Functional and radiological outcomes following a non-operative treatment algorithm after ACL injuries in skeletally immature children

Håvard Moksnes, Lars Engebretsen, May Arna Risberg

NAR, Norwegian School of Sport Sciences, Department of Sports Medicine
Department of Orthopaedics, Oslo University Hospital

Norway, OSTRC + Research

Chaired by: Prof Lars Engebretsen
Prof Roald Bahr

Ullevål University Hospital

Norwegian School of Sport Sciences, Oslo

Disclosures 2013:

- Consultant
  - Arthrex equipment development
- Fellowship grants
  - Smith & Nephew
  - Arthrex
- Editor and Editorial board
  - BJSM
  - JBJS (am)
  - SJMSS
  - KSSTA

Oslo Sports Trauma

- Research grants
  - Norwegian NIH
  - FIFA
  - IOC
  - NIH
  - Health South East Norway
  - Department of Culture Norway

Paper I

"There is no such thing as an ACL midsubstance injury in children"

(Rang M: Children's fractures 1974;186)

Management of Anterior Cruciate Ligament Injuries in Skeletally Immature Individuals

The clinical challenge

The risk of growth disturbance, the graft development, and the child’s compliance with rehabilitation related to ACL reconstruction versus

The possible increased risk of early osteoarthritis subsequent to secondary injuries after non-operative management

Frosch et al (2010)

Outcomes and Risks of Operative Treatment of the ACL in Children and Adolescents

- 935 children with median follow-up 40 months
- Low rates (1.8%) of leg-length differences or axis deviations
- Physeal-sparing techniques may increase the risk of growth disturbance (5.8% vs 1.9%)
- Risk of re-rupture was 4.8%


Who is having surgery in Norway?


ACL graft development

- ACL-tibial angles become significantly larger with increasing age during skeletal growth (Kim et al 2008)
- The ACL graft increases in length, but not in width during growth (Bollen et al 2006)

From Kim et al 2008

Paper II

The Current Evidence for Treatment of ACL Injuries in Children Is Low

A Systematic Review

Einar Mellemkjaer, PL Mico. Lars Engbretsen, Mj Ha and Alfred Aarli Stroeqen, PT, PhD

Results
Included papers (n=31)
- Non-operative treatment (n=4)
- Transphyseal ACL reconstruction (n=19)
- Physeal-sparing reconstructions (n=8)
  - 10 different surgical techniques

Results
- Mean CMS 44.7 (range 28-62)
- Most prominent deficiencies:
  - Study designs
  - Rehabilitation protocols
  - Valid outcome measurements

Conclusion
The methodological quality in the literature on treatment of skeletally immature children with anterior cruciate ligament injury using the Coleman Methodology Score was low

Conclusion
There was a critical lack of adequately sized prospective studies with valid outcome measurements

Purpose
To report changes in knee function and activity level in skeletally immature children following a non-operative treatment algorithm for a minimum of 2 years after ACL injury

Paper III
Functional outcomes following a non-operative treatment algorithm for anterior cruciate ligament injuries in skeletally immature children 12 years and younger. A prospective cohort with 2 years follow-up

Br J Sports Med Published Online First: Feb 27, 2013, doi:10.1136/bjsports-2012-092066
Inclusion criteria
Skeletally immature children with ACL injury sustained at age 12 years and younger

Intrasubstance ACL rupture
- History
- Clinical examination
- MRI
- KT1000 > 3mm difference

Methods
Functional evaluation
- Functional assessment at baseline
  - Follow-up at 1 and 2 years
- Four single leg hop tests (Noyes 1992)
- Isokinetic muscle strength
  - Biodex 6000; 5 reps 60°/s
- Patient related outcome measurements
  - KOOS, IKDC, and KOS-ADLs

Methods
Monitoring activities
- Internet based questionnaire
  - Submitted monthly by e-mail
  - Compliance > 90%
- Activities
- Giving way episodes
  - 2 episodes within 3 months → Assessment by surgeon
  - Brace used when giving way?

Treatment algorithm
- Primary non-operative treatment
- Physical therapist 1-2/month
- Brace when performing pivoting sports
- Surgical treatment is considered:
  - Repeated giving way episodes
  - Repairable meniscus injury

Material
- 46 skeletally immature children
  - 30 boys and 16 girls
  - Average age 11.0 years (min 7.0, max 12.9)
  - 15 right and 30 left knees
    - 1 bilateral

Diagnostic MRI
Menisci and cartilage
- 60% (n=28) normal
- 13% (n=6) medial injury
- 25% (n=12) lateral injury
- 2% (n=1) medial and lateral injury
- No cartilage injuries
Flow diagram

Activities at time of injury
- Alpine skiing n=23
- Soccer n=10
- Trampoline n=3
- Playground n=3
- Cycling n=2
- Handball n=2
- Motocross n=1
- Skateboard n=1
- Cross-country skiing n=1
- Ski-jumping n=1

Surgical treatment
- 36 non-operated children (37 knees)
  - 3 repaired medial menisci
  - 1 debridement medial meniscus
- 10 ACL reconstructed - all hamstrings
  - 1 medial and 1 lateral meniscus repairs
  - 1 medial and 1 lateral partial meniscectomies
  - 1 injury to nerve and artery

Results
- 78% of the children continued non-operative treatment
- The performance-based functional tests showed symmetrical knee function throughout the 2 years follow-up
- The number of surgical procedures for new secondary meniscal injuries was low (n=6, 13%).
- 91% maintained participation in pivoting sports and/or physical education in school
- 38% changed their main activity from a Level 1 to a Level 2 activity

Conclusion
A non-operative treatment algorithm is appropriate for skeletally immature children after ACL injury
The risk of secondary meniscus injuries was low following our treatment algorithm
A reduced participation in Level 1 sports must be expected in 1/3 of the children
Results KOOS
Non-operated children at 1 yr FU (n=19)

Material & Methods
MRI
Prospective cohort using 3.0T MRI
40 children bilateral MRI in 2009/10
40 children 2nd MRI in 2011/12
All MRIs analyzed by 2 independent experienced MRI radiologists

Material
Female n=14 (35%), Male n=26 (65%)

MRI 1
40 children (41 knees)
30 (31) non-operated
10 ACLR

MRI 2
40 children (41 knees)
27 (28) non-operated
13 ACLR

Conclusion
The incidence of new meniscus (3.2%, n=1) and cartilage injuries (3.2%, n=1) was low in non-operatively treated ACL injured skeletally immature children. The prevalence of meniscus injuries was comparable to previous literature.
IOC WORLD CONFERENCE ON PREVENTION OF INJURY & ILLNESS IN SPORT

24 symposia
5 keynote lectures
113 invited speakers
workshops
abstracts

MONACO
10-12 APRIL 2014
www.ioc-preventionconference.org