Relationship between the anterior horn of lateral meniscus and tibial tunnel in anatomical single bundle anterior cruciate ligament reconstruction

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I have no financial conflicts to disclose
Introduction

Relationship between ACL and anterior root of lateral meniscus (ARLM)

- Tibial footprint of ACL and ARLM overlap by 63%\(^1\).
- Outer fiber of ARLM blended with ACL footprint\(^2\).

**ACL and ARLM are very adjacent**

ARLM injury in ACL reconstruction

- The risks of iatrogenic ARLM injury in ACL reconstruction was reported in many cadaveric studies\(^1,3\).
- ARLM injury cause lateral meniscal extrusion (LME) and Osteoarthritic changes\(^4\).

In surgery, surgeons must pay attention to iatrogenic ARLM injury
Introduction

The risk factors of AHLM injury in previous reports\textsuperscript{3.5}

- Using a greater size reamer and low angle aimer
- Small bone morphology
- Inappropriate location of tibial tunnel

Almost all previous reports were cadaveric.

There is no research focused on Asian women who is smaller skeleton than Westerners.

The occurrence of ARLM injury in small skeletal people is unknown

Purpose

To investigate the occurrence rate and the character of ARLM injury in anatomical single bundle ACL reconstruction.
100 women were included in this retrospective study

Inclusion criteria:

✓ Performed anatomical single-bundle ACL reconstruction using hamstring autograft between April 2011 and February 2018.
✓ CT scan was taken at 1 week postoperatively.
✓ MRI was performed preoperatively and at 6 months postoperatively.

Our technic of creating the tibial tunnel in ACL reconstruction

- **Location:** anteromedial position in ACL tibial footprint
- **Size:** 8-9.5 mm (depend on graft size)
- **Shape:** round
- **Angle:** 50° (Use 50° Aimer)
- **ACL remnant:** preserved as much as possible
Evaluation of ARLM by CT

Using CT scan which was taken at 1 week after surgery

- To get the appropriate coronal slice for ARLM evaluation, 3D-CT as shown on the left was used.
- We got 3 special coronal slices which were parallel to the posterior aspect of the tibia (a) and included lateral edge point of the tibial tunnel (b), and evaluated these coronal plane of slice 1, 2 and 3.
- Because ARLM adheres to the lower half of this slope, we defined ARLM injury index to evaluate the potential of partial ARLM injury.

ARLM injury index = \( \frac{A}{B} \times 100(\%) \)

calculated as the average of the 3 coronal slices

A: The distance from the bottom of medial intercondylar ridge (MIR) to the tibial tunnel (ARLM tibial insertion)
B: The distance from the slope of the medial intercondylar ridge (SMIR)
We defined less than $40\%$ of the ARLM injury index as partial ARLM injury.

Comparison of the 2 groups

$A/B = 34\%$

$A/B = 54\%$

$<40\%$  Partial ARLM injury group

$\geq 40\%$  ARLM intact group

Definition of partial ARLM injury
Evaluation items and analysis

**Evaluation items**

- Height (cm)
- Body weight (kg)
- SMIR (mm)
- The distance of AHLM insertion (mm)
- Size of the tibial tunnel (mm)
- The change in LME based on pre- and post-operative MRI (mm)
- BMI (kg/m²)
- Age (years old)
- Cases of lateral meniscus tear

**Statistical analysis**

- Comparison between the two groups
- Using the Mann-Whitney U test
- The level of significance: $\alpha < 0.05$
### Results: Anatomical items

Partial ARLM injuries were suspected in **15** of 100 cases (15%).

<table>
<thead>
<tr>
<th></th>
<th>ARLM injury (N=15)</th>
<th>Intact (N=85)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years old)</td>
<td>23.7±13.3</td>
<td>24.7±8.8</td>
<td>0.52</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>158.3±5.8</td>
<td>159.8±5.9</td>
<td>0.41</td>
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<tr>
<td>Body weight (kg)</td>
<td>57.9±9.1</td>
<td>56.3±8.8</td>
<td>0.56</td>
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<tr>
<td>BMI (kg/m²)</td>
<td>22.9±2.9</td>
<td>21.9±2.7</td>
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<tr>
<td>Lateral meniscus tear</td>
<td>7 (46.6%)</td>
<td>41 (48%)</td>
<td></td>
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<tr>
<td>(longitudinal or horizontal)</td>
<td></td>
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</tbody>
</table>

- There was no significant difference in anatomical items.
- All lateral meniscus tears were performed meniscal repair using all inside suture device.
## Results: CT and MRI evaluations

<table>
<thead>
<tr>
<th></th>
<th>ARLM injury (N=15)</th>
<th>Intact (N=85)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>The distance of SMIR (mm)</td>
<td>15.1±1.9</td>
<td>16.9±1.4</td>
<td>&lt;0.05</td>
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<tr>
<td>The distance of AHLM insertion (mm)</td>
<td>5.4±0.8</td>
<td>8.4±1.4</td>
<td>&lt;0.05</td>
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<tr>
<td>Tibial tunnel (mm)</td>
<td>8.2±0.4</td>
<td>8.0±0.6</td>
<td>0.38</td>
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<tr>
<td>The change of LME (mm)</td>
<td>0.9±0.6</td>
<td>0.3±0.5</td>
<td>0.001</td>
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</table>

- The injury group had a significantly shorter distance of the SMIR and AHLM insertion than the intact group.
- The change in LME was significantly greater than that in the intact group.
## All data of the partial ARLM injury group

<table>
<thead>
<tr>
<th>Case</th>
<th>Age</th>
<th>Height (cm)</th>
<th>Body weight(kg)</th>
<th>SMIR (mm)</th>
<th>ARLM insertion(mm)</th>
<th>ARLM injury index(%)</th>
<th>Tibial tunnel size(mm)</th>
<th>The change of LME(mm)</th>
<th>LM tear</th>
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Limitation

✓ Our series included the cases of lateral meniscus tear.

✓ It was an evaluation only on the medial-lateral direction, not evaluating anterior-posterior direction.

✓ Because our study was short term results, it is unknown what is going on in the long term.

Now, we are promoting further research which include evaluation of anterior-posterior direction and no lateral meniscus tear cases.
Conclusions

- ARLM injury in anatomical single bundle ACL reconstruction was suspected in 15 of 100 females.

- In the injury group, the distance from the apex to the bottom of the SMIR was significantly shorter and the change in LME was significantly greater than those in the intact group.

- In cases of patients with small skeletons, surgeons should be aware that ARLM injury will occur if the tunnel deviates even a little.

References