Paediatric Anterior Cruciate Ligament Repair with Internal Brace – Early Results

John Dabis, SK Yasen, AJ Foster, LJ Pace, MJ Risebury, AJ Wilson
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High Failure Rate In This Group

- Up to 20% Failure rate
- 4.6 x increased risk of failure <18

Paediatric ACL Injury

- Surgical management of ACL tears in children and adolescents pose unique management challenges due to the presence of the open physes and high graft failure rates.

AIM

- To report on early clinical outcomes after arthroscopic primary ACL repair with internal bracing in a cohort of skeletally immature patients while providing an update to our original surgical technique.

Disclosures

J Dabis (I have no financial conflicts to disclose)
SK Yasen (This individual reported nothing to disclose)
AJ Foster (This individual reported nothing to disclose)
MJ Risebury (Smith&Nephew: Paid presenter or speaker; Research Support)
AJ Wilson (Arthrex, Inc; IP royalties; Paid consultant; Paid presenter or speaker; Research Support; Newclip: IP royalties; Paid consultant; Paid presenter or speaker)
A prospectively maintained database was retrospectively reviewed to identify all paediatric ACL repairs performed between January 2014 and May 2017.

**Inclusion criteria** included skeletally immature patients undergoing primary repair for a proximal femoral avulsion ACL tear with excellent ACL tissue quality defined by having a broad stump with mild interstitial tearing, with the ability to hold the fixation sutures.

**Exclusion criteria** included patients without pre-operative data, skeletal maturity, those who had a mid-substance tear or patients with an injury spectrum outside an isolated ACL rupture. An inadequate ACL stump remnant, i.e. inadequate tissue quantity or quality, on direct visualisation and probing would also preclude repair.

**Methods**

**Primary subjective outcomes**, validated for paediatric patients, were patient reported outcome measures (PROMs), which included the Lysholm, Tegner and KOOS-child scores. These were collected pre-operatively, six-months, one-year and two-years post-operatively.

**Primary objective measurements** were scored using the KiRa triaxial accelerometer which quantitatively assessed the Lachman’s and Pivot shift. The KiRa dynamic accelerometer was performed at final follow up. Our secondary outcomes included re-rupture, revision and growth arrest/disturbance rates.

Skeletal maturity was assessed via the presence or absence of open physes on radiographs and magnetic resonance imaging (MRI) and the Tanner-Whitehouse method.

**When To Repair?**

- **Attempt In All Children**
  - Especially Younger, Tanner 1 & 2
- **Femoral detachment of ACL**
  - ideally Type 1
- **Good stump quality**
- **Ideally Acute injury**
  - < 6 weeks
- **Final decision based on arthroscopy**

<table>
<thead>
<tr>
<th>Indications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Best indication is a Femoral Avulsion Tear</td>
</tr>
<tr>
<td>Best results in Intralesional Tears</td>
</tr>
<tr>
<td>Surgery 4-6 weeks after the Trauma</td>
</tr>
<tr>
<td>Final Decision Intraoperatively</td>
</tr>
</tbody>
</table>

Sherman Classification

**Surgical technique**

- Two high tensile braided composite looped sutures (0-FiberLink and TigerLink sutures) are passed around the proximal ACL stump, as a luggage tag type stitch, with an arthroscopic suture passing instrument to approximate the remnant to the sidewall of the femoral condyle.

- The internal brace used is created with a metal cortical suspension button and non-biodegradable suture tape. The adjustable loop from the Tight Rope RT is removed to leave a free suture button. The FiberTape is fed through the Tight Rope RT button. A Number 2 FiberWire is then fed through the button and the construct is loaded on to the shuttle suture.
PROMs

All PROMs showed a statistically significant improvement at all time points.

Table 1 demonstrating PROMs

<table>
<thead>
<tr>
<th>Patient</th>
<th>Pre</th>
<th>1-year</th>
<th>2-year</th>
<th>Post-op</th>
<th>3-year</th>
<th>5-year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>40</td>
<td>65</td>
<td>80</td>
<td>50</td>
<td>70</td>
<td>90</td>
</tr>
<tr>
<td>2</td>
<td>30</td>
<td>55</td>
<td>70</td>
<td>40</td>
<td>60</td>
<td>80</td>
</tr>
<tr>
<td>3</td>
<td>20</td>
<td>45</td>
<td>60</td>
<td>30</td>
<td>50</td>
<td>70</td>
</tr>
</tbody>
</table>

The mean pre-operative, one-year and two-year post-operative scores are shown above.

Table 2 demonstrating mean scores

<table>
<thead>
<tr>
<th>Patient</th>
<th>Pre-op</th>
<th>1-year</th>
<th>2-year</th>
<th>Post-op</th>
<th>3-year</th>
<th>5-year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>42.07</td>
<td>81.67</td>
<td>91.77</td>
<td>86.64</td>
<td>95.87</td>
<td>97.32</td>
</tr>
<tr>
<td>2</td>
<td>25.53</td>
<td>71.07</td>
<td>77.27</td>
<td>73.28</td>
<td>81.37</td>
<td>86.64</td>
</tr>
<tr>
<td>3</td>
<td>40.87</td>
<td>80.76</td>
<td>86.06</td>
<td>82.04</td>
<td>90.12</td>
<td>95.34</td>
</tr>
</tbody>
</table>

Dynamic Objective Assessment

The KIRA data demonstrated no significant side-to-side difference with regards to pivoting and a successful reduction in anterior translation to within 3 mm of the contralateral uninjured side. The average Lachman side-to-side difference was 1.28 mm. The average Pivot shift side to side difference was 0.5 m/s².

At 3 months a second look arthroscopy was undertaken and the internal brace released. During the arthroscopy, the internal brace was only just visible in four cases (28%).

The ACL repair was noted to be healed upon arthroscopic visualization and probing in all patients.

Our results – prospective cohort

- A total of 15 paediatric ACL repairs were performed and completed pre and post-operative outcome data.
- The mean duration of follow up for the whole cohort was 2.73 years (range 2.43 - 4.20).
- The mean age at time of surgery for the final cohort was 12.87 years (range 5-16 years).
- The mean duration to surgery was 76 days (range 14 - 515 days).

After excluding one outlier, the average time to surgery was 44.64 days (range 14 - 78 days).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Repair (15)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years - median)</td>
<td>15 (6-16)</td>
</tr>
<tr>
<td>Male gender (%)</td>
<td>53%</td>
</tr>
<tr>
<td>Right side (%)</td>
<td>60%</td>
</tr>
<tr>
<td>Average time from injury to surgery</td>
<td>6.4 weeks</td>
</tr>
</tbody>
</table>
Conclusions

• Promising early results
• No Failures
• No Complications
• Excellent Outcomes
• No Bridges Burned
• Will this become the Gold Standard For Children?

References

DiFelice GS, van der List JP. Clinical Outcomes of Arthroscopic Primary Repair of Proximal Anterior Cruciate Ligament Tears: Maintained at Mid-term Follow-up. Arthroscopy. 2018 Apr 1;34(4):1085-1093. PMID: 29373290