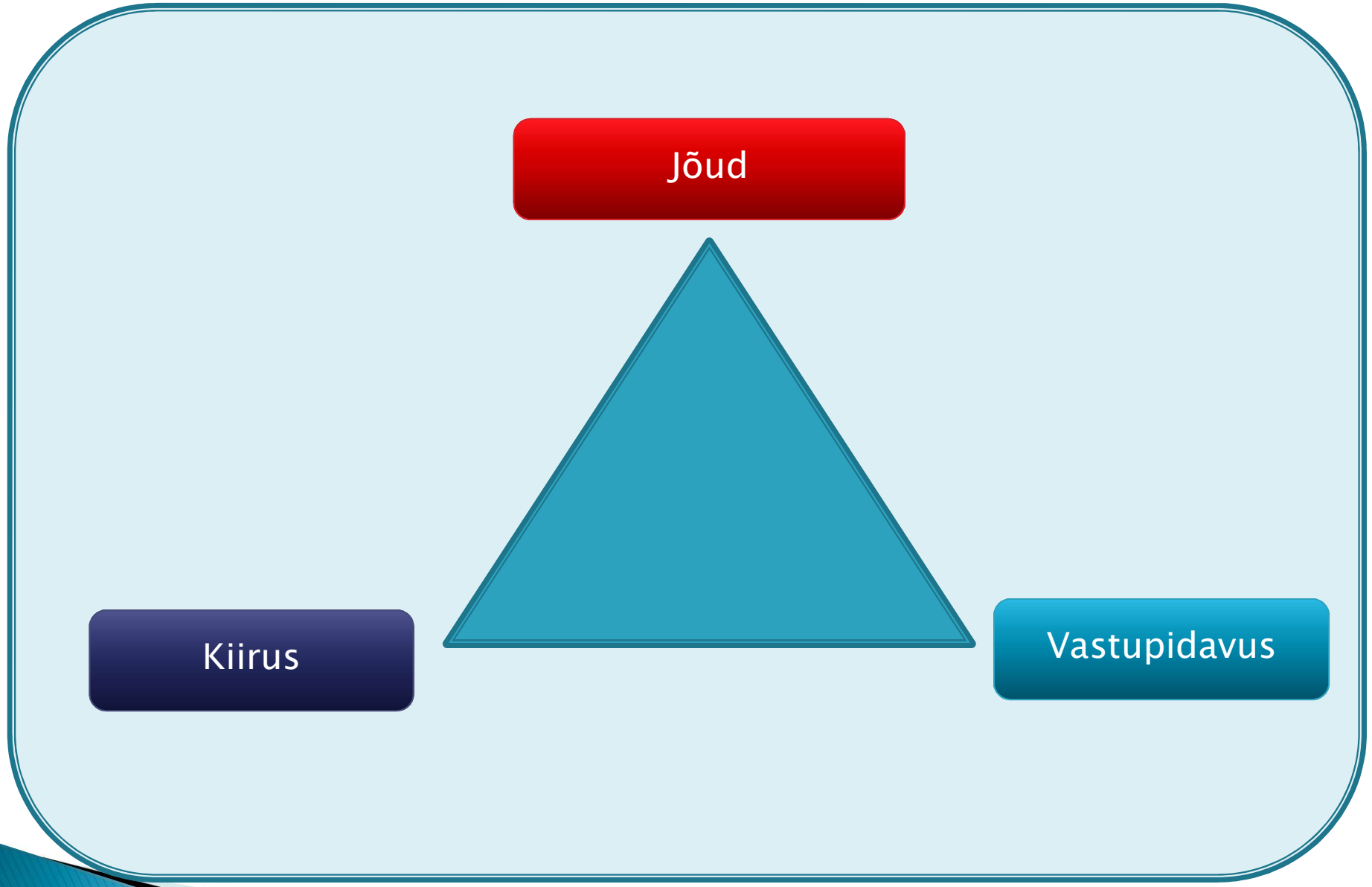
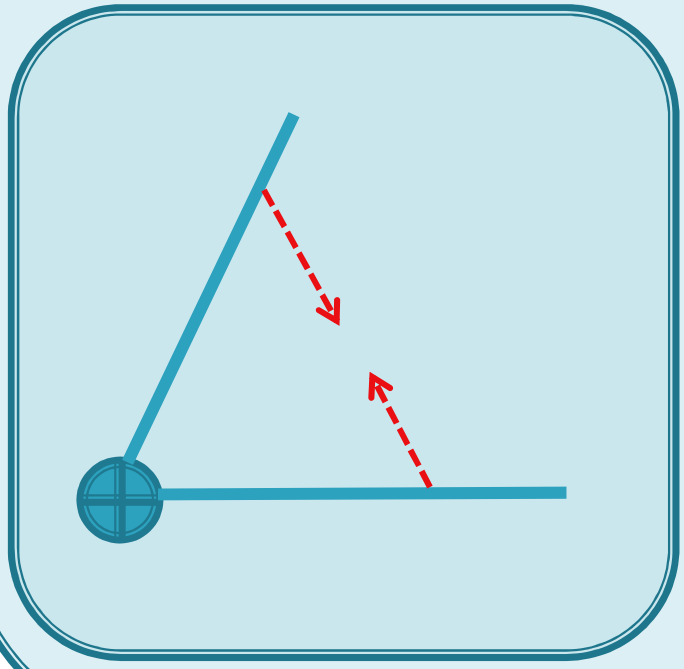
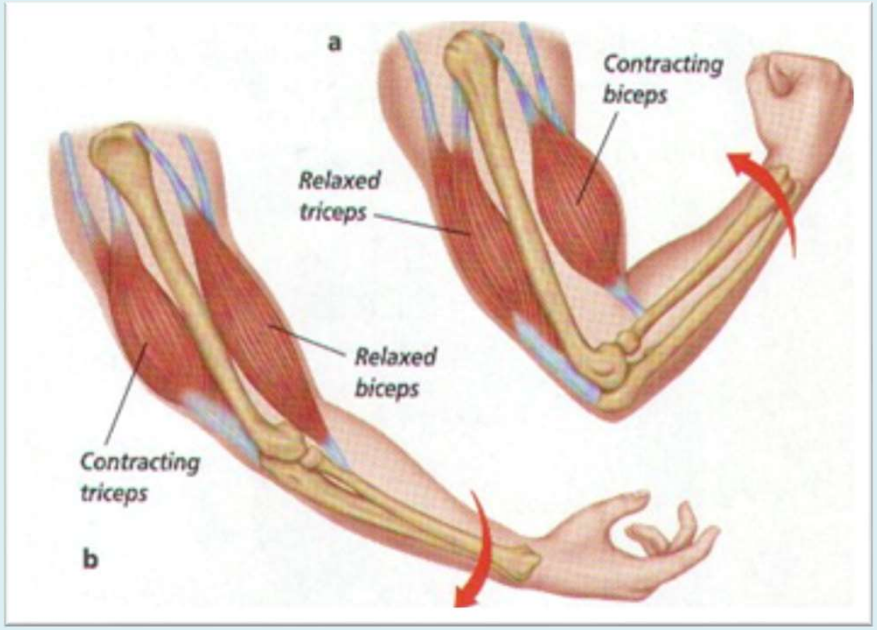
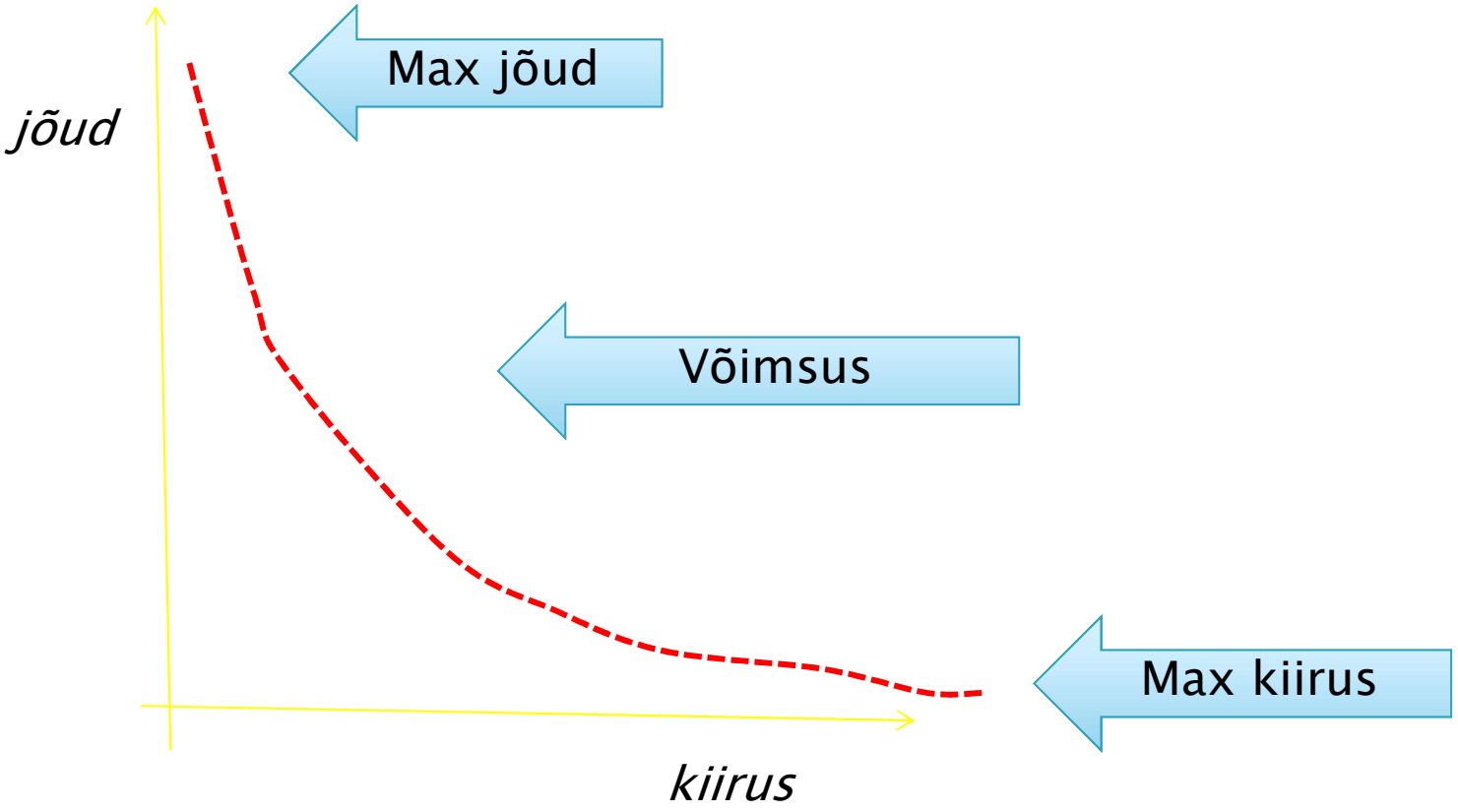
Jõutreening – vastupidavustreeningu osa

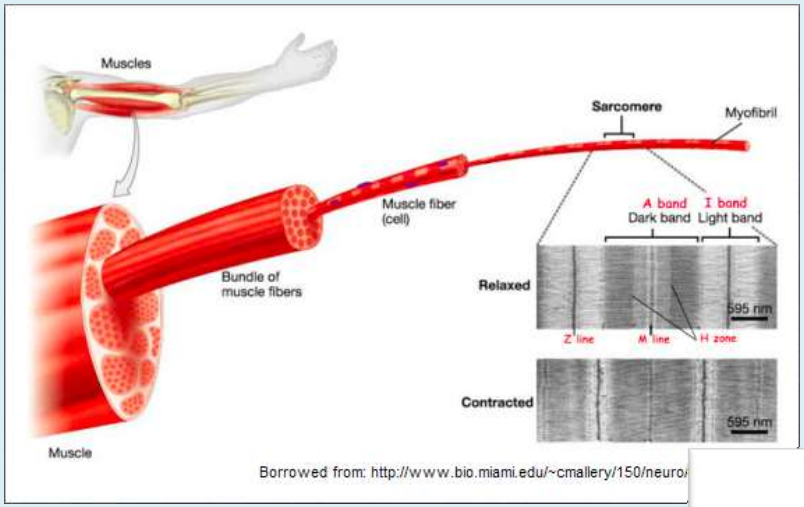
PhD Raivo Puhke
TÜ, Sporditeaduste ja füsioteraapia instituut


Jõud
Kiirus
Vastupidavus

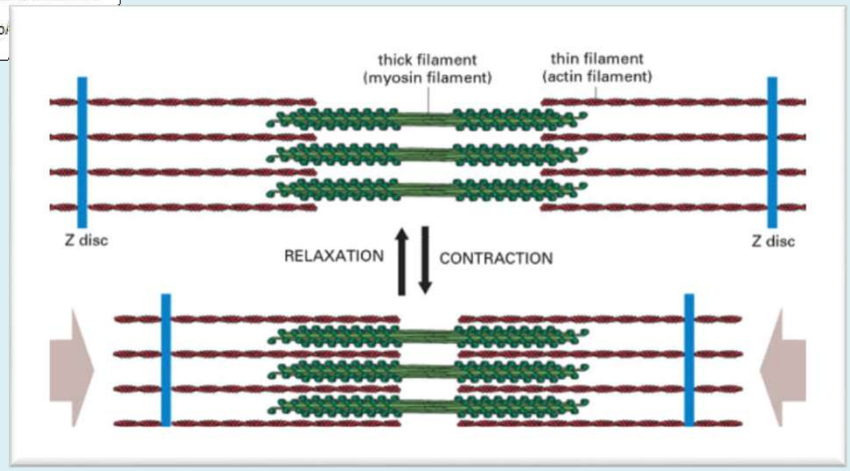


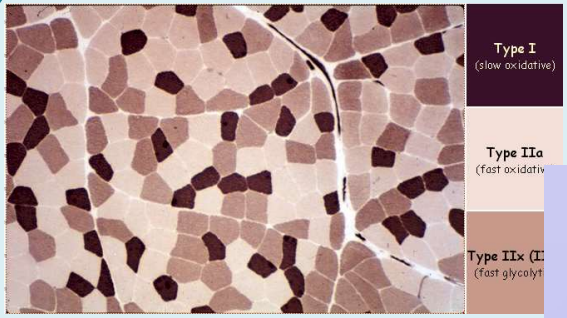

a
Contracting biceps
Relaxed triceps
Relaxed biceps
Contracting triceps
b

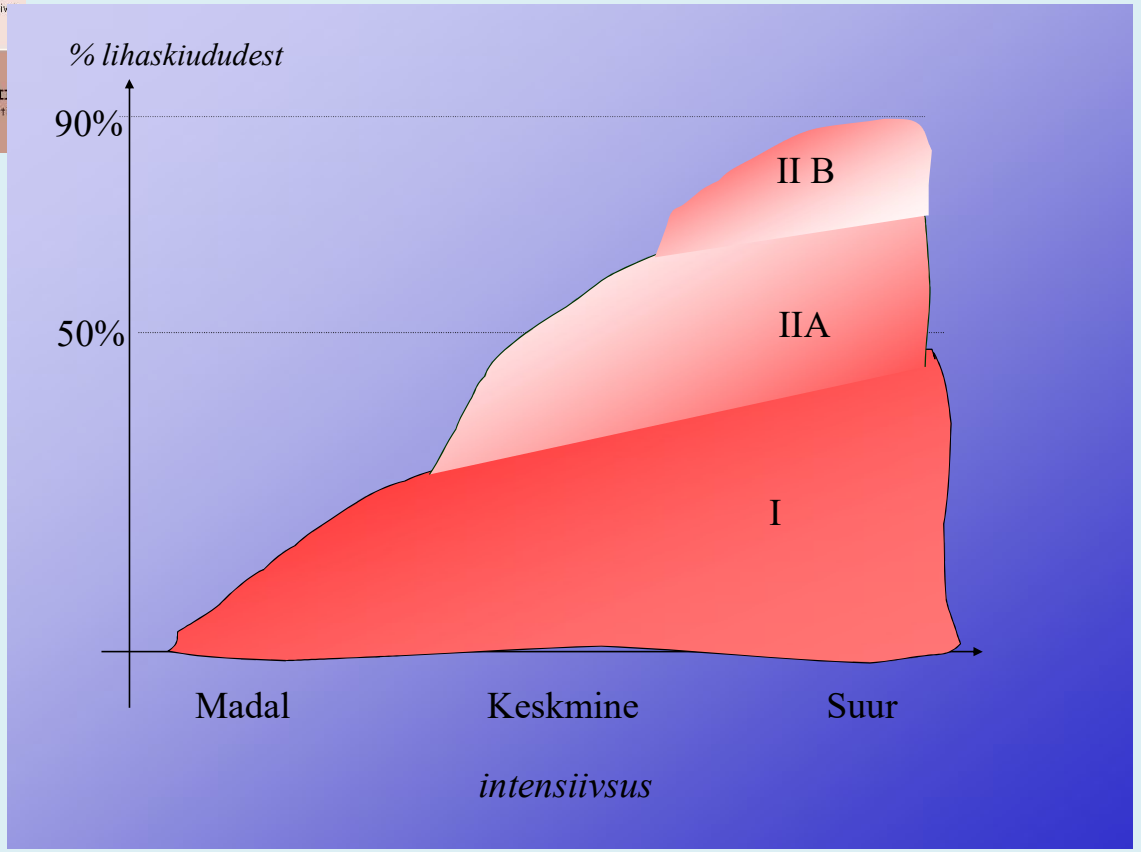

Max jõud
jõud
Võimsus
Max kiirus
kiirus



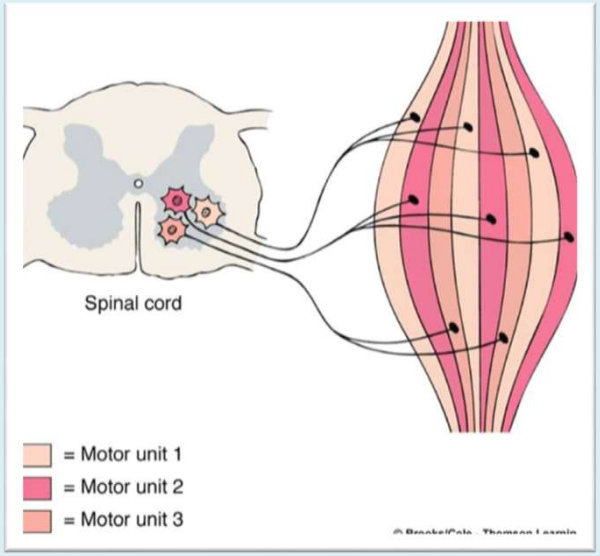
Borrowed from: http://www.bio.miami.edu/~cmallery/150/neuro

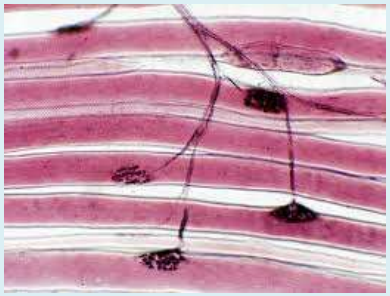


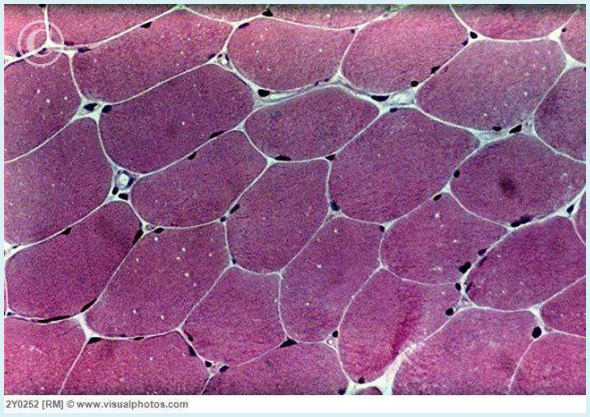

Type I
(slow oxidative)
Type IIa
Type IIx

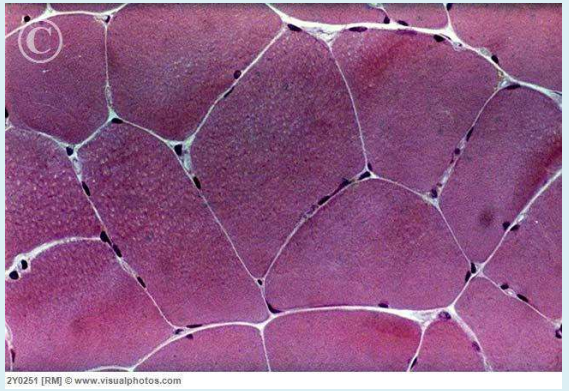

% lihaskiududest
90%
50%
II B
IIA
I
Madal
Keskmine
Suur
intensiivsus

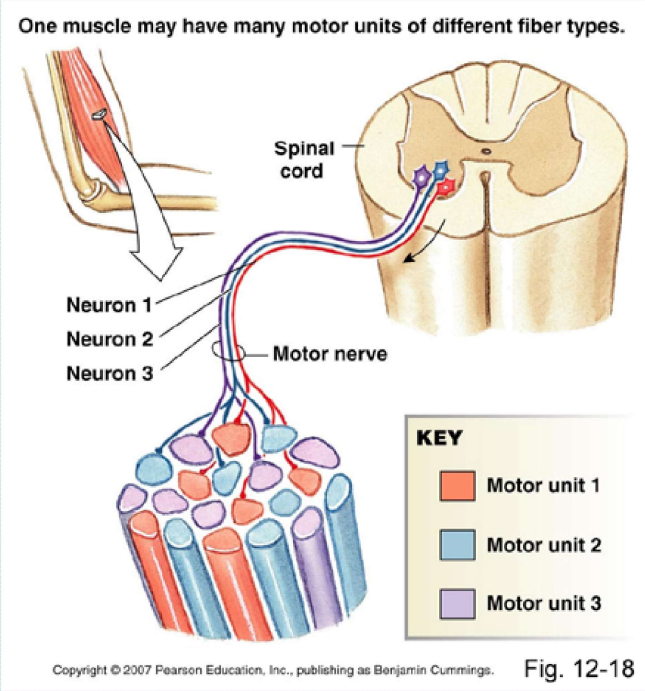
Lihase jõud

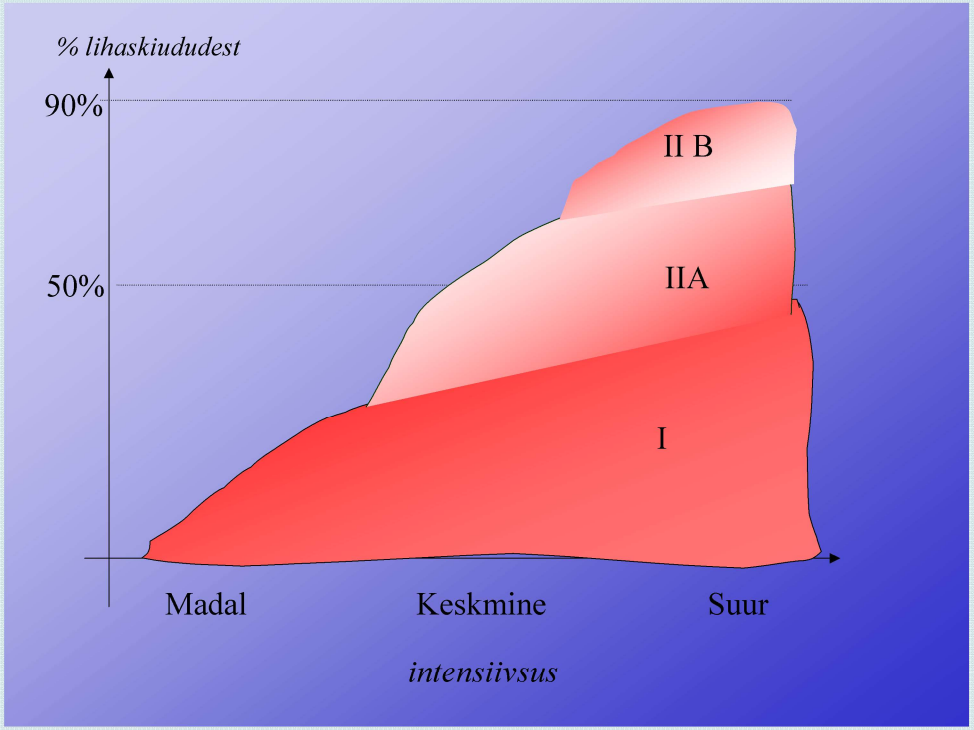

Spinal cord
= Motor unit 1
= Motor unit 2
= Motor unit 3



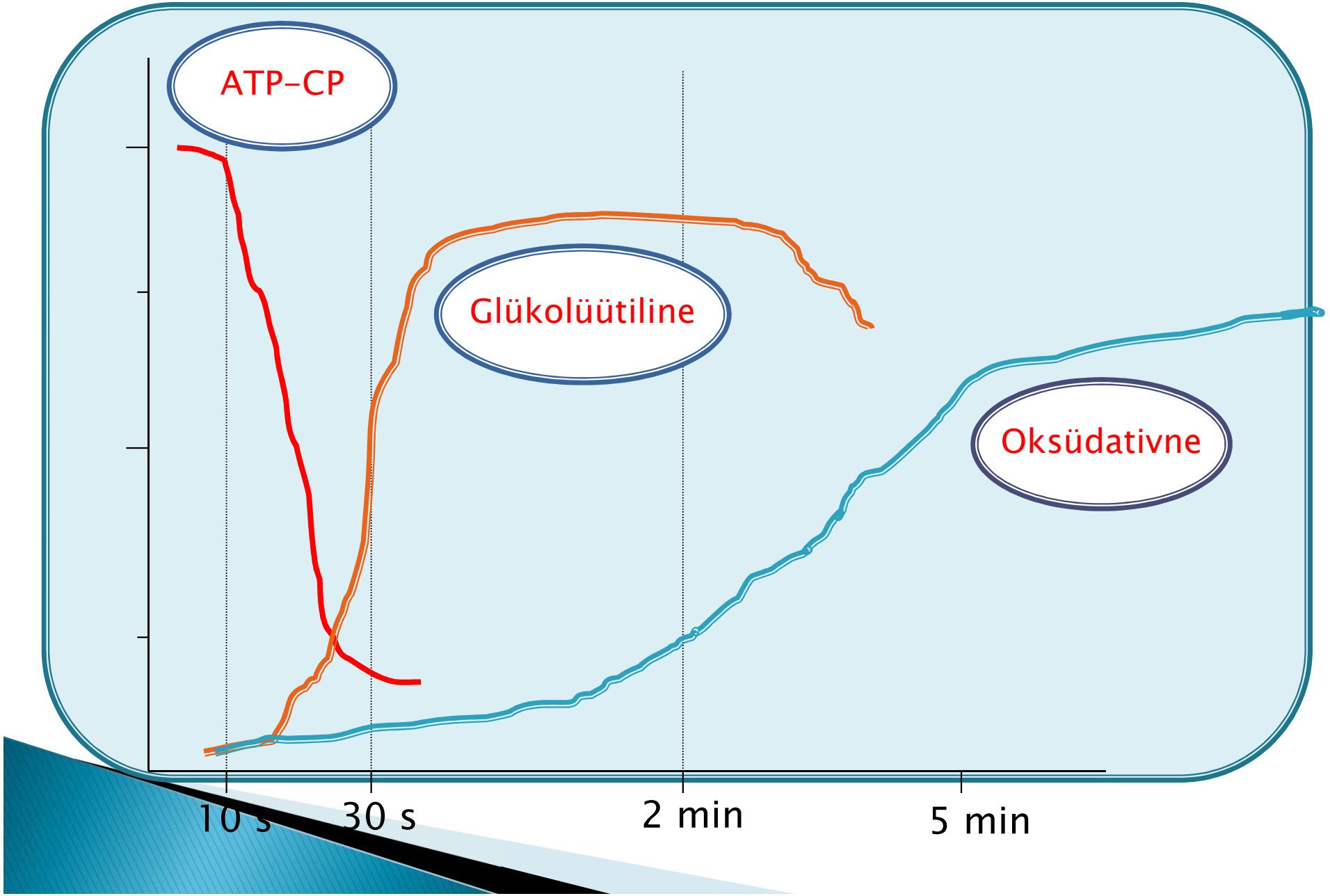

2Y0252 [RM] © www.visualphotos.com


2Y0251 [RM] © www.visualphotos.com

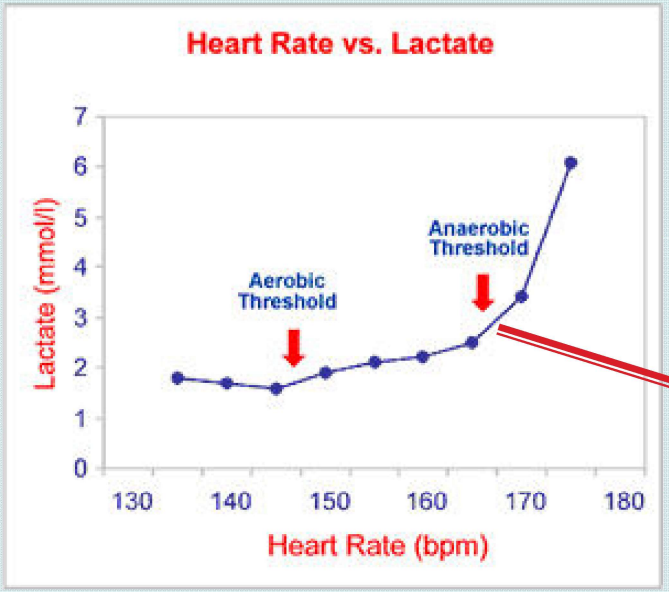

One muscle may have many motor units of different fiber types.
Spinal cord
Neuron 1
Neuron 2
Neuron 3
Motor nerve
KEY
Motor unit 1
Motor unit 2
Motor unit 3
Copyright © 2007 Pearson Education, Inc., publishing as Benjamin Cummings.
Fig. 12-18

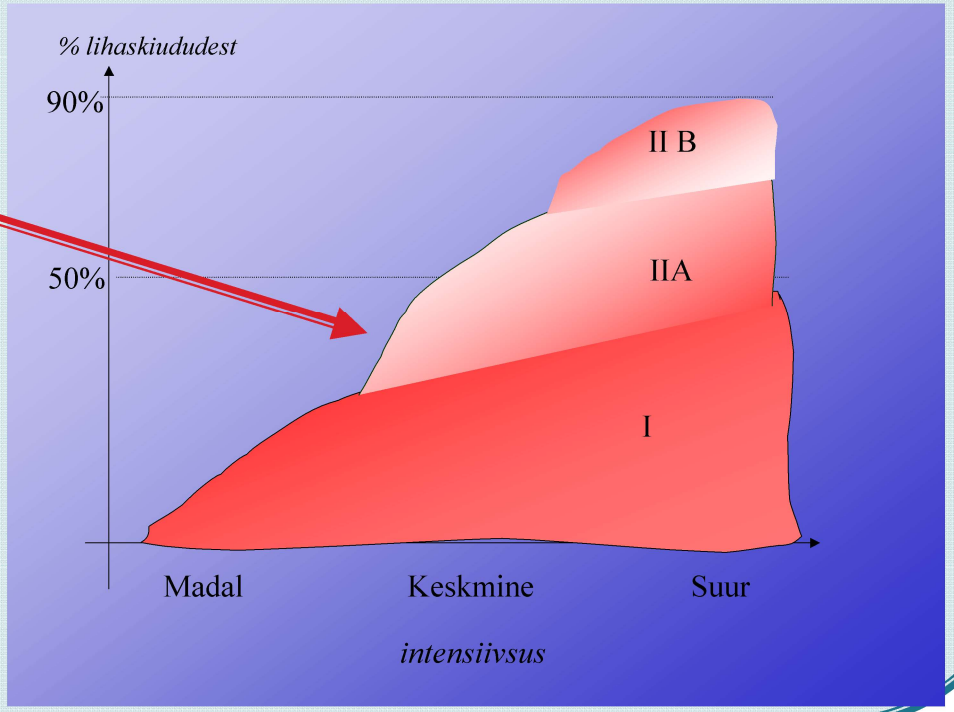

% lihaskiududest
90%
50%
II B
IIA
I
Madal
Keskmine
Suur
intensiivsus

Lihastöö energeetika



Anaeroobne lävi





	KESTUSJÕUD		MAX JÕUD		KIIRUSLIK JÕUD	
	Lihas VP	Jõu VP	Põhi jõud	Max jõud	Kiire jõud	Plahvat jõud
Lisaraskus %	oma keha	20–25	50–85	90–100	30–80	40–60
kordusi	20–50	10–20	4–12	1–3	6–10	1–5
puhkepaus	30”	20–45”	2–3`	2–4`	2–3`	2–4`
kordusi tr	500–1500	300–600	150–200	20–60	60–200	50–150
tempo	rahulik	kiire	aeglane	kiire	max	max

Jõutreening aitab parandada VP töövõimet parandades liigutuslikku ökonoomsust, lükates edasi väsimuse teket, parandades An võimekust ja maksimaalset kiirust.

B.R. Ronnestad., I.Muijka 2013

Ökonoomsus

O2 tarbimine submaksimaalsel intensiivsusel

Märkimisväärne individualne variatiivsus esineb sarnase VO2 max näitajatega sportlastel.

Positiivset jõutreeningu mõju ökonoomsusele on leitud jooksjatel jalgratturitel.

- VO2 max, laktaadi lävi ja ökonoomsus omavad märkimisväärset osa (>70%) vastupidavuslikus töövõimes. *Di Prampero et al 1986*

- Liikumise kiirus ja võimsus VO2max tasemel (Vmax ja Wmax) on nn toetavad faktorid mis eristavad treenitud ja hästitreenitud sportlasi. *Noakes et al 1990.*

- Wmax ja Vmax kiirus ja säilitamise aeg paraneb jõutreeningu mõjul jalgratturitel ja jooksjatel. *Millet et al 2001, Ronnestad et al 2010 jt*.

- Lühiajaline <u>suure intensiivsuse/võimsuse genereerimine</u> (startis, positsioonivõitlus, lõpuspurt jms).

  ✓ Võimsuse genereerimine on heas seoses lihashüpertroofia ulatusega.

  ✓ Intensiivne jõutreening (heavy-strength) parandas oluliselt Vmax näitajat hästitreenitud jalgratturitel (Ronnestad et al 2010)

  ✓ Anaeroobne võimsus paranes plahvatusliku jõutreeningu järgselt jooksjatel (Paavolainen et al 1999).

Eesmärk; uurida int jõutreeningu mõju VP töövõimele

Met; 16 hästi tr jun suusatajad (17 a, 60,5 VO2 max)
Jagati kahte gruppi, Jõutreening lisati ühe grupi VP treeningule 2xN 10n jooksul.

Erinevusi ei leitud

Scand J Med Sci Sports. 2016 Sep;26(9):1007-16. doi: 10.1111/sms.12517. Epub 2015 Jul 6.

Upper body heavy strength training does not affect performance in junior female cross-country skiers.

Skattebo Ø[1], Hallén J[1], Rønnestad BR[2], Losnegard T[1].

We investigated the effects of adding heavy strength training to a high volume of endurance training on performance and related physiological determinants in junior female cross-country skiers. Sixteen well-trained athletes (17 ± 1 years, 60 ± 6 kg, 169 ± 6 cm, VO2max running: 60 ± 5 mL/kg/min) were assigned either to an intervention group (INT; n = 9) or a control group (CON; n = 7). INT completed two weekly sessions of upper body heavy strength training in a linear periodized fashion for 10 weeks. Both groups continued their normal aerobic endurance and muscular endurance training.

One repetition maximum in seated pull-down increased significantly more in INT than in CON, with a group difference of 15 ± 8% (P < 0.01). Performance, expressed as average power output on a double poling ergometer over 20 s and as 3 min with maximal effort in both rested (sprint-test) and fatigued states (finishing-test), showed similar changes in both groups. Submaximal O2 -cost and VO2peak in double poling showed similar changes or were unchanged in both groups.

In conclusion, 10 weeks of heavy strength training increased upper body strength but had trivial effects on performance in a double poling ergometer in junior female cross-country skiers.

Eesmärk ; Uurida20” ja 180”intervalltr mõju võimsusele ja VO2 max

Met; 12M 8N hästi treenitud suusatajat, 6 nädalat 3x intervalltr.

Tulem; Mõlemal grupil paranes max võimsus 30” testil ja keskmine võimsus 6`testil. Ainult IT 120 gr vähenes La konts submax töö ning paranes VO2 (peak) .

Eur J Appl Physiol. 2004 Jun;92(1-2):121-7. Epub 2004 Mar 13.

Effects of 20-s and 180-s double poling interval training in cross-country skiers.

Nilsson JE[1], Holmberg HC, Tveit P, Hallén J.

The purpose of this study was to investigate the effect of upper body 20-s or 180-s interval training, using a double poling ergometer, on upper body power output and selected physiological and biomechanical parameters in cross-country skiers.
Twenty (12 male, 8 female) well-trained cross-country skiers took part. Two intervention groups, a 20-s interval training group (IT20; n=6) and a 180-s interval training group (IT180; n=7), underwent training three times a week for 6 weeks on a double poling ergometer. A third group served as a control (CON; n=7) and followed the same training program as the IT20 and IT180 groups without the double poling ergometer interval training.
The IT20 and IT180 groups significantly ($P<0.05$) increased both peak and mean power in a 30-s test and mean power in a 6-min test after double poling training. There was a significant improvement in work efficiency in both IT20 and IT180 ($P<0.05$) and, in IT180, a significant reduction ($P<0.05$) in blood lactate concentration at given sub-maximal workloads. VO(2peak) increased significantly during double poling in IT180 ($P<0.05$) only. VO(2max) did not change significantly in either group. There were no significant changes in any of the test variables in CON.
In conclusion, this study shows that 6 weeks of 20-s or 180-s double poling interval training, three times a week, significantly increases power output in both 30-s and 6-min tests, as well as in selected physiological and biomechanical parameters in well-trained cross-country skiers.

Hüpotrees; Max jõu arendamine parandab ökonoomsust ja An L

Meetod: Naised murdmaasuusat. 9 nädalat,
Max jõud paaristõuked suusa ergomeetril
8 max jõu gr; 7 kontroll gr.

Tulem
Eks grupil paranes paaristõukel ökonoomsus. AN L ns

Med Sci Sports Exerc. 1999 Jun;31(6):870-7.

Maximal strength training improves work economy in trained female cross-country skiers.

Hoff J[1], Helgerud J, Wisløff U.

PURPOSE:
The present study examines the hypothesis that maximal strength training improves work economy and anaerobic threshold in trained female cross-country skiers while working on a ski ergometer.
METHODS:
Fifteen female cross-country skiers (17.9 +/- 0.3 yr, 166.7 +/- 1.3 cm, 60.1 +/- 1.9 kg, and 55.3 +/- 1.3 mL x kg(-1) x min(-1)) participated in the study. Eight skiers made up the high-intensity strength-trained group, and seven served as the control group. Endurance performance was tested on a specially instrumented ski ergometer. Strength training and testing simulated double poling in cross-country skiing.
RESULTS:
A significant ($P < 0.001$) improvement in double-poling economy on the ski ergometer was observed among the strength-trained group. Anaerobic threshold did not change during the experimental period for either group. After a 9-wk training period, time to exhaustion increased from 5.2 (+/-0.9) to 12.3 (+/-1.6) min ($P < 0.001$) and from 4.0 (+/-0.9) to 6.3 (+/-0.9) min ($P < 0.01$) for the strength and control group, respectively. Time to exhaustion was significantly higher ($P < 0.001$) for the strength group compared with the control group after training. One repetition maximum increased 14.5% (1.8) ($P < 0.001$) in the strength group but was unchanged in the control group. Expressed in relation to peak force at one repetition maximum, strength training resulted in a significant reduction in the relative available force employed working on the ski ergometer ($P < 0.01$). Time to peak force at maximal aerobic velocity on the ski ergometer was significantly reduced in the strength-training group ($P < 0.01$).
CONCLUSIONS:
It is concluded that maximal strength training in the upper-body improved the double-poling performance by improved work economy. Work economy was improved by a reduction in relative workload and time to peak force while double poling.

Plahvatusliku jõutreeningu mõju vastupidavuslikule töövõimele (Ronnestad & Mujika 2014)

Potentsiaalne positiivne mõju	**Tõestatud muutused**	**Potentsiaalne negatiivne mõju**	**Tõestatud neg mõju**
Paraneb VO2max	EI	Suureneb keha mass	EI
Ökonoomsus	JA	Suureneb hüpertroofia	EI
Anaeroobne mahtuvus	JA	Väheneb kapillarisatsioon	EI
Laktaadi lävi	JA	Väheneb oks ensüümide akt	EI
Max jõud	JA		
Max kiirus	JA		
Vastupidavuslik töövõime	JA		

Tänan kuulamast!