Muskelfunksjon og rehabilitering
-fra klinikk til forskning til klinikk-

Nasjonal Forskningskonferanse – Muskelskjelett (MUSS)
Gardermoen 15.-16. november 2012

Professor og fysioterapeut May Arna Risberg

Norsk forskningssenter for aktiv rehabilitering (NAR)

www.aktiv-rehab.no

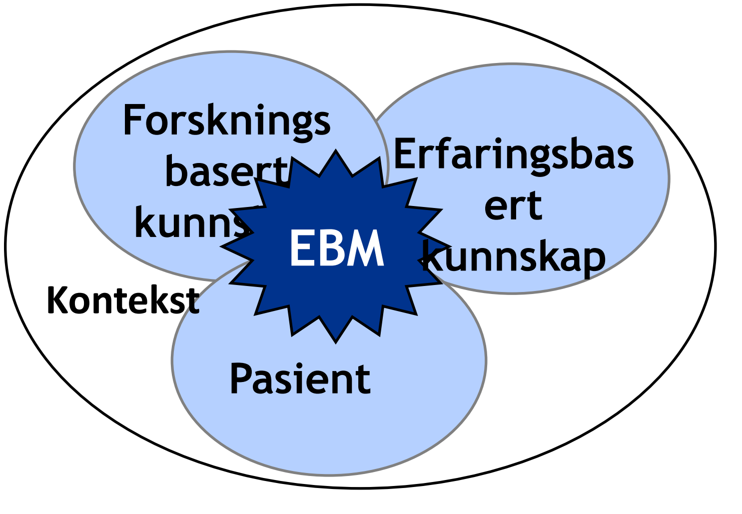
Ortopedisk avdeling, Oslo Universitetssykehus, Norges Idrettshøgskole og NIMI

Norsk forskningssenter for Aktiv Rehabilitering (NAR)

www.aktiv-rehab.no

Fra klinikk til forskning og tilbake til klinikk

- Viktige kliniske spørsmål?
- Utvikling og evaluering av rehabiliterings program ved muskelskjelettskader og artrose
- Hva er vår forskningsmodell?
- Hvordan kan kunnskapen implementeres?



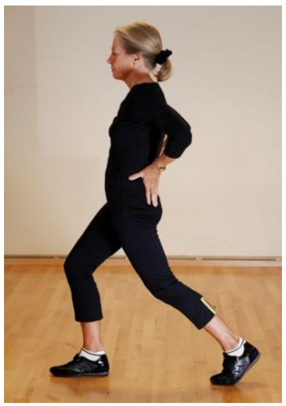
Muskelfunksjon

- kne skader, kne og hofte artrose -

- **Akutte muskelskjelett skader**
  - Tap av muskelfunksjon
  - Sekundær **forebygging**: reskade og utvikling av belastningslidelser
- **Immobilisering**
  - Tap av muskelfunksjon
  - Ikke "vent å se" behandling
- **Kroniske muskelskjelett plager (artrose)**
  - Tap av muskelfunksjon
  - Tap av bevegelighet, funksjon og uavhengighet

“Vent å se behandling”

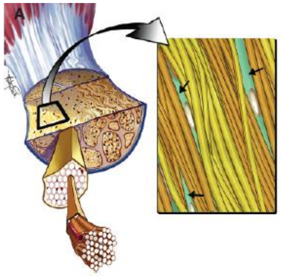
Hva skjer i muskulaturen ved immobilisering ?



Hva skjer i muskulaturen under rehabilitering ?

Hva er optimale stimuli for å rehabilitere hvilke muskeldysfunksjoner og for hvem?

Reardon KA 2001, Jones SW 2004, Tesch PA 2008, Roig M et al 2009, Hulmi JJ 2008
Hittel DS 2010, Glover EI 2010, Murton & Greenhaff 2010, **Marimuthu K et al 2011**



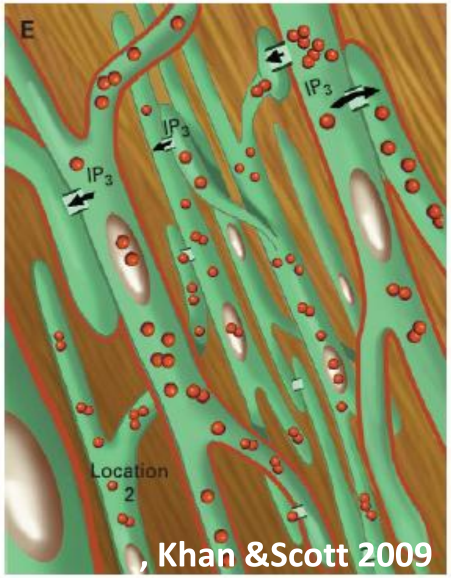
Muscloskeletal injuries
Ligament and tendon injuries

- Turning movement into tissue healing
- Dynamic mechano-responsive tissue
- “the body converts mechanical loading into cellular respons”
- Exercise promote tissue healing
- The effect of exercise
  - Eccentric exercise

Review

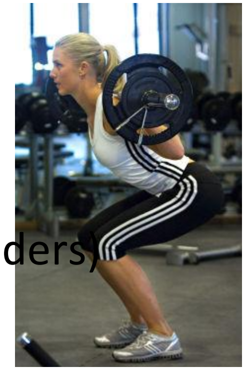
Mechanotherapy: how physical therapists’ prescription of exercise promotes tissue repair

K M Khan, A Scott



Wall ME et al 2005, Cheema U et al 2005, Banes AJ et al 2007, Khan &Scott 2009, Alfredson & Cook 2007, Jonsson P et al 2008

Muskelfunksjon og Rehabilitering



- **Muskelcelle proliferasjon og differensiering**
- **Aktivering av lokale satelitt celler** (responders and non-responders)

Retningslinjer for dose-respons:
AMERICAN COLLEGE OF SPORTS MEDICINE POSITION STAND

  - Satelitt celle differensiering

Retningslinjer for rapportering av styrketreningsprogram:
Augustsson J 2012

- **Myostatin**

Retningslinjer for nevromuskulær trening?
Balansetrening og plyometrisk trening?

  - Økte protein nivåer av myostatin: inaktive
  - **Undertrykkes under rehabilitering – lave nivåer**

Reardon KA 2001, Jones SW 2004, de Boer 2007, Tesch PA 2008, Hulmi JJ 2008, Glover EI 2010, Murton & Greenhaff 2010, Ten Broek 2010, Hittel DS 2010, **Marimuthu K et al 2011**

Effekt av trening ved artrose

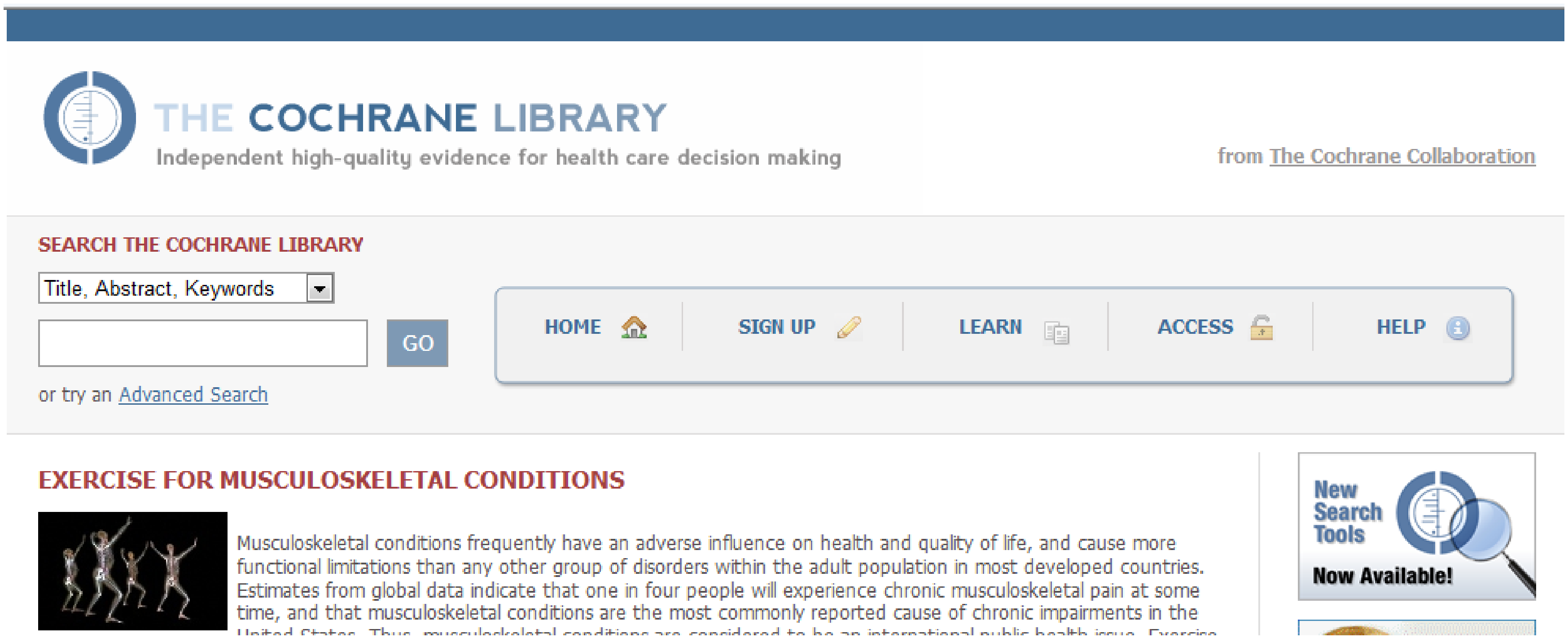
- Mange kliniske studier
  - Platina evidens: effekt av trening ved kneartrose (smerte og funksjon)
  - Trening påvirker ”overlevelse” av artrose hofte
- **Osteoarthritis of the knee: Why does exercise work?**
- Biomekanikse studier
- Biokjemiske studier
- Brusk metabolisme studier
- MR studier (dGEMRIC)
- Genetikk? responders and non-responders

Beckwee D et al 2013, ACR recommendations: Hochberg et al 2012, Bennell et al 2011, Escalante et al 2011, Pisters et al 2010, Zhang et al 2010, Foroughi et al 2011, Fransen & McConnel 2009, , Bennell et al 2008 , Roos & Dahlberg 2005

Exercise for musculoskeletal conditions

Cochrane reviews

- Osteoarthritis
- Osteoporosis
- Rheumatoid arthritis, ankylosing spondylitis, fibromyalgia, juvenile arthritis
- Regional musculoskeletal conditions
  - Knee, low back, neck, shoulder, chronic musculoskeletal pain



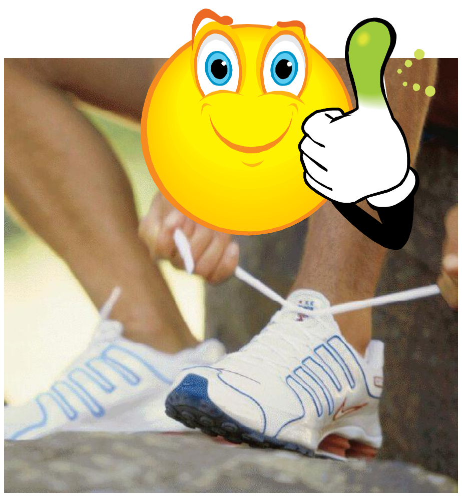
Exercise for chronic musculoskeletal pain

Adherence to exercise and physical activity

- **Cochrane review**
  - Exercise and physical activity *is beneficial* for the most common types of chronic musculoskeletal pain
  - Poor adherence to exercise and physical activity *limit long term effectiveness*
  - *Improve adherence* to exercise and physical activity!

Cochrane review; Jordan JL et al 2010

Behandling av muskelskjelettskader og belastningslidelser 2012



"What fits your busy schedule better, exercising one hour a day or being dead 24 hours a day?"

Knowledge gaps

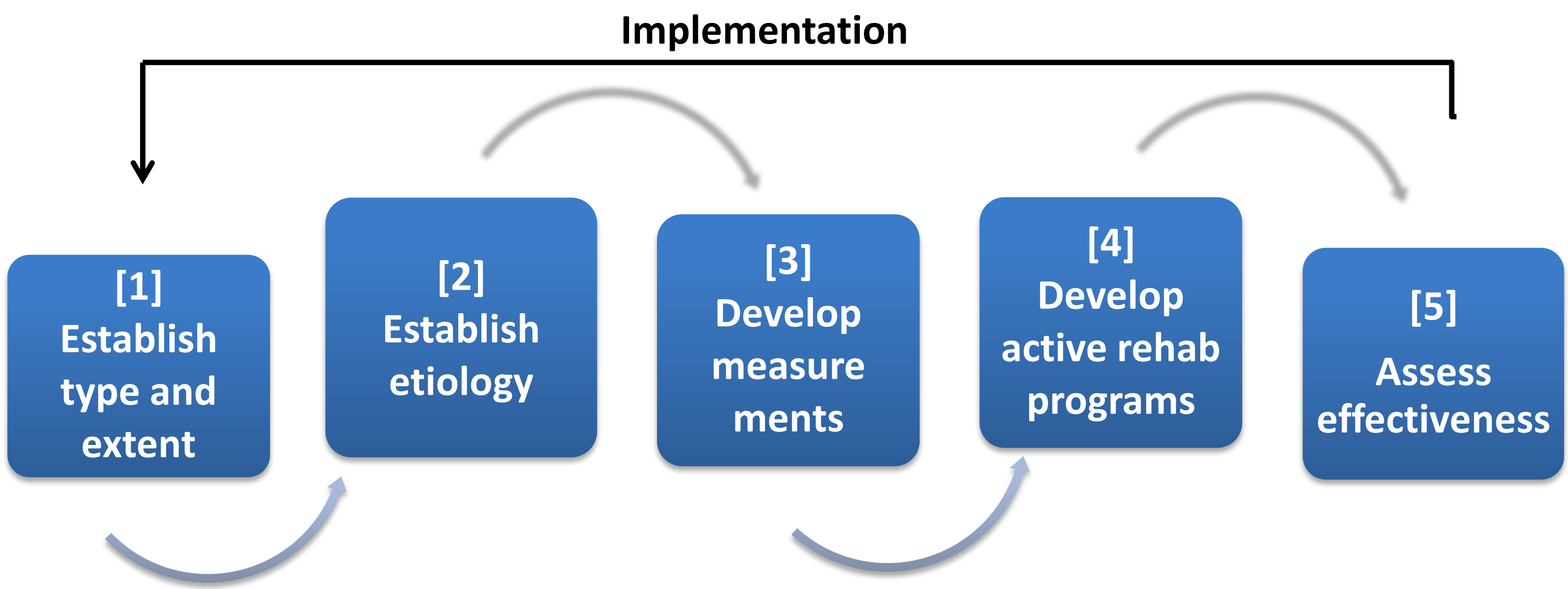
- **Dose-response**
- **Specific exercises**
- **Tailored exercise programs**
- **Why does exercise work?**

- **Are we specific in targeting muscle dysfunctions?**
  - Muscle mechanics and morphology
  - Neural factors (motor unit firing, frequency, synchronization)
    - Gamma-loop dysfunction – increase afferent information may reduce activation deficits and enhance muscle force
  - Environmental factors (fatigue, hormones, temperature)

THE EFFECT OF EXERCISES IN PATIENTS WITH HIP AND KNEE INJURY AND OSTEOARTHRITIS

Mechanisms and clinical interventions

Our research initiative and research model



Joint injury and disease

Exercise therapy for muscle dysfunction and articular cartilage health

Knee injury and OA

Measurements

Active Rehabilitation

Knee function and OA

Hip OA

Measurements

Active Rehabilitation

Hip function, OA and THA

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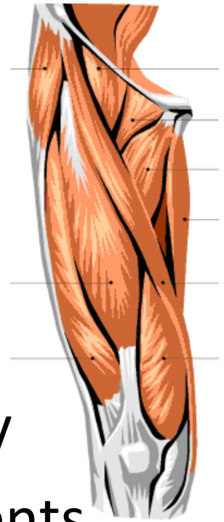
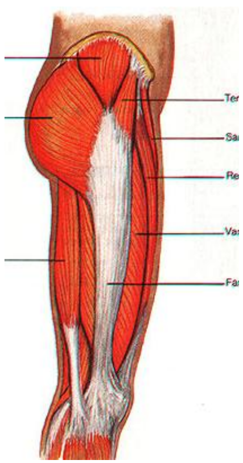
[1]
Establish
Type and
extent

Quadriceps strength

"joint protection"





- Pronounced both after knee injury and surgery
- Pronounced in both knee OA and hip OA patients
- Persistent over time
- Regain quadriceps strength early after knee injury
- Preoperative quadriceps function significant for long term result
- Associated with long-term development of knee OA?

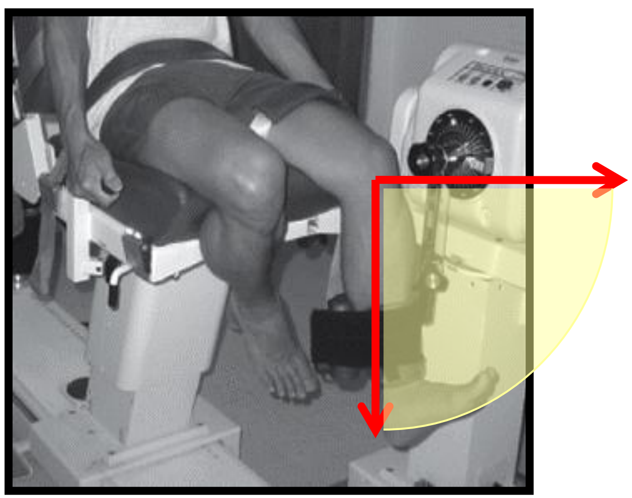
Krishman & Williams 2011, Keays et al 2010, Eitzen et al 2010, Konishi et al 2010, Øiestad et al 2010, Keays et al 2010, Rydevik et al 2010, Bennell et al 2008, Risberg et al 1999

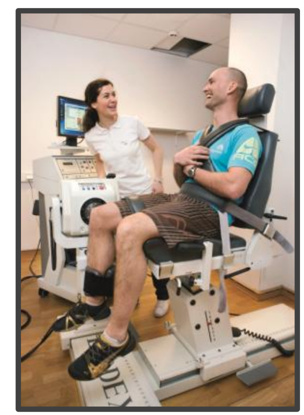
[3] Measurements

Eitzen et al AJSM 2010

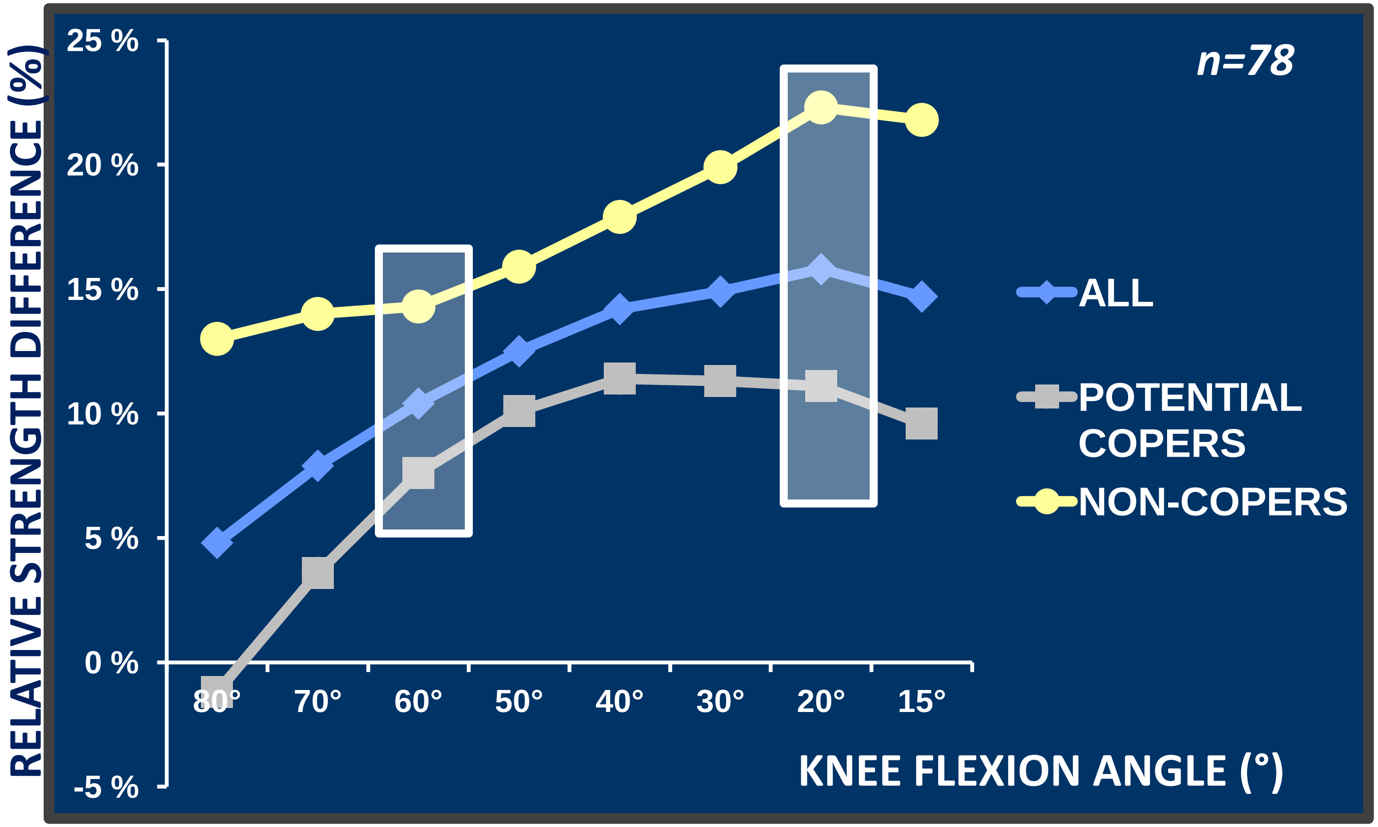
Anterior Cruciate Ligament–Deficient Potential Copers and Noncopers Reveal Different Isokinetic Quadriceps Strength Profiles in the Early Stage After Injury

Ingrid Eitzen,*† PT, MSc, Thomas J. Eitzen,‡ MSc, Inger Holm,§ PT, PhD, Lynn Snyder-Mackler,|| PT, ScD, FAPTA, and May Arna Risberg,† PT, PhD





RESULTS – ACL injured



Quadriceps exercises should also target 40-0° of knee flexion

Eitzen et al. AJSM 2010

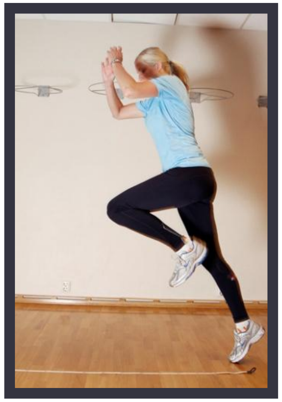
[3] Measure ments

Single-Legged Hop Tests as Predictors of Self-reported Knee Function in Nonoperatively Treated Individuals With Anterior Cruciate Ligament Injury

Hege Grindem,*† PT, MSc, David Logerstedt,‡ PT, MPT, SCS, Ingrid Eitzen,† PT, PhD, Håvard Moksnes,† PT, MSc, Michael J. Axe,§ MD, Lynn Snyder-Mackler,‡|| PT, DSc, SCS, ATC, FAPTA, Lars Engebretsen,¶ MD, PhD, and May Arna Risberg,† PT, PhD

The Delaware-Oslo ACL Cohort Study

Am J Sport Med 2011



Single-leg hop test:

Best predictor in non-operatively treated ACL-injured patients

Grindem, Logerstedt, Eitzen, Moksnes, Axe, Snyder-Mackler, Engebretsen, Risberg

NAR

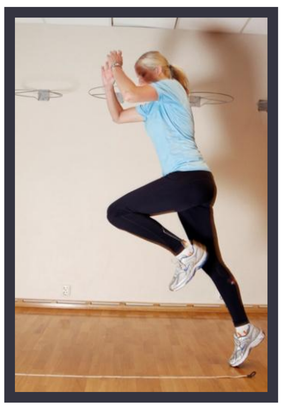
[3] Measure ments

Single-legged Hop Tests as Predictors of Self-reported Knee Function After Anterior Cruciate Ligament Reconstruction

The Delaware-Oslo ACL Cohort Study

David Logerstedt,[*†] PT, PhD, MPT, SCS, Hege Grindem,[‡] PT, MSc,
Andrew Lynch,[§] PT, PhD, DPT, Ingrid Eitzen,[‡] PT, PhD, Lars Engebretsen,[||] MD, PhD,
May Arna Risberg,[‡] PT, PhD, Michael J. Axe,[¶] MD, and
Lynn Snyder-Mackler,[†] PT, ScD, SCS, ATC, FAPTA

The Delaware-Oslo ACL Cohort Study
Am J Sport Med 2012



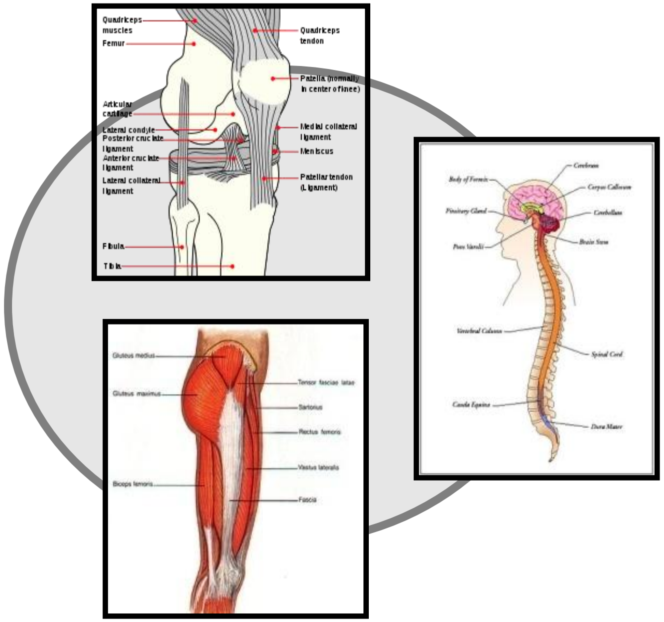
Crossover and 6-m timed hop:
Best predictors
after Anterior Cruciate Ligament Reconstructed

Logerstedt, Grindem, Lynch, Eitzen, Engebretsen, Risberg, Axe, Snyder-Mackler

[4]
Develop
active rehab
programs

Neuromuscular system

Modalities for developing muscle function



Muscle function

- the neuromuscular system -

- **Muscle mechanics**

Develop effective training programs that enhance muscle function and performance

- **Morphological factors**
  - Muscle fiber type
  - Muscle architecture
  - Tendon properties
- **Neural factors**
  - Motor unit recruitment
  - Firing frequency
  - Motor unit synchronization
  - Inter-muscular coordination
- **Muscle environment** (fatigue, hormones, temperature)

Modalities for muscle resistance training

- to improve muscle function -

- **Traditional weight training** (Wilson GJ et al 1993, 1996)
- **Instability resistance training** (Behm & Colado 2012)
  - Neuromuscular training: balance training
- **Explosive and ballistic exercises** (Newton RU et al 2006)
  - Neuromuscular training: plyometric training/jump training
- **Electrostimulation training** (Malatesta et al 2002, 2003)
- **Vibration training** (Cardinale M & Lim J 2003)
- **Blood flow restriction exercises** (Nielsen JL et al 2008, Wernbom et al 2009)
- **Combination of training modalities is recommended** (Blakey JB & Southard D 1987, Fatouros IG et al 2000, Bauer T et al 1990)

Eduardo Saez-Saez de Villarreal et al 2010, a meta-analysis

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[4]
Develop
active rehab
programs

Dose-response

- Training volume
- Intensity
- Duration
- Frequency

- Subject characteristics
  - Training level
  - Gender
  - Age
  - ADL and Sport activity

[4]
Develop
active rehab
programs

Utvikling av kunnskapsbaserte rehabiliteringsprogram

- Kne skader
  - ACL skader
  - Brusk skader
- Degenerativ menisk skader
- Kne artrose
- Hofte artrose
- Osteoporose

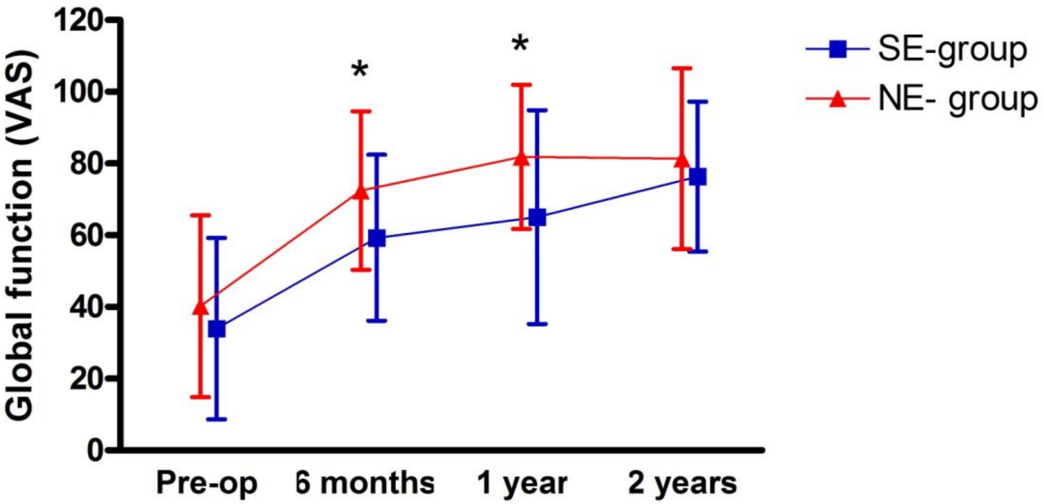
[4]
Develop active rehab programs

[5]
Assess effectiveness

JOSPT 2001

Journal of Orthopaedic & Sports Physical Therapy
2001;31(11):620–631

Design and Implementation of a Neuromuscular Training Program Following



Am J Sport Med 2009

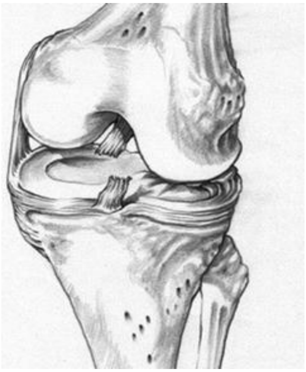
The Long-term Effect of 2 Postoperative Rehabilitation Programs After Anterior Cruciate Ligament Reconstruction

A Randomized Controlled Clinical Trial With 2 Years of Follow-Up

May Arna Risberg,*† PT, PhD, and Inger Holm,‡ PT, PhD
From the †NAR, Orthopedic Center, Oslo University Hospital, Ulleval, Oslo, Norway, and the ‡Division of Rehabilitation, Oslo University Hospital, Rikshospitalet, Oslo, Norway

[4]
Develop active rehab programs

Eitzen et al 2010



[RESEARCH REPORT]

INGRID EITZEN, PT, PhD[1] • HÅVARD MOKSNES, PT, MSc[2]
LYNN SNYDER-MACKLER, PT, ScD[3] • MAY ARNA RISBERG, PT, PhD[4]

A Progressive 5-Week Exercise Therapy Program Leads to Significant Improvement in Knee Function Early After Anterior Cruciate Ligament Injury

Active rehabilitation program for patients with ACL injury

Øiestad et al 2010

Arthritis Care & Research
Vol. 62, No. 12, December 2010, pp 1706–1714
DOI 10.1002/acr.20299

ORIGINAL ARTICLE

Quadriceps Muscle Weakness After Anterior Cruciate Ligament Reconstruction: A Risk Factor for Knee Osteoarthritis?

BRITT ELIN ØIESTAD,[1] INGER HOLM,[2] RAGNHILD GUNDERSON,[2] GRETHE MYKLEBUST,[3] AND MAY ARNA RISBERG[4]

$\boxed{\text{20 years follow-up}}$

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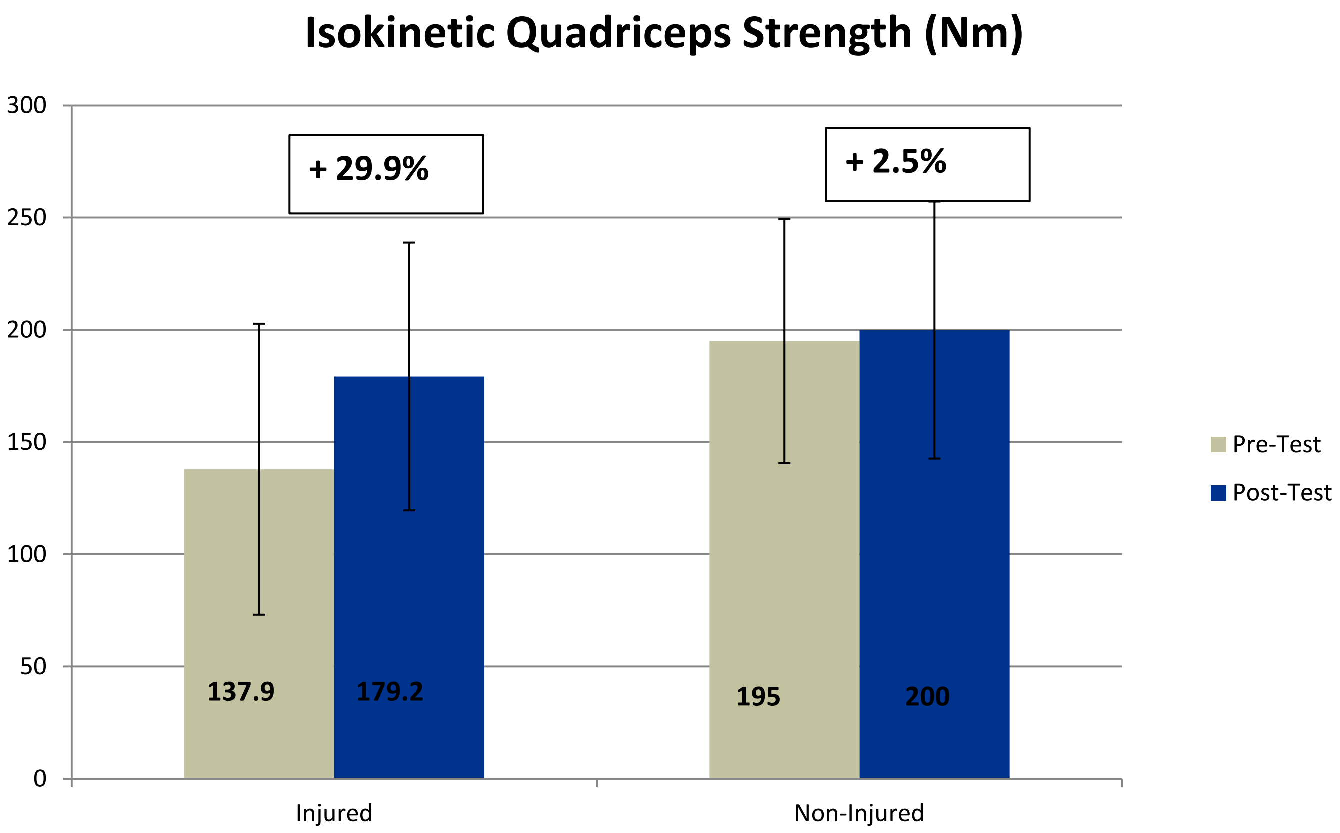
[4]
Develop active rehab programs

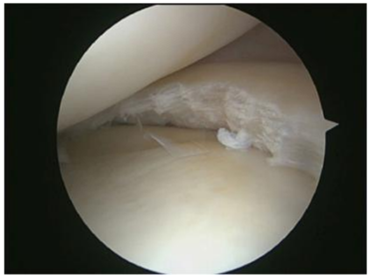
[5]
Assess effectiveness

Wondrasch et al (in revision)



[4]
Develop active rehab programs

Stensrud et al 2012



SILJE STENSRUD, PT, MSc[1] • EWA M. ROOS, PT, PhD[2] • MAY ARNA RISBERG, PT, PhD[3]

[5]
Assess effectiveness

A 12-Week Exercise Therapy Program in Middle-Aged Patients With Degenerative Meniscus Tears: A Case Series With 1-Year Follow-up

Active rehabilitation program for patients with degenerative meniscus tears

[4]
Develop active rehab programs

Fernandes et al 2010

Development of a Therapeutic Exercise Program for Patients With Osteoarthritis of the Hip

Linda Fernandes, Kjersti Storheim, Lars Nordsletten, May Arna Risberg

L. Fernandes, PT, MSc, is a PhD

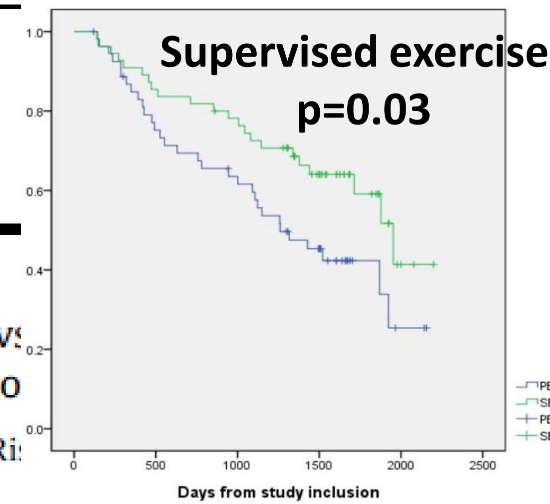
[5]
Assess effectiveness

Osteoarthritis and Cartilage 18 (2010) 1237–1243

Osteoarthritis
and Cartilage

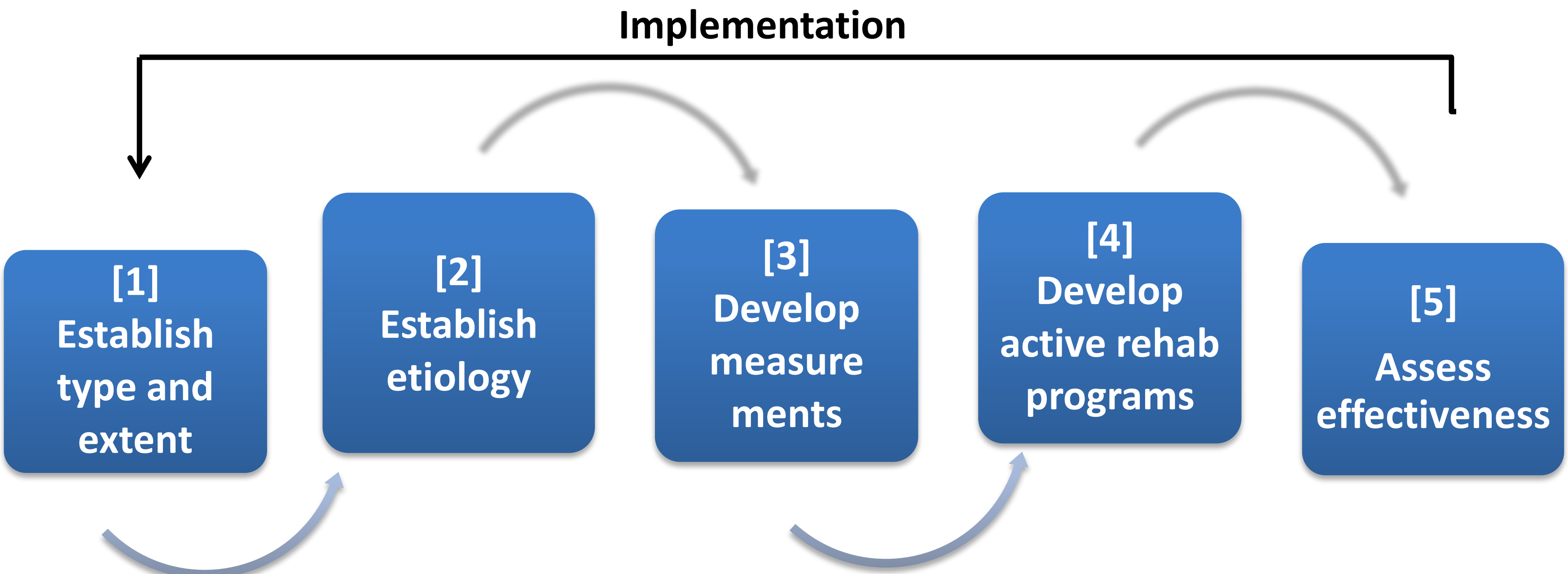
Efficacy of patient education and supervised exercise vs
in patients with hip osteoarthritis: a single blind rando

L. Fernandes †‡*, K. Storheim †‡, L. Sandvik §, L. Nordsletten ||¶, M.A. Ri



Take home message

- Mye forskningen innenfor noen felt – effekt av trening på muskelfunksjon og symptomer
- Lite om dose-respons
- *Mekansimer* for hvorfor det virker og på hvem er mangelvare
- **VI BØR IMPLEMENTERE MER AV ALLEREDE ETABLERT KUNNSKAP!**



Takk for oppmerksomheten!

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Acknowledgements

- NIH Grant # 2 RO1 HD 37985
- The South-Eastern Norway Regional Health Authority
- The Norwegian Research Council

Oslo University Hospital

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Norwegian School of Sport Sciences