Comparison of Muscle Area and Strength between Knees with and without Structural Progression – Pilot Data from the OAI

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Motivation

“In women but not in men, quadriceps weakness was associated with increased risk for tibiofemoral and whole knee JSN”

(Seal et al. 2010, OAC)

“Greater quadriceps strength at baseline was associated with increased likelihood of tibiofemoral osteoarthritis progression in malaligned and lax knees.”

(Sharma et al.)
Study objectives

Do baseline values or two-year changes in muscle status predict structural progression of osteoarthritis?

Study design

- Case-control study
  - Progressor – Non-progressor

- Analyzed muscle characteristics:
  - Anatomical cross sectional area (ACSA)
  - (Specific) strength
  - MR image signal intensity

- Analyzed muscles:
  - Quadriceps
    - Thigh muscle groups: Hamstrings, Adductors
  - Quadriceps heads
**Progressor definition**

**Criterion one: X-ray**
- ΔmmJSW > SDC*
- ΔMFTC_ThCtAB > SDC*
- Structural progressor in medial compartment
- Structural non-progressor

**Criterion two: MRI**
- ΔmmJSW < SDC*
- ΔMFTC_ThCtAB < SDC*
- Neither in medial nor in lateral compartment

*SDC derived from OAI pilot study

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**Progressor selection**

OAI sample with available quantitative MRI data: n=725
(Eckstein et al. 2011, ACR)

- 100 knees excluded: Missing JSW measurements
- JSW measurements available (BL & FU): n=625
- Progression by X-ray: n=141
- Progression by MRI: n=134
- Medial progression in MFTC_ThCtAB & mmJSW > SDC: n=54
- 8 knees excluded: KL grade 0,1 & 4
- 14 + 6 knees excluded: Missing data
- 26 + 6 structural progressors
Non-progressor selection

OAI sample with available quantitative MRI data: n=725 (Eckstein et al. 2011)

100 knees excluded: Missing JSW measurements

JSW measurements available (BL & FU): n=625

Progression by X-ray: n=141
Progression by MRI: n=134

Without progression in MFTC_ThCIAB & mmJSW > SDC : n=340

111 knees excluded: KL grade 0,1 & 4
71 knees excluded: Missing data

125 + 33 structural non-progressors

Participant matching

26 + 6 structural progressors

±3cm
±5 kg/m²
±5 units

20 case-controls longitudinal
23 case-controls cross-sectional

Paired Students T-Test

125 + 33 structural non-progressors
Data acquisition

Thigh muscle groups at 33% femoral length *

Quadriceps heads at 30% femoral length *

* location estimated by body height (Dannhauer et al. 2010)

Demographics

<table>
<thead>
<tr>
<th>Demographic</th>
<th>Cross sect. subsample (n=23 case-controls)</th>
<th>Long. Subsample (n=20 case-controls)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (y)</td>
<td>Cases 62.6±7.6, Controls 65.9±9.2</td>
<td>Cases 63.2±7.9, Controls 65.3±9.4</td>
</tr>
<tr>
<td>Body height (cm)</td>
<td>Cases 165±7.9, Controls 165±7.5</td>
<td>Cases 165.8±7.9, Controls 165.7±7.5</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>Cases 29.9±5, Controls 30±5.1</td>
<td>Cases 30±5.3</td>
</tr>
<tr>
<td>Sex (F/M)</td>
<td>Cases 13±7, Controls 13±7</td>
<td>Cases 12±8, Controls 12±8</td>
</tr>
<tr>
<td>WOMAC Pain (0-20)</td>
<td>Cases 3±2.7, Controls 2.3±2.6</td>
<td>Cases 2.6±2.5, Controls 1.8±2.2</td>
</tr>
</tbody>
</table>

6th International Workshop on Osteoarthritis Imaging | OARSI OA Biomarkers Workshop III
Hilton Head, July 12-14, 2012
Primary Endpoints
Cross-sectional

Quadriceps ACSA, strength and specific strength

Exploratory analyses
Cross-sectional

Quadriiceps head, thigh muscle group ACSAs, hamstrings strength and specific strength
In women but not in men, quadriceps weakness was associated with increased risk for tibiofemoral and whole knee JSN. Segal et al. 2010, OAC.
Secondary Endpoints
Longitudinal

Quadriceps ACSA, strength and specific strength

Mean longitudinal changes of quadriceps muscle status

-40% -30% -20% -10% 0% 10% 20% 30% 40%

* = p<0.05

Exploratory sex specific analyses
Longitudinal

Sensitivity analyses: Longitudinal changes of quadriceps muscle status in progressors

Sensitivity analyses: Longitudinal changes of quadriceps muscle status in non-progressors

* = p<0.05
Conclusion

Despite the robust definition of structural progression and a close matching between progressors and non-progressor knees, findings of this pilot study do not support that thigh muscle status is associated with structural progression in knees with radiographic OA.