Kolar's approach to Dynamic Neuromuscular Stabilization (DNS): A Developmental Kinesiology Approach

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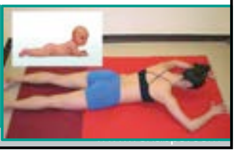
Charles University, 2nd Medical Faculty
University Hospital Motol
Prague, Czech Republic

REHABILITATION PRAGUE SCHOOL



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Dynamic Neuromuscular Stabilization

DNS is based on developmental kinesiology and the integration of both neurophysiological and biomechanical principles

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CNS MOTOR CONTROL

Man, unlike many animals, is immature at birth
Function & Anatomy
After birth maturation of the CNS occurs

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Ontogenesis = CNS maturation

- Neurogenesis
- Migration of the neuroblasts
- Synaptogenesis
- Myelinization
- Apoptosis
- Neurotransmiter's activation

NOT just growing!
CNS Maturation!

Spinal & Brain stem level of CNS motor control
Primitive reflexes, global movement patterns

Depending on level of CNS maturation specific motor patterns occur

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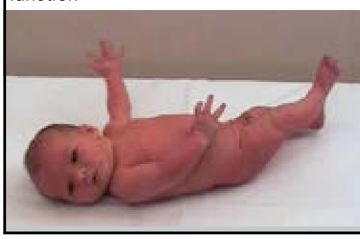
Neonatus

Global generalized motor patterns
No equilibrium
No purposeful movement possible
No support
No grasp
Diaphragm fulfills only respiratory function



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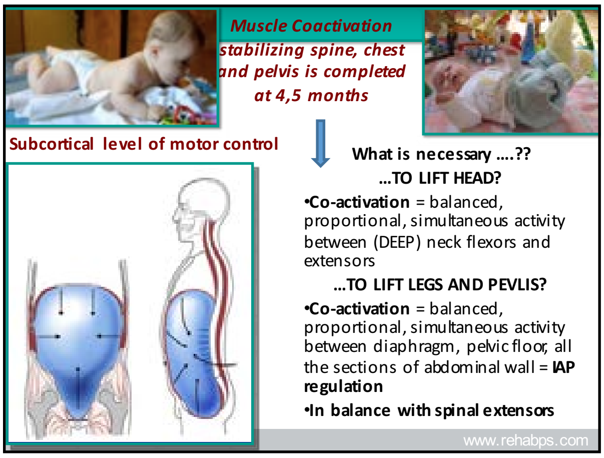
Muscle Coactivation
stabilizing spine, chest and pelvis is completed at 4,5 months
Subcortical level of motor control
What is necessary ....??
...TO LIFT HEAD?
•Co-activation = balanced, proportional, simultaneous activity between (DEEP) neck flexors and extensors
...TO LIFT LEGS AND PEVLIS?
•Co-activation = balanced, proportional, simultaneous activity between diaphragm, pelvic floor, all the sections of abdominal wall = IAP regulation
•In balance with spinal extensors
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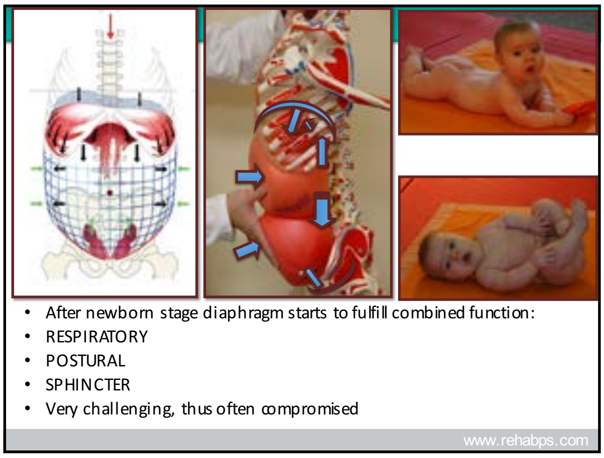
After newborn stage diaphragm starts to fulfill combined function:
RESPIRATORY
POSTURAL
SPHINCTER
Very challenging, thus often compromised
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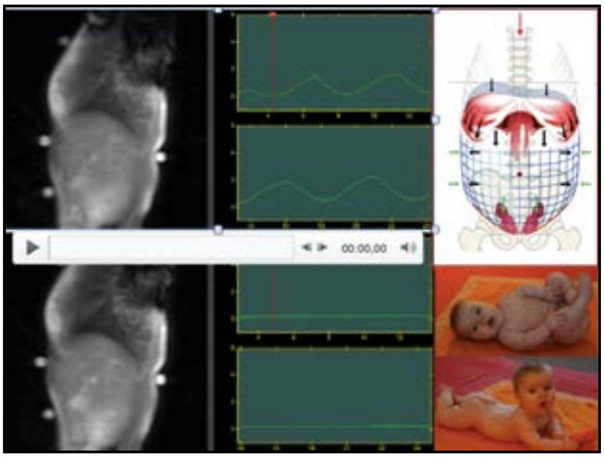
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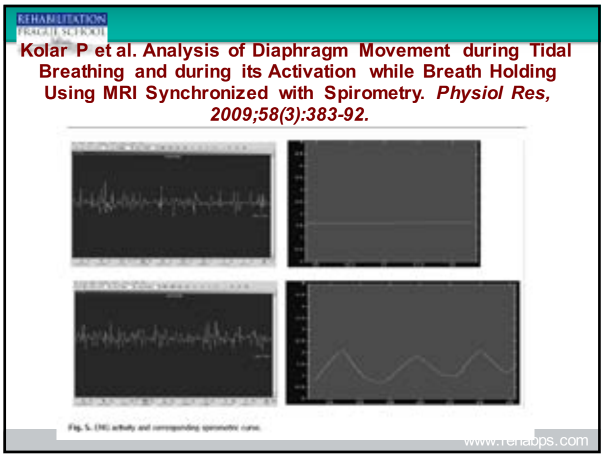
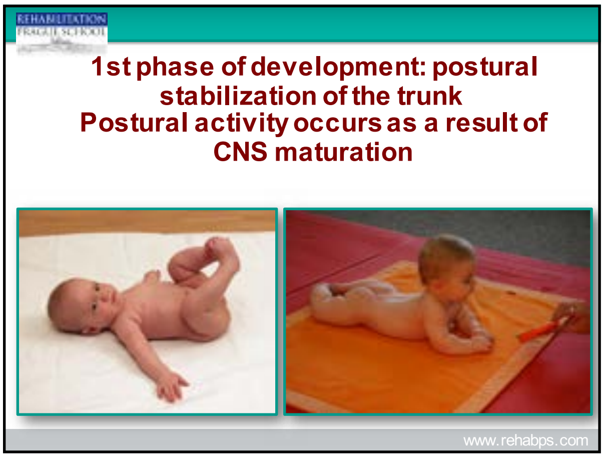

REHABILITATION PRAGUE SCHOOL
Kolar P et al. Analysis of Diaphragm Movement during Tidal Breathing and during its Activation while Breath Holding Using MRI Synchronized with Spirometry. Physiol Res, 2009;58(3):383-92.
www.rehabps.com


REHABILITATION PRAGUE SCHOOL
1st phase of development: postural stabilization of the trunk
Postural activity occurs as a result of CNS maturation
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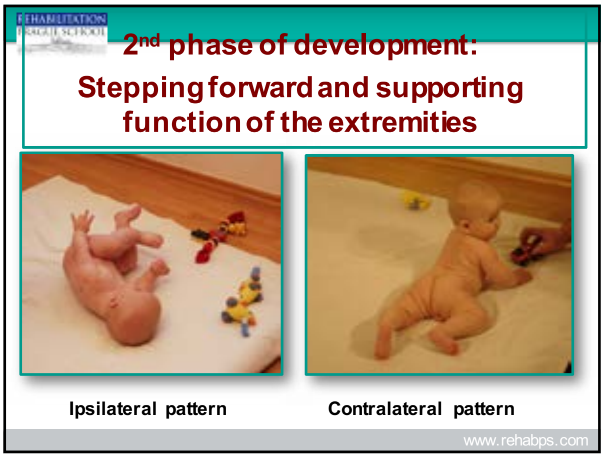
REHABILITATION PRAGUE SCHOOL
2nd phase of development:
Stepping forward and supporting function of the extremities
Ipsilateral pattern
Contralateral pattern
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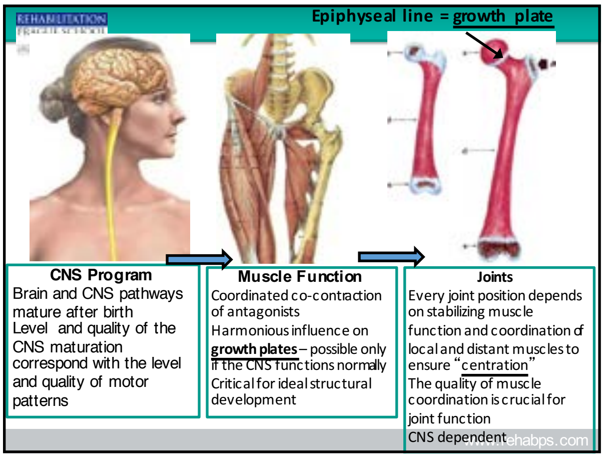
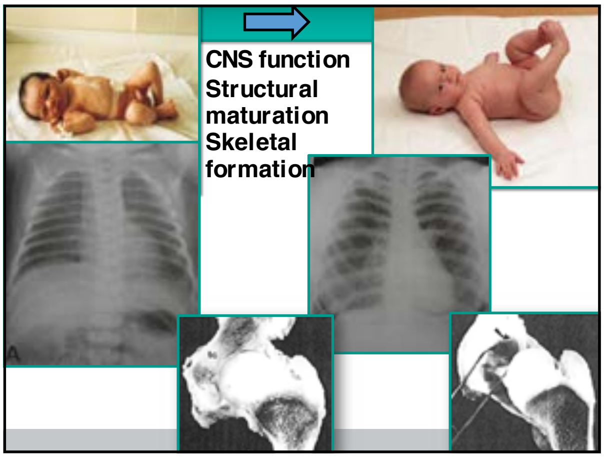
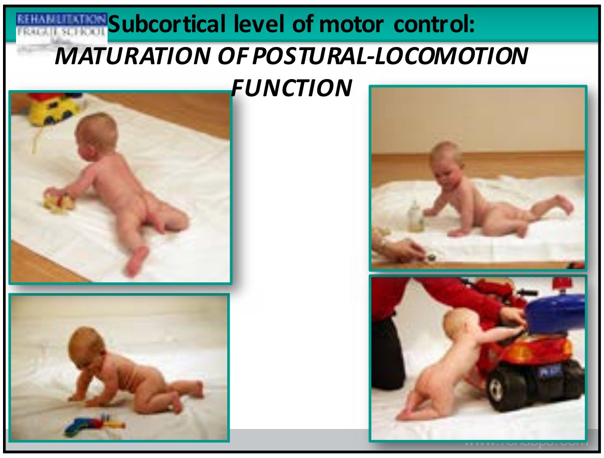
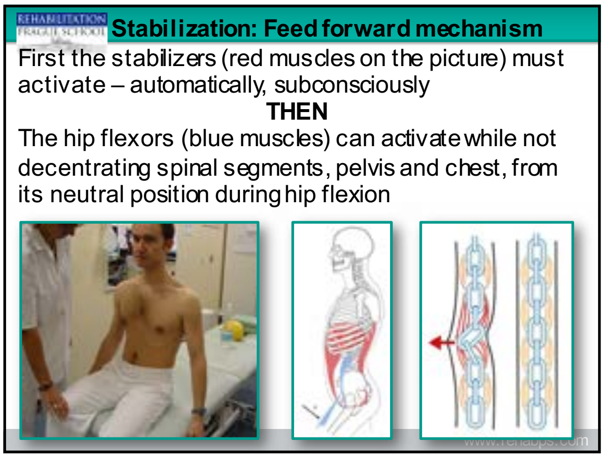
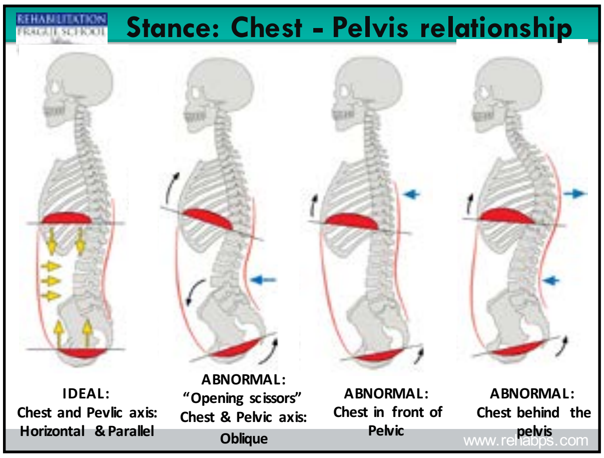
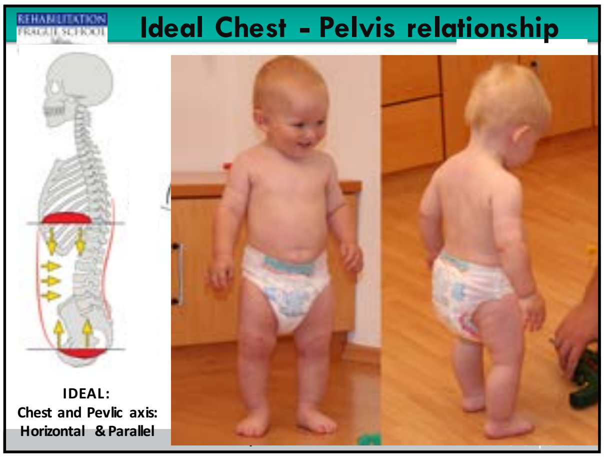

Epiphyseal line = growth plate
CNS Program
Brain and CNS pathways mature after birth
Level and quality of the CNS maturation correspond with the level and quality of motor patterns
Muscle Function
Coordinated co-contraction of antagonists
Harmonious influence on growth plates – possible only if the CNS functions normally
Critical for ideal structural development
Joints
Every joint position depends on stabilizing muscle function and coordination of local and distant muscles to ensure "centration"
The quality of muscle coordination is crucial for joint function
CNS dependent
www.rehabps.com

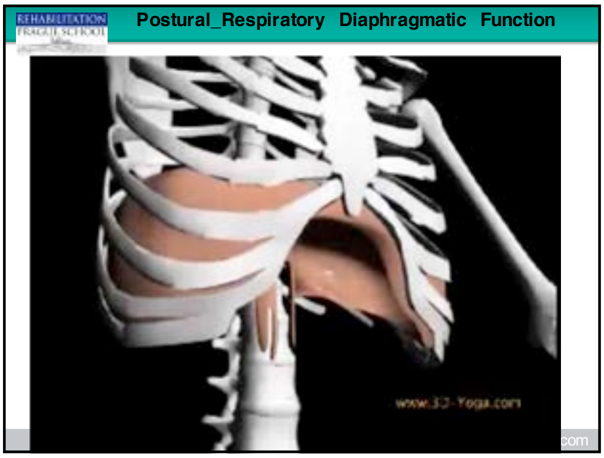

CNS function
Structural maturation
Skeletal formation

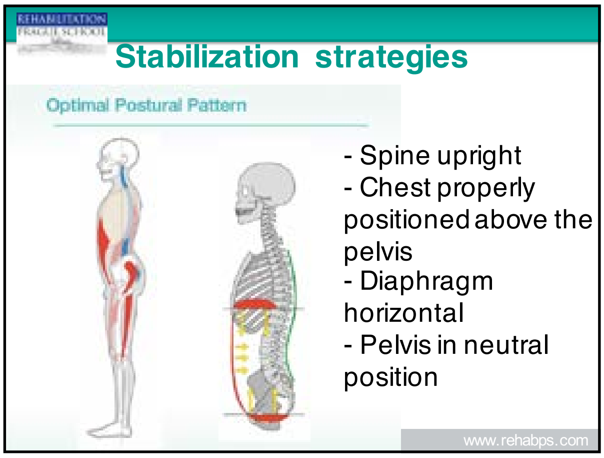

Subcortical level of motor control:
MATURATION OF POSTURAL-LOCOMOTION FUNCTION

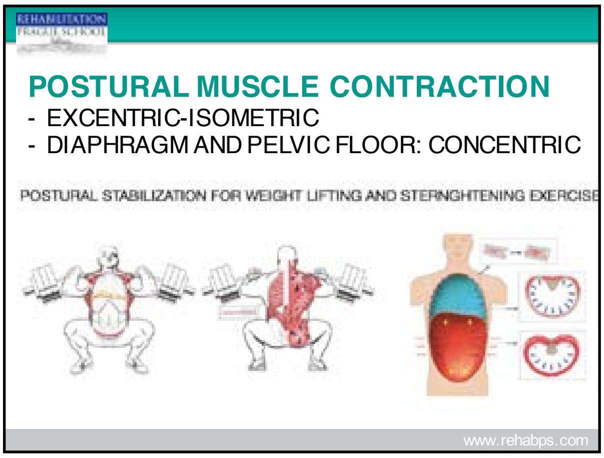

Stabilization: Feed forward mechanism
First the stabilizers (red muscles on the picture) must activate – automatically, subconsciously
THEN
The hip flexors (blue muscles) can activate while not decentrating spinal segments, pelvis and chest, from its neutral position during hip flexion

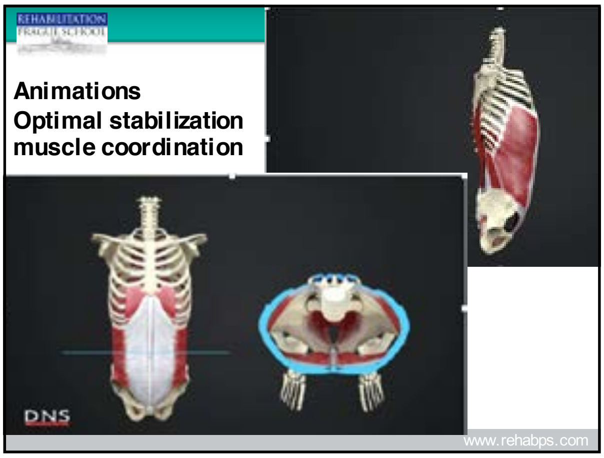

Stance: Chest - Pelvis relationship
IDEAL:
Chest and Pevlic axis:
Horizontal & Parallel
ABNORMAL:
"Opening scissors"
Chest & Pelvic axis:
Oblique
ABNORMAL:
Chest in front of Pelvic
ABNORMAL:
Chest behind the pelvis
www.rehabps.com

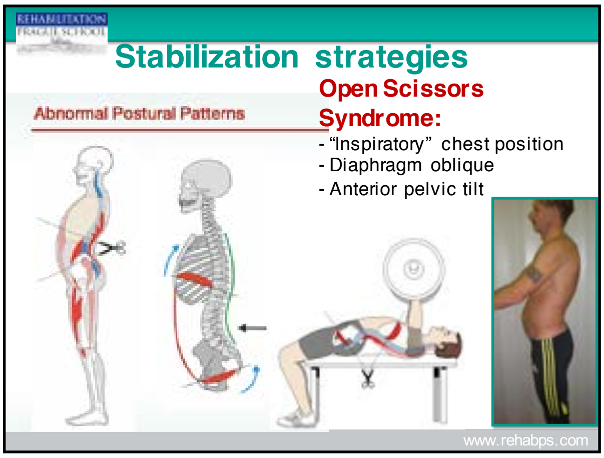

Ideal Chest - Pelvis relationship
IDEAL:
Chest and Pevlic axis:
Horizontal & Parallel

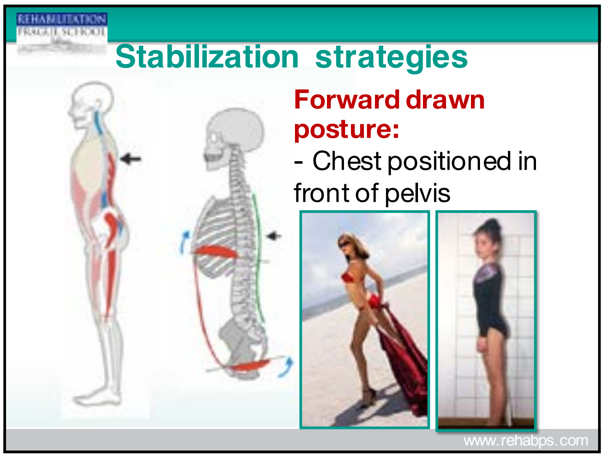

Postural_Respiratory Diaphragmatic Function
www.3D-Yoga.com


Stabilization strategies
Optimal Postural Pattern
- Spine upright
- Chest properly positioned above the pelvis
- Diaphragm horizontal
- Pelvis in neutral position
www.rehabps.com


POSTURAL MUSCLE CONTRACTION
- EXCENTRIC-ISOMETRIC
- DIAPHRAGM AND PELVIC FLOOR: CONCENTRIC
POSTURAL STABILIZATION FOR WEIGHT LIFTING AND STERNGHTENING EXERCISE
www.rehabps.com


Animations
Optimal stabilization muscle coordination
DNS
www.rehabps.com


Stabilization strategies
Abnormal Postural Patterns
Open Scissors Syndrome:
- "Inspiratory" chest position
- Diaphragm oblique
- Anterior pelvic tilt
www.rehabps.com


Stabilization strategies
Forward drawn posture:
- Chest positioned in front of pelvis
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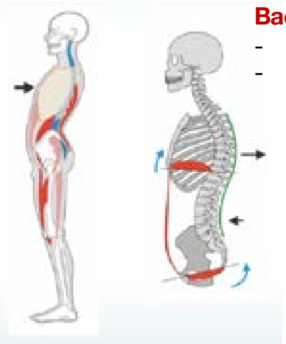
Stabilization strategies

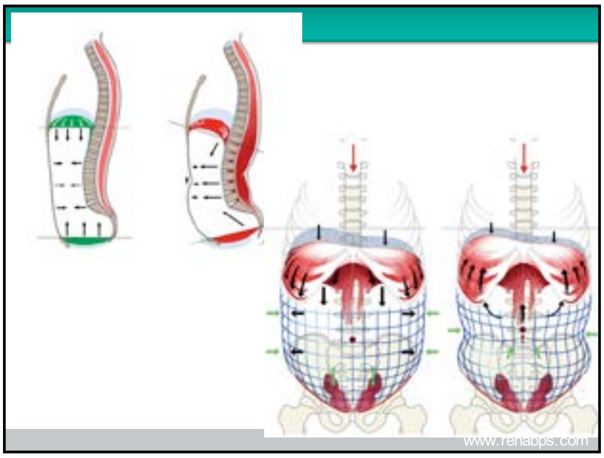
Backward drawn posture:

- Chest posterior to pelvis
- Rigid thoracic kyphosis



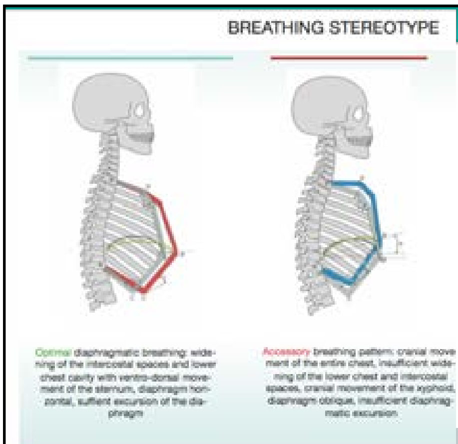
Hour Glass Syndrome:
Chest & diaphragm elevated

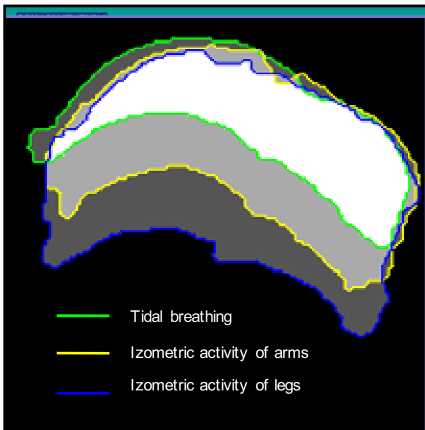
Diaphragmatic excursion for breathing and postural activity limited by constant concentric activity of the abdominal wall.



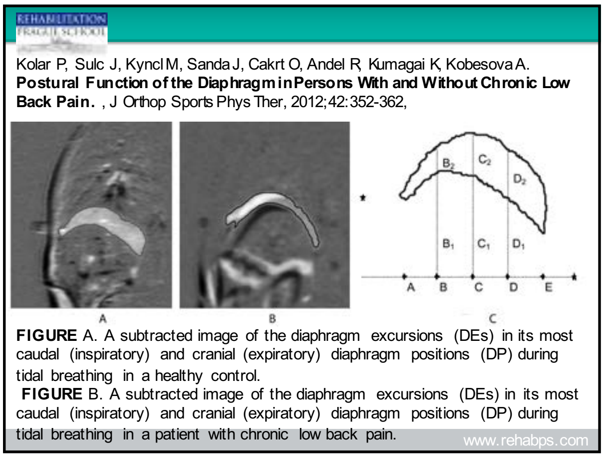
„If breathing is not normalized, no other movement pattern can be.“

Karel Lewit





Kolar P, Sulc J, Kyncl M, Sanda J, Neuwirth J, Bokarius AV, Kriz J, Kobesova A. **Stabilizing function of the diaphragm: dynamic MRI and synchronized spirometric assessment**, J Appl Physiol. , 2012;42(4):352-62


REHABILITATION PRAGUE SCHOOL
Kolar P, Sulc J, Kyncl M, Sanda J, Cakrt O, Andel R, Kumagai K, Kobesova A.
Postural Function of the Diaphragm in Persons With and Without Chronic Low Back Pain. , J Orthop Sports Phys Ther, 2012;42:352-362,
A
B
C
FIGURE A. A subtracted image of the diaphragm excursions (DEs) in its most caudal (inspiratory) and cranial (expiratory) diaphragm positions (DP) during tidal breathing in a healthy control.
FIGURE B. A subtracted image of the diaphragm excursions (DEs) in its most caudal (inspiratory) and cranial (expiratory) diaphragm positions (DP) during tidal breathing in a patient with chronic low back pain.
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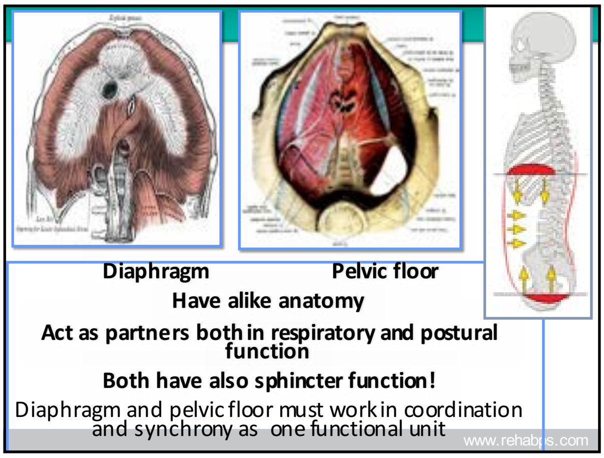
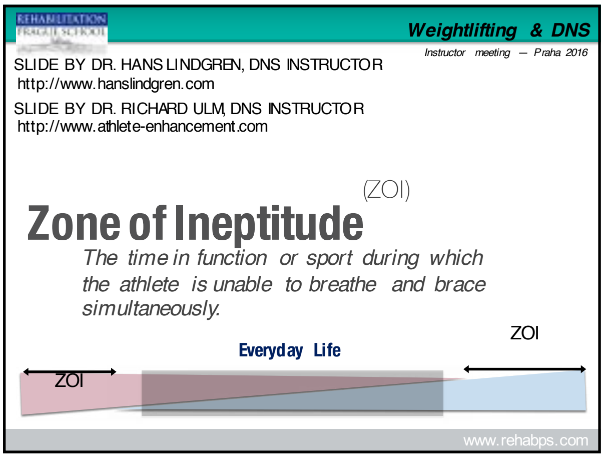

Diaphragm
Pelvic floor
Have alike anatomy
Act as partners both in respiratory and postural function
Both have also sphincter function!
Diaphragm and pelvic floor must work in coordination and synchrony as one functional unit


REHABILITATION PRAGUE SCHOOL
Weightlifting & DNS
Instructor meeting – Praha 2016
SLIDE BY DR. HANS LINDGREN, DNS INSTRUCTOR
http://www.hanslindgren.com
SLIDE BY DR. RICHARD ULM, DNS INSTRUCTOR
http://www.athlete-enhancement.com
Zone of Ineptitude (ZOI)
The time in function or sport during which the athlete is unable to breathe and brace simultaneously.
ZOI
Everyday Life
ZOI
www.rehabps.com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adidas
RMC
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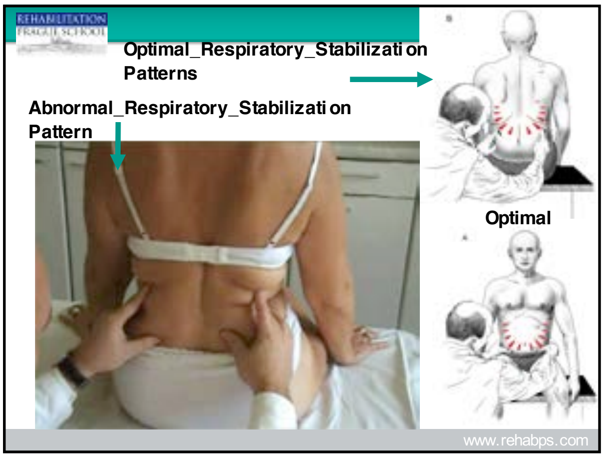
REHABILITATION PRAGUE SCHOOL
Optimal_Respiratory_Stabilization Patterns
Abnormal_Respiratory_Stabilization Pattern
Optimal
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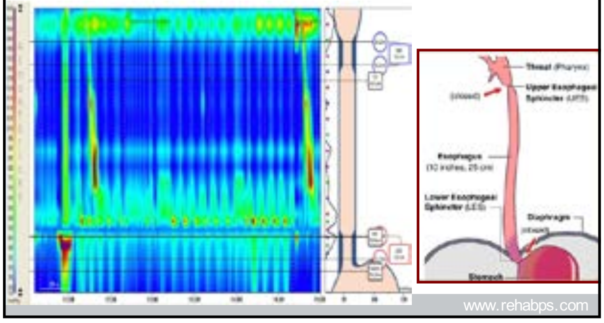
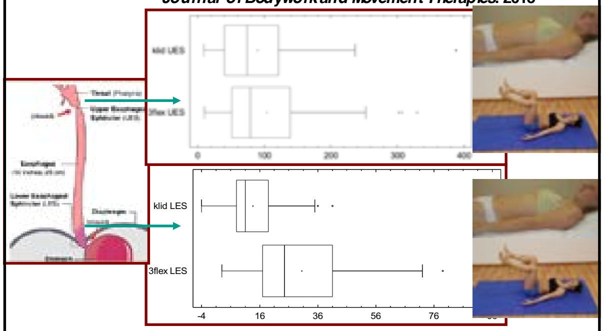
REHABILITATION PRAGUE SCHOOL
Auxiliary respiratory muscles over use

High Resolution Manometry study on 58 subjects with typical GERD symptoms

Leg raise increases pressure in lower and upper esophageal sphincter pressures



Bitnar P et al. **Leg raise increases pressure in lower and upper esophageal sphincter among patients with gastroesophageal reflux disease.**
Journal of Bodywork and Movement Therapies. 2015



M = **13.6**, SD = 9.5 mmHg vs. $Mean$ = **30.5**, SD = 18.3 mm Hg ; $P < 0.001$

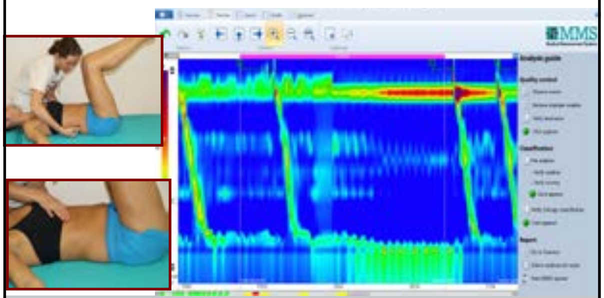
THE STUDY DEMONSTRATES:

- The influence of intra-abdominal pressure on intraesohpageal pressure
- The diaphragmatic postural and sphincter function are interrelated.
- The amount of LESP and UESP increase during postural activation depends on resting LESP and UESP.

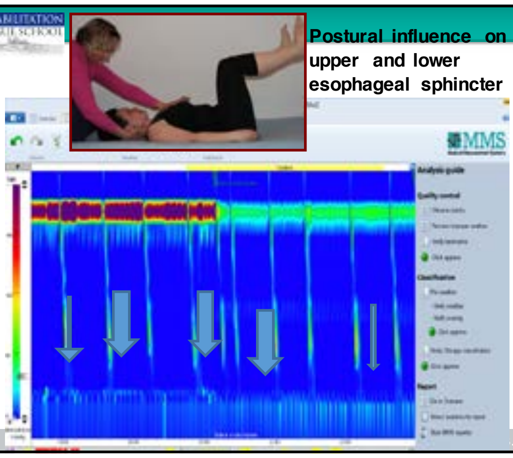
Bitnar P, Stovicek J, Andel R, Arlt J, Arltova M, Smejkal M, Kolar P, Kobesova A,. **Leg raise increases pressure in lower and upper esophageal sphincter among patients with gastroesophageal reflux disease.**
Journal of Bodywork and Movement Therapies. 2015

GERD

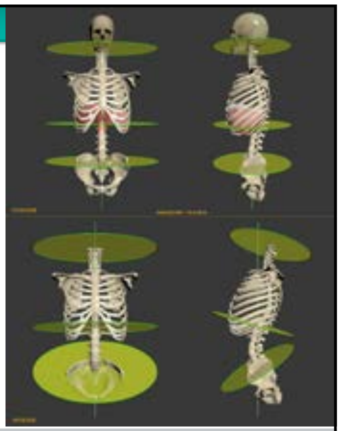
Gastroesophageal Reflux Disease = Diaphragmatic incompetence

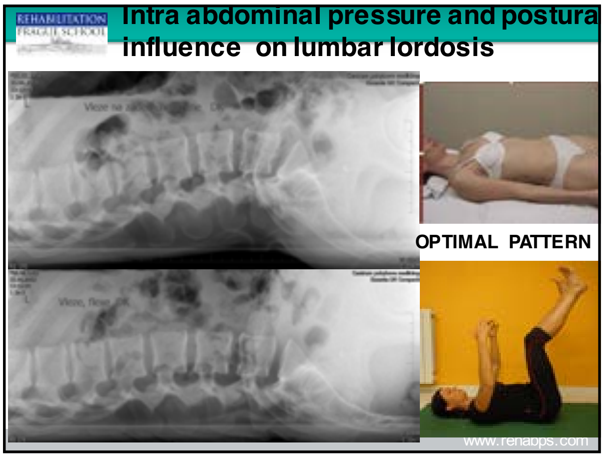


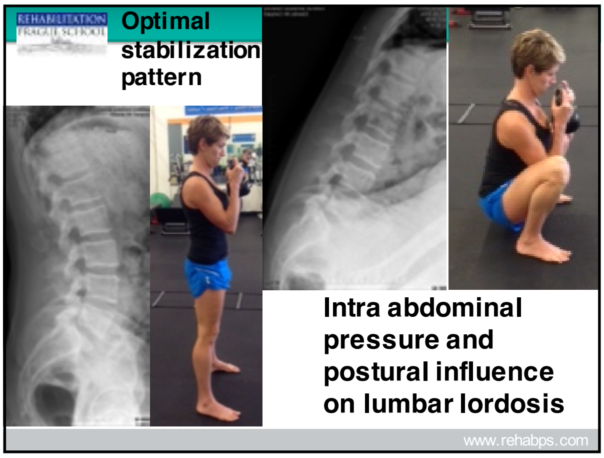
Postural influence on upper and lower esophageal sphincter



Alignment and functional integration between
1. Mouth floor (C spine)
2. Diaphragm (T spine, chest)
3. Pelvic floor (L spine, pelvic)







Sensoric intergration in postural – locomotion purpose

- Synthesis
- Selection
- Integration

Of all sensoric information into postural – locomotion function

- eyesight
- touch
- hearing
- proprioception
- vestibular perception

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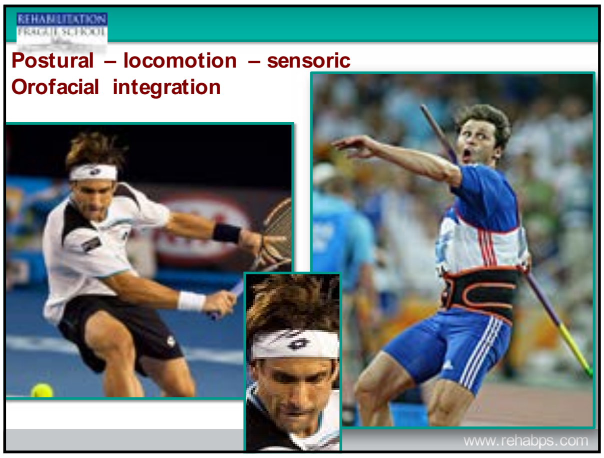
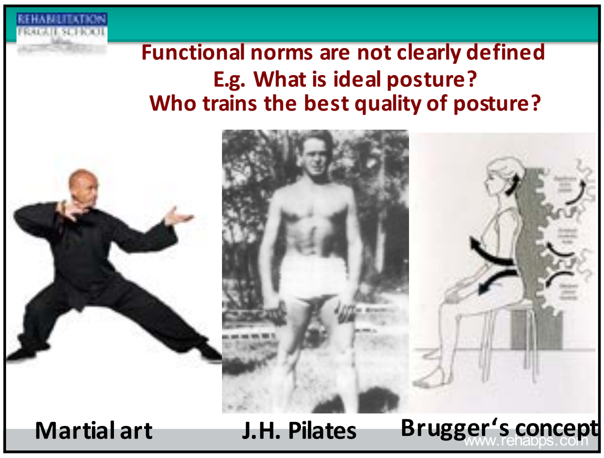



REHABILITATION PRAGUE SCHOOL
NATURAL SYNKINESIS
Look up + inhalation
Look down + exhalation
Often utilized in sport
& in mobilization techniques


REHABILITATION PRAGUE SCHOOL
Functional norms are not clearly defined
E.g. What is ideal posture?
Who trains the best quality of posture?
Martial art
J.H. Pilates
Brugger's concept
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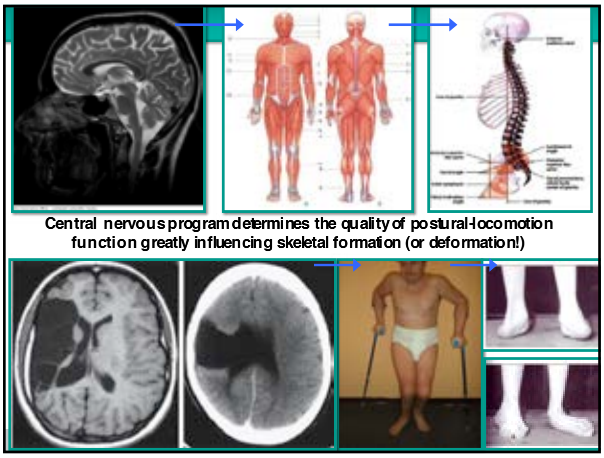
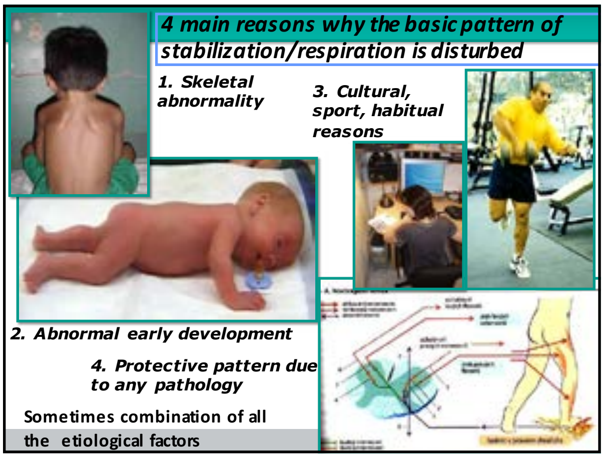
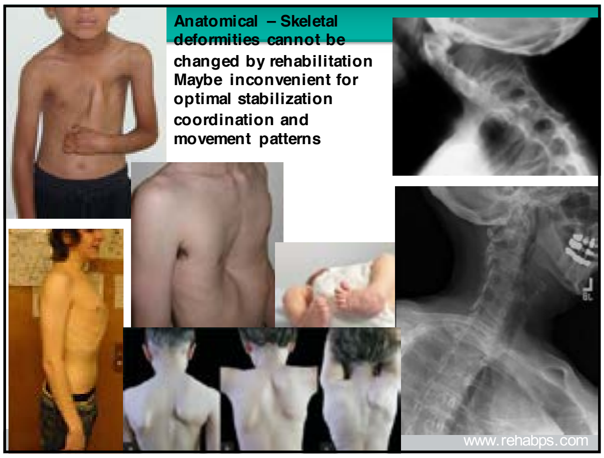

Central nervous program determines the quality of postural-locomotion function greatly influencing skeletal formation (or deformation!)


REHABILITATION PRAGUE SCHOOL
All locomtion patterns ate based on the same principles:
Stabilization is related to stepping forward and supporting extremities function in either ipsi or contralateral pattern


4 main reasons why the basic pattern of stabilization/respiration is disturbed
1. Skeletal abnormality
3. Cultural, sport, habitual reasons
2. Abnormal early development
4. Protective pattern due to any pathology
Sometimes combination of all the etiological factors


Anatomical – Skeletal deformities cannot be changed by rehabilitation
Maybe inconvenient for optimal stabilization coordination and movement patterns
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Structural pre-disposition for sport
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Structural pre-disposition for sport
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Central Coordination Disorder
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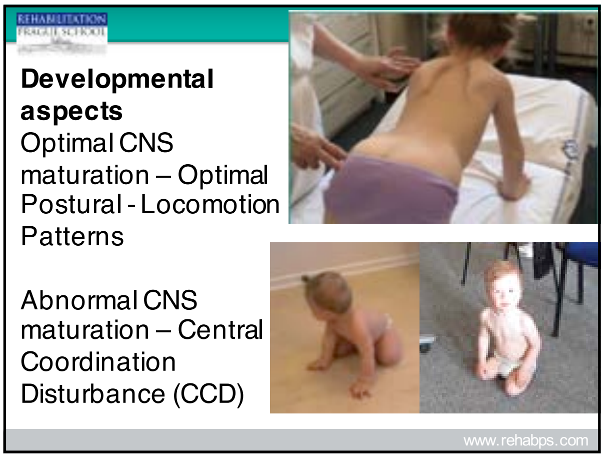
9:25:27


Developmental aspects
Optimal CNS maturation – Optimal Postural - Locomotion Patterns
Abnormal CNS maturation – Central Coordination Disturbance (CCD)
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Poor integration of eyesight into postural function
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Idiopathic (??) Scoliosis
Stutter Speech, Poor Posture
1 or 3 diagnoses???
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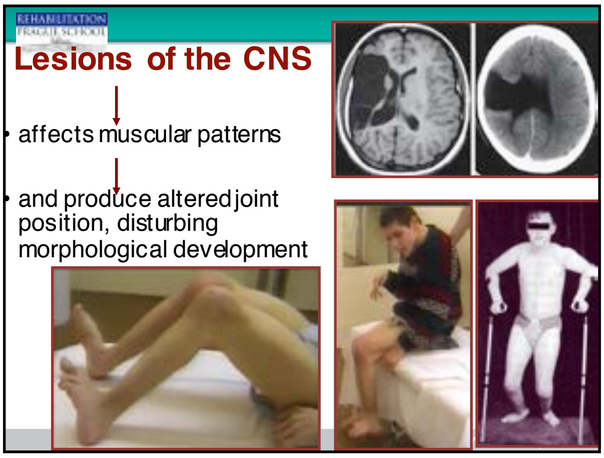
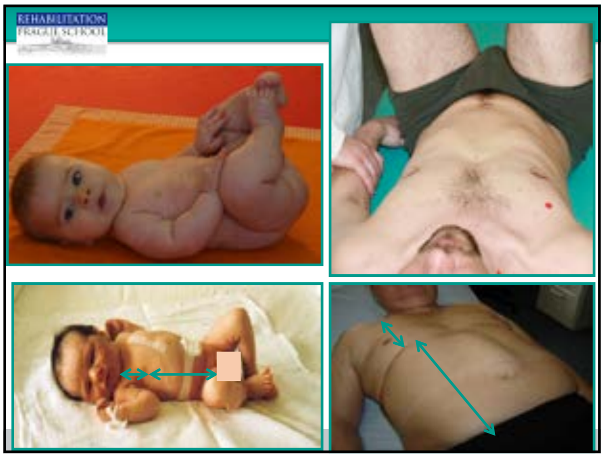

Lesions of the CNS
affects muscular patterns
and produce altered joint position, disturbing morphological development




Sport stabilization stereotypes
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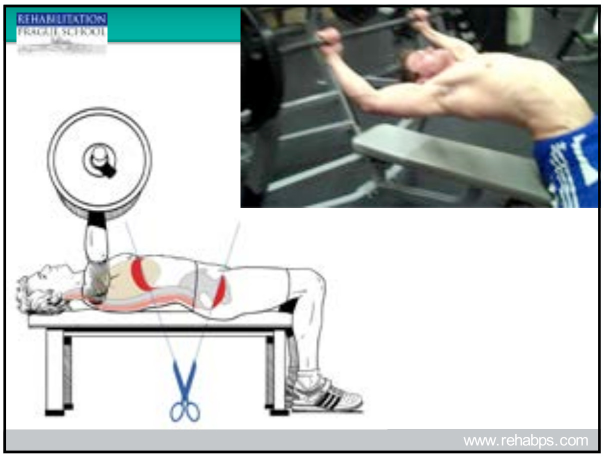
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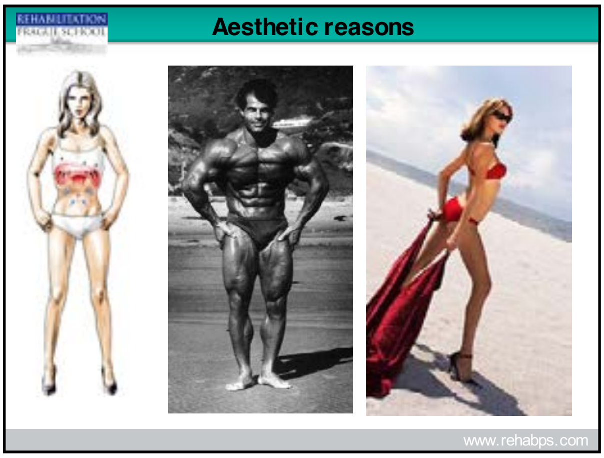
Aesthetic reasons
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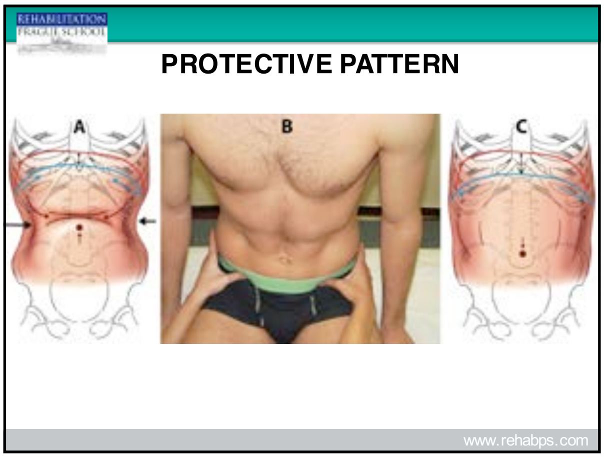
PROTECTIVE PATTERN
A
B
C
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3rd Level: Matures after one year of age
Cortical level of sensory-motor control
MOTOR LEARNING
& TRAINING
Individual qualities, motor patterns' characteristics

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Cortical Level of Sensory - Motor Function

AESTHESIS: Ability to perceive and experience sensation, somatognosis = BODY AWARENESS
MOTOR FUNCTION: Executive, expressive function isolated precise movement, relaxation
IDEOMOTOR: Constructive, planning

INDIVIDUAL QUALITY OF MOTOR PATTERNS

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DISTURBED IDEOMOTOR FUNCTION

(Developmental Coordination Disorder/Developmental Dyspraxia)

- Caused by:
  - Lack of motor imaginative ability
  - Lack of motor planning ability
- Therefore **difficulty in learning new movement stereotype**

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Developmental Coordination Disorder
Developmental Dyspraxia

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Weightlifting & DNS

Instructor meeting – Praha 2016

Multi-sensory integration

Disturbed central - cortical, motor regulation

- Repetitive injuries
- Degenerative disorders
- Tendinitis
- Orthopaedic problems resulting from chronic overload, repetitive stress injury
- Unsuccessful motor re- education after injuries, recurrent painful syndromes
- Psychosocial consequences

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Postural – Locomotion function (PLF)

- Compromised PLF= one of the **most frequent cause of orthopaedic disturbances** (chronic overload!)
- PLF cannot be improved by **manual/chiropractic techniques** only: weak muscle strengthening, short muscle stretching, mobilization, TrPs treatment etc.
- **Educational** therapeutic system respecting CNS processes is necessary!
- PLF always reacts to all orthopaedic, internal, central and others disorders – by a reflex mechanism

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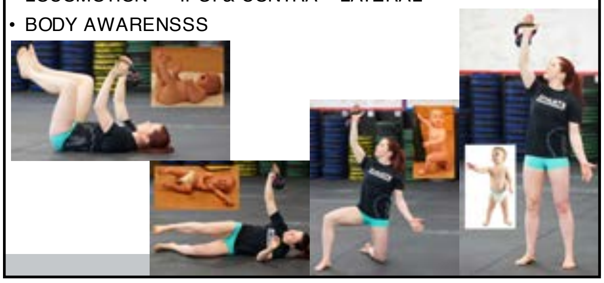
DNS APPROACH

- To train ideal patterns as defined by the developmental kinesiology/reflex locomotion
- STABILIZATION
- RESPIRATORY PATTERN
- LOCOMOTION – IPSI & CONTRA - LATERAL
- BODY AWARENSSS



Dynamic Neuromuscular Stabilization (DNS): Exercise in developmental positions

DNS goal:

To restore functional norms as defined by early physiological development

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Treatment effect

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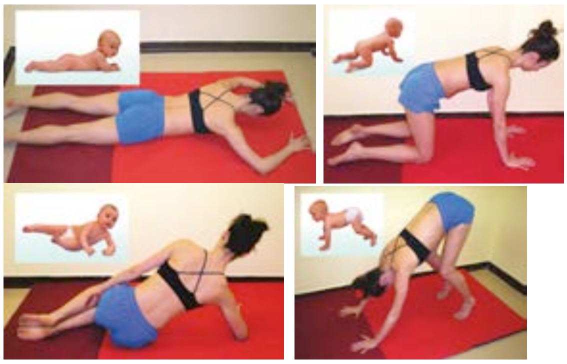
Treatment effect

Kobesova A, Dzvonik J, Kolar P, Sardina A, Andel R. Effects of shoulder girdle dynamic **stabilization exercise** on hand **muscle strength.** *Isokinetics and exercise Science*. 2015;23:21-32.

Effects of shoulder girdle dynamic stabilization exercise on hand muscle strength



The **training group gained** about 0.25 standard deviations **over the control group** per session for a total of 1.5 standard deviations (about 27 Newtons) across all sessions.
$p < 0.001$

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