Can Syndesmosis Screws Displace the Distal Fibula?

Nicholas G Vance, MD
PGY – 4
RC Vance, BS, PE; WT Chandler, BS;
VK Panchbhavi, MD, FACS
Can Syndesmosis Screws Displace the Distal Fibula?
Vinod K Panchbhavi, MD

My disclosure is in the Final AOFAS Mobile App.
I have no conflicts with this presentation
Background

- **Can the syndesmosis be overtightened?**
  - Tornetta et al showed that compression of the syndesmosis did not lead to decreased dorsiflexion.
    - They used lag by technique to place syndesmotic screw
  - Bragonzoni et al used RSA to evaluate position of the ankle during fixation, and showed no change of ROM.
  - Whittle suggested that placing the screw too proximally could deform the distal fibula and widen the mortise.
  - No biomechanical or clinical studies address distortion
Question:
- Can syndesmotic screw fixation cause lateral displacement of distal fibula?

Hypothesis:
- Lateral distal fibular displacement will occur with overtightening of syndesmotic screws.

Objectives:
- Primary:
  - Determine if the lateral clear space widens with tightening of syndesmotic screws
- Secondary:
  - At what level does tightening affect the distal fibula?
Methods

- Finite element (FE) analysis has been increasingly used to evaluate biomechanical questions in the literature.
- Various studies have validated that FE analysis accurately portrays mechanical models.
- A 3D geometric model was created from a CT scan of a lower extremity using Mimics® software, which was converted into a FE model.
- Standard values for Young’s modulus and Poisson’s ratio:
  - Cortical bone: 1700 MPa, 0.3
  - Cancellous bone: 700 MPa, 0.3
- Syndesmotic ligaments were assumed to be disrupted:
  - Published data were used to assign stiffness to the other ligaments.
Methods

Syndesmosis screws were modeled 2cm from the tibial plafond up to 5cm.

They were modeled at 5mm increments.

Over-compression of 2mm of each screw was simulated.

The change in distance between the talus and distal fibula was measured.
Results

Undeformed

Deformed

2mm
Over-tightening

Measured gap
## Results

<table>
<thead>
<tr>
<th>Fastener</th>
<th>Distance from plafond (mm)</th>
<th>Tibia - fibula deflection at screw (mm)</th>
<th>Fibula - talus gap (mm)</th>
<th>Magnification factor (mm/mm)</th>
<th>Fibula - talus gap for 2mm screw deflection (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20</td>
<td>1.926</td>
<td>1.467</td>
<td>0.762</td>
<td>1.523</td>
</tr>
<tr>
<td>2</td>
<td>25</td>
<td>1.887</td>
<td>1.164</td>
<td>0.617</td>
<td>1.233</td>
</tr>
<tr>
<td>3</td>
<td>30</td>
<td>1.883</td>
<td>0.981</td>
<td>0.521</td>
<td>1.043</td>
</tr>
<tr>
<td>4</td>
<td>35</td>
<td>1.911</td>
<td>0.869</td>
<td>0.455</td>
<td>0.909</td>
</tr>
<tr>
<td>5</td>
<td>40</td>
<td>1.973</td>
<td>0.801</td>
<td>0.406</td>
<td>0.812</td>
</tr>
<tr>
<td>6</td>
<td>45</td>
<td>1.991</td>
<td>0.733</td>
<td>0.368</td>
<td>0.737</td>
</tr>
<tr>
<td>7</td>
<td>50</td>
<td>2.003</td>
<td>0.678</td>
<td>0.339</td>
<td>0.677</td>
</tr>
</tbody>
</table>
Biomechanical testing has shown that screws closer to the plafond are stronger.

Recent literature has shown that screws placed higher (3-4 cm) above the plafond had less stress on the screw and less opening of the syndesmosis.

Tibiotalar contact forces are changed with even small shifts of the talus within the mortise.
Discussion

- While FE analysis has been validated repeatedly, there are limitations:
  - Single CT scan was used to make the model
  - Only the ligaments/capsules were modeled; the other soft tissue envelope was not taken into account
- Though distortion of the lateral clear space has been theorized in the past, ours is the first study to demonstrate it.
Conclusions

- Overtightening of syndesmotic screws can lead to widening of the lateral clear space.
- The effect is greater the closer screws are placed to the plafond.
- Syndesmotic screws placed more proximally may have a higher safety margin to prevent displacement of the distal fibula.
References

5) Baxter R, Bramlett K, Onel E, Daniels S.