Lateral Location of the Tibial Tunnel Increases Lateral Meniscal Extrusion After Anatomical Single Bundle Anterior Cruciate Ligament Reconstruction

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I have no financial conflicts to disclose
Background

- 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.\(^6\)

Damage of the ALMR cause the loss of the hoop function and it could be identified as lateral meniscal extrusion (LME).\(^7\)

Aim

To investigate the relationship between the location of the tibial tunnel and LME after anatomical single bundle ACL reconstruction.
Methods

Patient Selection

153 cases
- high resolution MRI (Oct 2014- July 2016)

95 cases
- meniscal injury

55 cases (35.9%)
- no meniscal injury from per-op MRI and intraoperative finding

Grasso, AJSM 2018 [8]

Inclusion criteria
1) Primary single bundle anatomical ACL reconstruction using hamstring autograft
2) No previous knee ligament surgery

Exclusion criteria
1) Multiligament reconstruction
2) Any meniscal injury diagnosed by preoperative MRI or intraoperative arthroscopy.
MRI measurement

Lateral meniscal extrusion

- The distance (mm) of the lateral meniscal margin from the tibia.

- The distances were standardised by tibial width (TW) and shown as percentage.

Tibial tunnel location

- The distance in ML and AP directions from medial tibial eminence.

- The distances were standardised by TW and TL and shown as percentages.
Evaluation variables

- Age (y), Height (cm), Weight (kg)
- LM extrusion (%)
- Tunnel location (%)
- Tunnel size (mm)
- Interval from injury to operation (week)
- One-year Clinical outcome (IKDC, Lysholm, Stability using KT-1000)

Statistical analysis

- A correlation analysis between LM extrusion and each variable
- The difference in LME (%) between patients above or below the identified cutoff value of ML(%) was evaluated using the Mann–Whitney U-test and chi-squared test.
## Results: Values and correlation between LME and each parameters

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Mean (range)</th>
<th>r</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>LME (%)</td>
<td>1.13 (-1 - 3.4)</td>
<td>-0.025</td>
<td>0.857</td>
</tr>
<tr>
<td>Age (y)</td>
<td>31.8 (15-58)</td>
<td>-0.025</td>
<td>0.857</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>174.0 (158.5-192.5)</td>
<td>0.078</td>
<td>0.590</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>75.3 (52.0-102.8)</td>
<td>-0.044</td>
<td>0.763</td>
</tr>
<tr>
<td>Tibial tunnel size</td>
<td>4/3/7/19/15/5/2</td>
<td>0.200</td>
<td>0.155</td>
</tr>
<tr>
<td><strong>ML Distance from tibial eminence (%)</strong></td>
<td>3.8 (-0.3 – 8.2)</td>
<td><strong>0.450</strong></td>
<td><strong>0.0006</strong>*</td>
</tr>
<tr>
<td>AP Distance from tibial eminence (%)</td>
<td>23.1 (13.4- 34.7)</td>
<td>0.136</td>
<td>0.324</td>
</tr>
<tr>
<td>Interval from injury to surgery (week)</td>
<td>13.2 (2- 114)</td>
<td>0.062</td>
<td>0.655</td>
</tr>
<tr>
<td>Lysholm</td>
<td>83.3 (50-97.7)</td>
<td>-0.147</td>
<td>0.401</td>
</tr>
<tr>
<td>IKDC</td>
<td>91.1 (48-100)</td>
<td>-0.178</td>
<td>0.266</td>
</tr>
<tr>
<td>KT-1000 (mm)</td>
<td>0.47 (-5- 8)</td>
<td>0.005</td>
<td>0.975</td>
</tr>
</tbody>
</table>

- Lateral location of the tibial tunnel increased LME.
- LME doesn’t influence the short-term clinical outcome.
Results: Correlation between LME and ML distance from medial eminence

- Sensitivity 80.0%
- Specificity 72.5% to more than 1.5% of LME
- y = 0.32x – 0.46
- r = 0.450
- p = 0.0006

Cutoff value: 4% of ML distance
## Results: Comparison between lateral and medial location tunnel groups

<table>
<thead>
<tr>
<th></th>
<th>Lateral location (ML &gt; 4%)</th>
<th>Medial location (ML ≤ 4%)</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of knees</td>
<td>22</td>
<td>33</td>
<td></td>
</tr>
<tr>
<td>Gender (male/female)</td>
<td>16/6</td>
<td>17/16</td>
<td>0.116</td>
</tr>
<tr>
<td>Age (y)</td>
<td>31.3</td>
<td>32.3</td>
<td>0.693</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>175.1</td>
<td>173.4</td>
<td>0.484</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>75.7</td>
<td>74.7</td>
<td>0.727</td>
</tr>
<tr>
<td>Tibial tunnel size (mm)</td>
<td>9.1</td>
<td>9.0</td>
<td>0.111</td>
</tr>
<tr>
<td>LME (%)</td>
<td>1.50</td>
<td>0.29</td>
<td>0.0007*</td>
</tr>
<tr>
<td>Interval to op (weeks)</td>
<td>11.1</td>
<td>14.6</td>
<td>0.852</td>
</tr>
<tr>
<td>Lysholm</td>
<td>91.3</td>
<td>90.9</td>
<td>0.802</td>
</tr>
<tr>
<td>IKDC</td>
<td>85.0</td>
<td>81.9</td>
<td>0.582</td>
</tr>
<tr>
<td>KT-1000 (mm)</td>
<td>0.18</td>
<td>0.75</td>
<td>0.393</td>
</tr>
</tbody>
</table>

- LME showed significant difference.
- There was no significant difference between both group for clinical outcome.
Limitations

• The LME was evaluated from only postoperative MRI.

• LME doesn’t influence the short-term clinical outcomes.

Future plan

• Comparing pre- and post high resolution MRI, evaluate the attachment loss, the location of tibial tunnel and LME.

• A longer follow-up is required to confirm the long-term relationship between LME and clinical outcomes.
Conclusions

– Lateral location of the tibial tunnel increased risk of lateral meniscal extrusion after single bundle ACL reconstruction using hamstring autograft.

– The lateral meniscal extrusion doesn’t influence the short-term clinical outcomes.


