Lateral Location of the Tibial Tunnel After Single Bundle Anterior Cruciate Ligament Reconstruction Decreases the Attachment Area of the Anterior Lateral Meniscus Root

Takeshi Oshima
Samuel Grasso
David A. Parker

Sydney Orthopaedic Research Institute
Sydney, Australia
Takeshi Oshima, MD, PhD

I have no financial conflicts to disclose
Graft tunnel placement is a critical variable in the success of ACL reconstruction.

Tibial insertion of ACL is close to the attachment of anterolateral meniscal root (ALMR).\(^1,^2\)

63\% of ALMR attachment and 41\% of ACL are overlapped.\(^3\)

Tibial tunnel reaming may cause damage to LM attachment.\(^4\)
Background

Function of ALMR

Anchor to the tibia
Injury of the ALMR attachment results in increasing contact pressure.\(^5\)

Sensory function
Uncalcified and calcified fibrocartilaginous zone of ALMR has nerve fibers.\(^6\)

Loss of ALMR attachment by creating tunnel is still unknown.

Aim
To investigate the loss of the attachment of ALMR after creating the tibial tunnel in single bundle ACL reconstruction.
Methods

- **11** primary ACL-reconstructed patients who had pre- and 1-y high resolution MRI.

**Technique to create a tibial tunnel**

- Single rounded tunnel (7-8.5 mm diameter)
- Anteromedial position in a footprint
- Tibial guide set at a 60° angle
- ACL remnant is preserved

**High resolution MRI**

<table>
<thead>
<tr>
<th></th>
<th>Femur</th>
<th>Tibia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intra-Op v MRI</td>
<td>0.59 ± 0.24 mm</td>
<td>0.60 ± 0.24 mm</td>
</tr>
<tr>
<td>Intra-Op v CT</td>
<td>0.59 ± 0.25 mm</td>
<td>0.61 ± 0.24 mm</td>
</tr>
<tr>
<td>MRI v CT</td>
<td>0.48 ± 0.28 mm</td>
<td>0.46 ± 0.27 mm</td>
</tr>
</tbody>
</table>

MRI (3T, Magnetom Skyra; Siemens AG Healthcare)
15-channel phased-array knee coil (Siemens AG Healthcare)

Grasso, AJSM 2018 [7]
Creating 3-D model

- 3D processing software (ScanIP, Simpleware Ltd, Exeter, UK)
- ALMR and tibial plateau were segmented, and the medial and lateral tibial eminences were used as references
MRI measurement

Variables from 3-D model

- The area, width (red) and length (yellow) of ALMR attachment were measured digitally.
- The mean percentage of the attachment loss, reduction rate of the width and length were calculated.

Tibial tunnel location

- The lateral border of the tunnel aperture from the medial end of the tibia (Red)
- The posterior border of the tunnel aperture from the anterior end of the tibia (Yellow)
- Both were divided by width and length of tibia
Statistical analysis

Evaluation variables

- Area of ALMR (mm$^2$)
- Width (mm) and Length of ALMR (mm)
- Loss of area (%)
- Reduction of width and length (mm)
- Tunnel location (%)

Statistical analysis

- Comparison between pre- and postoperative groups
- Correlations between the percentage of the loss of the area and the location of the tibial tunnel aperture were evaluated.
The attachment of ALMR was significantly decreased after ACL reconstruction.

A positive correlation was observed between the percentage of the attachment loss and the location of the lateral border of the tibial tunnel aperture ($r=0.236$), as well as the reduction rate of the attachment width ($r=0.625$).

<table>
<thead>
<tr>
<th></th>
<th>Pre-op</th>
<th>Post-op</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area ($\text{mm}^2$)</td>
<td>91.6 ± 5.9</td>
<td>73.8 ± 5.6</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Width (mm)</td>
<td>7.6 ± 0.3</td>
<td>5.8 ± 0.2</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Length (mm)</td>
<td>9.8 ± 0.5</td>
<td>9.4 ± 0.5</td>
<td>0.004</td>
</tr>
<tr>
<td>Loss of the area (%)</td>
<td></td>
<td>19.7 ± 7.0</td>
<td></td>
</tr>
<tr>
<td>Reduction of the width (%)</td>
<td></td>
<td>24.0 ± 8.3</td>
<td></td>
</tr>
<tr>
<td>Reduction of the length (%)</td>
<td></td>
<td>4.4 ± 7.0</td>
<td></td>
</tr>
<tr>
<td>Lateral border of the tunnel aperture (%)</td>
<td>52.7 ± 2.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Posterior border of the tunnel aperture (%)</td>
<td>51.3 ± 2.9</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Distance and Morphology of ACL and ALMR attachment

20 normal knee 3-D models

<table>
<thead>
<tr>
<th></th>
<th>ACL</th>
<th>ALMR</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area (mm²)</td>
<td>106.2 ± 21.3</td>
<td>56.2 ± 12.3</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Length (mm)</td>
<td>16.8 ± 2.0</td>
<td>11.0 ± 1.8</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Width (mm)</td>
<td>6.9 ± 1.3</td>
<td>6.6 ± 1.0</td>
<td>0.433</td>
</tr>
<tr>
<td>The distance between ACL and ALMR (mm)</td>
<td>8.1 ± 1.3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Oshima et al, before publish

Tunnel location in ML direction is more important to avoid the ALMR attachment.
Limitations

- Small number of the patients.
- The clinical relevance of damaging the ALMR is still unclear.

Future plan

- Increasing the number of patients, evaluate the attachment loss, the location of tibial tunnel and a lateral meniscal extrusion (LME).
- A longer follow-up is required to confirm the long-term relationship between ALMR loss, LME and clinical outcomes.
Conclusions

– The ALMR attachment was significantly decreased (about 20 %) after creation of the tibial tunnel in single bundle anterior cruciate ligament reconstruction.

– More lateral location of the tibial tunnel appears to decrease the ALMR attachment area, implying damage to this structure.
References


