Accelerated return to sport after anterior cruciate ligament reconstruction and early knee osteoarthritis features at one year

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Accelerated return to sport after ACL reconstruction and early knee osteoarthritis features at 1 year: an exploratory study

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PM&R: Journal of injury, function and rehabilitation

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NHMRC Early Career Fellow (Austria / La Trobe)
ACL injury and reconstruction

Return to sport

Knee osteoarthritis

Osteophytes & JSN

Osteophytes & JSN
Return to Sport after ACL reconstruction

55% of people return to competitive sport following ACLR
65% of people return to pre-injury level of sport
81% of people return to any kind of sport

83% of elite athletes return to pre-injury sport following ACLR
Time to return to sport: < 12 months (only 2/15 > 12 months)

- Time to RTS varies (unrelated to type and severity of injury)
- RTS decisions should include information from a battery of tests (including decision making)
- Workload should be considered in RTS decisions
- Psychological factors should be considered
- Consensus on RTS criteria are needed
Simple decision rules can reduce reinjury risk by 84% after ACL reconstruction: the Delaware-Oslo ACL cohort study

Hège Grindem, Lynn Snyder-Mackler, Havard Moksnes, Lars Engebretsen and May Arna Risberg

*Br J Sports Med* published online May 9, 2016

**What are the findings?**

- In the first 2 years after ACL reconstruction, 30% of people who returned to level I sports sustained a reinjury compared with 8% of those who participated in lower level sports.

- More symmetrical quadriceps strength prior to return to sport significantly reduced the knee reinjury rate.
Return to Sport after ACL injury

Functional capacity and RTS?

73% of total participants (n=158) met discharge criteria

Those who did meet discharge criteria, but returned to sport.... 4 X greater risk of graft rupture

**Table 1** Discharge tests and criteria used during the study period

<table>
<thead>
<tr>
<th>Six-part return to sport tests</th>
<th>Discharge permitted when each of these criteria was met</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isokinetic test at 60, 180 and 300°/s</td>
<td>Quadriceps deficit &lt;10% at 60°/s</td>
</tr>
<tr>
<td>Single hop</td>
<td>Limb symmetry index &gt;90%</td>
</tr>
<tr>
<td>Triple hop</td>
<td>Limb symmetry index &gt;90%</td>
</tr>
<tr>
<td>Triple crossover hop</td>
<td>Limb symmetry index &gt;90%</td>
</tr>
<tr>
<td>On-field sports-specific rehabilitation</td>
<td>Fully completed</td>
</tr>
<tr>
<td>Running t test</td>
<td>&lt;11 s</td>
</tr>
</tbody>
</table>

*Br J Sports Med* published online May 23, 2016
ACL injury and reconstruction

Return to Sport
~ 50-60%

Function capacity important
(quadriceps strength, hop tests, sports specific tests)

Reinjury
~ 30%
51-80% of people, 10-15 years after ACL injury have radiographic OA (mean age 37 years) (Øiestad, 2010; Holm, 2010)
ACL injury and reconstruction

Return to Sport ~ 50-60%

Reinjury ~ 30%

Knee osteoarthritis

Osteophytes & JSN

OA ~ 50-80%
At 6 months post ACLR........

Cartilage thickness or volume not different to controls

BUT......

Cartilage had low \textit{in vivo} resilience (slower recovery from impact loading)

Additionally, early postoperative sports participation (< 5months) ~ increased cartilage volume, thickness, deformation and slower recovery of cartilage morphological characteristics after running.

And functional capacity........

Poor functional capacity predicts worse PRO at 2 and 5 years post ACL injury

\textbf{Ericsson, BJSM 2013}

Poorer performance on the 1-leg-rise test at one year predicted worse KOOS-QOL at 3-years post ACLR

\textbf{Culvenor, ACR 2016}

Van Ginckel, AJSM 2013
Knee osteoarthritis after ACL injury

51-80% of people, 10-15 years after ACL injury have radiographic OA (mean age 37 years) (Øiestad, 2010; Holm, 2010)
AIMS

Exploratory study
To determine if accelerated return to sport (< 10 months) was associated with early knee OA features on MRI at 1 year post ACLR.

Sensitivity analysis:
1. Type of ACL injury (isolated and combined)
2. Lower limb function (good and poor function)
Consecutive patients (18-50 yo) who had a primary hamstring tendon ACLR by either one of two surgeons in 2011-12 \(N=186\)

Total included: \(N=111\) (60%) one year post-ACLR

Excluded:
- Unable to contact = 8
- Unable to attend (distance) = 35
- Declined invitation = 31
- Ruptured ACL graft on MRI = 1

Sex: 64% male;
Age: 29 ± 9 yrs;
Injury to ACLR:
3 mths (1wk to 4.6 yrs)
> 30% had early OA features in PFJ and/or TFJ

<table>
<thead>
<tr>
<th>Changes</th>
<th>PFJ (%)</th>
<th>Med TFJ (%)</th>
<th>Lat TFJ (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMLs</td>
<td>22</td>
<td>14</td>
<td>22</td>
</tr>
<tr>
<td>Cartilage injury</td>
<td>49</td>
<td>29</td>
<td>28</td>
</tr>
<tr>
<td>Osteophytes</td>
<td>50</td>
<td>31</td>
<td>36</td>
</tr>
<tr>
<td>Meniscal tears</td>
<td>NA</td>
<td>29</td>
<td>25</td>
</tr>
</tbody>
</table>

Radiographic OA: PFJ OA = 5%  TFJ OA = 4%

Contralateral uninjured knee OA: PFJ OA = 0%  TFJ OA = 1%

*Not related to age, surgical delay, gender

Culvenor et al, Arthritis and Rheumatology, 2015
Methods

Return to Sport Questionnaire

12 months post ACLR

RTS questionnaire
  ◦ Have you returned to competitive sport?
  ◦ Which sport returned to?
  ◦ First month return to full competition?

RTS defined as:
Return to competitive sport/unrestricted training at least 2x per week
(included running > 30 mins at least 2x per week)
Magnetic Resonance Imaging

MRI: 3Tesla, 3D
Variables
- Cartilage defects
- Bone marrow lesions (BMLs)
- Osteophytes
- Meniscal lesions

MRI OA Knee Scoring System

Methods

Magnetic Resonance Imaging

(Hunter, 2011)
Methods

Type of injury

- Isolated ACL rupture VS combined ACL injury (meniscal/cartilage)

Functional Capacity

- Good lower-limb function (LSI ≥90%) VS Poor lower-limb function (LSI <90%)

Sensitivity Analyses

Side to side hop test
- 40 cm hops
- Number of successful hops
111 participants following ACLR

46 (41%) had returned to sport within 10 months following ACLR
13 (12%) RTS between 10-12 months

...........Overall RTS rate at 12 months.... 53%
........... 40 (36%) had returned to competitive sport at 12 months

Mean side to side hop test LSI was 79 (29)%
..... 43 (39%) had poor function (LSI<90%)
Primary analysis

RTS within the first 10 months following ACLR was associated with greater odds of having **BML** at 1 year following ACLR

OR: 2.72 (95%CI: 1.25 to 5.95)

**No association** between RTS within the 10 months following ACLR and

.... Cartilage lesion (OR: 1.17; 0.52 to 2.63)

.... Osteophyte (OR: 0.64; 0.29 to 1.43)

..... Meniscal lesion (OR: 0.83; 0.39 to 1.76)

at 1 year following ACLR

(Culvenor et al., PMR 2017)
## Results

### Sensitivity Analyses

<table>
<thead>
<tr>
<th></th>
<th>Cartilage lesion</th>
<th>Bone marrow lesion</th>
<th>Meniscal tear</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total n=111</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RTS &lt;10-months post-ACLR (n= 46)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isolated injury (n=27)</td>
<td>N=16. OR: 1.07 (0.38, 3.00)</td>
<td>N=13. OR: 2.79 (0.93, 8.79)</td>
<td>N=11. OR 1.06 (0.38, 2.99)</td>
</tr>
<tr>
<td>Combined injury (n=19)</td>
<td>N=16. OR: 1.78 (0.41,7.73)</td>
<td>N=13. OR: 3.17 (0.96,10.49)</td>
<td>N=14. OR: 0.29 (0.06, 1.39)</td>
</tr>
</tbody>
</table>

(Culvenor et al., PMR 2017)
Results

Sensitivity Analyses

<table>
<thead>
<tr>
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<th>Early OA features on MRI 12-months post-ACLR</th>
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<tr>
<td><strong>Total n=111</strong></td>
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<tr>
<td>RTS &lt;10-months post-ACLR (n=46)</td>
<td>Cartilage lesion</td>
</tr>
<tr>
<td>Poor function (n=23)</td>
<td>N=17. OR 1.5 (0.5, 4.5)</td>
</tr>
<tr>
<td>Good function (n=23)</td>
<td>N=15. OR 1.1 (0.4, 3.0)</td>
</tr>
</tbody>
</table>

(Culvenor et al., PMR 2017)
RTS < 10 months
Should Return to Sport be Delayed Until 2 Years After Anterior Cruciate Ligament Reconstruction? Biological and Functional Considerations

Christopher V. Nagelli\textsuperscript{1,2,4,5}, Timothy E. Hewett\textsuperscript{1,2,3,4,5}

Functional performance 6 months after ACL reconstruction can predict return to participation in the same preinjury activity level 12 and 24 months after surgery

Zakariya Nawasreh\textsuperscript{1,2}, David Logerstedt\textsuperscript{3,4}, Kathleen Cummer\textsuperscript{1}, Michael Axe\textsuperscript{5,6}, May Arna Risberg\textsuperscript{7}, Lynn Snyder-Mackler\textsuperscript{1,4,5}
Discussion / Implications

Bone Marrow Lesions

**BMLs can fluctuate...**
MOAKS score doesn’t distinguish resolving, new or stable
Most BMLs had signs of degeneration

**BMLs can fluctuate...**
Therefore, more likely to show changes (including load response changes) over a small time (e.g. compared with cartilage)
May relate to further cartilage loss and osteophyte development over time

**BMLs can fluctuate...**
Longer term follow up studies are needed to:
...... See if this relationship holds true over time
...... Determine if BML progress to other OA features
**Discussion / Implications**

**Concomitant injury...**
Is related to development of post-traumatic OA
.... In this exploratory analyses, was NOT associated with increased odds of MRI OA changes in accelerated RTS

**Functional capacity...**
Stronger relationship between early RTS and BMLs in those with POOR function
.... Time from surgery should not dictate RTS
..... Objective tests of function are essential
BUT!!!! Function was measure after RTS, and may have deteriorated

**Sensitivity analyses**

Take care with participants who have poor functional capacity
Discussion / Implications

Limitations

Retrospective recall in Return to Sport Questionnaire
Function measured at 1 year
No baseline imaging
No standardised rehabilitation or RTS testing
Small numbers in sensitivity analyses

FUTURE Directions........
Watch out for Brooke Patterson
RCTs
PhD opportunities!!!
Conclusion

Caution with RTS < 10 months
Function likely to be important