RIGID SYNDESMOTIC FIXATION ALTERS JOINT CONTACT MECHANICS & TALAR KINEMATICS

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Disclosure

NO CONFLICT TO DISCLOSE
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Our disclosures are in the Final AOFAS Mobile App. We have no potential conflicts with this presentation.
Syndesmotic Compression

- Often quoted studies have suggested that overcompression is unlikely, though recent literature has shown otherwise
- Overcompression is seen intraoperatively
Syndesmotic Fixation

• There are variable methods of fixation available:
  • 3.5 mm screw(s)
  • 4.5 mm screw(s)
  • Tightrope

• Effects of rigid fixation on changes in joint kinematics and contact mechanics remain unclear

PURPOSE:
Evaluate the effects of rigid fixation on talar kinematics and joint contact mechanics in a cadaveric model
Methods – Cadaveric Testing

• 12 fresh-frozen cadaveric ankle joints
  • Tekscan pressure sensor inserted over talar dome (n=6)
  • Tekscan pressure sensor cut and inserted simultaneously in medial and lateral gutter (n=6)

• Rigid cluster of reflective markers mounted on tibia, fibula, and talus for motion capture
Methods – Cadaveric Testing

- 600 N applied
  - 20° Plantar Flexion
  - 10° Plantar Flexion
  - Neutral
  - 10° Dorsiflexion

- Conditions
  - Intact - No syndesmotic fixation
  - 1 x 3.5mm, 4-cortex screw
  - 2 x 3.5mm, 4-cortex screws

- Free internal/external rotation
- Free inversion/eversion
Methods - Analysis

• Transformed to anatomic coordinate system

• Calculated fixed center of rotation (CoR) in a sagittal plane

• Calculated changes in peak contact stress on talar dome and in medial/lateral gutters
Results – Center of Rotation

- Center of rotation was calculated in 10 degree increments.
- Increasing fixation rigidity generally increased anterior and superior movement.

### Anterior CoR Movement

<table>
<thead>
<tr>
<th></th>
<th>20P to 10P</th>
<th>10P to Neu</th>
<th>Neu to 10D</th>
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<tbody>
<tr>
<td>Ant.</td>
<td>0.9</td>
<td>-0.1</td>
<td>11.1</td>
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<tr>
<td>Sup.</td>
<td>3.1</td>
<td>-1.4</td>
<td>4.0</td>
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### Superior CoR Movement

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<th>20P to 10P</th>
<th>10P to Neu</th>
<th>Neu to 10D</th>
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<tbody>
<tr>
<td>Ant.</td>
<td>2.3</td>
<td>1.4</td>
<td>13.3</td>
</tr>
<tr>
<td>Sup.</td>
<td>2.2</td>
<td>0.1</td>
<td>5.9</td>
</tr>
</tbody>
</table>
Results – Contact Stress

- Talar dome stress decreased 10%-20% (depending on flexion angle) with increasing fixation
- Gutter contact stress generally increased with each additional syndesmotic screw
Discussion - Limitations

- No proximal tibiofibular articulation due to space constraints in the MTS frame
- Quasi-static loading rather than dynamic
- No relaxation of compression over time or with motion
  - Screws are rigid, however the bone in which they insert is viscoelastic and can creep
  - Several cycles of motion may decrease the magnitude of the stress measured in this work
- Lack of statistical significance among CoR data
  - Several specimens translated significantly, several did not
  - Effective levering-out of talus from mortise caused dramatic and variable changes in the CoR
Discussion & Conclusions

• Increasing rigidity of syndesmotic fixation caused the talar center of rotation to move anteriorly and superiorly in the sagittal plane.
  • Two screws effectively caused the talus to lever-out of the mortise in several specimens, dramatically changing the CoR, and increasing variability in the average talar movement
  • While no statistical significance was achieved, it seemed realistic that some ankles were at greater risk for significant talar translation

• Increasing rigidity of syndesmotic fixation slightly decreased the contact stress on the talar dome and increased contact stress in the gutters
  • Changes in contact stress supported by talar translations
References