Comparison of 4 types of repair for mid-substance Achilles tendon ruptures: A biomechanical bovine study of cyclic failure with early mobilization

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Investigation performed at Instituto Traumatologico from Universidad de Chile
I (and/or my co-authors) have something to disclose.

Comparison of 4 types of repair for mid-substance Achilles tendon ruptures:
A biomechanical bovine study of cyclic failure with early mobilization

My disclosure is in the Final AOFAS Mobile App.
INTRODUCTION

- Incidence: 18 cases x 100,000 hab/year (Wilkins et al. 2012)

- A myriad of surgical techniques.

- Trend to more aggressive rehabilitation:
  - Immediate weight bearing and early mobilization
    (Suchak et al. 2006) (Kearney et al. 2002)

- Biomechanical behavior of different suturing techniques.
  - Which is the optimal configuration?
OBJECTIVES

• Primary Objective:
  Compare biomechanical behavior of four Achilles repair techniques (Double Dresden (DD), Triple Dresden (TD), Double Kessler (KS), Krakow (KR))

Hypothesis:
  » H0₁: TD will tolerate more progressive deformation of the construct before producing a 5 mm gap at the repair site.
  » H0₂: TD will have more strain resistance at maximum strain.

• Secondary Objective:
  To determine “Hazard Ratio” of the three Achilles repair techniques (DD, KS y KR) versus TD.
Materials & Method

- Sixty fresh frozen bovine Achilles tendon were harvested.
- A midsubstance rupture at 4.5 cm from the insertion was simulated.
- Specimens were randomized to one of four Achilles repair groups: Krakow (Kw), Double Kessler (Dk), Double Dresden (Dd), Triple Dresden (Td)
Materials & Method

Each specimen was positioned on a customized device, specifically designed for this experiment. The system includes a linear actuator, a loading cell and two synchronized digital cameras controlled by Matlab 7.1 software.

To simulate early rehabilitation, cyclic traction was then applied to 4.7 mm, 5.8 mm, 7.9 mm and 11.7 mm which represent 5°, 8°, 10° and 15° of range of motion (ROM), respectively. Failure was defined as gapping greater than 5 mm at the repair site. Gapping at the repair site, tensile strength, construct deformation and failures were documented. Finally, a maximum traction test was performed to register maximum resistance. Statistical analysis was performed using ANOVA in SPSS software, with Bonferroni’s post hoc correction (α = 0.05).
Results

- **Gaping** during cycle test:

  p<0.05 con DD = ə
  p<0.05 con KS = ж
  p<0.05 con KW = ё
  p<0.05 con TD = ё

![Graph showing gap size vs grades with annotations](image)
Results

- **Strain Resistance** during cycle test

\[
\begin{align*}
p < 0.05 \text{ con DD } &= * \\
p < 0.05 \text{ con KS } &= \rho \\
p < 0.05 \text{ con KW } &= \eta \\
p < 0.05 \text{ con DT } &= \varsigma \\
\end{align*}
\]
Results

- **Construct deformation** during cycle test:

  
  
  \[ p<0.05 \text{ con DD} = \]

  \[ p<0.05 \text{ con KS} = \]

  \[ p<0.05 \text{ con KW} = \]

  \[ p<0.05 \text{ con TD} = \]
Results

- **Maximum resistance and Failure type** during traction test

<table>
<thead>
<tr>
<th>Technique</th>
<th>HR</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>DD</td>
<td>2.8*</td>
<td>0.043</td>
</tr>
<tr>
<td>KS</td>
<td>6.4*</td>
<td>0.003</td>
</tr>
<tr>
<td>KW</td>
<td>10.1*</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

DD= Double Dresden . KS= Kesler. KW= Krakow. HR = Hazard Ratio. * = p < 0.05
Discussion

- Dresden repair technique has better biomechanical performance than Krakow or Kessler repair techniques.

- Triple Dresden configuration seems to be the best alternative from a biomechanical point of view, to initiate immediate weight bearing and mobilization after a percutaneous achilles repair.

- Further clinical studies should be conducted to confirm our results.
References


