Hingamislihaste treening ja selle mõju sportlikule sooritusvõimele

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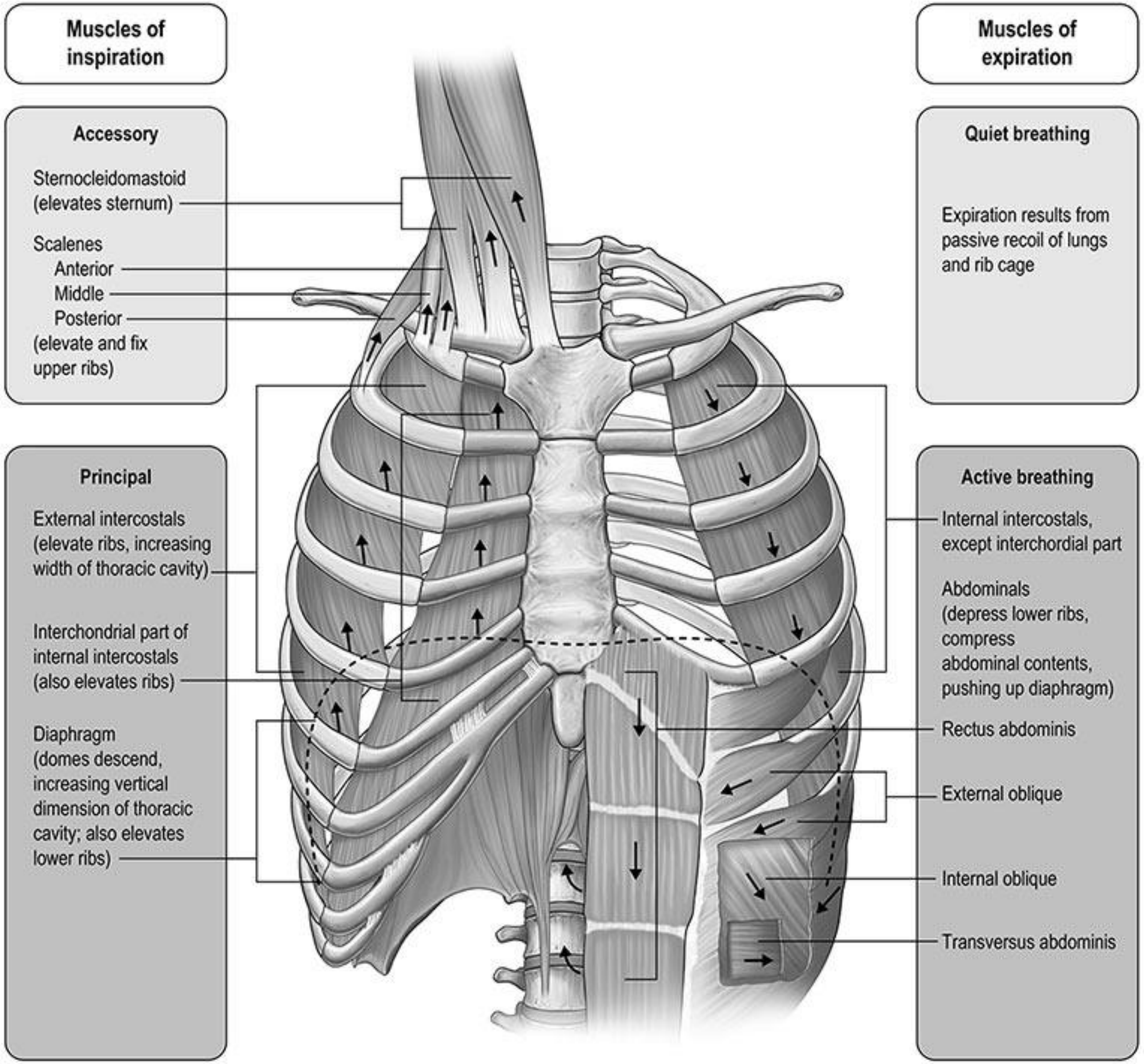
Tartu Ülikool

Tartu Ülikooli kliinikum


Muscles of inspiration
Accessory
Sternocleidomastoid (elevates sternum)
Scalenes
Anterior
Middle
Posterior
(elevate and fix upper ribs)
Principal
External intercostals (elevate ribs, increasing width of thoracic cavity)
Interchondrial part of internal intercostals (also elevates ribs)
Diaphragm (domes descend, increasing vertical dimension of thoracic cavity; also elevates lower ribs)
Muscles of expiration
Quiet breathing
Expiration results from passive recoil of lungs and rib cage
Active breathing
Internal intercostals, except interchordial part
Abdominals (depress lower ribs, compress abdominal contents, pushing up diaphragm)
Rectus abdominis
External oblique
Internal oblique
Transversus abdominis

Kas hingamissüsteem väsib?

- Hingamislihaste väsimus võib tekkida ühekordse maksimaalse vastupidavusliku tegevuse käigus või ka pikemaajalise submaksimaalse pingutuse käigus (Inbar et al., 2000; Johnson et al., 1993).

Inbar, O., Weiner, P., Azgad, Y., Rotstien, A., and Weinstein, Y. 2000. **Specific inspiratory muscle training in well-trained endurance athletes.** Med. Sci Sports. Exerc. 32: 1233-1237.
Johnson, B.D., Babcock, M.A., Suman, O.E., and Dempsey, J.A. 1993. **Exercise-induced diaphragmatic fatigue in healthy humans.** J Physiol. 460: 385–405.

Kuidas hingamissüsteem väsib?

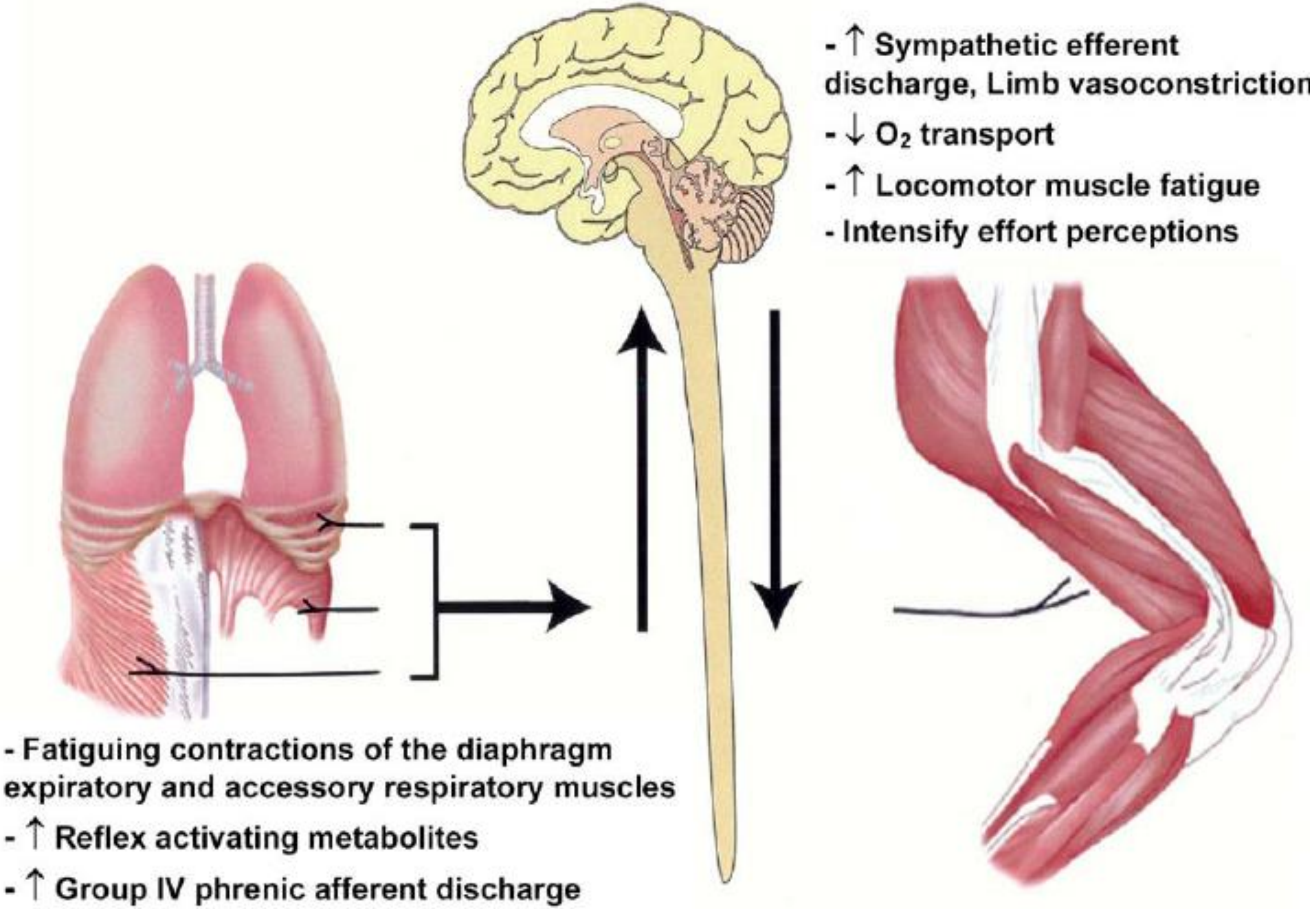
- Üheks võimalikuks tekkemehhanismiks pakutakse nö metaborefleksi ehk et automaatset närvisüsteemi reaktsiooni (diafragma) väsimusele, mille tõttu limiteeritakse jäsemete verevarustust, et tagada hingamissüsteemi verevarustus (Wüthrich et al., 2015; Sheel et al., 2001; St Croix et al., 2000).

Wüthrich, T.U., Marty, J., Benaglia, P., Eichenberger, P.A, and Spengler, C.M. 2015**. Acute Effects of a Respiratory Sprint-Interval Session on Muscle Contractility.** Med. Sci. Sports. Exerc. 47(9): 1979-87.

Sheel, AW, Derchak, PA, Morgan, BJ, Pegelow, PF, Jackques, AJ, and Dempsey, AJ. **Fatiguing inspiratory work muscles causes reflex reduction in resting leg blood flow in humans.** J Physiol 537: 277-289, 2001.

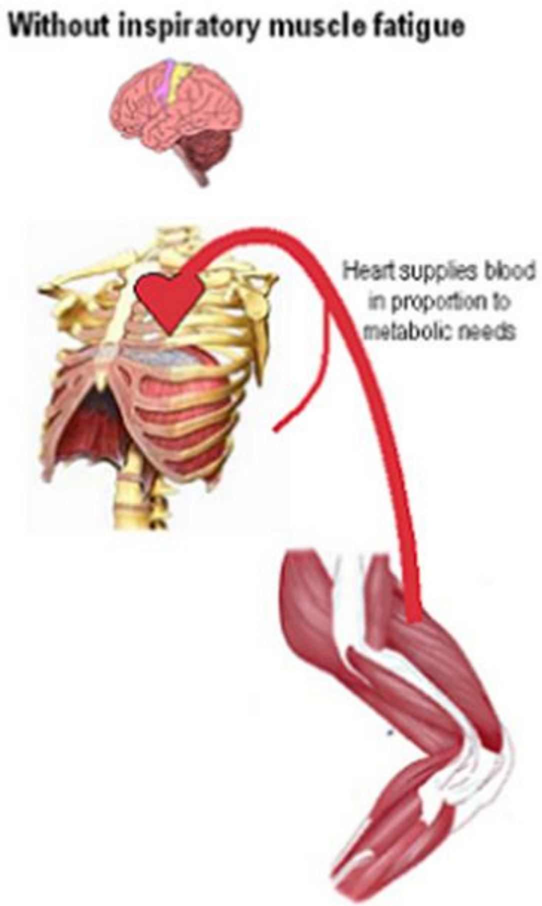
St Croix, CM, Morgan, BJ, Wetter, TJ, and Dempsey, JA. **Reflex effects from a fatiguing diaphragm increase sympathetic efferent activity (MSNA) to limb muscle in humans.** J Physiol 529: 493–504, 2000.

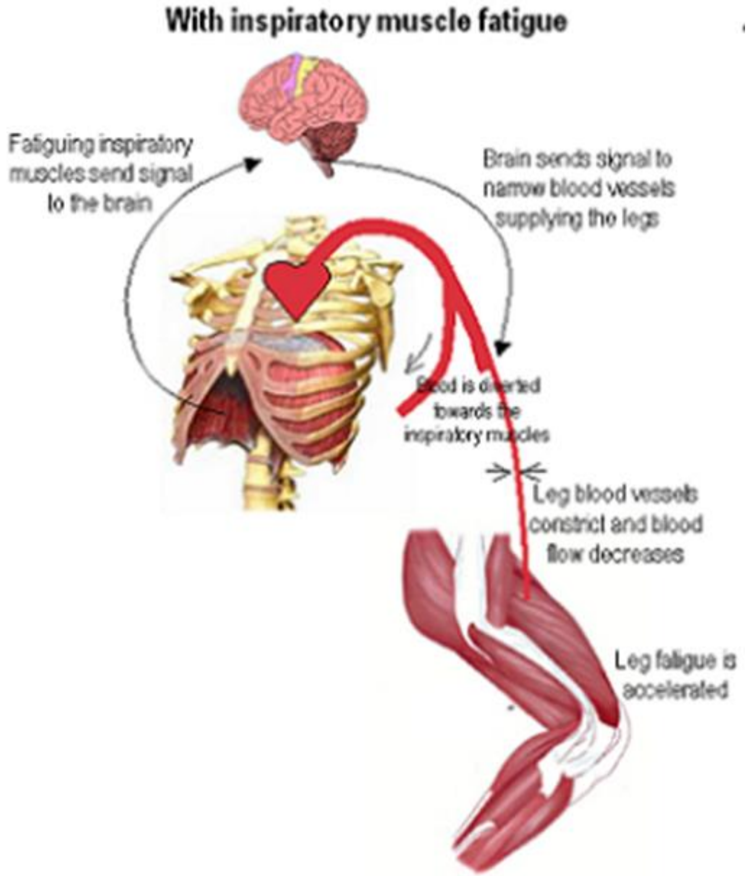
RESPIRATORY MUSCLE METABOREFLEX



➢ ***Vasokonstriktsioon!!***

Katajama et al., Physiol Report, 2015





Kas saame hingamissüsteemi treenida?

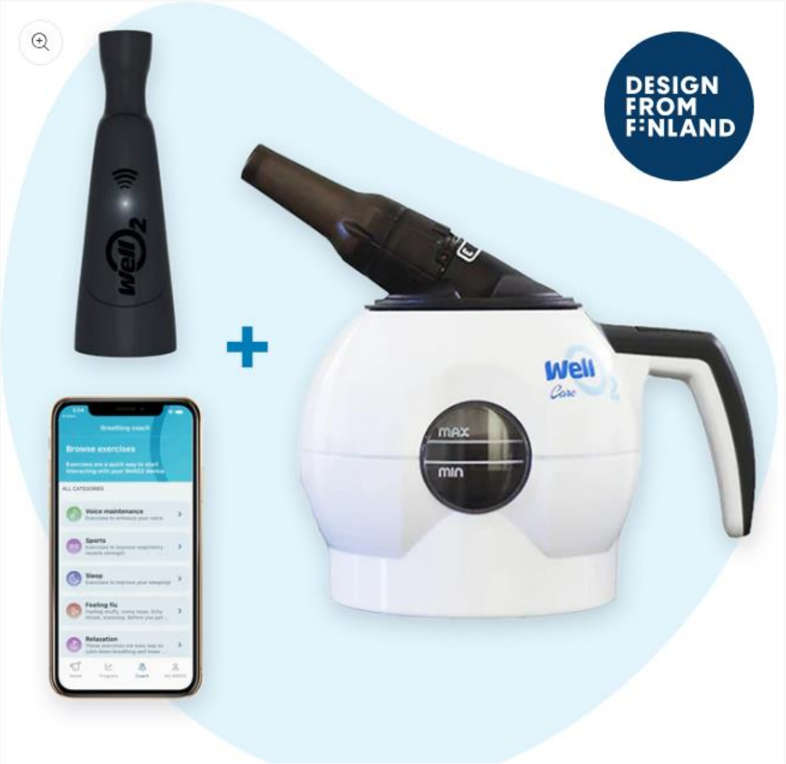
Ja kas see parandab sooritusvõimet?

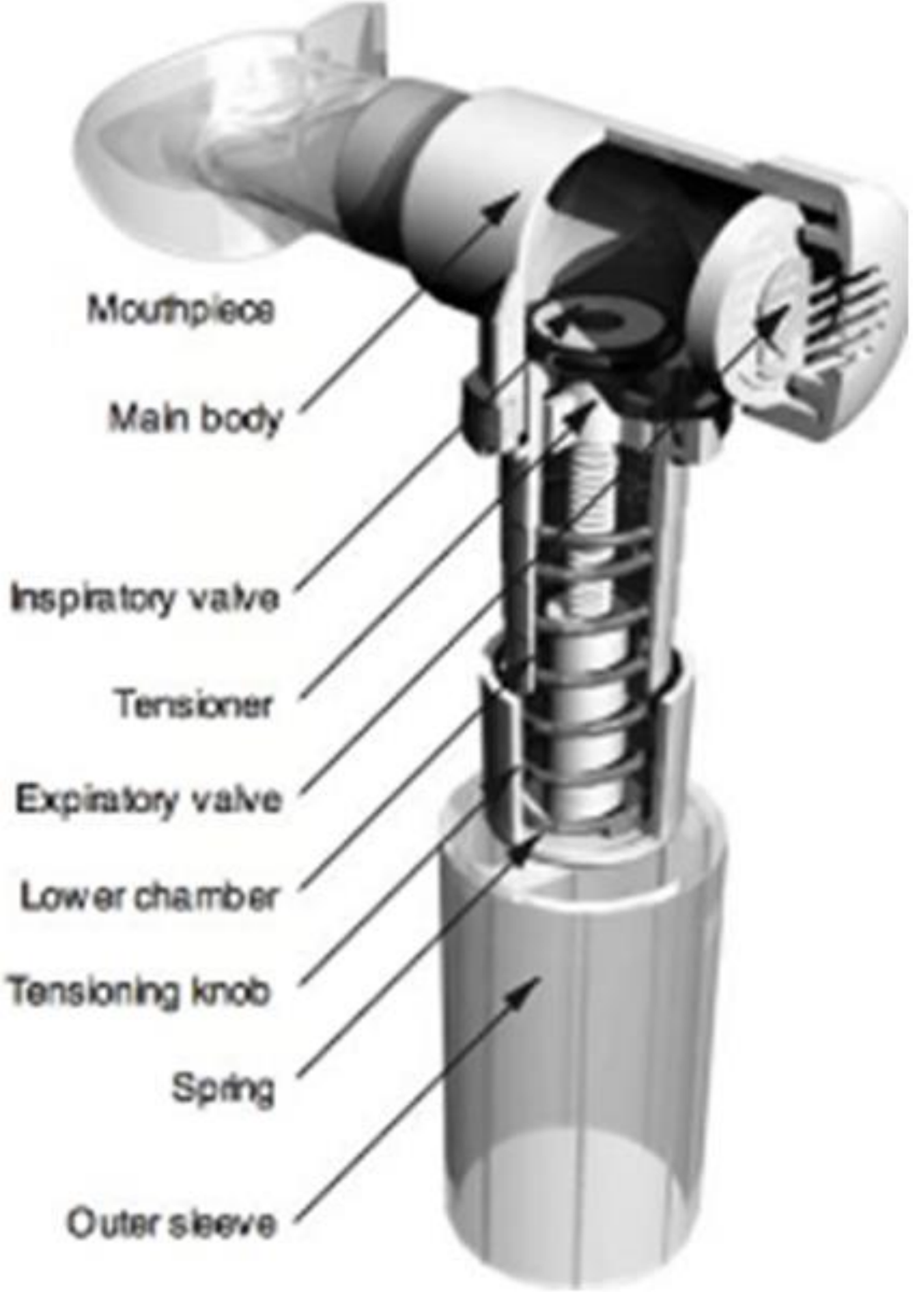
- Spetsiifiline vastupanuga hingamislihaste treening (Leith and Bradley, 1976).

- Hingamislihased reageerivad treeningule sarnaselt teiste skeletilihassüsteemi lihastega – ehk et regulaarsus ja progresseerumine (Kraemer et al., 2002).

Leith, DE and Bradley, M. **Ventilatory muscle strength and endurance training**. J App Physiol 41: 508-516, 1976.
Kraemer, WJ, Adams, K, Cafarelli, E, Dudley, GA, Dooly, C, Feigenbaum, MS, Fleck, SJ, Franklin, B, Fry, AC, Hoffman, JR, Newton, RU, Potteiger, J, Stone, MH, Ratamess, NA, and Triplett-McBride T. **American college of sports medicine position stand: progressive models in resistance training for healthy adults.** Med Sci Sports Exerc 34: 364-380, 2002.

Seadmed treenimiseks

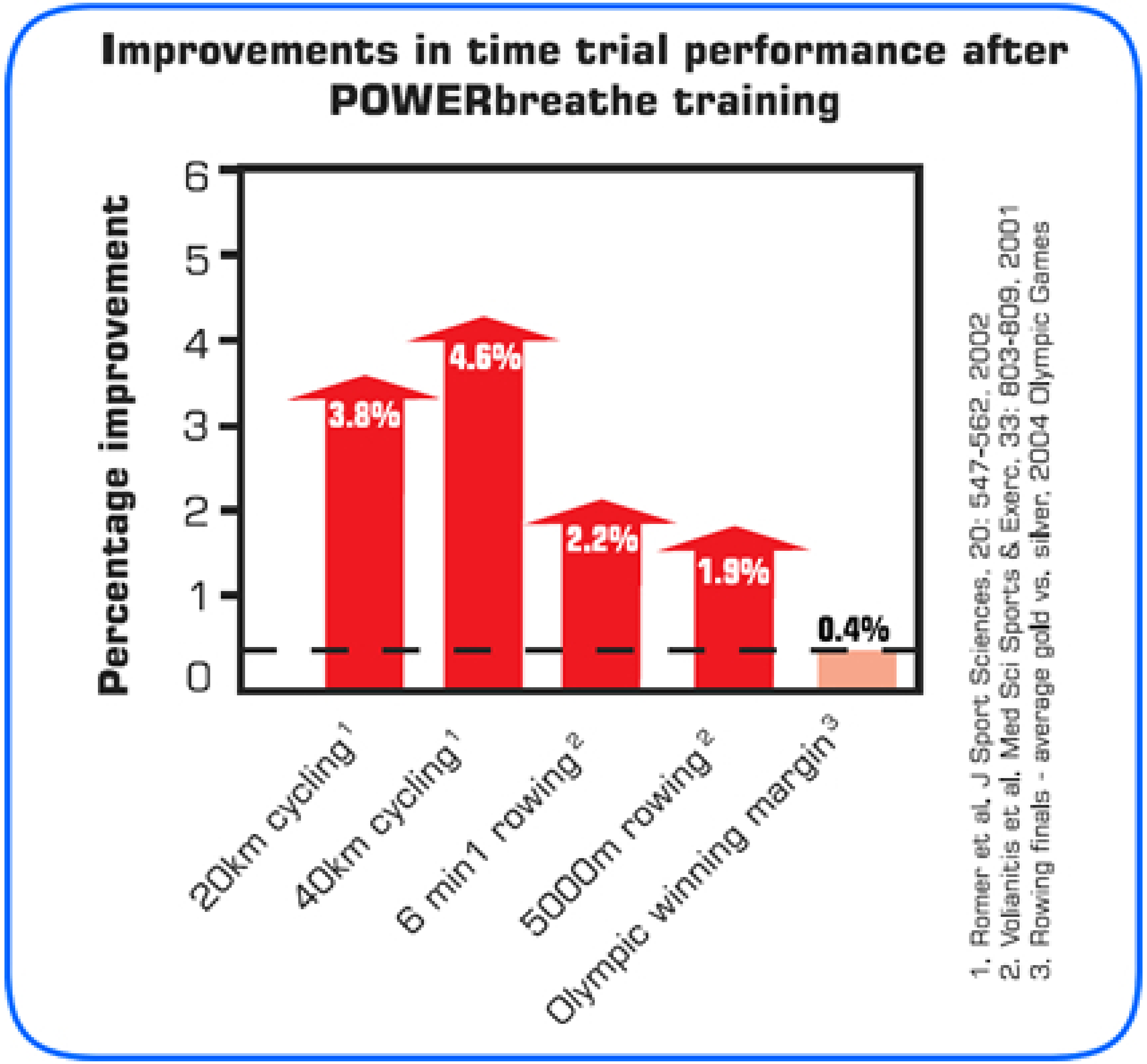




Mouthpiece
Main body
Inspiratory valve
Tensioner
Expiratory valve
Lower chamber
Tensioning knob
Spring
Outer sleeve

Hingamissüsteemi treenimine

- Süstemaatilises ülevaateartiklis toodi välja, et spetsiifiline sissehingamislihaste treenimine takistusvahenditega on efektiivne parandamaks sportlikku sooritusvõimet erinevatel aladel (Illi et al., 2012).


Improvements in time trial performance after POWERbreathe training
Percentage improvement
6
5
4
3
2
1
0
3.8%
4.6%
2.2%
1.9%
0.4%
20km cycling 1
40km cycling 1
6 min1 rowing 2
5000m rowing 2
Olympic winning margin 3
1. Romer et al. J Sport Sciences. 20: 547-562. 2002
2. Volianitis et al. Med Sci Sports & Exerc. 33: 803-809. 2001
3. Rowing finals - average gold vs. silver. 2004 Olympic Games


concept 2


concept 2






Abstract

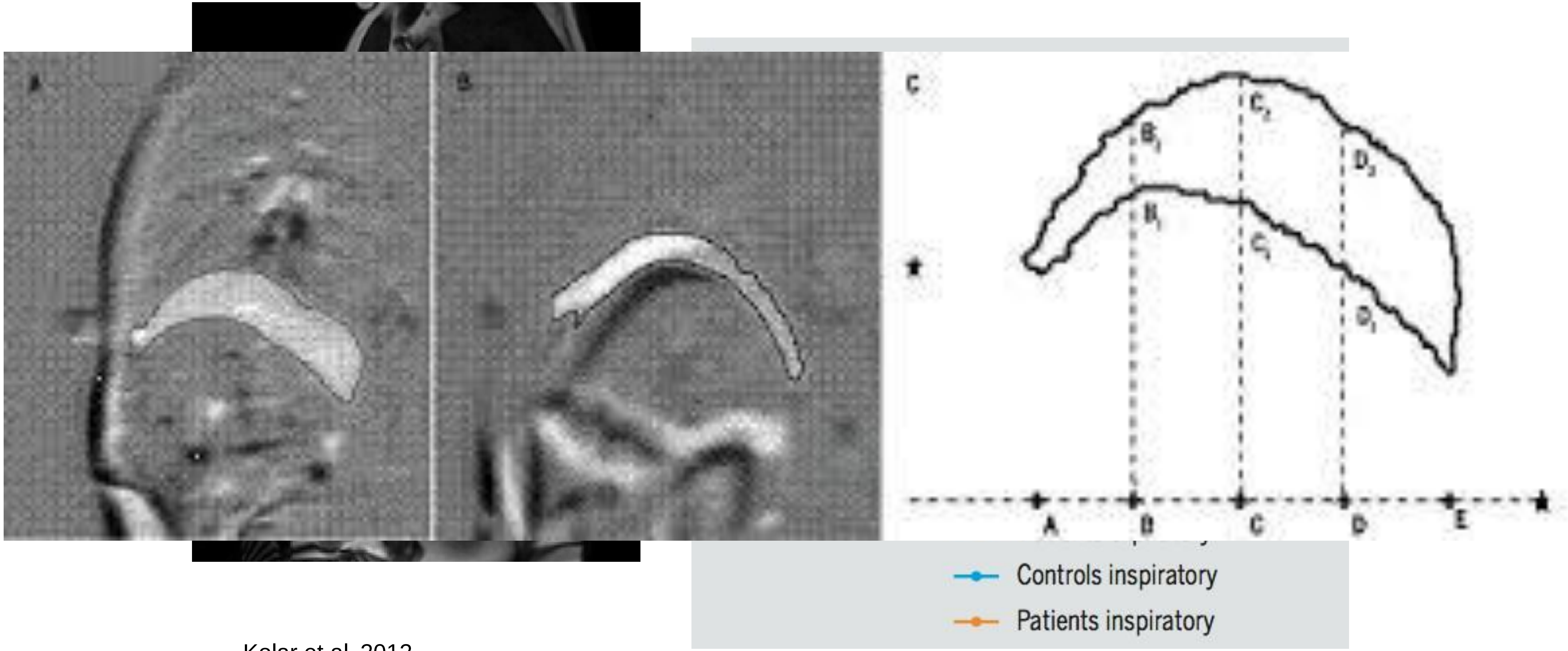
BACKGROUND This study examined the effects of abdominal draw-in lumbar stabilization exercises (ADIM) with respiratory resistance on women ages 40-49 years with low back pain. MATERIAL AND METHODS Forty-four women ages 40-49 years were screened for participation and were randomly assigned to either a respiratory with resistance exercise group (n=22) or a control group (n=22). Abdominal draw-in lumbar stabilization exercises were administered to both groups, but only the respiratory with resistance exercise group received the respiratory resistance training. The exercise training lasted 50 min per session, 3 sessions per week for 4 weeks. The assessment methods used were the quadruple visual analogue scale (QVAS), Oswestry disability index-Korean version (ODI-K), diaphragm thickness and contraction rate, and lung capacity test. RESULTS Both groups showed significant differences in the QVAS, ODI-K, maximum voluntary ventilation (MVV), and diaphragm thickness and contraction rate before and after the intervention ($p<0.05$). In the respiratory resistance exercise group, the ODI-K, forced vital capacity (FVC), forced expiratory volume in one second (FEV1), MVV, and diaphragm thickness and contraction rate showed significantly better improvement than the control group ($p<0.05$). CONCLUSIONS A lumbar stabilization exercise program consisting of ADIM and respiratory resistance resulted in decreased pain, reduced dysfunctions, and increased muscle thickness in contraction, contraction rate, and pulmonary function. Strong contraction of the diaphragm and deep abdominal muscles through breathing resistance increased the pressure in the abdominal cavity. Therefore, this may be an effective clinical exercise method for patients with lumbar instability.

Hingamislihased ja alaseljavalu?

- Alaseljavaludega patsientidel on uuringutes (fMRT) nähtud diafragma õhenemist/atroofiat ja mitte korrektset toimimist võrreldes tervete inimestega.

Kovacs F.M., Fernández C., Cordero A., Muriel A., González-Luján L. Real MTG Del. Non-specific low back pain in primary care in the Spanish National Health Service: A prospective study on clinical outcomes and determinants of management. *BMC Health Serv. Res.* 2006;6:1–12.
Calvo-Lobo C., Almazán-Polo J., Becerro-De-Bengoa-Vallejo R., Losa-Iglesias M.E., Palomo-López P., Rodríguez-Sanz D., López-López D. Ultrasonography comparison of diaphragm thickness and excursion between athletes with and without lumbopelvic pain. *Phys. Ther. Sport.* 2019;37:128–137.
Vostatek P., Novák D., Rychnovský T., Rychnovská Š. Diaphragm postural function analysis using magnetic resonance imaging. *PLoS ONE.* 2013;8:e56724.

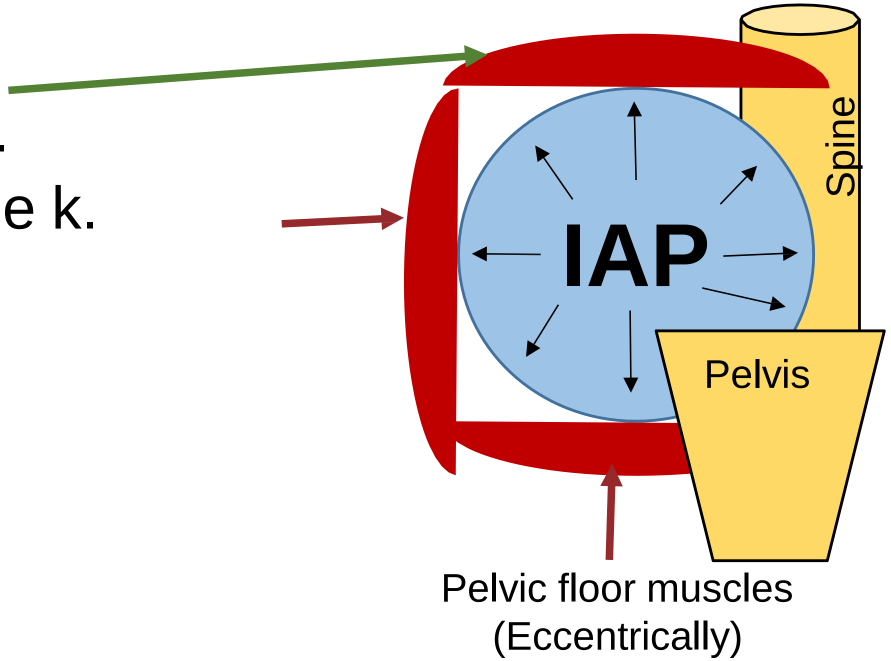
Diafragma ebakorrektne reageerimine/refleks alaseljavaludega inimestel



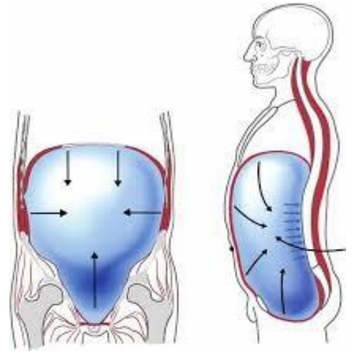
Kolar et al. 2012

Diafragma ja kõhulihaste töö

- Sissehingamine
  - Diafragma = kontsentriline k.
  - Kõhulihased = Ekstsentriline k.
  - Kõhuõõnerõhk (IAP)



- Väljahingamine
  - Diafragma = ekstsentriline k
  - Kõhulihased = Kontsentriline k



Chaitow et al., 2014

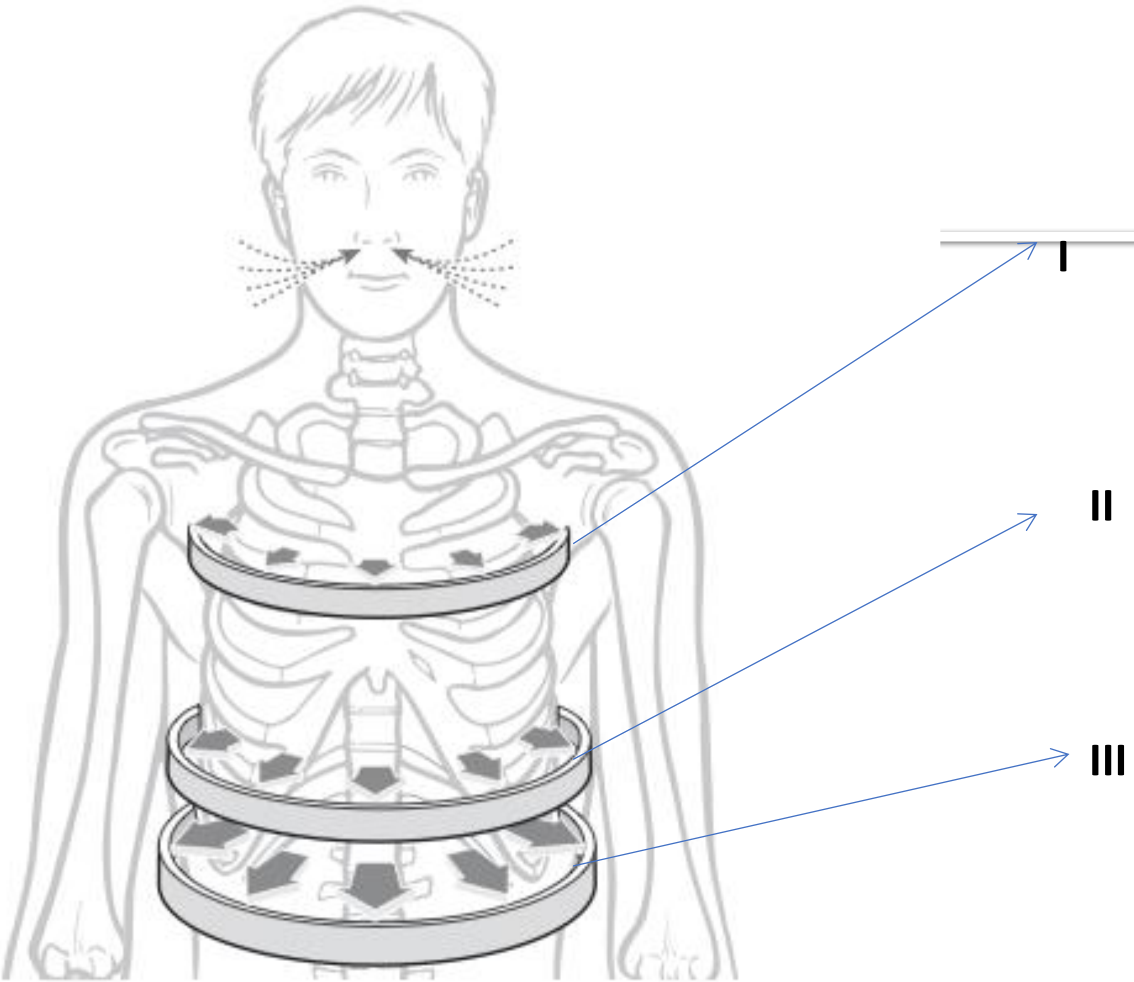
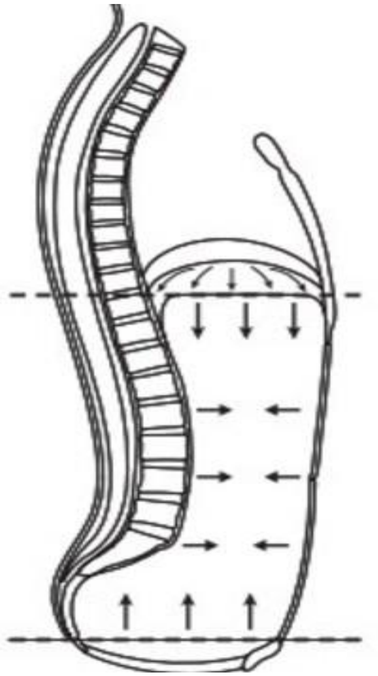


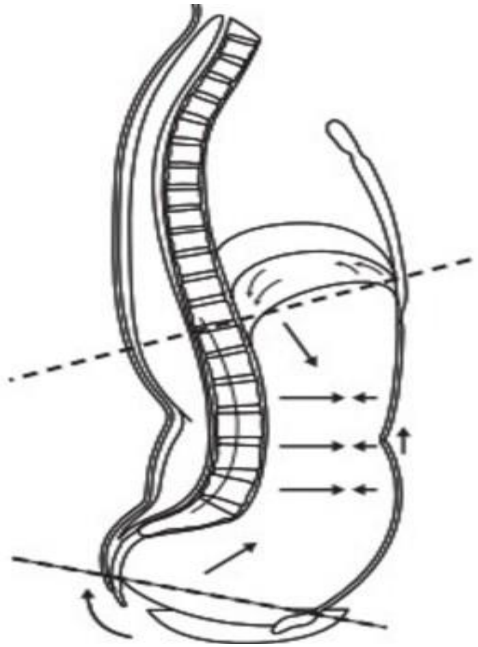
Figure 6 Normal pattern of inspiration. Note the expansion, like a balloon in all directions initiating in the abdomen, moving to the lower ribs and then in the upper chest.

Rüht ja hingamine ja lülisamba tugevus

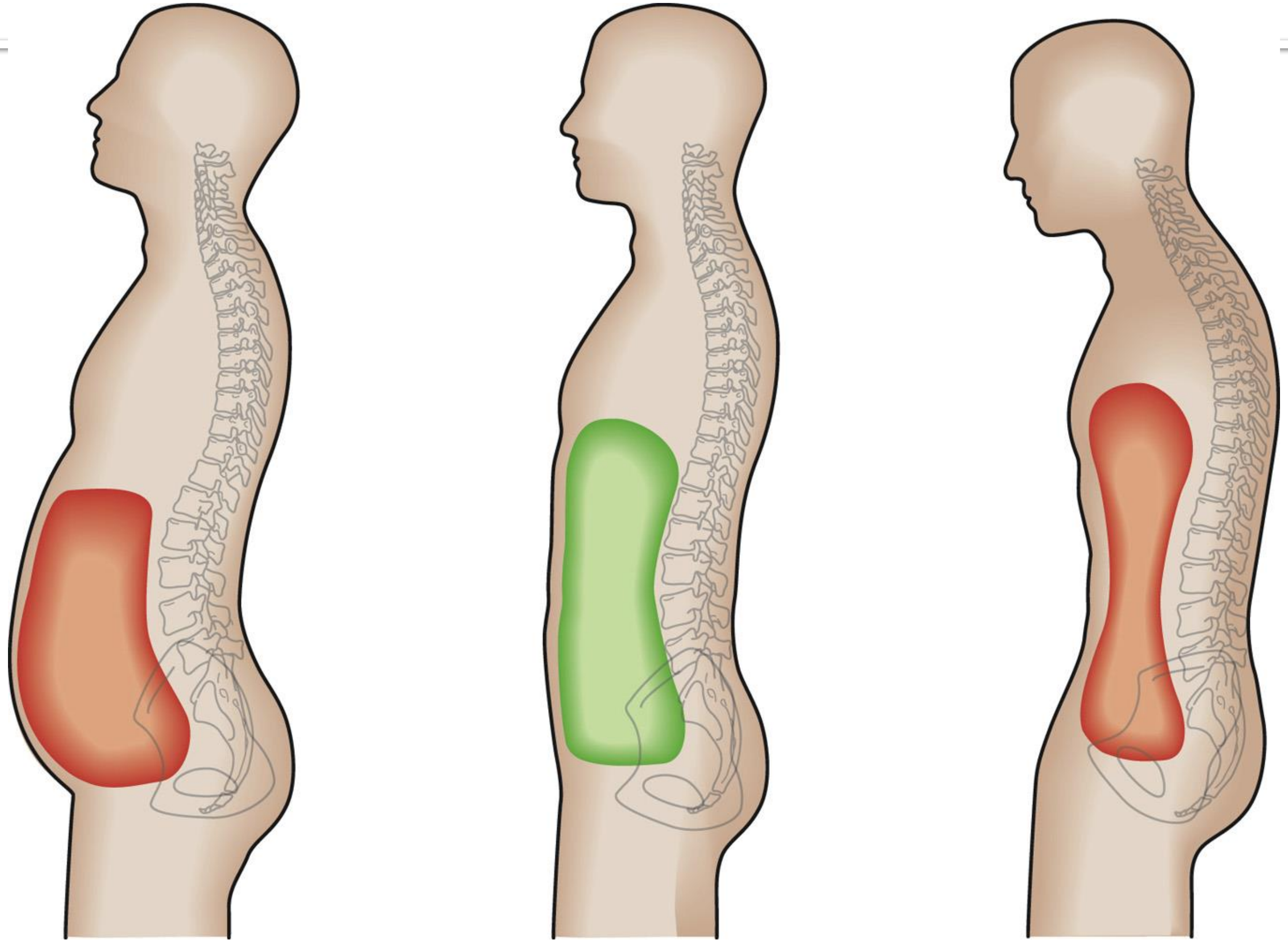
- Korrektne/tugev



- Ebakorrektne?



Cahitow et al., 2014; Hruska., 2005; DeTryoyer and Estenne 1998



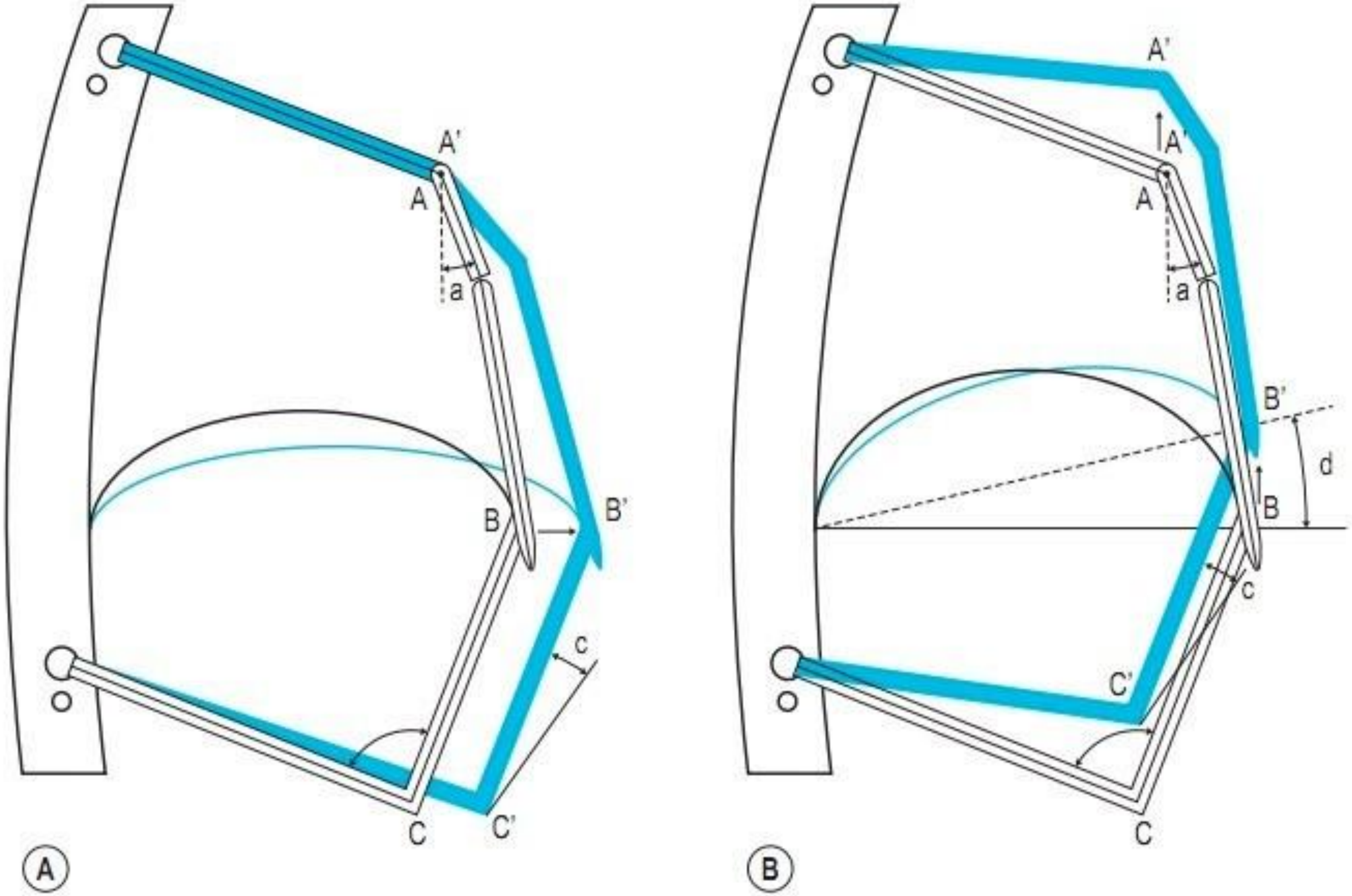


Figure 2.1.1 **A** Optimal 'diaphragmatic' breathing: position of the ribs in transverse plane remains more or less the same during respiratory cycle; widening of the intercostal spaces and lower chest cavity occurs (distance C–C′); movement of the sternum is mainly ventro-dorsal (distance B–B′, 'a' angle); with inspiration the diaphragm descends caudally and flattens while maintaining its position in sagittal plane. **B** Accessory breathing pattern: cranial movement of the whole chest occurs with every inspiration (A–A′ distance, B–B′, C–C′ distance); insufficient widening of the lower chest and intercostal spaces (distance C–C′) and cranial movement of the xyphoid (distance B–B′); diaphragmatic excursion is smaller and as the chest lifts the diaphragm goes into a more oblique position ('d' angle) without the ideal flattening.

Randomized C
doi: 10.1183/139

Inspirato COVID-1

Melitta A McNar
Jamie Duckers [6]

Background: Many people recovering from coronavirus disease 2019 (COVID-19) experience prolonged symptoms, particularly breathlessness. We urgently need to identify safe and effective COVID-19 rehabilitative strategies. The aim of the current study was to investigate the potential rehabilitative role of inspiratory muscle training (IMT).

Methods: 281 adults (age 46.6±12.2 years; 88% female) recovering from self-reported COVID-19 (9.0±4.2 months post-acute infection) were randomised 4:1 to an 8-week IMT or a "usual care" waitlist control arm. Health-related quality-of-life and breathlessness questionnaires (King's Brief Interstitial Lung Disease (K-BILD) and Transition Dyspnoea Index (TDI)), respiratory muscle strength, and fitness (Chester Step Test) were assessed pre- and post-intervention. The primary end-point was K-BILD total score, with the K-BILD domains and TDI being key secondary outcomes.

Results: According to intention to treat, there was no difference between groups in K-BILD total score post-intervention (control: 59.5±12.4; IMT: 58.2±12.3; $p<0.05$) but IMT elicited clinically meaningful improvements in the K-BILD domains for breathlessness (control: 59.8±12.6; IMT: 62.2±16.2; $p<0.05$) and chest symptoms (control: 59.2±18.7; IMT: 64.5±18.2; $p<0.05$), along with clinically meaningful improvements in breathlessness according to TDI (control: 0.9±1.7 *versus* 2.0±2.0; $p<0.05$). IMT also improved respiratory muscle strength and estimated aerobic fitness.

Conclusions: IMT may represent an important home-based rehabilitation strategy for wider implementation as part of COVID-19 rehabilitative strategies. Given the diverse nature of long COVID, further research is warranted on the individual responses to rehabilitation; the withdrawal rate herein highlights that no one strategy is likely to be appropriate for all.

Pange endale kirja 5 asja, mida sellest loengust kaasa võtate.