Prevention of knee OA in the young: the role of injuries, training and muscles

Professor Ewa Roos PT PhD

Institute of Sports Science and Clinical Biomechanics, University of Southern Denmark, Denmark
eroos@health.sdu.dk

Dept of Orthopedics, Lund University, Sweden

Outline

- Risk factors
  - Knee injury
  - Decreased muscle function
- Prevention
  - Knee injury
  - Post-injury OA
- The role of exercise vs. neuromuscular training in OA prevention

Risk factors of knee OA

Non-modifiable

- Age
- Gender
- Genetics

Modifiable

External factors
- Overload
  - Body weight
  - Work
  - Sports
- Injury (ACL, meniscii)

Internal factors
- Neuromuscular function
  - Dynamic alignment, 3D
  - Strength
- Leg alignment
  - Static, 2D x-ray

Prevention of knee OA

Modifiable

External factors
- Overload
  - Body weight
  - Work
  - Sports
- Injury (ACL, meniscii)

Internal factors
- Neuromuscular function
  - Dynamic alignment, 3D
  - Strength
- Leg alignment
  - Static, 2D x-ray

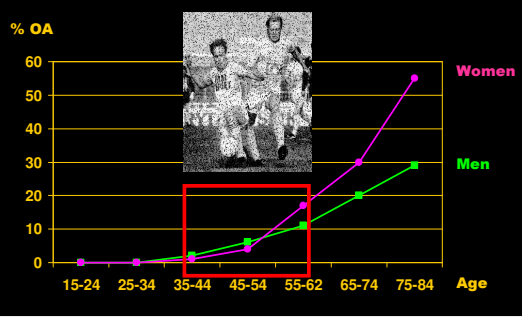
Prevention of knee OA in the young

Modifiable

External factors
- Overload
  - Body weight
  - Work
  - Sports
- Injury (ACL, meniscii)

Internal factors
- Neuromuscular function
  - Dynamic alignment, 3D
  - Strength
- Leg alignment
  - Static, 2D x-ray

In the population: 2 out of 3 aged 35-54 with OA have a prior knee injury

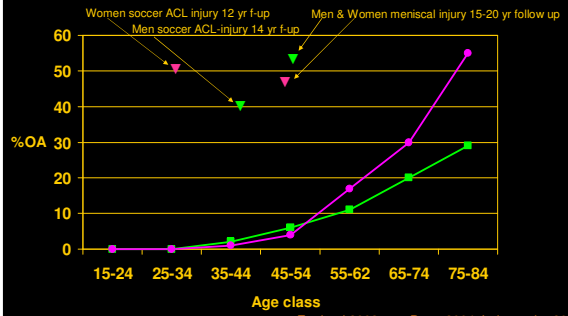


Women, soccer and knee injuries

- 106 women, 19 yrs at injury
- ACL injury during soccer 1986
- At 12 yr f-up, mean age 31:
  - 51% OA

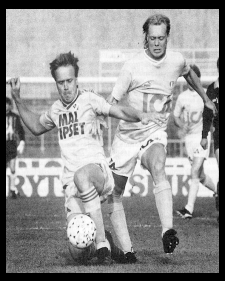
Lohmander 2004

Young people with old knees



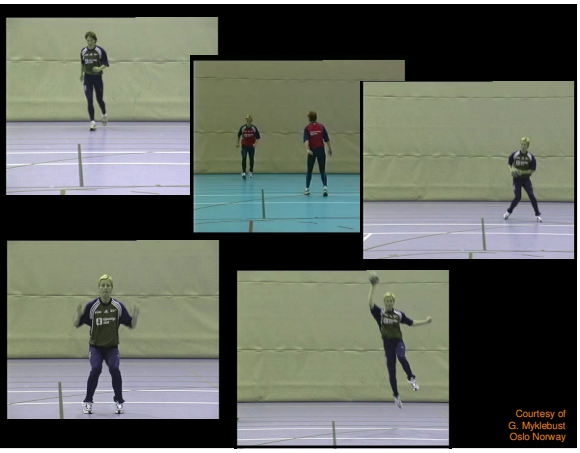
Englund 2003, von Porat 2004, Lohmander 2004

Can knee injuries be prevented?



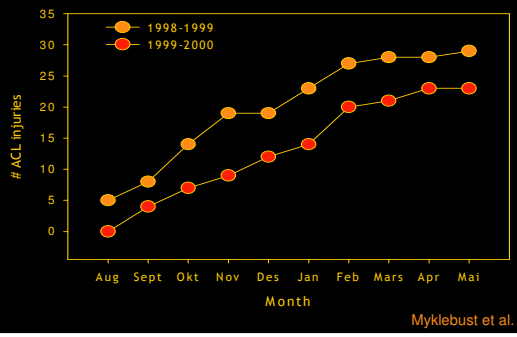
ACL injury in handball

Courtesy of G. Myklebust, Oslo, Norway



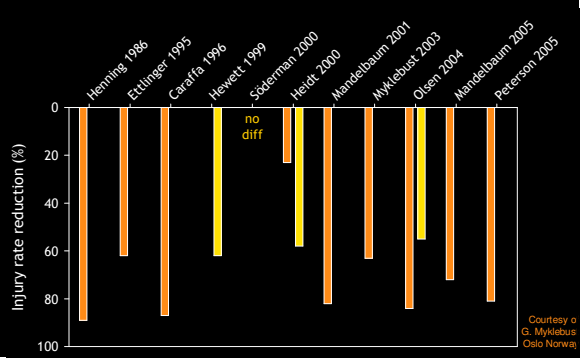
Courtesy of G. Myklebust Oslo Norway

All divisions



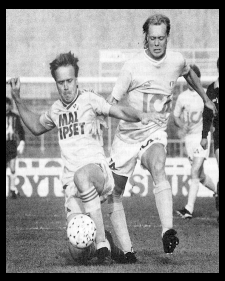
Myklebust et al. 2003

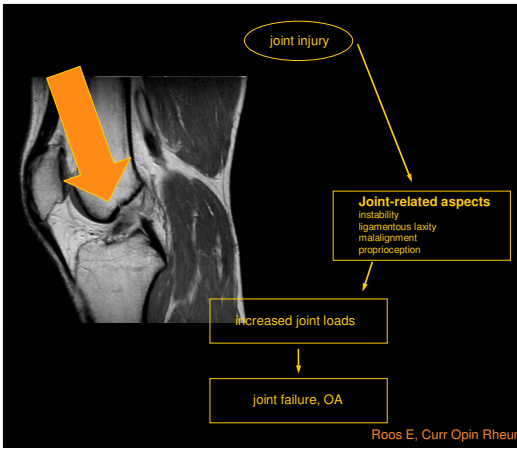
Knee Injury Prevention Programs



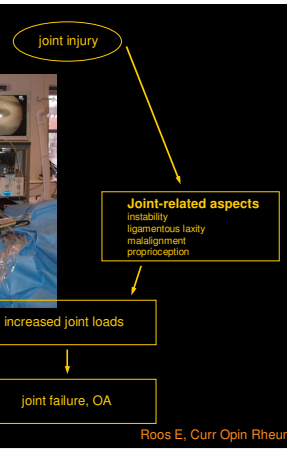
Summary
Prevention of knee OA in the young: Knee injuries, training and muscles

Can post-injury OA be prevented?



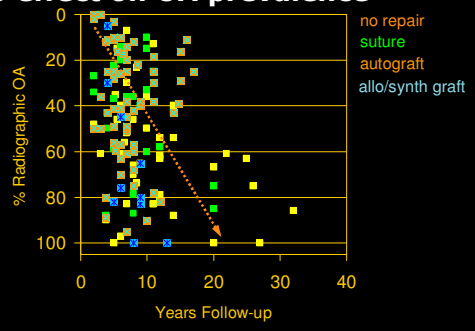


Roos E, Curr Opin Rheumatol, 2005



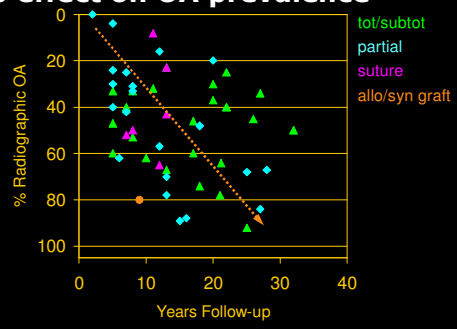
Roos E, Curr Opin Rheumatol, 2005

ACL reconstruction -no effect on OA prevalence



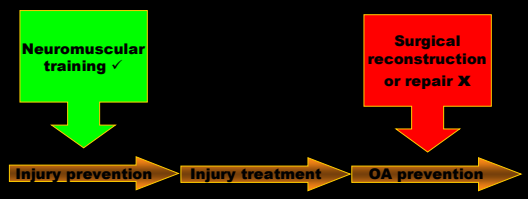
Lohmander et al. AJSM 2007

Surgery for meniscal lesions -no effect on OA prevalence



Lohmander et al. AJSM 2007

Summary
Prevention of knee OA in the young: Knee injuries, training and muscles



- Reconstruction is usually performed in those wanting a higher physical activity level
  - Sweden 50% reconstructed
  - US >90% reconstructed
- Lack of RCT:s

Prevention of knee OA in the young

Modifiable

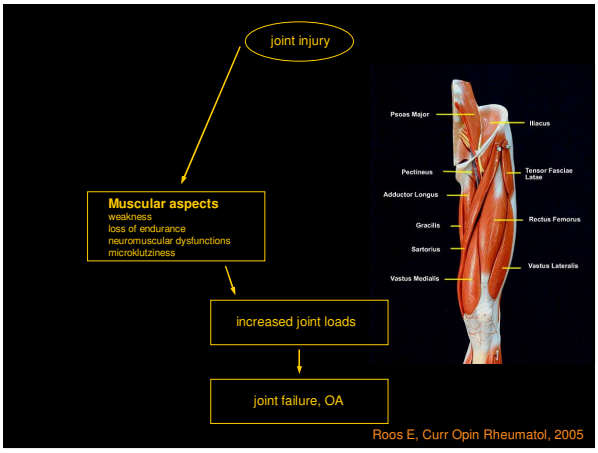
External factors
- Overload
  - Body weight
  - Work
  - Sports
- Injury (ACL, meniscii)

Internal factors
- Neuromuscular function
  - Dynamic alignment, 3D
  - Strength
- Leg alignment
  - Static, 2D x-ray

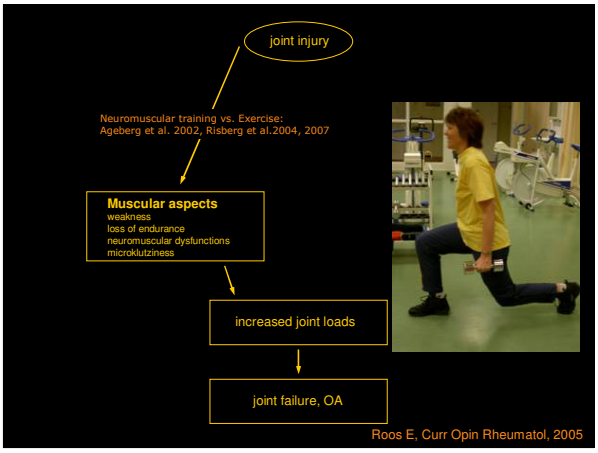
Prevention of knee OA in the young

Modifiable

External factors
- Overload
  - Body weight
  - Work
  - Sports
- Injury (ACL, meniscii)
- Neuromuscular function
  - Dynamic alignment, 3D
  - Strength
- Leg alignment
  - Static, 2D x-ray



Roos E, Curr Opin Rheumatol, 2005



Roos E, Curr Opin Rheumatol, 2005

Intervention (exercise) studies

Muscular aspects
weakness
loss of endurance
neuromuscular dysfunctions
microklutziness

Joint-related aspects
instability
ligamentous laxity
malalignment
proprioception

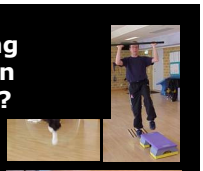
?

increased joint loads

dGEMRIC

joint failure, OA

Can neuromuscular training improve cartilage quality in patients at high risk of OA?



- RCT, n=45
- Exercise vs. controls
- Medial degenerative meniscus tear
- Mean age=46

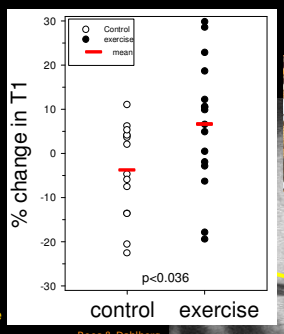
- Neuromuscular training
  - 4 months
  - Offered 5 times/w, expected participation 3 times/w
  - One hour sessions
  - Individualized
  - Supervised by physical therapist

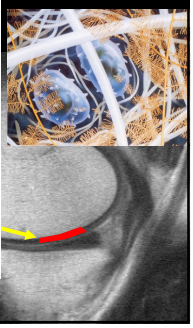
Intention-to-treat analysis

better

Glucosaminoglycan content

worse





Roos & Dahlberg
Arthritis & Rheumatism 2005

- Neuromuscular training
- Results:
  - Functional tests
  - Ham strength
  - Q-ceps endurance
  - Q-ceps strength ⟺
  - Aerobic capacity ⟺

Table 5. Within group analysis of change in muscle strength and functional performance in operated leg from baseline to four-month follow-up*

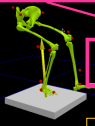
Variable	Base-line		Follow-up		P
	Mean	SD	Mean	SD	
Exercise group					
One-leg hop (cm)	106	29	114	30	**0.001**
One- leg rising (*n*)	13	11	20	23	**0.043**
Square-hop (*n*)	7	4	9	4	**0.002**
Quadriceps strength (PT F60)	152	44	154	42	0.497
Quadriceps endurance (TW E180)	2122	480	2277	605	**0.003**
Hamstrings strength (PT F6)	81	26	89	28	**0.008**
Hamstrings endurance (TW F180)	1174	336	1251	398	0.066
Control group					
One-leg hop (cm)	108	37	111	37	0.161
One-leg rising, *n*	10	8	13	14	0.141
Square-hop (*n*)	6	5	7	4	0.200
Quadriceps strength (PT F60)	169	53	171	48	0.647
Quadriceps endurance (TW E180)	2443	642	2403	623	0.157
Hamstrings strength (PT F60)	90	20	90	28	0.690
Hamstrings endurance (TW F180)	1283	450	1282	474	0.984

Ericsson et al. Scand J Med Sci Sports. 2008 Apr 6; [Epub ahead of print]

Intervention (exercise) studies

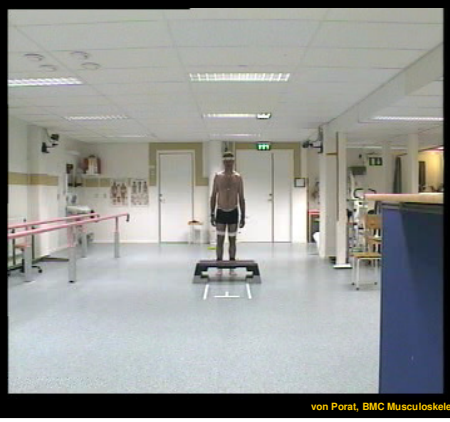
Muscular aspects
weakness
loss of endurance
neuromuscular dysfunctions
microklutziness

Joint-related aspects
instability
ligamentous laxity
malalignment
proprioception



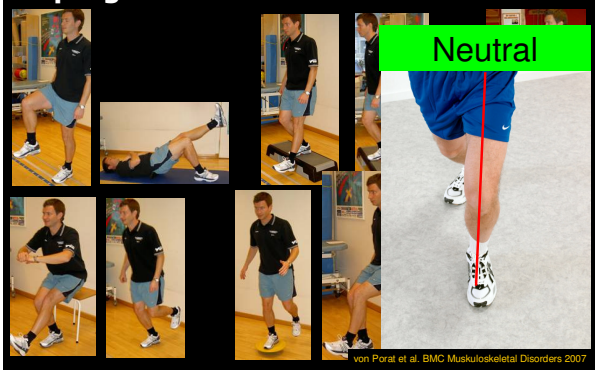
increased joint loads

joint failure, OA



von Porat, BMC Musculoskeletal Disorders 2007

12 weeks "knee control" exercise program



von Porat et al. BMC Muskuloskeletal Disorders 2007

Neuromuscular exercise may improve knee joint load

- 16 yrs post ACL-injury, n=12, 40 yrs
  - Decrease in ground reaction force and improved knee flexion during step and hop activity
  - Best effect in patients with Q-ceps weakness at baseline
  - Improved self-reported function (KOOS)

von Porat et al. BMC Muskuloskeletal Disorders 2007

Neuromuscular training twice weekly/8 weeks

Neuromuscular training may decrease knee adduction moment

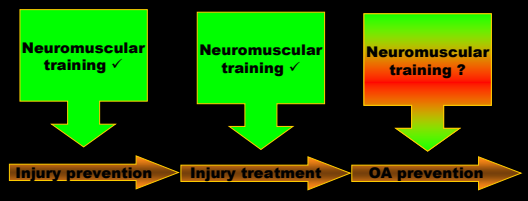
- Early knee OA, n=11, 54 (48-63) yrs
- 8 weeks training
- 13% decrease in knee adduction moment, p=0.04
  - Comparable to improvement from unloader orthoses

Thorstensson et al. Osteoarthritis & Cartilage 2007

Neuromuscular training as prevention of OA after injury

- Neuromuscular training has a potential as OA prevention
- Lack of long-term follow-ups
- Neuromuscular training + no initial surgery + no return to sport, 16% OA after 16 yrs
  - Neuman 2008
- At least 10% less hop length in the injured leg at 1-year f-up predicted radiographic OA at 10 years
  - Pinczewski 2007

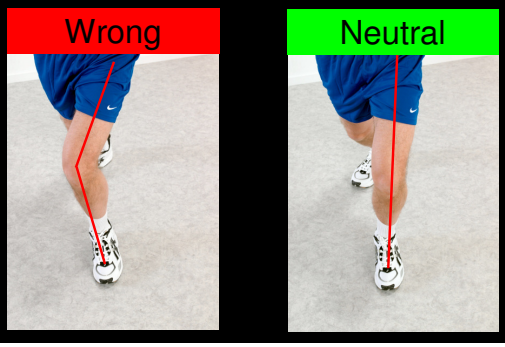
Summary
Prevention of knee OA in the young: Knee injuries, training and muscles



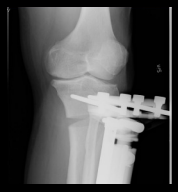
Neuromuscular training biomechanical principles

- Active movements in synergies of all joints in the extremity
  (Putnam 1991)
- Bilateral transfer effect of motor learning to the injured leg
  (Kannus et al 1992, Dietz 1996)
- Closed kinetic chains
  (Palmitier et al 1991, Lutz et al 1993)
- Postural function – postural reactions – voluntary movements
  (Bouisset & Zattara 1987, Dietz 1996)
- Postural control with dynamic alignment
  (Palmitier et al, 1991)
- Evenly distributed articular surface pressure by muscular coactivation
  (Baratta et al 1988)

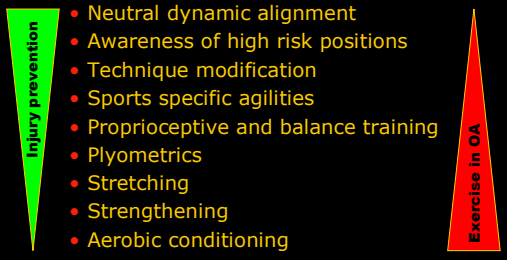
Neuromuscular training improves dynamic alignment



Static alignment

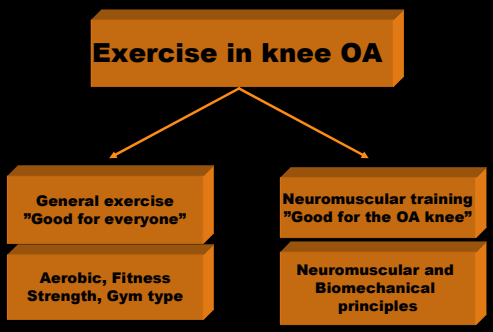


Neuromuscular training prevents knee injury

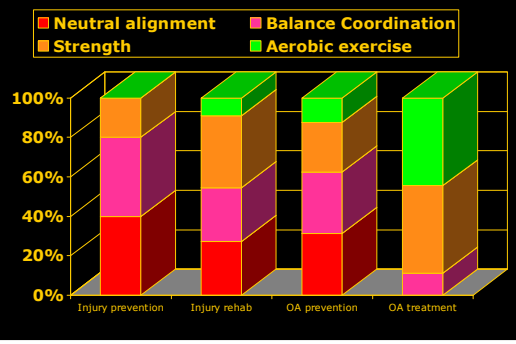


- Neutral dynamic alignment
- Awareness of high risk positions
- Technique modification
- Sports specific agilities
- Proprioceptive and balance training
- Plyometrics
- Stretching
- Strengthening
- Aerobic conditioning

Renström et al. Br J Sports Med 2008



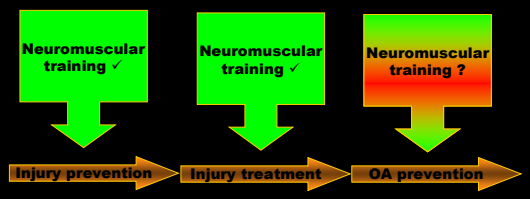
Training elements



Summary I
Prevention of knee OA in the young: Knee injuries, training and muscles

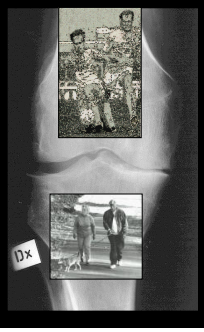
- Knee injury AND poor muscle function are major, intertwined and modifiable risk factors for knee OA
- Surgical repair or reconstruction does not prevent OA
- Knee injuries can be prevented …

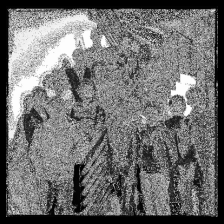
Summary II
Prevention of knee OA in the young: Knee injuries, training and muscles



Thank you!

Poster 510: Feasibility of neuromuscular training in patients with severe hip or knee osteoarthritis





Ewa Roos
Institute of Sports Science and Clinical Biomechanics, University of Southern Denmark, Denmark
eroos@health.sdu.dk

Dept of Orthopedics, Lund University, Sweden