Is a Stenotic Intercondylar Notch a Risk Factor for Failure in Skeletally Immature Athletes who Undergo ACL Reconstructions?

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BACKGROUND

• There are conflicting reports about the influence of notch geometry on the risk of ACL tears.1,2
• Despite a lack of consensus, studies have focused mainly on the intercondylar notch width index (NWI), suggesting that narrow notch sizes are associated with a higher risk of ACL rupture.1,4
• Other novel radiographic parameters, such as the intercondylar roof angle or the notch angle (NA), have been reported as possible non-modifiable factors for ACL injuries.
• To our knowledge, this is the first study to evaluate whether notch morphology predicts failure specifically following ACL reconstruction (ACLR).
• Our hypothesis is that a stenotic and steeper notch increases risk for failure following ACLR in the pediatric population.
• Objective: to determine whether alterations in the intercondylar notch geometry are associated with failure of ACLR in skeletally immature athletes.

METHODS

• Radiographic case-control study of 17 failed hamstring ACLR identified in a cohort of skeletally immature patients operated by the same surgical team.
• Failures were compared to a control group of 27 intact-ACLR in skeletally immature patients who had returned to athletics and had a minimum of 2 years follow-up; average skeletal age at the time of surgery was 13.6 years (range 10 - 17).
• Notch width index (NWI) and notch angle (NA) were measured in coronal and axial plane density weighted MRI studies using a previously validated method (Figure 1).3
• Inclination of the intercondylar roof (Blumensaat Line) was measured using midsagittal proton density weighted MRI image (Figure 1).1,4
• The Wilcoxon-Rank sum test was used to compare the continuous predictors and Fisher’s exact test was used to compare the categorical predictors (Table 1).

RESULTS

<table>
<thead>
<tr>
<th></th>
<th>Failed ACLR Group</th>
<th>Intact ACLR Group</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>NWI (axial plane)</td>
<td>0.224</td>
<td>0.271</td>
<td>0.0001</td>
</tr>
<tr>
<td>NWI (coronal plane)</td>
<td>0.213</td>
<td>0.216</td>
<td>0.0001</td>
</tr>
<tr>
<td>NA (axial plane)</td>
<td>45.4°</td>
<td>55.1°</td>
<td>0.0008</td>
</tr>
<tr>
<td>NA (coronal plane)</td>
<td>46.8°</td>
<td>60.8°</td>
<td>0.0001</td>
</tr>
<tr>
<td>Notch Roof Angle</td>
<td>135.8°</td>
<td>126.5°</td>
<td>0.0005</td>
</tr>
</tbody>
</table>

Table 1. Measurements in failed vs. intact ACLR subjects.

Figure 1. Example measurements of (a) the notch width index (NWI); (b) the notch angle (NA); and (c) the intercondylar roof angle

DISCUSSION

• Notch geometry may specially contribute to ACLR failure in the pediatric population, whose growth plates have not yet fused.
• When the knee is in full extension, the ACL contacts the top of the intercondylar notch, leading to increased force on the mid-part of the ligament.
• The identification of risk factors can guide the use of preventive measures in patients at risk, such as the decision to perform a notchplasty in selected patients.
• This is particularly relevant in pediatric population, where there is a great need to minimize the complications and morbidity associated with ACLR failure and consequent revision surgery.
• Further studies are needed to clarify the influence of the roof angle, yet it has been theorized that a more vertical (steeper) intercondylar roof angle might be associated with failure due to an anterior impingement mechanism (especially at low knee flexion angles).

CONCLUSION

• This pilot study demonstrates that NWI and NA may be predictors for graft failure in skeletally immature athletes who undergo ACLR.
• Interestingly, a steeper inclination of the notch roof was also related to ACLR failure in this population, possibly leading to altered biomechanics of the reconstructed ACL.

REFERENCES


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