CLINICAL OUTCOME & MORPHOMETRY OVER 2 & 5 YEARS -

data from a treatment RCT on acute ACL injury

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DISCLOSURES

RF & SL - Nothing to declare

FE, WW & MH – Owner, co-owner / employee at Chondrometrics GmbH, where image analysis was performed
ACL INJURY

Incidence – 80 / 100 000 inhabitants & year
(Frobell et al, SJMSS 2007)

Treatment – Early ACLR + rehabilitation
Rehabilitation + delayed ACLR if needed

Risk of OA – 0-90%, but likely 50% in general
No differences in treatment for ACL injury
(Lohmander et al, AJSM 2007)
Symptomatic OA

Radiographic OA

MRI signs of OA

Who comes first – the hen or the egg?
VirtualScopics Inc.

KANON intense FUP
58 individuals
26 years
16 women
34 Early ACLR
24 Early Rehab

Frobell et al, OAC 2009
MORPHOMETRY - CARTILAGE THICKNESS

VirtualScopics Inc.
1 year
Cartilage swelling cMF
Decreased AC in TrF

Early ACLR may delay restitution

Frobell et al, OAC 2009
VirtualScopics Inc.
2 years
34 Early ACLR
11 Delayed ACLR
16 Rehab alone

Cartilage swelling cMF
Decreased AC in TrF

No difference between treatment groups

Frobell, JBJS 2011
OBJECTIVES

Within a treatment RCT, we followed patients with an acute ACL injury to a previously uninjured knee:

• To investigate the association between patient relevant outcomes and changes in cartilage thickness (ThC) and total area of subchondral bone (tAB) of the total femurotibial joint at 2 and 5 years

• To explore these associations in subgroups of treatment actually received
The KANON-trial, a randomized controlled trial comparing:

Early surgical treatment strategy (n=62)
Delayed surgery if needed strategy (n=59)

Similar rehabilitation in both groups
No differences in PRO or activity level @ 2 years

Frobell et al, NEJM 2010

No differences in PRO, activity level or ROA @ 5 years

Frobell et al, under revision July 2012
107 / 121 patients of the RCT had complete set of MR images at:
Baseline
2 years
5 years
1 / 107 was lost to clinical FUP @ 5 years – leaving 106 included in study

<table>
<thead>
<tr>
<th>Category</th>
<th>All N=106</th>
</tr>
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<tbody>
<tr>
<td>Women</td>
<td>26 (24%)</td>
</tr>
<tr>
<td>Right knee (%)</td>
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<td>Age, yrs (SD)</td>
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<td>BMI, kg/m2 (SD)</td>
<td>24.2 (3.0)</td>
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MATERIAL

107 / 121 patients of the RCT had complete set of MR images at:
- Baseline
- 2 years
- 5 years
1 / 107 was lost to clinical FUP @ 5 years – leaving 106 included in study

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<tr>
<td>Women</td>
<td>26 (24%)</td>
<td>12 (21%)</td>
<td>8 (32%)</td>
<td>6 (25%)</td>
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<tr>
<td>Right knee (%)</td>
<td>59 (55%)</td>
<td>29 (51%)</td>
<td>16 (64%)</td>
<td>13 (54%)</td>
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<td>Age, yrs (SD)</td>
<td>26 (5)</td>
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<td>BMI, kg/m2 (SD)</td>
<td>24.2 (3.0)</td>
<td>24.5 (3.2)</td>
<td>23.5 (2.0)</td>
<td>24.3 (3.1)</td>
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CLINICAL OUTCOME

Knee injury & Osteoarthritis Outcome Score
0-100; worst to best

Primary outcome of RCT
KOOS$_4$; (Pain + Symptoms + Sports & Rec + QOL) / 4

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<td>81.4 (18.5)</td>
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Frobell et al 2010
# Clinical Outcome

**Knee injury & Osteoarthritis Outcome Score**

0-100; worst to best

**Primary outcome of RCT**

KOOS$_4$; (Pain + Symptoms + Sports & Rec + QOL) / 4

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<tr>
<td><strong>KOOS$_4$ @ 5 yrs</strong></td>
<td>80.4 (16.6)*</td>
<td>79.7 (16.7)</td>
<td>79.0 (18.0)</td>
<td>83.5 (14.9)</td>
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Frobell et al 2010
Frobell et al 2012 (under revision)
MR IMAGING

1.5T Philips Intera

Sagittal FLASH sq
0.29mm IPR
1.5mm slice spacing

Image acquisition @
BL (within 4 w of injury)
2 years
5 years
SEGMENTATION & COMPUTATION

Segmentation of cartilages in femorotibial joint (FTJ):
- Medial and lateral tibia (MT/LT)
- Central 75% of the medial and lateral femoral condyle (cMF/cLF)

\[
\text{FTJ} = \text{MFTC} + \text{LFTC}
\]
RESULTS – ThCtab

Abstract #10, W Wirth, Friday 11:15 AM
RESULTS – tAB

2 years change
- Total femurotibial joint (FTJ)
- Medial compartment (MFTC)
- Lateral compartment (LFTC)

5 years change

Early ACLR  Delayed ACLR  Rehab alone
CARTILAGE THICKNESS - CLINICAL OUTCOME

Cartilage thickness @ 2 & 5 years

No significant correlations between KOOS4 @ 2 & 5 years and ThCtab change over 2 & 5 years for FTJ MFTC LFTC for entire sample or for any treatment group.
SUBCHONDRAL BONE AREA – CLINICAL OUTCOME

Full analysis set
2 years
↑ tAB medial compartment (MFTC) - ↓ KOOS₄ at 2 years
(r= -0.21, p=0.03)

5 years
↑ tAB in total joint (FTJ) - ↓ KOOS₄ at 2 years
(r= -0.20, p=0.04)

No correlations to KOOS₄ at 5 years
MFTC tAB 2 YR CHANGE – KOOS4 @ 2 YRS

**Full analysis set**

- Early ACLR: $r = -0.21$, $p = 0.03$
- Delayed ACLR: $r = -0.33$, $p = 0.01$

**As treated analysis**

- Delayed ACLR: $r = -0.18$, $p = 0.39$
- Rehab alone: $r = 0.19$, $p = 0.37$

The scatter plots show the relationship between tAB change in MFTC over 2 years and KOOS4 @ 2 yrs.
FTJ tAB 5 YR CHANGE – KOOS4 @ 2 YRS

Full analysis set

As treated analysis

Dealyed ACLR: $r = -0.19$, $p=0.35$
Rehab alone: $r = 0.13$, $p=0.56$

Early ACLR
Dealyed ACLR
Rehab alone

KOOS4 @ 2 yrs

TAB change in FTJ over 5 years
As treated analysis (but not in full analysis set)

2 years

Early ACLR

↑ tAB in total joint (FTJ) - ↓ KOOS4 at 2 & 5 years

(r= -0.33, p=0.01 & r= -0.27, p=0.04)

Delayed ACLR & Rehab alone

No relations found
LIMITATIONS

KANON-trial is a treatment RCT – not powered to find predictors
  Early ACLR group is twice as big as the other two groups

Symptoms @ 2 & 5 years may not be related to OA

We do not know who will develop ROA or SxOA
CONCLUSION

Increased tAB, but not change in ThC, may be related to worse clinical outcome 2 years after ACL injury

May be especially true for those treated with early ACLR
- where increased tAB of the total femurotibial joint was related to worse clinical outcome at both 2 & 5 years
THANK TO

The KANON study group

Felix Eckstein
Martin Hudelmaier
Wolfgang Wirth
Techs @ Chondrometrics GmbH

Founding sources:
Swedish Research council
Zoega foundation
Gorthonfoundation
Crafoord foundation
Tore Nilsson foundation
Region Skåne
Swedish medical association
CIF