Biomechanical comparison of the Achillon vs. a minimally invasive locking suture device for Achilles tendon repair (PARS).

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My disclosure is in the Final AOFAS Program Book.

I have a potential conflict with this presentation due to:

Study funded by Arthrex Research Grant
Background

- Acute Achilles tendon ruptures are common injuries
- Controversy over best approach to treatment
  - Surgical vs. non-operative management
    - Less risk of re-rupture
- Surgical approaches: open vs. limited open vs. percutaneous
  - Percutaneous demonstrated lower complication rates when compared to open repairs. (Ceccarelli et al. Clin Orthop Relat Res 2007)
  - Controversy persists regarding the strength of repair of percutaneous and limited open techniques. (Hockenbury et al. FAI 1990)
Background

- Achilles tendon repairs benefit from
  - *Shorter immobilization time*
  - *Earlier range of motion*
  - *Earlier weight bearing and strengthening*

- Therefore, surgical repairs must demonstrate sufficient tensile strength and gap resistance to allow for aggressive post-operative rehabilitation
Overarching Goal:
Minimize complications while increasing strength of repair

Study Objective:
To determine resistance to gap formation under cyclical load and evaluate maximum load to failure for the Achillon device (Integra, Lyon, France), and the PARS device (Arthrex, Naples, FL).
PARS Device
(Arthrex, Naples, FL)

- Novel instrument
- Allows for percutaneous placement of **locking sutures** in the Achilles tendon
- Up to three sutures may be placed in either end of the tendon
- Each suture may be placed transverse or in locking fashion.
Methods

- Twenty-one fresh-frozen human cadaver lower limbs were randomized to one of three testing groups.

- Each repair was performed using #2 polyblend sutures (FiberWire, Arthrex, Naples, FL).

- All repairs were performed open (confirming each suture passed through the midportion of the tendon in the AP plane).

<table>
<thead>
<tr>
<th>Testing Group</th>
<th>Suture Configuration*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Achillon</td>
<td>3 transverse sutures</td>
</tr>
<tr>
<td>PARS 1</td>
<td>1 transverse and 1 locking suture</td>
</tr>
<tr>
<td>PARS 2</td>
<td>2 locking sutures</td>
</tr>
</tbody>
</table>

* Suture configuration in each end of the tendon.
Methods

- Specimens were subject to a two stage cyclic loading protocol *(Lee et al. AJSM 2009)*
  - Phase 1: 20N to 100N x 1,000 cycles at 1Hz
  - Phase 2: 20N to 190N x 1,000 cycles at 1Hz
- A differential variable reluctance transducer (DVRT, Microstrain, Burlington, VT) was used to measure displacement during each cycle.
- The number of cycles to a 2mm and 9.5mm gap was recorded for each specimen
Methods

- Cyclical loading of each repair was stopped once a gap of 9.5mm was achieved.
- Specimens were then loaded to failure at a rate of 0.025 m/s.
- Failure was defined as
  - Suture pullout
  - Suture breakage
  - Tendon tear from the proximal clamp.
- Maximum load to failure and mode of failure was recorded for each repair.
Statistical Analysis

- The Kruskal-Wallis test was used to assess differences among repair techniques on the number of cycles to gap formation, and maximum load to failure.
- If an effect was noted, Mann-Whitney U tests were performed to compare the three groups.
- An alpha level of 0.05 was deemed statistically significant.
Results

- There was a difference in strength of repair noted across the groups for 2mm gap formation at the repair site ($p=0.03$).
- Post-hoc analysis demonstrated a significant difference between the Achillon and PARS 1 groups ($p=0.048$), and between the Achillon and PARS 2 groups ($p=0.015$), with the PARS groups being superior.
- Two specimens from the PARS 1 group and two specimens from the PARS 2 group completed the loading protocol without reaching a 9.5mm gap.

### Number of Cycles to Gapping at Repair Site

<table>
<thead>
<tr>
<th>Repair Type</th>
<th>2mm</th>
<th>9.5mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Achillon</td>
<td>17</td>
<td>1,091</td>
</tr>
<tr>
<td>PARS 1</td>
<td>116*</td>
<td>1,373</td>
</tr>
<tr>
<td>PARS 2</td>
<td>207*</td>
<td>1,188</td>
</tr>
</tbody>
</table>

Median number of cycles to 2mm and 9.5mm gapping at the repair site for each group. * denotes a value significantly greater than the Achillon group ($p<0.05$).
Failure Results

- There was a difference in strength of repair noted across the groups for maximum load to failure (p=0.004).
- Post-hoc analysis showed that the PARS 2 group was superior in maximum load to failure when compared to the Achillon group (p=0.001).

<table>
<thead>
<tr>
<th>Load to Failure</th>
<th>Achillon</th>
<th>PARS 1</th>
<th>PARS 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>288N</td>
<td>340N</td>
<td>392N</td>
</tr>
<tr>
<td>Median</td>
<td>304N</td>
<td>342N</td>
<td>387N*</td>
</tr>
</tbody>
</table>

* denotes a value significantly greater than the Achillon group (p<0.05).
Failure Results

- **Achillon group**
  - 7 suture pullout from the tendon.

- **PARS 1**
  - 1 suture breakage
  - 3 suture pullout from tendon
  - 2 tendon tear
  - 1 n/a

- **PARS 2**
  - 6 suture breakage
  - 1 tendon tear
  - 1 n/a
Conclusions

- This study compared the strength of repair of the Achillon system with the PARS device.
- The PARS device demonstrated greater resistance to initial gap formation, and greater load to failure when compared to the Achillon.
References


