week 12, we recommend low impact activities and no twisting / pivoting exercise.

After 12 weeks, patient can return to appropriate recreational sports / activities as indicated golf, doubles tennis, progressive walking or biking program.

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Table 4. Components of the kinetic program (home-training) applied for patients with knee arthroplasty after 6 weeks after surgical intervention

Objective	Advanced Exercises and Activities	
	Example exercises	**Exercise parameters**
Flexibility (ROM)	Active movement of lower limbs Stretching of calf muscles, hamstrings and quadriceps	Daily, 5 sets for each of lower limb joints, since distal to proximal Daily, 5 sets of 6 seconds for each of muscle groups
Muscle strength	Isometric contraction of vastus medial oblique into quadriceps muscle and gluteus maximus	Daily, 3 sets, 5 repetitions/set, 6 seconds for isometric contraction, 1 minute rest between contractions
	Isotonic contraction of leg flexor and leg extender, quadriceps muscle, calf muscles	Daily, in antigravity position for each muscle, 2 sets, 10 repetitions/ set, 2 minutes' rest between sets. Intensity equal with maxim voluntary contraction
Endurance	Cycling, walking, housework	Daily, 30 – 40 minutes. Intensity equal with submaximal voluntary contraction
Control of movement and gait coordination	Frenkel exercises for lower limbs Exercises on the balance board Front and back cross over stepping Tandem walking Eyes closed walking (supervised !)	3 per week
ADL (functional activities)	Sitting to standing in chair, bed, other places Stair climbing Getting in and out of car	Daily

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3.3.3.4. Communication with patients

3.3.3.4.1.Preoperative

- Most of the osteoarthritis patients are over 60 years of age, when degenerative joint disease involving other joints and spine. Presence of associated illnesses is common.
- Total knee arthroplasty is a major surgery which has a high impact on the body. Before the operation the patients should be informed about the potential complications of surgery, complications specific to total knee arthroplasty and their treatment policies, possibility of transfusion, and use of medication.
- Patients should also know the prosthetics options, brands to be used and alternatives. Expectations of the patient should be realistic.
- Patients should be aware that total knee arthroplasty will relieve pain originating from the knee only. Postoperative pain and management modalities / rehabilitation program should be described.
- Patients should be informed about mobilization time, need for assistive devices, bathroom usage, possible return to regular life.

3.3.3.4.2.Postoperative

- Understand of post-operative activity recommendations/precautions including use of proper positioning of the lower extremity, range of motion and strengthening exercises
- Care for the prosthetics for longevity of the device should be told.
- Learning and respecting the orthopedic hygiene of the knee, and other lower limb joints , are very important and complete the program. Reminder for stair use:
  - upstairs - the nonoperative leg goes first, then the arthroplasty leg, lastly the assitive device (crutches or cane),
  - downstairs - the crutches or cane go first, then the arthroplasy leg, lastly the oposite leg.
- Develop a maintenance program and educate patient on the importance of adherence, including methods of joint protection
- For relative repose between kinetic sessions, the patient was asked to comply with the correct posture, alternating the position (with knees slightly flexed) with functional position (with knees in extension).
- All patients must understand the importance of regular exercise to restore / maintain the knee mobility and strength, 20 – 30 minutes two or three times a day, walk 30 minutes.

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3.4. HALLUX VALGUS

REHABILITATION PROGRAM IN A PATIENT WITH HALLUX VALGUS – PRE AND AFTER SURGICAL TREATMENT

1. Hallux Valgus

Hallux valgus is a progressive foot deformity in which the first metatarsophalangeal (MTP) joint is affected (the medial eminence becomes prominent as the distal end of the first metatarsal drift medially and the proximal phalanx deviates laterally) and is often accompanied by significant functional disability and foot pain. There is a high prevalence of hallux valgus in the overall population (23% in adults aged 18-65 years and 35.7% in elderly people aged over 65 years). It has a higher prevalence in women (females 30% - males 13%) and the elderly (35,7%).
The MTP joint is gradually subluxed (lateral deviation) resulting in an abduction of the first metatarsal while the phalanges adduct. At a late stage, these changes lead to an exostosis on the dorsomedial aspect of the first metatarsal head (bunion) with pain and impaired gait (lateral and posterior weight shift, late heel rise, decreased single-limb balance, pronation deformity).

2. Role of complete diagnosis / assessment (etiopathogenical, clinic, laboratory - screening laboratory, imaging examination and functional assessment):

a. The **etiopathogenical and clinical assessment** included:

- careful patient history to determine: the factors that have been considered to play a role in the development of hallux valgus (gender, shoewear - tight pointed shoes, congenital deformity or predisposition, chronic achilles tightness, severe flatfoot, hypermobility of the first metatarsocunieform joint, and systemic disease), parameters of pain, accompanying symptoms;
- general physical state examination (system examination including sensory evaluation);
- exam clinically anatomy; the angle created between the lines that longitudinally bisect the proximal phalanx and the first metatarsal is known as the hallux valgus angle; the values of this angle are:
  - less than 15 degrees is considered normal;
  - values of 20 degrees and greater are considered abnormal (hallux valgus);
  - values >45-50 degrees is considered severe.
- musculoskeletal examination – somatoscopic exam, appreciation of the range of motion and manual muscle testing of the leg muscles, especially the leg alignment, the presence of pes planus and contracture of the Achilles tendon, the height of the longitudinal arch; if physical examination is executed, performed with the patient both seated and standing, the following indications could be present:
  - pain,
  - lateral deviation of the MTP joint - the first MTP becomes subluxed, what leads to a lateral deviation of the hallux, medial displacement of the distal end of the first metatarsal and bony enlargement of the first metatarsal head; with progression, the pull of the adductor hallucis tendon and the intermetatarsal ligament cause the sesmoids to erode the cristae underneath the first metatarsal cuasing the sesmoids to sublux laterally,
  - swelling of first MTP joint,
  - shortening of flexor hallucis brevis muscle,
  - tenderness of hallux,
  - weakness of hallux abductor muscles,

○ gait exam, pace and dynamics, analyze pain when walking (on flat ground and stairs); during weight bearing, the deformity is generally accentuated.

b. **Imaging examination** – radiographs (Manchester scale)

○ the hallux abductus angle formed between the longitudinal bisections of the first metatarsal and the proximal phalanx,
○ the degree of displacement of the sesamoids,
○ the osteoarthritic change within the first MTP joint.

c. **Functional assessment**

- the VAS - Visual Analogue Scale (from 0 to 10, 0 = absence of pain and 10 = maximum pain score, other values between 0 and 10 is directly proportional with the intensity of pain, depending on the individual pain threshold);
- the WAS - walking ability scale;
- the FHSQ - foot health status questionnaire for pain and function.

3. Rehabilitation program (RP)

3.1. Preoperative period

Objectives of RP:

- painful status control;
- restoring normal toe and foot joint range of motion and muscle length;
- restore normal muscle control and strength;
- correcting abnormal walking scheme, with recovery of normal walking;
- regaining motor control, optimal foot function.

Methods of RP:

- non-pharmacological and non-surgical modalities:

○ educational, dietary (weight reduction) and hygienic, posture (activity modification), adjustment to footwear help in eliminating friction at the level of the medial eminence (patients should be provided of a shoe with a wider and deeper tip);
○ physical (thermotherapy - paraffin leg and electrotherapy - magnetodiaflux, TENS, ultrasound, whirlpool) - decreased joint leg pain will reduce chances of developing complications during the rehabilitation process;
○ massage – classic and special massage (Cyriax);
○ kinetic (three times per week for 3 – 6 months)

▪ deloading taping techniques,
▪ joint mobilisation (foot mobilization techniques) and alignment techniques,
▪ graded mobilisation of the affected hallux /1st MTPJ, increase extension of MTP joint (passive abduction of the hallux with traction of the first metatarsophalangeal joint and active abduction of the hallux), passive abduction of the hallux with traction of the first metatarsophalangeal joint and active abduction of the hallux;
▪ sesamoid mobilization,
▪ muscle and joint stretches,
▪ stretching or even lengthening of Achilles tendon;

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▪ the ankle dorsiflexion exercise strengthens the ankles and lower leg muscles (without and with towel or band exercises), special of the peroneus longus muscle;
▪ gait training (the different phases)
o leg orthoses (to relieve weight-bearing stresses) - orthotics to off-load the bunion; the condition of pes planus may be helped by an orthosis; a sever pes planus condition can lead to a recurrence of hallux valgus following surgery;
• pharmacological modalities - analgesics, chondroprotective medicine, anti-inflammatory drugs;
• surgical modalities (more than 150 surgical options published in literature) - classes of surgical procedures include the following:
o capsulotendon balancing or exostectomy,
o osteotomy,
o resectional arthroplasty,
o resectional arthroplasty with implant,
o first MTP joint arthrodesis,
o first metatarsocuneiform joint arthrodesis.

The most frequent procedure applied, depending on the severity of the injury, are:
o distal soft tissue procedure in mild case,
o Chevron osteotomy or diaphyseal osteotomies in halux angle < 30°,
o Akin procedure in hallux < 25°,
o Keller arthoplasty in patients with age > 65 year,
o arhrodesis - the most common surgical procedure.

3.2. Postoperative period

3.2.1. First interval. See table 1. **- Period of operative sandal / special shoe worn**

Table 1. Components of the rehabilitation program applied for patients with surgical hallux valgus correction

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Objective		Rehabilitation components
1 – 7 days (week 1) = The first week after a surgical intervention		
1	Control postoperative leg	1. Strict elevation for pain, swelling and wound healing control 2. Special postoperative shoe / rigid postoperative sandal – mobilize full weight bearing 3. Seeing the toe bandage (some bleeding is normal in the first days) 4. Icing on the top of the surgical toe, periodically
2	Increase / mention the range of motion (ROM) of lower limb	1. Moving the all joints of lower limb (toe, ankle, knee, hip) 2. Gait without weight bearing in the operated leg; patient can used two crutches or canes
8 – 14 days (week 2) = the second week after a surgical intervention		
1	Control postoperative leg	1. Strict elevation for pain, swelling and wound healing control 2. The rest of leg on a big pillow, especially in sleep time 3. Special postoperative shoe / rigid postoperative sandal – mobilize full weight bearing 4. Icing on the top of the surgical toe, periodically
2	Increase / mention the range of motion (ROM) of lower limb	1. Moving the all joints of lower limb (toe, ankle, knee, hip) 2.Raising the straight legs 3.Gait without weight bearing in the operated leg; patient can used two crutches or canes
3	Restore the hallux joint movements	Hallux joint exercises – 4 times / day
15 – 21 days (week 3) = the third week after a surgical intervention		
1	Restore / consolidate the hallux joint movements	Hallux joint exercises – 5 times / day

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3.2.2. Second interval. See table 2. - **Period of normal shoe worn**

Table 2. Components of the rehabilitation program applied for patients with surgical hallux valgus correction

Objective		Rehabilitation components
22 – 42 days (weeks 4 - 6) = the fourth, fifth and sixth weeks after a surgical intervention		
1	Reduce the swelling	1. Elevation of the leg 2. Lymphatic drainage 3. Activation of the muscle pump of the lower limb 4. Cryotherapy (cool packs) ! once a day for 20 minutes
2	Restore / consolidate the hallux joint and metatarsophalangeal (MTP) joints movements	Hallux joint exercises – 5 times / day - caudal sliding of the proximal phalanx (to improve flexion), - dorsal sliding of the proximal phalanx (to improve extension) Manual therapeutic interventions for all MTP joints - mobilization of the first MTP, Lisfranc, transverse tarsal, subtalar, and ankle joints. 1day session of 45 minutes
after 42 days (after 6 weeks) = after 6 weeks post surgical intervention		
1	Restore / consolidate the hallux joint movements	Hallux joint exercises – 5 times / day A marble pick-up exercise Active range of motion of Hallux
2	Regain the tone and strength of all muscles of the toes	1.Isometric contraction of the intrinsic muscles of the foot to maximum tolerance (three repetitions twice daily), 2. Isometric contraction of the extrinsic muscles of the foot to maximum tolerance (three repetitions twice daily), 3. Dynamic adduction and release of the abductor

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		hallucis with five-second holds (five repetitions twice daily). 4. Concentric strengthening exercises of the great toe flexors 5. Concentric strengthening exercises of extensors of leg toes
3	Regain / maintain the tone and strength of calf muscles	1.Hallux joint exercises – 5 times / day 2.Ankle and calf exercises - ankle plantar flexion - ankle dorsiflexion - selective strengthening of the peroneal muscles - stretching the tibialis anterior muscle, the Achilles tendon
4	Gait training	Optimize the load distribution for the whole surgical foot For the stance phase - performing a heel-strike in its physiological position at the lateral aspect of the heel, followed by weight bearing of the first metatarsal during midstance For mid stance and terminal stance - training of active push-off by the great toe flexors, the flexor digitorum longus and brevis muscles, and the lumbrical muscles.
5	Maximize patients' mobility and functional independence	Balance / proprioception work Returning to work Driving

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4. Communication with patients

a. Preoperative

- Most of the patients are over 60 years of age, when degenerative joint disease involving other joints and spine. Presence of associated illnesses is common.
- Patients should be aware that surgery for hallux valgus, while technically demanding, has a high rate of success in appropriately selected patients.
- Postoperative pain and management modalities / rehabilitation program should be described.
- Patients should be informed about mobilization time, need for assistive devices, bathroom usage, possible return to regular life (work).

b. Postoperative

- All patients must understand the importance of the special shoe postoperative that allows weight bearing of the operated limp while reducing stress in the forefoot region. Also, patients need to wear a compressive dressings for 8 weeks.
- Develop a maintenance program and educate patient on the importance of adherence, including methods of joint protection and gait training.
- For relative repose between kinetic sessions, the patient was asked to perform the selective strengthening of the peroneus longus muscle, because the function of this muscle is to pronate the midfoot and pronation is essential for ground contact of the first ray, the most heavily loaded structure of the foot during gait.

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3.5. OSTEONECROSIS OF THE FEMORAL HEAD

REHABILITATION PROGRAM IN A PATIENT WITH OSTEONECROSIS OF THE FEMORAL HEAD – PRE AND AFTER CORE DECOMPRESSION

1. Osteonecrosis of the femoral head

Osteonecrosis of the femoral head (avascular necrosis or aseptic necrosis) is a painful disorder that occurs when the blood supply to the bone is disrupted, so osteocytes of the femoral head dying along with the bone marrow; resorption of the dead tissue by new but weaker osseous tissue can then lead to subchondral fracture and collapse; ultimately lead to destruction of the hip joint and arthritis.
Although osteonecrosis affects people of all ages, it most commonly occurs between the third to sixth decades of life. Men develop osteonecrosis more often than women (the ratio is about 4:1). In many cases (at least 50%), both hips are affected by the disease.
This condition develops in stages and the progression varies from several months to over a year. It is important to diagnose this disease early, because some studies show that early treatment is associated with better outcomes.

2. Role of complete diagnosis / assessment (etiopathogenical, clinic, laboratory - screening laboratory, imaging examination and functional assessment):

a. The **etiopathogenical and clinical assessment** included:

- careful patient history to determine the traumatic or atraumatic form of disease, parameters of pain, accompanying symptoms;
  - the traumatic form of hip osteonecrosis occurs in 10% of undisplaced femoral neck fractures, 10% of hip dislocations, and 15-30% of displaced femoral neck fractures;
  - corticosteroid use and alcohol abuse contributes to the atraumatic form of osteonecrosis in 5-25% of patients;
  - the idiopathic cases make up the third most common category.
- general physical state examination (system examination including sensory evaluation);
  - musculoskeletal examination – somatoscopic exam, appreciation of the range of motion and manual muscle testing of the lower limb muscles, especially the hip muscles.
  - pain is typically the first symptom; may lead to a dull ache or throbbing pain in the groin or buttock area; pain with range of motion;
  - gait exam, pace and dynamics, analyze pain when walking (on flat ground and stairs). As the disease progresses, it will become more difficult to stand and walk, put weight on the affected hip, and moving the hip joint will be painful.

b. Imaging examination

- **X-rays -** are used to determine whether the bone in the femoral head has collapsed and to what degree.
- **Magnetic resonance imaging (MRI) scans – are used** to evaluate how much of the bone is has been affected by the disease. An MRI may show early osteonecrosis that has yet to cause symptoms (if it is developing in the opposite femoral head).
- **PET scans** – are used to show earlier involvement in the acetabulum than is discernible by other radiographic modalities.

c. Functional assessment

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- the VAS - Visual Analogue Scale (from 0 to 10, 0 = absence of pain and 10 = maximum pain score, other values between 0 and 10 is directly proportional with the intensity of pain, depending on the individual pain threshold);
- the WAS - walking ability scale;
- the WOMAC scale.

3. Rehabilitation program (RP)

3.1. Preoperative period

Objectives of RP:

- Relief of symptoms; painful status control;
- Prevention of disease progression / reduce the risk of further damage to the bone;
- Improvement of the affected joint and ensure bone and joint survival;
- Improvement of functionality.

It must take into consideration that physical therapy cannot cure avascular necrosis, but it can slow down the progression of the disease and decrease associated pain.

Methods of RP:

- non-pharmacological and non-surgical modalities:
  - educational - restricted patient weight bearing with the use of a cane or crutches, dietary (weight reduction), addressing known risk factors (smoking, alcohol abuse, monitor steroid use), rest (activity modification, to restrict patient physical activity);
  - osteoporosis screening is indicated in in patients with prolonged corticosteroid use;
  - physical therapy provides only symptomatic control and also does little to alter disease progression, can be used to stimulate bone growth (thermotherapy - paraffin and electrotherapy - magnetodiaflux, TENS, interferential current, ultrasound, whirlpool, electrical stimulation); shock wave therapy in an attempt to get the bone to heal;
  - massage – classic and special massage, particularly for the buttocks, back, or anterior and lateral hip muscles;
  - kinetic (three times per week):
    - training the patient in how to properly use crutches or other gait aids, for regaining lower limb function and relieve painful symptoms;
    - exercises to maintain joint mobily and improve the range of motion in all joints;
    - mobilization of the hip may be combined with assisted stretching of any tight muscles around the joint;
    - muscle stretches; it may also be necessary to stretche knee, ankle and calf - areas that can become tight with the use of a walking aid;
    - exercises to strengthen the muscles around the affected hip joint, thight and back - resistance band exercises (Theraband), soft weight lifting (exercises promote the flow of blood to the joint); exercises that involve the entire lower limb, such as squats on both legs at the same time or just one leg, exercises in these non-weightbearing positions, sitting (exercise bike) or lying in will be prescribed;
    - pool exercises (gentle aerobic exercises);
    - exercises to regain balance and proprioception;
    - daily physical therapy exercises for recreational activities and an active lifestyle.

!! Should be avoided:

- excessive compressive and shear forces on the joint;

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▪ exercises that work the muscles while in standing most effectively assist with daily activities (walking, stair climbing);

○ occupational therapy – teaching how to do ADLs, to rebuild general endurance.

• pharmacological modalities - analgesics, nonsteroidal anti-inflammatory drugs, osteoporosis drugs (bisphosphonates - alendronate), cholesterol – lowering drugs, blood thinners.

• most patients will eventually need surgical treatment, such as:

○ **core decompression - t**he most commonly performed prophylactic surgical intervention often supplemented with bone grafting, in early stages of the disease, before the stage of collapse;

○ **bone transplant (graft),**

○ **bone reshaping (osteotomy),**

○ **arthroplasty (total joint replacement) -** the most commonly performed and successful surgery for advanced AVN of the hip,

○ **regenerative medicine treatment (stem cells transplant).**

3.2. Postoperative period

3.2.1. First interval. See table 1. **– The acute care period and inpatient rehabilitation**

3.2.2. Second interval. See table 2. - **Period of outpatient rehabilitation**

4. Communication with patients

a. Preoperative

• Postoperative pain and management modalities / rehabilitation program should be described.

• Patients should be informed about mobilization time, need for assistive devices, and possible return to regular life (work).

• All patients must understand that moving the joint helps to move any swelling that may be present, and gets fresh blood to the healing areas.

b. Postoperative

• The activity level will depend on which joint have undergone a core decompression.

• All patients must understand the importance of the cane / crutches postoperative that allows weight bearing of the operated hip while reducing stress in the femoral head, for six weeks, possibly longer depending on the severity of the disease. Using a walking aid allows pressure to be taken off the bone while it heals and reduces the risk of fracturing the hip while the bone is healing. Patients who have had bone and blood vessels grafted are required to limit how much weight they place on the hip for up to six months.

• During the kinetic program, only mild discomfort at the very end ranges of motion during the stretching exercises, however, is permissible.

Table 1. Components of the rehabilitation program applied in the 1 – 3 weeks after core decompression

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Objective		Rehabilitation components
1 – 7 days (week 1) = The first week after a surgical intervention **Acute care period**		
1	Relieving any pain and/or inflammation that may still have from the surgical procedure	1.Cryotherapy – ice around hip can decrease any pain or swelling, periodically, seeing the local bandage (in the first and second days) 2.Electrotherapy – TENS, dyadinamic current, ultrasound in the hip region; the neuromuscular electric stimulation of muscles around operated hip 3. Massage - gentle around the surgical site and classical anywhere down the extremity (hip, ankle, leg) and back 4. Posture in the lying (supine) position, with neutral abduction of lower limbs
2	Mention the ROM of other joints of the lower limbs without operated hip	1. Standard mobilization of the opposite lower limb – passive and active ROM exercises of toe, leg, ankle, knee and hip (20 minutes / three times / daily) 2. Assisted stretching of any tight muscles around the previous joints !! Stretches for knee, ankle and calf may also be necessary as these areas can become tight with the use of a walking aid 3. Gait without weight bearing in the operated lower limb; teaching how to safely use the crutches or a walker
3	Preserve the muscle status of the lower limbs	1. Isometric contraction – bed exercises aimed at mention the strenght of thight and calf muscles (6 – 10 seconds / contraction; 1 session = 6 – 10 contractions; 6 sessions / daily) 2. The neuromuscular electric stimulation of muscles around operated hip
8 – 21 days (weeks 2 and 3) = the second and the third weeks after a surgical intervention		

Inpatient rehabilitation		
1	Increase / mention the range of motion (ROM) of lower limbs	1. Operated hip joint - passive flexion and extension ROM exercises were initiated 2 weeks after surgical treatment; passive adduction was initiated 3 weeks after surgical treatment (20 minutes / three times / daily) 2. Active mobilization of all other joints, in all plans of motion (20 minutes / three times / daily) 3. Assisted stretching of any tight muscles around the previous joints
2	Increase muscle strength of lower limbs	*Operated lower limb* 1. Isometric contraction – bed exercises aimed at mention the strenght of thight and calf muscles (6 – 10 seconds / contraction; 1 session = 6 – 10 contractions; 6 sessions / daily) 2. The neuromuscular electric stimulation of muscles around operated hip and quadriceps *Opposite lower limb* 1. Isometric contraction in kinetic chain (6 – 10 seconds / contraction; 1 session = 6 – 10 contractions; 6 sessions / daily) 2. Isotonic contraction of hip muscles (abductors, flexors, extensors), quadriceps and calf muscles, with constant low resistance weight tied on the ankle (example - daily knee extension with sandbags strapped to the ankle, leg press and knee extension) 3 sets by 10 repetitions / set, daily
3	Increase / preserve the upper limb muscle-strength	Upper limb muscle-strengthening exercises – isotonic contractions; the intensity of exercise was increased by increasing the load by 40% to 80% of 10-repetition maximum (RM) Patient may adopted the seated position
4	Restore the gait	Gait without weight bearing in the operated lower limb

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Table 2. Components of the rehabilitation program applied for patients with core decompression in outpatient period.

	Objective	Rehabilitation components
22 – 42 days (weeks 4 - 6) = the fourth, fifth and sixth weeks after a surgical intervention		
1	Restore / consolidate the ROM of lower limb	1. All previous ROM exercises must performed 2. Passive rotation ROM exercise in affected hip may be initiated
2	Restore / consolidate the strength muscles of lower limbs	*Operated lower limb* 1. Isometric contraction exercises in sitting or lying 2. Isotonic flexion muscle-strengthening exercise, straight leg raising with no weight 3. Electrical muscle stimulation to assist the muscles in contraction *Opposite lower limb* 1. Exercises will focus mainly on the muscles of hip and thigh 2. Exercises that involve the entire lower limb, such as squats on both legs at the same time, or just on one leg, will be prescribed. 3. Exercises used of Theraband or weights to provide some added resistance for hip and lower extremity
3	Gait training	Gait without weight bearing in the operated lower limb
After 42 days (after 6 weeks) = after 6 weeks post surgical intervention		
1	Consolidate the ROM of lower limbs	1. All previous ROM exercises must performed 2. Active ROM exercise in operated hip in all directions may be initiated
2	Consolidate the strength muscles	1. All previous muscle strength exercises must performed 2. Isotonic and isokinetic muscle strengthening in operated hip may be performed (flexor, abductor, extensor, adductor, rotators muscles)

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		The intensity of exercise is defined by pain level and is increased by increasing the load by 50% to 80% of 10-repetition maximum (RM).
3	Regain balance and proprioception	1. Exercises that work the muscles while in standing are most effective for improving balance, walking and stair climbing. 2. Standing on one foot or balancing on an stable, then unstable surface 3. Advanced exercises such as the stepper or elliptical machines
4	Gait training	1. Optimize progressing the load of weight bearing 2. Full weight-bearing was permitted 6 - 10 weeks after intervention
5	Maximize patients' mobility and functional independence	1.Exercises that simulate your specific everyday activities of daily living and any recreational activities that you may want to return to 2. Aerobic training is started 8 weeks after surgical intervention (stationary bicycle exercise, pool) 3. Returning to work, driving are permitted after 10 – 12 weeks after 4. Patients were allowed to resume sports 4 - 6 months, when bone is healed

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3.6. CHONDRAL / OSTEOCHONDRAL DEFECTS OF THE KNEE

PATELLA PATHOLOGY

The patella is a relatively small bone in the front of the knee that is embedded in the quadriceps (thigh muscle) tendon and acts to increase the biomechanical leverage of the quadriceps. The patella slides in a groove on the femur as the knee flexes and extends. Because the patella 'floats' within the substance of the quadriceps, proper tracking of this bone in the femoral groove is dependent on proper muscle balance to maintain a central position. Congenital anatomic factors such as the shape of the patella also influence this tracking. Also, because of the location of the patella, it is subject to higher stresses than other joint surfaces. So, despite having a thicker cartilage lining than any other bone, it often begins to wear out before other parts of the knee.

CHONDROMALACIA PATELLAE

Definition: Latin term, meaning softening or break down of cartilage. Chondromalacia of the patella is one of the most common problems to affect the knee, and is particularly common in running and jumping athletes. Chondromalacia usually begins as softening of the otherwise very resilient cartilage and proceeds to cracking and eventually complete loss of the cartilage lining beneath the patella. **Symptoms** include: Pain in the front of the knee, crunching under the knee cap, swelling in the knee, symptoms increase with stair climbing, or prolonged sitting.

Early on, symptoms may simply be mild aching in the area of the patella due to the loss of integrity of the cartilage and a diminished ability for it to protect the underlying bone. Nerve fibers in the bone sense the increased stresses and pain occurs. In later stages of chondromalacia, the cartilage surface of the patella becomes roughened as pieces of cartilage begin to break off. This roughened surface causes a crunching sound under the patella and can lead to swelling of the knee. Symptoms will aggravate as small fragments of cartilage continue to break off and irritate the joint.

Treatment Options: Initial treatment focuses on physical therapy techniques for strengthening the muscles around the patella to balance the patella tracking and more evenly distribute forces on the patella. In severe cases, ***ice and anti-inflammatory drugs*** will be necessary to calm down inflammation before exercises can be initiated. Occasionally, a patella tracking brace or special taping techniques will be utilized. Most patients will improve with non surgical management. In resistant cases arthroscopic surgery can be very helpful in smoothing out the roughened surface of the patella, removing any loose fragments of cartilage, and realigning the patella. Many cases of chondromalacia can be helped by a ***mini arthroscopy*** performed under local anesthesia in the office.

PATELLA MALALIGNMENT

The normal patella should track straight down the middle of the femoral groove. There are varying degrees of abnormal tracking, or patella malalignment. In mild cases of

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malalignment the patella is simply tilted in the groove, leading to increased pressure on the downward tilted side of the patella. Think of this as being like a tire out of alignment, where a subtle imbalance can quickly lead to uneven wear of the tire treads. In more severe cases, the patella will actually sublux, or slide partially out of the groove. In the most severe cases of malalignment, the patella will actually completely dislocate.

Proper tracking of the patella is influenced by many factors. Proper muscle balance is important and is one of the few factors that we can control. Usually the patella wants to sublux toward the outside of the knee (lateral). Strengthening the inside muscle (the VMO) can act to counter this tendency.

Tracking is also influenced by the anatomical shape of your patella, femoral groove, the angle your knee makes with your hip (knock knees) and even the position of your foot (pronation). The hip knee angle is important because the patella is embedded in the quadriceps tendon which originates at the hip and attaches at the knee. The more knock kneed someone is, the more of an angular pull occurs on the patella every time the quadriceps contracts. This angle is called the "Q" angle in medical terminology. In severe cases of angulation (a high "Q" angle) surgery can be performed to correct the "Q" angle. The shape of the patella and femoral groove cannot be easily modified. Increased pronation of the foot (flat feet) can influence the tracking of the patella. This occurs because the rotation of the rest of the leg is affected by the way the foot contacts the ground. In patients with increased pronation, use of shoe orthotics (arch supports) may help patella tracking by modifying the rotation of the knee.

Patella malalignment - Surgical Treatment: For severe cases of patella malalignment surgery may be necessary. This is a new all arthroscopic method for realigning the patella (knee cap). Traditionally, patients with an unstable patella are subjected to an extensive operative procedure that involves making an incision to tighten the inner ligaments controlling the tracking of the patella.

An even newer technique for treatment of some types of patella instability is the use of a heated probe to shrink the stretched patella ligament or retinacullum. This method eliminates the need for any incisions or sutures in the knee. This method is currently being utilized for patients with less severe instability of the patella (called subluxation). With this method, rather than using sutures to tighten the ligaments and realign the patella, the stretched ligaments are heated which shrinks and tightens them.

PATELLA DISLOCATION

The patella is held in place by thin ligaments that act as check reins, keeping it from coming out of the femoral groove, while the muscles provide the fine tuning. With severe twisting maneuvers or direct trauma, the patella can dislocate, tearing these ligaments and coming completely out of place. Sometimes the patella will spontaneously reduce, sometimes a trip to the emergency room is necessary. Because the ligaments have torn, the patella usually will continue to be off balance even after the dislocation is reduced. This will lead to

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abnormal tracking and increased risk of redislocation in the future. In addition, small fragments of cartilage are often chipped off as the patella dislocates, and can cause damage to the joint as they float around.
Numerous studies have shown that patients who have dislocated their patella do not do well in the long term, and suffer either repeated dislocations or develop degeneration under the knee cap due to the now abnormal tracking. Recommended treatment is for immediate arthroscopic evaluation to remove the loose chips and to repair the torn ligaments and rebalance the patella tracking.

PATELLA FRACTURES
Fractures of the patella most commonly occur from direct trauma, usually a fall on the knee or a direct blow to the patella. Less frequently, the patella can be fractured by a sudden, violent contraction of the quadriceps.
Patella fractures are classified as either transverse, stellate or vertical. These three categories can be further classified as displaced or nondisplaced. The arterial blood supply to the patella is derived from two systems of vessels from branches of the geniculate arteries. These two systems supply the middle third and apex of the patella. In cases of displaced transverse fractures, the proximal blood supply may be compromised leading to avascular necrosis of the proximal segment.
Overall, the management of patella fractures is based on classification and morphology of the injury. Treatment options range from nonoperative to operative with open reduction and internal fixation to partial or total patellectomy.
Nondisplaced Fractures
Nonoperative care involves the use of extension splinting from four to six weeks. Weight-bearing status is as tolerated. Generally, quad sets and straight leg raises are permitted as soon as pain allows. Usually at around four weeks, active knee flexion can proceed once radiographic confirmation is made of fracture consolidation.
The contralateral limb is exercised freely, and a general conditioning program is initiated for upper and lower extremity strengthening. Aerobic fitness is maintained via a single leg stationary cycle ergometer or upper body ergometer (UBE). Care is taken during the maximum protection phase of recovery to guard against passive knee flexion beyond the healing constraints of the fracture.
If quadriceps strengthening and knee flexion are progressed too soon, the forces acting across the healing fracture may delay union. Therefore, the PTA must be acutely aware of osseous healing mechanisms and time constraints when overseeing range of motion and strengthening exercises during each phase of recovery from nondisplaced patella fractures. Usually, active range of motion is initiated. Gradual progression to passive range of motion will correlate with solid bone union. Close consultation with the PT is important, since some degree of evaluative skills is necessary for patient progression.
Displaced Fractures

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Treatment of patella fractures is based on ranges of acceptable fracture fragment separation exceeding 3 to 4 millimeters. Although patella fracture patterns may vary, stabilization of displaced patella fragments is best accomplished with an open reduction internal fixation procedure. Various techniques are used including tension band wiring, cerclage wiring, lag screws or combinations of the above.

Commonly, tension band and cerclage wiring is used to stabilize displaced transverse patella fractures. The tension band is a dynamic compression device that approximates and compresses the fracture fragments. The additional use of cerclage wiring adds to the stability of the repair and allows early joint motion without redisplacing the fracture fragment. Postoperatively, the involved limb is immobilized in 20 degrees of flexion to support dynamic compression of the tension band wiring procedure.

Postoperative rehabilitation begins approximately one week after surgery. Active knee flexion should be limited to about 100 degrees for at least six weeks following surgery to allow for proper fracture consolidation.

Straight leg raises, submaximal quad isometrics and gentle active short arc knee extension exercises characterize the initial maximum protection phase of recovery. Weight bearing as tolerated with assistive devices is encouraged during the first few weeks following surgery, progressing to full weight bearing by the third or fourth week.

As clearly stated during treatment of nondisplaced patella fractures, care must be taken not to overstress the healing fracture by aggressive flexion, range of motion or resisted knee extension exercises. Radiographic confirmation of fracture consolidation with stable implant fixation and postoperative time greater than six weeks will dictate to the physician and the PT the gradual implementation of the moderate protection phase of recovery.

Active-assisted knee flexion and light resistance quad exercises are begun once the patient is able to demonstrate good quad control, improved knee flexion to 100 degrees, reduced pain and swelling and normalized gait mechanics. Functional closed chain resistance exercises are deferred until the patient is able to demonstrate increased range of motion without signs or symptoms of articular cartilage degeneration. Strength-training exercises of remedial isometrics and progressive concentric and eccentric resistance must approximate and correlate with solid bone union.

Severe comminuted patella fractures are treated surgically with a partial or total patellectomy if significant bone mass cannot be salvaged. However, as little as 25 percent of the patella can be retained with a good outcome when compared to the overall poor results of total patellectomy.

PHASES OF THE REHAB PROGRAM (principal bases)

Pre-op (if available)

- *Measure for and fit for post-operative brace (double up right, locked at 0);*

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- *Measure for and fit with ted hose;*
- *Perform crutch / walker training and issue crutches / walker if needed;*
- *Evaluation should be scheduled for 2-3 days after surgery*
- *Post-op instructions and education from surgery date to initial physical therapy appointment.*

Phase 1: *0-2 weeks post-op*

Goals:

- *Maintain integrity of repair;*
- *Decrease pain and inflammation;*
- *Promote tissue and fracture healing;*
- *Achieve / maintain full extension;*
- *Incrementally increase passive ROM (per surgeon consultation);*
- *Facilitate quadriceps contraction;*
- *Patient education of precautions and progressions.*

Knee immobilizer: *worn at all times, taken off only for physical therapy sessions (converted to hinged knee brace at first post-op visit)*
Weight bearing: *WBAT with the knee locked in extension*
Range of motion: *A-ROM / AA-ROM / P-ROM 0-30 degrees*
Therapeutic exercises: *Isometric quadriceps / hamstring / adductor / abductor strengthening. Ankle theraband exercises*

Precautions:

- ✓ *No quick movement;*
- ✓ *No aggressive stretching;*
- ✓ *Avoid passive ROM that is too aggressive or provokes muscle guarding;*
- ✓ *Keep incision dry and clean;*
- ✓ *Ensure proper brace fit / locked in extension.*

0 – 2 weeks

- *PROM 0° extension – must achieve 0 grades extension, No flexion.*
- *Patella mobilizations;*
- *May initiate quadriceps isometrics (relative pain-free);*
- *Brace locked at 0° and PWB;*
- *Note: If painful / swollen may keep PWB for additional weeks (or per physician recommendation).*

2 – 4 weeks

- *Maintain 0 degrees extension;*

Grasp and Gait REHABILITATION

- *ROM flexion to 30 degrees;*
- *NMES to facilitate quad contraction (if indicated);*
- *Ambulation with brace locked at 0o and WBAT.*

4 – 6 weeks

- *Advance flexion ROM to 60 degrees (or per physician recommendation);*
- *Continue with current exercises and activities.*

Phase 2: *2 – 6 weeks post-op*

Knee brace: *worn with WB activities still locked in full extension; may be removed at night*
Weight bearing: *WBAT with the knee locked in extension*
Range of motion: *A-ROM / AA-ROM / P-ROM add 15 degrees of flexion each week; goal is 90 degrees by post-op week 6*
Therapeutic exercises: *Isometric quadriceps / hamstring / adductor / abductor strengthening. Ankle theraband exercises***.** + initiate straight leg raises

Phase 3: *6 - 10 weeks post-op*

Criteria to progress to phase 3:

- *Achieve bone healing by adhering to precautions in phase 1 – check with surgeon;*
- *Staged ROM goals achieved (per consultation with surgeon);*
- *Minimal pain / effusion.*

Goals for phase 3:

- *Continue healing of fracture site;*
- *Do not over stress healing structures;*
- *Restore full PROM by week 12;*
- *Normalize A ROM ;*
- *Initiate gradual return to functional activities and light work activities*
- *Note: progression is time and criterion based;*
- *Note 2: progress per continuous assessment of patient's impairments and functional limitations.*

Knee brace: *Unlocked - worn with WB activities*
Weight bearing: *Full*
Range of motion: *A-ROM / AA-ROM / P-ROM – progress to full ROM by post-op week 10*
Therapeutic exercises: *Isometric quadriceps / hamstring / adductor / abductor strengthening. Ankle theraband exercises***.** Initiate straight leg raises.

Weeks 6 – 12:

- *Initiate functional weight bearing exercises;*

Grasp and Gait REHABILITATION

- *Initiate open kinetic chain AROM;*
- *Initiate isotonic strengthening exercises;*
- *Initiate balance / proprioception exercises;*
- *Advance intensity of PROM;*
- *Unlock brace with ambulation, once displays functional quadriceps control may switch to functional short hinge knee brace.*

Phase 4: *10 - 12 weeks post-op*

Knee brace: *Discontinue*
Weight bearing: *Full*
Range of motion: *full ROM*
Therapeutic exercises: *Isometric quadriceps / hamstring / adductor / abductor strengthening. Ankle theraband exercises*. Initiate straight leg raises. + Start stationary bicycle.

Phase 5: *3-6 months post-op*

Return to full activities *as tolerated*

Criteria to progress to this phase (12+ weeks)::
- *Minimal pain with AROM and strengthening activities;*
- *Full AROM without substitution;*
- *5 / 5 strength without substitution.*

Goals (12+ weeks)::
- *Full passive / active ROM;*
- *Enhancing dynamic stability;*
- *Gradual restoration of strength, power and endurance;*
- *Advance neuro-muscular control;*
- *Return to full ADLs / work.*

Note !!!
- *Advance all activities based upon patient's goals and expectations.*
- *Each patient is an individual and should be treated as such.*
- *Work together with the referring orthopedic for optimal patient outcome.*

Phase 6 (final):
LONGLIFE MAINTENANCE PROGRAMME (KNEE CONDITIONING PROGRAM)

Aim – *to stimulate the patient to return to daily activities*

Grasp and Gait REHABILITATION

Methods:
Strengthening exercises
Flexibility exercises – stretching the muscles for restoration of ROM and prevention of future injuries

Target muscles:
- ✓ Quadriceps (front of the thigh);
- ✓ Hamstrings (back of the thigh);
- ✓ Abductors (outer thigh);
- ✓ Adductors (inner of the thigh);
- ✓ Gluteus medius & maximus (buttocks).

Length of the program - every day for a minimal period of 6 months
After that – maintenance program for lifelong protection of knees (2 – 3 days a week)

Structure of the procedure:
- *Warm-up,*
- *Stretch,*
- *Strengthening exercises,*
- *Stretching exercises.*

Stretching exercises
- Heel cord stretch
- Standing quadriceps stretch
- Supine hamstring stretch

Strengthening exercises
- Half squats
- Hamstring curls
- Calf raises
- Leg extensions
- Straight leg raises
- Straight leg raises (prone)
- Hip abduction
- Hip adduction
- Leg presses

Grasp and Gait REHABILITATION

Recommendations to the patient:

- *Do not ignore pain*
- *Ask questions – to be sure that the exercise is well done*

EXAMPLE

MENISCUS TEAR

The *meniscus* is a disc of cartilage tissue and its function is shock absorption between the bones of the knee. Menisci are frequently damaged in twisting injuries or with repetitive impact over time. *Meniscal tear* is a frequent lesion in clinical practice of Orthopedics & Traumatology departments. Meniscus rupture can be the consequence of high energy stress of the joint in position of capsulo-ligamentar relaxation in case of closed kinetic chain and the characteristic model includes combination of torsion stress with valgus or varus angulation.

The meniscus tear is among the most common orthopedic injuries and has been colloquially referred to as “torn cartilage” in the knee. It has affected athletes of literally every sport. While it is most commonly seen in the posterior horn, it can occur in any location and affect either the medial , lateral, or both sides. Common types of meniscus tears are: Radial, Flap or Parrot-beak, Peripheral longitudinal, Bucket-handle, Horizontal cleavage, Complex degenerative tears.

The application of mini-invasive arthroscopic techniques in the surgical treatment of meniscal lesions induces *actualization of the rehabilitation approach*. The post-op rehabilitation can begin immediately with active exercises. Weight bearing is permitted with crutches during the first week. Bandages are removed after 24 hours and band-aids are applied. Stationary bicycling is allowed within a few days.

Normally, the *healing process* finishes between 4-8 weeks but it can take up to 6 months maximum. The patient can return to his normal life including sportive activity.

Contemporaneous rehabilitation protocols for these patients are principally oriented to kinesiotherapy or physiotherapy. But some rehabilitation schools (Bulgarian, Russian, Romanian, etc.) traditionally prefer to apply a complex rehabilitation program with combination of different physical modalities, not only movement therapy.

Functional assessment methods

The ***evaluation protocol*** consists of history of the condition, clinical patterns, and functional assessment, including: goniometry of the knee joint, centimetry, manual muscle test, visual analogue scale of pain (0-20), gait test (test of 5 meters).

Treatment methods

The rehabilitation program is focused on following **tasks**: *functional recovery, restoration of the knee kinetic and kinematic; reduction of pain and oedema; gait training; prevention of complications due to hypomobility (e.g. myo-hypotrophy).*

- **PT programme**

Grasp and Gait REHABILITATION

All patients must receive a detailed **physiotherapeutic program**, including active exercises oriented in training the muscles that allow the function of the knee (m.quadriceps femoris, m.biceps femoris, m.semimembranosus, m.semitendinosus and m.triceps surae), working hip stabilizers (with focus on the hip abductors, hip flexors and gluteal muscles), increasing muscle endurance (using low-impact cardio-vascular activities, e.g. stationary bicycle or/and swimming). Special attention is paid to *Heel slides* à passive flexion and to push the involved leg back up into extension; *supine wall slides* to increase flexion ROM (when 110-115° of flexion is achieved); strengthening exercises for the quadriceps muscle (especially for *Vastus medialis* segment); *isotonic strengthening exercises for the hamstring muscles* (when 80-90° of flexion is obtained); *hip abduction strengthening* (when Vastus medialis obliquus /VMO/ muscle is strong enough).

PATIENT EDUCATION

All patients must receive detailed instructions for rest and rehabilitation. **Patient education** includes information about the lesion and the operation; recommendations to reduce activities and to use crutches - during the first week, to avoid knee-twisting movements or positions, to elevate the knee higher than the heart during rest - for at least 1 month.

CRYOTHERAPY

Cryotherapy is applied for 10 minutes, twice a day for the first week, and once a day for the next week;

MANUAL THERAPY TECHNIQUES

We can add **manual mobilizations** – patella mobilizations, *soft tissue techniques of G. Maitland and B. Mulligan;*

PRE-FORMED MODALITIES

- ***Interferential currents***;
- ***Low frequency low intensity magnetic field***;
- ***Deep oscillation*** (*DO*) – a modern physical modality consisting of electrostatic field, that provokes oscillation of the tissues in profundity, explained with the Rahbek – Johnson effect.

Grasp and Gait REHABILITATION

3.7. ACETABULAR FRACTURES- POSTERIOR STABILIZATION

3.7.1.REHABILITATION MANAGEMENT OF FRACTURES

The management of post-traumatic rehabilitation is based on the ***RICE rule*** (*Rest, Ice, Compress, Exercises).*

The algorithm is divided into *immobilization and post-immobilization periods* of the PRM programme of care (PRM = physical and rehabilitation medicine). Some authors prefer the next classification of the rehab periods: *Pre-operative* (if planning of the operation); *Early post-operative* period; *Middle post-operative* period; *Tardive rehabilitation* (stabilization).

The ***goal of rehabilitation*** of individuals with fractures is *to restore functional abilities of the individual* (Salter). The duration and type of OT rehab required following a fracture are related to the associated soft tissue involvement, as well as the location and type of fracture and the method of stabilization (Chapman). Protocols for rehabilitation must be based upon stability of the fracture and fracture management (operative, nonoperative).

Rehabilitation emphasizes restoring full range of motion, strength, proprioception, and endurance, while maintaining independence in all activities of daily living (Bucholz). Cold and other modalities may be used in controlling pain and edema (Salter). The individual should be encouraged to continue functional activities *to prevent complications of inactivity and bed rest*. Depending on the stability of the fracture, range of motion exercises of the adjacent joints may be started immediately and progressed to *strengthening exercises* as indicated (Chapman).

Bone healing may occur within 6 to 20 weeks; however the bone strength and the ability of the bone to sustain a heavy load may take up to several years (Chapman). Once healing has occurred, the individual may resume full activities of daily living. Resumption of pre-injury status is the goal, with consideration of any residual deficit. The treating physician should guide the resumption of heavy work and sports; it is important to instruct the individual not to overload the fracture site until the bone has regained its full strength.

After either surgery, a ***period of non weight bearing for 6 to 8 weeks*** is recommended in a cast or cast boot. Weight bearing is started while the patient is in the boot if the X-rays look appropriate after 6 to 8 weeks. The amount of weight a patient can put on their foot, as well as the distance the patient is allowed to walk, is at the surgeon's discretion. Impact activities, such as running and jumping, should be avoided until the hardware has been removed. A lot of ***ankle supports*** are applied: *splints, braces, insoles*, *and ankle-foot orthosis orthoses.*

Rehabilitation includes predominantly ***physiotherapy (hands on) procedures - active or passive kinesitherapy*** *in combination with cryotherapy (cold application)*: *range-of-motion* exercises, *strength exercises*, *analytic exercises with a gradual increase of the resistance, soft tissue techniques (post isometric relaxation, calf stretch, soleus stretch, plantar fascia* *stretch, massages),* ***cryotherapy*** *(ice or cold packs),* ***hydro or balneo-kinesitherapy*** *(underwater exercises).* The ***ergonomic approach*** and ***ergotherapy (occupational therapy)*** are obligatory for the quality of ***gate rehabilitation***. In some countries a lot of ***preformed physical modalities*** with trophic and analgesic effects are applied: low frequency electric currents, low frequency low intensity magnetic field, laser therapy or laser puncture

In every case a detailed and individually adapted ***patient education*** is included in the fracture management process.

3.7.2.REHABILITATION AFTER FEMUR FRACTURES

The goal of rehabilitation after a femur fracture is *to restore function*. The rehabilitation protocol depends on the type, location, and severity of the fracture, as well as the physician's protocol for treatment. Consideration must be given to the method for stabilizing the fracture (operative, nonoperative) and on the stability of the fractured bone. The individual's general condition prior to the fracture and the individual's weight-bearing status may influence the rehabilitation process.

Of primary importance during the early phase of recovery is ambulation, with weight bearing as advised, and assistive devices as needed. Depending on the procedure, partial weight bearing may be delayed until there is evidence of bony union, and full weight bearing may be restricted for an additional month (Whittle). The physical therapist should teach ankle exercises to promote circulation through the lower extremities and should advise individuals to perform these intermittently throughout the day.

As the individual increases his or her mobility, an occupational therapy evaluation may be beneficial to maximize independence with activities of daily living and to supply adaptive equipment, such as a raised commode or tub seat, to promote independence.

Once the fracture is stable, gentle range of motion and strengthening exercises can be started and progressed as indicated. The therapist should make sure that adjacent joints are exercised to prevent loss of motion and strength (Whittle). Both to complement supervised physical therapy and to be continued independently after the completion of rehabilitation, a home exercise program should be taught during this period.

Bone healing may occur within 6 to 12 weeks; however, the bone strength and the ability of the bone to sustain a heavy load may take up to several years (Chapman). Once healing has occurred, the individual may resume full activities of daily living. It is important to instruct the individual not to overload the fracture site until the bone has regained its full strength. The resumption of heavy work and sports should be guided by the treating physician.

PATIENT COMPLAINTS

- *moderate pain and stiffness in the right hip and muscles around it*
- *difficulties in standing up, transfers and mobility,*

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- *decrease in autonomy in activities of daily living (adl).*
- *gait with crutches.*

FUNCTIONAL ASSESSMENT

Goniometry of the correspondent hip joint

Before rehabilitation – difficulty in transfers, impossible normal gait, the patient can effectuate 10 meters walk test – with crutches and an assistant PT.

Evaluation of the rehabilitation potential

ICF assessment:

- impairments of body functions – hip pain, muscle weakness, and restricted hip ROM;
- changes in body structures;
- activity limitation - limited walking ability and problems with putting on socks and shoes;
- participation restrictions - reduced participation in leisure activities and in household chores;
- decrease of the patient's level of function.

Evaluation of the physical performance:

- *10 meters walk test (10mWT)* – before rehab ;
- *Timed Up and Go test (TUG)* - before intervention;
- *6 Minutes Walk Test (6 MWT)* - if possible - before and after rehabilitation.

OT rehab programme

GOAL – *functional reeducation of the hip and related activities (walking, transfers)*

TASKS:

- *recovery of the stability and mobility of the lower limb joints, restoration of the muscle and ligament balance, accentuating on muscles around the hip joint; keeping the hip in the economic limb biomechanics;*
- *pain control; control of the cicatrix; control of joint ROM; control of possible complications;*
- *education of transfers, normal gait recovery with correction of eventual abnormal walking scheme;*
- *ADL (activities of daily living) training; amelioration of autonomy in everyday life;*
- *psycho-emotional stimulation , amelioration of the health-related quality of life.*

METHODS :

- ✓ ***drugs*** – Fraxiparine daily; analgesics, chondral protectors,
- ✓ ***patient's education;***
- ✓ ***posture*** (activity modification),
- ✓ ***electrotherapy*** – interferential currents, laser therapy;
- ✓ ***cryotherapy*** - for the hip joint (cryo-massage and cryo-kinesitherapy);

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- ✓ ***massage*** – classic massage (relaxing for the anterior group of muscles of the hip; stimulating for gluteal muscles),
- ✓ ***Individualized kinesitherapeutic programme*** - correct posture of lower limb, analytic exercises for gluteal muscles especially for *gluteus medius* muscle, lower limb joint mobilization (assistive active and active range of motion), post-isometric relaxation /PIR/ for *iliopsoas muscle*; stretching and strengthening in all muscles of the lower limb (accentuating on muscles around the hip joint), gait training with supporting walker, two crutches or two canes, then only with one cane when patient up and down the stairs.
- ✓ ***Ergotherapy & ADL training***.

COMMON RESULTS OF THE EARLY REHABILITATION PROGRAMME

- *Amelioration of the range of motion of the operated hip;*
- *Amelioration of the functional capacity;*
- *Amelioration of the neuro-muscular coordination;*
- *Independent verticalization (stand up) and transfers;*
- *Independent gait with crutches – in the room and the corridor ;*
- *Stabilization of the gait;*
- *Amelioration of the self-service.*

RECOMMENDATIONS:

Treatment plan after the dehospitalization:
Auto-PT at home:
kinesiotherapy every day at the 3-th month after the operation
Gait – with a walker or with two crutches
Next rehabilitation course at hospital – after 3 months

General HIP CONDITIONING PROGRAM – *for longlife protection after surgery*

Aim: *to stimulate the patient to return to daily activities, to sport and other recreational activities.*

Methods:

- *Strengthening exercises;*
- *Flexibility exercises – stretching the muscles for restoration of ROM and prevention of future injuries;*
- *Low frequency low intensity magnetic field;*
- *Deep Oscillation;*
- *Interferential currents;*
- *Cryotherapy;*
- *Underwater exercises.*

Grasp and Gait REHABILITATION

Target muscles for physiotherapy: Gluteus maximus; Gluteus medius; M. Ilio-psoas; M. Pirifomis; Hamstrings; Hip Adductors – after the month 6; Hip Abductors – from the beginning; Tensor fasciae latae.

Length of the program - every day for the first period – after the 6th post-op month (for one month minimum)
After that – *maintenance program for lifelong protection* (2 – 3 days a week)
Structure of the procedure: *Warm-up (5-10 minutes); Stretch, Strengthening exercises, Stretching exercises.*

Stretching exercises: Standing ilio-tibial stretch, Seated rotation stretch, Knee to chest, Supine hamstring stretch
Strengthening exercises: Hip Abduction, Hip Adduction, Hip extension (prone), Internal hip rotation, External hip rotation

Recommendations:
Exercises must be done without pain (or increase of current pain)
Patient can realize exercises at home, only if the therapist is sure that the application of exercises is correct !

Grasp and Gait REHABILITATION

3.8. INTERTROCHANTERIC FRACTURES- GAMMA NAIL/ DHS

INTERTROCHANTERIC FEMUR FRACTURES

Intertrochanteric fractures are considered one of the three types of hip fractures. The anatomic site of this type of hip fracture is the proximal or upper part of the femur or thigh bone.

An intertrochanteric fracture was described by Cooper in his treatise of 1851 as follows: ''...fracture of the femur through the trochanter major, passes obliquely upwards and outwards from the lower portion of the neck but instead of traversing the neck completely, it penetrates the base of the trochanter major; the line of fracture being such as to separate the femur into two fragments, one of which is composed of the head, neck and trochanter major, and the other of the shaft with the remaining portions of the femur. Cooper's recommended treatment was "moderate extension and steady support of the limb in its natural position."

Current treatment of intertrochanteric fractures involves surgical intervention.

Open reduction and internal fixation (ORIF) is indicated for all intertrochanteric fractures, unless the patient's medical condition is such that any anesthesia, general or spinal, is contraindicated. Total hip arthroplasty has a limited role in treatment and is usually reserved for patients with coexisting severe symptomatic arthritis of the hip. External fixation is also rarely indicated but is useful as a quick procedure in patients who may not tolerate general or spinal anesthesia and can only tolerate local techniques. Medial displacement osteotomy and valgus reduction are no longer practiced, because of the severe deformities they produced and because of substantial advances in the understanding of fracture fixation.

The future of intertrochanteric fracture repair focuses, in part, on preventing such fractures by means of antiosteoporosis treatments, including medications and health programs. Another focus includes fixation devices that require smaller incisions and are more forgiving, with retention of the fixation, regardless of whether the fracture is ideally reduced or has an element of instability. A final goal is to eliminate or substantially decrease the mortality and morbidity of postoperative deep vein thrombosis (DVT) and pulmonary embolism (PE) by developing a better understanding of the clotting mechanism and the genetic, metabolic, serologic, and hormonal factors that affect the likelihood of developing PE.

Rehabilitation begins in the first post-operatory day. The early physiotherapy is oriented towards impairments in range of motion, knee extensor and hip abductor strength, and gait.

The PRM programme includes: respiratory exercises, active exercises for hip and knee muscles, gait training. Interventions are focused on immediate weight bearing and early progression of strengthening.

Grasp and Gait REHABILITATION

PATIENT COMPLAINTS

Important pain and stiffness in the correspondent hip and muscles around it ; reduced length of the lower extremity – after a fall at home or at the ice (in winter).
After the operation – Difficulties in mobility (transfers), decrease in autonomy in activities of daily living (ADL); impossible gait.
Orthopedical exam: Limited range of motion of the operated lower extremity.
Exam of the the Post-operative cicatrix on the thigh (Prevent complications)

FUNCTIONAL ASSESSMENT

reduced length of the operated leg – centimetry for quantitative evaluation of the *reduction of the relative length, complications of the* post-operative cicatrix.

- ❑ KINESIOLOGICAL ANALYSIS:

Goniometry of the hip joint
Gait – impossible.

- ❑ *ICF assessment:*
  - *impairments of body functions – hip pain, muscle weakness, and restricted hip ROM;*
  - *changes in body structures;*
  - *activity limitation - limited walking ability and problems with putting on socks and shoes;*
  - *participation restrictions - reduced participation in leisure activities and in household chores;*
  - *decrease of the patient's level of function.*
- ❑ *Evaluation of the physical performance: if possible*

POST-OP REHAB PROGRAMME

GOAL – *functional reeducation*

TASKS:

- *recovery of the stability and mobility of the lower limb joints, restoration of the muscle and ligament balance, accentuating on muscles around the hip joint; keeping the hip in the economic limb biomechanics;*
- *pain control; control of the cicatrix; control of joint ROM; control of possible complications;*
- *education of transfers, normal gait recovery with correction of eventual abnormal walking scheme;*
- *ADL (activities of daily living) training; amelioration of autonomy in everyday life;*
- *psycho-emotional stimulation , amelioration of the health-related quality of life.*

Grasp and Gait REHABILITATION

METHODS :

- ✓ *drugs* – Sintrom (schema); analgesics,
- ✓ *patient's education;*
- ✓ *posture* (activity modification),
- ✓ *Pre-formed modalities:* low frequency low-intensity magnetic field, interferential currents;
- ✓ *cryotherapy* - for the hip joint (cryo-massage and cryo-kinesitherapy);
- ✓ *massage* – classic massage (relaxing for the anterior group of muscles of the hip; stimulating for gluteal muscles),
- ✓ *Individualized kinesitherapeutic programme* - correct posture of lower limb, analytic exercises for gluteal muscles especially for *gluteus medius* muscle, Iexercises contra resistance – for the muscles around the hip joint; post-isometric relaxation /PIR/ for *iliopsoas muscle*; stretching and strengthening in all muscles of the lower limb (accentuating on muscles around the hip joint).
- ✓ *Verticalization and training of the balance (in sitting and standing position); Transfers training;*
- ✓ *Gait education and training – with a walker and with two crutches;*
- ✓ *Ergotherapy & ADL training*.

General HIP CONDITIONING PROGRAM – *for longlife protection after surgery*

Aim: *to stimulate the patient to return to daily activities, to sport and other recreational activities.*

Methods:

- ➢ *Strengthening exercises;*
- ➢ *Flexibility exercises – stretching the muscles for restoration of ROM and prevention of future injuries;*
- ➢ *Low frequency low intensity magnetic field;*
- ➢ *Deep Oscillation;*
- ➢ *Interferential currents;*
- ➢ *Cryotherapy;*
- ➢ *Underwater exercises.*

Grasp and Gait REHABILITATION

Target muscles for physiotherapy: Gluteus maximus; Gluteus medius; M. Ilio-psoas; M. Pirifomis; Hamstrings; Hip Adductors – after the month 6; Hip Abductors – from the beginning; Tensor fasciae latae.

Length of the program - every day for the first period – after the 6th post-op month (for one month minimum)

After that – *maintenance program for lifelong protection* (2 – 3 days a week)

Structure of the procedure:

- *Warm-up (5-10 minutes);*
- *Stretch,*
- *Strengthening exercises,*
- *Stretching exercises.*

Stretching exercises: Standing ilio-tibial stretch, Seated rotation stretch, Knee to chest, Supine hamstring stretch

Strengthening exercises: Hip Abduction, Hip Adduction, Hip extension (prone), Internal hip rotation, External hip rotation

Recommendations:

Exercises must be done without pain (or increase of current pain)

Patient can realize exercises at home, only if the therapist is sure that the application of exercises is correct !

Grasp and Gait REHABILITATION

3.9. DISTAL FEMORAL FRACTURE

FEMUR SHAFT FRACTURES

Fractures of the femoral shaft often result from high energy forces such as motor vehicle collisions. Complications and injuries associated with midshaft femur fractures in the adult can be life-threatening and may include hemorrhage, internal organ injury, wound infection, fat embolism, and adult respiratory distress syndrome. Femoral shaft fractures can also result in major physical impairment due to potential fracture shortening, malalignment, or prolonged immobilization of the extremity with casting or traction [2]. The art of femoral fracture care involves a balancing act between anatomic alignment and early functional rehabilitation of the limb.

DISTAL FEMUR FRACTURES

Defined as fractures from articular surface to 5 cm above metaphyseal flare.
Two types of mechanisms are described:

- *In young patients - high energy with significant displacement,*
- *older patients - low energy in osteoporotic bone with less displacement.*

Descriptive classification – supracondylar or intercondylar;

AOTA classification:
A: extraarticular,
B: partial articular - portion of articular surface remains in continuity with shaft, or: 33B3 is in coronal plane (Hoffa fragment),
C: complete articular - articular fragment separated from shaft.

Non-operative Treatment: hinged knee brace with immediate ROM, NWB for 6 weeks

Operative treatments includes: open reduction internal fixation, retrograde IM nail, distal femoral replacement

Surgical techniques:

- ✓ *ORIF Approaches (anterolateral, lateral parapatellar, medial parapatellar, medial/lateral posterior);*
- ✓ *Blade Plate Fixation;*
- ✓ *Dynamic Condylar Screw Placement;*
- ✓ *Locked Plate Fixation;*
- ✓ *Non-fixed angle plates;*
- ✓ *Retrograde interlocked IM nail.*

Grasp and Gait REHABILITATION

COMPLICATIONS

- ***Symptomatic hardware***
    - ***lateral plate*** -
        - pain with knee flexion / extension due to IT band contact with plate;
    - ***medial screw irritation***:
        - excessively long screws can irritate medial soft tissues
        - determine appropriate intercondylar screw length by obtaining an AP radiograph of the knee with the leg internally rotated 30 degrees
- ***Malunions***:
    - most commonly associated with plating,
    - functional results satisfactory if malalignment is within 5 degrees in any plane;
- ***Nonunions***: treatment with revision ORIF and autograft indicated (consider changing fixation technique to improve biomechanics).

REHABILITATION must be initiated ASAP after the operation.

Hospitalization in the PRM Department / Clinic after surgery

PATIENT COMPLAINTS
Moderate pain and stiffness in the right tight (tight muscles); reduced mobility.
Difficulties in activities of daily living (ADL) – transfers and self-service.
Impossible autonomic gait.

CLINICAL EXAM:

- ✓ *Limited range of motion of the correspondent lower extremity.*
- ✓ *Splint for the right tight & knee;*
- ✓ *Exam of the post-operative cicatrix – presence of complications.*

FUNCTIONAL ASSESSMENT

- ✓ reduced length of the operated leg – absolute & *relative length,*
- ✓ post-operative cicatrix – *complications;*
- ✓ KINESIOLOGICAL ANALYSIS:
- ✓ ***Goniometry ;***
- ✓ ***Exam of ADL*** **:** difficulty and pain during movements in bed, standing, impossible gait or possible with assistant and with / without technical aids – walker or crutches;

GLOBAL EVALUATION OF THE REHABILITATION POTENTIAL - poor, *limited , good, very good.*

ICF assessment:

- ✓ Impairments of body functions – leg pain, muscle weakness, and restricted hip, knee & ankle ROM;

Grasp and Gait REHABILITATION

- ✓ Changes of body structures;
- ✓ Activity limitations – impossible walking , problems with self-service of the legs;
- ✓ Participation restrictions - reduced autonomy in ADL;
- ✓ Decreased level of function.

❑ *Impossible or possible evaluation of the physical performance.*

CONSIDERATION OF CO-MORBIDITIES OF THE PATIENT, especially Ischemic heart disease, arterial hypertension, cardiac and respiratory insuffitiency; cerebro-vascular disease.

REHABILITATION PROGRAMME

GOAL – *functional reeducation & functional recovery.*

TASKS:

- *recovery of the stability and mobility of the lower limb joints,*
- *restoration of the muscle and ligament balance, accentuating on muscles around the tight and the knee joint; keeping the leg in the economic limb biomechanics;*
- *pain control;*
- *control of the cicatrix;*
- *control of joint ROM;*
- *control of possible complications;*
- *education of transfers,*
- *normal gait recovery with correction of eventual abnormal walking scheme;*
- *ADL (activities of daily living) training;*
- *amelioration of autonomy in everyday life;*
- *psycho-emotional stimulation ,*
- *amelioration of the health-related quality of life.*

METHODS:

- ✓ ***drugs* – Sintrom – decreasing schema; Xarelto; analgesics,**
- ✓ ***patient's education;***
- ✓ ***Verticalization and training of the balance,***
- ✓ ***stabilization of the posture* (activity modification),**
- ✓ ***Pre-formed modalities:* low frequency pulsed magnetic field; IFC, DO;**
- ✓ ***cryotherapy -*** for the distal part of the tight and for the knee joint (cryo-massage and cryo-kinesitherapy);
- ✓ ***massage –*** classic massage (relaxing for the anterior group of muscles of the tight);
- ✓ ***Post-isometric relaxation (PIR)* for the ilio-psoas muscle, the rectus femoris muscle and soleus muscle;**

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- ✓ ***Individualized kinesitherapeutic programme*** - correct posture of lower limb, analytic exercises for tight muscles especially for *vastus medialis and vastus lateralis* muscles, lower limb joint mobilization (passive, assistive active and active range of motion exercises), stretching and strengthening in all muscles of the lower limb (accentuating on muscles around the knee joint), gait training with supporting walker, after – with two crutches, training of gait up-stairs and down-stairs.
- ✓ ***Ergotherapy & ADL training*.**

Example
General KNEE CONDITIONING PROGRAM
After surgery
Aim – to stimulate the patient to return to daily activities
Strengthening exercises
Flexibility exercises – stretching the muscles for restoration of ROM and prevention of future injuries

Target muscles:
- ✓ Quadriceps (front of the thigh);
- ✓ Hamstrings (back of the thigh);
- ✓ Abductors (outer thigh);
- ✓ Adductors (inner of the thigh);
- ✓ Gluteus medius & maximus (buttocks).

Length of the program - 4-6 weeks
After that – maintenance program for lifelong protection of knees (2 – 3 days a week)

Structure of the procedure: *Warm-up, Stretch, Strengthening exercises, Stretching exercises.*

Do not ignore pain
Ask questions – to be sure that the exercise is well done

Stretching exercises
- Heel cord stretch
- Standing quadriceps stretch
- Supine hamstring stretch

Strengthening exercises
- Half squats
- Hamstring curls
- Calf raises
- Leg extensions
- Straight leg raises
- Straight leg raises (prone)
- Hip abduction
- Hip adduction
- Leg presses

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3.10. FRACTURE OF THE TIBIAL PLATEAU

REHABILITATION PROGRAM IN A PATIENT WITH SURGICAL TREATMENT OF EPI-METAPHYSEAL PROXIMAL SCHATZKER VI FRACTURE OF THE TIBIAL PLATEAU

1. Epi-metaphyseal proximal Schatzker VI fracture of the tibial plateau

Low and high-energy fractures of the tibial plateau (a complex group of injuries that involve knee - one of the major weight-bearing joints in the human body) present a spectrum of soft tissue and bony injuries that account for 1.3% of all fractures and affect young adults or the 'third age' population, males more commonly than females.

The Schatzker classification system for the tibial plateau fractures is most commonly used and is based on the location and extent of the fracture and associated depression of the bone. Type VI fractures are bicondylar fractures with dissociation of the diaphysis from the metaphysic (distal oblique metaphyseal / shaft fractures) and are the most challenging subgroups, with an incidence ranging from 20-40% of all tibial plateau fractures. These complex injuries produced by high-energy trauma can produce permanent disabilities. One-third of type VI fractures are open, and frequently (86%) there is extensive soft-tissue injury with increased risk of compartment syndrome, postoperative inflammation, wound problems and infections. Various surgical approaches and fixation techniques have been developed to treat Schatzker type VI fractures. Open reduction and internal fixation (ORIF) treatment is the gold standard. Limb alignment and restoration of articular congruity and stability, allowing early knee motion, are the main goals of complex treatment.

2. Role of complete diagnosis / assessment (etiopathogenical, clinic, laboratory - screening laboratory, imaging examination and functional assessment):

a. The **etiopathogenical and clinical assessment** included:

○ usually, the Schatzker type VI fractures are seen in road traffic accidents (the most common mechanism of injury), work-related accidents, fall from a height, higher-energy trauma in sports, the osteoporotic bone, with low-energy injurie.

The mechanism of injury is believed to be a a combination of axial loading and bending forces resulting in several fracture patterns, the most common being either a multifragmentary wedge fracture or articular surface depression. The magnitude of the force determines both the degree of fragmentation and the degree of displacement.

○ general physical state and local examination (system examination including skin and sensory evaluation); musculoskeletal examination – somatoscopic exam, appreciation of the range of motion and manual muscle testing of the all uninjuried lower limb joints; immediate, severe pain is typically the first symptom; decreased knee function; the soft tissue surrounding the knee joint - bruising, swelling around the knee, tenderness, knee deformity (joint may look "out of place"), open wounds; inability to stand or walk on the injured leg; pain is worse when weight is placed on the affected leg; limited bending of the joint; gait exam, pace and dynamics; it cannot be tested in most cases as the joint may be swollen, painful, fractured or dislocated; assessment of neurovascular status of the limb - the nerve and blood supply to injured leg and foot; the presence of distal pulses does not exclude an arterial injury.

b. **Imaging examination**

- **X-rays (**anteroposterior, lateral and oblique views) - provide clear images of bone; can show whether a bone is intact or broken, the type of fracture and where it is located within the tibia;
- **Computerised tomography** (CT) scanning - allows more detailed examination of the bony; has been shown to increase the accuracy of fracture classification and surgical planning;

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- **Magnetic resonance imaging** (MRI) scanning - is an effective diagnostic tool for ruling out internal derangement of the knee; is useful if ligamentous or other soft tissue injuries are suspected. It is important to have a high index of suspicion for vascular injuries, especially in cases involving a high energy mechanism. **Functional assessment**
- the VAS - Visual Analogue Scale (from 0 to 10, 0 = absence of pain and 10 = maximum pain score, other values between 0 and 10 is directly proportional with the intensity of pain, depending on the individual pain threshold);
- the Knee Injury and Osteoarthritis Outcome Score (KOOS);
- the Lower Extremity Functional Scale.

3. Rehabilitation program (RP)

Correct management includes surgical treatment and rehabilitation program, after intervention. The goals of surgical treatment are anatomical reconstruction of the joint surface, restoration of the limb axis, fixation spanning the metaphyseal comminuting and further minimization of morbidity to an already traumatized soft tissue envelope.

Objectives of RP:

- relief of symptoms; painful status control;
- improvement of the affected joint (full extension and 90˚ of flexion, as soon as possible) and ensure bone and joint survival;
- regain the important functions of knee (muscle mass gain, improved motor control, adhesions preventions, knee stabilization) to restore gait;
- improvement of quality of life (returning to full function with a painless mobile knee and maintaining independence in all activities of daily living).

Methods of RP:

- non-pharmacological modalities:
  - educational - restricted patient weight bearing with the use of crutches, walker or cane, dietary (weight reduction), addressing known risk factors (smoking, alcohol abuse, monitor steroid use), rest (activity modification, to restrict patient physical activity);
  - knee orthosis - long-leg splint for 2 weeks after the operation, than hinged brace with ROM 0–90˚ for 6 weeks; brace during sleep for 6 weeks;
  - kinetic measures, especially after orthosis removal:
    - range-of-motion (ROM) exercises, for all joint of both lower limbs;
    - progressive weight bearing (PWB) should begin at 6 - 8 – 12 weeks, depending on the stability of the fixation and the state of the soft tissues, with full weight bearing (FWB) by 12 weeks; high-energy, unstable fracture patterns are best kept non weight bearing (NWB) until signs of union are visible, usually around 8 to 12 weeks postoperatively;
    - strengthening exercises;
    - proprioception exercises;
    - gait training - using appropriate assistive devices;
    - functional activities – to prevent complications of inactivity and bed rest;
  - physical therapy provides only symptomatic control and also does little to alter disease progression, can be used to stimulate bone growth (thermotherapy – cold packs and electrotherapy - magnetodiaflux, TENS, interferential current, ultrasound, whirlpool, electrical stimulation);
  - massage – classic and special massage, particularly for soft tissues;
  - occupational therapy – teaching how to do ADLs, to rebuild general endurance;

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- pharmacological modalities - analgesics, narcotic pain medication, nonsteroidal anti-inflammatory drugs, blood thinners.

<u>Components of rehabilitation program</u> are mentioned in ***Table 1.***

4. Communication with patients

a. Preoperative

- Early infection (wound dehiscence and wound healing problems) and later (secondary knee osteoarthritis, loss of reduction, collapse of articular fragments, malunion and nonunion) complications after surgery and management modalities / rehabilitation program should be described.
- Patients should be informed about mobilization time, need for assistive devices, and possible return to regular life (work).
- It is important to instruct the patient not to overload the fracture site until the bone has regained its full strength. The resumption of heavy work and sports should be guided by the physician.

b. Postoperative

- Pain, stiffness, weakness and swelling are all barriers to overcome for successful rehabilitation. Pain after surgery is a natural part of the healing process.
- It is important to consider patient factors, particularly their ability to use a temporary immobilization device and their compliance with exercise regimes. If the bone was fractured in many pieces or the bone is weak, it may take longer to heal, and it may be a longer time before doctor recommends motion activities.
- Postoperatively it is important to start early ROM exercises, because it has been shown that long term immobilization can cause decreased function of the knee joint.
- Patient / family education should include importance of maintaining NWB and progression of WB as appropriate, safety with assistive device as well as instruction in home exercise program.

***Table 1.* Components of the rehabilitation program applied for patients after surgical intervention**

Objective		Rehabilitation components
7 – 14 days (weeks 1 and 2) = Acute care period		
1.	Relieving any pain, swelling and inflammation	1. Bandage and elevate posture - 0º knee extension; 2. Cryotherapy – several times a day the patient has an ice treatment 3. Pain medication 4. At two weeks, the dressings were removed, the sutures were removed. 5. Long-leg splint for 2 weeks after the operation; brace during sleep for 6 weeks;
2.	Restore / consolidate the ROM of	1.Continuous passive motion (CPM) machine; ROM to increase from 15º to 70º 2. Active assistive range of motion (AAROM) exercises, as incision

	lower limbs	healing allows; gentle bending of the knee in the brace, as far as the patient can go with no pain, many repetitions at a time (tens of repetitions) 3. Initiate patella mobility drills full passive /active knee range of motion exercises 4. Bed ROM exercises of all other joints of both lower limbs
3.	Restore / consolidate the strength muscles	*Operated lower limb* 1. Isometric contraction exercises in lying (Quadriceps setting) 2. Stretching – passive and active (hamstring and calf muscles) 3. Multi-plane open kinetic chain straight leg raising *Opposite lower limb and upper extremities* 1. Exercises that involve the entire lower limb; putting a towel under the knee of a straight leg, and trying to press down on it – straightening the leg; 2. Exercises used of Theraband or weights
4.	Maximizing patient independence	1. NWB gait training with walker or crutches 2. Maintain NWB on the affected leg with assistive device (walker or cruntches) on activity of daily living modification, transfers and short distance ambulation
14 – 28 days (weeks 3 - 4) post surgical intervention		
1.	Control edema	1. Brace for 6 weeks in full extension; hinged knee brace; 2. Gentle lower limb massage
2.	Consolidate ROM of limbs	1. All previous ROM exercises 2. AAROM /passive range of motion (PROM) of the knee joint - 90º flexion in 4 wks
3.	Consolidate the strength muscles and restore	1. Initiate global lower extremity stretching program 2. Manual Muscle Testing of joints proximal and distal to the knee 3. Multi-plane ankle strengthening, quad sets and SLR (without weights) 4. Manual lower extremity PNF (proprioception neuromuscular) patterns- Kabat diagonals and EMG biofeedback quadriceps

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	motor control	5. Upper extremities and univolved lower limb exercises for strength (isometric and isotonic contraction of hip and knee muscle, closed kinetic chain multi-plane hip strengthening, body strengthening)
4.	Gait training	1. Ability to maintain balance with NWB using an assistive device 2. Reassess gait, balance activities
5 – 8 weeks post surgical intervention		
1.	Control edema	1. Gentle retrograde lower limb massage 2. Brace for 6 weeks in full extension
2.	Consolidate the ROM of lower limbs	1. All previous ROM exercises 2. Normal patellar mobility and tibial-femoral mobility once fracture is healed
3.	Consolidate the strength muscles and endurance	1.All previous muscle strength exercises must performed 2. Resistive exercises in sitting position 3. Stationary bike program
4.	Balance and proprioception, gait training	1. Continue proprioception training 2. Assess as appropriate in uninvolved leg, and in involved leg once beginning weight bearing or as appropriate 3. Balance on the involved lower extremity is equal to the uninvolved lower extremity, using single leg stance time to measure. 4. Begin PWB gait at 25% of body weight and increase by 25% approximately every 3 days. May progress to one crutch at 7 weeks as tolerated, gradually wean off of crutches by week 8
After 8 weeks post surgical intervention		
1.	Maximize ROM of lower limbs	Increase flexion to within normal limits; may remove brace for sleep at 8 weeks
2.	Maximize balance and	1. Exercises that work the muscles while in standing are most effective for improving balance, walking and stair climbing

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	proprioception	2. Theraband strengthening in closed kinetic chain (stand on involved leg and perform hip flexion / extension / abduction / adduction with uninvolved limb) 3. Advance stationary bike program; begin treadmill walking and elliptical trainer; 4. Assess as appropriate in uninvolved leg, and in involved leg once beginning weight bearing or as appropriate
3.	Gait training on surfaces, level, hills, stairs	1. Continue previous gait training 2. Normalize gait pattern (FWB - start at 25%, progress up to 100% by week 10) 3. Initiate closed kinetic chain exercises, progressing bilateral to unilateral 4. Avoid running and impact activity
4.	Maximize patients' functional independence	1. Independent transfers, ambulation and reciprocal stair climbing 2. Exercises that simulate the specific everyday activities of daily living and any recreational activities that patient may want to return to 3. Home exercise program • stretching • Theraband strengthening exercises • gym strengthening-beginning bilateral progressing to unilateral (leg press, heel raises, hamstring curls, squats, lunges, knee extensions –progressing to full range) • bilateral plyometric activity progressing to unilateral as tolerated • cardiovascular training, and flexibility.

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3.11. BIMALLEOLAR FRACTURE

REHABILITATION PROGRAM IN A PATIENT WITH SURGICAL TREATMENT OF BIMALLEOLAR FRACTURE BY OPEN REDUCTION AND INTERNAL FIXATION

1. Bimalleolar fractures

The upper part of the ankle joint comes from the tibia and the fibula. The ends of these bones are called malleoli. Ankle fractures are the most common fractures involving joint and occur when the malleoli are broken. Bimalleolar fractures are more common in women, people over 60 years of age, and patients with existing comorbidities. The prevalence of such fractures has increased over the last two decades in both young, active patients and the elderly people.

It is very important in all the ankle fractures that a definitive diagnosis is made based on clinical evaluation of history, mechanism of injury, degree of immediate disability and obtaining proper radiograph to demonstrate lesion. Most ankle fractures are complex injuries that are difficult to manage. A bimalleolar fracture is a debilitating injury, especially if the fracture is unstable and has the potential to produce significant long-term disability and complications in the form of pain, instability, and early degenerative arthritis. The treatment of choice for an unstable ankle fracture is open reduction and internal fixation (ORIF). Slight variation from normal alignment of joint is incompatible with adequate function. Therefore it is essential to obtain anatomic reduction and stability following such fracture. Recently, emphasis has been placed on functional outcome and rehabilitation. Faster return of function and return to work are related to rehabilitation strategy.

2. Role of complete diagnosis / assessment (etiopathogenical, clinic, laboratory - screening laboratory, imaging examination and functional assessment):

c. The <u>**etiopathogenical and clinical assessment**</u> included:

- The bimalleolar fractures are most often occurred during a:
  - road traffic accidents,
  - slip while walking or getting down from stairs,
  - fall from a height,
  - twisting injury in sports.

There are two different mechanisms of injury. One occurs with a twisting mechanism where the body rotates around the foot, and the other occurs with a crushing mechanism following an impact to the foot (a motor vehicle accident). Great majority of ankle injuries are caused by indirect violence.

- general physical state examination (system examination including skin and sensory evaluation);
  - musculoskeletal examination – somatoscopic exam, appreciation of the range of motion and manual muscle testing of the all uninjuried lower limb joints;
  - immediate, severe pain is typically the first symptom; it is accompanied by bruising, swelling, tenderness, joint deformity;
  - inability to weight bear, although patients do sometimes walk on ankle fractures;
  - assessment of neurovascular status - sensation over the dorsal and plantar surfaces of the foot, measuring capillary refill in all digits, and palpating the distal pulses;

○ gait exam, pace and dynamics; it cannot be tested in most cases as the joint may be swollen, painful, fractured or dislocated.

d. <u>Imaging examination</u>

- **X-rays (**anteroposterior, lateral and mortise views can be taken; for the mortise view, the foot is rotated about 15° internally; if one injury is seen on X-ray, always look for a second) **-** are used to determine whether the malleoli are broken and whether the bones are displaced and to what degree.
- **Computed tomography (CT) scans and MRI scanning -** will produce a more detailed, cross-sectional image of patient ankle and can provide about the severity fracture; are sometimes needed for fracture diagnosis and assessment of ligamentous or intra-articular injuries.

e. <u>Functional assessment</u>

- the VAS - Visual Analogue Scale (from 0 to 10, 0 = absence of pain and 10 = maximum pain score, other values between 0 and 10 is directly proportional with the intensity of pain, depending on the individual pain threshold);
- the WOMAC scale, other quality of life generic scales.

3. Rehabilitation program (RP)

Bimalleolar fracture is considered to be an unstable ankle fracture. Correct management includes operative treatment and rehabilitation program, after intervention. Surgery usually consists of open reduction and internal fixation, followed by casting or splinting.

<u>Objectives</u> of RP:

- relief of symptoms; painful status control;
- regain the important functions of ankle (increase dorsiflexion) to restore gait;
- improvement of the affected joint and ensure bone and joint survival;
- improvement of quality of life (returning to full function with a painless mobile ankle and maintaining independence in all activities of daily living).

<u>Methods</u> of RP:

- non-pharmacological modalities:

○ educational - restricted patient weight bearing with the use of a cane or crutches, dietary (weight reduction), addressing known risk factors (smoking, alcohol abuse, monitor steroid use), rest (activity modification, to restrict patient physical activity);

○ orthosis – removable boot cast, cast or splint;

○ kinetic measures, especially after orthosis removal:

▪ range-of-motion (ROM) exercises, for all joint of both lower limbs;

▪ progressive weightbearing should begin at 8 weeks, with full weightbearing by 12 weeks (bone healing may occur within 10 to 12 weeks);

▪ strengthening exercises;

▪ proprioception exercises;

▪ gait training - using appropriate assistive devices;

▪ functional activities – to prevent complications of inactivity and bed rest;

○ physical therapy provides only symptomatic control and also does little to alter disease progression, can be used to stimulate bone growth (thermotherapy – cold packs and electrotherapy - magnetodiaflux, TENS, interferential current, ultrasound, whirlpool, electrical stimulation);

○ massage – classic and special massage, particularly for soft tissues;

○ occupational therapy – teaching how to do ADLs, to rebuild general endurance;

- pharmacological modalities - analgesics, narcotic pain medication, nonsteroidal anti-inflammatory drugs, blood thinners.

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<u>Components of rehabilitation program</u> are mentioned in ***Table 1.***

4. Communication with patients

f. Preoperative

- Early and later complications after surgery and management modalities / rehabilitation program should be described.
- Patients should be informed about mobilization time, need for assistive devices, and possible return to regular life (work).
- It is important to instruct the patient not to overload the fracture site until the bone has regained its full strength. The resumption of heavy work and sports should be guided by the physician.

g. Postoperative

- Pain, stiffness, weakness and swelling are all barriers to overcome for successful rehabilitation; ankle swelling will generally persist for about 1 year or less. The ankle starts to feel comfortable after 3 months postsurgical intervention.
- Patients with intra-operative evidence of osteoporosis or osteomalacia will be non weight bearing for an extended period of time (generally 8 - 10 weeks).
- Frequently the patients are placed in a removable cast boot, to maintain the anatomic reduction and prevent development of tibiotalar joint arthritis. The post operative cast immobilization will not cause restriction of range of motion of ankle and it aids in better healing of soft tissue.
- It is important to consider patient factors, particularly their ability to use a temporary immobilization device and their compliance with exercise regimes.
- Patient can drive if the left ankle is fractured by 5-7 days, but much later if it is the right ankle.

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Table 1. Components of the rehabilitation program applied for patients after surgical intervention

Objective		Rehabilitation components
7 – 14 days (weeks 1 and 2) = Acute care period		
1.	Relieving any pain, swelling and inflammation	1. Bandage, splint or cast and elevate posture - the foot and calf is elevated; 2. Cryotherapy – several times a day the patient has an ice treatment to reduce inflammation, swelling and pain. 3. Pain medication 4. At two weeks, the dressings were removed and the wound assessed. The sutures were removed. 5. Removable boot cast (example – Controlled Ankle Motion Walker Boot)
2.	Restore / consolidate the ROM of lower limb	1. Early basic non-weight bearing ROM exercises, after the surgical incision has begun healing, usually 10-12 days after surgery – movement of the ankle out of the removable boot cast 3. Bed ROM exercises of all joints above surgical site
3.	Restore / consolidate the strength muscles	*Operated lower limb* 1. Isometric contraction exercises in lying *Opposite lower limb and upper extremities* 1. Exercises that involve the entire lower limb 2. Exercises used of Theraband or weights
14 – 42 days (weeks 3 - 6) post surgical intervention		
1.	Control edema	1. Compression stocking 2. Gentle lower limb massage 3. Electro stimulation in calf muscles
2.	Consolidate the ROM of lower limbs	1. Active ROM exercise for ankle, subtalar, midtalar joints with pain tolerance – ankle pumps, inversion / eversion, toe crunches, alphabets, figure eights (with ankle brace) 2. Stationary bike – without resistance 3. Should be walking on a treadmill with wean up to 3.5 mph, after 4 weeks

3.	Consolidate the strength muscles	1. All previous muscle strength exercises must performed – isometric exercises for dorsiflexion, plantar flexion, inversion, eversion. 2. Progressive stretching for dorsiflexion muscles 3. Upper extremities and univolved lower limb exercises for strength (isometric and isotomic contraction of hip and knee muscle, body strengthening)
4.	Gait training	1. Partial weight bearing with crutches 2. Full weight bearing in removable boot with or without cane
6 – 8 weeks post surgical intervention		
1.	Control edema	1. Gentle retrograde lower limb massage
2.	Consolidate the ROM of lower limbs	1. All previous ROM exercises 2. Grade 1-2 joint mobilizations ankle and subtalar joints 3. Passive ROM exercises into restricted ranges 4. Leg extension, curl, press 5. Stationary bike – without resistance
3.	Consolidate the strength muscles and endurance	1. All previous muscle strength exercises must performed 2. Wall stretch with knee flexed and extended 3. Theraband in dorsiflexion / plantar flexion / inversion / eversion in open chain 4. Manual resistance in open chain for dorsiflexion / plantar flexion / inversion / eversion and multiplanar motions 5. Exercises for intrinsic foot musculature – seated towel toe crunches, push aways 6. Treadmill with progressive resistance
4.	Gait training	1. Full weight bearing; removable boot is discontinued 2. Standing heel raise, minisquat, one leg balance on floor
After 8 weeks post surgical intervention		
1.	Maximize balance and	1. Exercises that work the muscles while in standing are most effective for improving balance, walking and stair

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	proprioception, full ankle and subtalar flexibility	climbing 2. Theraband strengthening in closed kinetic chain (stand on involved leg and perform hip flexion / extension / abduction / adduction with uninvolved limb) 3. Standing balance progress floor - eyes open/closed, level incline/decline, with knee flexed/extend 4. Standing on one foot or balancing on an stable, then unstable surface, eyes open/closed
2.	Gait training on surfaces, level, hills, stairs	1. Continue previous gait training 2. Various gait exercises - toe-walking, ascending and descending stairs 3. Agility gait exercises - lateral shuffles, tandem walking, lateral stepping, backwards walking
3.	Maximize patients' functional independence	1.Exercises that simulate the specific everyday activities of daily living and any recreational activities that patient may want to return to 2. Home exercise program • Theraband strengthening exercises • mini squats, toe raises (bilateral and unilateral) • stretching • unilateral standing balance (eyes open, eyes closed) 3. Sport and job – specific training; initiate sport specific drills with gradual return to athletics at or after 16 weeks

Please see video

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3.12. CALCANEUS (HEEL BONE) FRACTURES

REHABILITATION PROGRAM IN A PATIENT WITH SURGICAL TREATMENT OF CALCANEUS FRACTURE

3.12.1. Calcaneus fractures

Fractures of the calcaneus (heel bone that has an important function of supporting the foot and making normal walking possible; the joint above the calcaneus, allows the foot to rotate inwards and outwards) commonly occur after a fall from a height (when the heel is crushed under the weight of the body) or car accident. Calcaneus fractures are uncommon, can be a painful and disabling quite severe injury; the heel can widen, shorten, and become deformed. Damage to the articular cartilage covering the joint may cause long-term complications such as chronic pain, arthritis, and loss of motion.

The calcaneus fractures frequently occur in young adult men (2.4 times more frequently in males than females) and account for 2-3% of all fractures of the body and 50 - 60% of all tarsal fractures. In females, a gradual increase in incidence towards the post-menopausal year was described.

The severity of a calcaneus injury depends on several factors (the number of fractures, the amount and size of the broken bone fragments, the amount each piece is out of place, the injury to the cartilage surfaces in the subtalar joint, the injury to surrounding soft tissues, such as muscle, tendons, and skin).

Treatment of these fractures may require surgery to reconstruct the normal anatomy of the heel and restore mobility so that patients can return to normal activity.

3.12.2.Role of complete diagnosis / assessment (etiopathogenical, clinic, laboratory - screening laboratory, imaging examination and functional assessment):

3.12.2.1. The **etiopathogenical and clinical assessment** included:

- The calcaneus fractures are most often occurred during a:
  - fall from a height,
  - twisting injury to the ankle,
  - car injury (a force of a head-on car collision, may result in the comminuted fracture),
  - being the outcome of an ankle sprain,
  - a stress fracture caused by overuse, usually seen in athletes.

Similar fractures can result from different mechanisms; generally, the greater the impact, the more the calcaneus is destroyed.

- general physical state examination (system examination including skin and sensory evaluation);
  - musculoskeletal examination – somatoscopic exam, appreciation of the range of motion and manual muscle testing of the lower limb;
  - pain is typically the first symptom; it is accompanied by bruising, swelling, heel deformity;
  - check the pulse at key points of the foot to be sure that there is a good blood suply to the distal lower limb (foot and toes);
  - check to see if the patient can move his toes, and can feel things on the bottom of your foot;
  - gait exam, pace and dynamics; patient has the inability to put weight on the heel or walk.

3.12.2.2.Imaging examination

- **X-rays (**a lateral x-ray and an axillary heel views) **-** are used to determine whether the heel bone is broken and whether the bone is displaced and to what degree.

- **Computed tomography (CT) scans -** will produce a more detailed, cross-sectional image of patient foot and can provide about the severity fracture.

3.12.2.3.Functional assessment

- the VAS - Visual Analogue Scale (from 0 to 10, 0 = absence of pain and 10 = maximum pain score, other values between 0 and 10 is directly proportional with the intensity of pain, depending on the individual pain threshold);
- the WOMAC scale.

3.12.3. Rehabilitation program (RP)

3.12.3. *1. Non-operative rehabilitation program* – see **Table 1**

Are generally treated conservatively:

- extra-articular fractures - !! exceptions include fractures of the sustentaculum tali with displacement of more than 2 mm, posterior avulsion fractures, and significant fractures of the calcaneal body;
- **calcaneal stress fracture;**
- patient with comorbid conditions (diabetes, poor blood flow), elderly patient, concurrent injuries;
- comminuted intra-articular fractures if the pieces of broken bone have not been displaced by the force of the injury;
- severely comminuted intra-articular fractures;

Objectives of RP:

- relief of symptoms; painful status control;
- regain the important functions of calcaneus;
- improvement of the affected joint and ensure bone and joint survival;
- improvement of functionality (returning to full function with a painless mobile ankle and maintaining independence in all activities of daily living).

Methods of RP:

- non-pharmacological modalities:
  - educational - restricted patient weight bearing with the use of a cane or crutches, dietary (weight reduction), addressing known risk factors (smoking, alcohol abuse, monitor steroid use), rest (activity modification, to restrict patient physical activity);
  - orthopedic measure - closed reduction may be attempted by plantarly displacing both the forefoot and the hindfoot to reverse the mechanism of injury, which allows for elevation of the posterior facet;
  - short leg casting and no weightbearing for 2 weeks; compressive wrapping to control the swelling (edema) for 2 to 3 weeks;
  - kinetic measures, especially after cast removal:
    - range-of-motion (ROM) exercises, for all joint of both lower limbs;
    - progressive weightbearing should begin at 8 weeks, with full weightbearing by 12 weeks (bone healing may occur within 10 to 12 weeks);
    - strengthening exercises;
    - proprioception exercises;
    - gait training - using appropriate assistive devices;
    - functional activities – to prevent complications of inactivity and bed rest;
  - physical therapy provides only symptomatic control and also does little to alter disease progression, can be used to stimulate bone growth (thermotherapy – cold packs and electrotherapy - magnetodiaflux, TENS, interferential current, ultrasound, whirlpool, electrical stimulation); shock wave therapy in an attempt to get the bone to heal;
  - massage – classic and special massage, particularly for soft tissues;

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- occupational therapy – teaching how to do ADLs, to rebuild general endurance;
- return to demanding job duties – after 4 to 6 months.

- pharmacological modalities - analgesics, narcotic pain medication, nonsteroidal anti-inflammatory drugs, blood thinners.

3.12.3. ***2. Postoperative period* –** see **Table 2.**

The most patients need surgical treatment for various types of fractures such as:

- minimally invasive percutaneous screw fixation;
- open reduction techniques and internal fixation may be performed by using medial, lateral or combined approaches, depending on the extent of injury and the location of the fracture.

3.12.4. Communication with patients

a. Preoperative

- Postoperative pain and management modalities / rehabilitation program should be described.
- Patients should be informed about mobilization time, need for assistive devices, and possible return to regular life (work).
- Smoking affects both bone and wound healing. With or without surgery, injuried bone may take longer to heal if patients smoke.
- It is important to instruct the patient not to overload the fracture site until the bone has regained its full strength. The resumption of heavy work and sports should be guided by the physician.

b. Postoperative

- If the injury is minor, such as a crack in the bone with little muscle damage, patient may be able to resume normal activities from 3 to 4 months after surgery. If the fracture is severe, however, it may take from 1 to 2 years before recovery is complete (there will be moderate swelling of the ankle and leg for about 6 – 9 months).
- The exercises will temporarily increase the foot pain. However, these exercises are an essential part of the rehabilitation program.
- Common problems that may persist after rehabilitation program are: skin irritation, altered gait (problems walking on grassy surfaces, hill), pain.
- Despite the best efforts of the doctor and patient, normal foot and ankle motion is rarely regained after a severe fracture and patients do not typically resume their pre-injury level of function. A patient who is not very active might tolerate a foot that is not normal.
- Patient may need to wear a heel pad, lift or shoe cup, as weel as special shoes with extra depth in the toe compartment.

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Table 1. Components of the rehabilitation program applied in non-operative calcanean fractures

Objective		Rehabilitation components
7 – 14 days (weeks 1 and 2) = Acute care period		
1	Relieving any pain, swelling and inflammation	1. Cryotherapy – several times a day the patient has an ice treatment to reduce inflammation, swelling and pain. 2. Immobilization. A cast, splint, or brace will hold the bones in injuried foot in proper position while they heal and sometimes in slight eversion. Patient may has to wear a cast for 6 to 8 weeks — or possibly longer. During this time, patient will not be able to put any weight on foot until bone is completely healed. 3. Electrotherapy – TENS, dyadinamic current, ultrasound in the foot and ankle 4. Massage - gentle around the soft tissues of the foot and ankle 5. Rest - The affected foot must rest and the patient is not allowed to use the foot.
2	Mention the ROM of other joints of the lower limbs	1. Standard mobilization of the opposite lower limb – passive and active ROM exercises of toe, leg, ankle, knee and hip (20 minutes / three times / daily) 2. Standard mobilization of the hip, knee and toes of affected lower limb 3. Gait without weight bearing in the affected heel bone; teaching how to safely use the crutche or a cane
15 – 42 days (weeks 3 – 6) = Partial weight-bearing gait		
1	Increase / mention the range of motion of lower limbs	1. Daily range of motion exercises aimed at optimizing the amount of motion in the ankle, subtalar, and transverse tarsal joints 2. Active mobilization of all other joints, in all plans of motion (20 min. / 3X / daily) 3. Assisted stretching of any tight muscles around the previous joints
2	Increase muscle strength of lower limbs	1. Isometric contraction – bed exercises aimed at mention the strenght of thight and calf muscles (6 – 10 seconds / contraction; 1 session = 6 – 10 contractions; 6 sessions / daily) 2. The neuromuscular electric stimulation of muscles 3. Isotonic contraction of hip muscles (abductors, flexors, extensors), quadriceps and calf muscles, with constant low resistance weight tied on the ankle (example - daily knee extension with sandbags strapped to the ankle, leg press and knee extension) 3 sets by 10 repetitions / set, daily
3	Regain the balance and proprioception	1. Balancing exercises 2. Gait with partial weight bearing in the affected heel bone; used the cane in the opossite hand
After 42 days = Complete weight – bearing gait		
1	Returning to advanced activity	1. Flexibility exercises for lower limbs 2. Balancing and proprioception exercises 3. Gait with complete weight bearing in the affected heel bone

Table 2. Components of the rehabilitation program applied for patients with surgical intervention

Objective		Rehabilitation components
7 – 14 days (weeks 1 and 2) = Acute care period		
1.	Relieving any pain, swelling and inflammation	1. Posture - the foot is elevated with the ankle in the standard neutral position of a 90° angle between the foot and the tibia; this position is maintained for up to 72 hours to reduce postoperative swelling. 2. Cryotherapy – several times a day the patient has an ice treatment to reduce inflammation, swelling and pain. 3. Cast with ankle in neutral / slight eversion (orthosis is necessary to prevent gastrocnemius-soleus contracture).
2.	Restore / consolidate the ROM of lower limb	1. Early basic non-weight bearing ROM exercises, after the surgical incision has begun healing, usually 10-12 days after surgery, in order to limit the hindfoot stiffness – gentle subtalar active ROM and passive / active assistive ROM toes 3. Bed ROM exercises of all joints above surgical site
3.	Restore / consolidate the strength muscles of lower limbs	*Operated lower limb* 1. Isometric contraction exercises in lying 2. Stretching into dorsiflexion at MTPs with MTs stabilized *Opposite lower limb and upper extremities* 1. Exercises that involve the entire lower limb, such as squats on both legs at the same time, or just on one leg, will be prescribed. 2. Exercises used of Theraband or weights
14 – 56 days (weeks 3 - 8) post surgical intervention (sutures are removed at 2-3 weeks)		
1.	Control edema	1. Compression stocking and 2. Gentle scar massage
2.	Consolidate the ROM of lower limbs	1. Active ROM exercise in operated foot in all directions may be initiated (tibiotalar, subtalar, midtarsal, toe joints); passive and active assistive ROM forefoot and toes 2. Daily exercises – ankle pumps, alphabets, figure eights, inversion / eversion
3.	Consolidate the strength muscles	1. All previous muscle strength exercises must performed 2. Progressive resisted strengthening of the gastrocnemius muscles is done by weighted exercises 3. Upper extremities and univolved lower limb exercises for strength (isometric and

		isotomic contraction of hip and knee muscle, body strengthening)
4.	Gait training	Partial weight bearing after 6 weeks – with crutches, cane, walker
9 – 12 weeks post surgical intervention		
1.	Regain balance and proprioception	1. Progess and monitor the subtalar joints ability to adapt for full weight bearing 2. Exercise bicycle but no resistance 5. Plyometric exercises
2.	Gait training	Gradual increase in weight bearing
3.	Maximize patients' functional independence	1. Exercises that simulate the specific everyday activities of daily living and any recreational activities that patient may want to return to 2. Home training exercises – exercise bicycle, calf stretching, progressive elastic band strengthening
After 12 weeks post surgical intervention		
1.	Maximize balance and proprioception	1. Progess and monitor the subtalar joints ability to adapt for gait on all surfaces 2. Exercises that work the muscles while in standing are most effective for improving balance, walking and stair climbing – ankle and subtalar isometric / isotonic strengthening 3. Standing on one foot or balancing on an stable, then unstable surface 4. Soft tissue mobilization – theraband strengthening in all planes
2.	Gait training	1. Various gait exercises - toe-walking, ascending and descending stairs 2. The normal full weight bearing after 12 weeks
3.	Maximize patients' functional independence	1.Exercises that simulate the specific everyday activities of daily living and any recreational activities that patient may want to return to 2. Home training exercises – calf stretching, exercise bicycle, progressive elastic band strengthening, single leg stance activities, step-ups stairs, squats

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Part 4.

CLINICAL CASES

Grasp and Gait REHABILITATION

CASE REPORT :
REHABILITATION PROGRAM IN PATIENT WITH KNEE ARTHROPLASTY

Rodica Traistaru, Diana Kamal, Constantin Kamal
Filantropia Hospital – Craiova

PI, 68 year old woman with long history of knee osteoarthritis and bilateral knee replacement

1. Personal data
2. Clinical data
3. Imagistic data
4. Functional data
5. Complete diagnosis
6. Rehabilitation program

1. Personal data →
2. Clinical data
3. Imagistic data
4. Functional data
5. Complete diagnosis
6. Rehabilitation program

Grasp and Gait REHABILITATION

Personal data

Patient Complaints
Moderate pain and stiffness in left knee
Post procedure (total knee arthroplasty) rehabilitation status

ANAMNESIS (history)
Our 68 year old woman has primary degenerative arthritis of the knees and of the lumbosacral spine (in 1998 she was diagnosed with postural backache and lumbosacral spondylosis).
She has previous history of Hypertension and Ischemic Heart Disease, well controlled with medication.
Onset of pain in the knees was in winter 2002, without apparent reason. She mentioned that her knee alignment is progressively disturbed and she has much difficulty in walking and climbing stairs. Since 2003, she performed regular rehabilitation program for knee pain with asymmetrical bilateral knee valgus. In the last 3 years, her functional status progressively worse and limiting her daily activity level. She has failed the use of nonsurgical management (activity modification, gait aids, acetaminophen, systemic NSAIDs and selective COX-2 inhibitors, intraarticular cortico-steroid injections, infiltrations with hyaluronic acid, physical therapy program, bracing and activity modification). No arthroscopic exam was performed (patient refused this interventional attitude).
The progression of disease occurred over 12 years, generating continuous pain and significant stiff knee disability.
In 2015 PI was diagnosed with severe bilateral knee osteoarthritis, so she was scheduled for right total knee arthroplasty, in September 2015 and for left knee arthroplasty in May 2016.
She denied any trauma or fall to her knees but she performed daily activities in standing and walking postures in her professional life.

Personal data
Questions (for assessment detailed answers see next page)

1. Why is important to mention the knee alignment in female with knee pain?
a. Malalignment of knee axes can generate knee effusion
b. Malalignment of knee axes mainly caused the knee cartilage wear (arthrosis)
c. It is no important, between two aspects is no conditioning
R = b

2. Is corect the pharmacological management of knee osteoarthritis pain (first acetaminophen, second systemic NSAIDs and selective COX-2 inhibitors)?
a. Yes
b. No
c. It is no important the order of the medication
R = a

3. How can explain the knee pain and limitation of movement in our patient?
a. In osteoarthritis all adiacent peripheral nerves are affected
b. Loss of femoral, tibial and pattelar cartilage causes friction between the segmental joints
c. The medication dosage is not adequate
R = b

4. What is missed significant aspect in our patient (female) anamnesis?
a. The age of her menopausal status
b. The number of her children
c. Her hobby
R = a

Personal data

Questions` answers

1. Why is important to mention the knee alignment in female with knee pain?

The cartilage wear (arthrosis) is the most common reason for disorders of the knee joint and it is mainly caused by a malalignment of the lower limb axe; knee is considered the intermediary pivot of lower limb and has an important biomechanical role.

2. Is corect the pharmacological management of knee osteoarthritis pain (first acetaminophen, second systemic NSAIDs and selective COX-2 inhibitors)?

High dose acetaminophen is first-line therapy in the pharmacological management of osteoarthritis pain. Acetaminophen and NSAIDs show equivalence in efficacy[4]; however, acetaminophen is preferred due to its decreased risk of side effects such as GI bleeding, congestive heart failure, and renal failure.

3. How can explain the knee pain and limitation of movement in our patient?

Loss of the cartilage causes friction between the joints and leads to pain, limitation of movement and severe deformities.

4. What is missed ssignificant aspect in our patient (female) anamnesis?

The menopausal status is important for bone resistance. If our patient would have a younger age of menopausal status she is expose to higher risk for osteoporosis. Osteoarthrosis and osteoporosis are two disorders that sum their disabiliry on the lower limbs.

1. **Personal data**
2. **Clinical data**
3. **Imagistic data**
4. **Functional data**
5. **Complete diagnosis**
6. **Rehabilitation program**

Clinical data

- **Previous bilateral knee replacement (2013)**

  PI was 1.60 m height and a weight of 68 kg. Pulmonary, cardiac, digestive and urogenital systems were normal in clinical exam. Mental status was clear. Vertebral spine – lumbar hyperlordosis, back pain. Upper limb joints – ROM and muscle strength with normal values in accordance with her age. Lower limb with knee asymmetrical valgus, passively partial correctable to neutral, flexion contracture in right knee, small right knee effusion. Right AROM -10 to 100 degrees and left AROM -5 to 105 degrees. Both knee crepitus palpable with ROM (active and passive) and pain along the lateral greater than medial joint line. Right thight circumference measured 10 cm from the proximal pole of pattela was 2cm less than the contralateral side. MMT values were 4 for great gluteus, +4 for hip stable muscle, -4 for right quadriceps and 4 for left quadriceps, 4 for posterior limb muscles. Gait was possible with a front wheeled walker. Neurovascularly of lower limbs were intact.

- **Actual (2016, post left knee total replacement)**

  PI is 1.60 m height and a weight of 63 kg. Pulmonary, cardiac, digestive and urogenital systems are normal in clinical exam. Mental status is clear. Vertebral spine – lumbar hyperlordosis, back pain. Upper limb joints – ROM and muscle strength with normal values in accordance with her age. Lower limb with knee minimal valgus, passively correctable to neutral.

Clinical data

- Skin in prepattelar region with post intervention scars, without any pathologic aspects. Right AROM 0 to 110 degrees and left AROM 0 to 80 degrees. Without knee crepitus palpable with ROM (active and passive). Pain along the lateral and medial left knee sides. MMT values are +4 for great gluteus, +4 for hip stable muscle, +4 for right quadriceps and 4 for left quadriceps, 4 for posterior limb muscles. Gait is possible with cane in right hand. Neurovascularly of lower limbs are intact. Vital Signs: temperature 36.8°C, blood pressure 140/70 mmHg, rhythmic pulse 72 b/min, 18 respirations / min.

Clinical data

Questions (for assessment detailed answers see next page)

1. Why is atrophy of the thigh muscle typically associated with severe knee osteoarthritis?

a. Because the cartilage is destroyed

b. Because our patient is female in menopausal status

c. Voluntary activation deficits are the source of weakness and atrophy

R = c

2. Knee range of motion is important for gait rehabilitation ?

a. Yes

b. No

c. It is a biomechanical parameter that can be ignored in gait rehabilitation program

R = a

3. How can explain the knee flexion contracture in our patient?

a. Medication have adverse effects

b. In severe knee osteoarthritis posture and ambulating are affected

c. Due to her back pain and spondylosis

R = b

4. What is important to perform MMT (manual muscle testing) for all muscles of lower limb?

a. For gait are important both extension and flexion kinetic chains of lower limb

b. For control the knee pain

c. For chose the AINS medication

R = a

Clinical data

Questions` answers

1. Why is atrophy of the thigh muscle typically associated with severe knee osteoarthritis?

Muscle weakness and atrophy have been correlated with slow walking speed and knee disability. Voluntary muscle activation deficits are the source of weakness. It can results from pain, effusion, joint damage. They are described a failure of recruiting all available motor units and a reduction of the maximal motor unit number.

2. Knee range of motion is important for gait rehabilitation ?

For a normal gait any patient with knee replacement must have minimal 90 degrees in flexion. This value is necessary for ambulating in any type of surface.

3. How can explain the knee flexion contracture in our patient?

The loss of extension is detrimental to the function and stability of the knee joint. In severe knee osteoarthritis more patients present this abnormal postural alignment in association with valgus or varum.

4. What is important to perform MMT (manual muscle testing) for all muscles of lower limb?

All rehabilitation program for gait in patient with knee arthroplasty take into consideration the global kinetic exercises, after analytic kinetic program. The kinetic muscle chains of the lower limb – for extension and for flexion – are very important for independence ambulation, so previous kinetic program must do the MMT.

1. **Personal data**
2. **Clinical data**
3. **Imagistic data**
4. **Functional data**
5. **Complete diagnosis**
6. **Rehabilitation program**

Imagistic data

- **Previous bilateral knee replacement (2013)**

Knee RMN before surgical intervention – no images for lesions of the ligaments or meniscal fibrocartilage tears, moderate amount of articular effusion, specific findings of diffuse femoral-tibial arthritic abnormalities, predominant in the medial joint compartment.

Lumbosacral spine X-ray showed spondyloarthrosis, reduced regional lordosis, and reduction in the intersomatic spaces.

Knees X-ray showed signs of severe gonarthrosis (significant joint-space narrowing, osteophytes, loss of bony architecture, subchondral sclerosis and cyst formation, lateral subluxation of tibia on the femur in both sides).

- **Actual (2016, post left knee total replacement)**

Knees X-ray showed the total knee replacement, in both sides - cemented total non-constrained endoprosthesis (bicondylar).

Imagistic data

Questions (for assessment detailed answers see next page)

1. What is the position of studied patient for which we have the following image?

a. A supine non–weight-bearing anteroposterior (AP) radiograph in extension
b. A lateral radiograph in flexion
c. A rest position for arthroscopic exam

R = a

2. The imagistic findings observed in the patient image are specific for?

a. Occult fractures
b. Degenerative arthritis and subluxation of the tibia on the femur
c. The femoral condyles and soft tissue lesions

R = b

3. The imagistic findings of last knees X-ray can suggeted the type of used endoprosthesis ?

a. Yes
b. No
c. It is an incorrect knees X – ray

R = a

4. Is RMN examination essential for our patient?

a. Yes
b. No
c. It is possible to performe if the patient inssurance is complete and extended

R = b, c

Imagistic data

Questions` answers

1. What is the position of studied patient for which we have the following image?

In knee osteoarthrosis is indicated reproducible radiographs in a systematic manner. Comparison with attention the affected and unaffected knees helps to document even subtle radiographic changes. A standard AP view with the patient standing in extension with his or her body weight evenly distributed on both legs is commonly obtained.

2. The imagistic findings observed in the patient image are specific for?

The history, physical examination, and plain radiographs are all that is required to make the appropriate diagnosis. More than 85% of individuals older than 65 years have radiographically detectable osteoarthritis.

3. The imagistic findings of last knees X-ray can suggeted the type of used endoprosthesis ?

Actual modern knee endoprostheses are basically classified into the following types: single endoprosthesis (unicondylar or mono-sledge) and total endoprosthesis (bicondylar) - non-constrained (the surfaces of the joint are replaced while largely preserving the patient's own ligament structures, without any mechanical connection between the thigh and the shin section of the joint) and constrained (a cone-shaped connection stabilizes the joint whose ligament structures could not be fully preserved).

4. Is RMN examination essential for our patient?

Typically, the earliest loss of cartilage is in the 30- to 60-degree flexion zone and thus is easily overlooked with radiographs obtained in full extension. Symptoms of joint-line pain and a loss of cartilage clear space by 2 mm or more is likely to be due to chondrosis rather than meniscal pathology. So, in our patient knee X-ray is an essential examination.

1. **Personal data**
2. **Clinical data**
3. **Imagistic data**
4. **Functional data**
5. **Complete diagnosis**
6. **Rehabilitation program**

Functional data

We assess, in accordance with ICF:
- impairments of body functions - pain, muscle weakness, and restricted knee flexibility;
- changes in body structures - the new joint has damaged several proprioceptors because of:
  - capsular excision,
  - injured some muscles because of splitting or detaching them, followed by suturing and reattaching them;
- activity limitation - limited walking ability and problems with putting on socks and shoes;
- participation restrictions - reduced participation in leisure activities and in household chores;
- the changes in the patient's level of function over the knee replacement.

We used:
- easily reproducible physical performance measures for activity limitation and participation restriction
  - 6 Minute Walk = 420 meters before intervention; 260 meters post intervention (after first rehabilitation program)
  - Timed Up and Go = 18 seconds before intervention; 20 seconds post intervention (after first rehabilitation program)
- scales for condition-specific health –status measures
  - WOMAC (with 3 subscales measuring pain -5 items, stiffness - 2 items, physical function - 17 items; lower score indicates a better outcome) = 78 before intervention; 43 post intervention (after first rehabilitation program)
  - Lequesne's index (11 - 13 very severe disability; >= 14 extremely severe) = 20 before intervention; 7 post intervention (after first rehabilitation program)
  - SF-36 (the lower the score the more disability - a score of zero is equivalent to maximum disability; the higher the score the less disability – a score of 100 is equivalent to no disability) = 23 before intervention; 75 (after first rehabilitation program)

Functional data

Questions (for assessment detailed answers see next page)

1. Although the painful knee joints have been replaced by endoprothesis, previous impairments in body function of our patient still carry with her?

a. No

b. Yes

c. Is no important to mention

R = b

2. The changes in body structures that appeared from surgery may explain?

a. A further disturbance in the neuromuscular status

b. Optimal balance and gait

c. Back pain and lumbar stifness

R = a

3. The final score of the two scales used for our patient – WOMAC and Lequesne's index – are in concordance for disability status ?

a. Yes

b. No

c. It is no possibility to compare the two score scales

R = a

4. **How can explain the values of the two tests used in functional assessment - 6 MWD and Timed Up and Go?**

a. There are no explanations

b. The functional status is not improved after intervention

c. The rehabilitation program for muscular – joint status takes a few weeks after intervention

R = c

Functional data
Questions` answers

1. Although the painful knee joints have been replaced by endoprothesis, previous impairments in body function of our patient still carry with her?

Yes - minial reduced of left knee ROM and quadriceps muscle weakness, activity limitations, participation restrictions from having gonarthrosis for 15 years. A compensatory movement pattern may have become a habit after years of volitional unloading of the painful both limbs, and this problem may sustain after replacement.

2. The changes in body structures that appeared from surgery may explain?

Additionally, the changes in body structures that appeared from surgery may explain the picture of a further disturbance in the neuromuscular status.

3. The final score of the two scales used for our patient – WOMAC and Lequesne's index – are in concordance for disability status ?

Yes. The potential candidates for total joint replacement are defined as patients who have a summed WOMAC score ≥ 39, clinical and radiographic evidence of OA, and no absolute contraindication to total joint replacement. Lequesne's index is an algofunctional index that is used as an outcome measure in clinical trials; a score greater than 12 as an indicator for considering surgery.

4. How can explain the values of the two tests used in functional assessment - 6 MWD and Timed Up and Go?

Patients' recovering from total knee replacement typically reclaim 3 – 4 month for plateau in strength and functional gains. The outcome measures chosen for our patient study are common clinical measures and their associated impairments are theoretically addressable by targeted rehabilitation techniques, in accordance with medical literature data.

Grasp

1. **Personal data**
2. **Clinical data**
3. **Imagistic data**
4. **Functional data**
5. **Complete diagnosis**
6. **Rehabilitation program**

Complete diagnosis

- **Previous bilateral knee replacement (2013)**

After clinical assessment, we performed lab (complete blood test, liver function tests, urine test), electrocardiogram and imagistic exam, for complete diagnosis.

Complete diagnosis for our patients is:

1. Severe primary bilateral gonarthrosis with significant ambulation disability
2. Mechanical low back pain. Lumbosacral spondylosis.
3. Hypertension and Ischemic Heart Disease (medication controlled)

Differential diagnosis must take into consideration the following: secondary gonarthrosis, osteonecrosis, rheumathoid arthritis, knee tumoral, post traumatic knee status.

- **Actual (2016, post left knee total replacement)**

1. Severe primary bilateral operated gonarthrosis. Total bilateral knee replacements with cemented total non-constrained endoprosthesis.
2. Mechanical low back pain. Lumbosacral spondylosis.
3. Hypertension and Ischemic Heart Disease (medication controlled)

Grasp and G

Complete diagnosis

Questions (for assessment detailed answers see next page)

1. What are the clinical arguments for our patient complete diagnosis?

a. Knee pain that is made worse with activity and is accompanied by stifness and abnormal gait
b. Clinical maneuvers for ligamentous instability
c. AROM limitation

R = a, c

2. The following diagnosis can take into consideration for differential diagnosis in our patient?

a. Tibial stress fracture associated with osteoporosis
b. Osteonecrosis of distal femoral or proximal tibial plateau
c. Tumoral knee

R = a, b

3. Why our patient is not diagnosed with secondary gonarthrosis?

a. Because all three compartments of knee are affected by denerative joint process
b. Because she is 68 years old
c. Because she mentioned a long period of knee pain and disability of lower limb

R = a

4. We must mentioned in complete diagnosis all patients disorders? Why?

a. No, it is not an important aspect
b. Yes, because the disorders have an important conditioning for rehabilitation program goals and methods
c. Yes, but not important for rehabilitation program

R = b

Complete diagnosis

Questions` answers

1. What are the clinical arguments for our patient complete diagnosis?

Knee pain that is made worse with activity and is accompanied by swelling without frank ligamentous instability is unlikely to be caused by a torn ligament, infection, tumor, or systemic inflammatory condition. This patient's symptoms are more likely to be related to cartilage injury, such as an onset of degenerative arthritis, readily appreciated by plain radiographs.

2. The following diagnosis can take into consideration for differential diagnosis in our patient?

Osteonecrosis, more commonly seen in 50- to 60-year-old women, is associated with the sudden onset of pain at rest, painful weight-bearing, and effusions.

Osteoporosis with tibial stress fracture associated would be detected through a careful history and physical examination. A bone scan and a MRI are nondiagnostic sustained.

3. Why our patient is not diagnosed with secondary gonarthrosis?

Primary gonarthrosis most frequently affects the three joint compartments. It is bilaterally, but not necessarily symmetrical, like in our patient. The primary knee arthrosis is a degenerative process on the cartilage, not previously exposed to pathologic influences .

4. We must mentioned in complete diagnosis all patients disorders? Why?

Recovering program for total knee replacement typically reclaim kinetic exercises. In cardiac patient all kinetic program must respect the intensity, duration and frequency in accordance with cardiac status.

Also, the back pain (lumbosacral spondylosis) is a real stone in rehabiliation program goals and sessions.

1. **Personal data**
2. **Clinical data**
3. **Imagistic data**
4. **Functional data**
5. **Complete diagnosis**
6. **Rehabilitation program**

Rehabilitation program (RP)

1. Objectives of RP in our patient:
• painful status control;
• controlling the residual inflammatory process;
• control of joint damage - regaining stability and mobility of the lower limb joint, muscle and ligament balance, restoring balance to the muscle groups serving the entire "knee" complex;
• correcting abnormal walking scheme, with recovery of normal walking;
• keeping the knee in the economy of the limb biomechanics;
• maintenance of normal daily activities;
• maximization of quality of life.

2. Methods of RP used in our patient:
• pharmacological modalities - analgesics, chondroprotective drugs
• non-pharmacological modalities:
- educational, dietary and hygienic,
- posture (activity modification),
- physical (thermotherapy - paraffin for hip; electrotherapy - TENS, laser, NMES) - decreased joint swelling and pain will reduce chances of developing complications during the rehabilitation process;
- massage – classic and special massage (Cyriax) of knees,
- kinetic – correct posture of lower limb, disto-proximal lower limb joint mobilization (assistive active and active range of motion), stretching and strengthening in all muscles (early quadriceps and hip stable muscles retraining and strength training), gait training with supporting walker or both canes, then only with one cane when patient up and down the stairs.

Rehabilitation program

Questions (for assessment detailed answers see next page)

1. Why it is important the rehabilitation program (RP) in our patient?

a. Because the RP improves the hip ROM
b. Because the RP improves the upper limb function
c. Because the RP improves the lower limb function

R = c

2. Why we should respect the kinetic algorithm program in our patient rehabilitation ?

a. Because ROM exercises must preceded the strength exercise
b. Because it is the patient option
c. Because the osteoarthritis knee is replaced

R = a

3. Is laser therapy an opportune choice in RP for our patient ?

a. No
b. Yes
c. It is no important

R = b

4. The dysfunction in quadriceps muscle is optimal controlled with NMES in our patient?

a. Yes
b. No
c. It is no important

R = a

Rehabilitation program

Questions` answers

1. Why it is important the rehabilitation program in our patient?

The main aim of the operation is to achieve freedom from pain and mobility including restoration of the natural leg axis. Rehabilitation program is essential to preserve the joint mobility, to counterbalance flexion deformity of the knee, and above all, to maintain the strength of peri-articular muscles, which assists to improve the joint stability. When properly rehabilitated, knee arthritis becomes easier to tolerate, which may allow postponing the surgery.

2. Why we should respect the kinetic algorithm program in our patient rehabilitation ?

Because all osteoarthritis patients with knee replacement follow some kinetic step until obtain optimal gait and function of lower limb: increase knee range of motion (0-115°), increased dynamic joint stability, muscle strength 4/5-5/5, full weight bearing per implant status, appropriate balance and proprioception, control of movement and gait coordination, maximize patients' mobility and functional independence.

3. Is laser therapy an opportune choice in RP for our patient ?

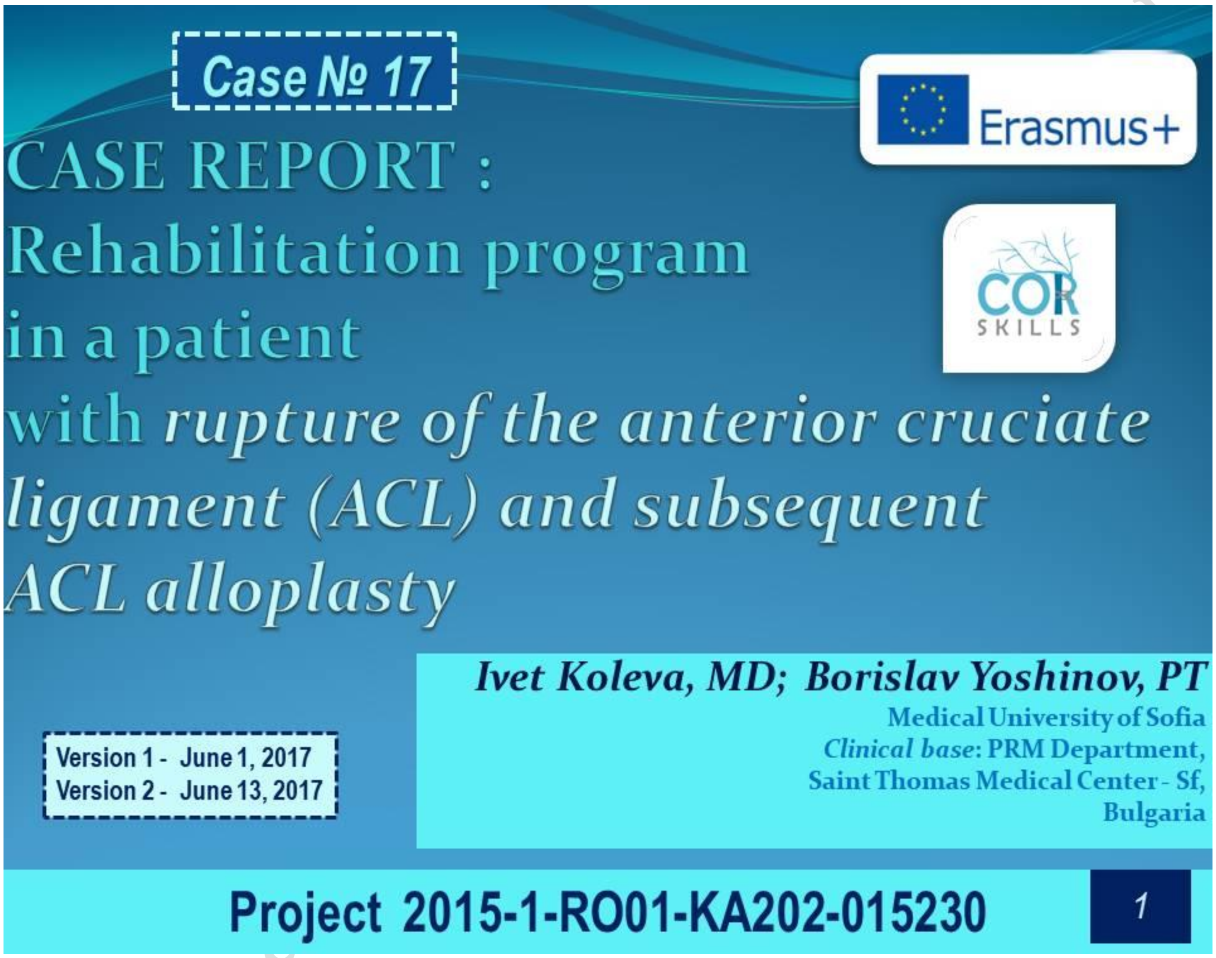
Yes. Laser therapy is very effective post surgically, reduces inflammation and scar tissue, both of which can restrict range of motion of knee and, secondary, entire lower limb. Laser therapy is light that penetrates deep into the tissues; it works both while it is on the body, and after it has been taken off, because it works on the cellular level, without affecting the prostheses.

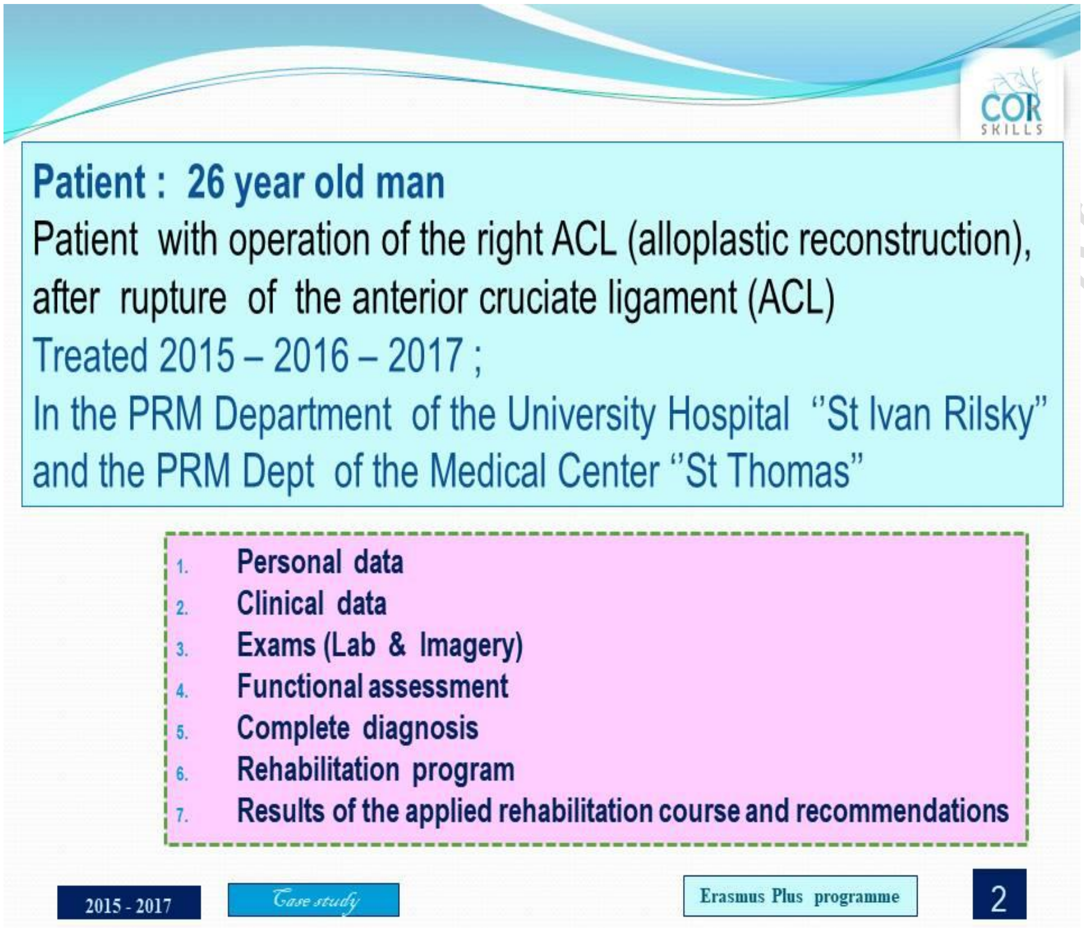
4. The dysfunction in quadriceps muscle is optimal controlled with NMES in our patient?

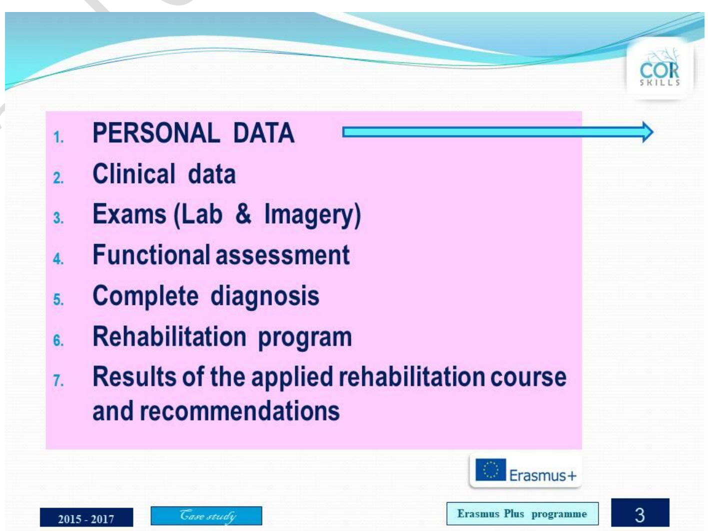
Yes. Recent studies have demonstrated that neuromuscular electric stimulation (NMES) at sufficient intensity can be combined with volitional exercise to more effectively increase muscle strength and functional performance than volitional exercise alone. The incorporating high-intensity NMES into a RP in our patient restored optimal the muscle function and gait scheme.

CASE REPORT : REHABILITATION PROGRAM IN A PATIENT WITH *RUPTURE OF THE ANTERIOR CRUCIATE LIGAMENT (ACL) AND SUBSEQUENT ACL ALLOPLASTY*

Ivet Koleva, MD; Borislav Yoshinov, PT
Medical University of Sofia
Clinical base: PRM Department, Saint Thomas Medical Center - Sf, Bulgaria




COR SKILLS
Patient : 26 year old man
Patient with operation of the right ACL (alloplastic reconstruction), after rupture of the anterior cruciate ligament (ACL)
Treated 2015 – 2016 – 2017 ;
In the PRM Department of the University Hospital "St Ivan Rilsky" and the PRM Dept of the Medical Center "St Thomas"
1. Personal data
2. Clinical data
3. Exams (Lab & Imagery)
4. Functional assessment
5. Complete diagnosis
6. Rehabilitation program
7. Results of the applied rehabilitation course and recommendations
2015 - 2017
Case study
Erasmus Plus programme
2


COR SKILLS
1. PERSONAL DATA
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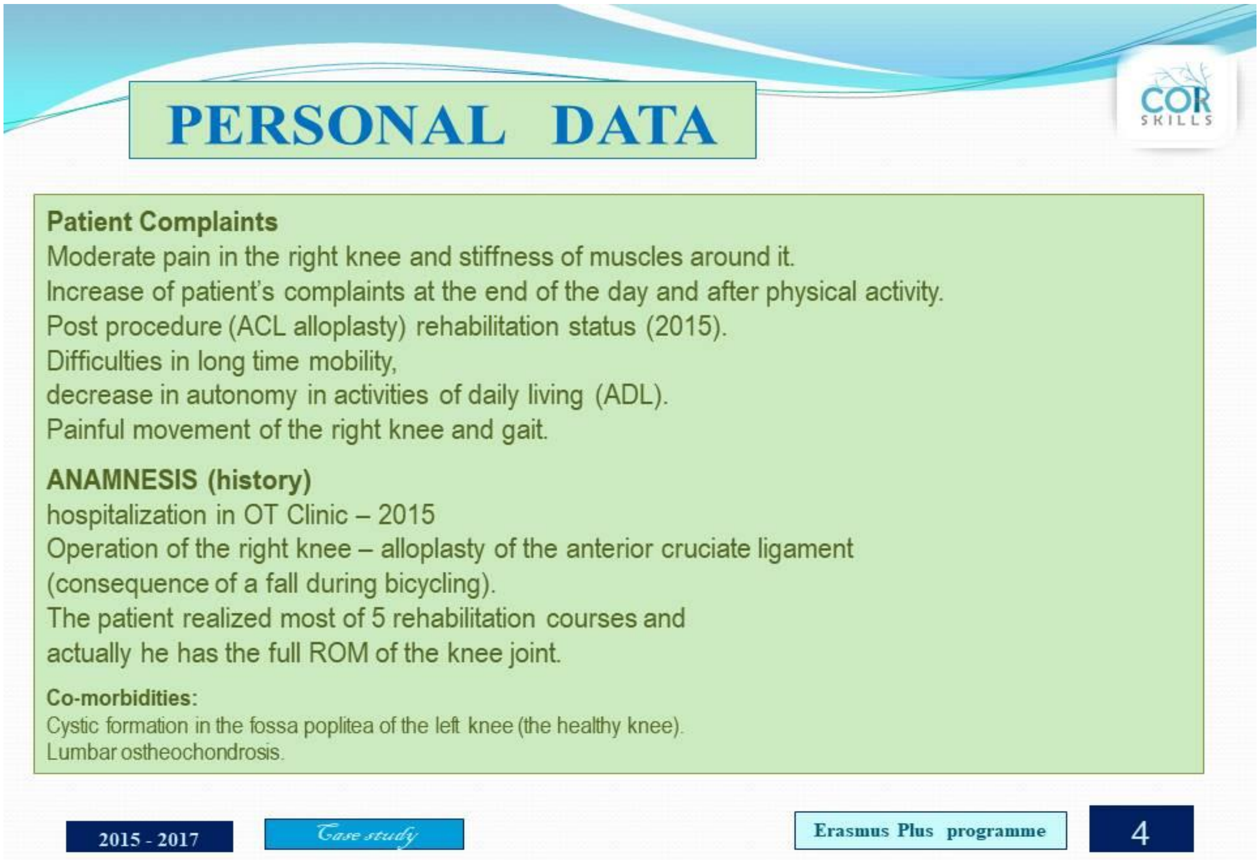
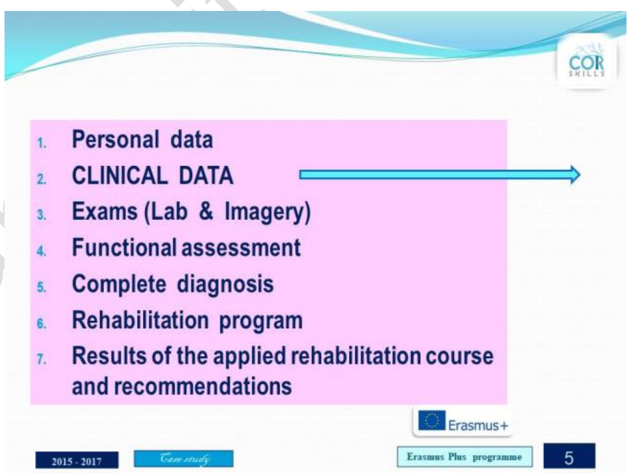
6. Rehabilitation program
7. Results of the applied rehabilitation course and recommendations
Erasmus+
2015 - 2017
Case study
Erasmus Plus programme
3


PERSONAL DATA
Patient Complaints
Moderate pain in the right knee and stiffness of muscles around it.
Increase of patient's complaints at the end of the day and after physical activity.
Post procedure (ACL alloplasty) rehabilitation status (2015).
Difficulties in long time mobility,
decrease in autonomy in activities of daily living (ADL).
Painful movement of the right knee and gait.
ANAMNESIS (history)
hospitalization in OT Clinic – 2015
Operation of the right knee – alloplasty of the anterior cruciate ligament
(consequence of a fall during bicycling).
The patient realized most of 5 rehabilitation courses and
actually he has the full ROM of the knee joint.
Co-morbidities:
Cystic formation in the fossa poplitea of the left knee (the healthy knee).
Lumbar ostheochondrosis.
2015 - 2017
Case study
Erasmus Plus programme
4


1. Personal data
2. CLINICAL DATA
3. Exams (Lab & Imagery)
4. Functional assessment
5. Complete diagnosis
6. Rehabilitation program
7. Results of the applied rehabilitation course and recommendations
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2015 - 2017
Case study
Erasmus Plus programme
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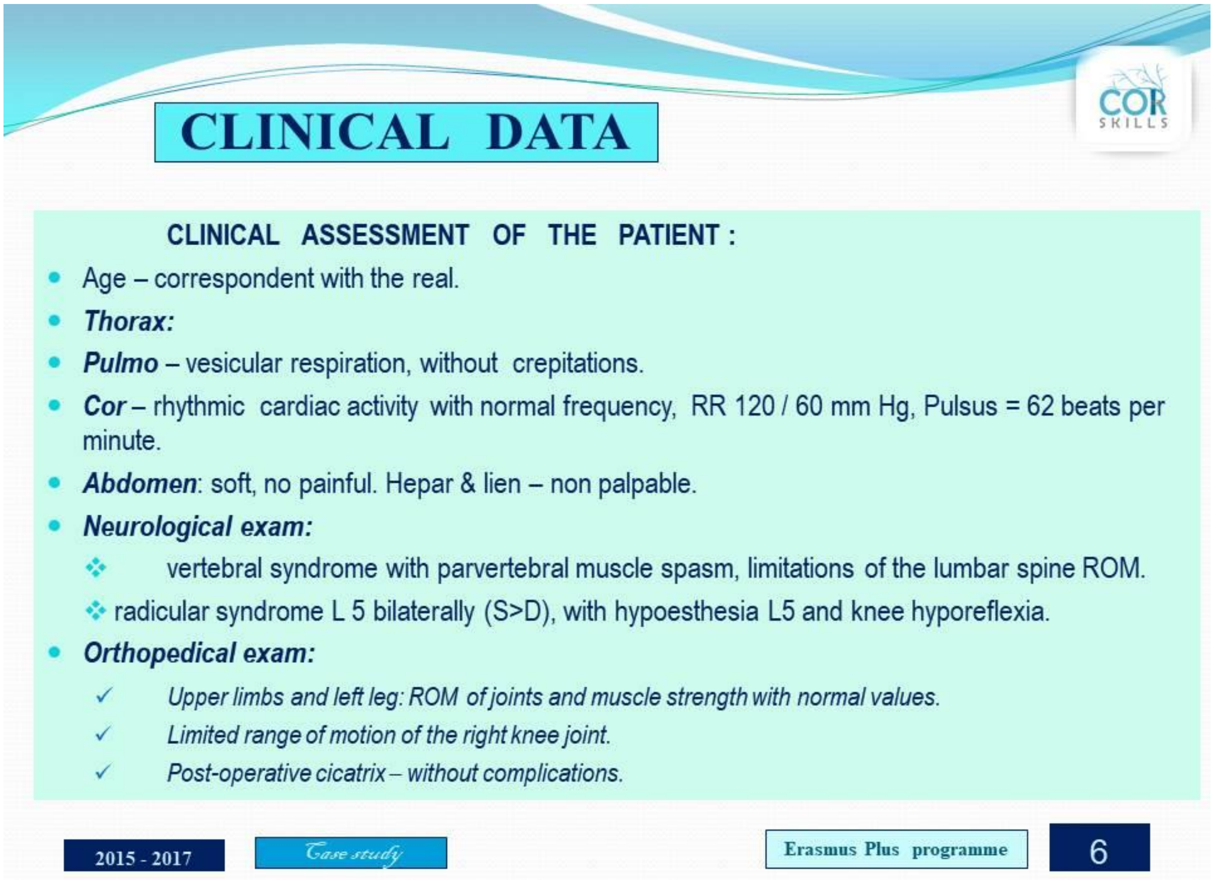
CLINICAL DATA
CLINICAL ASSESSMENT OF THE PATIENT :
Age – correspondent with the real.
Thorax:
Pulmo – vesicular respiration, without crepitations.
Cor – rhythmic cardiac activity with normal frequency, RR 120 / 60 mm Hg, Pulsus = 62 beats per minute.
Abdomen: soft, no painful. Hepar & lien – non palpable.
Neurological exam:
vertebral syndrome with parvertebral muscle spasm, limitations of the lumbar spine ROM.
radicular syndrome L 5 bilaterally (S>D), with hypoesthesia L5 and knee hyporeflexia.
Orthopedical exam:
Upper limbs and left leg: ROM of joints and muscle strength with normal values.
Limited range of motion of the right knee joint.
Post-operative cicatrix – without complications.
2015 - 2017
Case study
Erasmus Plus programme
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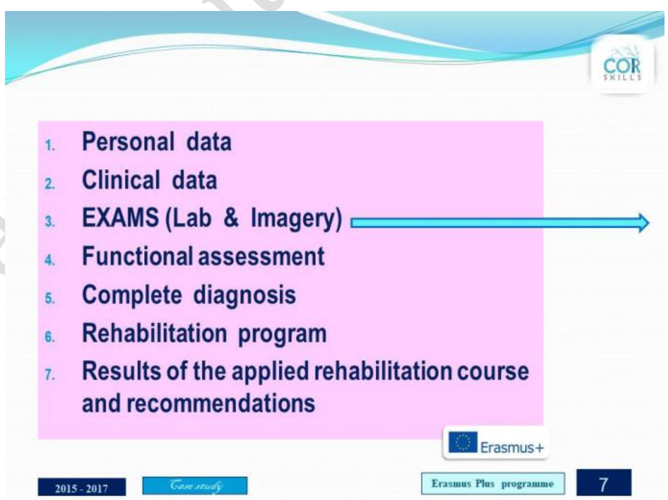
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Erasmus+
2015 - 2017
Case study
Erasmus Plus programme
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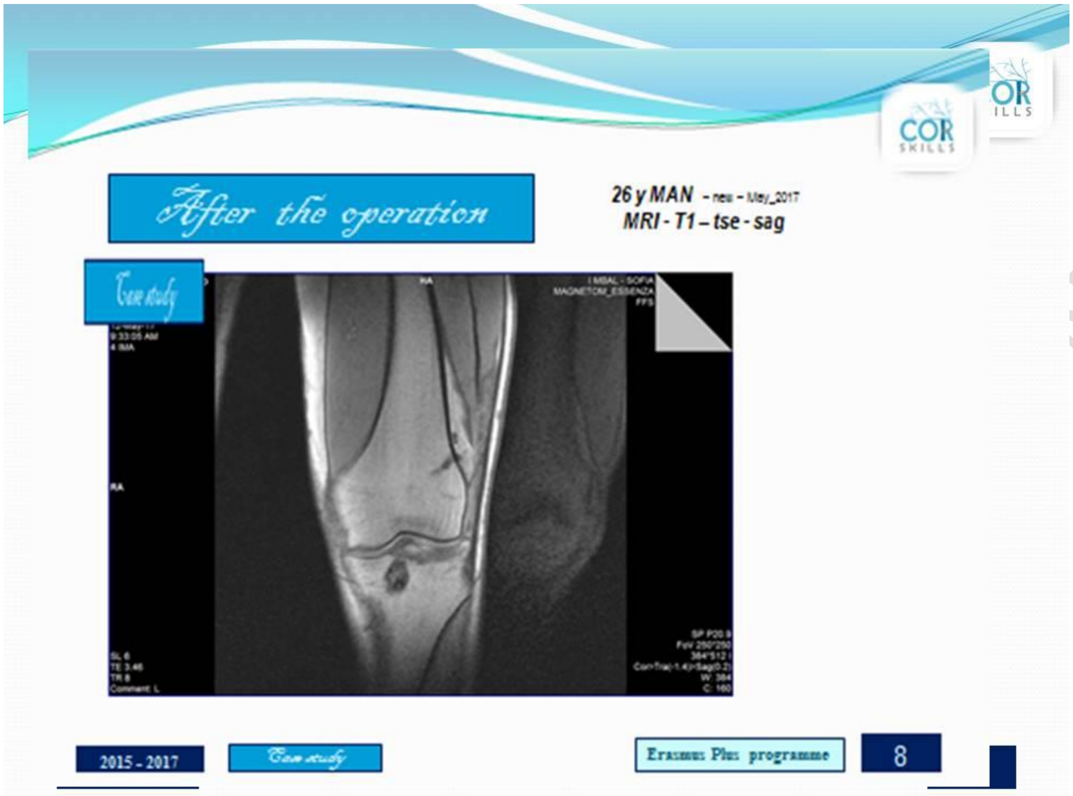
After the operation
26 y MAN - new - May_2017
MRI - T1 – tse - sag
Case study
2015 - 2017
Case study
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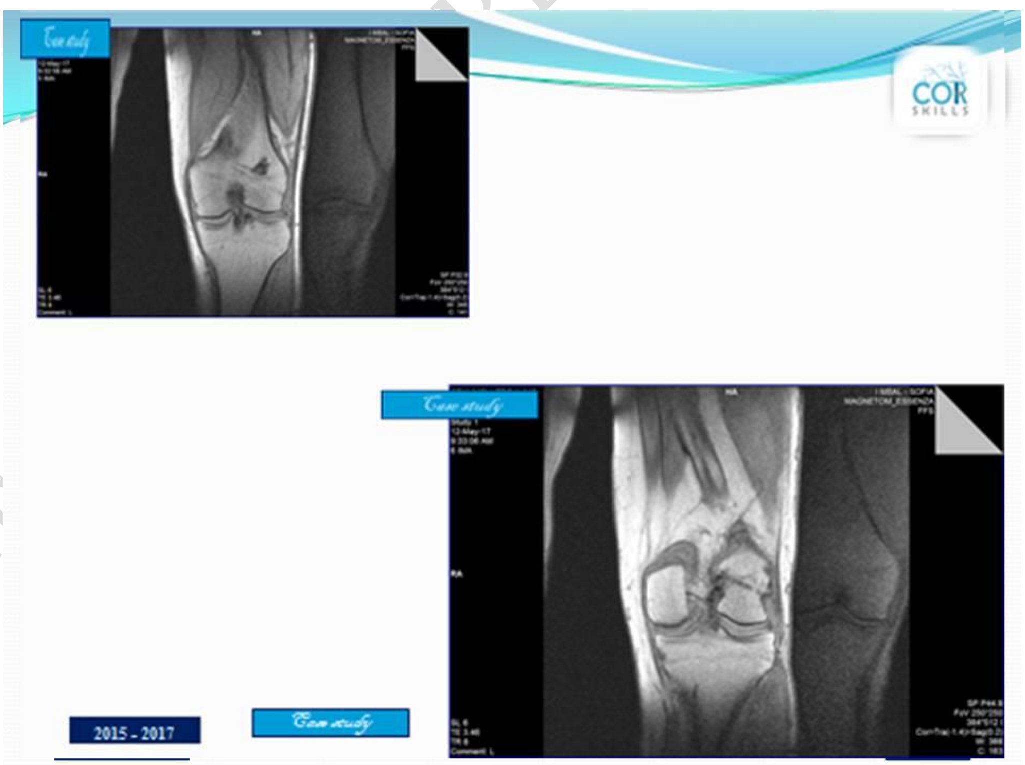
Case study
Case study
2015 - 2017
Case study


Case study
2015 - 2017
Case study
Erasmus Plus programme
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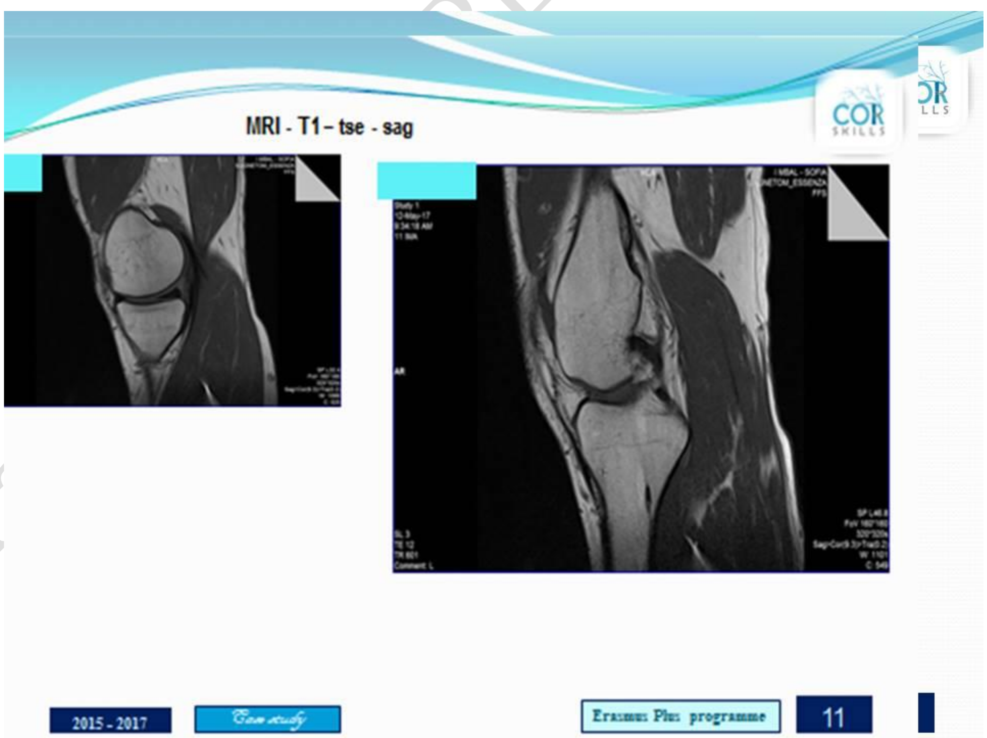
MRI - T1 – tse - sag
2015 - 2017
Case study
Erasmus Plus programme
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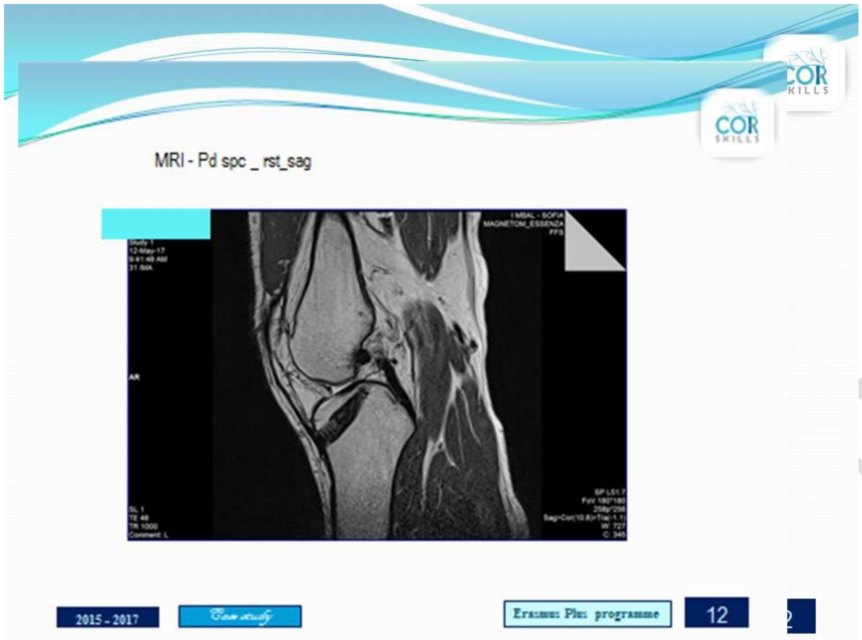
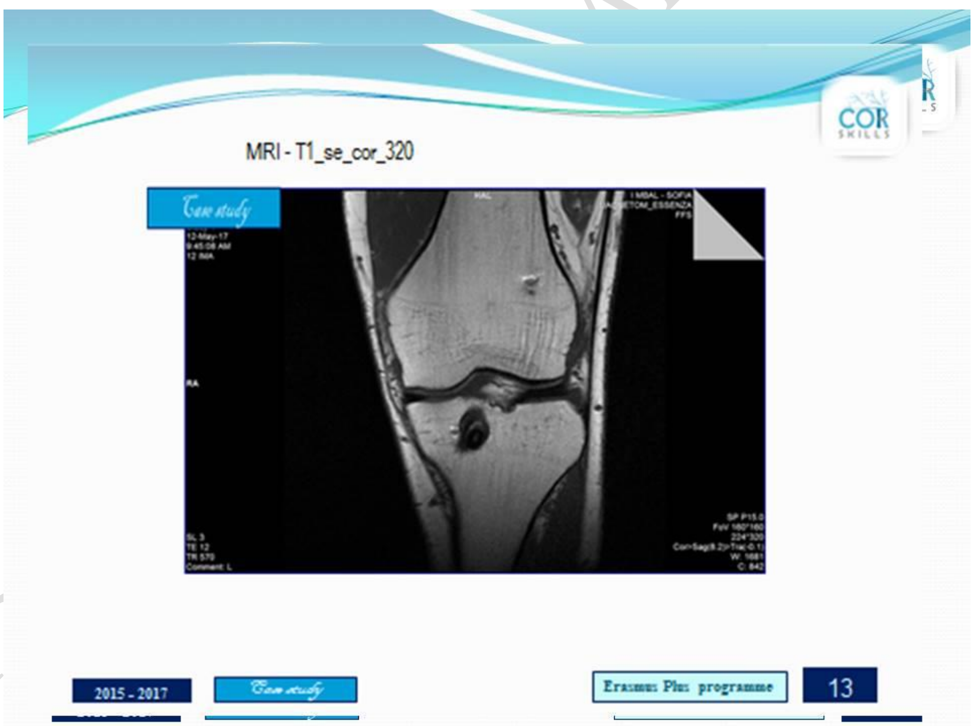

MRI - Pd spc _ rst_sag
2015 - 2017
Case study
Erasmus Plus programme
12


MRI - T1_se_cor_320
Case study
2015 - 2017
Case study
Erasmus Plus programme
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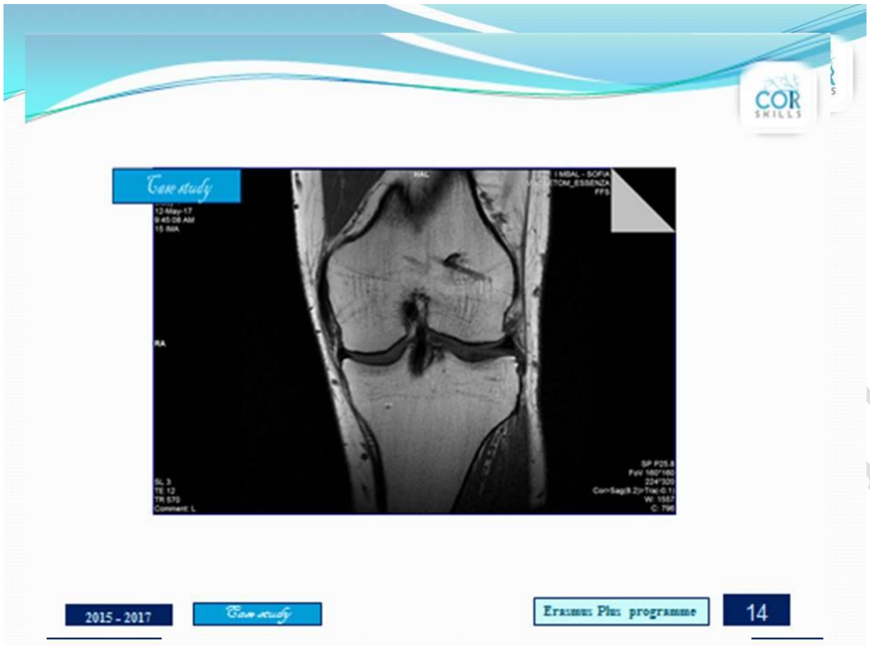
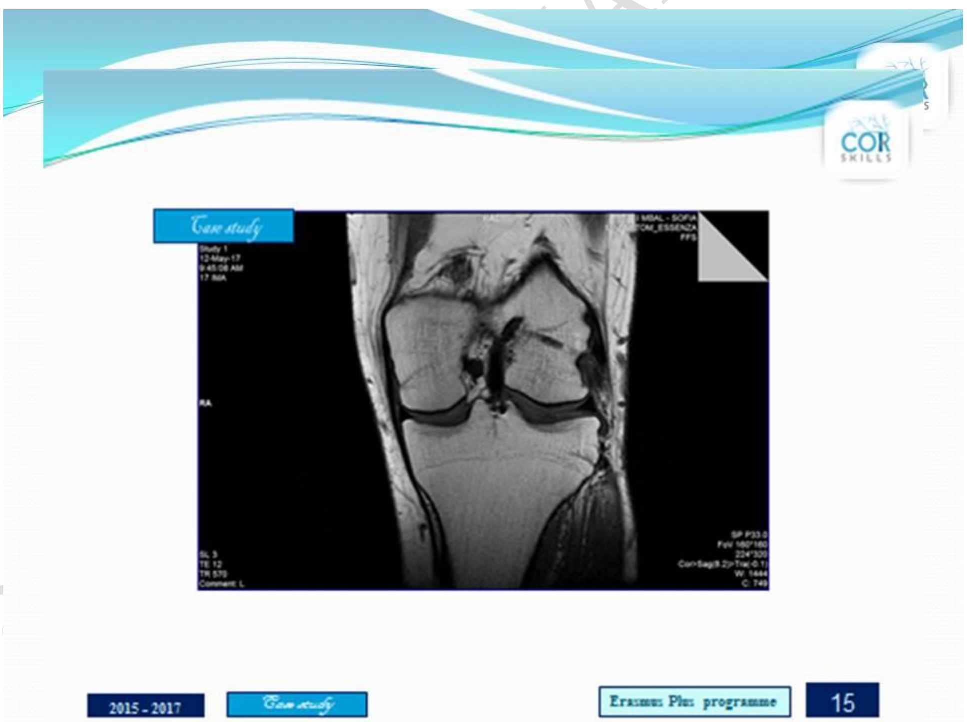
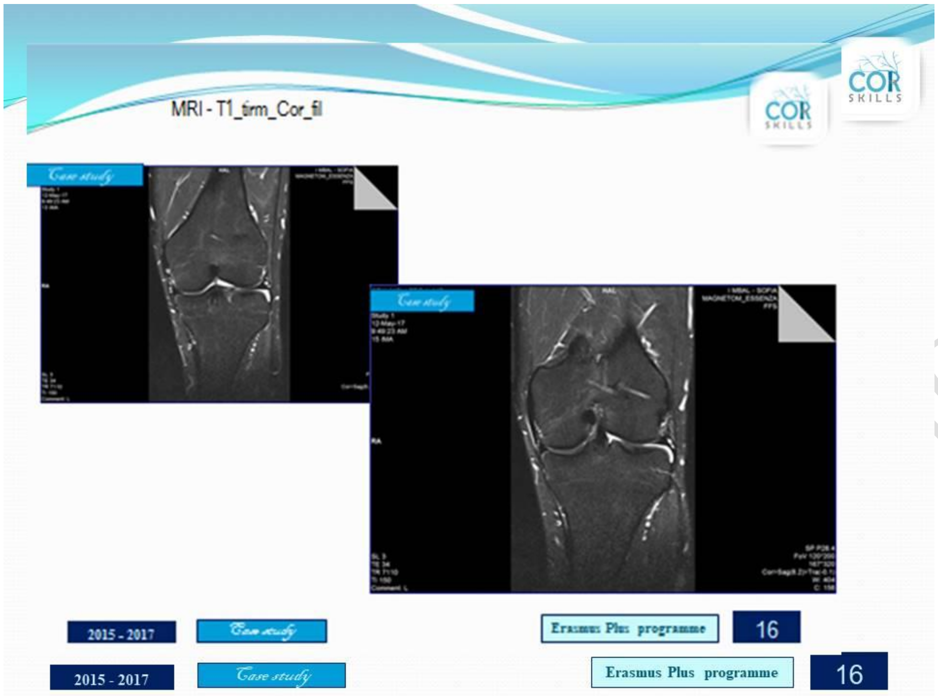




Grasp and Gait REHABILITATION


MRI - T1_tirm_Cor_fil
Case study
2015 - 2017
Case study
Erasmus Plus programme
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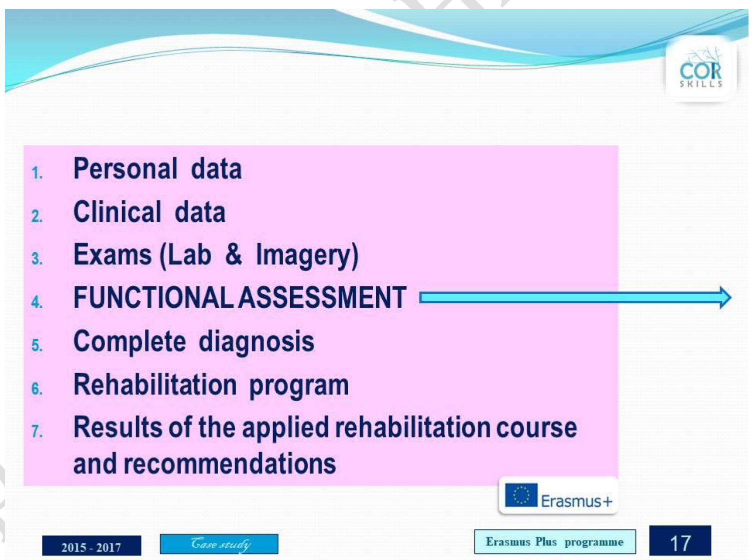
1. Personal data
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3. Exams (Lab & Imagery)
4. FUNCTIONAL ASSESSMENT
5. Complete diagnosis
6. Rehabilitation program
7. Results of the applied rehabilitation course and recommendations
Erasmus+
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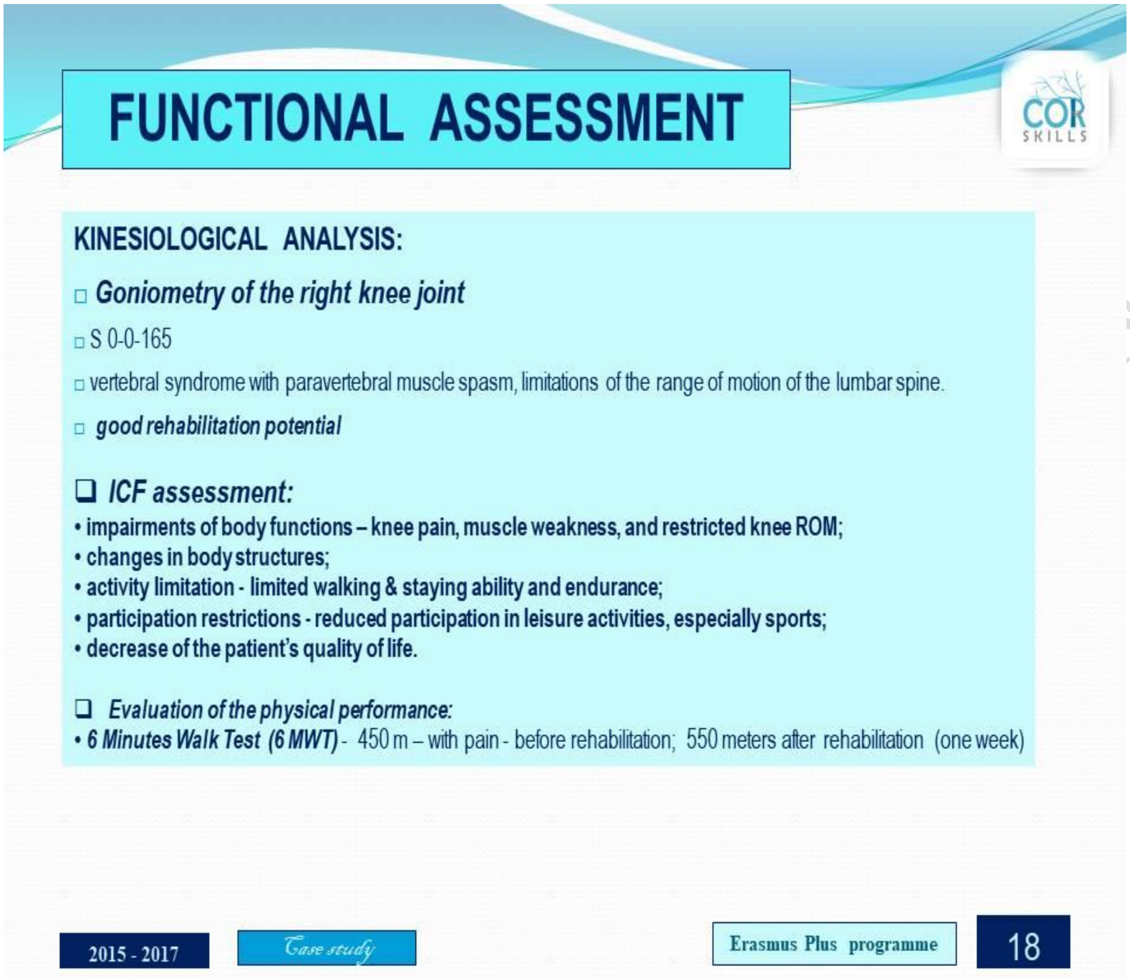
FUNCTIONAL ASSESSMENT
COR SKILLS
KINESIOLOGICAL ANALYSIS:
Goniometry of the right knee joint
S 0-0-165
vertebral syndrome with paravertebral muscle spasm, limitations of the range of motion of the lumbar spine.
good rehabilitation potential
ICF assessment:
• impairments of body functions – knee pain, muscle weakness, and restricted knee ROM;
• changes in body structures;
• activity limitation - limited walking & staying ability and endurance;
• participation restrictions - reduced participation in leisure activities, especially sports;
• decrease of the patient's quality of life.
Evaluation of the physical performance:
• 6 Minutes Walk Test (6 MWT) - 450 m – with pain - before rehabilitation; 550 meters after rehabilitation (one week)
2015 - 2017
Case study
Erasmus Plus programme
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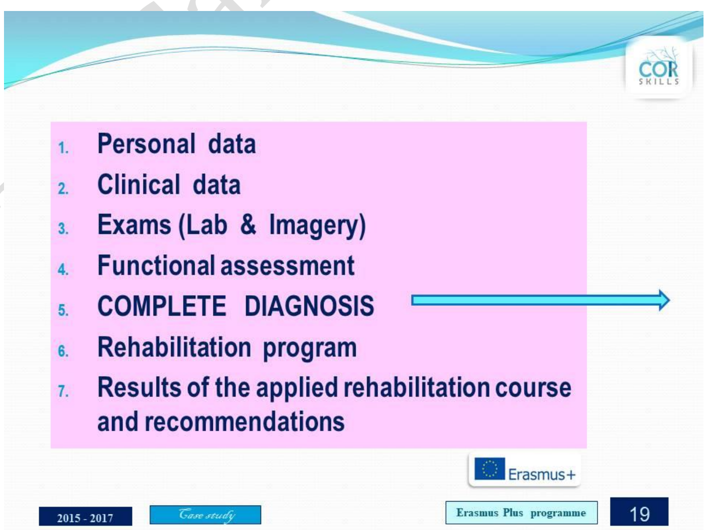
COR SKILLS
1. Personal data
2. Clinical data
3. Exams (Lab & Imagery)
4. Functional assessment
5. COMPLETE DIAGNOSIS
6. Rehabilitation program
7. Results of the applied rehabilitation course and recommendations
Erasmus+
2015 - 2017
Case study
Erasmus Plus programme
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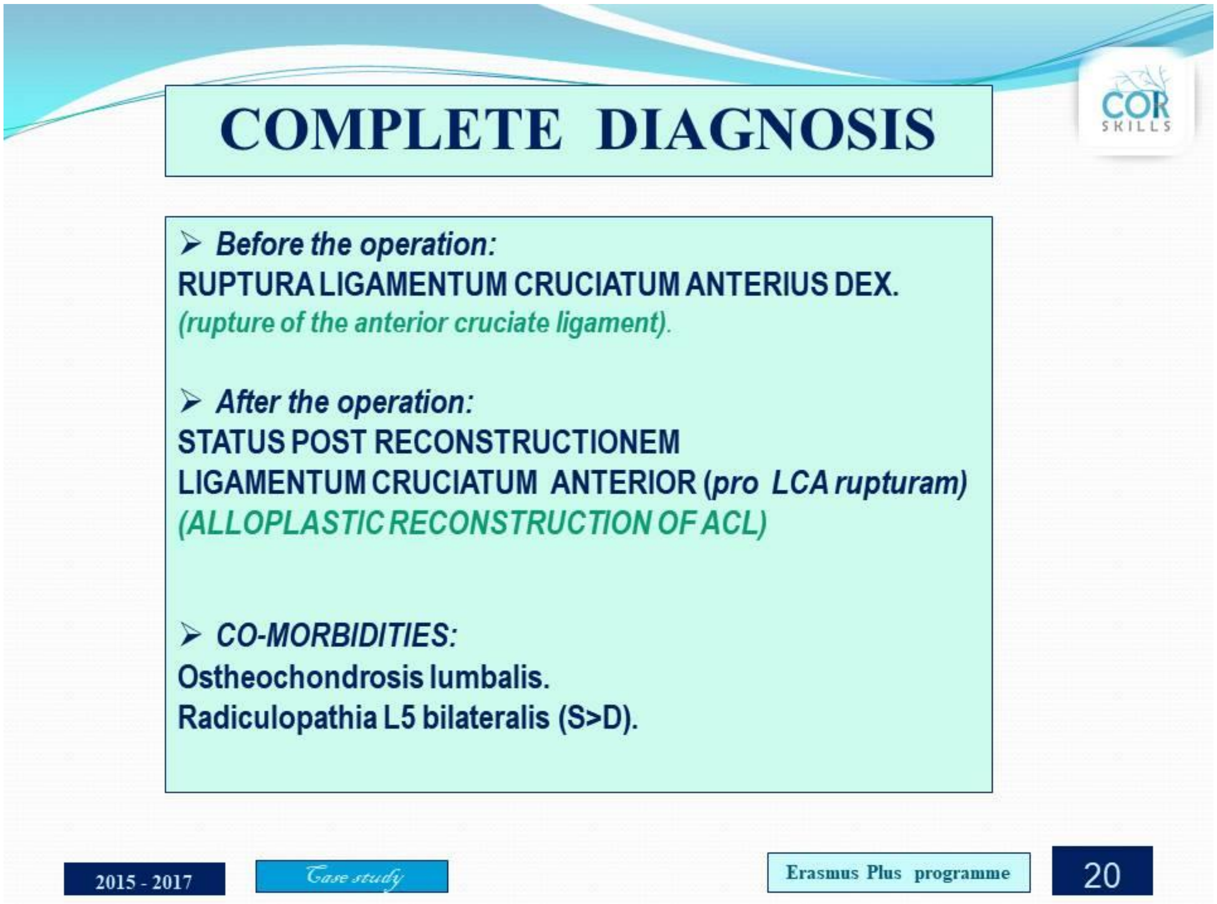
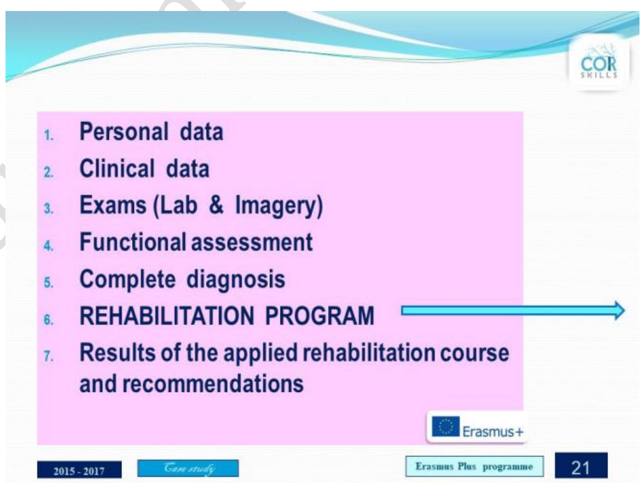

COMPLETE DIAGNOSIS
Before the operation:
RUPTURA LIGAMENTUM CRUCIATUM ANTERIUS DEX.
(rupture of the anterior cruciate ligament).
After the operation:
STATUS POST RECONSTRUCTIONEM
LIGAMENTUM CRUCIATUM ANTERIOR (pro LCA rupturam)
(ALLOPLASTIC RECONSTRUCTION OF ACL)
CO-MORBIDITIES:
Ostheochondrosis lumbalis.
Radiculopathia L5 bilateralis (S>D).
COR SKILLS
2015 - 2017
Case study
Erasmus Plus programme
20


1. Personal data
2. Clinical data
3. Exams (Lab & Imagery)
4. Functional assessment
5. Complete diagnosis
6. REHABILITATION PROGRAM
7. Results of the applied rehabilitation course and recommendations
COR SKILLS
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2015 - 2017
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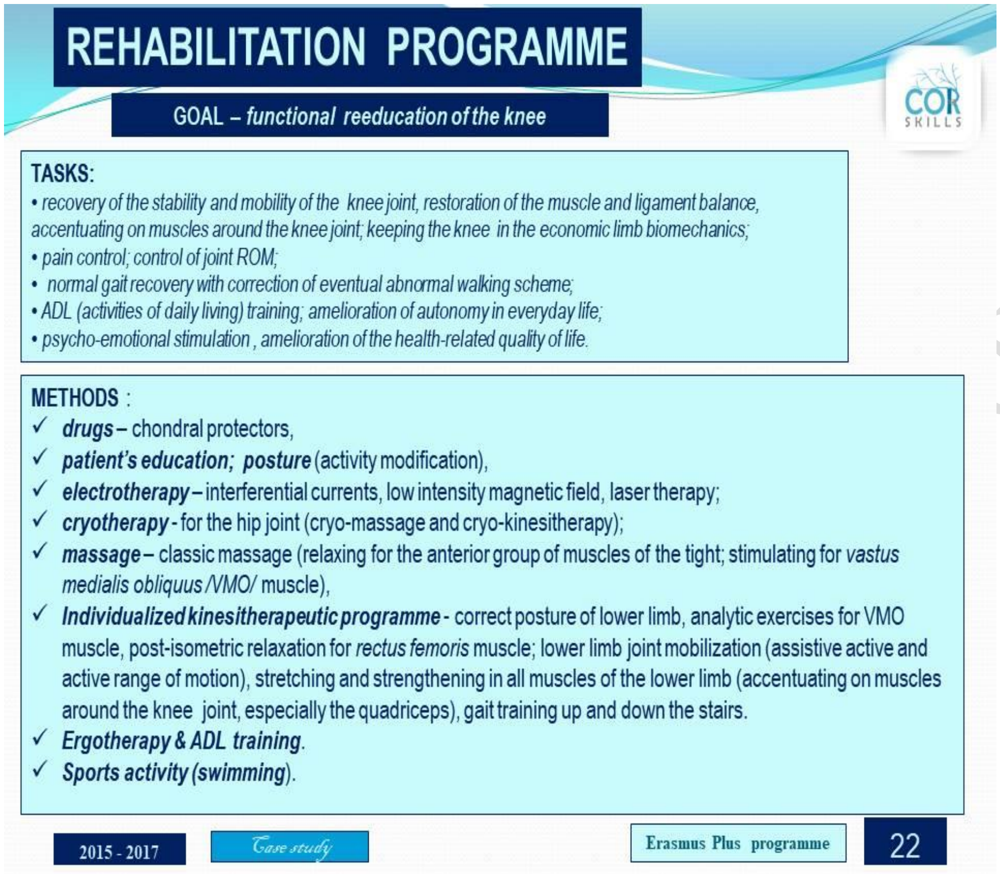

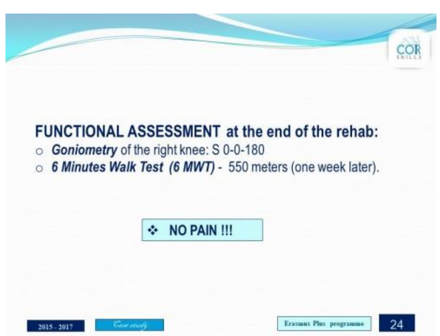

Grasp and Gait REHABILITATION


COR SKILLS
RESULTS OF THE REHABILITATION PROGRAMME
Pain relief;
Amelioration of the range of motion of the knee;
Amelioration of the functional capacity;
Amelioration of the neuro-muscular coordination;
Stabilization of the gait;
Amelioration of the quality of life.
2015 - 2017
Case study
Erasmus Plus programme
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COR SKILLS
RECOMMENDATIONS:
Treatment plan after the dehospitalization:
Auto-PT at home: kinesiotherapy every day.
Sports activity: swimmimg.
Next rehabilitation course – after 3 months
2015 - 2017
Case study
Erasmus Plus programme
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COR SKILLS
Erasmus+
Project 2015-1-RO01-KA202-015230
2015 - 2017
Case study
Erasmus Plus programme
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ARTERIAL VASCULAR COMPLICATIONS IN A PATIENT AFTER TOTAL KNEE ARTHROPLASTY DECREASE THE QUALITY OF POST-OP REHABILITATION

(a case report)

Ivet Koleva *, Borislav Yoshinov , Radoslav Yoshinov

Abstract:
Introduction: *Routinely patients with hip or knee arthroplasty are transferred from acute to rehabilitation department at an ever earlier stage (one week post-op).*
The most frequent complications after low leg arthroplasty are: local pain, edema, contracture, tardive calcification, infection, hemorrhage, pulmonary embolism and deep vein thrombosis. Sometimes unexpected complications can provoke a delay or even suspension of the rehabilitation.
Aims of the study: *The principal objective of the current article is to remind to the wide public the possible presence (and subsequent care) of other complications, e.g. the lower limb arteritis.*
Case presentation: *The presented patient is 77 years old male. Hospitalized in our PRM Department one week after operation, with the objective of post-op orthopedic rehabilitation after total knee arthroplasty (for advanced gonarthrosis - genu varum with angle 4°).* ***Arterial Echo-Doppler*** *of the lower extremities: Acute thrombosis of the left femoral superficial arteria, and the left popliteal supra-articular arteria (aneurysm of 30 mm), missing images of retro & supra-articular popliteal arteriae.* ***Urgent operation*** *was needed for the* ***left leg*** *diagnosed with* ***arteritis:*** *femoro-peroneal distal pontage in the intern saphenous vein with angioplasty of the distal anastomosis.*
Discussion: *In every case our goal is to prevent possible complications and to assure a high quality of the rehabilitation.*
Conclusion: *Vascular complications after joint replacement can be very dangerous for the rehab process. In every clinical case the PRM & OT medical doctors must be immediately alerted of any concern for complication or significant variation in expected progression / outcomes*

Keywords: knee arthroplasty, complication, arteritis, rehabilitation, physiotherapy

1. INTRODUCTION

The joint replacement (endoprosthesis, arthroplasty) is frequently applied in cases with permanent pain complaints due to advanced arthrosis, joints deformations and calcifications that do not respond to intra-articular drug injections or simple physiotherapy [1, 2].

Routinely, patients with hip or knee arthroplasty are transferred from acute to rehabilitation (rehab) department at an ever earlier stage (one week post-op).

In rehab, major goals are the improvement of range of motion of the knee or hip, improvement of the 'normal' patient condition, rehabilitation of the posture and gait, resocialization of patient and restoration of his / her autonomy in everyday life [3, 4].

The most frequent complications after low leg arthroplasty are indisputably: local pain, edema, tardive calcification (due to general osteoporosis), infection or hemorrhage; development of joint or muscle contractures, pulmonary embolism and deep vein thrombosis [1, 3].

Sometimes unexpected complications can occur and provoke an important delay or even suspension of the normal rehabilitation process. This is the present case.

The principal objective of the current article is to remind to the wide public the possible presence (and the subsequent care) of rare complications, like the lower limb arteritis [5].

2. PRESENTATION OF CASE

2.1 Patient presentation

The presented patient is 77 years old male. Hospitalized in our PRM Department one week after operation, with the objective of *post-op orthopedic rehabilitation* after *total knee arthroplasty*, for advanced femorotibial arthrosis - genu varum with angle = 4° (gonarthrosis).

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Details of the operative protocol: Total knee arthroplasty, prosthesis type Smith Nephew TC + without preservation of the posterior cruciate ligament (PCL) ; femur - size 8, tibial rotatory base – size 8, tibial plateau - polyethylene 11 mm ; Patella arthroplasty (S Celle 29/8). Loco-regional anesthesia (rachis anesthesia).

Co-morbidities**:** arterial hypertension; thrombophlebitis, deep vein thrombosis (DVT x 2); pulmonary embolia; hemorrhoids; cataract; bilateral total hip arthroplasty (right THA – in 2001, left THA – in 2013); appendectomy.

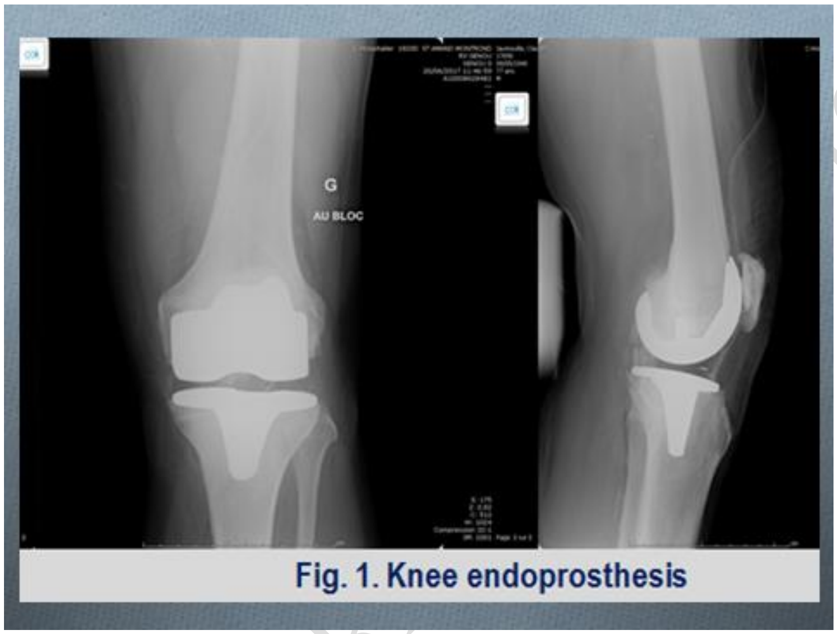

Fig. 1. Knee endoprosthesis

Fig.1. Recent knee endo-prosthesis

Fig. 2. Bilateral hip endo-prosthesis of the same patient

Grasp and Gait REHABILITATION

Patient Complaints:
Excessive pain and stiffness in the left knee and muscles around it; Difficulties in standing up, transfers and mobility; Reduced autonomy in activities of daily living (ADL); Impossible autonomic gait.
Clinical exam before rehabilitation [6]:
Limited range of motion (ROM) of the correspondent lower extremity; Post-operative cicatrix – with complications.
ROM of the left knee: active flexion - 75°, passive flexion - 90° (with tolerable pain); active extension was reduced to 10°.
Manual muscle test (MMT) for muscles around the knee: MMT=3/5 for vastus medialis & vastus lateralis.
Reduced capacity for transfers; Verticalization realized; Reduced capacity for autonomic gait: locomotion is possible with technical aids (walker) and with an assistant physiotherapist (PT).
Intensive pain – in bed and during movements (VAS=8/10).
Small black spot (necrosis of diameter of 2cm) - present at the surface of the first toe of left foot (fig.3a).
ICF** (International classification of functioning)* ***assessment [7]:
- Impairments of body functions – hip pain, muscle weakness, and restricted knee ROM;
- Changes in body structures;
- Activity limitation - limited walking ability and problems with putting on socks;
- Participation restrictions - reduced participation in leisure activities;
- Decrease of the patient's level of autonomy.

Biological constants: RR 140/85 mm Hg, frequency – 72 beats/min., saturation – 100 %.
LAB exam: normal Hb, Leuco, Thrombo; ionogram, lipid and glucidic patterns. Transient increase of CRP.
Cardiological consultation *(with Electrocardiography, Echocardiography and Doppler):* Possible ischemic P wave, preserved rejection function of the left ventricle.
Venous Echo-Doppler *of the lower extremities:* without signs of acute deep vein thrombosis (DVT), but DVT sequelae: residual thrombi (non-occlusive) in arteriae: femoralis communis dextra, femoralis superficialis, poplitea sinistra.
Arterial Echo-Doppler *of the lower extremities:* Acute thrombosis of the left femoral superficial arteria, and of the left popliteal supra-articular arteria (aneurysm of 30 mm), missing images of retro & supra-articular popliteal arteriae.
Urgent operation was needed for the left leg diagnosed with ***arteritis:*** *femoro-peroneal distal pontage in the intern saphenous vein with angioplasty of the distal anastomosis.* (Post-op cicatrix in fig.3b)
After the operation: ***secretion of the operative cicatrix*** with temperature, sedimentation time 140 mm at the first hour, C-reactive protein /CRP/ 71,7 mg/L, isolation of colonies of *Escherichia coli*; antibiotic treatment with Amoxicillin-Clavulanic acid (Augmentin).
Pain in the left foot and toes (Visual analogue scale - VAS 6/10)**.**
Radiography: osteochondritis of the astragalin dome.
Scanner: Arthrosis, subchondral lesions of the talus dome, no signs of bone infarct.

2.2 PRM program of care [8, 9]
Goal: *functional recovery.*
Tasks:
- *recovery of the stability and mobility of the lower limb joints;*
- *restoration of the muscle and ligament balance, accentuating on muscles around the knee joint; keeping the knee in the economic limb biomechanics;*
- *control of pain, cicatrix, ROM, possible complications;*
- *education of transfers;*

Grasp and Gait REHABILITATION

- *normal gait recovery with correction of eventual abnormal walking scheme;*
- *ADL (activities of daily living) training;*
- *amelioration of autonomy in everyday life;*
- *psycho-emotional stimulation;*
- *amelioration of the health-related quality of life;*
- *Home adaptations;*
- *Recovery of functionality at home and resocialization.*

Methods:

- ***Antalgic and anti-thrombotic drugs*;**
- ***patient's education;***
- ***posture* (activity modification),**
- ***preformed physical modalities:*** Transcutaneous electroneurostimulation (TENS) for pain relief, low intensity low frequency magnetic field (MF) for edema reduction.
- ***cryotherapy* -** for the knee joint (before the massage and the kinesitherapy);
- ***massage*** – classic massage (relaxing for the *rectus femoris muscle*; stimulating for *vastus lateralis* and *vastus medialis*),
- ***Individualized physio-therapeutic (PT) programme* -** *correct posture of lower limb, analytic exercises for vastus muscles; lower limb joint mobilization (active range of motion), post-isometric relaxation /PIR/ for rectus femoris muscle;*
- **Balance and gait training** with supporting walker or two crutches, education in mobility up and down the stairs.
- ***Occupational therapy (OT) & ADL training.***

PT / OT program includes *ROM techniques*: passive and active mobilizations of the knee joint, passive mechanotherapy (device Kinetec); *proprioceptive training; strengthening (active) exercises* for the muscles of the kinetic chain of lower extremities, *analytic exercises* for the quadriceps muscle (with special attention to the two heads *vastus lateralis* & *vastus medialis obliquus)*; *balance and gait training*, with technical aids (walker at the beginning, two crutches, two canes, one cane).

During gait rehabilitation the principle of *progressive weight bearing (WB*), with restoration of the correct gait pattern was considered (no WB for the first post-op week, after that – progressive augmentation of the WB).

2.3 Results of the applied PRM programme and future recommendations

After the rehabilitation, we observed:

- ✓ *Amelioration of the ROM of the left knee:* active flexion 95^{o}, full extension;
- ✓ *Amelioration of the functional capacity:* 10 meters walk test – 6,5 seconds;
- ✓ *Independent stand up and transfers - Timed Up & Go test 5,2 sec;*
- ✓ *Independent gait with crutches – in the room and the corridor;*
- ✓ *Balance & Gait stabilization;*
- ✓ *Decrease of pain in distal parts of lower limbs* – Visual analogue scale 2/10;
- ✓ *Revascularization of the operated limb* (fig.3c);
- ✓ *Amelioration of the autonomy in ADL.*

Treatment plan after the dehospitalization includes: Auto-PT at home: physiotherapy every day at the 3-th month after the operation; Gait – with crutches; Next rehabilitation course at hospital – 3 months later.

Grasp and Gait REHABILITATION

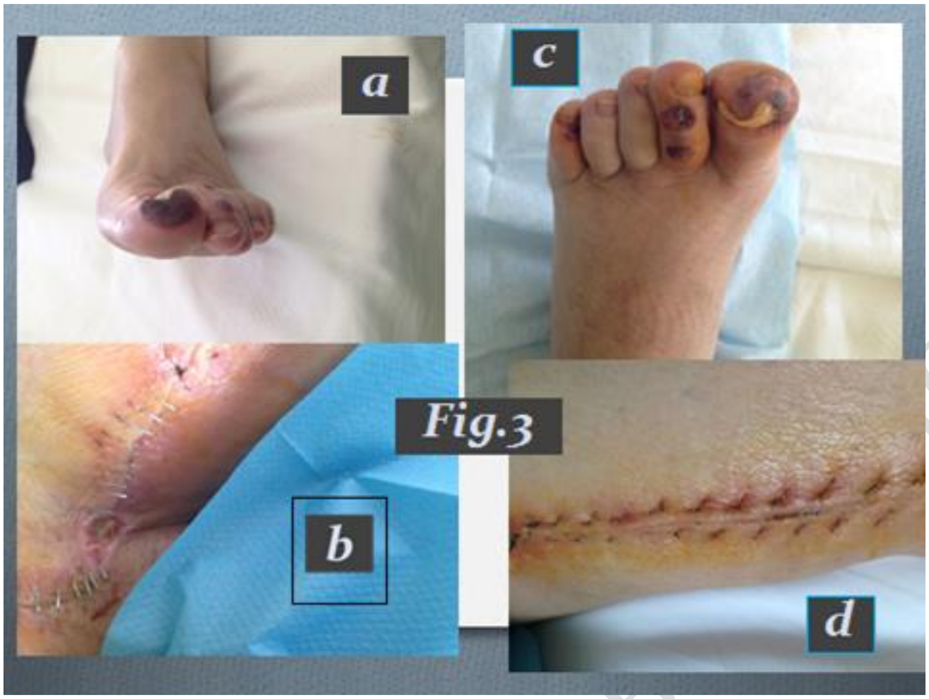

Fig. 3. Black necrotic spot before operation [a] and sic necrosis after revascularization [c]; Post-operative cicatrix [b & d]

3. DISCUSSION

According to the definition of the European Union of Medical Specialists – PRM Section [1] **Physical and Rehabilitation Medicine (PRM)** is an „independent medical specialty, oriented to the promotion of physical and cognitive functioning, activities (including environment), participation (including quality of life) and changes in personal factors and environment. The specialty PRM is responsible for the management of the prevention, diagnostics, treatment and rehabilitation of patients with health-related disability and co-morbidity of all ages.

According to the White Book on Physical and Rehabilitation Medicine [1] **the basic objective of PRM** is the optimization of social participation and the amelioration of the quality of life of patients. This includes the aid of the patient to reach possible levels and patterns of autonomy and independence, including participation in professional, social and leisure activities, part of his human rights [3].

Tasks of PRM are: treatment of existing pathology; reduction of disability; prevention and therapy of complications; amelioration of functioning and activity; stimulation of patient's participation in different types of activities [3, 8, 9].

In orthopedic and traumatologic (OT) conditions, including after orthopedic surgery, during ***clinical assessment*** we accentuate on some analyses: *pain* (localization, type, intensity – verbal or visual analogue scale; modifying pain activities); *joint stability* (including joint position sense) *and range of motion* (active and passive); presence of oedema, muscle or joint *contractures*; *evaluation of the muscle force / muscle insufficiency, motor deficit; analysis of the grasp and gait; mobility* (necessity of technical aids - canes, walking sticks, crutches, walkers, wheelchairs and other devices); *fatigue* (physical endurance, necessity of rest during the examination or the functional activity); *autonomy in everyday activities (*bathing, dressing, eating, putting shoes on, personal hygiene, need of help in ADL). Evaluation of problems must be qualitative and quantitative, including: fatigue, motor deficiency, coordination problems (body position, gait, grasp); pain; conscience for the necessity of technical aids; difficulties in ADL; limitations in functional mobility [6].

Grasp and Gait REHABILITATION

The complexity of rehabilitation in OT cases imposes the necessity of a holistic approach to the patient – detailed functional analysis before and after the rehabilitation courses; application of therapeutic methods of different medical specialties (principally orthopedics and traumatology; neurology and neurosurgery; rheumatology; PRM) and from non-medical fields (kinesitherapy, sociology, psychology, occupational therapy). We apply basic principles of the specialty Physical and Rehabilitation medicine [3, 6, 9].
In every stage of the rehabilitation processus we must define precisely the goal, tasks and algorithms of rehabilitation. In every case our goal is to assure a high quality of the rehabilitation, optimal for the clinical form of the principal disease or condition, adapted to the age, co-morbidities, capacity and desire of the concrete patient; with the strategic goal to receive the best result for his quality of life.

4. CONCLUSION

Vascular complications after joint replacement can be very dangerous for the rehab process.
In every clinical case the PRM & OT medical doctors must be immediately alerted of any concern for arteritis, deep venous thrombosis, pulmonary embolism, infection, excessive oedema, or significant variation in expected progression / outcomes.

ACKNOWLEDGEMENTS

Some activities, related to current article, were realized under the *Erasmus Plus Project* 2015-1-RO01-KA202-015230 *Cor-skills* (post-op rehabilitation).

CONSENT

All authors declare that '*written informed consent* was obtained from the patient for publication of this case report and accompanying images'.
Protection of privacy of the patient is guaranteed.
Authors accomplished all requirements of SDI Patient Consent Form 1.0.

ETHICAL APPROVAL

All authors hereby declare that the work have been examined and approved by the appropriate ethics committee and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki.

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Grasp and Gait REHABILITATION

Part 5.

EDUCATION

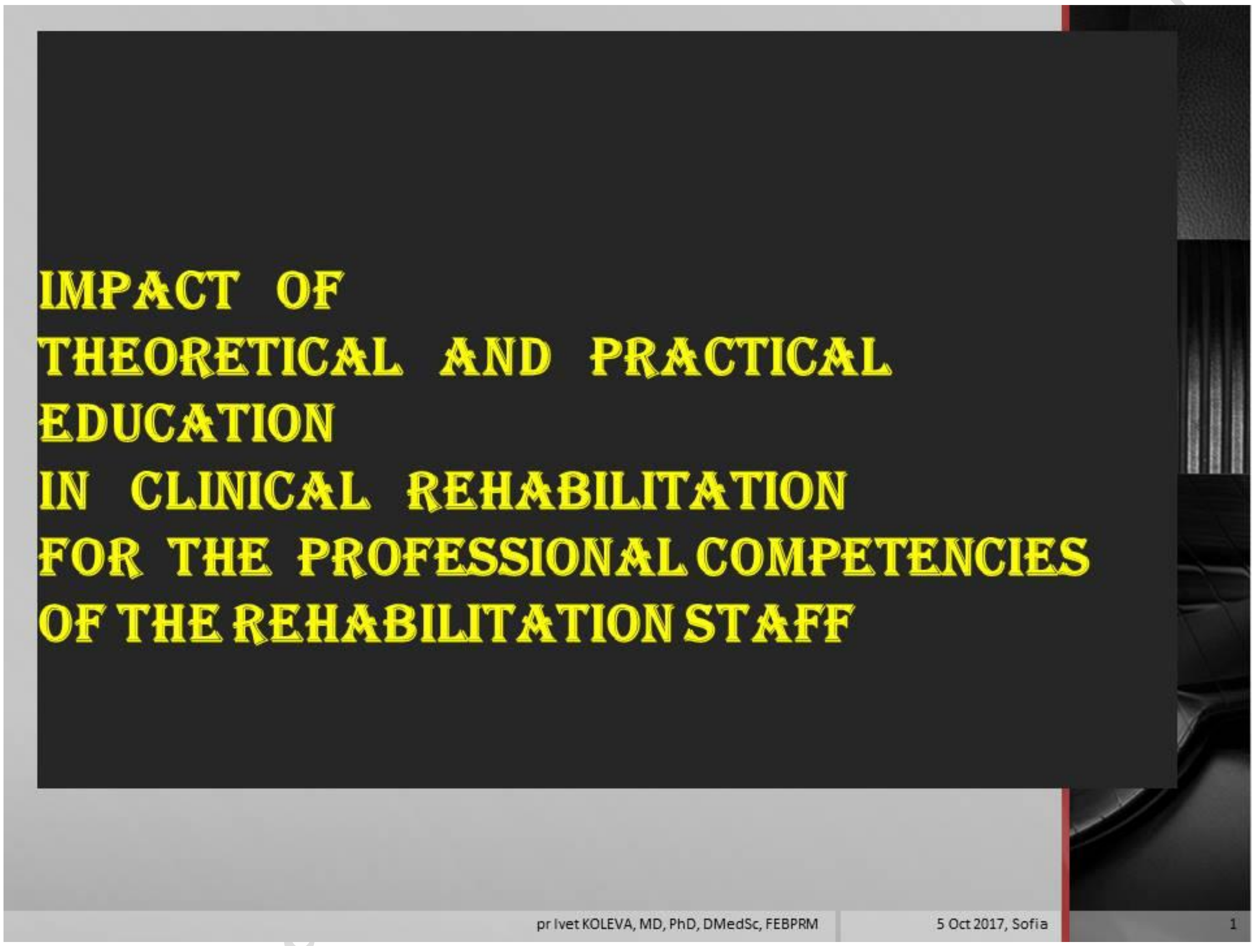
IN THE FIELD OF GRASP AND GAIT

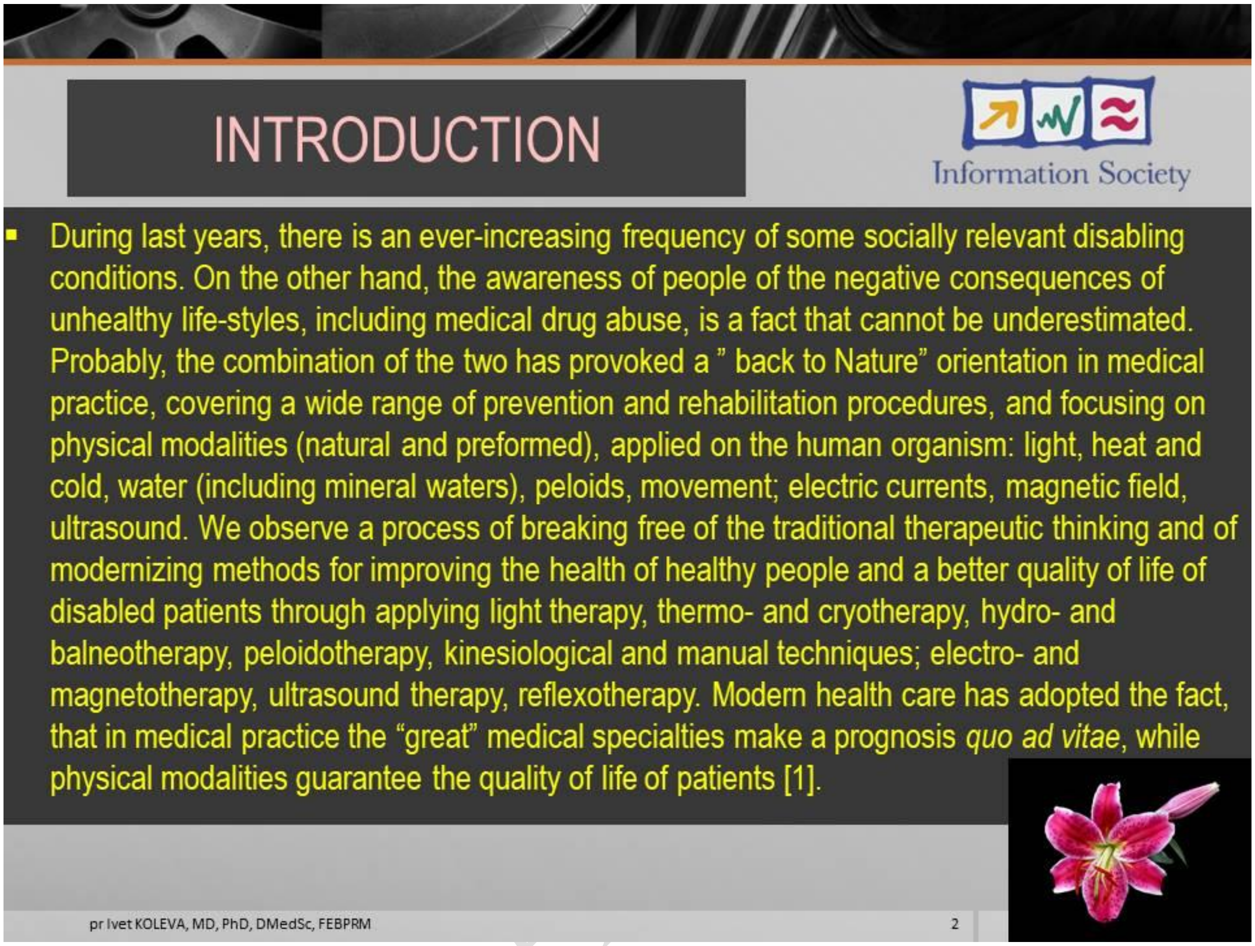
REHABILITATION

Grasp and Gait REHABILITATION

IMPACT OF THEORETICAL AND PRACTICAL EDUCATION IN CLINICAL REHABILITATION FOR THE PROFESSIONAL COMPETENCIES OF THE REHABILITATION STAFF

Radoslav Yoshinov, Ivet Koleva




INTRODUCTION
Information Society
During last years, there is an ever-increasing frequency of some socially relevant disabling conditions. On the other hand, the awareness of people of the negative consequences of unhealthy life-styles, including medical drug abuse, is a fact that cannot be underestimated. Probably, the combination of the two has provoked a " back to Nature" orientation in medical practice, covering a wide range of prevention and rehabilitation procedures, and focusing on physical modalities (natural and preformed), applied on the human organism: light, heat and cold, water (including mineral waters), peloids, movement; electric currents, magnetic field, ultrasound. We observe a process of breaking free of the traditional therapeutic thinking and of modernizing methods for improving the health of healthy people and a better quality of life of disabled patients through applying light therapy, thermo- and cryotherapy, hydro- and balneotherapy, peloidotherapy, kinesiological and manual techniques; electro- and magnetotherapy, ultrasound therapy, reflexotherapy. Modern health care has adopted the fact, that in medical practice the "great" medical specialties make a prognosis *quo ad vitae*, while physical modalities guarantee the quality of life of patients [1].
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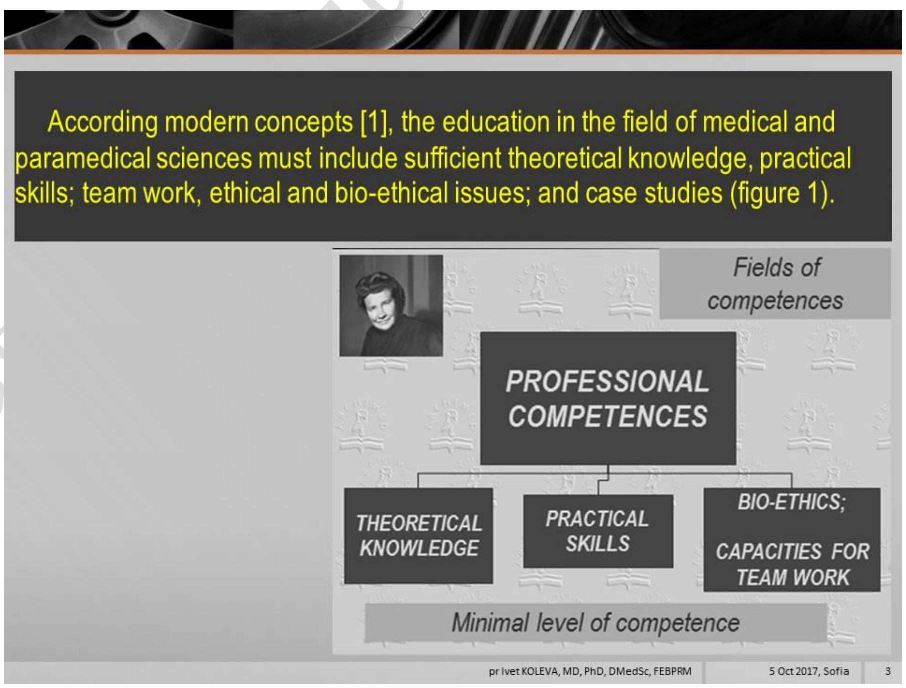
According modern concepts [1], the education in the field of medical and paramedical sciences must include sufficient theoretical knowledge, practical skills; team work, ethical and bio-ethical issues; and case studies (figure 1).
Fields of competences
PROFESSIONAL COMPETENCES
THEORETICAL KNOWLEDGE
PRACTICAL SKILLS
BIO-ETHICS;
CAPACITIES FOR TEAM WORK
Minimal level of competence
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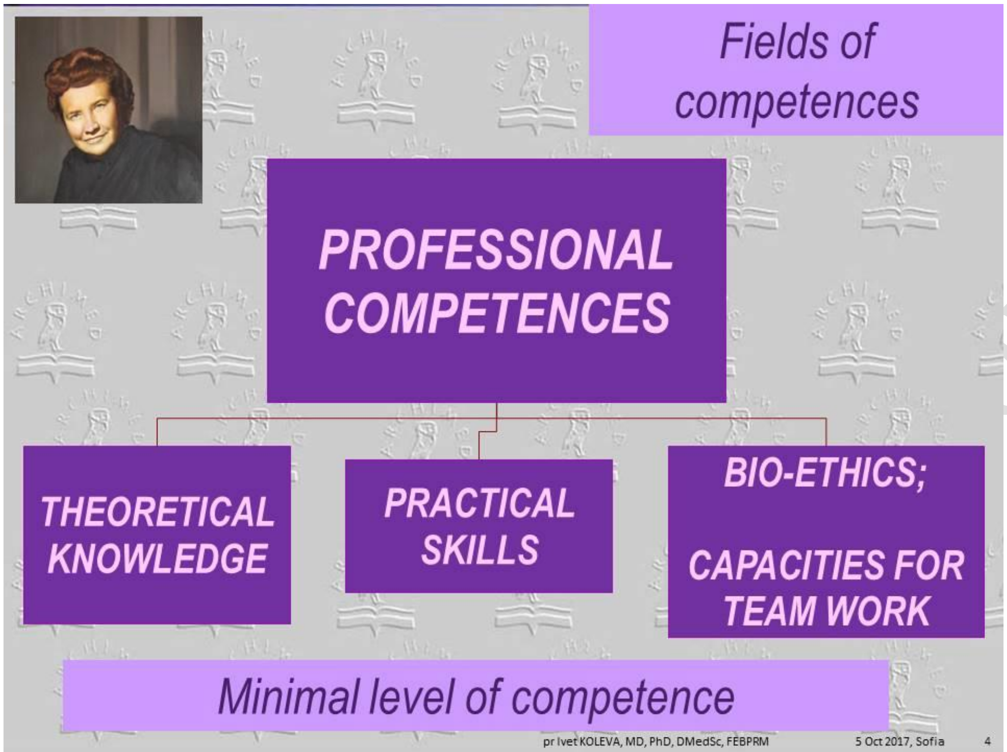
Fields of competences
PROFESSIONAL COMPETENCES
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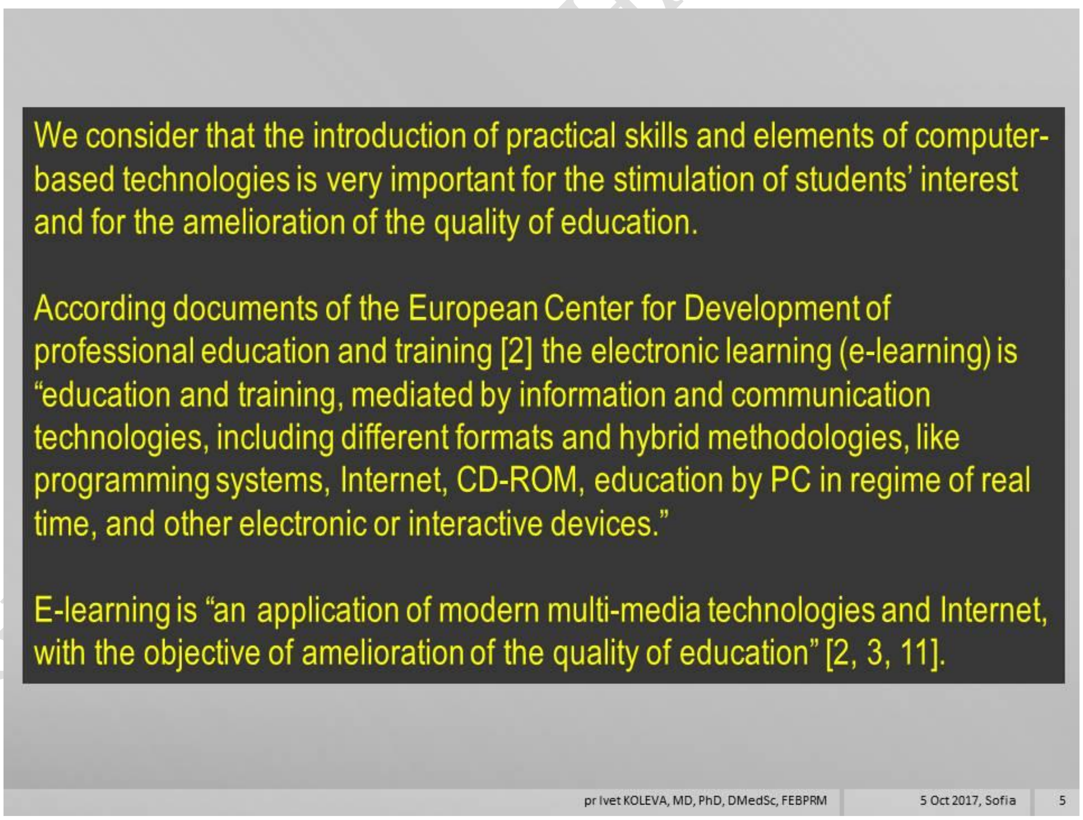
We consider that the introduction of practical skills and elements of computer-based technologies is very important for the stimulation of students' interest and for the amelioration of the quality of education.
According documents of the European Center for Development of professional education and training [2] the electronic learning (e-learning) is "education and training, mediated by information and communication technologies, including different formats and hybrid methodologies, like programming systems, Internet, CD-ROM, education by PC in regime of real time, and other electronic or interactive devices."
E-learning is "an application of modern multi-media technologies and Internet, with the objective of amelioration of the quality of education" [2, 3, 11].
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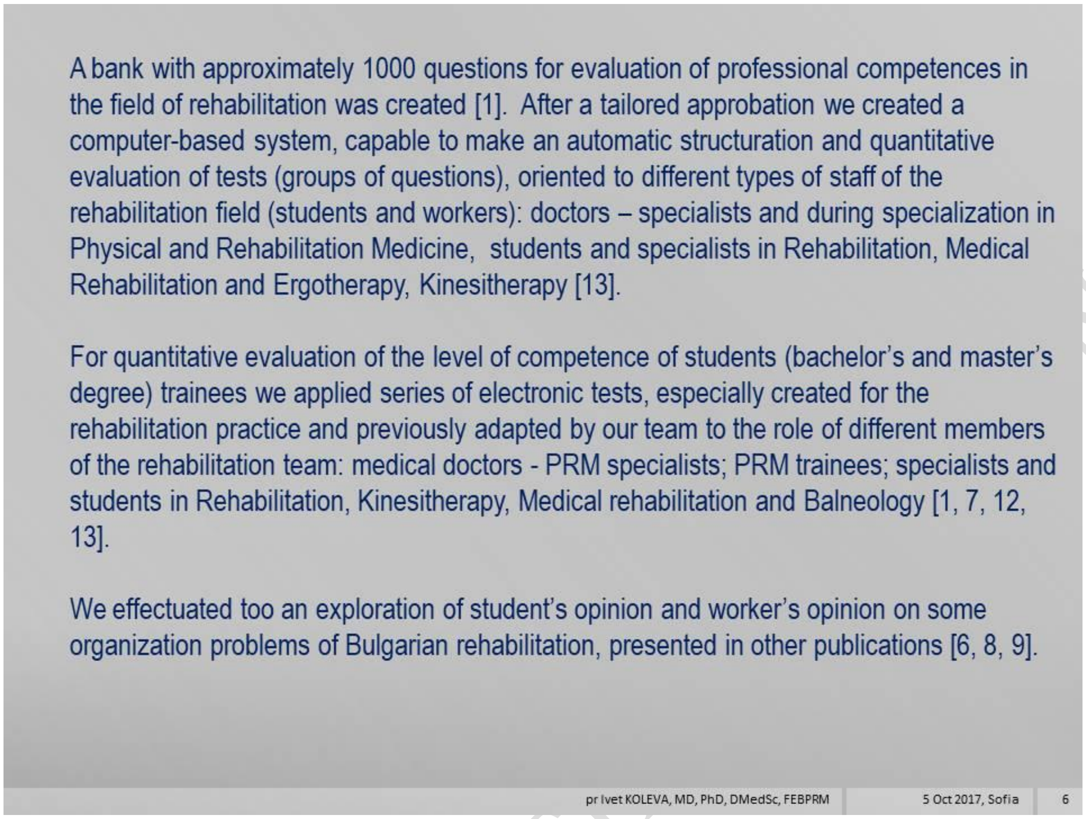
A bank with approximately 1000 questions for evaluation of professional competences in the field of rehabilitation was created [1]. After a tailored approbation we created a computer-based system, capable to make an automatic structuration and quantitative evaluation of tests (groups of questions), oriented to different types of staff of the rehabilitation field (students and workers): doctors – specialists and during specialization in Physical and Rehabilitation Medicine, students and specialists in Rehabilitation, Medical Rehabilitation and Ergotherapy, Kinesitherapy [13].
For quantitative evaluation of the level of competence of students (bachelor's and master's degree) trainees we applied series of electronic tests, especially created for the rehabilitation practice and previously adapted by our team to the role of different members of the rehabilitation team: medical doctors - PRM specialists; PRM trainees; specialists and students in Rehabilitation, Kinesitherapy, Medical rehabilitation and Balneology [1, 7, 12, 13].
We effectuated too an exploration of student's opinion and worker's opinion on some organization problems of Bulgarian rehabilitation, presented in other publications [6, 8, 9].
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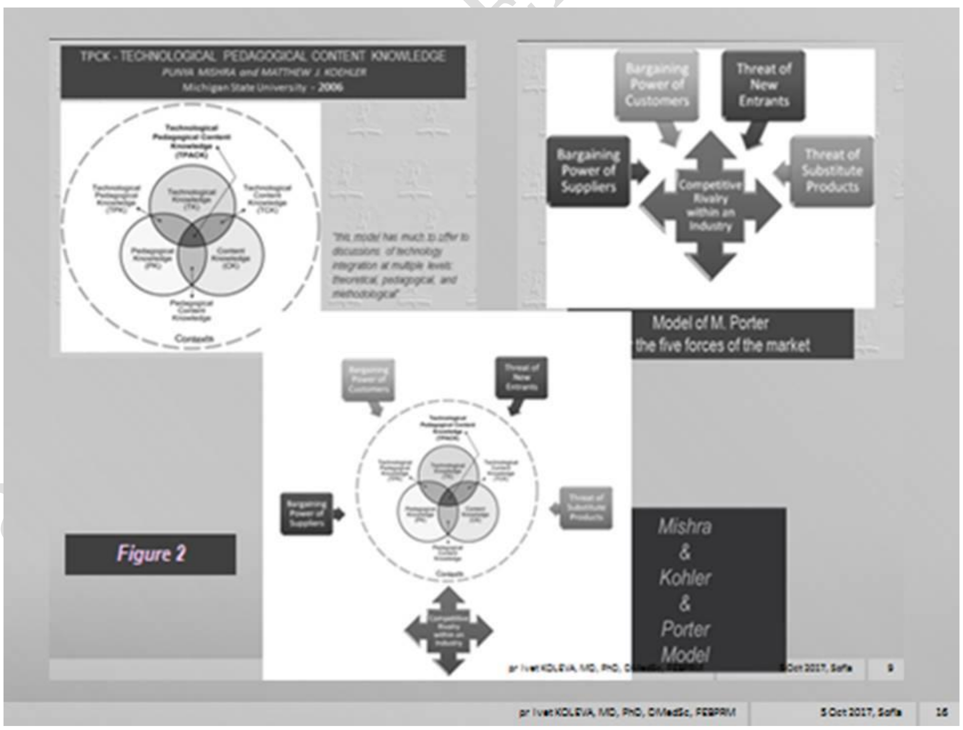
TPCK - TECHNOLOGICAL PEDAGOGICAL CONTENT KNOWLEDGE
PUNYA MISHRA and MATTHEW J. KOEHLER
Michigan State University - 2006
Contexts
"this model has much to offer to discussions of technology integration at multiple levels: theoretical, pedagogical, and methodological"
Bargaining Power of Customers
Threat of New Entrants
Bargaining Power of Suppliers
Competitive Rivalry within an Industry
Threat of Substitute Products
Model of M. Porter
the five forces of the market
Figure 2
Mishra
&
Kohler
&
Porter
Model
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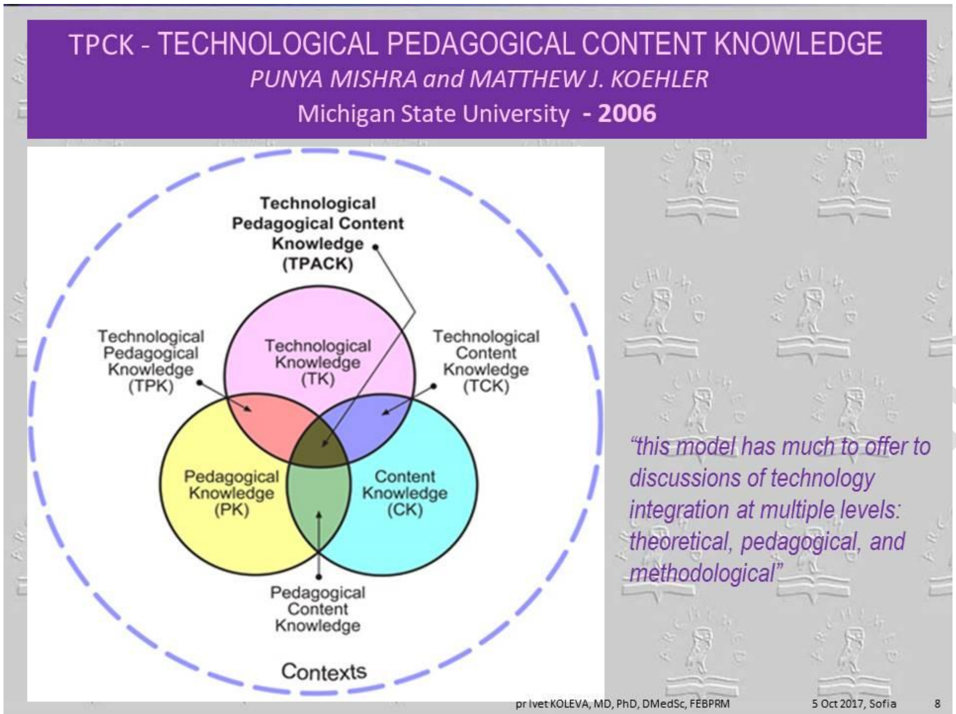
TPCK - TECHNOLOGICAL PEDAGOGICAL CONTENT KNOWLEDGE
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Michigan State University - 2006
Technological Pedagogical Content Knowledge (TPACK)
Technological Pedagogical Knowledge (TPK)
Technological Knowledge (TK)
Technological Content Knowledge (TCK)
Pedagogical Knowledge (PK)
Content Knowledge (CK)
Pedagogical Content Knowledge
Contexts
"this model has much to offer to discussions of technology integration at multiple levels: theoretical, pedagogical, and methodological"
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Bargaining Power of Customers
Threat of New Entrants
Bargaining Power of Suppliers
Competitive Rivalry within an Industry
Threat of Substitute Products
Model of M. Porter
For the five forces of the market
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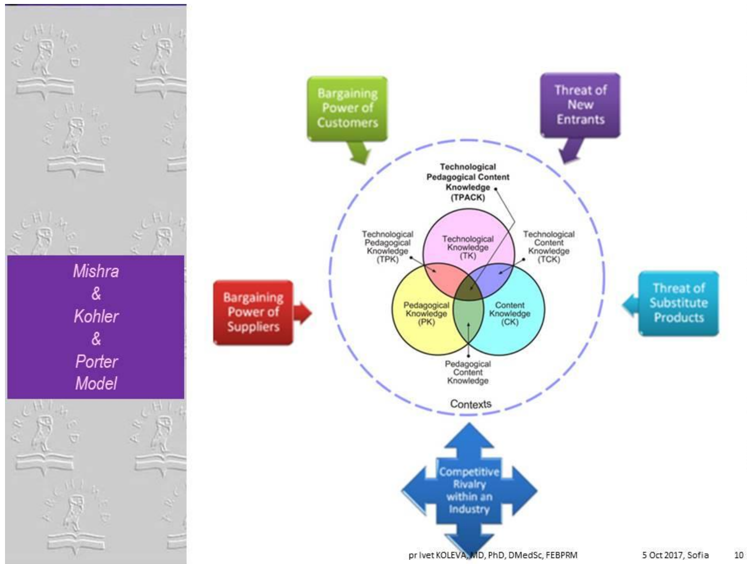

RESULTS AND ANALYSIS

Here we present the results of the evaluation (tests and solution of clinical cases) of students in Kinesitherapy (bachelor's degree) and in Medical Rehabilitation and Balneology (master's degree) of the Faculty of Public Health at the Medical University of Sofia (period Sep 2015 – Sept 2017). The comparison of theoretical knowledge, practical skills and professional competences in the fields of Physiotherapy, Kinesitherapy, Massage, Ergotherapy (Occupational Therapy), and Neurorehabilitation is demonstrated in figures 3, 4, 5.

A net amelioration is observed after the introduction of practical modules and presentation of clinical cases in the fields of Neurorehabilitation, Gasp and Gait rehabilitation, Physical analgesia (last phase).

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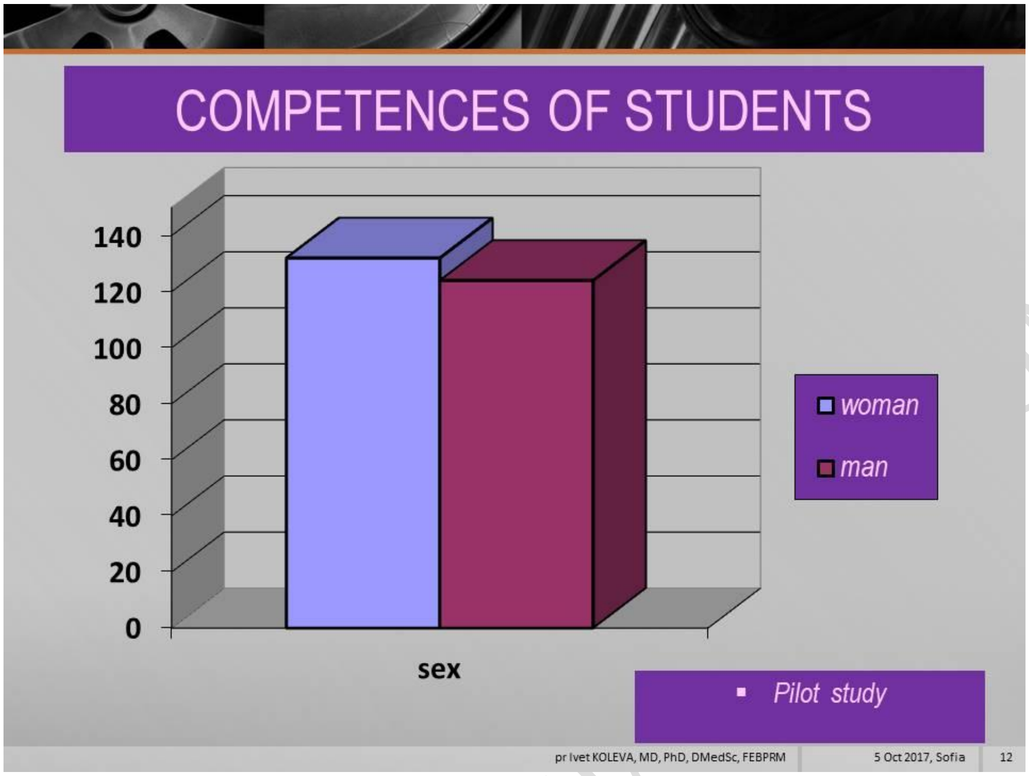

COMPETENCES OF STUDENTS
140
120
100
80
60
40
20
0
sex
woman
man
Pilot study
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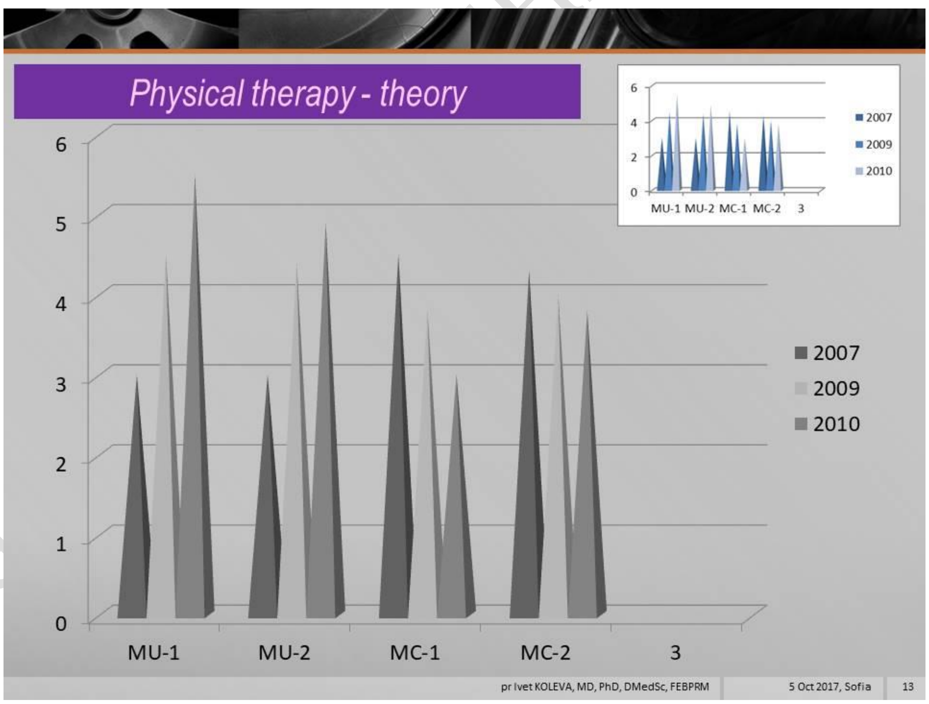

Physical therapy - theory
6
5
4
3
2
1
0
MU-1
MU-2
MC-1
MC-2
3
2007
2009
2010
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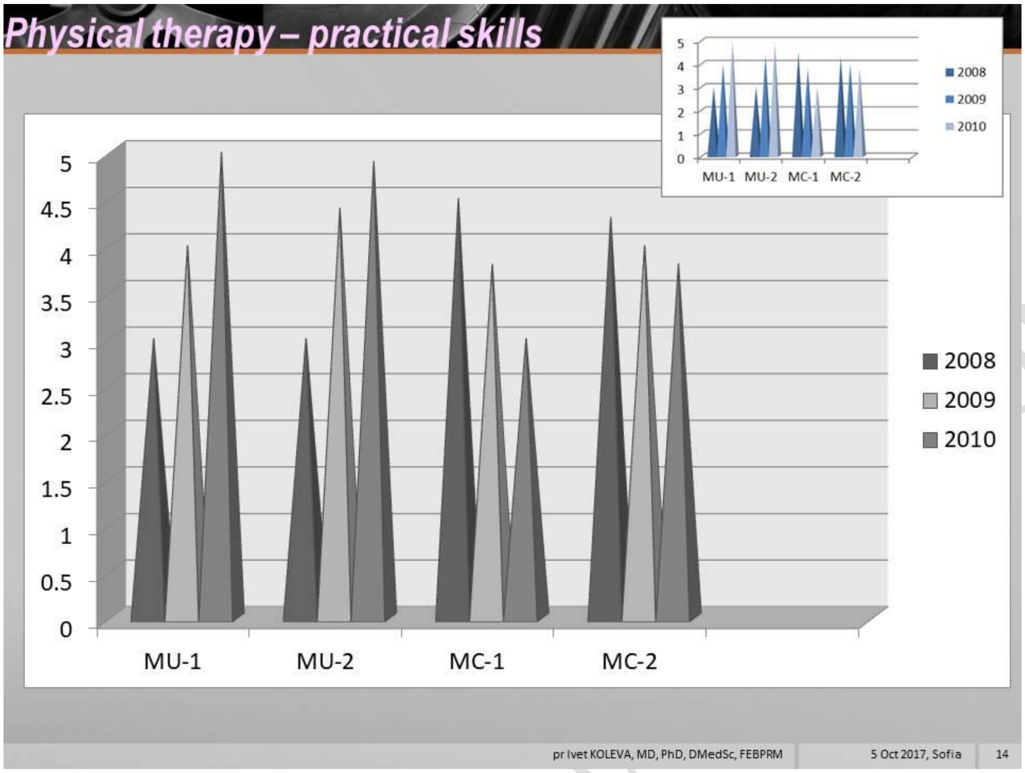
Physical therapy – practical skills
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
MU-1
MU-2
MC-1
MC-2
2008
2009
2010
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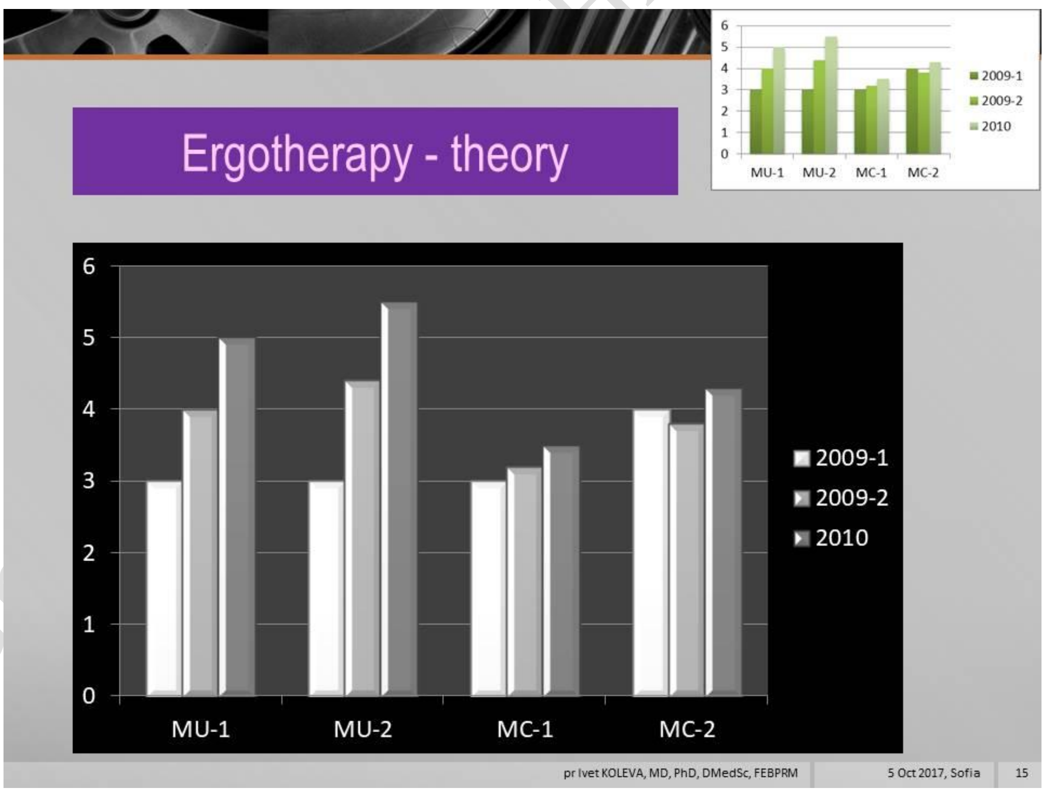
Ergotherapy - theory
6
5
4
3
2
1
0
MU-1
MU-2
MC-1
MC-2
2009-1
2009-2
2010
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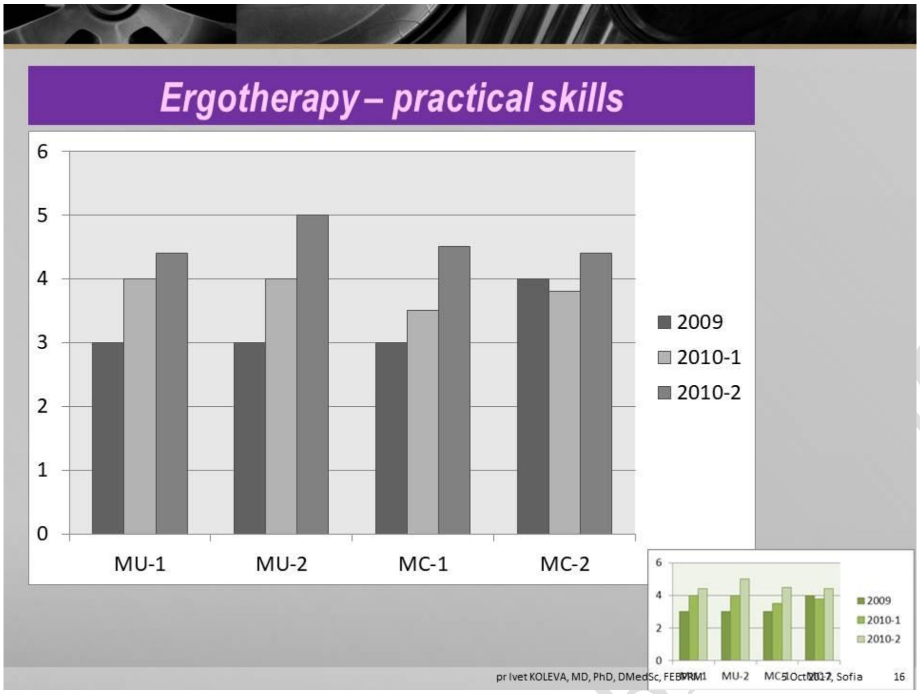
Ergotherapy – practical skills
6
5
4
3
2
1
0
MU-1
MU-2
MC-1
MC-2
2009
2010-1
2010-2
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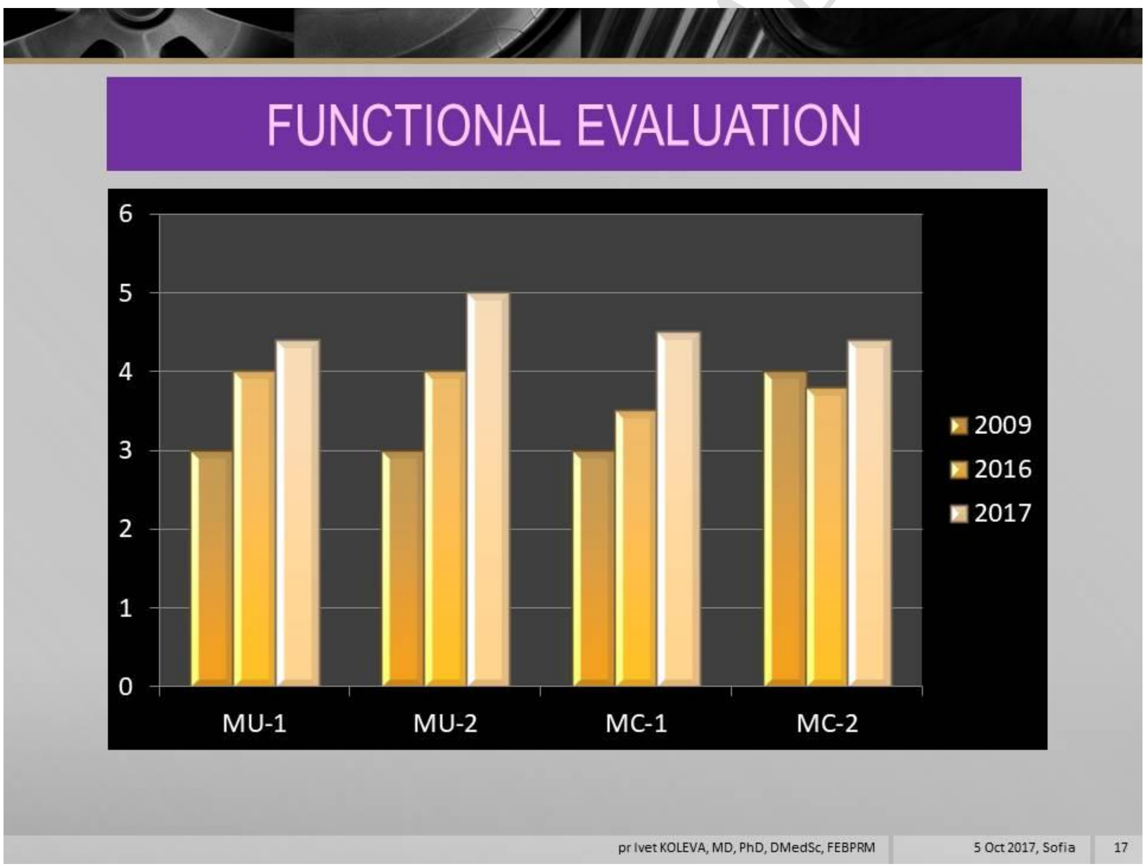
FUNCTIONAL EVALUATION
6
5
4
3
2
1
0
MU-1
MU-2
MC-1
MC-2
2009
2016
2017
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Figure 3
Physical therapy - theory
Physical therapy – practical skills
Ergotherapy - theory
Ergotherapy – practical skills
FUNCTIONAL EVALUATION
MU-1
MU-2
MC-1
MC-2
2009
2016
2017
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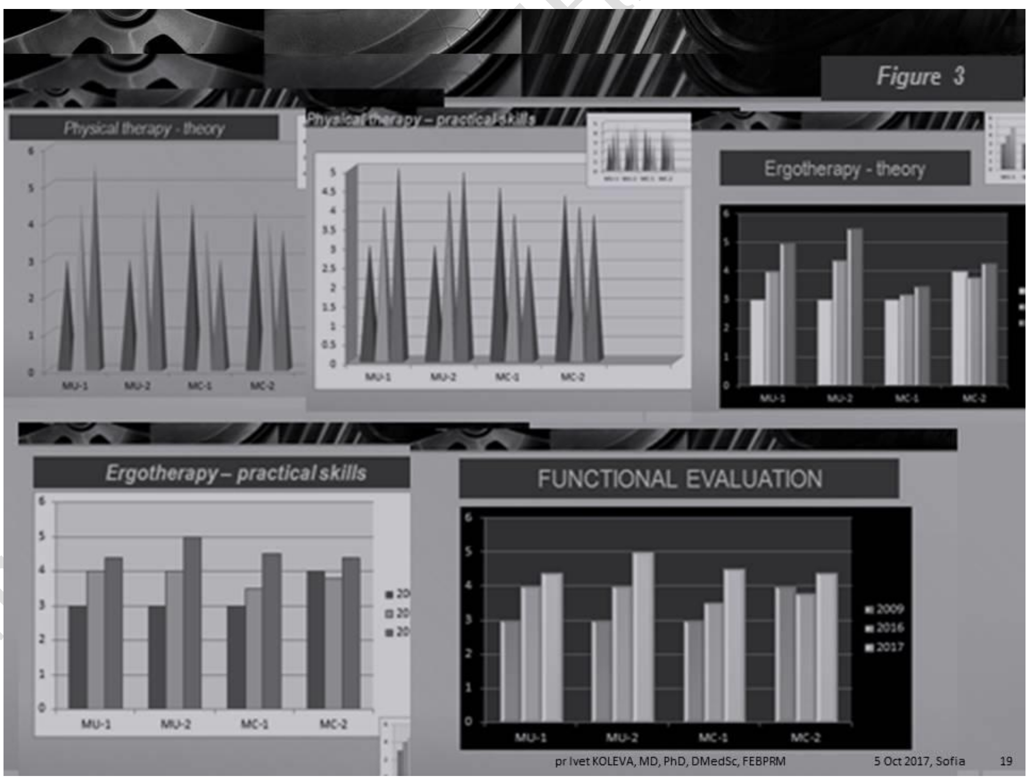
Figure 3
Physical therapy - theory
Physical therapy – practical skills
Ergotherapy - theory
Ergotherapy – practical skills
FUNCTIONAL EVALUATION
MU-1
MU-2
MC-1
MC-2
2009
2016
2017
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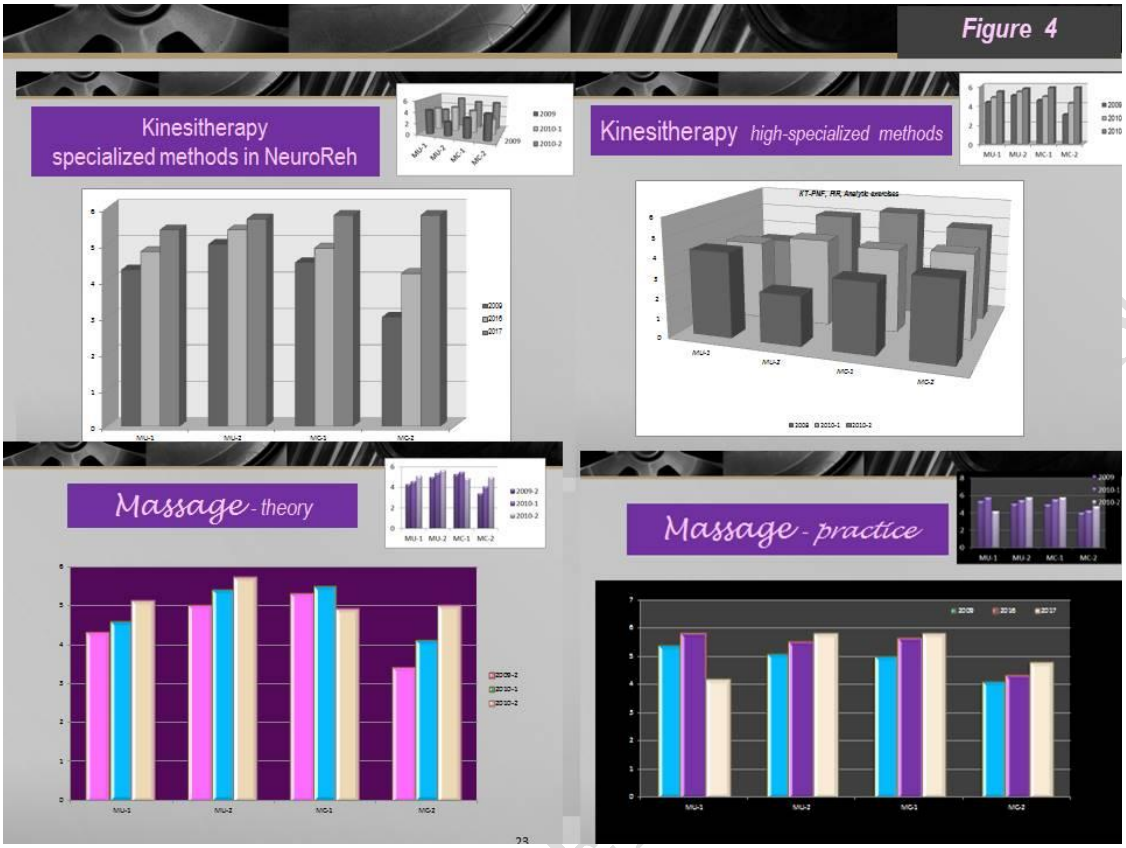
Figure 4
Kinesitherapy
specialized methods in NeuroReh
Kinesitherapy high-specialized methods
KT-PNF, RR, Analytic exercises
Massage - theory
Massage - practice
MU-1
MU-2
MC-1
MC-2

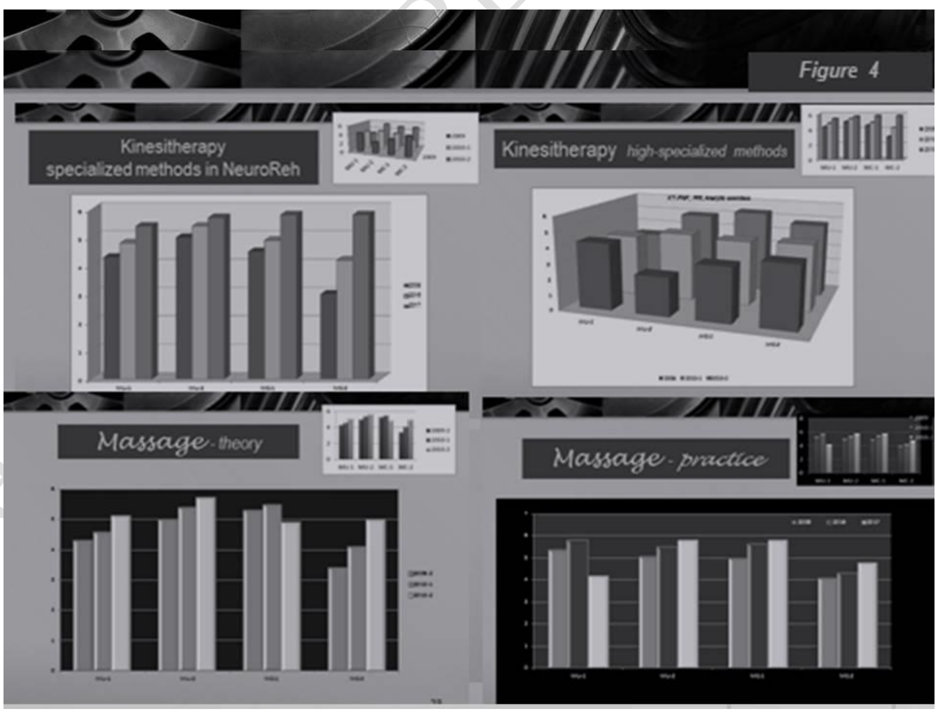
Figure 4
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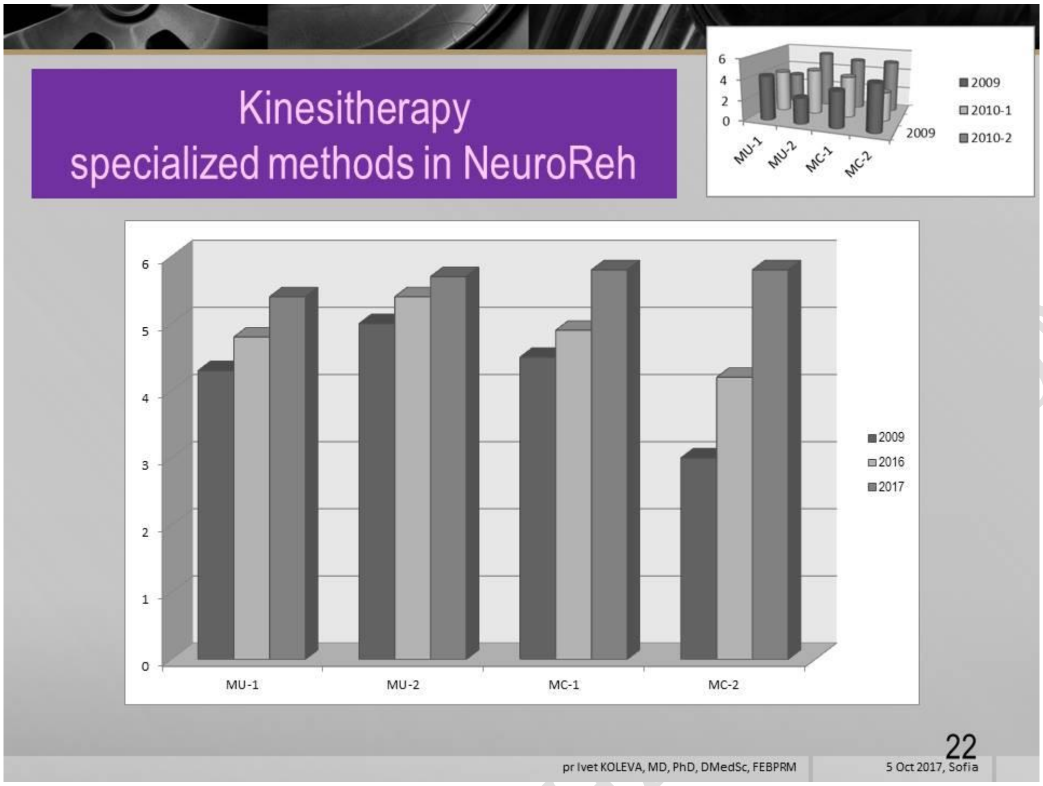
specialized methods in NeuroReh
Kinesitherapy high-specialized methods
Massage - theory
Massage - practice


Kinesitherapy
specialized methods in NeuroReh
2009
2010-1
2010-2
MU-1
MU-2
MC-1
MC-2
2009
2016
2017
22
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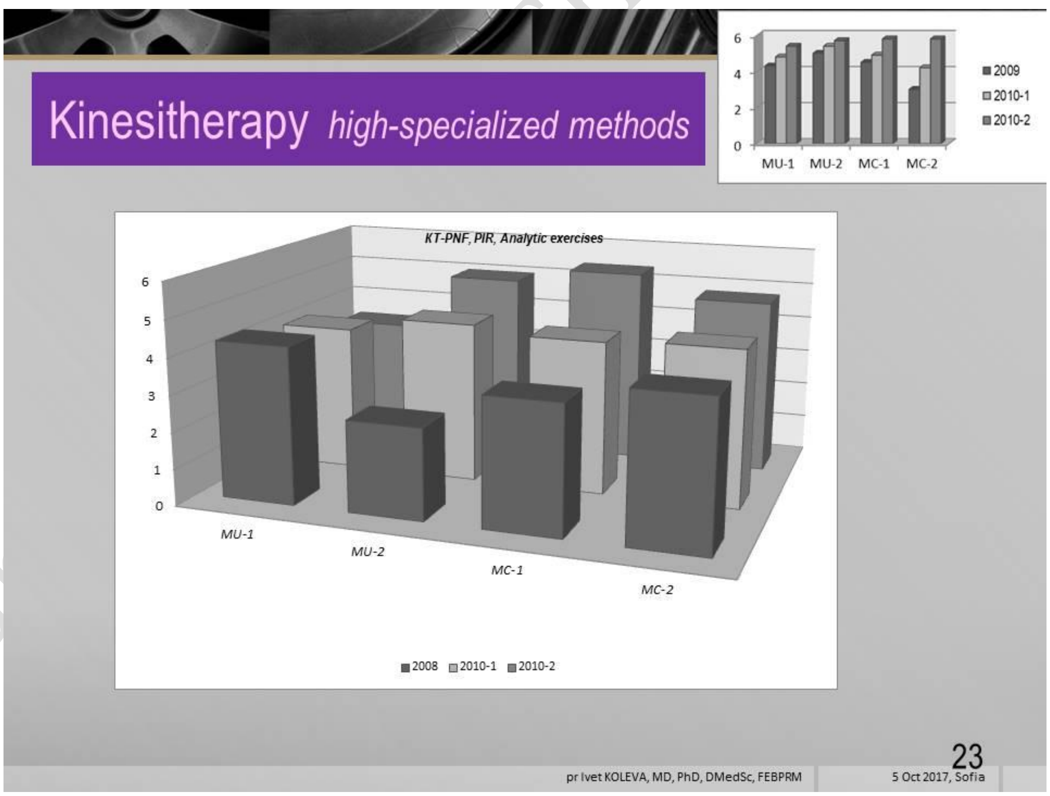
Kinesitherapy high-specialized methods
2009
2010-1
2010-2
MU-1
MU-2
MC-1
MC-2
KT-PNF, PIR, Analytic exercises
2008
2010-1
2010-2
23
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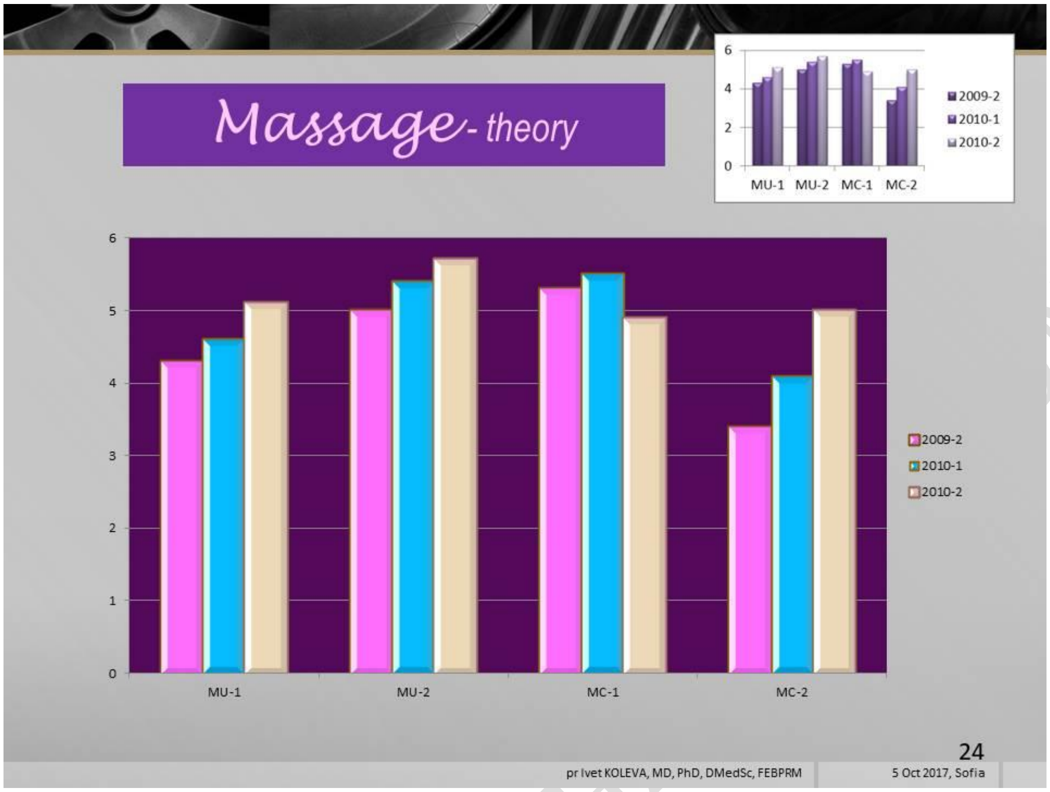
Massage- theory
2009-2
2010-1
2010-2
MU-1
MU-2
MC-1
MC-2
24
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Massage - practice
2009
2010-1
2010-2
2016
2017
MU-1
MU-2
MC-1
MC-2
25
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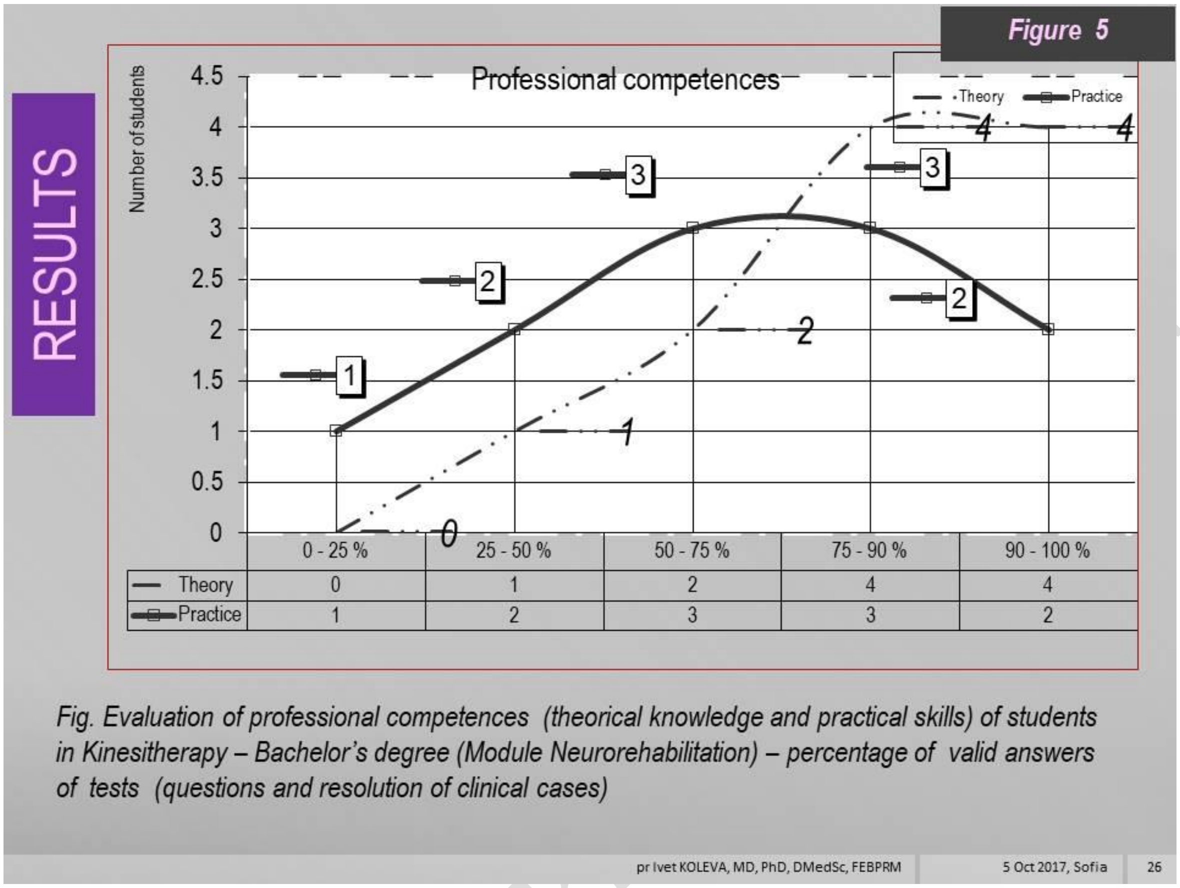
Figure 5
RESULTS
Professional competences
Number of students
Theory
Practice
0 - 25 %
25 - 50 %
50 - 75 %
75 - 90 %
90 - 100 %
Theory 0 1 2 4 4
Practice 1 2 3 3 2
Fig. Evaluation of professional competences (theorical knowledge and practical skills) of students in Kinesitherapy – Bachelor's degree (Module Neurorehabilitation) – percentage of valid answers of tests (questions and resolution of clinical cases)
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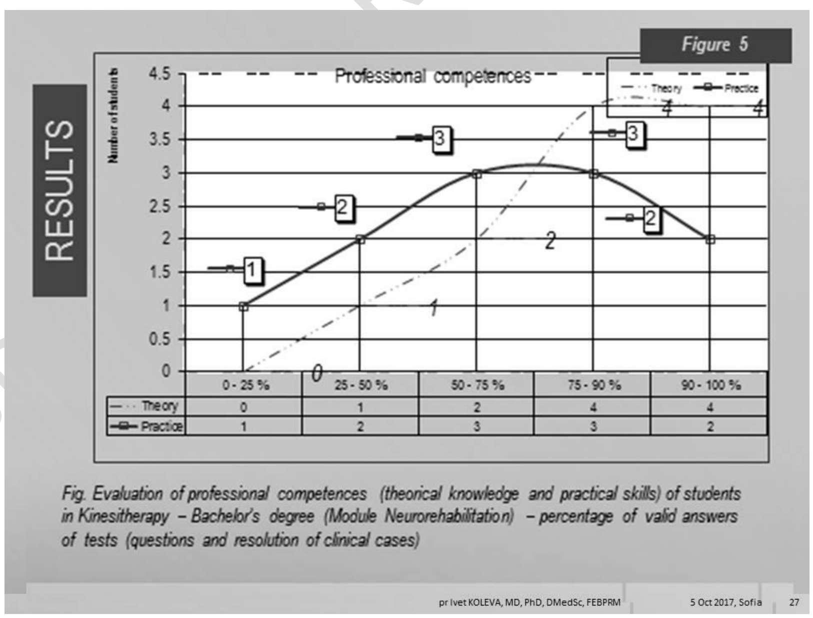
Figure 5
RESULTS
Professional competences
Number of students
Theory
Practice
0 - 25 %
25 - 50 %
50 - 75 %
75 - 90 %
90 - 100 %
Theory 0 1 2 4 4
Practice 1 2 3 3 2
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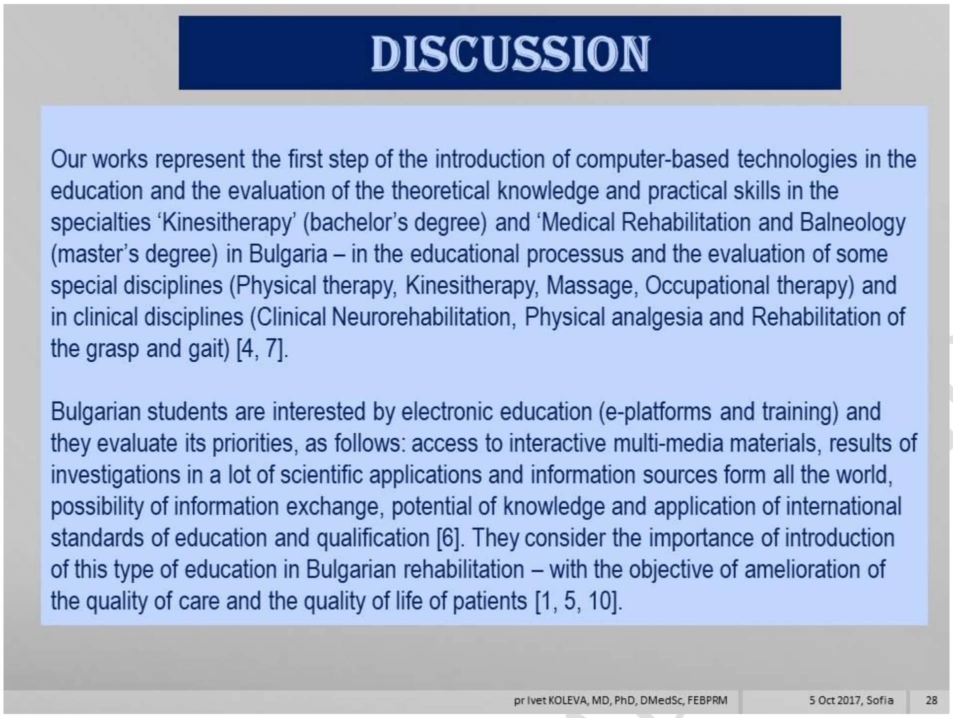
DISCUSSION
Our works represent the first step of the introduction of computer-based technologies in the education and the evaluation of the theoretical knowledge and practical skills in the specialties 'Kinesitherapy' (bachelor's degree) and 'Medical Rehabilitation and Balneology (master's degree) in Bulgaria – in the educational processus and the evaluation of some special disciplines (Physical therapy, Kinesitherapy, Massage, Occupational therapy) and in clinical disciplines (Clinical Neurorehabilitation, Physical analgesia and Rehabilitation of the grasp and gait) [4, 7].
Bulgarian students are interested by electronic education (e-platforms and training) and they evaluate its priorities, as follows: access to interactive multi-media materials, results of investigations in a lot of scientific applications and information sources form all the world, possibility of information exchange, potential of knowledge and application of international standards of education and qualification [6]. They consider the importance of introduction of this type of education in Bulgarian rehabilitation – with the objective of amelioration of the quality of care and the quality of life of patients [1, 5, 10].
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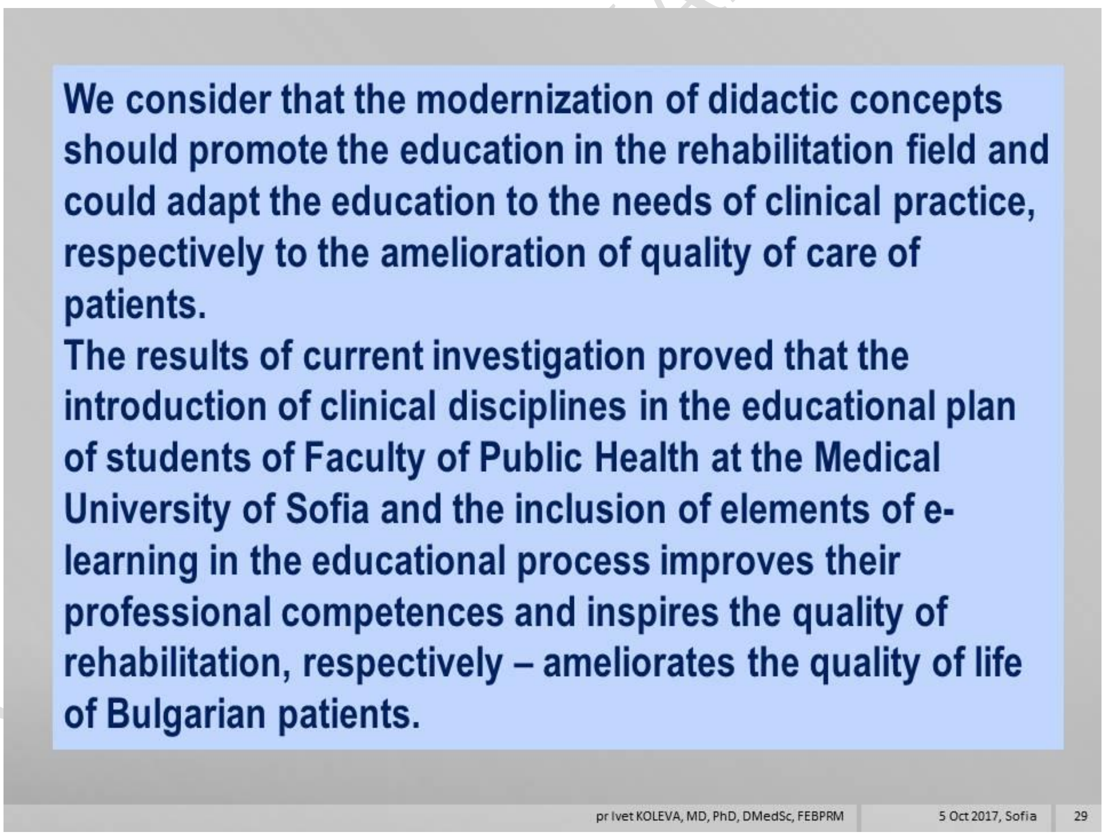
We consider that the modernization of didactic concepts should promote the education in the rehabilitation field and could adapt the education to the needs of clinical practice, respectively to the amelioration of quality of care of patients.
The results of current investigation proved that the introduction of clinical disciplines in the educational plan of students of Faculty of Public Health at the Medical University of Sofia and the inclusion of elements of e-learning in the educational process improves their professional competences and inspires the quality of rehabilitation, respectively – ameliorates the quality of life of Bulgarian patients.
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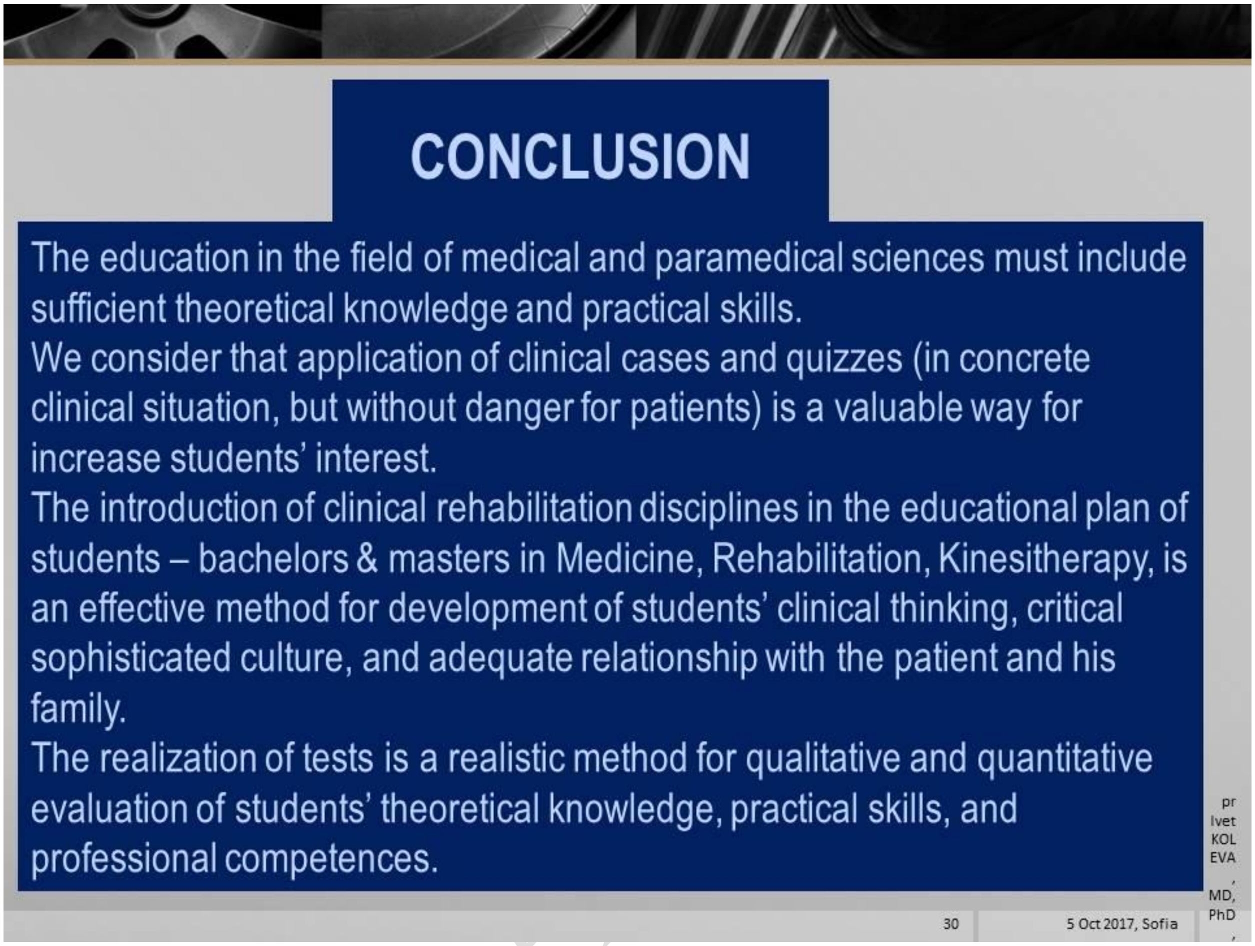
CONCLUSION
The education in the field of medical and paramedical sciences must include sufficient theoretical knowledge and practical skills.
We consider that application of clinical cases and quizzes (in concrete clinical situation, but without danger for patients) is a valuable way for increase students' interest.
The introduction of clinical rehabilitation disciplines in the educational plan of students – bachelors & masters in Medicine, Rehabilitation, Kinesitherapy, is an effective method for development of students' clinical thinking, critical sophisticated culture, and adequate relationship with the patient and his family.
The realization of tests is a realistic method for qualitative and quantitative evaluation of students' theoretical knowledge, practical skills, and professional competences.
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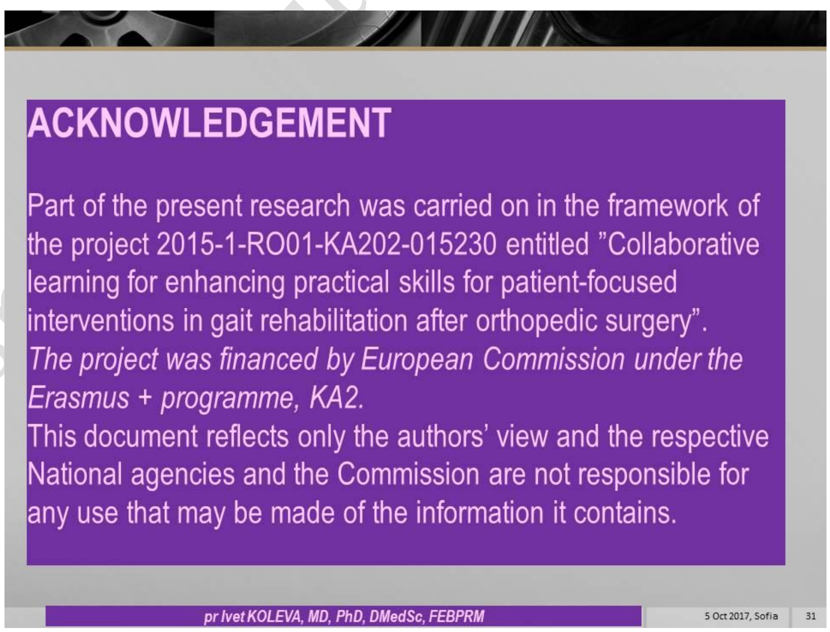
ACKNOWLEDGEMENT
Part of the present research was carried on in the framework of the project 2015-1-RO01-KA202-015230 entitled "Collaborative learning for enhancing practical skills for patient-focused interventions in gait rehabilitation after orthopedic surgery".
The project was financed by European Commission under the Erasmus + programme, KA2.
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HIGHLIGHTED NEEDS IN MEDICAL VOCATIONAL EDUCATION & TRAINING FOR ORTHOPEDIC AND REHABILITATION PROFESSIONALS

BULGARIAN NATIONAL REPORT

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Abstract

The report aims to develop common references for vocational and educational training (VET) in the field of gate rehabilitation: Medical doctors – specialists in Orthopedics and traumatology (OT) and in Physical & Rehabilitation Medicine (PRM), and specialists in Physiotherapy (Kinesitherapy – KT), Medical Rehabilitation & Ergotherapy (MRET), Medical Rehabilitation & Balneology (MRB), and Rehabilitation.

The Document introduces a brief picture of learning needs in the target groups of concerned staff and e-learning training approaches, by a national research, study and analyses on labour market demands, based on surveys and questionnaires addressed to the target group and potential users.

A further analysis of training expectations and lacks is available as well.

1. PURPOSE OF THE REPORT

Increasing the quality of vocational skills requires the development of world-class VET systems. Increasing transversal and basic skills alone will not be sufficient to generate growth and competitiveness, and there is still too much distance between the educational environment and the workplace. VET must be able to react to the demand for advanced vocational skills, tailored to the regional economic context. It also needs to be an open door for those who want to access higher education,as well as individuals who need to update skills

The need for harmonisation development of an unitary system in medical education across Europe with common standard procedures is a well known fact. All EU medical graduates should have equal chances to practice all over EU. Our project focuses on the project partners' identification of common needs that EU educational and training systems are facing and that can be met only by a common effort.

The present report represents a national research on labour market demands for Bulgaria, aiming to reflect needs' identification for our target groups on the use of the orthopedic and rehabilitation procedures at work place, based on surveys and questionnaires.

In order to attain this goal, analysis of learners' actual knowledge and of knowledge needs for identifying the current performances and gaps was carried on, as well as analysis of the VET in orthopedics and rehabilitation, correlated with the use of orthopedic and rehabilitation procedures in practice. The last part of the report tries to identify the ways for introducing orthopedic surgical procedures and rehabilitation protocols after surgery into the work environment.

The aim of this report has a special value as needs analysis is essential for the development of the COR-skills project; the project is designed to provide solutions to clearly identified needs of the target groups and this is the reason we have dedicated a a report for needs assesment. Even if the project includes an ex-ante analysis of the needs on EU

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context, this was based on EU literature, reports and researchers for medical education in general and previous needs assesement in ORTHO e-man. Needs assesment of the target group will now foccus on specific issues (orthopedics, rehabilitation, gait assessment) and must be carried on in order to integrate further outcomes of COR-skills project into national and/or sectoral training systems.

In this way the present research aims to:

1. Analyze the vocational training needs in orthopaedics and rehabilitation and state of art of medical e-learning in Bulgaria;
2. Define the needs of the target groups
3. Identify the current interest level to e-learning of the target groups;
4. Describe the reference levels, certification principles and VET methods and programmes in the field of medical specialties Orthopedics & Traumatology (OT), and Physical and Rehabilitation Medicine (PRM); and Physiotherapy (Rehabilitation & Kinesitherapy) in Bulgaria.

Identification of initial requirements must be followed by their validation against the project objectives, identification of best solutions how this will be achieved and identification of best resources and tools in order to create an interdisciplinary on-line collaborative platform with specific learning tools and content, supporting participants in acquisition of skills in the field of orthopedics and rehabilitation directly linked to their needs, expectatives and labour market requirements.

2. TARGET GROUP

2.1. Forseen target groups and indicators

According to project work plan and indicators, Bulgarian **direct target group** (primary target group) includes organizations and individuals that will be direct users of the project results. For Bulgaria ***we forsee about 50 trainees*** *for both training modules represented by: medical doctors in OT and PRM, and physiotherapists.* The medical professionals can be on different levels of training and different working places (specialists, residents).

In terms of organisations the target includes:

- Vocational training organizations and other training providers
- Universities, colleges and other providers of medical education
- Public and private health institutions
- Professional associations (ENT-PROFS)

2.2. Indirect Target Group

The indirect Target Group (secondary target group) includes individuals and organizations related to the direct target group of the project, as follows:

- Staff in the medical educational system in participant countries, including individuals with local responsibility for educational programs at all levels of the continuum — for example, deans and their staff, department chairs, and responsibles for resident

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training programmes in orthopedics and rehabilitation from organizations with whom project partners are networking.

- ❖ Institutional officials at clinical orthopedics and rehabilitation departments, as directly interested in CME of their employees
- ❖ Accreditors, certifying and licensing bodies. Organizations that accredit educational programs/providers at continuing level of medical education
- ❖ Medical education and related associations in the field of orthopedics and rehabilitation; national organizations

This group will function as key stakeholders and will be involved in dissemination activities, evaluation of outcomes, in reaching the target group. Reaching this group will be done by the networks of each partner organisation. *For Bulgaria we estimate:*

- Min 5 institutional officials/managers

- Min 6 professionals in the medical educational system

- Min 5 members of professional organisations and accreditors

2.3. Long-term Beneficiaries

Long-term beneficiaries are certain interest groups that will benefit from the project outcomes on a long term basis like medical doctors that will benefit of the training program after the project ends, due to inclusion of courses into CME. The dissemination plan indicates scanning activities to identify broader target groups with a potential interest in the results, so they will be targeted by our dissemination as potential trainees after the end of the project.

2.4. Target group respondents

The short description of the respondents' classes, number of respondents, and other details about each category mentioned above follows.

The structure of the respondent group on category and country was as follows:

We applied questionnaires on different target groups, but we received complete questionnaires form a total of 83 respondents. Table 1 & Fig.1:

Country	Total	OT specialists	OT residents	PRM specialists	PRM trainees	Phy-ther Kine_ther[1]	Managers
Bulgaria	**83**	*19*	*3*	*23*	*6*	*22*	*10*

[1] Phy-ther is used for physical therapists

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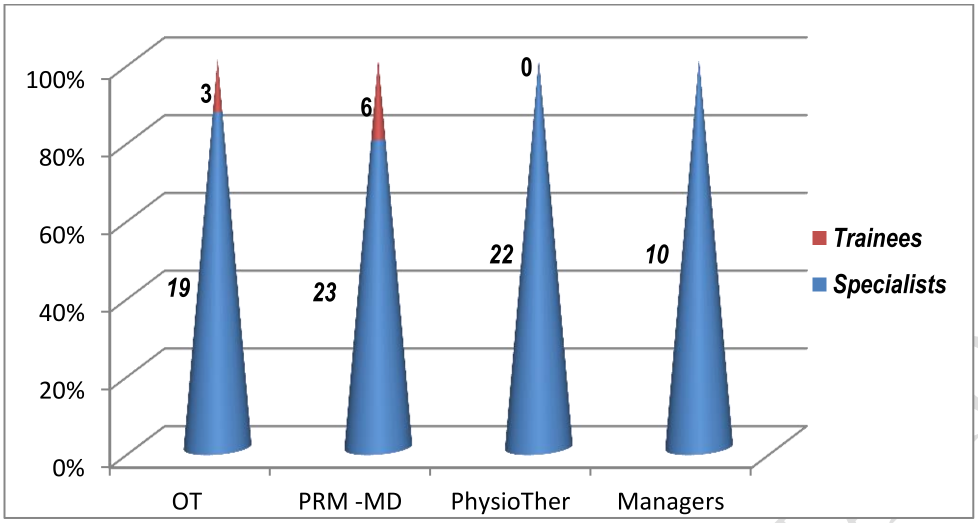
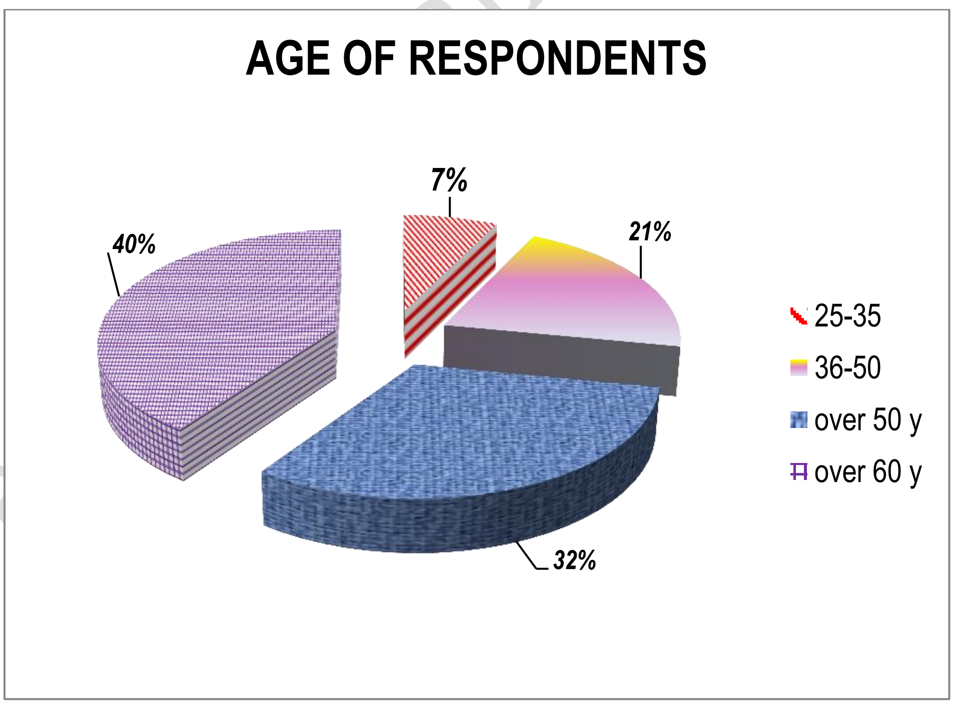


Regarding the age of respondents – Tabl.2 & Fig.2:

Country	Age 20-35	36-50	Over 50	Over 60	TOTAL
RO					
BG	6	17	26	33	83



- **The Orthopedics and Thraumatology /OT/ category** –The total number of the survey respondents in this category is 22. All the respondents are representatives of the OT Departments of the University hospitals of Sofia, Bulgaria. All specialists and residents in OTwho took part in the COR project survey are members of the Bulgarian Medical Union. The survey respondents from this target group are representatives of the following two classes (see Fig. 1):

- ***Specialists - Medical doctors specialized in Orthopedics and Thraumatology /OT/*** - 19 medical doctors;
- ***Residents*** *in OT* – 3 residents.

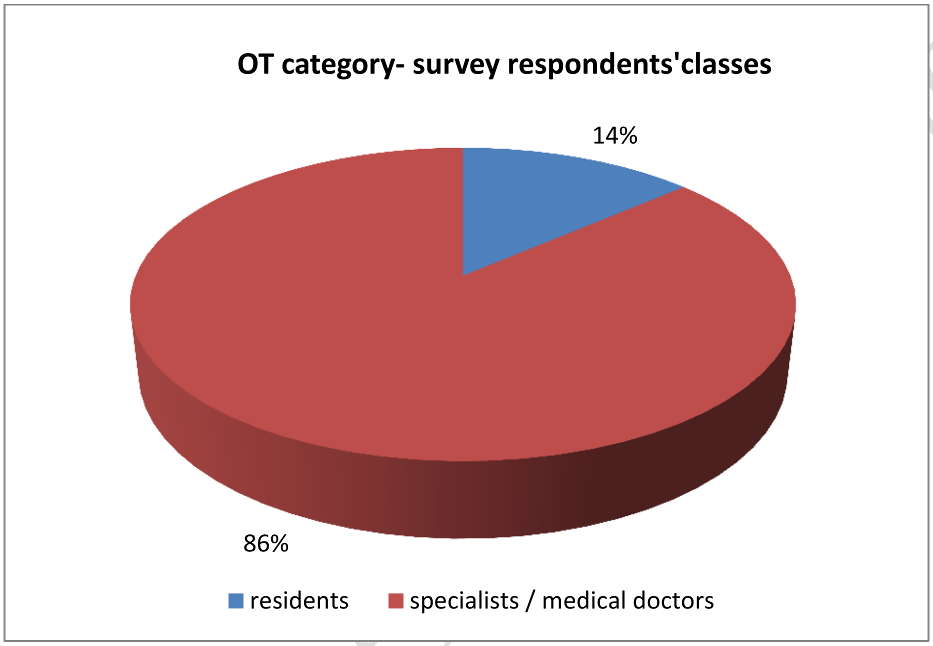


Figure 3. Orthopedics and Thraumatology category - COR survey respondents

- **The Physical & Rehabilitation Medicine /PRM/ & Rehabilitation category** - *The total number of the survey respondents from this category is 51. All the respondents are medical doctors – specialists in Physical and Rehabilitation Medicine (PRM) or PRM-residents; and physiotherapists (kinesitherapists and rehabilitators) of the Departments of Physical & Rehabilitation Medicine at the University Hospitals of Sofia and Pleven, and partcipants in CME courses of 2016 from all the country.* 29 of the people involved in this survey are members of the Bulgarian Medical Union. The rest 22 respondents are members of the Bulgarian Association of Physiotherapists. The survey respondents from this target group are representatives of the following three classes (see Fig.2):
    - *Specialists - Medical doctors specialized in PRM – 23 medical doctors;*
    - *Residents in PRM – 6 residents;*
    - *Physiotherapists – 22 physiotherapists.*

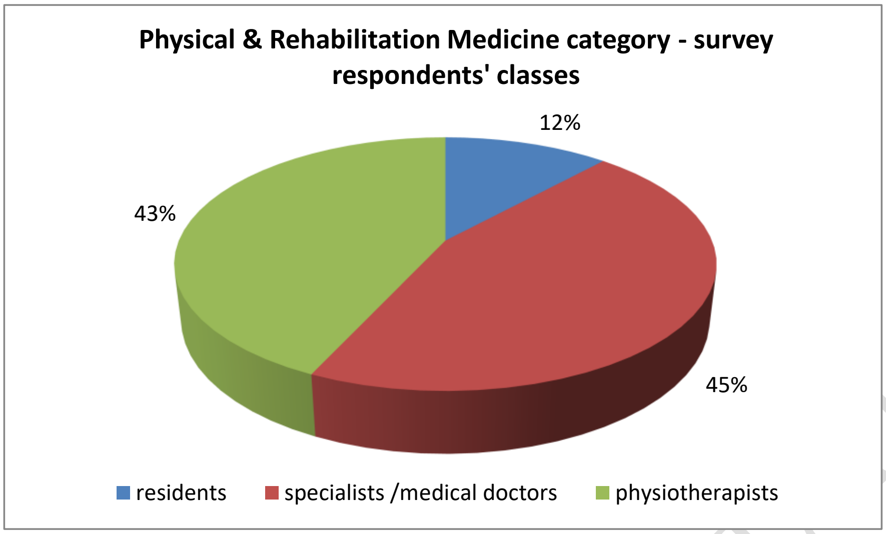


Figure 4. Physical & Rehabilitation Medicine category - COR survey respondents

- The Managers, medical educational policy makers and academic medical stuff – The total number of the survey respondents is 10 where. All the respondents are representatives of University hospitals of Sofia and Pleven. The respondents' classes are as follows:

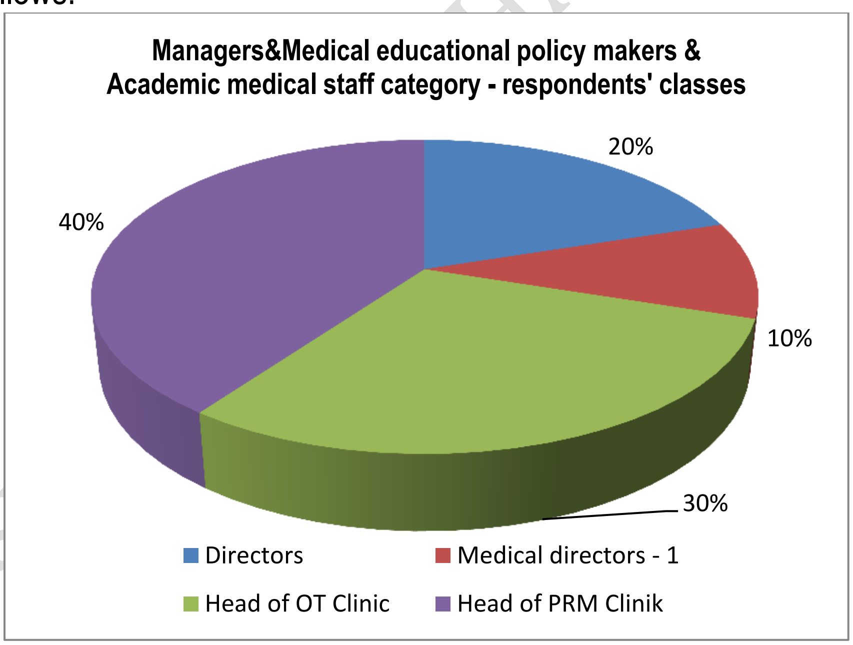


Figure 5. Managers, medical educational policy makers and academic medical stuff category – COR survey Respondents

3. EVALUATION METHODOLOGY

Bulgarian National Report has been conducted by disseminating needs assessment questionnaires in scientific meetings and analyzing the results. Documentary research was done for regulations of specialty education.

3.1. Field Work

The COR project survey was conducted on the base of the questionnaires (provided in AnnexI, II, and III of this document) developed by the project team taking into account the three main categories: Orthopedics and Thraumatology domain professionals; Physical & Rehabilitation Medicine professionals, and Managers&Medical educational policy makers &Academic medical stuff - staff in the medical educational system in participant countries, including individuals with local responsibility for educational programs at all levels of the continuum. The three types of questionnaires were developed in English and then translated on the national languages of the respondents. The aim of these questionnaires was to evaluate the perceived level of IT ability and accessibility, the experiences and attitudes of the target groups towards e-learning and clinical skills training.

The printed versions of the translated questionnaires were disseminated among the professionals representing the main three survey categories, taking into consideration the structure of each target group.

Questionaires were distributed via various means: by direct contact (during meetings, courses, team building, etc).

The respondents were contacted from February 15th to May 15th. Afterwards, responses provided have been collected, processed and summarized.

3.2. Documentary Research

An online documentary research was done through the legal regulations pages about postgraduate specialty eduction in Bulgaria.

4. EVALUATION RESULTS

4.1. For Orthopedics and Thraumatology Professionals

Total number of respondents: 22

Question 1. Reffers to the frequency of accessing the internet and 18% stated that they access the internet daily. 64% of the respondents declare that they usually access the internet 2-3 times a week, and the rest 18% - access the internet once a week. Taking into account these results, we can conclude that for the majority of the respondents internet usage is becoming a regular activity, which outlines really promising prospects for the COR project aims and objectives achievement.

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Question 2. This question is about the use of the internet for improving the professional career. The responces received are classified into 3 frequency cathegories and the collected data are as follows.

Table 3:

Daily	**5%**
Weekly	**23%**
Montly	**72%**

Question 3. The question is focused on the familiarity and the confidence of the respondents in usage of some of the most popular e-tools and services. The answers are presented in the table below.

Table 4:

	Never heard of it	**I have heard but never used it**	**I can manage with help**	**I can use it**
Chat	**9%**	**36%**	**5%**	**50%**
Wiki	**0%**	**9%**	**5%**	**86%**
Audio conferencing	**0%**	**68%**	**0%**	**32%**
Video conferencing	**0%**	**77%**	**0%**	**23%**
Forum	**0%**	**59%**	**0%**	**41%**
E-mail groups	**0%**	**0%**	**0%**	**100%**
Internet Mobile / mobile learning	**0%**	**82%**	**0%**	**14%**

E-mail groups, Wiki and Chat applications are used by most of the respondents. The internet mobile / mobile learning platforms as well as audiao and video conferencing facilities are not so popular.

Question 4. Reffers to the main categories of information that the medical professionals require and how often they you use them.

The answers showed that all the respondents are interested to receive weekly (18%) and monthly (82%) information and knowledge about clinical issues, which is a theme of great importance for the project. 68% of the participants want to receive montly news and publications, and 55% would like to receive monthly information about medication.

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Table 5:

		Daily	Weekly	Monthly
Clinical issues	***100%***	***0%***	***18%***	**82%**
Medical Legislation	**18%**	**0%**	**0%**	**18%**
Medication	**55%**	**0%**	**0%**	**55%**
Medical events	**27%**	**0%**	**0%**	**27%**
News Publications	**68%**	**0%**	**0%**	**68%**
Science & Research	**23%**	**0%**	**0%**	**23%**

Question 5. Concerning the preferable styles and means to improve their professional career the majority of the respondents have selected classical courses (64%) and workshops (59%). The survey shows that the e-learning (methodologies and tools) is not so popular among the OT domain professionals who have participated in the survey and by this reason active promotion and fostering is needed.

Table 6:

Classical courses	***64%***
Workshops	***59%***
e-learning	***32%***

Question 6. This question evaluates the interest of respondents in e-learning. 64% of the respondents declare their interest but still big number (36%) of participants in this survey are not enough interested in e-learning. These results outline the need for the development of friendly, easy-to-use and in the same time highly motivating and attractive e-learning solutions and contents.

Question 7. Explores the interest of respondents in mobile learning. Only 23% were interested in mobile learning. This rate is very low perhaps because of the lack of native language sources.

Question 8. The question is in regard to the target group interest towards e-learning. An open sub-question aims to detect the most frequently used and searched domains.

Table 7:

Yes	**9%**
No	**82%**

The answers showed that currently only 9% of respondents have looked for e-learning courses in Internet. The traditional courses and workshops are still preferred formats in Bulgaria. As mostly used domains are specified the following: ***Hip endoprothesis; Sport trauma; Geronotologic trauma.***

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Question 9. Explores the amount of time that the target group think are necessary to refresh their knowledge and improve skills and competencies.
The responses vary from minimum 10 hours to maximum 55 hours are necessary.

Questions 10-11. Evaluate the willingness of the respondents in using an e-learning platform for continuous education on payment basis. 64% of the respondents turn to free online platform, while 14% are ready to pay for such a service if it was worth.

Question 12. Regards the language for the course information. 82% of the respondents prefer native language and in the same time only 18% could use information in English.

Table 8:

English or Bulgarian	***18%***
Bulgarian	***82%***

Question 13. Aimed to identify the lower limb pathology that would interest mostly the target group. All respondents are interested in post-traumatic pathologies. The lower interest is demonstrated regarding **Congenital and Inflammatory.**

Table 9:

LOWER LIMB PATHOLOGY	**Yes**	**No**
Congenital	**14%**	**86%**
Post-traumatic	**100%**	**0%**
Inflammatory	**27%**	**73%**
Degenaritive	**82%**	**18%**
Tumoral	**68%**	**77%**

Question 14. The question aims at evaluation of the respondents' interest towards the application of gait analysis in orthopedic surgery. More than 73% declare high level of interes to this topic.

Question 15. This question asked the respondents to express their interest in methods that would be provided through an e-learning platform dedicated to lower limb orthopedic pathology (including complications).The collcted feedback is presented in the table below. As is visible the topics such as hip trauma and knee trauma are the most interesting topics for this target group.

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Table 10:

LOWER LIMB DIAGNOSES	Yes	No
Hip trauma	100%	0%
Hip osteoarthritis	86%	14%
Knee trauma	100%	0%
Knee osteoarthritis	73%	27%
Surgery for neuro-muscular disorders	14%	86%
Ankle osteoarthritis	32%	68%
Fractures of tibia and ankle	77%	23%
Ankle arthrodesis	59%	41%
Diabetic foot	18%	82%
Congenital and developmental disorders	9%	91%
Fractures of the calcaneum	55%	45%
Bone tumors	41%	59%

Question 16. Asked about the most probable subjects that would interest the participants in e-learning. Most attractive subjects were again hip and knee surgeries.

Table 11:

	Yes	No
Diaphyseal fracture fixation	100%	0%
Articular and peri-articular frecture fixation	100%	0%
Hip Arthroplasty	100%	0%
Knee arthroplasty	100%	0%
Knee oseotomy	82%	18%
Hip osteotomy	59%	41%
Ankle arthrodesis	27%	73%
Tenotomies and capsulotomies	14%	86%
Ligamentous surgery	9%	91%

Question 17. Concerning the most useful aspects of the application of gait analysis in the orthopedic practice the biggest number of the respondents point “guiding psot-op rehabilitation” (86%) and patient evaluation (68%). The complete description of all collected results is presented in the table below.

Table 12:

	Yes	No
Patient evaluation	*68%*	*32%*
Pre-operative planning	*55%*	*45%*
Establish the timing of surgery	*36%*	*64%*
Guiding psot-op rehabilitation	*86%*	*14%*
Predicting the onset of complications	*18%*	*82%*

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Question 18. This question aims at collecting data about success perception of the respondents concerning the orthopedic treatment. Good functional results and the absence of any complications are among the alternatives with the highest rates.

Table 13:

	Yes	*No*
Good functional result	*73%*	*27%*
No complications	*100%*	*0%*
Social and professional reintegration of the patient	*36%*	*64%*
Radiological healing, nomatter the functionla result	*9%*	*91%*

Question 19. Determined the demographics of interest distribution among the participants. As is visible form the table with the collected feedback, the professionals participated in this survey declare high level of interest in all provided alternatives /aspects.

Table 14:

	Yes	No
Indications for each procedure	82%	18%
Surgical approach	100%	0%
Necessary instruments	95%	5%
Bone preparation	73%	27%
Implant positioning	95%	5%
Tips and tricks	77%	23%
Possible failures and complications	82%	18%

Question 20 – 21 - 22. Evaluates the use of human gait analysis in practice. More than 70% of the respondents are familiar with gait analysis. 82% use human gait analysis in their practice by by clinical observation but no one has used computerized gait analysis. 86% are interested in this technique and want to learn more about application of gait analysis in rehabilitation.

Question 23 – 24. Explore the interest of the target group in sharing their knowledge by a Forum on medical topics and sharing experiences for second opinion. Nearly 60% of the respondents declare interest in using a forum on medical topics, but only 36% are interested in sharing experiences for second opinion on on-line basis.

4.2. For Physical & Rehabilitation Medicine (PRM) Professionals

Total number of respondents: 51

Question 1. Reffers to the frequency of accessing the internet and 25% stated that they access the internet daily. At about 50% of the respondents declare that they usually access the internet 2-3 times a week, and the rest 25% - access the internet once a week. Taking into account these results, we can conclude that for the majority of the respondents internet usage is becoming a regular activity, which outlines really promising prospects for the COR project aims and objectives achievement.

Question 2. This question is about the use of the internet for improving the professional career. The responces received are classified into 3 frequency cathegories and the collected data are as follows.

Table 15:

Daily	**2%**
Weekly	**27%**
Montly	**71%**

Question 3. The question is focused on the familiarity and the confidence of the respondents in the use of some of most popular e-tools and services. The answers are presented in the table below.

Table 16:

	Never heard of it	***I have heard but never used it***	***I can manage with help***	***I can use it***
Chat	**31%**	**43%**	**12%**	**31%**
Wiki	**0%**	**0%**	**0%**	**0%**
Audio conferencing	**27%**	**73%**	**0%**	**27%**
Video conferencing	**31%**	**69%**	**0%**	**31%**
Forum	**76%**	**24%**	**0%**	**76%**
E-mail groups	**0%**	**0%**	**4%**	**0%**
Internet Mobile/ mobile learning	**0%**	**8%**	**25%**	**0%**

Question 4. Reffers to the main categories of information that the medical professionals require and how often they you use them.

The answers showed that all the respondents prefer to receive news and information on weekly or monthly basis.

There is registered interest to all proposed cathegories. The biggest interest is declared towards Medication (73% of the respondents) where 30% prefer to be informed weekly and the rest 43% - monthly.

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As total 65% are interested to receive weekly (24%) and monthly (41%) information and knowledge about clinical issues, which is a theme of great importance for the project.
All the collected data are summarized and presented in the next table.

Table 17:

		Daily	*Weekly*	*Monthly*
Clinical issues	**65%**	**0%**	**24%**	**41%**
Medical Legislation	**29%**	**0%**	**0%**	**29%**
Medication	**73%**	**0%**	**30%**	**43%**
Medical events	**33%**	**0%**	**0%**	**33%**
News Publications	**31%**	**0%**	**8%**	**24%**
Science & Research	**27%**	**0%**	**0%**	**27%**

Question 5. Concerning the preferable styles and methodologies for improving the professional career the half of the respondents have selected classical courses (51%) and workshops (41%). The survey shows the results similar to these already obtained via the survey among the target group of orthopedics and thraumatology professionals. Here also is visible that the e-learning (methodologies and tools) is not so popular among the RMT domain professionals, who have participated in the survey. Here the results are even lower – only 8% of the respondents prefer e-learning to the other methogologies. The necessity of urgent actions focused on the active promotion and fostering of the e-learning among this target group is really crucial.

Table 18:

Classical courses	**51%**
Workshops	**41%**
e-learning	**8%**

Question 6. This question evaluates the interest of respondents in e-learning. 51% of the respondents declare their interest but still big number (49%) of the participants in this survey are not enough interested in e-learning. These results outline the need for improvement the awareness, interest, and motivation of this target group through the development of well and professionally designed, friendly, easy understandable and in the same time very attractive e-learning solutions and contents.

Question 7 explores the interest of respondents in mobile learning. Only 33% were interested in mobile learning. This rate is very low perhaps because of the lack of native language sources.

Question 8. The question is in regard to the target group interest towards e-learning. An open sub-question aims to detect the most frequently used and searched domains.

Table 19:

Yes	**27%**
No	**73%**

The answers showed that currently less than one thirsd of the representatives of PRM target group participated in the survey have looked for e-learning courses in Internet. The traditional courses and workshops are still preferred formats in Bulgaria. As mostly used domains are specified the following: ***Neurorehabilitation; OT Rehab; Cardiorehab; Oncologic rehab; Pain management.***

Question 9. Explores the amount of time that our target group think are necessary to refresh their knowledge and improve skills and competencies.
The responses vary from minimum 10 hours to maximum 55 hours are necessary.

Questions 10-11 evaluate the willingness of the respondents in using an e-learning platform for continuous education on payment basis. 69% of the respondents turn to free online platform, while 35% are ready to pay for such a service if it was worth.

Question 12. Regards the language for the course information. 69% of the respondents prefer native language and in the same time 31% could use information in English.

Table 20:

English or Bulgarian	**31%**
Bulgarian	**69%**

Question 13. Aimed to identify the pathologies, localized to the lower limb joints, which are most interesting for the respondents.

Table 21:

	Yes	**No**
Congenital	**24%**	**76%**
Post-traumatic	**94%**	**6%**
Inflammatory	**86%**	**14%**
Degenaritive	**100%**	**0%**
Tumoral	**14%**	**86%**

Question 14. This question asked the respondents to express their interest in topics *(methods)* that would be provided through an e-learning platform dedicated to the joints of the lower limb pathology, requiring surgery.The collcted feedback is presented in the table below. As is visible the topics such as hip trauma and knee trauma are the most interesting topics for this target group.

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Table 22:

	Yes	***No***
Kinetotherapy/ Hidro – Balneo-kinesitherapy	**94%**	**6%**
Massage	**31%**	**69%**
Electrotherapy	**57%**	**43%**
Magnetotherapy	**31%**	**69%**
Other preformed physical modalities	**27%**	**73%**
Techniques for orthosis/prosthesis	**55%**	**45%**
Occupational therapy	**35%**	**65%**
Balneology	**29%**	**71%**
All of the above	**75%**	**25%**
Kinetotherapy/ Hidro – Balneo-kinesitherapy	**94%**	**6%**
Massage	**31%**	**69%**
Electrotherapy	**57%**	**43%**

Question 15. Asked about the most probable subjects that would interest the participants in e-learning. As is visible from the collected and summarized data presented in the table below all topics are interesting for the audience.

Table 23:

	Yes	**No**
Kinetotherapy/ Hidrokinetotherpay	**53%**	**47%**
Massage	**29%**	**71%**
Electrotherapy	**37%**	**63%**
Techiniques for orthosis/prosthesis	**35%**	**65%**
Ocupational therapy	**43%**	**76%**
Balneology	**27%**	**73%**
All of the above	**57%**	**43%**

Question 16 – 17 - 18. These questions refer the use of the human gait analysis in practice. More than 73% of the respondents are not familiar with gait analysis. 94% use human gait analysis in their practice by clinical observation but no one has used computerized gait analysis. 96% are interested in human gait analysis technique and want to learn more about its application in rehabilitation.

Question 19 – 20. Explore the interest of the target group in sharing their knowledge by a Forum on medical topics and sharing experiences for second opinion. 96% of the respondents declare interest in using a forum on medical topics, and more than a half of them (55%) are interested in sharing experiences for second opinion on on-line basis.

4.3. For Managers, medical educational policy makers and academic medical stuff

Total number of respondents: 10

Question 1. This question refers to the respondents' opinion about the importance of the continuous medical education for them and their employees. All the respondents state that the continuous medical education is very important for them, their institutions and for their employees.

Question 2. The question aims at gathering information about how many hours and respectively ECTS credits do the employees need yearly for continuous medical education, according to Bulgarian heath legislation.
In accordance with the Bulgarian Ihealth legislation the employees need yearly 40 – 60 hours per year and respectively 3-5 ECTS credits

Question 3 - 4. This question evaluates the interest of respondents in e-learning and mobile learning. 100% of the respondents declare their interest in bothe e-learning and m-learning domains.

Table 24:

Yes	**100%**
No	**0%**

These results reveal the promising prospects and existence of the understanding and support by side of the managers, medical educational policy makers and academic medical stuff to the development of the e-learning medical educational policy and inclusion of the professionals engaged in the medicine domain in the digital education.

Question 5. The question is in regard to the target group interest towards e-learning courses. An open sub-question aims to detect the most frequently used and searched domains. All of the respondents involved in this survey declare that they have looked for e-learning courses on internet.

Table 25:

Yes	**100%**
No	**0%**

As domains of biggest interest are specified the following: **Physical & Rehabilitation Medicine; Rehabilitation; Surgery; Neurology; Neurosurgery; Orthopedics and Thraumatology; Pain medicine.**

Question 6. This question refers to the familiarity of the employees of the respondents' institutions and organisations with the usage of e-learning platforms. 60% of the respondents declare that their employees are familiar with the e-platforms and their usage, bur the rest of the sample (quite big number - 40%) declare that their employees are not enough familiar with e-platforms. This impose the need of initiatives and activities for

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improvement the awareness, knowledge and skills of the of the medical stuff regarding the use of the e-platforms and their tools, functionality and instruments.

Question 7. Refers to the readiness of the respondents (if they have access to an e-learning medical platform) to promote it within their organisations.
100% of the respondents participating in this survey declare that they will promote the use of an e-learning medical platform among their colleagues and employees.

Question 8 - 9. Evaluate the willingness of the respondents in using an e-learning platform for continuous education on payment basis. 100% of the respondents turn to free online platform, while 40% are ready to pay (depending on the price) for such a service if it was worth.

Question 10. This question refers to the preferences of the respondents concerning the courses presentation language.70% of the respondents declare that they prefer the courses' contents to be presented in English and Bulgarian languages and the rest part of the sample would like the courses' contents to be in Bulgarian language.

General Overview of the Process - Results assessment and interpretation

Analyzing the field survey results and the documentary research, the general conclusions could be gathered in the following categories:

- *The knowledge of new means for training/assessment must be continuously updated;*
- *The knowledge of theory and its empirical use and terminology;*
- *Use of training/assessment methods and tools which fit the medical areas;*
- *The impact of assessment on the teaching/learning process and on teacher/instructor;*
- *The continuous improvement of various abilities development while using new means and techniques of training/assessment;*
- *Practicing the training/assessment abilities and the feedback continuously reported;*
- *The possibility of application and use of knowledge and competences gained based on the new means and techniques for training/assessment.*

Accordingly, the results were checked taking into account the professional level.
Therefore, the following groups were covered:

1. Specialists in Orthopedics and Traumatology
2. Residents in Orthopedics and Traumatology
3. Specialists in Physical & Rehabilitation Medicine;
4. Residents in Physical & Rehabilitation Medicine;
5. Physiotherapists;
6. Managers, medical educational policy makers and academic medical stuff.

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4.4. MEDICAL DOCTORS: Specialists in Orthopedics and Traumatology and Physical & Rehabilitation Medicine

All respondents underlined the importance of IT implementation in medicine while mentioning various fields where IT could be beneficial:

- *Continuing medical education*
- *Following new advancements in practice*
- *Keeping knowledge update*
- *Developing skills*
- *Competing with peers*
- *Obtaining news about occupational events*
- *Consulting and sharing experience with peers*
- *Conducting research and literature overview*

Also, they all mentioned the importance of IT field for the continuous improvement and knowledge updating.

They use weekly/monthly the enlisted sources of information and continuously train in any relevant topic. They share the area from good knowledge of e-tools and distance learning methodologies to having no knowledge of the issues. All use email and internet. They would like to spend from 200 to 400 hours per year for training, but the schedule and work planning do not allow them the fulfilment.

Even if their experience in e-learning is not well defined, they all trust the methods and means for the topics enlisted. Even strongly empirical topics and subjects are of interest when linked to e-tools and an acceptance of free of charge or paid (partially contribution from employees) is obvious.

4.5. MEDICAL DOCTORS: Residents in OT and in PRM

Even if never participated in distance learning, students and residents have competencies, training needs and expectations various from those of the above categories. They use and are familiar with e-tools and they heard about distance and mobile learning. They weekly/monthly sometimes, on a daily basis, check sources of information such as new jobs and career opportunities, European new techniques, technologies, publications and Science and Research last innovations.

They use e-mail, internet, e-tools and social network and they often checked or looked for distance courses.

4.6. Managers, medical educational policy makers and academic medical staff

REMARKS:

In Bulgaria, there is only one medical speciality working in this field: the medical doctor – specialist in Physical and Rehabilitation Medicine, but we have a lot of specialists – auxiliary staff, working in Departments / Clinics of Physical and Rehabilitation Medicine. We have Bachelors and Masters in Kinesitherapy, Bachelors and Masters in Medical Rehabilitation

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and Occupational therapy (Ergotherapy), Masters in Medical Rehabilitation and Balneology; Professional Bachelors in Rehabilitation, and others. This is a problem for MD, for managers and for patients too.

5. ACCREDITATION / CERTIFICATION OF NEW COMPETENCIES

Main issues taken into consideration in our project were to achieve validation of training by CME credits. For this reason it is important to present the certification system in each country and to make early contact with correspondant ECM office and will act as stipulated by national regulations regarding the crediting criteria in CME. Also it is important to take care if creditation is available for CME programs via the Internet, online, or by interactive informational support offered. For this reason each report will present specific details linked to these 2 aspects.

5.1. Postgraduate medical education in Bulgaria.

Postgraduate medical education provides specialization and professional development of individuals with higher education in the medical field, in order to improve a better level of *theoretical knowledge, practical skills and abilities* for increase the quality of care and level of performance in health system.

It is coordinated by medical universities, with the help of correspondent professional organisations: *Bulgarian Medical Union, Bulgarian Union of Medical Specialists and Association of Physiotherapists of Bulgaria.*

5.2. Types of postgraduate medical education forms in Bulgaria.

Postgraduate medical education form in Bulgaria includes **Postgraduate specialty education in medical universities** & **correspondent University Hospitals.**

Graduates of medical schools enter an exam in the correspondent Medical university whith University Hospital. The exam is theoretical and written. The exam is effectuated periodically – once or twice a year. The score is based on achivements on medical knowledge. A preference list is made and depending on the score the graduates are placed to a program. The specialty programs take 5 years in Orthopedics and 4 years in Physical and Rehabilitation Medicine. The specialization ends with an exam (practical, oral and written parts) – for evaluation of acquired practical skills and theoretical knowledge.

5.3. Continuous Medical Education (CME) in Bulgaria

The post-graduated medical education may include too thematic courses or individual practical education. Thematic courses include 2-3 lectures per day and 3-4 hours clinical practice with patients). Individual practical education is dedicated only to clinical practice. Normally Sofia Medical University organizes courses for participants from all the country.

By the way, every medical doctor must effectuate continuing medical education (credits for every year). For every form of CME, organized by Medical universitites or University hospitals, participants receive a number of credits (about 5-25 credits for thematic course or 5 credits per day for individual course). Some scientific societies, members of Bulgarian Union of medical specialists (member of the European Union of Medical specialists - UEMS)

Grasp and Gait REHABILITATION

organize scientific events (congresses and conferences) with hands-on workshops. Participants receive credits for participation in every event (if accredited by the Bulgarian Medical union).

6. CONCLUSIONS

Medicine is one of the most rapidly changing fields of science and practice. Most of the surgical methods which were considered as gold standard have changed. Even now physicians are aware that the methods they are applying currently may not exist 5 to 10 years later. Research and development is taking place all over the globe and results are disseminated world wide. To assure quality of service given for the patient a medical worker should always be in touch with the current advances.

A medical student or a resident gathers vast amount of information during the education period. After graduation it is usually upto personal preference for one to keep upto date. The ones who do not keep in touch with the advances in medicine are doomed to stay faded in professional life.

A couple decades ago, before the internet, access to knowledge was difficult. Medical applications would vary greatly between countries. One would either require to travel abroad to gather current information or subscribe to printed periodicals. Medline was accessed via cd's which were updated every 6 to 12 months. Internet provided an incredible ease in access to knowledge. Availability of audio and video media made skill development possible in addition to knowledge.

Currently internet has its disadvantages too. One may reach vast amount of knowledge with variable validity. Even in the literature one can find support for any idea coming to mind. Evidence levels and metaanalysis studies emerged to filter the knowledge. For the skills education we still prefer the sources we thrust. Several countries have prepared guidelines for treatment of most common diseases. For assurance of quality and validity of knowledge and skills information formation of standards is very important.

Nearly everyone, especially in profession related to medicine have easy access to internet. The questionnaire results also confirm this. Availability of a trustworthy source of information where standards of treatment are formed by agreement of multiple centers and where the information is supported with visual documents will readily be accepted and used by the residents and specialists.

Proposals

a. To inform associations dealing with professional education identified as references on our platform, about the opportunity to participate as users to courses offered by our platform.

b. Maintaining of questionaires on the project website appealing to visitors to help us in expanding the research to other geographical areas.

Grasp and Gait REHABILITATION

INVESTIGATION OF STUDENTS' OPINION ABOUT THE NECESSITY OF INTRODUCTION OF VOCATIONAL EDUCATION AND TRAINING IN GAIT REHABILITATION

Ivet Koleva, Borislav R. Yoshinov, Radoslav R. Yoshinov

ABSTRACT:

The current report accentuates on the necessity of vocational education and training in the field of gate rehabilitation – opinion of a total of 61 students from the Medical universities of Sofia and Pleven: students in Medicine (English speaking students, 5^{th} course), students in Physiotherapy – bachelor's degree (2^{d} & 3^{th} year), students in Medical Rehabilitation & Balneotherapy – master's degree (1^{st} course).

We present results of a questionnaire for evaluation of learning needs and possible e-learning training approaches. All students present interest to an e-learning platform. More than 35 % of students prefer e-learning, presented in native language; 62 % like training in English and native language.

About 99 % of students consider gait rehabilitation like an important item for recovery of autonomy of patients in every-day life.

Keywords:

Orthopedic rehabilitation, e-learning, gait

1. INTRODUCTION

* According documents of the European Center for Development of professional education and training [2] ***the electronic learning (e-learning)*** is "*education and training, mediated by information and communication technologies,* including different formats and hybrid methodologies, like programming systems, Internet, CD-ROM, education by PC in regime of real time, and other electronic or interactive devices." E-learning is "an application of modern multi-media technologies and Internet, with the objective of amelioration of the quality of education" [2,3,4].
* From last year we are participants in an *Erasmus Plus* project, treating the problems of gait rehabilitation after orthopedic surgery. One of our obligations during this project was the evaluation of necessity of introduction of e-learning on gait rehabilitation between groups of potential beneficiaries: medical doctors – specialists in *Orthopedics & Traumatology (OT)* and in Physical & Rehabilitation Medicine (PRM), physiotherapists, etc. The team of the project developed questionnaires, destined to mentioned target groups [8,9]. Due to the interest of our students, demonstrated during our lectures to this problem, we decided to effectuate the same investigation in three groups of our students.

2.GOAL AND TASKS

2.1.The objective of current research was evaluation of the necessity of vocational education and training in '*gait rehabilitation*' - between different groups of health professionals, during their studies in this thematic field.

2.2.TASKS:

* *Definition of target groups: students in specialty „Medicine" („Master's degree" – education in English), students in „Medical rehabilitation & Balneology" („Master's degree") and students in „Kinesitherapy" („Bachelor's degree");*
* *Adaptation of present questionnaires to students' level of competence and necessities of students' education;*
* *Realization of studies – during the students' education – after the end of lectures and exams of disciplines related with the thematic of the project (Physical & Rehabilitation Medicine, Natural & Pre-formed physical modalities; Medical Rehabilitation & Balneology in different diseases and nosology);*
* *Statistical evaluation of obtained data;*
* *Analysis of results and*
* *Discussion and Conclusions.*

3. METHODS OF THE INVESTIGATION

* In relationship with an assessment of the opinion of future potential users of the project „Erasmus Plus“ treating the „Gait rehabilitation“ the team of the project elaborated questionnaires, destined to medical doctors – specialists in Orthopedics & Traumatology (OT), medical doctors – specialists in Physical & Rehabilitation Medicine (PRM), and to the staff of correspondent Clinics and Departments OT & PRM [7,8]. The goal of the investigation was the evaluation of the necessity of development of the gait rehabilitation in the country, and to the readiness of the target groups to receive the possibility of access and to use with efficacy electronic education and practical training on this subject. We decided to amplify the investigation to potential future beneficiaries – students in Medicine (M) of the course V (before the practical last year of studies), students of the bachelor's degree in Kinesitherapy (KT) from the courses II & III (before the practical summer stage), and students of the Master's degree in „Medical Rehabilitation & Balneology“ (MRB) before the last practical part of studies.

* We must underline that the discipline 'Physical & Rehabilitation Medicine' is during the fifth year of education in Medicine (and during the sixth year future medical doctors have only practical training). We must put emphasis on the facts, that all students of the master's programme in Medical Rehabilitation & Balneology have the degree of Professional Bachelor in Rehabilitation and most of them are working in PRM Departments or Clinics in different hospitals (stationary rehabilitation for inpatients) or in Medical centres (ambulatory rehabilitation for outpatients).
* We adapted part of questions to the age and professional competence of students. Tests were translated in Bulgarian language for Bulgarian students, for students in Medicine – education in English the tests were presented in English language.
* The investigation was effectuated during the period from May to June 2016 with *students in Medicine* of the Medical University of Pleven (*education in English*) and *students in KT & MRB* of the Medical University of Sofia. The target groups received questionnaires electronically (by e-mail) or directly (after the end of lectures and after the exam of the corresponding discipline).
* For current study we applied different ***methods***: Screening, Questionnaires, Analysis of documents, Statistics.
* The final statistical evaluation of results we made with the ***statistical package SPSS***, version 19: options two samples comparison with parametrical analysis of variances ANOVA and non-parametrical distribution and correlation analysis, as follows: *t-test* (t-критерий, p value), *Signed test, Signed rank test, Kolmogorov – Smirnov test, Mann – Whitney (Wilcoxon) W test (W медиана)*. For statistical significant effects we consider results with value of $p<0.05$, but in some cases we obtained lower *p* values ($p<0.01$).

4. MATERIAL

Table 1.
Distribution of respondents – students in different specialties (number).

TOTAL NUMBER OF STUDENTS	SPECIALTY OF EDUCATION		
	MEDICINE – English speaking students	KINESITHERAPY - Bachelor's degree	MEDICAL REHABILITATION & BALNEOLOGY – Master's degree
61	28	17	16

- The questionnaire was proposed to the cited target groups. Here we refer only results of the students' opinions from full answered questionnaires (a total of 61 responders).
  The distribution of students by specialties (absolute numbers and percent) is presented in Table 1 and Figure 1.

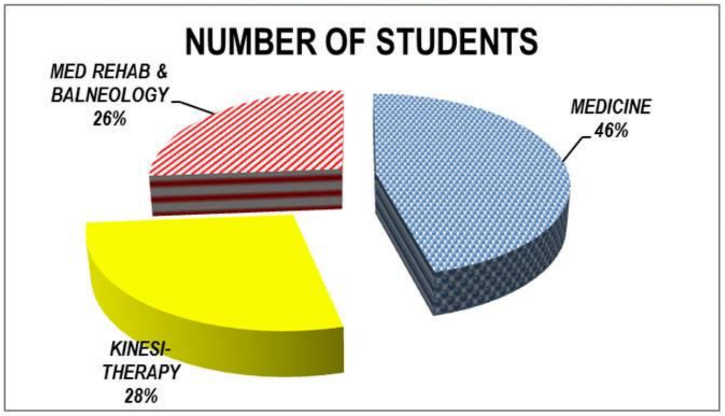


Figure 1.
Distribution of respondents – students in specialties (in percent).

Distribution of students by age and sex is presented in table 2 and figures 2 & 3.

Country	Age 20-35	36-50	Over 51 y
BG	58	2	1

Table 2.
Age of respondents (absolute value)

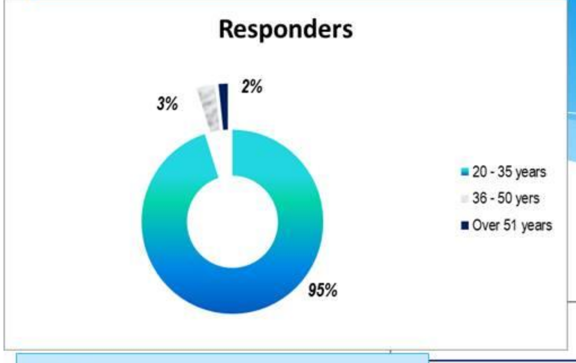


Figure 2.
Distribution of respondents by age groups (in percent)

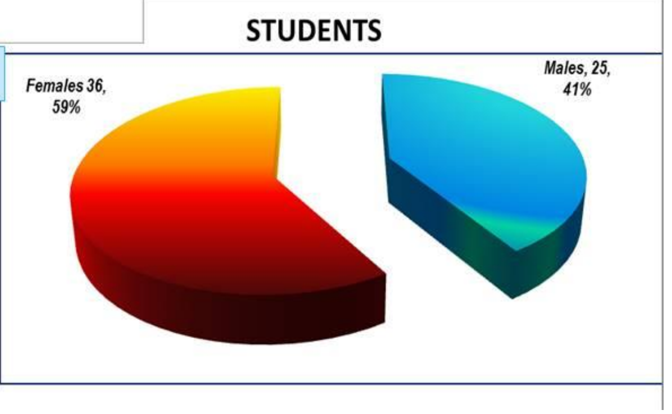
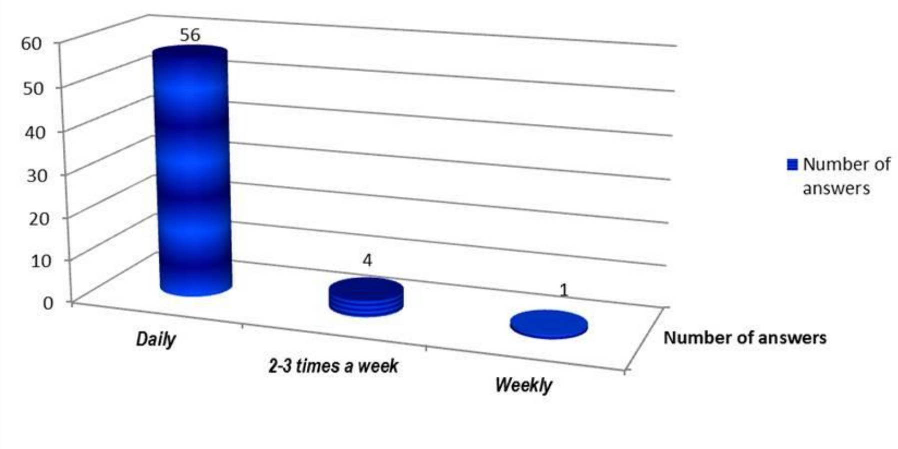


Figure 3.
Distribution of respondents Males : Females (in absolute value and in percent)

5. RESULTS AND ANALYSIS

- Most of students access the Internet sources of information every day.
- The detailed presentation of answers is on Figure 4:

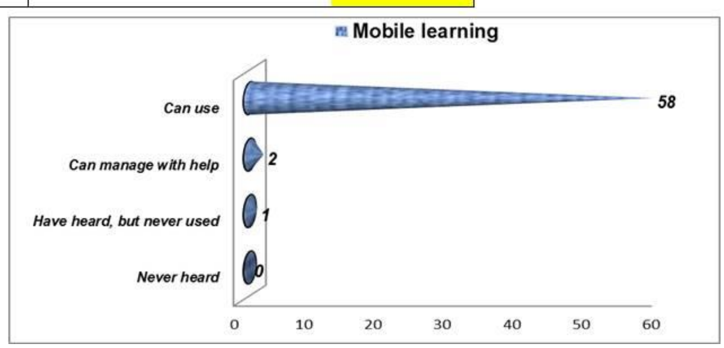
Fig. 4. Periodicity of accessing Internet



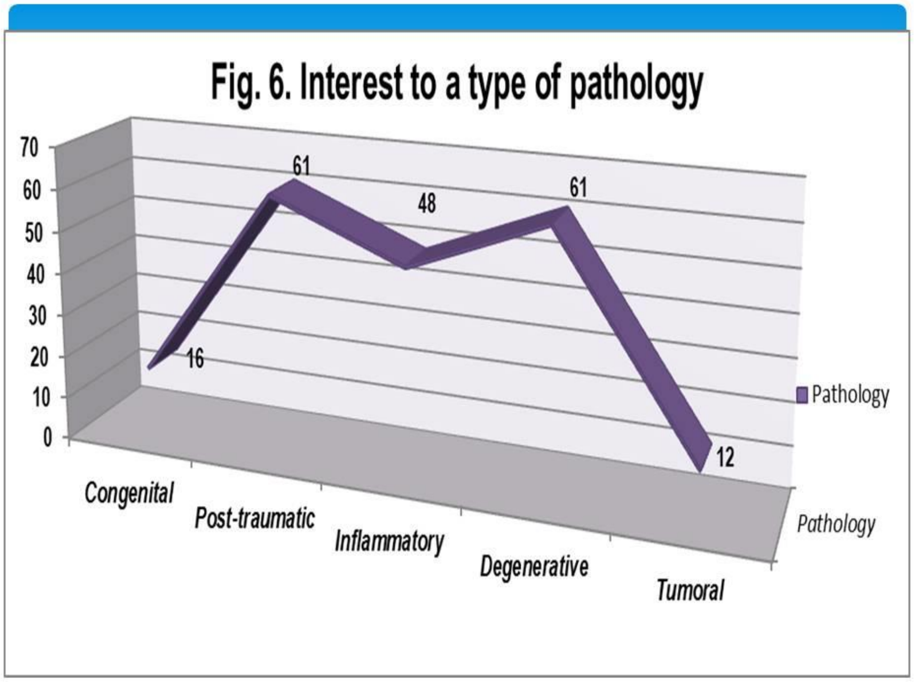
Answers of the question about the '*Which of the following e-tools are you familiar with and to which extent?*' are presented on Table 3. Figure 5 refers to the familiarity of students with the usage of mobile learning and e-learning platforms:

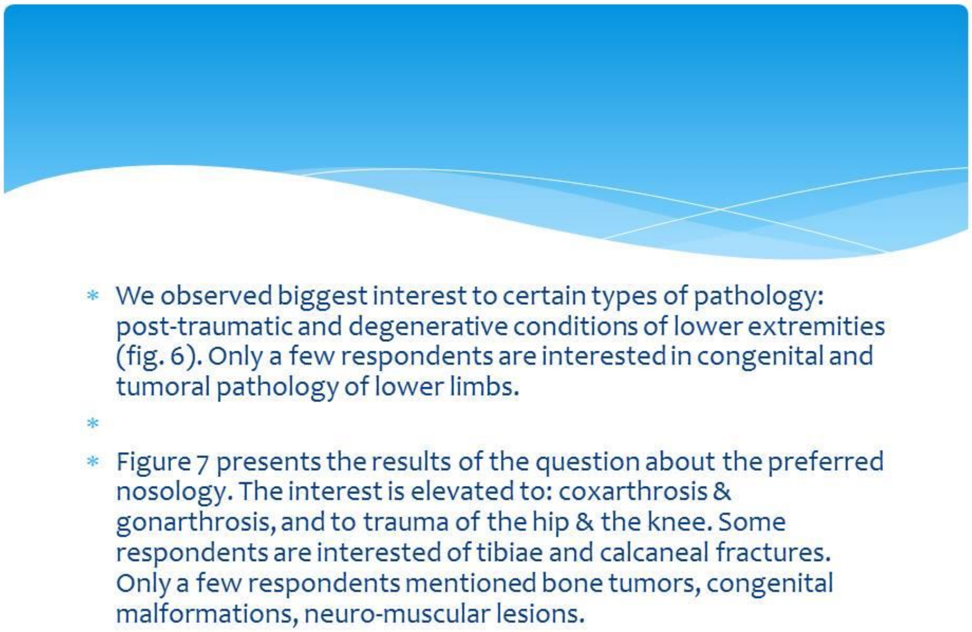
Table 3.
Application of Internet for professional goals

	Never heard	Have heard but never used	Can manage with help	Can use without help
Chat	0	1	3	57
Wiki	0	0	1	60
Audio-conference	0	0	0	61
Video-conference	0	0	0	61
Forum	0	1	1	59
E-mail groups	0	0	0	61
Mobile Internet / Mobile learning	0	1	2	58



- All students from the target group (100%) have positive answers to the questions „*Are you interested in mobile learning?*“ and „*Are you interested in e-learning?*“.
-
- The next question „*What language would you prefer for the course information?*“ received two types of answers: 23 students (37,76 %) prefer e-learning in their native language, and 38 responders (62,29 %) would like education in English and in native language.
-
- Very useful for the project were answers of questions dedicated to the most interesting „*types of OT pathology of the lower extremities*“ and „*OT diagnosis of the lower extremities*“. Both questions permit more than one response. Figure 6 presents results of the question: „*What is the lower limbs OT pathology, that would interest you?*“. Figure 7 presents results of the next question: „*If you would apply to an e-learning platform dedicated to lower limb post op OT diagnosis (including complications) , would you be interested in… *“.




We observed biggest interest to certain types of pathology: post-traumatic and degenerative conditions of lower extremities (fig. 6). Only a few respondents are interested in congenital and tumoral pathology of lower limbs.
Figure 7 presents the results of the question about the preferred nosology. The interest is elevated to: coxarthrosis & gonarthrosis, and to trauma of the hip & the knee. Some respondents are interested of tibiae and calcaneal fractures. Only a few respondents mentioned bone tumors, congenital malformations, neuro-muscular lesions.

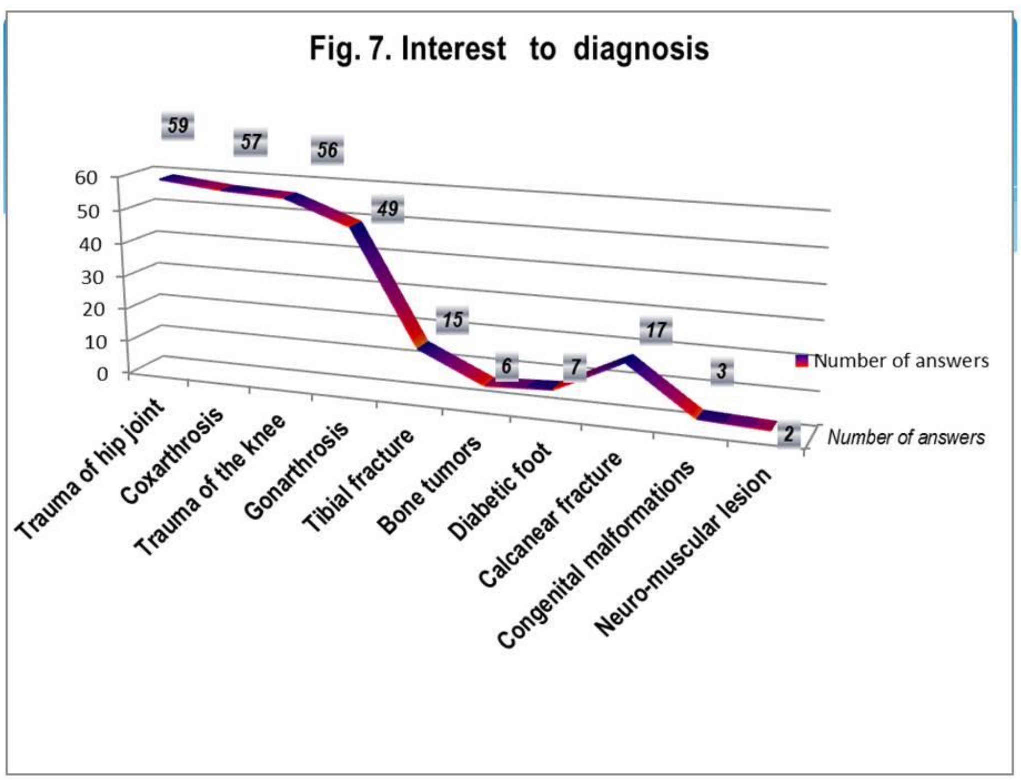
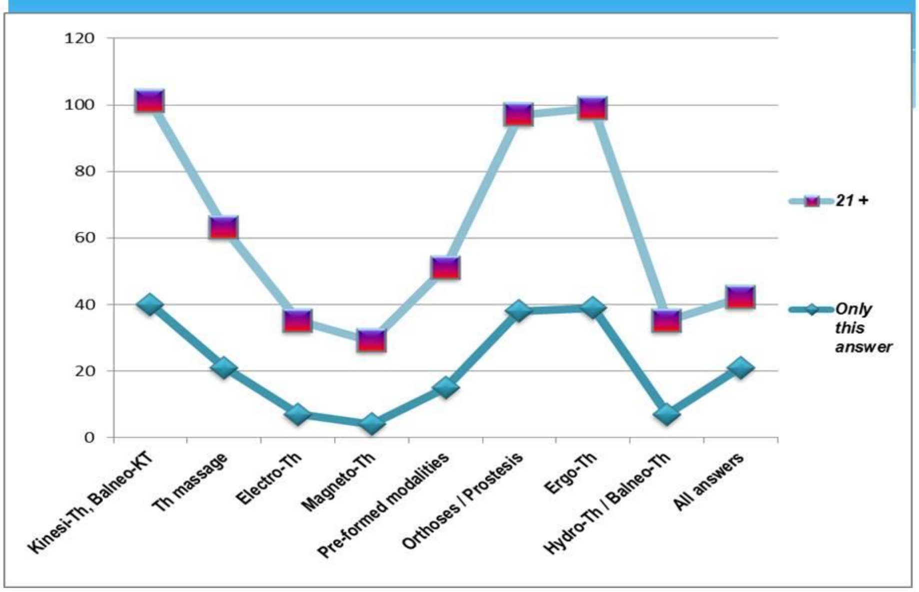


Fig. 7. Interest to diagnosis
59
57
56
49
15
6
7
17
3
2
60
50
40
30
20
10
0
Trauma of hip joint
Coxarthrosis
Trauma of the knee
Gonarthrosis
Tibial fracture
Bone tumors
Diabetic foot
Calcanear fracture
Congenital malformations
Neuro-muscular lesion
Number of answers
Number of answers

* All answers of students (100%) are positive to the question: „*Would you be interested in learning about application of gait analysis in orthopedic post-surgical rehabilitation?*".
* Figure 8 presents the answers of question: „*Which of the following methods of rehabilitation, for this kind of patient, would you be most interested in?*". More than 1 answer is permitted.
* The biggest interest is demonstrated towards the kinesitherapy and hydro-/ balneo-kinesitherapy, orthosis and prosthesis, and to ergotherapy (occupational therapy). The interest is lower towards pre-formed modalities and the therapeutic massage, and towards the pure hydrotherapy and Balneotherapy. About 33 % of students (21 respondents) are answered with interest to 'all the above' (fig.8).

Fig. 8. REHABILITATION PROCEDURES



6. DISCUSSION

* The results of our investigation proved that students in Bulgaria have the potential to accept an electronic educational platform on „Gait rehabilitation“. All of them are familiar with e-learning. An important part of respondents prefer a bilingual education (in native language and in English).
* The areas of biggest interest are post-traumatic and degenerative pathology of lower extremities, particularly traumatic injuries and arthrosis of the hip and the knee.
* They would like to receive detailed information about kinesitherapy and hydrokinesitherapy, occupational therapy, prosthesis and orthosis. All of them are interested in learning gait analysis.

7.CONCLUSION

* Bulgarian students are interested by electronic education (e-platforms and training) and they evaluate its
* Electronic education is interesting for our students, because of its positive characteristics: access to interactive multi-media materials, results of investigations in a lot of scientific applications and information sources form all the world, possibility of information exchange, potential of knowledge and application of international standards of education and qualification [5,6]. They consider the importance of introduction of this type of education in Bulgarian OT rehabilitation – with the objective of amelioration of the quality of care and the quality of life of Bulgarian patients [1,9].

ACKNOWLEDGEMENT

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* *The project was financed by European Commission under the Erasmus + programme, KA2.*
* *This document reflects only the authors' view and the NA and the Commission are not responsible for any use that may be made of the information it contains.*

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ANNEX 1.

NEEDS ASSESSMENT QUESTIONNAIRE IN ORTHOPEDICS

PERSONAL DETAILS
(These details are required for communication purposes only and will not be disclosed)
NAME:* optional

Position:
Resident ☐ in...................
Medical doctor ☐ specialization.....................
Member of professional organization ☐name of organization....................
Manager ☐
Institution................
Department...............
Position....................

EMAIL:* optional

Tick the box that suits best your situation.

1. . How often do you access the internet?

Daily ☐ 2-3 times a week ☐ weekly ☐

2. How much do you use the internet for improving your professional career?

Daily ☐ Weekly ☐ Monthly ☐

3. Which of the following e-tools are you familiar with and to which extent? Tick the box that suits best your situation.

	Never heard of it	I have heard but never used it	I can manage with help	I can use it
Chat				
Wiki				
Audio conferencing				
Video conferencing				
Forum				
e-mail groups				
Internet Mobile/ mobile learning				

Grasp and Gait REHABILITATION

4. What are the main categories of information that you require? How often do you use them?

Clinical issues	☐	**Daily** ☐	**Weekly** ☐	**Monthly** ☐
Medical Legislation	☐	**Daily** ☐	**Weekly** ☐	**Monthly** ☐
Medication	☐	**Daily** ☐	**Weekly** ☐	**Monthly** ☐
Medical events	☐	**Daily** ☐	**Weekly** ☐	**Monthly** ☐
News Publications	☐	**Daily** ☐	**Weekly** ☐	**Monthly** ☐
Science & Research	☐	**Daily** ☐	**Weekly** ☐	**Monthly** ☐

5. How do you prefer to improve your professional career?
Classical courses ☐ **Workshops** ☐ **e learning**☐

1. Are you interested in e-learning?
☐**Yes** ☐**No**

2. Are you interested in mobile learning?
☐**Yes** ☐**No**

3. Have you looked for e-learning on internet?
☐**Yes** ☐**No**

In what domains……………………………………………………………………………….

9. How many hours/per year do you think are necessary to refresh your knowledge and improve skills and competencies?
………………………………………………………………….

10. **If you would have on your disposal an e-learning platform for continuous education would you apply to it if it is on free basis?**

☐**Yes** ☐**No**

11. If you would have on your disposal an e-learning platform for continuous education would you apply to it if it is on payment basis?

☐**Yes** ☐**No**

12. What language would you prefer for the course information?
………………………………………………………………………………………………………

13. What is the pathology, localized to the lower limb joints that would interest you?

Congenital	☐**Yes**☐**No**
Post-traumatic	☐**Yes**☐**No**
Inflammatory	☐**Yes**☐**No**
Degenerative	☐**Yes**☐**No**
Tumoral	☐**Yes**☐**No**

Grasp and Gait REHABILITATION

14. Would you be interested in learning about application of gait analysis in orthopedic surgery?

☐Yes☐No

15. If you would apply to an e-learning platform dedicated to lower limb orthopedic pathology (including complications), would you be interested in:

Hip trauma	**☐Yes☐No**
Hip osteoarthritis	**☐Yes☐No**
Knee trauma	**☐Yes☐No**
Knee osteoarthritis	**☐Yes☐No**
Surgery for neuro-muscular disorders	**☐Yes☐No**
Ankle osteoarthritis	**☐Yes☐No**
Fractures of tibia and ankle	**☐Yes☐No**
Ankle arthrodesis	**☐Yes☐No**
Diabetic foot	**☐Yes☐No**
Congenital and developmental disorders	**☐Yes☐No**
Fractures of the calcaneum	**☐Yes☐No**
Bone tumors	**☐Yes☐No**

16. What kind of surgical procedures for lower limb pathology would you be interested in being detailed on an e-learning platform:

Diaphyseal fracture fixation	**☐Yes☐No**
Articular and peri-articular fracture fixation	**☐Yes☐No**
Hip arthroplasty	**☐Yes☐No**
Knee arthroplasty	**☐Yes☐No**
Knee osteotomy	**☐Yes☐No**
Hip osteotomy	**☐Yes☐No**
Ankle arthrodesis	**☐Yes☐No**
Tenotomies and capsulotomies	**☐Yes☐No**
Ligamentous surgery	**☐Yes☐No**

17. Do you think that gait analysis can be useful for certain aspects of orthopedic practice

Patient evaluation	**☐Yes☐No**
Pre-operative planning	**☐Yes☐No**
Establish the timing of surgery	**☐Yes☐No**
Guiding psot-op rehabilitation	**☐Yes☐No**
Predicting the onset of complications	**☐Yes☐No**

18. If you had to describe a successful orthopedic treatment, this would include

Good functional result	**☐Yes☐No**
No complications	**☐Yes☐No**
Social and professional re-integration of the patient	**☐Yes☐No**
Radiological healing, no matter the functional result	**☐Yes☐No**

Grasp and Gait REHABILITATION

19. When referring to orthopedic procedures, your major points of interest(s) are:

Indications for each procedure	**☐Yes☐No**
Surgical approach	**☐Yes☐No**
Necessary instruments	**☐Yes☐No**
Bone preparation	**☐Yes☐No**
Implant positioning	**☐Yes☐No**
Tips and tricks	**☐Yes☐No**
Possible failures and complications	**☐Yes☐No**

20. Are you familiar with human gait analysis?

☐Yes☐No

21. Do you use human gait analysis in your practice?

☐Yes by clinical observation
☐Yes by computerized methods
☐No

22. Would you be interested in learning about application of gait analysis in rehabilitation?

☐Yes☐No

23. Would you be interested in a Forum on medical topics?

☐Yes ☐No

24. Would you be interested in sharing your own experience for second opinion?

☐Yes ☐No

Grasp and Gait REHABILITATION

ANNEX 2.

NEEDS ASSESSMENT QUESTIONNAIRE IN REHABILITATION

PERSONAL DETAILS
(These details are required for communication purposes only and will not be disclosed)
NAME:* optional

Position:
Resident ☐ in...................
Medical doctor ☐ specialization.....................
Physiotherapist ☐ specialization.....................
Member of professional organization ☐name of organization....................
Manager ☐
Institution................
Department...............
Position....................

EMAIL:* optional

Tick the box that suits best your situation.

1. **How often do you access the internet?**

   Daily ☐ 2-3 times a week ☐ weekly ☐

2. **How much do you use the internet for improving your professional career?**

   Daily ☐ Weekly ☐ Monthly ☐

3. **Which of the following e-tools are you familiar with and to which extent? Tick the box that suits best your situation.**

	Never heard of it	I have heard but never used it	I can manage with help	I can use it
Chat				
Wiki				
Audio conferencing				
Video conferencing				
Forum				
e-mail groups				
Internet Mobile/ mobile learning				

Grasp and Gait REHABILITATION

4. **What are the main categories of information that you require? How often do you use them?**

Clinical issues	☐	**Daily** ☐	**Weekly** ☐	**Monthly** ☐
Medical Legislation	☐	**Daily** ☐	**Weekly** ☐	**Monthly** ☐
Medication	☐	**Daily** ☐	**Weekly** ☐	**Monthly** ☐
Medical events	☐	**Daily** ☐	**Weekly** ☐	**Monthly** ☐
News Publications	☐	**Daily** ☐	**Weekly** ☐	**Monthly** ☐
Science & Research	☐	**Daily** ☐	**Weekly** ☐	**Monthly** ☐

5. **How do you prefer to improve your professional career?**

   Classical courses ☐ **Workshops** ☐ **e learning**☐

6. **Are you interested in e-learning?**
   ☐**Yes** ☐**No**

7. **Are you interested in mobile learning?**
   ☐**Yes** ☐**No**

8. **Have you looked for e-learning on internet?**
   ☐**Yes** ☐**No**

In what domains...

9. **How many hours/per year do you think are necessary to refresh your knowledge and improve skills and competencies?**
   ...

10. **If you would have on your disposal an e-learning platform for continuous education would you apply to it if it is on free basis?**
    ☐**Yes** ☐**No**

11. **If you would have on your disposal an e-learning platform for continuous education would you apply to it if it is on payment basis?**
    ☐**Yes** ☐**No**

12. **What language would you prefer for the course information?**

..

..

13. **What is the pathology, localized to the lower limb joints, that would interest you?**

Congenital	☐**Yes**☐**No**
Post-traumatic	☐**Yes**☐**No**
Inflammatory	☐**Yes**☐**No**
Degenerative	☐**Yes**☐**No**
Tumoral	☐**Yes**☐**No**

Grasp and Gait REHABILITATION

14. If you would apply to an e-learning platform dedicated to the joints of the lower limb pathology, requiring surgery, would you be interested in:

Kinetotherapy/ Hidro – Balneo-kinesitherapy	**☐Yes☐No**
Massage	**☐Yes☐No**
Electrotherapy	**☐Yes☐No**
Magnetotherapy	**☐Yes☐No**
Other preformed physical modalities	**☐Yes☐No**
Techniques for orthosis/prosthesis	**☐Yes☐No**
Occupational therapy	**☐Yes☐No**
Balneology	**☐Yes☐No**
All of the above	**☐Yes☐No**

15. Which of the following methods of rehabilitation, for this kind of patient, would you be most interested in?

Kinetotherapy/ Hidrokinetotherpay	**☐Yes☐No**
Masage	**☐Yes☐No**
Electrotherapy	**☐Yes☐No**
Techiniques for orthosis/prosthesis	**☐Yes☐No**
Ocupational therapy	**☐Yes☐No**
Balneology	**☐Yes☐No**
All of the above	**☐Yes☐No**

16. Are you familiar with human gait analysis?
☐Yes☐No

17. Do you use human gait analysis in your practice?
☐Yes by clinical observation

☐Yes by computerized methods

☐No

18. Would you be interested in learning about application of gait analysis in rehabilitation? ☐Yes☐No

19. Would you be interested in a Forum on medical topics? ☐Yes☐No

20. Would you be interested in sharing your own experience for second opinion? ☐Yes☐No

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ANNEX 3.

NEEDS ASSESSMENT QUESTIONNAIRE ADDRESSED TO MANAGERS

(MANAGERS- Staff in the medical educational system, Institutional officials at clinical orthopedic and rehabilitation departments, Medical education and related associations in the field of orthopedics and rehabilitation; national organizations)

PERSONAL DETAILS ***(These details are required for communication purposes only and will not be disclosed)***

NAME:* optional

Institution:
Department:
Position:
EMAIL:* optional

***Tick the box that suits best your situation.**

1. How important is continuous medical education for you and your employees?
……………………………………………………………………………………………………

2. How many hours and /or ECTS credits do your employees need yearly for continuous medical education, according to your national heath legislation?
……

3. Are you interested in e-learning? ☐**Yes** ☐**No**

4. Are you interested in mobile learning? ☐**Yes** ☐**No**

5. Have you looked for e-learning courses on internet? ☐**Yes** ☐**No**
In what domains ………………………………………………………………………………

6. Employees in your institution are familiar /use an e-learning platform?

☐**Yes** ☐**No**

6. In what medical domains do you think that e-learning would be useful for professional formation of your employees?

7. If you would have access to an e-learning medical platform would you promote it within your institution? ☐**Yes** ☐**No**

8. **If you would have on your disposal an e-learning platform for continuous education would you apply to it for your employees if it is on free basis?**
☐**Yes** ☐**No**

9. If you would have on your disposal an e-learning platform for continuous education would you apply to it for your employees if it is on payment basis?
☐**Yes** ☐**No**

Comments: ………………………………………………………………

10. What language would you prefer for the course information?
……

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AUTHORS' PUBLICATIONS IN THE FIELD

MANUALS: ***in Bg language***

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