Objective

The purpose of this study is to compare the maximum load and mode of failure of Broström anterior talofibular ligament (ATFL) repairs with InternalBrace Ligament Augmentation as a function of SwiveLock anchor size and insertion order in the fibula and talus.

Methods and Materials

Twelve matched pairs of fresh-frozen human cadaveric ankle specimens (average age=51±13 years) were used. The ATFL was isolated during specimen dissection and the InternalBrace Ligament Augmentation construct was performed by Nicholas T. Gates, MD (Edgewood, KY). A medial to lateral hole was drilled through the distal fibula, proximal to the lateral malleolus and the fibula was shortened to facilitate loading in the material testing machine. The repairs were then isolated by releasing the ATFL.

All repairs were performed using one 3.5 mm BioComposite SwiveLock and one 4.75 mm BioComposite SwiveLock (AR-2325BCC and AR-2324BCC, respectively) and the appropriate drills and taps found in Implant System, InternalBrace Ligament Augmentation Repair (AR-1678-CP). The repairs were categorized into one of four groups as presented in Table 1.

Table 1: Test Group Description

<table>
<thead>
<tr>
<th>Group</th>
<th>Talus Anchor Size (mm)</th>
<th>Fibular Anchor Size (mm)</th>
<th>Inserted First</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1a</td>
<td>4.75</td>
<td>3.5</td>
<td>Fibula</td>
</tr>
<tr>
<td>Group 1b</td>
<td>4.75</td>
<td>3.5</td>
<td>Talus</td>
</tr>
<tr>
<td>Group 2a</td>
<td>3.5</td>
<td>4.75</td>
<td>Fibula</td>
</tr>
<tr>
<td>Group 2b</td>
<td>3.5</td>
<td>4.75</td>
<td>Talus</td>
</tr>
</tbody>
</table>

Following repair, each sample was strapped to a custom designed jig which held the foot in 20° of inversion and 10° of plantar flexion to simulate worst-case mechanical loading. A set screw was turned into the superior portion of the heel to prevent lift during testing and the fibula was secured to an INSTRON ElectroPuls Dynamic Testing System (INSTRON, Canton, MA) via the fibula drill hole using a clevis/pin fixture, Figure 1.

After preloading, each sample was pulled to failure at a rate of 20 mm/min. A two-way ANOVA was performed to identify any statistically significant differences in maximum load with respect to insertion order and anchor size, (α=0.05).

Results

The average maximum load for each group is presented in Table 2 and illustrated in Figure 2. The results of the two-way ANOVA indicated that the order in which anchors were implanted did not significantly influence maximum load (p=0.722). Additionally, a significant difference was noted in anchor size. Constructs with 4.75 mm anchors in the fibula had significantly higher maximum loads than those implanted with the 3.5 mm anchors (p=0.001). No significant interaction existed between anchor size and insertion order (p=0.156). Each of these four test groups provide maximum load values above that of native ligament (154N) and studied Broström repairs (68N & 79N). [1,2]
**Figure 2:** Average Maximum Load per Group

![Average Maximum Load per Group](image)

**Conclusion**

Insertion order did not significantly influence maximum load. Additionally, each of the constructs and insertion protocols tested in the current study demonstrated maximum load values comparable or higher than those found for native ligament (154N) and previously studied Broström repairs (68N & 79N). [1,2] Suture slip/pull-out contributed to 87.5% of the observed failures as compared to eyelet/anchor pull-out, 33%. Bone avulsion did not contribute to construct failure.

**References**
