A Biomechanical Comparison of a Limited Open and Standard Open Technique for Achilles Tendon Rupture Repair

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I (and/or my co-authors) have something to disclose.

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Background
Acute Achilles Tendon Rupture

• Treatment may be surgical or non-surgical

• Surgical treatment is associated with earlier return to work\(^2^6\) and greater plantar flexion strength\(^3^1\)
  – Open repair
    • Considered the “gold standard”
    • A very common technique is a two-strand running locking stitch repair with an epitendinous weave\(^1^2, ^3^1\)
    • Non re-rupture complications after surgery are as high as 34%\(^1^8, ^3^1\)

• Less invasive techniques are gaining popularity\(^3, ^8, ^1^2, ^1^5\)
• Done through a small incision to allow for assessment of tendon apposition and quality of repair

• Suture is passed percutaneously, which does not allow the surgeon to judge the accuracy of suture placement

• Clinical Outcomes have been mixed \cite{12,17}
Previous Biomechanical Studies

- Only two studies have biomechanically examined the PARS

- **Achillon vs. PARS**
  - PARS withstood more cycles to gapping & higher load to failure

- **Kessler suture repair vs. PARS**
  - No difference in number of cycles to failure

- **Two-strand Krackow repair with epitendinous weave vs. PARS**
  - No comparison has been performed
Hypothesis

- **Objective**: Compare ultimate strength (*load to failure*) of limited open PARS repair and open Krackow technique
  - Why?
    - Has implications on ability of repair to withstand early accelerated rehabilitation
    - Many re-ruptures in early post-op period occur from acute injury (i.e. trip & fall)

- **Hypothesis**: No difference exists between techniques
Methods

• 9 pairs of fresh frozen human cadaveric lower limbs (18 specimen)

• Randomly assigned to:
  – Two-strand Krackow repair w/ epitendinous weave
  – PARS

• Gastroc-soleus unit dissected free
  – As done in previous studies \(^{10, 13}\)
  – Reduce confounding to eccentric suture placement

• Mid-substance Achilles tendon rupture created
Figure 1. Schematic diagram illustrating each repair and their suture configurations. The open repair consisted of A) a two-strand Krackow repair augmented with B) Epitendinous weave. After the Krackow stitch, the epitendinous weave was passed through the tendon 2.5 cm from its torn edge as described by Lee et al. C) The PARS Achilles Jig System (Arthrex, Inc). The PARS repair consisted of two simple transverse and one locking suture.
Testing

- Servo-hydraulic testing machine
  - Loaded to failure at 25.4 mm/s
  - As done in other studies $^4,^7$

Figure 2. The repaired Achilles tendon secured onto the material testing machine (858 Mini Bionix, MTS Systems). The tendon is secured proximally in a tightened clamp. The calcaneal wedge is potted into a 5 cm PVC pipe using PMMA cement.
Results

• Load to failure was not statistically different between the two repair types

• Initial linear stiffness was significantly greater for the Open Krackow repair group

<table>
<thead>
<tr>
<th>Table II. Biomechanical Outcomes</th>
<th>Open</th>
<th>PARS</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load to Failure (N)</td>
<td>353.5 (88.8)</td>
<td>313.3 (99.9)</td>
<td>0.38</td>
</tr>
<tr>
<td>Work to Failure (J)</td>
<td>6.4 (2.3)</td>
<td>6.3 (3.5)</td>
<td>0.904</td>
</tr>
<tr>
<td>Initial Linear Stiffness (N/mm)</td>
<td>17.8 (5.4)</td>
<td>11.8 (2.5)</td>
<td>0.011</td>
</tr>
</tbody>
</table>

All values expressed as Mean (Standard deviation)
Conclusion

• Repair strength should not be a driving factor when deciding which repair to perform for a given patient

• Initial linear stiffness for the Open Krackow repair was significantly greater than PARS repair, which may suggest greater resistance to gap formation which may occur during accelerated post-operative rehabilitation

• We believe patient factors such as risk for infection, regard for cosmesis and time to return to work or sport should play a larger role in the decision of whether to perform an open or limited open Achilles tendon repair
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