The correlation between mid-substance cross-sectional area of the anterior cruciate ligament and the knee osseous morphology.

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Introduction

It is essential to obtain more accurate predictors of ACL size before surgery. Considering that the most important structure of the ACL is its mid-substance portion, evaluation of the mid-substance portion of the ACL should be performed more on detail. Recently, Iriuchishima et al.\textsuperscript{1}) reported the correlation between tibial or femoral ACL footprint size and the tibia plateau or femoral condyle. However, to the best of our knowledge, no study has reported the correlation between mid-substance cross-sectional area of the ACL and the knee osseous morphology.

\textsuperscript{1}) Iriuchishima et al. KSSTA,2015
Objective
✓ To reveal the correlation between the mid-substance cross-sectional area of the ACL and the knee osseous morphology.

Hypothesis
✓ Native mid-substance cross-sectional area of the ACL would be correlated with the knee osseous morphology.
Materials and Method

✓ 39 non-paired formalin fixed cadaveric knees were used. (18 males, 21 females, average age: 78.6 ± 10.6 y.o.)

✓ Measurement of mid-substance cross-sectional area of the ACL. A: Slice plane of mid-substance cross-section ACL was sliced at the tangential plane of the femoral posterior condyles at 90 degree of knee flexion. B: Mid-substance cross-sectional area of the ACL was measured with Image J software.
Method

✓ **On the femoral side**, femur was split along the sagittal plane through the most superior point of the anterior outlet of the intercondylar notch. Femoral ACL footprint size, Blumensaat’s line length, lateral wall of the femoral intercondylar notch area and height were measured with Image J software.

✓ **On the tibial side**, ACL footprint size, tibia plateau size, whole, medial and lateral AP length of the tibia plateau, ML length of the tibia plateau were measured with Image J software.

✓ The Pearson’s product movement correlation was calculated to reveal the correlation between mid-substance cross-sectional area of the ACL and the measured parameters of the knee osseous morphology.
## Results

<table>
<thead>
<tr>
<th>ACL size</th>
<th>Correlation (p-value)</th>
<th>Pearson’s correlation coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mid-substance cross-sectional area</td>
<td>62.2 ± 17.3mm²</td>
<td>N.S.</td>
</tr>
<tr>
<td>Femoral footprint size</td>
<td>59.8 ± 20.2mm²</td>
<td>0.001</td>
</tr>
<tr>
<td>Tibial footprint size*</td>
<td>115.5 ± 30.3mm²</td>
<td>0.513</td>
</tr>
</tbody>
</table>

### Femoral osseous morphology

- Lateral wall of the femoral intercondylar notch height: 15.2 ± 2.3mm, N.S.
- Lateral wall of the femoral intercondylar notch area: 386.3 ± 91.0mm², N.S.
- Blumensaat’s line length: 30.9 ± 4.2mm, N.S.

### Tibial osseous morphology

- Tibia plateau size*: 2504.1 ± 475.8mm², 0.001, 0.519
- ML length of the tibia plateau*: 72.0 ± 6.4mm, 0.001, 0.531
- Whole AP length of the tibia plateau*: 48.0 ± 5.2mm, 0.0304, 0.350
- Medial AP length of the tibia plateau: 45.0 ± 4.6mm, N.S.
- Lateral AP length of the tibia plateau*: 37.8 ± 4.3mm, 0.006, 0.447

* p<0.05
Discussion

✓ Harner et al.\(^2\) measured mid-substance area of the ACL using a laser micrometer system. The result was approximately 40 mm\(^2\).

✓ Hashemi et al. \(^3\) measured smallest mid-substance area of the ACL using a 3D camera system. The result was 46.75mm\(^2\).

✓ The tibial ACL footprint was evaluated larger than the femoral ACL footprint and mid-substance ACL size in this study and previous studies \(^2-4\). This study’s mid-substance ACL size(62.2mm\(^2\)) was relatively larger than previous studies \(^2-4\), because cross-sectioned on the posterior condylar line in the 90 degree of knee flexion, this was evaluated at the close portion of the tibial footprint.

2) Harner CD et al. Arthroscopy 1999  
For the clinical relevance, in the planning stages of ACL reconstruction, there is the possibility that the native mid-substance cross-sectional area of the ACL would be predicted with measurement of the tibia plateau osseous morphology.

If surgeons could predict the mid-substance cross-sectional area of the ACL before surgery, it will be useful for the graft or tunnel size selection, and more accurate anatomical ACL reconstruction can be archived.
Limitation

1. ACL dissection was performed by macroscopic evaluation only.
2. The average age of the cadavers used was significantly older than the average age of patients who undergo ACL reconstruction.
3. Our sample size was not large. (n = 39)
4. The ACL footprint was evaluated with a 2-dimensional technique only.
5. Radiographic evaluation was not performed in this study.
✓ Tibial footprint size, the tibia plateau, ML length of the tibia plateau, whole and lateral AP length of the tibia plateau were significantly correlated with mid-substance cross-sectional area of the ACL.

✓ It might be possible to predict the mid-substance cross-sectional area of the ACL measuring these parameters.
Reference


