Allograft Augmentation of Hamstring ACL Autografts is Associated with Increased Graft Failure

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Background

- Rates of second ACL injury in adolescents have been reported to be as high as 37%\(^1\)
- Numerous factors associated with ACL graft failure
  - Graft selection\(^2-8\)
    - Hamstring vs Patellar Tendon vs Quad Tendon
    - Autograft vs Allograft
    - Graft Diameter
  - Patient age and activity level\(^9-10\)
  - Meniscal integrity\(^11\)
Purpose

- To evaluate the association of soft tissue graft constructs and graft rupture following pediatric and adolescent ACL reconstruction.
Methods

Single center retrospective review

• 2012 - 2016
• 2 surgeons, same fixation and drilling techniques

Inclusion criteria

– Age <20 years
– Transphyseal or conventional drilling
– Hamstring autograft +/- allograft augmentation

Exclusion criteria

– Revision ACL reconstruction
– Physeal sparing ACL reconstruction
– Multiligament knee reconstruction
– < 6 months clinical follow-up
# Grafts

- 4-strand doubled semitendinosus + gracilis autograft
  - 4-STG

- 5-strand tripled semitendinosus + doubled gracilis autograft
  - 5-STG

- 6-strand doubled semitendinosus + gracilis autograft + allograft augmentation
  - 6-STGAllo
Demographics and Graft Failure

<table>
<thead>
<tr>
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<th>Overall (n = 354)</th>
</tr>
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<tbody>
<tr>
<td>Rupture</td>
<td>51 (14.4%)</td>
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<td>Age (years)</td>
<td>15.3 ± 1.8</td>
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<td>BMI</td>
<td>24.2 ± 5.0</td>
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<td>Graft size (mm)</td>
<td>8.6 ± 0.7</td>
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<td>Follow-up (mo)</td>
<td>25.3 ± 13.6</td>
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54% female  
Age range 10 – 19 years
Demographics and Graft Failure

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<th>Overall (n = 354)</th>
<th>4-STG (n = 198)</th>
<th>6-STGAllo (n = 65)</th>
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Highest rate of failure with allograft-augmented grafts
### Demographics and Graft Failure

Older age and larger graft sizes found in patients with allograft-augmented grafts

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<td>Age (years)</td>
<td>15.3 ± 1.8</td>
<td>14.9 ± 1.9</td>
<td>16.0 ± 1.5</td>
<td>15.6 ± 1.7</td>
<td>&lt;0.001</td>
</tr>
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<td>BMI</td>
<td>24.2 ± 5.0</td>
<td>24.3 ± 5.0</td>
<td>24.5 ± 5.4</td>
<td>23.6 ± 4.1</td>
<td>0.46</td>
</tr>
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<td>Graft size (mm)</td>
<td>8.6 ± 0.7</td>
<td>8.3 ± 0.6</td>
<td>9.2 ± 0.5</td>
<td>8.9 ± 0.6</td>
<td>&lt;0.001</td>
</tr>
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<td>Follow-up (mo)</td>
<td>25.3 ± 13.6</td>
<td>25.5 ± 13.6</td>
<td>25.8 ± 14.7</td>
<td>24.3 ± 12.6</td>
<td>0.74</td>
</tr>
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Predictors of Graft Failure

<table>
<thead>
<tr>
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<th>Non-Ruptured (n = 303)</th>
<th>Ruptured (n = 51)</th>
<th>P value</th>
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<tbody>
<tr>
<td>Age (years)</td>
<td>15.3 ± 1.8</td>
<td>14.9 ± 1.8</td>
<td>0.07</td>
</tr>
<tr>
<td>BMI</td>
<td>24.4 ± 5.2</td>
<td>23.1 ± 3.6</td>
<td>0.07</td>
</tr>
<tr>
<td>Graft size (mm)</td>
<td>8.6 ± 0.7</td>
<td>8.6 ± 0.7</td>
<td>0.55</td>
</tr>
<tr>
<td>Male sex</td>
<td>134 (44%)</td>
<td>23 (45%)</td>
<td>1.00</td>
</tr>
<tr>
<td>Right knee</td>
<td>155 (51%)</td>
<td>20 (39%)</td>
<td>0.16</td>
</tr>
<tr>
<td>Meniscus debridement</td>
<td>108 (36%)</td>
<td>17 (33%)</td>
<td>0.49</td>
</tr>
</tbody>
</table>

Graft rupture was associated with trends toward **younger age** and **lower BMI**
No association between graft rupture and graft size
Kaplan-Meier Survival Curve

Mean time to failure 16 months
Odds Ratios for Graft Failure

- Controlled for age and graft size

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<tr>
<td>6-STGAllo vs 4-STG</td>
<td>2.6</td>
<td>0.04</td>
</tr>
<tr>
<td>5-STG vs 4-STG</td>
<td>1.2</td>
<td>0.72</td>
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- An 8mm 6-strand allo-augmented graft has a 2.6 times increased risk of failure as compared to an 8mm 4-strand autograft
Conclusions

• High rate of graft failure following adolescent ACL reconstruction

• Hybrid hamstring autograft-allograft constructs have a significantly increased risk of graft rupture as compared to hamstring autografts

• 5-strand hamstring autografts with a tripled semitendinosus have equivalent failure rates to 4-strand autografts

• If a 4-strand autograft is “inadequate” in size, obtain a larger graft diameter by tripling the semitendinosus rather than augmenting with an allograft
Thank you
References


