List of Topics

Neurophysiology technicians (NT) and Physical and Rehabilitation Medicine (PRM)

Disability/Rehab principles

Working as a TEAM/rehab settings

Useful applications of the study of the functions of the nervous system in predicting outcomes in PRM

Let's begin!

Disability

The number of people requiring rehabilitation is progressively increasing

Chronic neurological disorders
Chronic musculoskeletal disorders
Chronic Pain
Elderly people

The study of the functions of the nervous system is important!

Neurological disorders

Stroke, Head injuries

Neurodegenerative diseases (Parkinson's disease, Multiple Sclerosis, Amiotrophic Lateral Sclerosis)

Peripheral neuropathies

Most individuals lack the ability to perform the activities of daily living (ADLs) due to a neurological condition.

Muscolo-skeletal disorders

Deformity, chronic pain
Degenerative diseases
Traumatic injuries (bone and soft tissues)
Post-surgical conditions

Most individuals lack the ability to perform the activities of daily living (ADLs) due to a muscolo-skeletal disease.

Visceral disorders

Bladder
Bowel
Swallowing

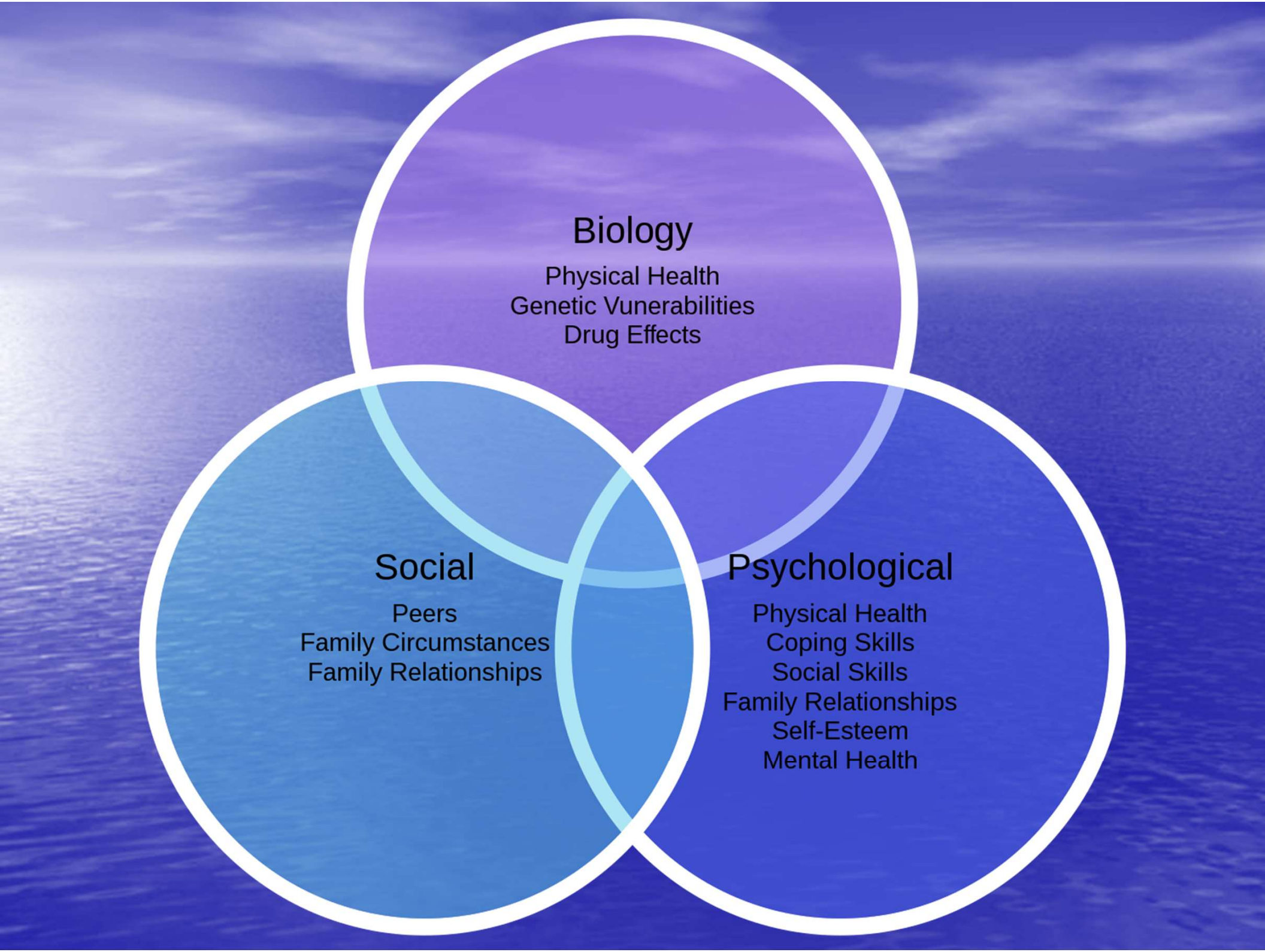
Most individuals lack the ability to perform the activities of daily living (ADLs) due to a visceral condition.

Disability

Physical problems
Cognitive problems
Behavioral problems

Rehabilitation needs are diverse and complex!

The bio-psychosocial approach is the healthier way!


Biology
Physical Health
Genetic Vunerabilities
Drug Effects
Social
Peers
Family Circumstances
Family Relationships
Psychological
Physical Health
Coping Skills
Social Skills
Family Relationships
Self-Esteem
Mental Health

Disability

NT are expected to merge their knowledge with PRM specialists and their allied professionals to ensure they provide the best possible contribution to people's management.

Increase alltogether competences and professional skills!

Rehab principles

Prevention, diagnosis and treatment of concomitant medical problems

Training people for maximum functional independence
(…but, what is it?)

The Barthel Index

THE BARTHEL INDEX

Patient Name: _____

Rater Name: _____

Date: _____

Activity	Score
FEEDING 0 = unable 5 = needs help cutting, spreading butter, etc., or requires modified diet 10 = independent	_____
BATHING 0 = dependent 5 = independent (or in shower)	_____
GROOMING 0 = needs to help with personal care 5 = independent face/hair/teeth/shaving (implements provided)	_____
DRESSING 0 = dependent 5 = needs help but can do about half unaided 10 = independent (including buttons, zips, laces, etc.)	_____
BOWELS 0 = incontinent (or needs to be given enemas) 5 = occasional accident 10 = continent	_____
BLADDER 0 = incontinent, or catheterized and unable to manage alone 5 = occasional accident 10 = continent	_____
TOILET USE 0 = dependent 5 = needs some help, but can do something alone 10 = independent (on and off, dressing, wiping)	_____
TRANSFERS (BED TO CHAIR AND BACK) 0 = unable, no sitting balance 5 = major help (one or two people, physical), can sit 10 = minor help (verbal or physical) 15 = independent	_____
MOBILITY (ON LEVEL SURFACES) 0 = immobile or < 50 yards 5 = wheelchair independent, including corners, > 50 yards 10 = walks with help of one person (verbal or physical) > 50 yards 15 = independent (but may use any aid; for example, stick) > 50 yards	_____
STAIRS 0 = unable 5 = needs help (verbal, physical, carrying aid) 10 = independent	_____
TOTAL (0–100):	_____

Rehab principles

To support psychosocial coping and assist in the adaptation of individuals and families

To support the return to community life

To improve the quality of life of persons and family members who provide care.

Individuals' lyfestyle changes

The main goals are:

1) Adaptation

2) Evaluation of functions

3) Upgrading autonomy

Rehab team

Physiatrist is a specialist physician who treat persons that have had injuries or suffer from disabilities that affect physical and cognitive functioning.

Physioterapist is an allied health profession who work with people to help them manage pain, balance, mobility, and motor function

Rehab team

Occupational therapist is an allied health profession that involves the therapeutic use of everyday activities, to treat the physical, mental, developmental, and emotional ailments that impact the ability to perform daily tasks.

Speech therapist is an allied health profession who assess and treat speech, language, and oral/feeding/swallowing skills.

Rehab team

Rehabilitation nurse is an allied health care professional specialized in the care of dependent or semi-dependent individuals, and provides direct person care, educates disabled individuals and their families, and provides care coordination.

Rehab team

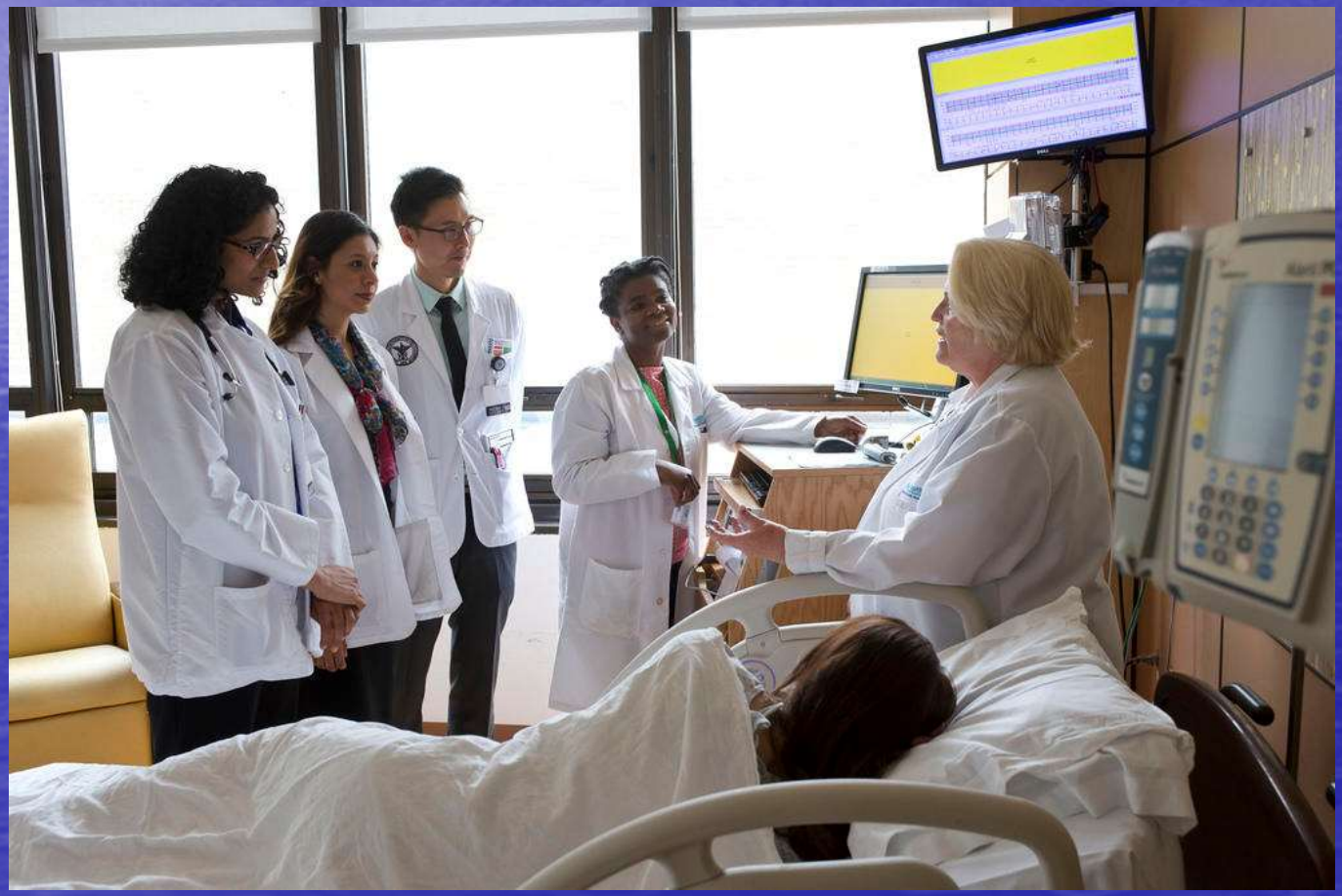
Psychologist is a trained mental health professional who helps people learn healthy ways to handle mental health challenges.

Social service assistant is an allied health profession who support families in a wide variety of fields (personal and social needs).

The health care team

NT interventions: where?

In-patient (acute and rehabilitation settings)

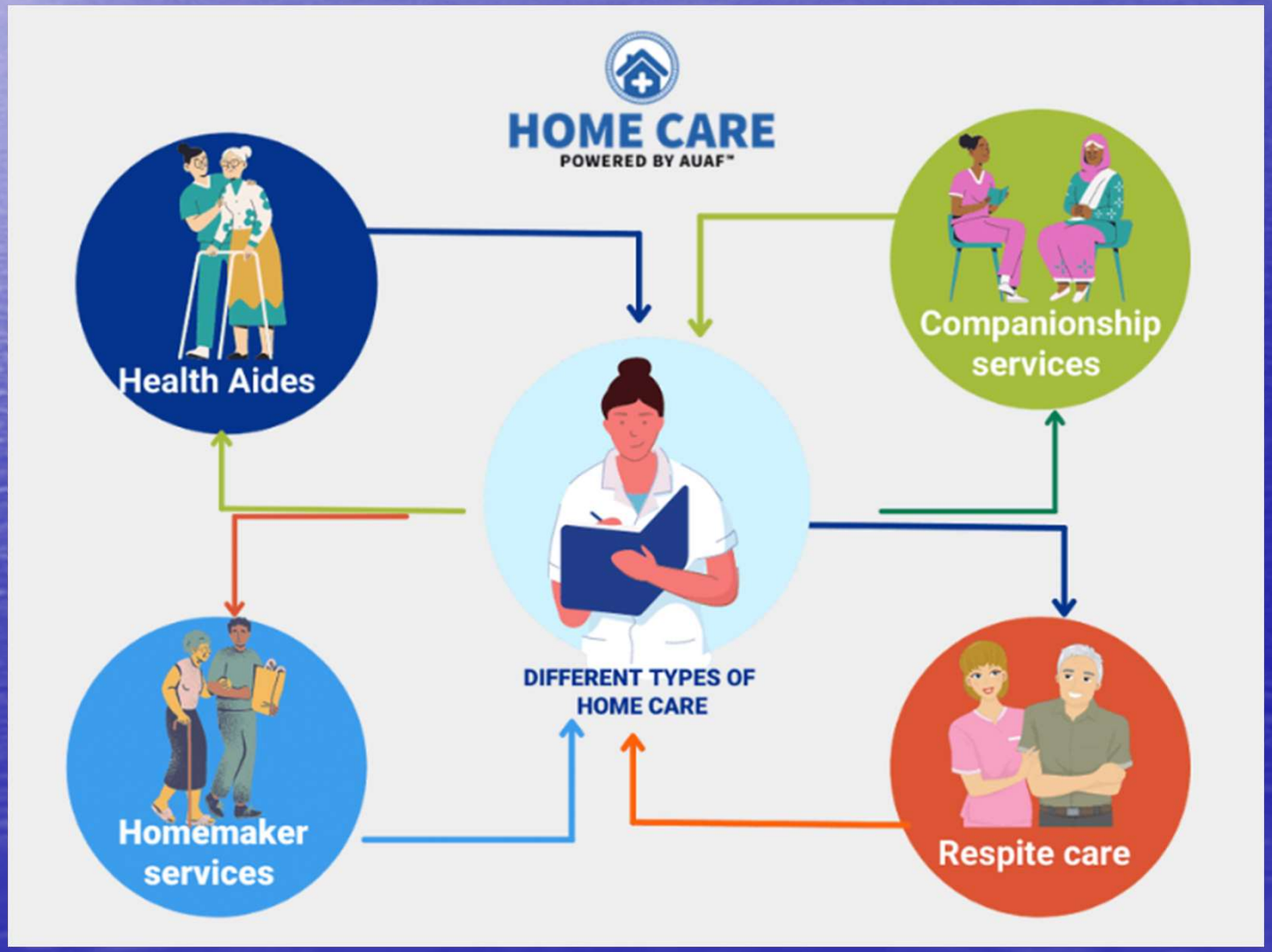


NT interventions: where?

Out-patient

NT interventions: where?

Home care



NT interventions: where?

Residential (long term) facilities

NT interventions: where?

Tele-rehabilitation

By delivering care remotely through the use of technology, including mobile devices, tablets, and computers.

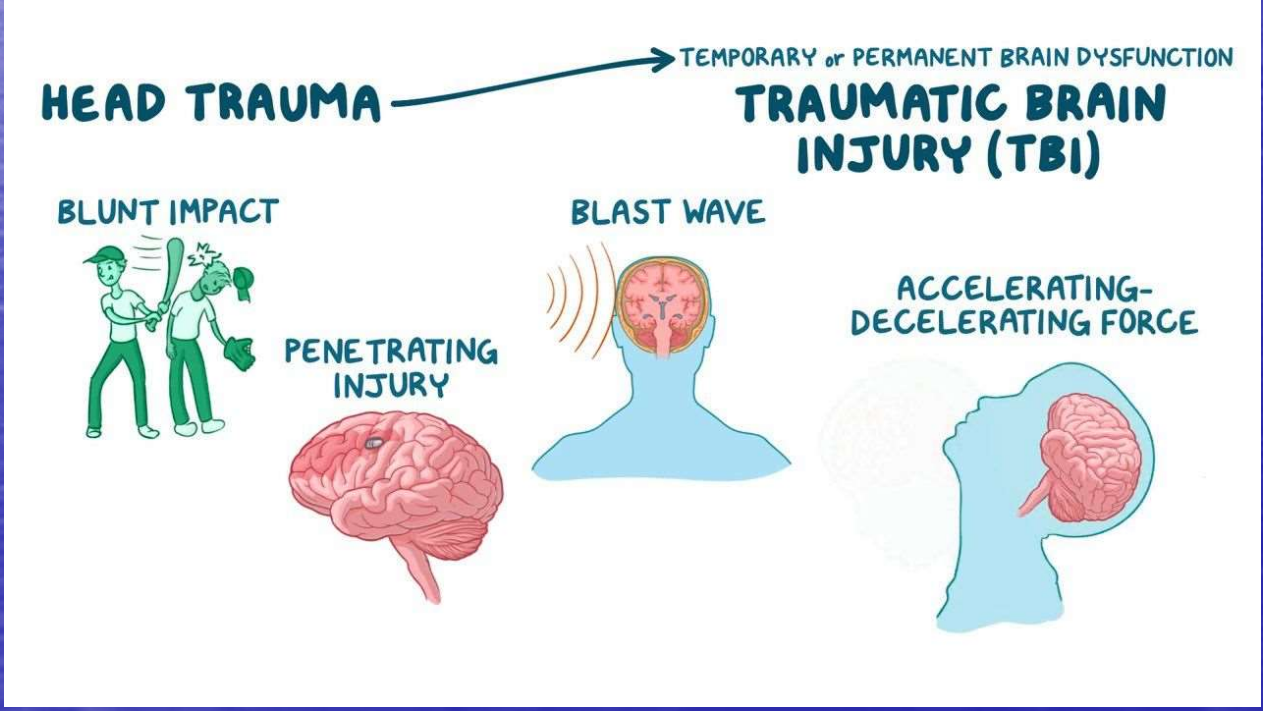
Outcome prediction

Along with clinical and neuroimaging findings, clinical neurophysiologic testing may help make more reliable outcome prediction.

Neurophysiologic techniques such as electroencephalography (EEG) and evoked potentials (EPs) are simple to apply, inexpensive, safe, and available in most rehabilitation facilities.

Outcome prediction

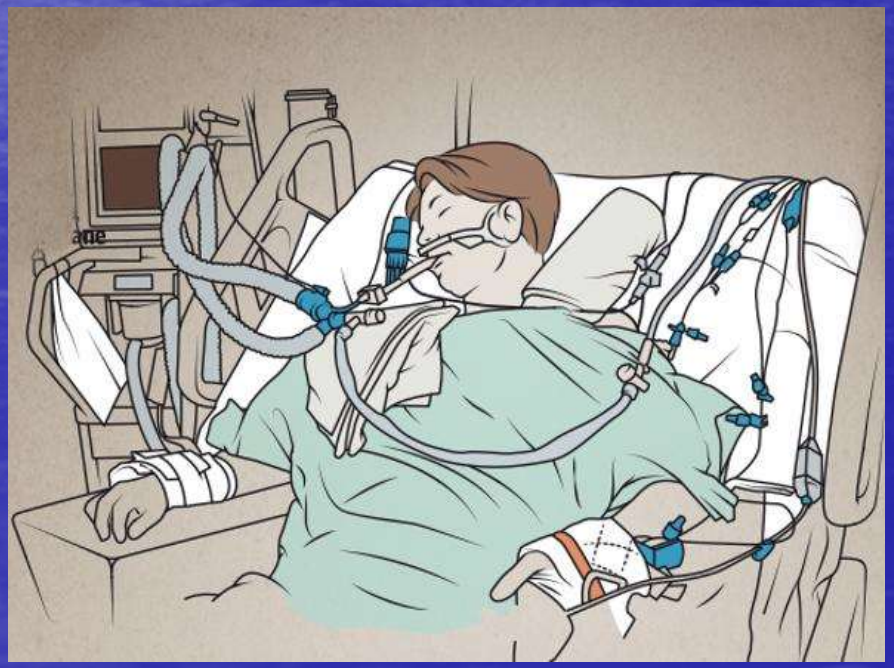
The example of Traumatic Brain Injuries (TBI) which lead to COMA, unresponsive wakefulness syndrome (UWS), and minimally conscious state (MCS).



Rollnik JD. Clinical neurophysiology of neurologic rehabilitation. Handbook of clinical neurology. 2019

COMA

A neurological disorder characterized by unconsciousness and reflex behavior (i.e., an involuntary and rapid response to a stimulus) without eye opening, even to strong painful stimuli.



Rollnik JD. Clinical neurophysiology of neurologic rehabilitation. Handbook of clinical neurology. 2019

UWS

Also known as vegetative state, eyes are open and reflex behavior occurs, but people are completely unresponsive.

Rollnik JD. Clinical neurophysiology of neurologic rehabilitation. Handbook of clinical neurology. 2019

MCS

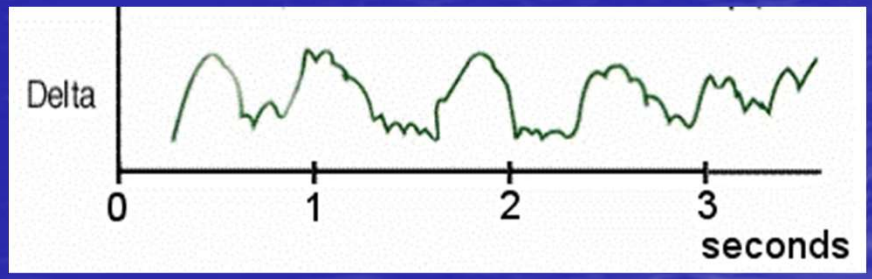
Individuals show signs of consciousness, such as command following (even if inconsistent), visual pursuit, localization to noxious stimulation, and appropriate responses to emotional stimuli without being able to functionally communicate.

Rollnik JD. Clinical neurophysiology of neurologic rehabilitation. Handbook of clinical neurology. 2019

EEG

EEG in the acute phase of hypoxic brain damage seems to be a simple but reliable outcome predictor.

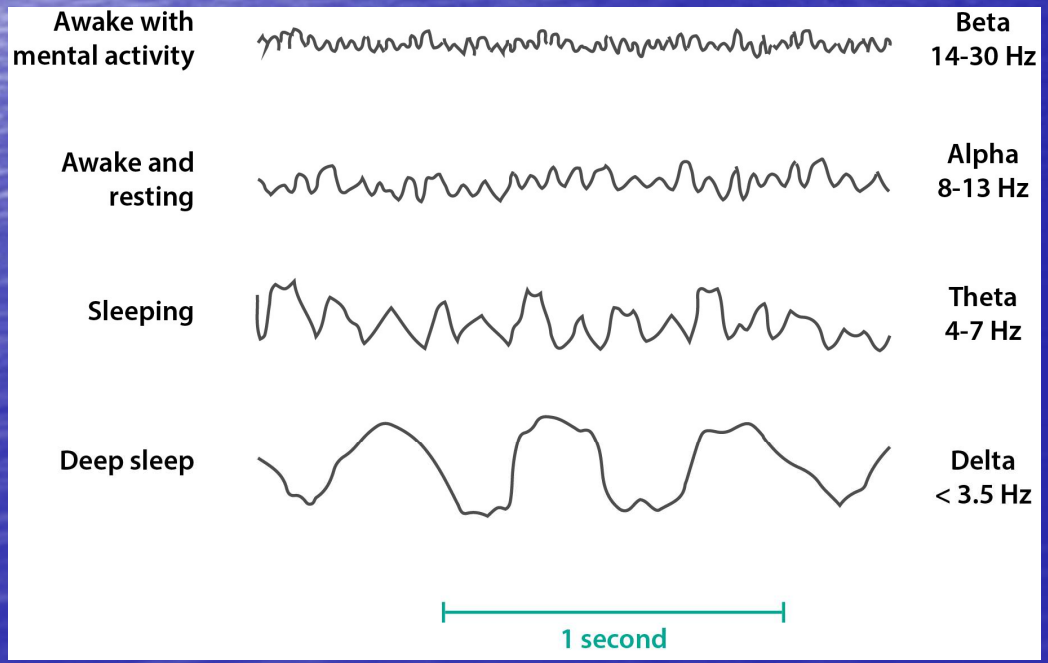
Suppression, burst suppression, **delta frequencies**, and generalized periodic complexes are associated with **poor outcomes**.



Wijdicks EF et al. Practice parameters. Neurology. 2006

EEG

In neurologic early rehabilitation, 4 weeks after hypoxic brain damage, people in the **good outcome** group more frequently had **alpha and less frequently theta or delta rhythms** compared to subjects with poor outcomes.



Heinz U. Outcome of hypoxic brain damage. BMC Res Notes 2015.

EP

With respect to EPs, short-latency SSEPs, in particular of the median nerve, have been most frequently studied in the acute phase of hypoxic brain damage while brainstem auditory (AEPs) and visual evoked potentials (VEPs) have not been thoroughly tested for their prognostic value.

Wijdicks EF et al. Practice parameters. Neurology. 2006
Heinz U. Outcome of hypoxic brain damage. BMC Res Notes 2015.

EP

SSEPs are much less influenced by sedatives or metabolic influences as compared with EEG and may therefore be more accurate in prognostication.

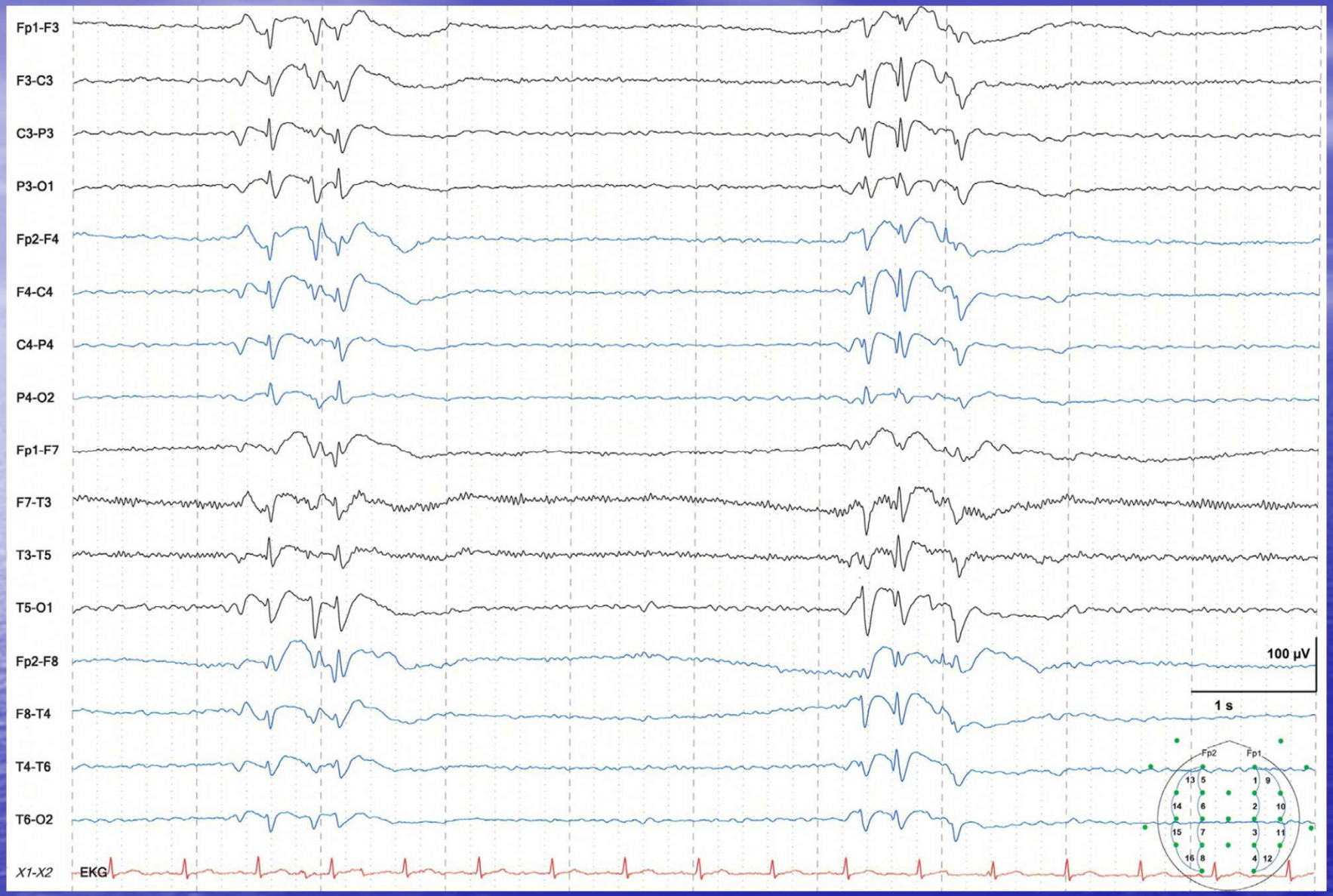
Wijdicks EF et al. Practice parameters. Neurology. 2006
Heinz U. Outcome of hypoxic brain damage. BMC Res Notes 2015.

EP

Bilateral absence of the N20 component with median nerve SSEP recorded within 3 days after CPR may predict poor outcomes.

Flash VEP and SSEP may be useful to differentiate between good and poor outcome groups.

Wijdicks EF et al. Practice parameters. Neurology. 2006
Heinz U. Outcome of hypoxic brain damage. BMC Res Notes 2015.



Burst-suppression EEG of a female 54-year-old hypoxic brain-damaged patient, 10 weeks after cardiopulmonary resuscitation, 1 week after admission into a neurologic early rehabilitation center. Cortical SSEP responses (median nerve stimulation) were present, with latencies prolonged on the right side. The patient showed only moderate improvement of DOC, from UWS to MCS at discharge, 2 months later. An inconsistent visual pursuit and localization to stimulation could be observed.

Post TBI

TBI shows a wider range of severities and anatomic localizations.

It is quite difficult to compare different TBI and hypoxic brain damage studies and to draw generally applicable conclusions.
Some clinical neurophysiologic studies have addressed outcome during long-term rehabilitation in TBI patients.

Rollnik JD. Clinical neurophysiology of neurologic rehabilitation. Handbook of clinical neurology. 2019

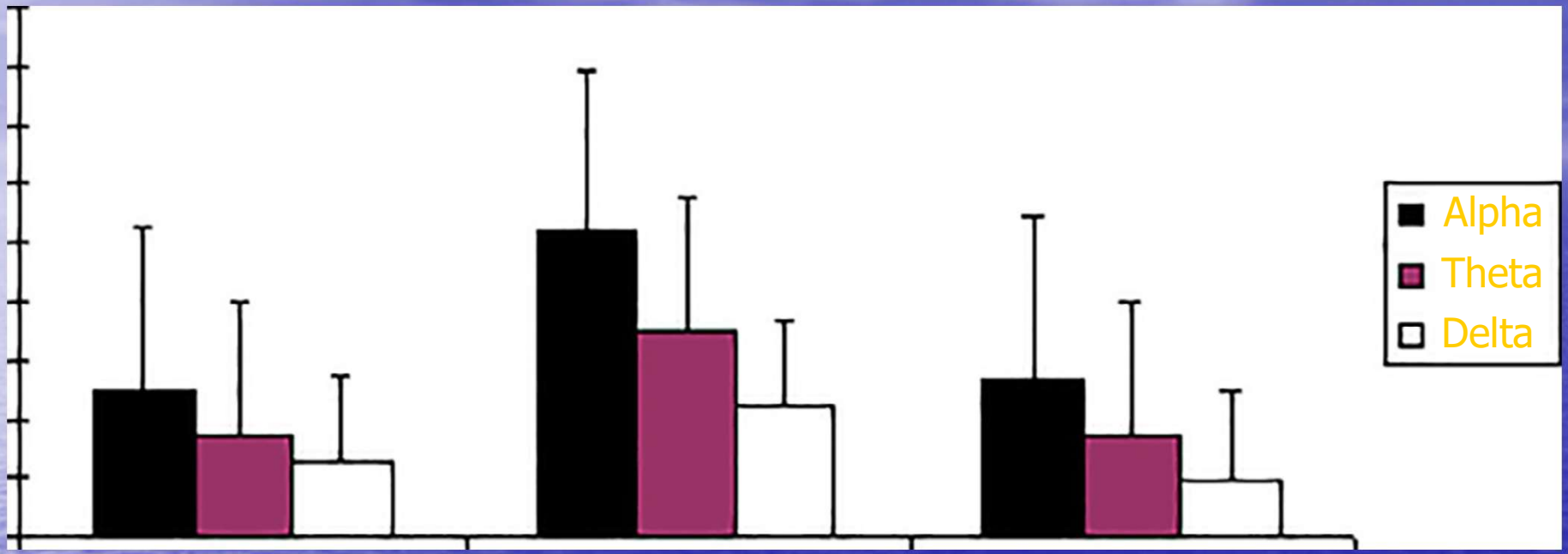
Post TBI

Delta activity, burst suppression and isoelectric EEG patterns indicate poor outcome in TBI.

During neurologic rehabilitation, improvement in functional independence (Barthel index) may be smaller when people have delta or theta EEG frequencies.

Synek VM. Prognostically important EEG coma patterns. J Clin Neurophysiol 1988; Rollnik JD. May clinical neurophysiology help to predict the recovery. BMC Neurol 2015

Admission Discharge Discharge-Admission



When patients had alpha EEG activity, Barthel index (BI) on admission and at discharge and changes of Barthel index (discharge minus admission) were significantly higher than in patients with theta or delta activity

Rollnik JD. Clinical neurophysiology of neurologic rehabilitation. Handbook of clinical neurology. 2019

Post TBI

While loss of cortical SSEP is generally regarded as a negative prognostic sign in the acute phase of postanoxic encephalopathy, absence of cortical SSEP responses is not uniformly associated with poor outcome in TBI.

Schorl M. Median evoked somatosensory potentials in severe brain injury Clin Neurol Neurosurg 2014; Rollnik JD. May clinical neurophysiology help to predict the recovery. BMC Neurol 2015

Post TBI

It is not uncommon
for cortical responses to return during
rehabilitation.

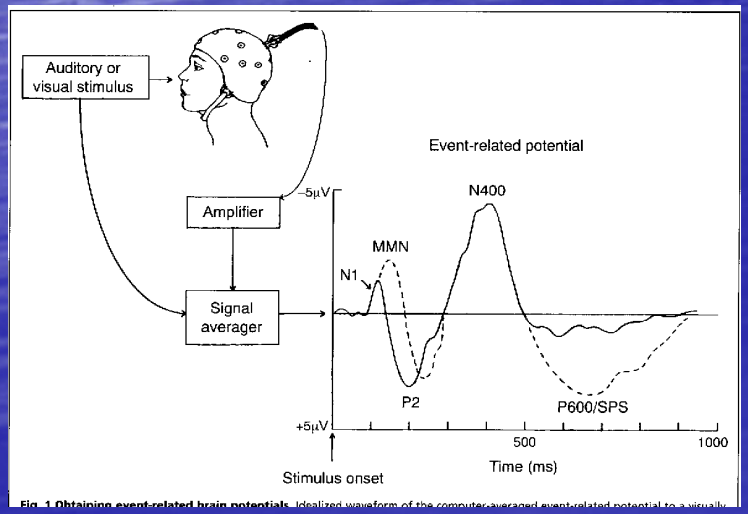
Up to 50% of TBI patients with initial bilateral absence of SSEP showed reoccurrence of cortical potentials, either uni- or bilaterally.

Schorl M. Median evoked somatosensory potentials in severe brain injury
Clin Neurol Neurosurg 2014

Event-related potentials (ERPs)

ERPs are measured brain responses resulting from specific cognitive tasks, sensory stimulation, or planned motor activity.

There is evidence suggesting that ERPs may be superior to SSEP in predicting functional and disorders of consciousness outcomes.



Lew HL. Use of somatosensory evoked potentials and cognitive event-related potentials. Am J PMR 2003

ERPs

The N100 is a large, negative potential, elicited by any unpredictable (primarily auditory) stimulus in the absence of task demands.

The mismatch negativity is a component of the ERP to an odd stimulus in a sequence of stimuli occurring in any sensory system.

Rollnik JD. Clinical neurophysiology of neurologic rehabilitation. Handbook of clinical neurology. 2019

ERPs

The P300 is an endogenous potential linked to a person's reaction, not to the physical attributes of a stimulus. It probably reflects processes involved in cognitive information processing (e.g., memory, attention, executive function).

The N400 is part of the response to words and other meaningful (or potentially meaningful) stimuli.

Rollnik JD. Clinical neurophysiology of neurologic rehabilitation. Handbook of clinical neurology. 2019

ERPs

Preservation of the N100, the MMN, and the P300 are highly significant predictors of awakening from disorders of consciousness of different etiologies.

Conservation of the N400, indicates residual higher-level semantic information processing abilities and appears to be associated with recovery from UWS and MCS.

Daltrozzo J. Predicting coma. Clin Neurophysiol 2007.

Scoliosis

Adolescent idiopathic scoliosis (AIS) has been defined as a three-dimensional deformity of the spine and trunk occurring in healthy pubertal children.

The prevalence of AIS with a Cobb angle of 10° is approximately 2.5 % in the general population.

Weinstein SL. Adolescent idiopathic scoliosis. Lancet. 2008

Scoliosis

Aetiology remains unknown

The main causes seem to be genetic predisposition, connective tissue abnormalities, and skeletal, **muscular** and neurological disturbances during growth.

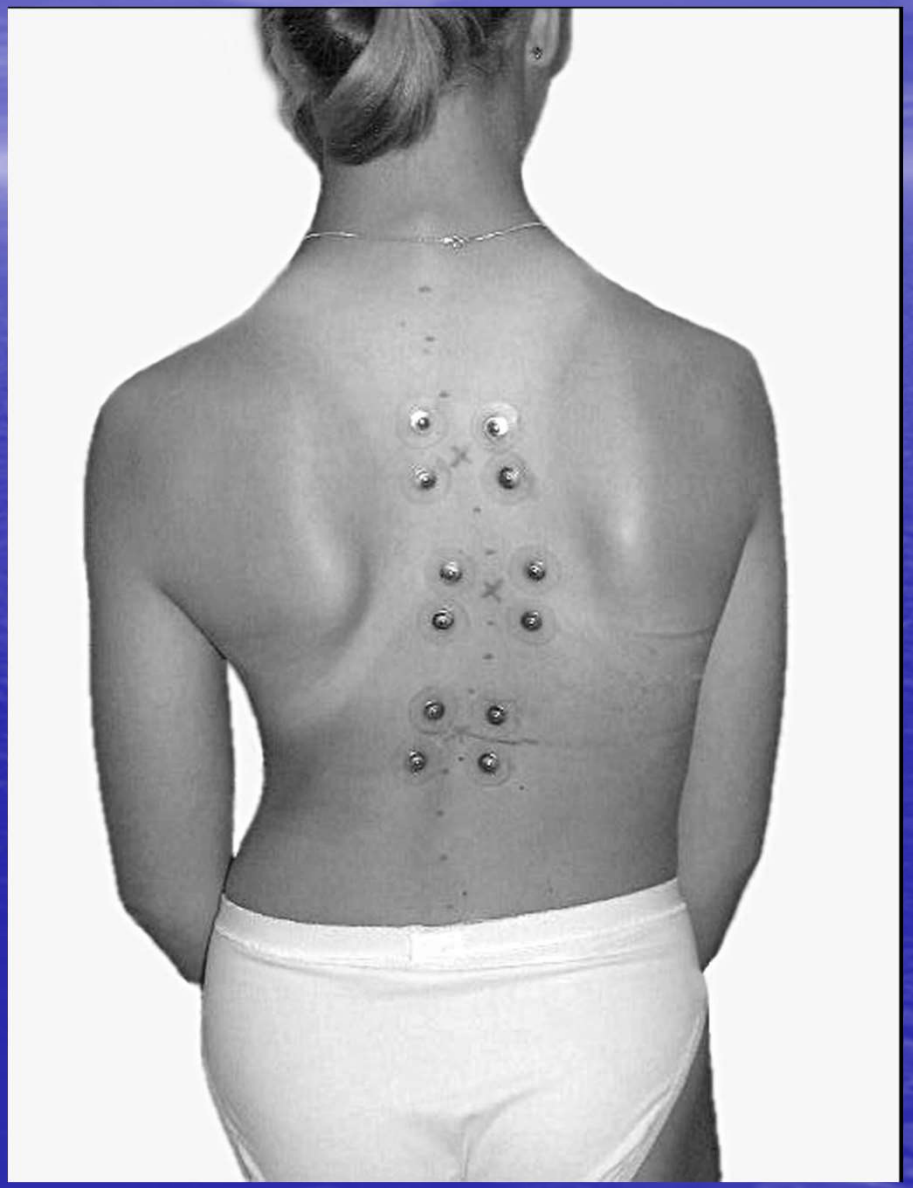
Weinstein SL. Adolescent idiopathic scoliosis. Lancet. 2008

Scoliosis

- EMG abnormalities (type 1 fibers).

- During progression of the deformity:
  - -muscolar hyperactivity at the convex side of the curve
  - -rapid vertebral growth

This activity is a primary or secondary cause of scoliosis?



Cheung J. The Relation Between Electromyography and Growth Velocity of the Spine in the Evaluation of Curve Progression in AIS. Spine 2004

Scoliosis

Definition of a nomogram, with clinical and prognostic value.

Table 2. Nomogram using the Variables Spinal Growth Velocity (SGV) in mm/year and EMG Ratio for predicting the Probability of Progression

SGV	<8	8–15	>15	Total
EMG Ratio				
<0.8	0/8 (0%)	0/6 (0%)	0/4 (0%)	0/18 (0%)
0.8–2.0	0/22 (0%)	3/15 (20%)	3/7 (43%)	6/44 (14%)
>2.0	0/9 (0%)	3/5 (60%)	8/9 (89%)	11/23 (48%)
Total	0/39 (0%)	6/26 (23%)	11/20 (55%)	17/85 (20%)

Cheung J. The Relation Between Electromyography and Growth Velocity of the Spine in the Evaluation of Curve Progression in AIS. Spine 2004

Low Back Pain (LBP)

It is common and experienced by people of all ages.

Rarely a specific cause is identified, and most cases are non-specific.

When pain lasts up to six weeks we talk of acute LBP, if symptoms persist over 12 weeks of chronic LBP (+ sciatica).

Hartvigsen J. Low back pain. Lancet. March 2018

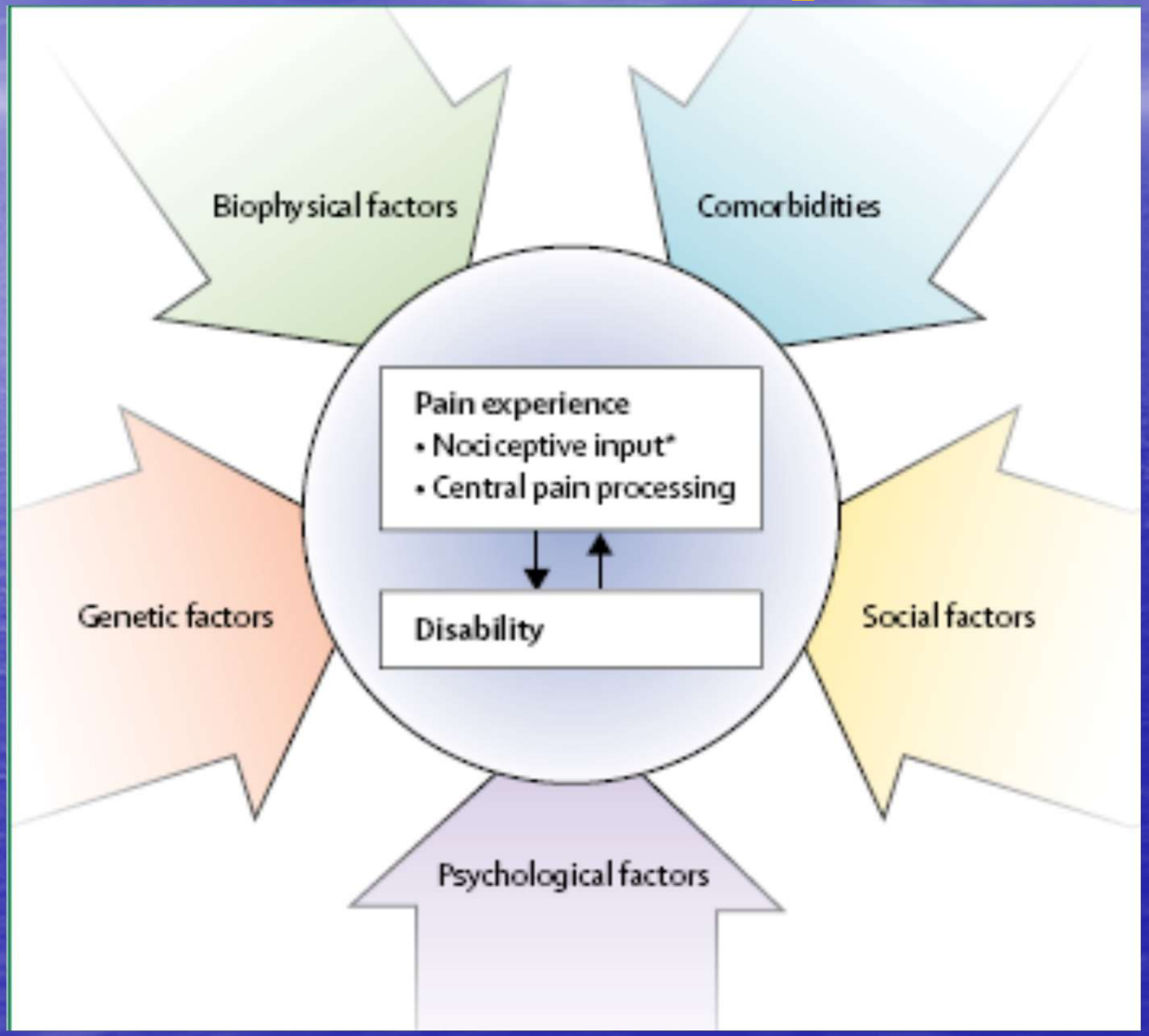
Low Back Pain (LBP)

It is responsible for 60.1 million disability-adjusted life-years (2015), with an increase of 54% since 1990.

Disability from LBP is highest in working age groups, which is especially concerning in low-income and middle-income countries where informal employment is common and possibilities for job modification are limited.

Hartvigsen J. Low back pain. Lancet. March 2018

Contributors to LBP and disability

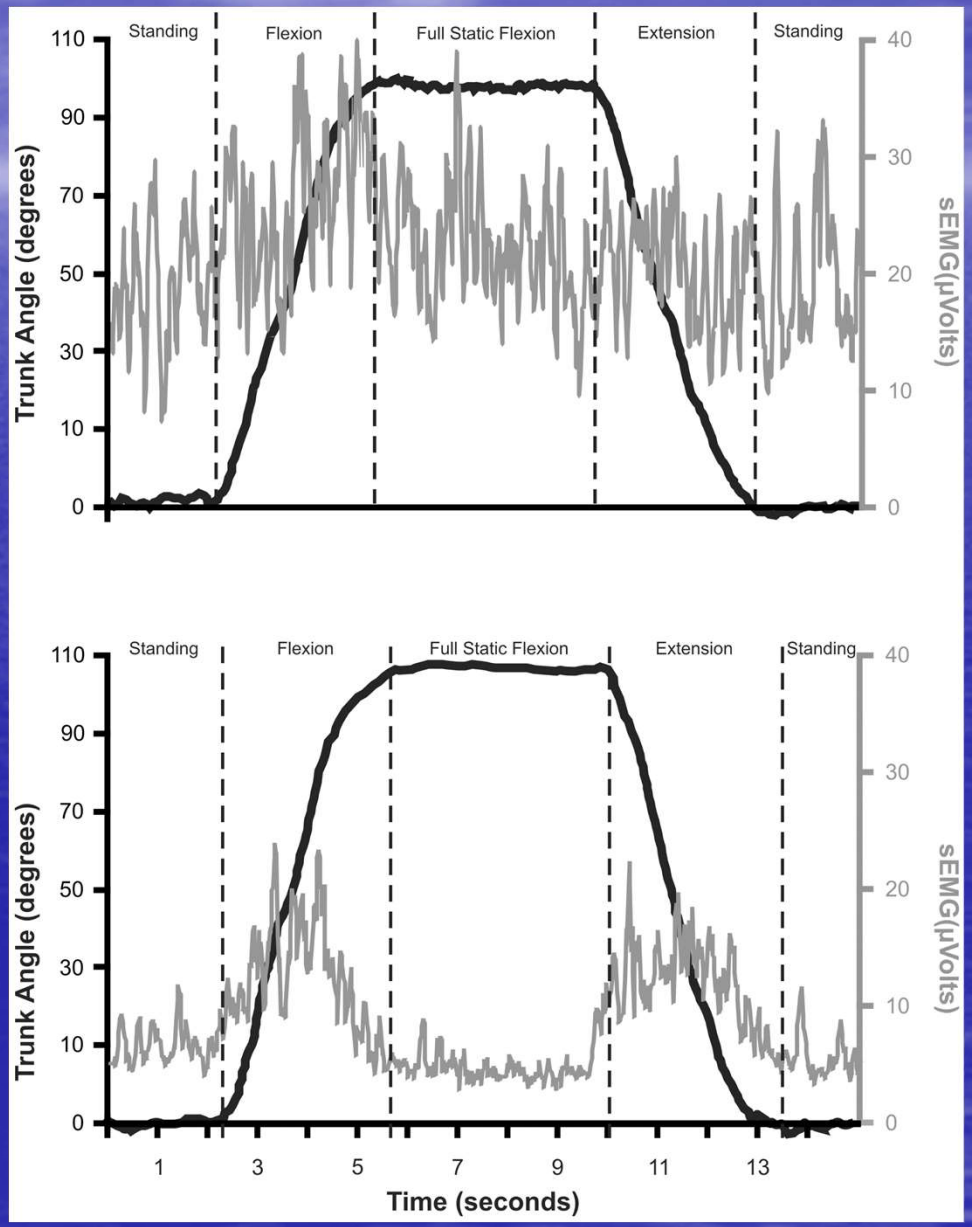


Hartvigsen J. Low back pain. Lancet. March 2018

Surface EMG

cLBP

Individuals underwent a dynamic EMG evaluation for which they were asked to stand, then bend forward as far as possible, stay fully flexed, and return to standing.

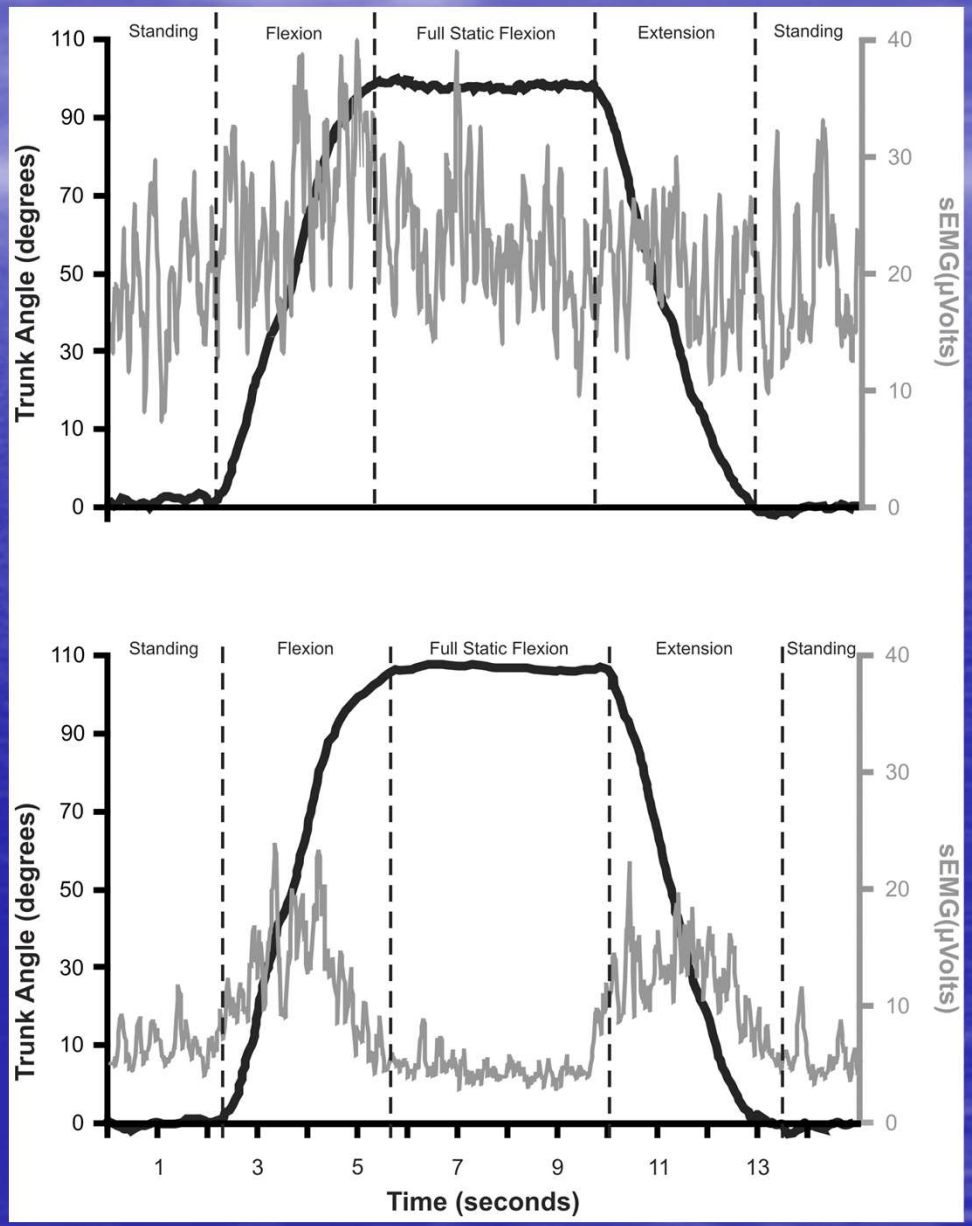


Helathy people

Geisser ME. Pain-Related Fear, Lumbar Flexion, and Dynamic EMG Clin J Pain 2008

Surface EMG

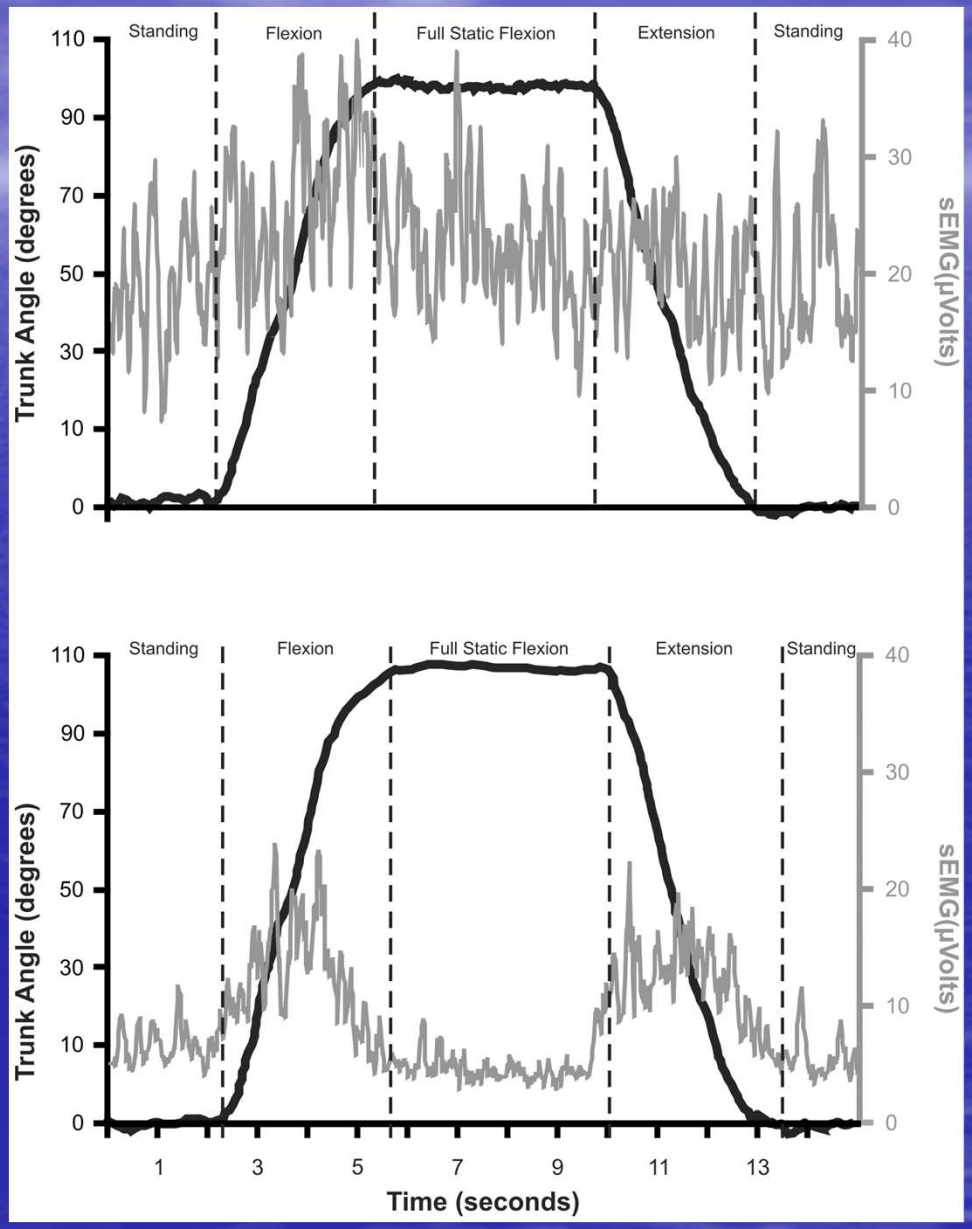
Lumbar EMG and angle of flexion were recorded during this time. A flexion-relaxation ratio (FRR) was computed by comparing maximal EMG while flexing to the average EMG in full flexion.



Geisser ME. Pain-Related Fear, Lumbar Flexion, and Dynamic EMG Clin J Pain 2008

Surface EMG

Pain-related fear is significantly associated with reduced lumbar flexion, greater EMG in full flexion, and a smaller FRR.

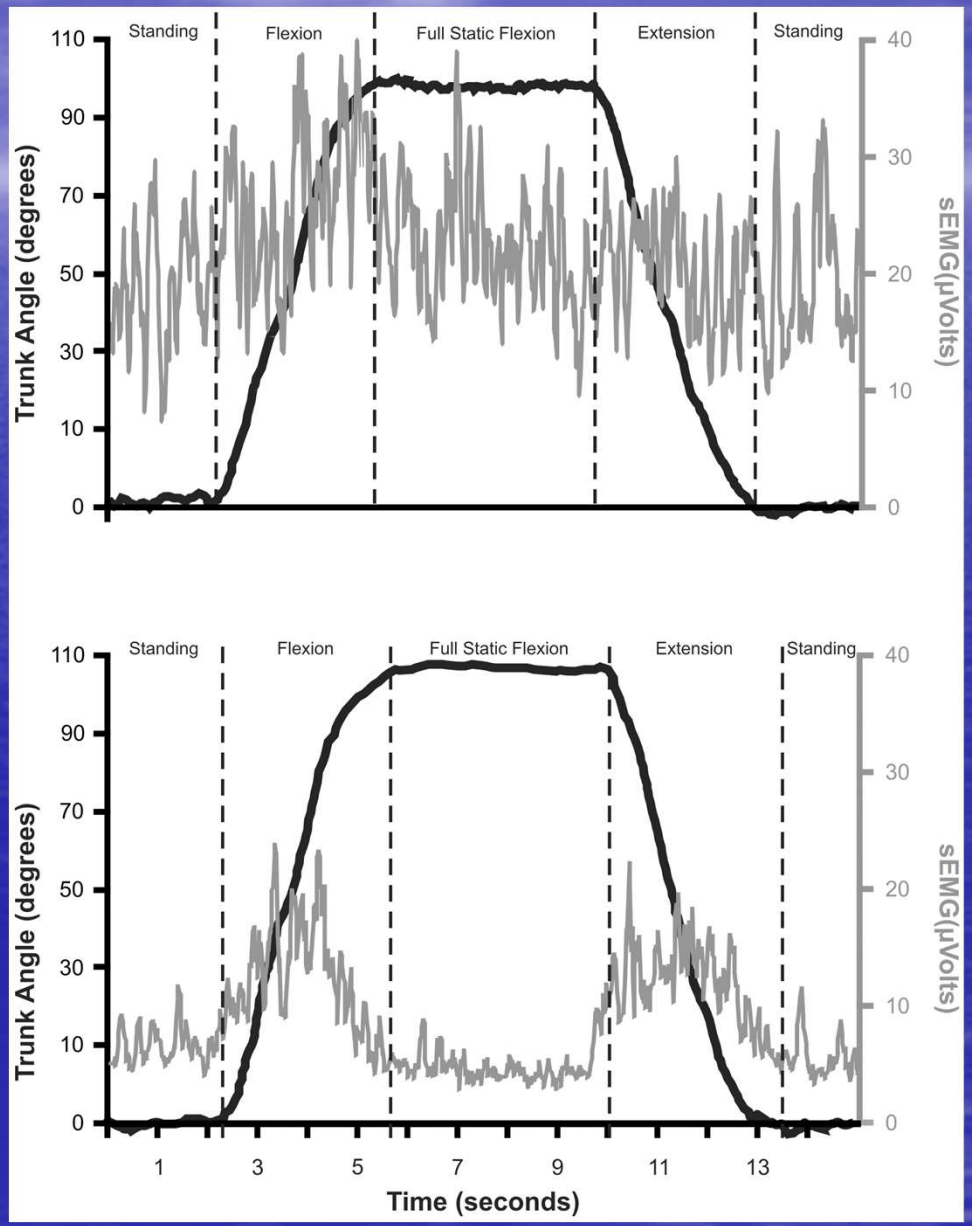


Geisser ME. Pain-Related Fear, Lumbar Flexion, and Dynamic EMG Clin J Pain 2008

Surface EMG

The relationship between pain-related fear and EMG during flexion and extension appears to be mediated by reduced lumbar flexion.

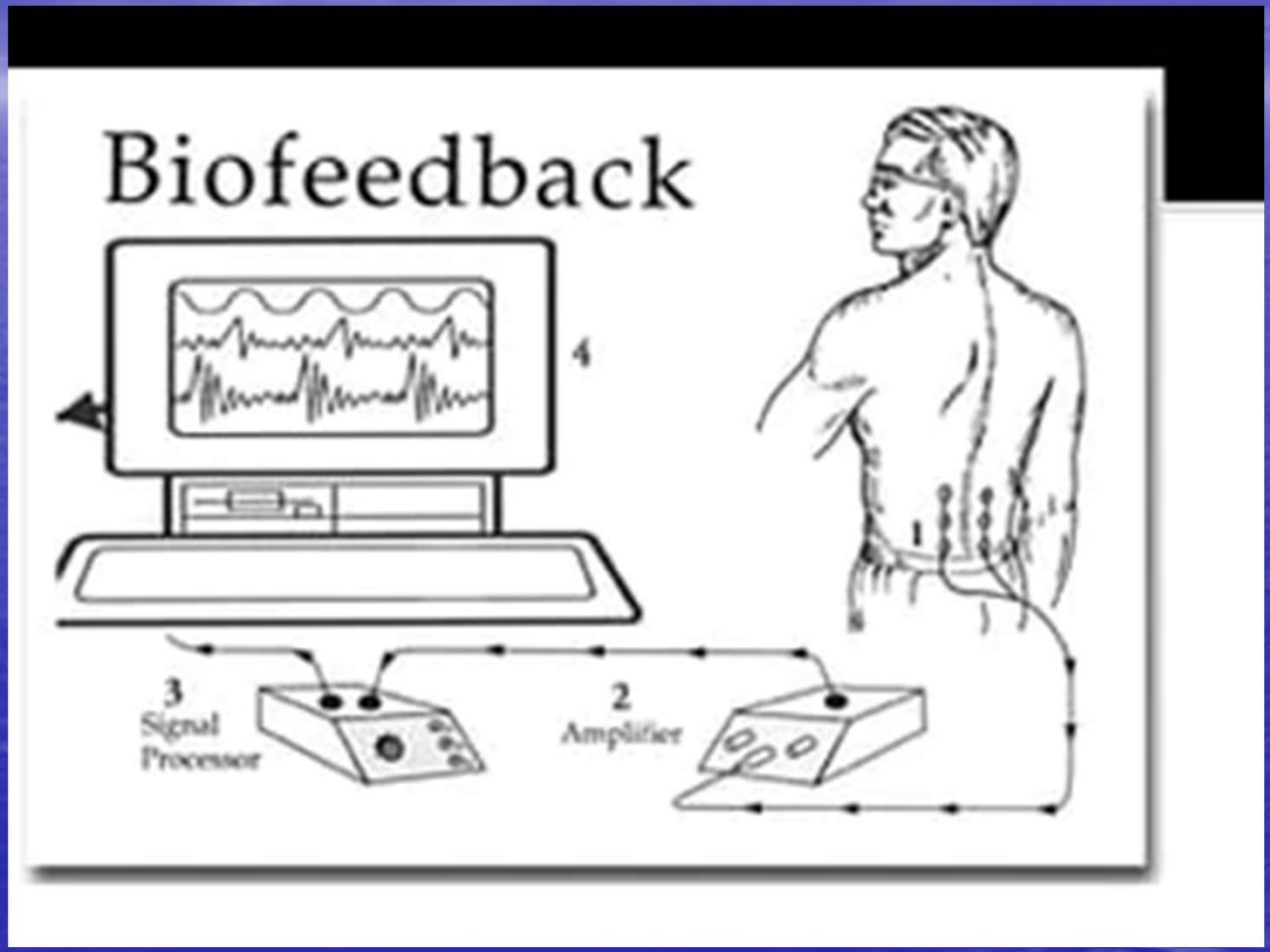
Implication for treatment!



Geisser ME. Pain-Related Fear, Lumbar Flexion, and Dynamic EMG Clin J Pain 2008

Biofeedback sEMG

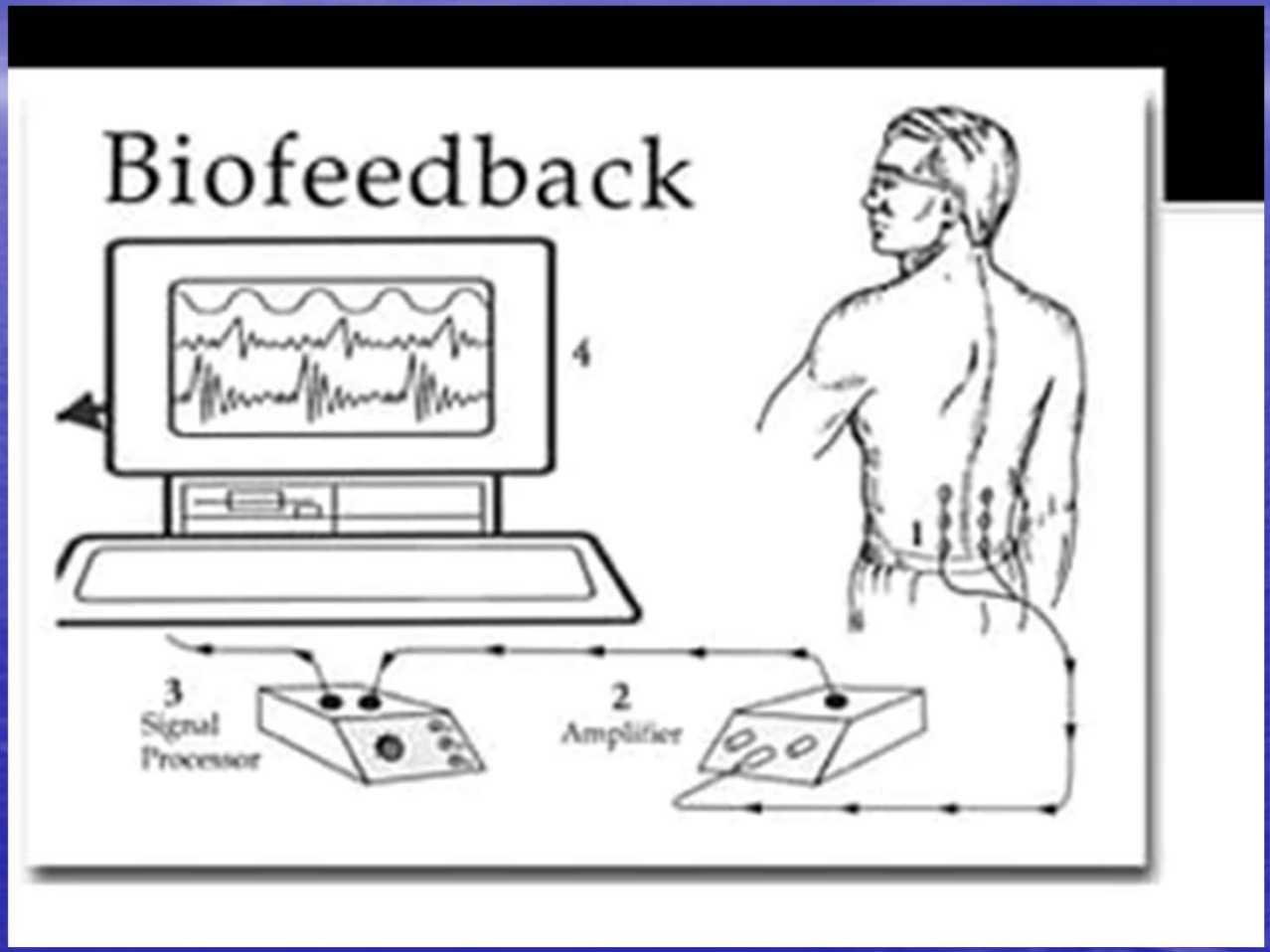
EMG uses surface electrodes to detect a change in skeletal muscle activity, which is then fed back to the user usually by a visual or auditory signal.



Newton-John TO. Cognitive-behavioural therapy versus EMG biofeedback. Behav Res Ther 1995

Biofeedback sEMG

It measures muscle activity and tension.
It may be used for a number of diseases, including LBP, muscle retraining after injury, and incontinence.



Newton-John TO. Cognitive-behavioural therapy versus EMG biofeedback. Behav Res Ther 1995

Sciatica

Signs of radiculopathy (straight leg raising test)

quite different from

signs of peripheral neurological compression

quadriceps

gastrocnemius

Savage NJ. The prognostic value of electrodiagnostic testing in patients with sciatica. ESJ 2015

Needle EMG

It is really useful only in the latter case to confirm specific from non-specific causes of sciatica!

quadriceps

gastrocnemius

Savage NJ. The prognostic value of electrodiagnostic testing in patients with sciatica. ESJ 2015

Neck Pain (NP)

Extremely frequent. 4th cause of disability.

Its aetiology is multifactorial and includes age, gender, wrong posture, repetitive strains and poor self-rated health.

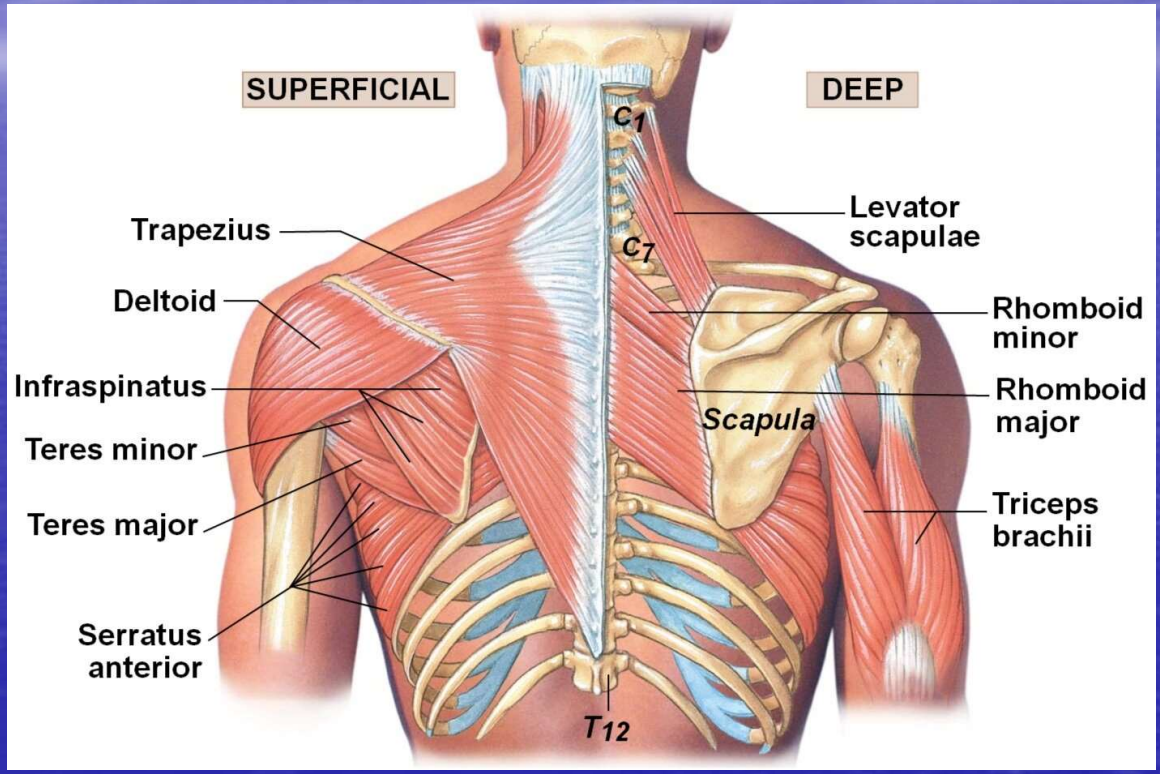
Research based on bio-psychosocial models links chronic NP to physical dysfunction and psychological factors (fear of movement).

Johansen JB. The determinants of function and disability in neck patients referred to a specialized outpatient clinic. Clin J Pain 2013

sEMG

Scapular muscles activity in chronic NP:

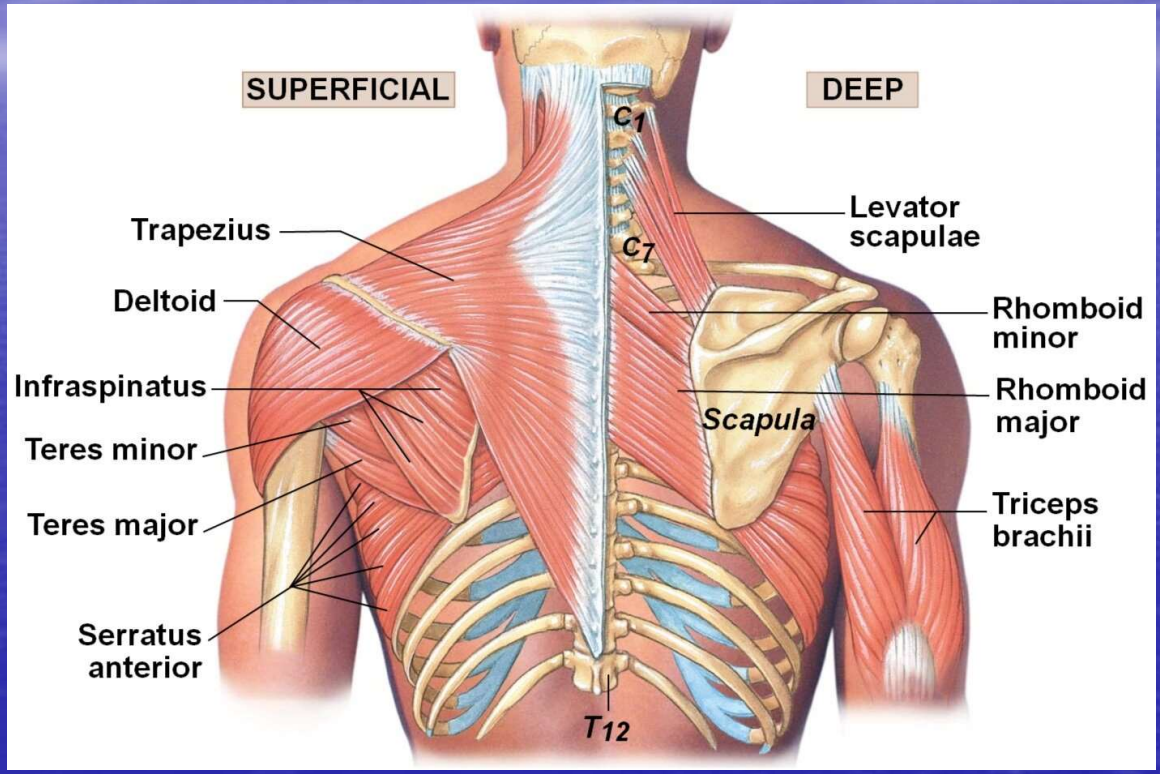
1) amplitude
2) timing
3) fatigue



Castelein B. Analysis of scapular muscle EMG activity in patients with idiopathic NP. J EMG and Kinesiol 2015

sEMG: Amplitude

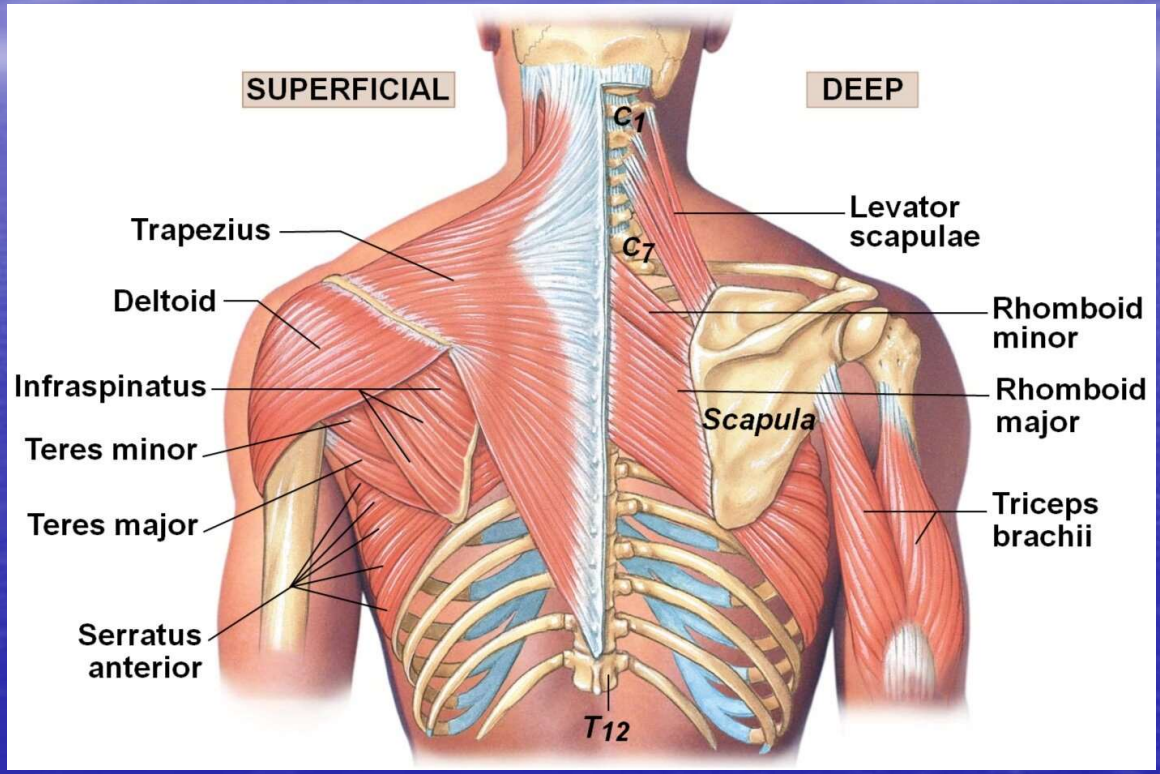
No significant differences in upper trapezius (UP) EMG amplitude activity between patients with NP and pain-free controls.



Castelein B. Analysis of scapular muscle EMG activity in patients with idiopathic NP. J EMG and Kinesiol 2015

sEMG: Timing

Significant delayed onset of muscle activation and shorter duration of activity of the serratus anterior (SA) in the presence of NP.

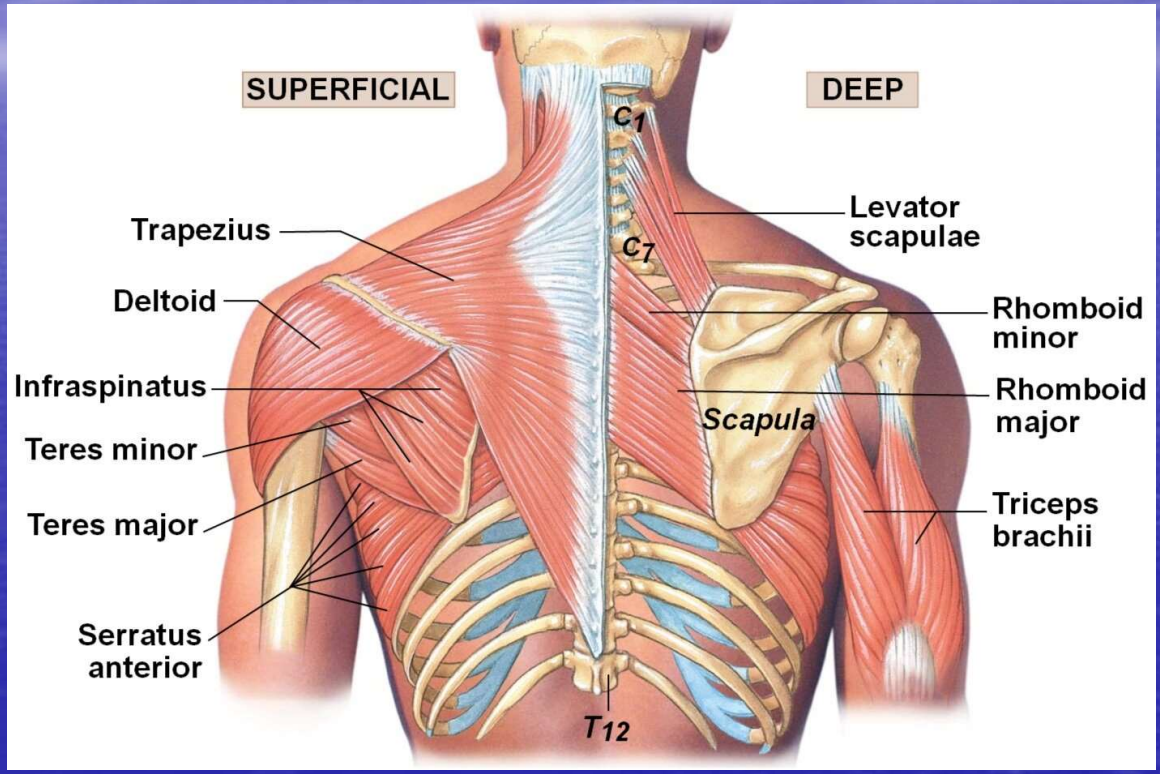


➡ Dyssynergia between SA and UT

Castelein B. Analysis of scapular muscle EMG activity in patients with idiopathic NP. J EMG and Kinesiol 2015

sEMG: Fatigue

There are differences in scapular EMG fatigue parameters between persons with chronic idiopathic NP and healthy people



esp: a fall in the center frequency

Castelein B. Analysis of scapular muscle EMG activity in patients with idiopathic NP. J Electromyogr Kinesiol 2015

Brachial pain

Signs of radiculopathy (shoulder abduction test)

quite different from

signs of peripheral neurological compression

biceps

triceps

Bissett A. The cervico-brachial pain syndrome: Muscle activity and pain relief. Behaviour Change. 1985

Needle EMG

It is really useful only in the latter case to confirm specific from non-specific causes of brachial pain!

biceps

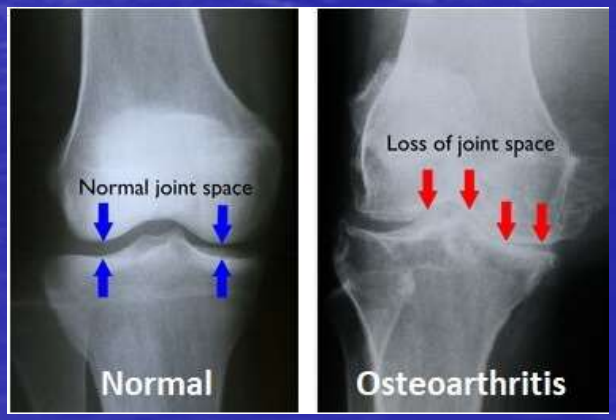
triceps

Bissett A. The cervico-brachial pain syndrome: Muscle activity and pain relief. Behaviour Change. 1985

Knee osteoarthritis (OA)

OA is the most common joint disorder. It affects various joints in the musculoskeletal system.

Knee osteoarthritis affects 30-40% of the population aged 65 and over.

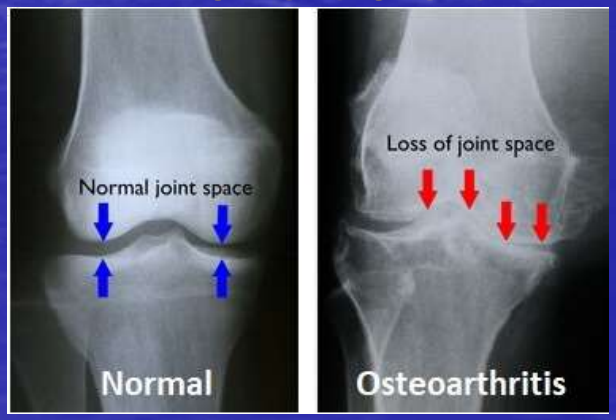


Lewek MD. Quadriceps femoris muscle weakness and activation failure in patients with symptomatic knee osteoarthritis. J Orthop Res 2004

Knee osteoarthritis (OA)

Knee OA is the main cause of disability among elderly and this causes a significant economic burden in the population.

Muscle weakness is associated with pain and function loss and affects the progression of the disease.



Lewek MD. Quadriceps femoris muscle weakness and activation failure in patients with symptomatic knee osteoarthritis. J Orthop Res 2004

Biofeedback sEMG

It is used to help the person to develop greater voluntary control of either neuromuscular relaxation or muscle re-education.

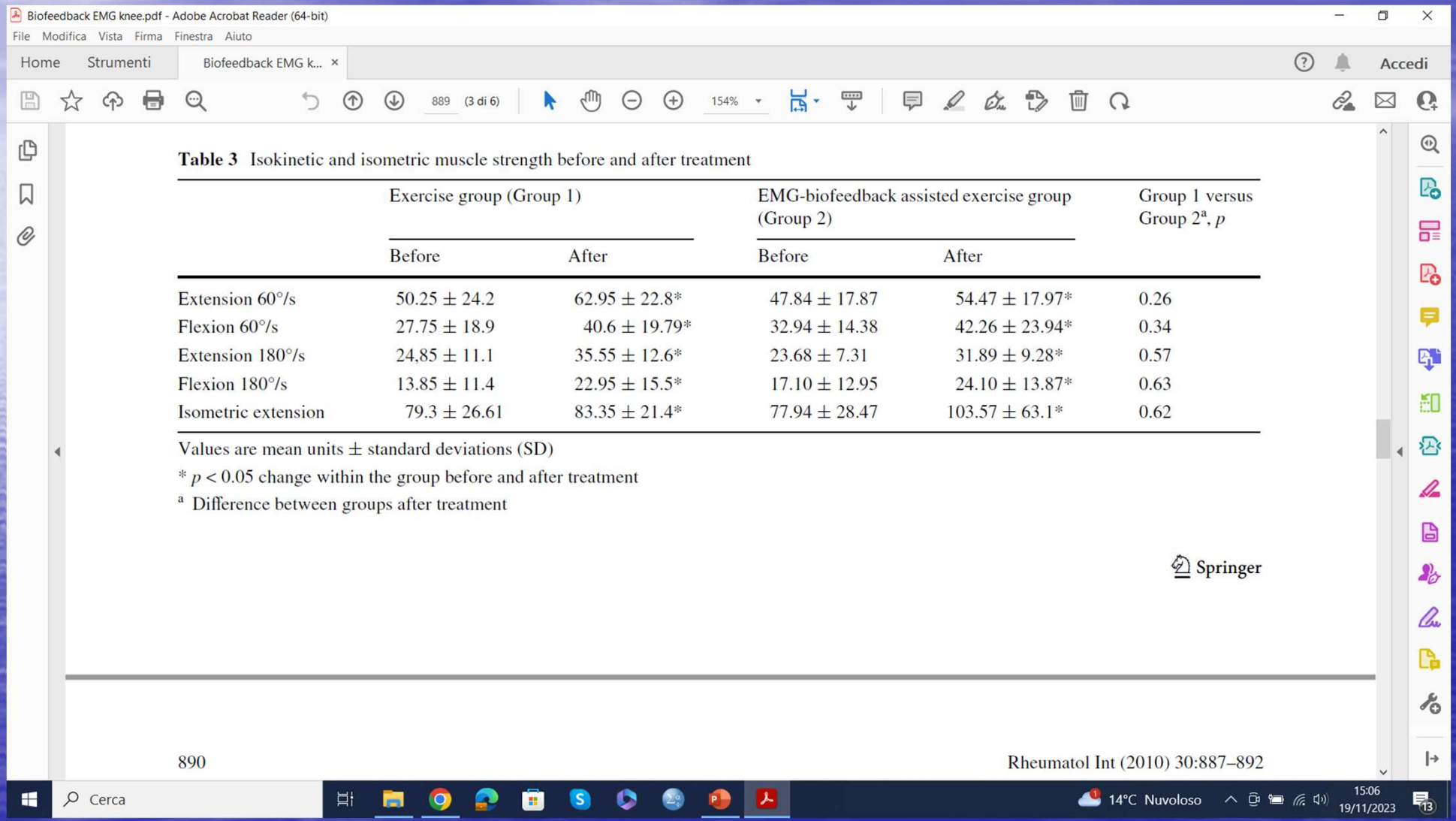
Prentice WE. Biofeedback. In: Prentice WE (ed) Therapeutic modalities in rehabilitation, 3rd edn. The McGraw-Hill, New York, 2005

Biofeedback sEMG

EMG-biofeedback assisted exercise programs are suggested as they increase compliance with exercise and motivation of individuals.

Christanell F. The influence of electromyographic biofeedback therapy on knee. BMC Sports Science, Med and Rehab. 2012.

Biofeedback sEMG



Biofeedback EMG knee.pdf - Adobe Acrobat Reader (64-bit)

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889 (3 di 6) 154%

Table 3 Isokinetic and isometric muscle strength before and after treatment

	Exercise group (Group 1)		EMG-biofeedback assisted exercise group (Group 2)		Group 1 versus Group 2[a], *p*
	Before	After	Before	After	
Extension 60°/s	50.25 ± 24.2	62.95 ± 22.8*	47.84 ± 17.87	54.47 ± 17.97*	0.26
Flexion 60°/s	27.75 ± 18.9	40.6 ± 19.79*	32.94 ± 14.38	42.26 ± 23.94*	0.34
Extension 180°/s	24,85 ± 11.1	35.55 ± 12.6*	23.68 ± 7.31	31.89 ± 9.28*	0.57
Flexion 180°/s	13.85 ± 11.4	22.95 ± 15.5*	17.10 ± 12.95	24.10 ± 13.87*	0.63
Isometric extension	79.3 ± 26.61	83.35 ± 21.4*	77.94 ± 28.47	103.57 ± 63.1*	0.62

Values are mean units ± standard deviations (SD)

* $p < 0.05$ change within the group before and after treatment

[a] Difference between groups after treatment

Springer

890 Rheumatol Int (2010) 30:887–892

Cerca 14°C Nuvoloso 15:06 19/11/2023

Increase in pain, function, strenght

Yilmaz OO. Efficacy of EMG-biofeedback in knee osteoarthritis. Rheumatol Int 2010.

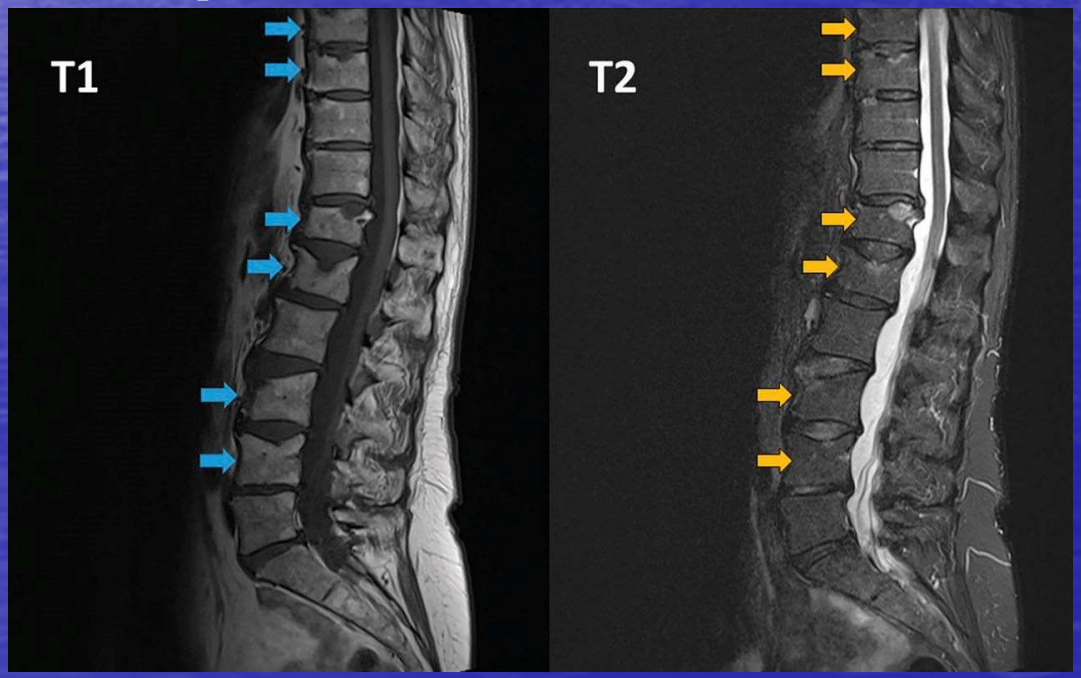
Vertebral fractures

Osteoporotic vertebral fractures occur most frequently in the mid-thoracic spine and thoracolumbar junction.

Briggs AM. Paraspinal muscle control in people with osteoporotic vertebral fracture. ESJ 2007.

Vertebral fractures

Once an individual sustains a fracture, the risk of subsequent fracture increases by up to four to sevenfold and then exponentially for each fracture sustained thereafter (vertebral fracture cascade).

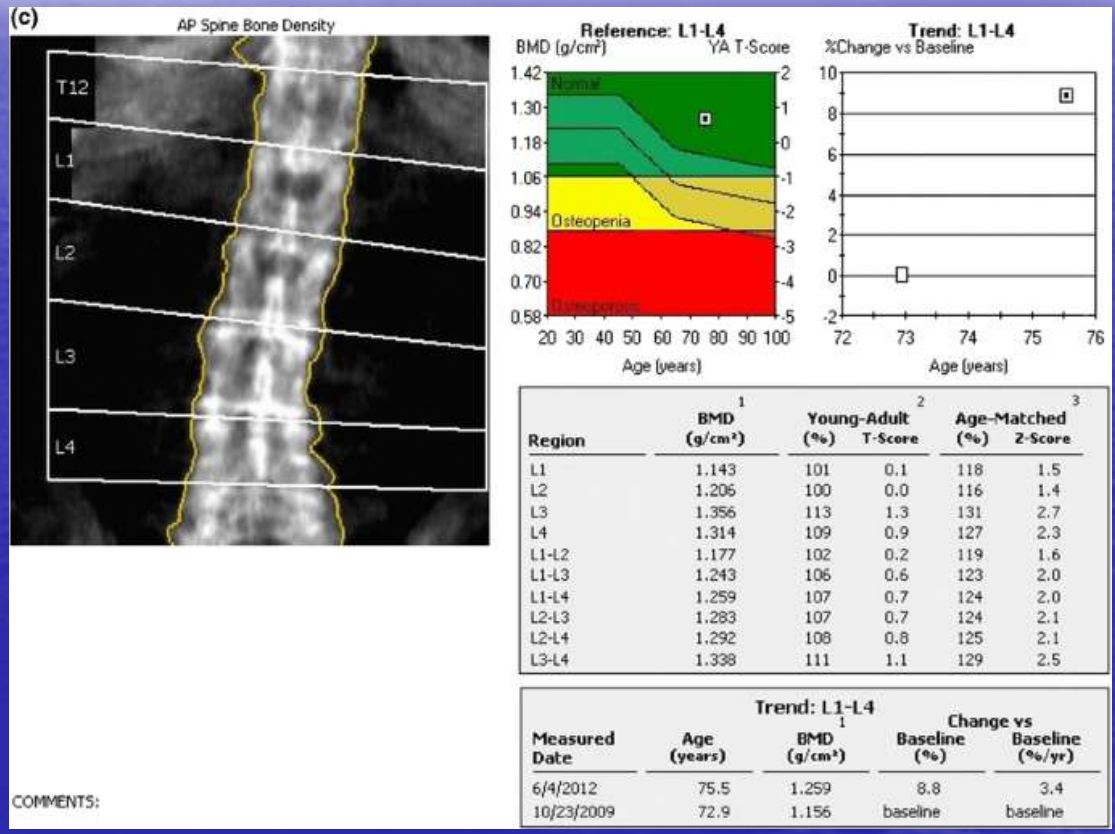


Briggs AM. Paraspinal muscle control in people with osteoporotic vertebral fracture. ESJ 2007.

Vertebral fractures

Bone Mineral Density is an inadequate predictor of vertebral fracture risk.

Other factors include also the neuromuscular activity!



Region	BMD (g/cm²) [1]	Young-Adult (%) [2]	Young-Adult T-Score [2]	Age-Matched (%) [3]	Age-Matched Z-Score [3]
L1	1.143	101	0.1	118	1.5
L2	1.206	100	0.0	116	1.4
L3	1.356	113	1.3	131	2.7
L4	1.314	109	0.9	127	2.3
L1-L2	1.177	102	0.2	119	1.6
L1-L3	1.243	106	0.6	123	2.0
L1-L4	1.259	107	0.7	124	2.0
L2-L3	1.283	107	0.7	124	2.1
L2-L4	1.292	108	0.8	125	2.1
L3-L4	1.338	111	1.1	129	2.5

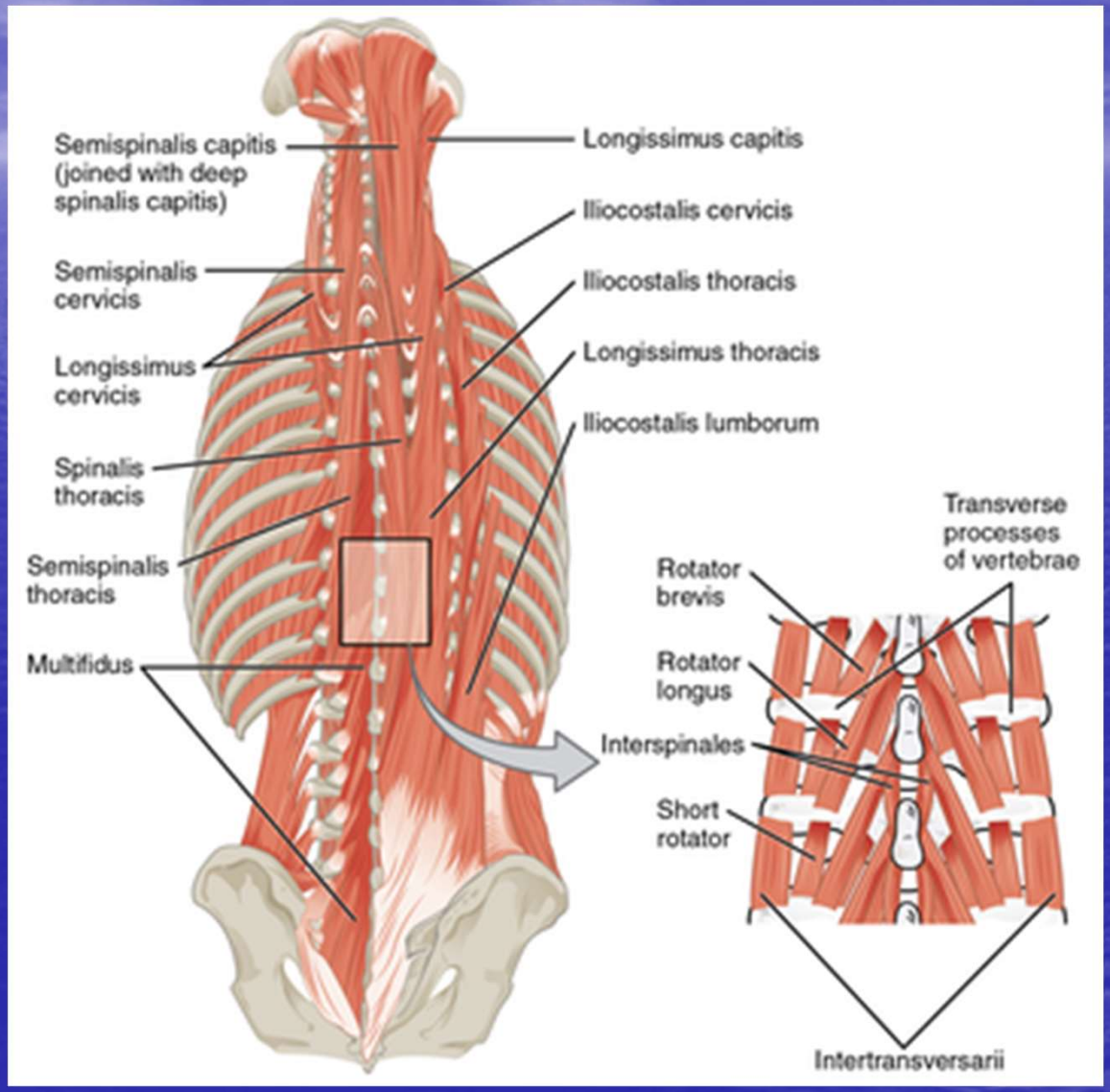
Trend: L1-L4

Measured Date	Age (years)	BMD (g/cm²) [1]	Change vs Baseline (%)	Change vs Baseline (%/yr)
6/4/2012	75.5	1.259	8.8	3.4
10/23/2009	72.9	1.156	baseline	baseline

Briggs AM. Paraspinal muscle control in people with osteoporotic vertebral fracture. ESJ 2007.

Vertebral fractures

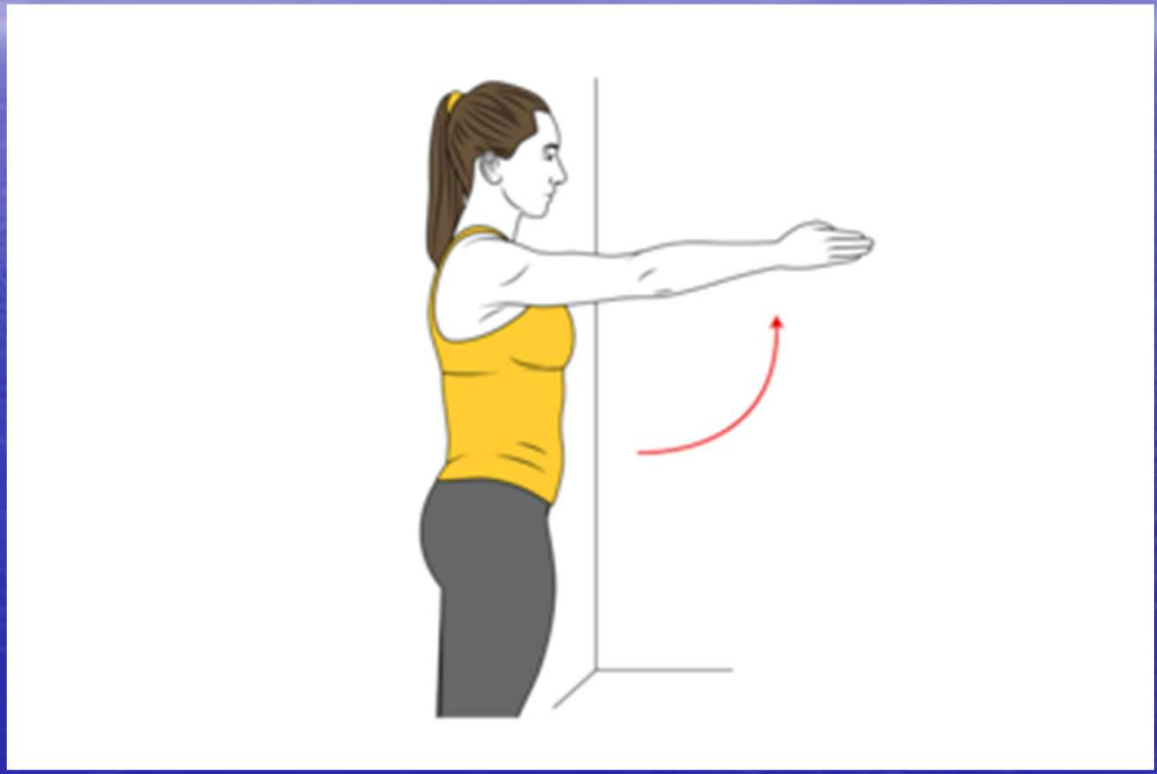
The paraspinal muscles (including also the multifidus) attach to the vertebrae or in close proximity, and are responsible for generating large compressive forces.



Briggs AM. Paraspinal muscle control in people with osteoporotic vertebral fracture. ESJ 2007.

Vertebral fractures

An experiment required to osteoporotic women rapid shoulder flexions to perturb the trunk while standing.

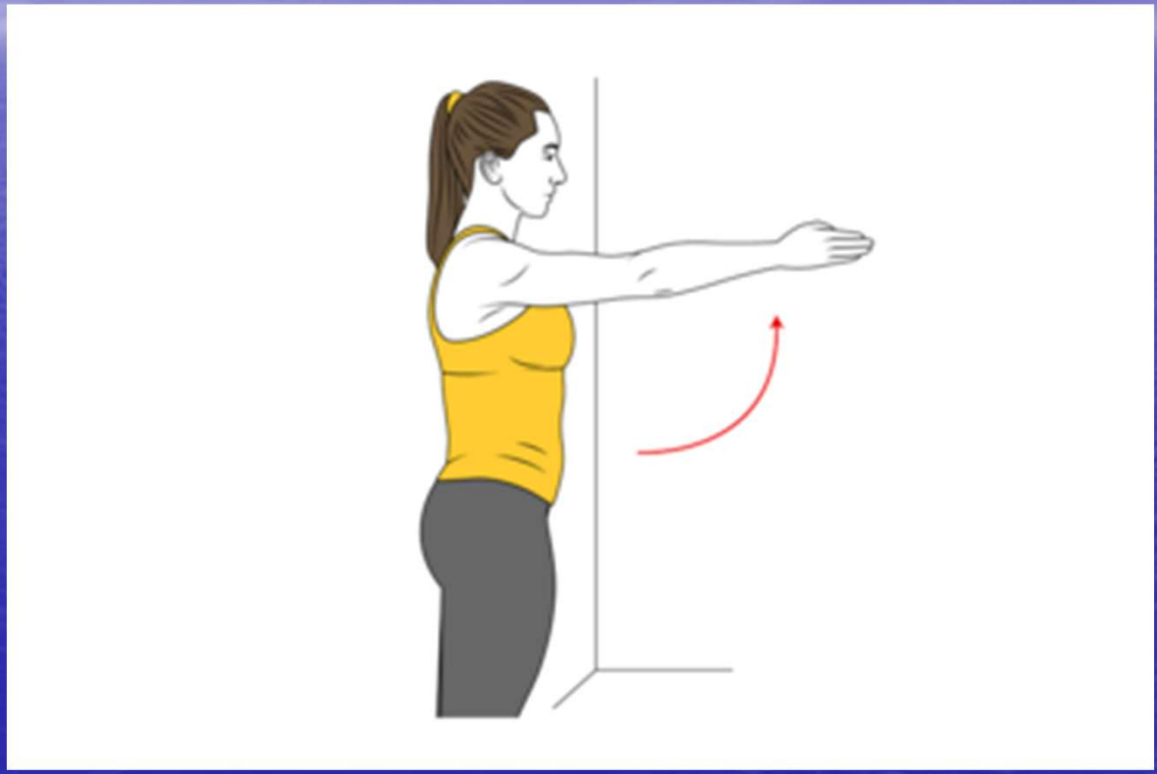


Needle EMG recordings of paraspinals muscles.

Briggs AM. Paraspinal muscle control in people with osteoporotic vertebral fracture. ESJ 2007.

Vertebral fractures

Findings pointed out a longer time to initiate a postural response and a shorter time to reach maximum amplitude.

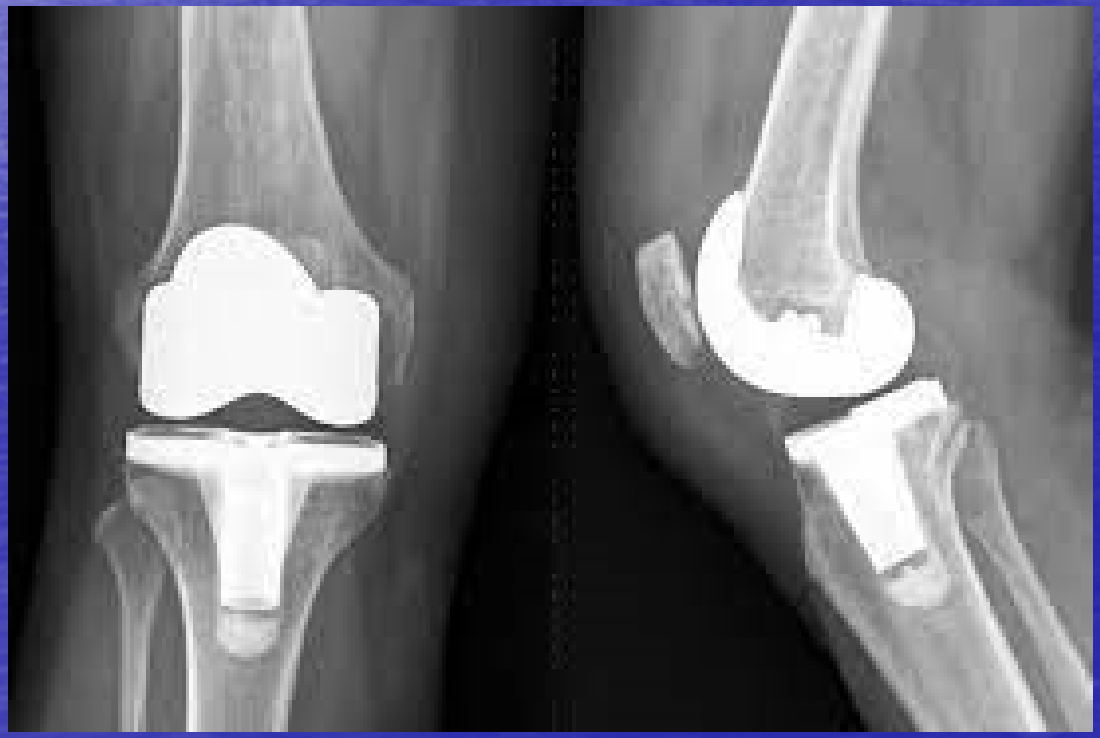


Probably it is an adaptive characteristic of the central nervous system to minimise vertebral loading time.

Briggs AM. Paraspinal muscle control in people with osteoporotic vertebral fracture. ESJ 2007.

Total Knee Arthroplasty (TKA)

It represents an invasive surgery that mechanically stresses knee joint and its surrounding tissue.



Paravlic AH. Muscle-specific changes of lower extremities in the early period after TKA. JMNI 2020.

TKA

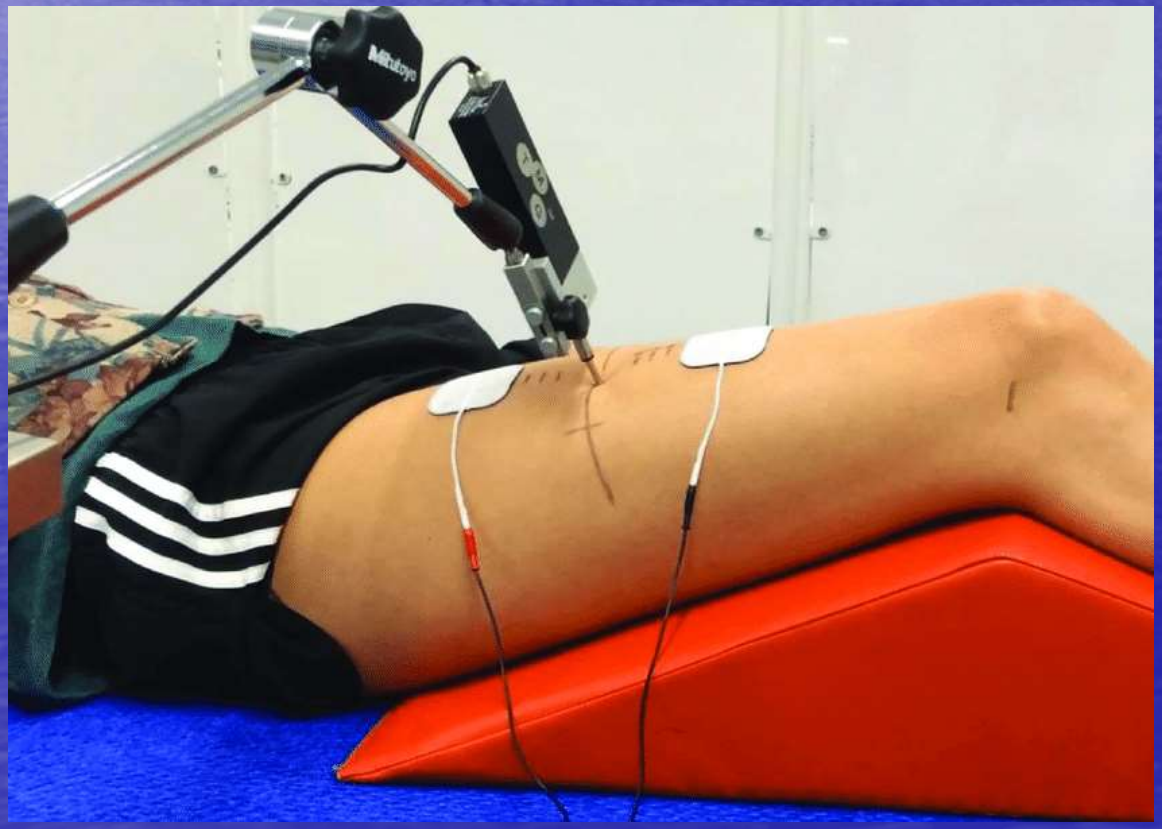
Whiles in the long term this knee surgery reliefs pain and improves patients' physical function and overall quality of life, early days after surgery are marked with great pain and impaired mobility.

How assessing responses of individual muscles surrounding knee joint from pre-to-post TKA?

Paravlic AH. Muscle-specific changes of lower extremities in the early period after TKA. JMNI 2020.

Tensiomiography

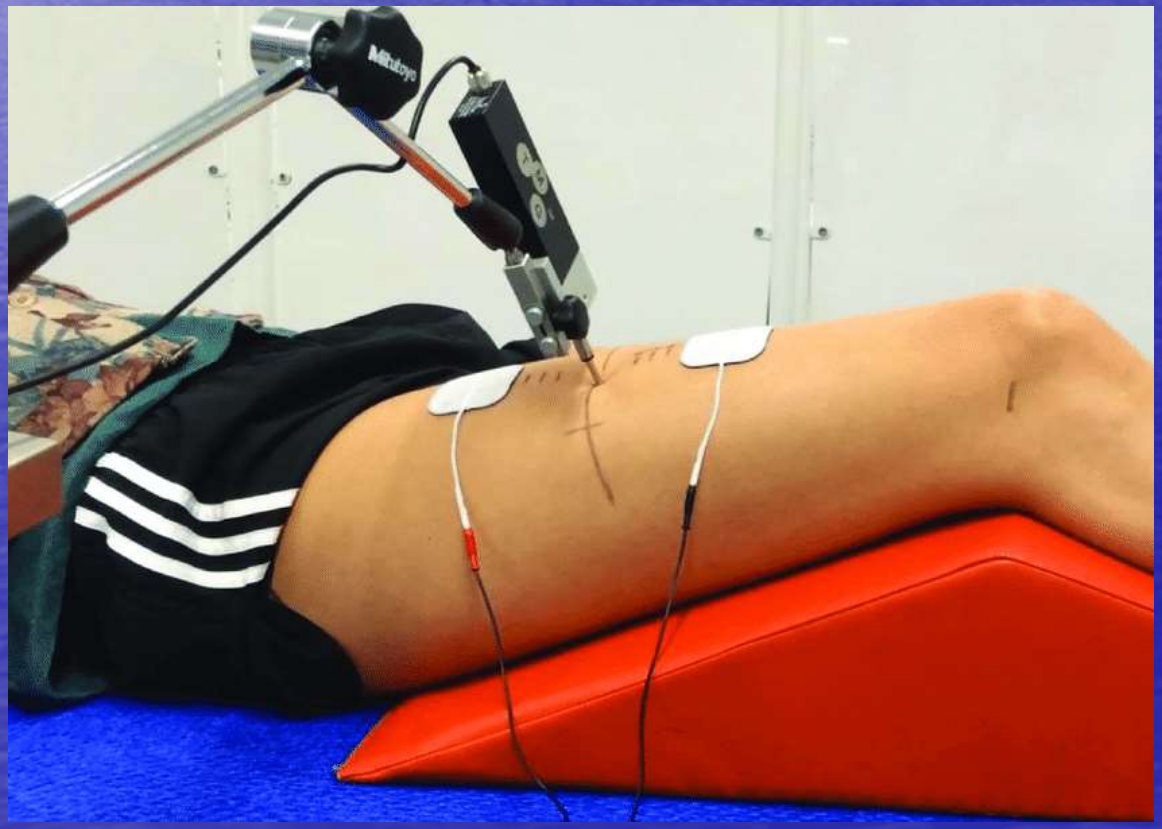
It has been extensively used to assess evoked twitch contractions of individual superficial skeletal muscles non-invasively.



Šimunič B. Between-day reliability of a method for non-invasive estimation of muscle composition. J Electromyogr Kinesiol 2012

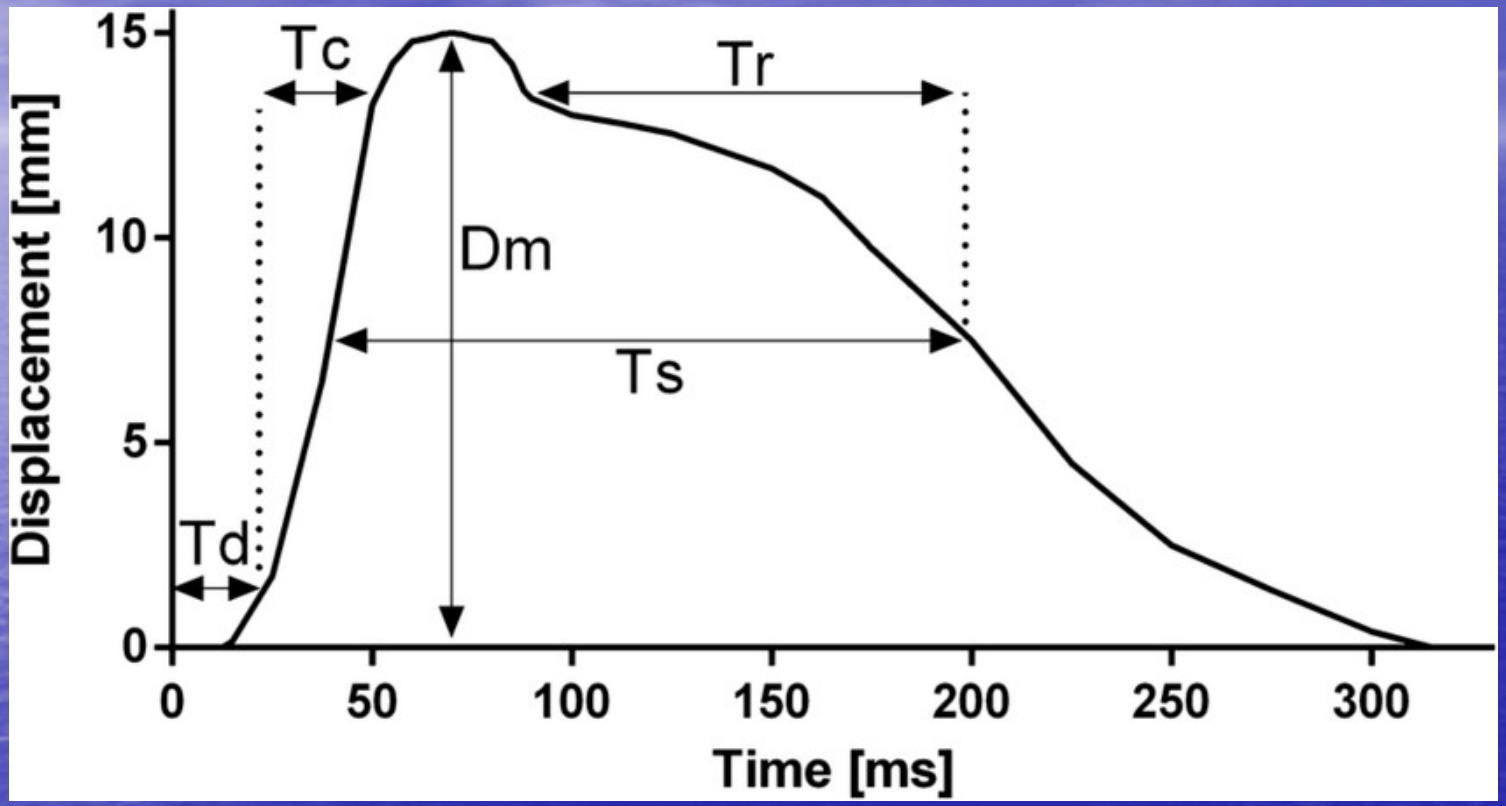
Tensiomiography

There are contractile parameters such as contraction time (Tc) and radial displacement (Dm) of muscle belly.



Šimunič B. Between-day reliability of a method for non-invasive estimation of muscle composition. J Electromyogr Kinesiol 2012

Tensiomiography



Tc was found to be correlated to muscle fibre type composition at least in vastus lateralis.

Dm is correlated to anatomical muscle atrophy as well as early atrophic processes.

Šimunič B. Between-day reliability of a method for non-invasive estimation of muscle composition. J Electromyogr Kinesiol 2012

Tensiomiography

After TKA, it was found:

- a decrease of Dm of vastus medialis (i.e., muscle stiffness)
- an increase in Tc of both the vastus lateralis and rectus femoris muscles of the involved leg.

Reduced gait speed, stair-climbing, and chair sit-to-stand performance.

Paravlic AH. Muscle-specific changes of lower extremities in the early period after TKA. JMNI 2020.

A post-op complication

Acute Limb Compartment Syndrome is a threatening condition caused by bleeding or edema in a closed muscle compartment surrounded by fascia and bone, which leads to muscle and nerve ischemia, due to acute arterial obstruction (prolonged surgery).

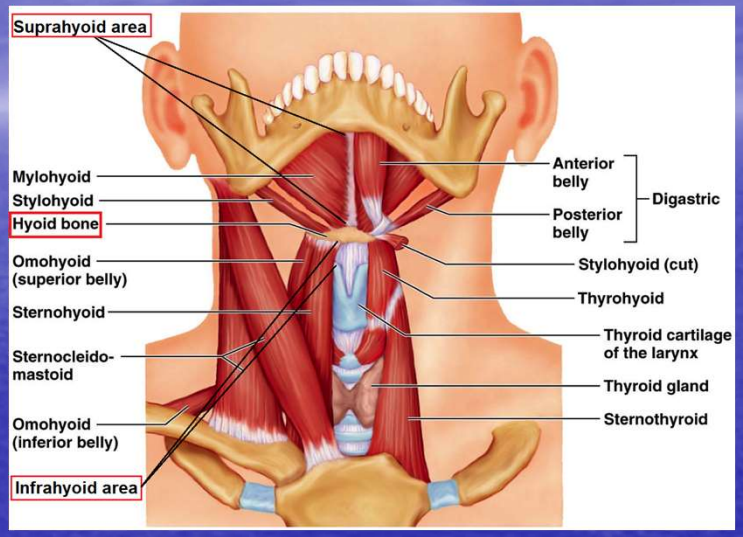
Pain, paresthesia, paralysis, pallor, and pulselessness

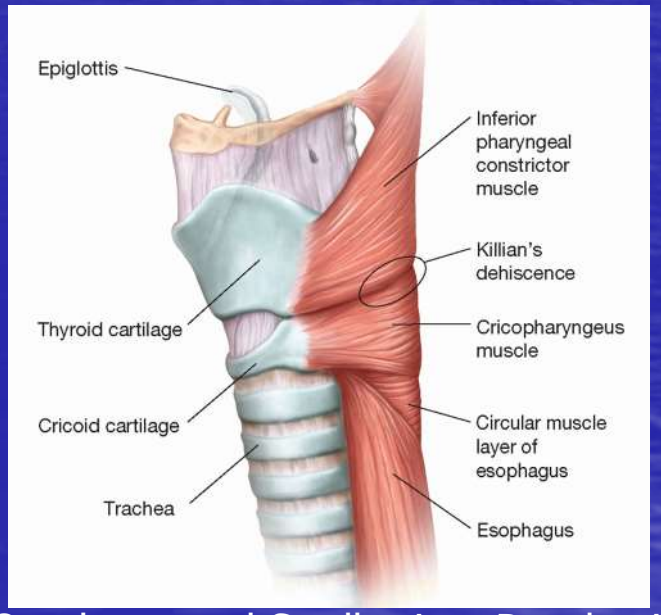
Early diagnosis, which may also include EMG.

Gourgiotis. Acute limb compartment syndrome: a review. J Surg Educ 2007

Oropharyngeal swallowing

Deglutition engages dozens of muscles, from facial-mimetic and masticatory muscles to those of the oral cavity, laryngopharyngeal structures and esophagus as far as the stomach.



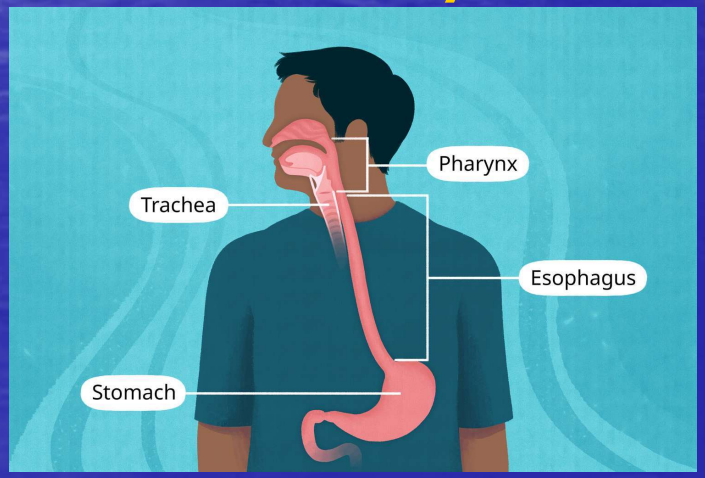


Alfonsi E. Electrokinesiographic Study of Oropharyngeal Swallowing. Dysphagia 2023

Neurogenic dysphagia

It is due to a damage to the medullary swallowing center.

Commonly, it is investigated by videofluoroscopy, fiberoptic endoscopic evaluation, high-resolution manometry and scintigraphy.



Alfonsi E. Electrokinesiographic Study of Oropharyngeal Swallowing. Dysphagia 2023

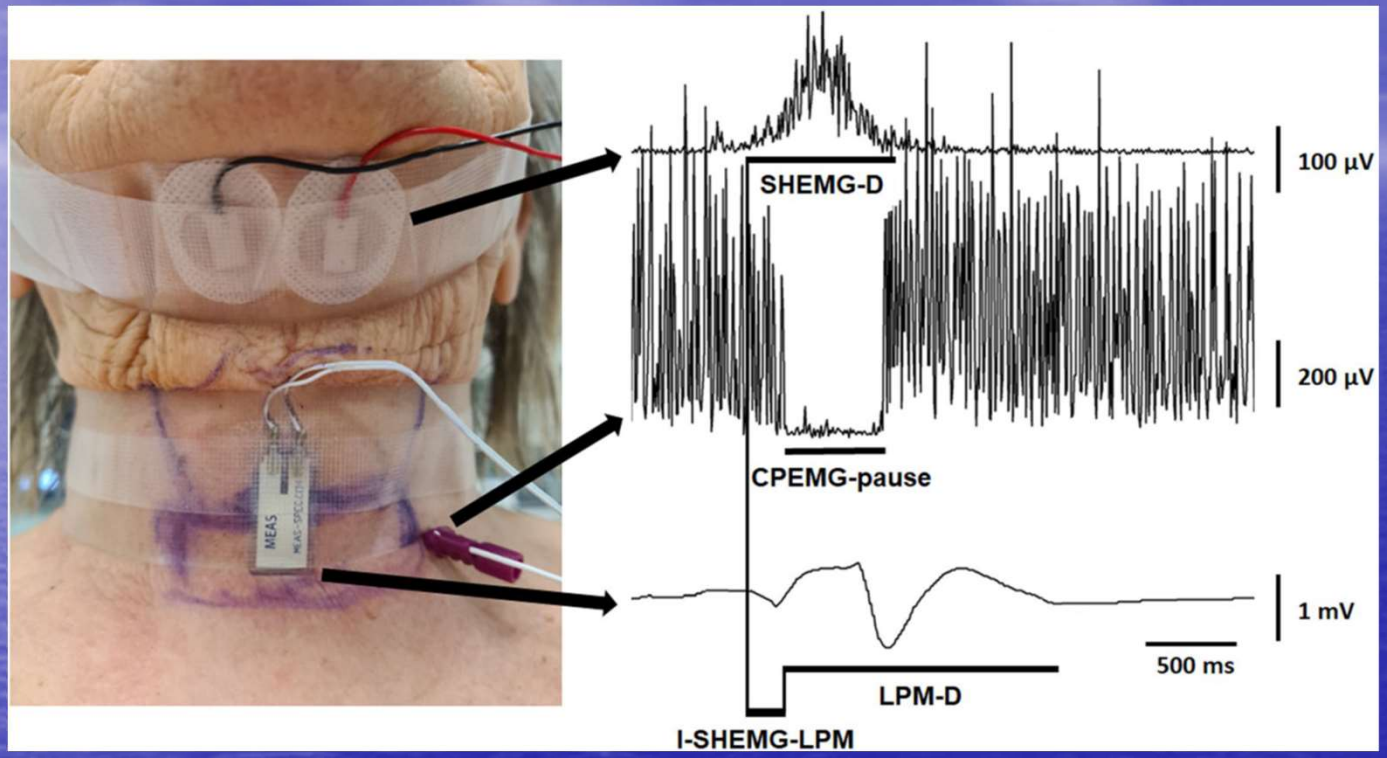
Electrokinesiographic study

It is a polygraphic study, which includes both EMG and electromechanical recordings.

It allows an evaluation of the magnitude, duration and temporal relations of the different events that characterize oropharyngeal swallowing.

Alfonsi E. Electrokinesiographic Study of Oropharyngeal Swallowing. Dysphagia 2023

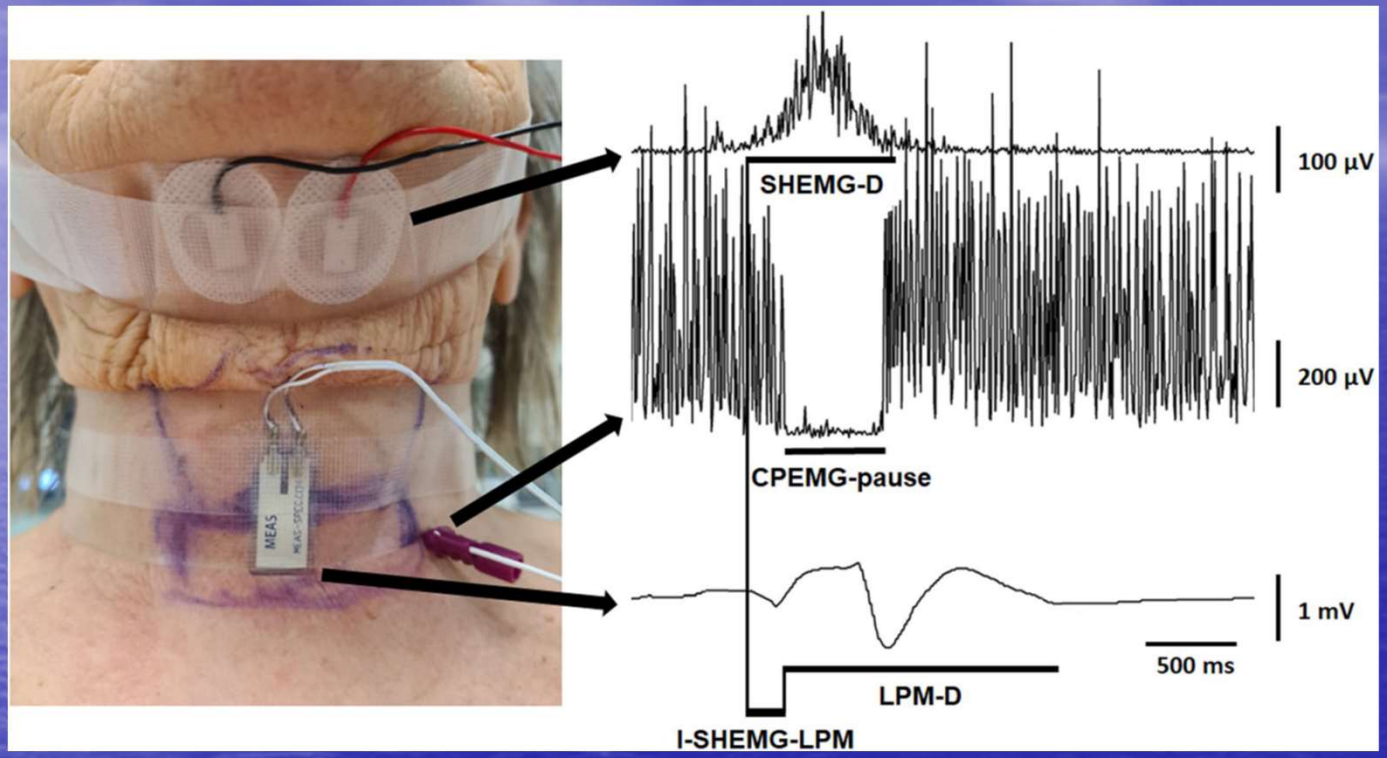
Electrokinesiographic study



SHEMG: it records the activity of suprahyoid/submental muscles (+ intrinsic of the tongue). It corresponds to the oral phase and pharyngeal phases, and to the elevation and forward motion of the laryngopharyngeal structures during swallowing.

Alfonsi E. Electrokinesiographic Study of Oropharyngeal Swallowing. Dysphagia 2023

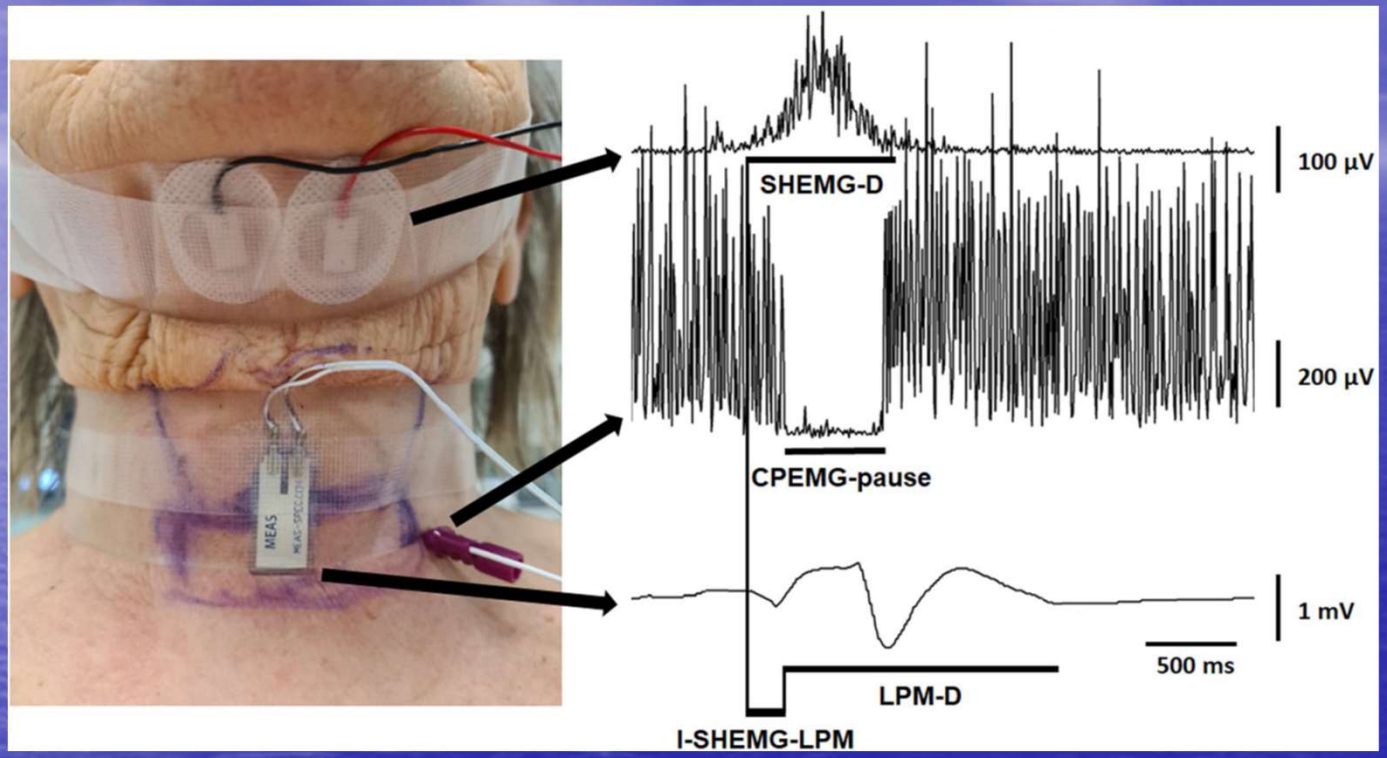
Electrokinesiographic study



CPEMG: it records the activity of cricopharyngeal (CP) muscle, which is the main component of the upper esophageal sphincter. The pharyngeal phase of swallowing is characterized by a sudden and brief decrease in the EMG activity of the CP muscle by showing an inhibitory pause.

Alfonsi E. Electrokinesiographic Study of Oropharyngeal Swallowing. Dysphagia 2023

Electrokinesiographic study



LPM: it provides the laryngopharyngeal mechanogram of deglutition, and derives from mechanical deformations of laryngopharyngeal structures (epiglottis) during swallowing.

Alfonsi E. Electrokinesiographic Study of Oropharyngeal Swallowing. Dysphagia 2023

Overactive bladder (OAB)

Urgency, with or without urge incontinence, usually with frequency and nocturia, in the absence of no proven infection or other obvious pathology.

Common causes are benign prostatic hyperplasia, urethral obstruction, and neurogenic bladder.

Abrams P. The standardization of terminology of lower urinary tract function. Neurourol Urodyn 2002

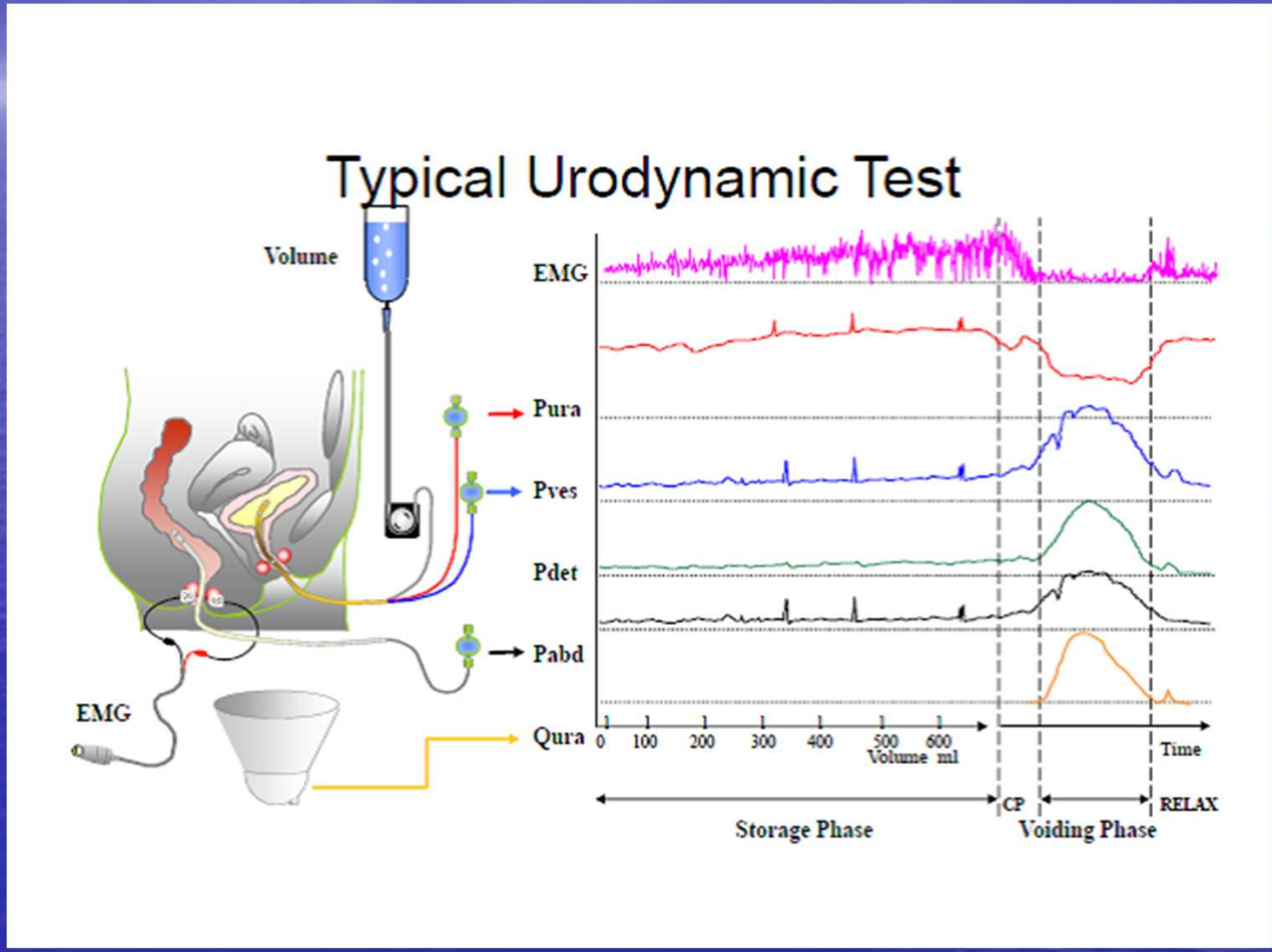
Cystometry and EMG

They are an essential part of the diagnostic evaluation of OAB during the urodynamics exam.

Flisser AJ. Role of cystometry in evaluating patients with overactive bladder. Urology 2002

Cystometry and EMG

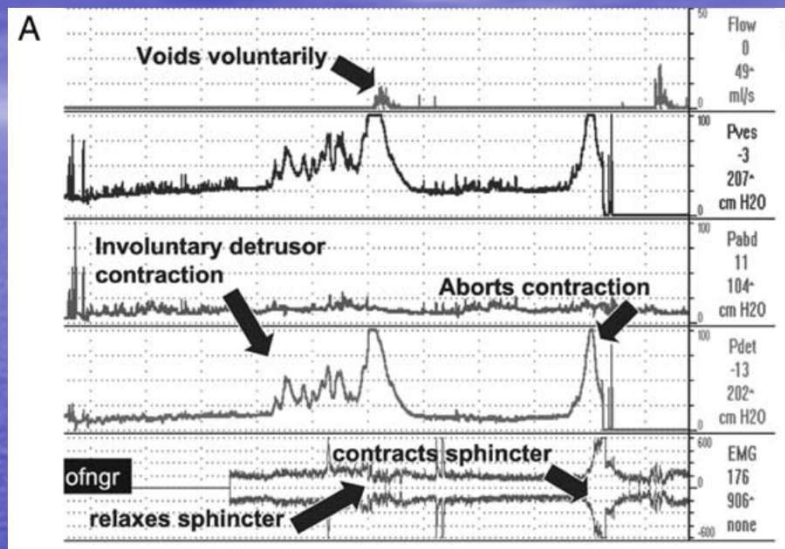
They are an essential part of the diagnostic evaluation of OAB during the urodynamics exam.



Flisser AJ. Role of cystometry in evaluating patients with overactive bladder. Urology 2002

EMG

Crucial to measure the sphincter muscles of the pelvic floor (i.e., sphincter ani ext/int, and sphincter urethrae).



Flisser AJ. Role of cystometry in evaluating patients with overactive bladder. Urology 2002