Calcaneal osteotomy safe-zone to prevent neurological damage: fact or fiction?

Parke Hudson, BS; Bradley Wills, MD; Cesar de Cesar Netto, MD, PhD; Bahman SahraNavard, MD; Ibukunoluwa Araoye, MS; Brent Cone, BS; Sung Lee, BS; Shelby Bergestresser, BS; Ashish Shah, MD.
Disclosures

• None
Background

- Calcaneal osteotomy is a relatively common procedure used to address hindfoot deformities.
- The procedure puts neurological structures at risk. A previous cadaveric study described a neurological “safe zone” 11.2 mm anteriorly from “line A” (extending from the posterior-superior aspect of the calcaneal tuberosity to the origin of the plantar fascia).
- Lateral structures include the sural nerve and lateral calcaneal nerve. While medial structures include the lateral plantar nerve and branches of the posterior tibial artery.

Safe-zone as described by Talusan et al.

Talusan et al. Foot ankle Int. 2015
Casey et al. J Orthop Trauma. 2004
Davis et al. Foot ankle Int. 1995
Didomenico et al. J Foot Ankle Surg. 2011
Greene et al. Foot ankle Int. 2001
Study Purpose

- Perform a retrospective chart review to correlate the position of calcaneal osteotomy and neurological injuries
- Identify which nerves are most at risk from calcaneal osteotomy
Methods

• We reviewed charts of patients who underwent calcaneal osteotomy at our institution in the past 5 years
• Inclusion criteria included patients over 10 years of age, undergoing calcaneal osteotomy with pre and postsurgical imaging
• All immediate postoperative radiographs were examined and the distance between the calcaneal osteotomy and line A was measured
Methods (cont.)

• Over 11.2 mm was defined as “anterior to safe zone”, and osteotomies posterior to line A were defined as “posterior to the safe zone”
• Nerve complications were defined damage to the sural, calcaneal, or plantar nerves, presenting as paresthesias or numbness
• Poisson regression was performed to obtain the relative risk (RR) and 95% confidence interval (CI) for nerve injury with osteotomy anterior to the “safe zone” compared to that of osteotomy inside the safe zone
Results

- We identified 242 calcaneal osteotomy cases with adequate radiographs and follow-up for inclusion in our analysis. Of these, 179 had appropriate images to evaluate osteotomy location in relation to the neurological safe zone.

- A total of 5 (2.8%) nerve complications were noted in this study. 3 were associated with osteotomies inside the safe zone and 2 anterior to the safe zone.

- When compared to osteotomies within the safe zone, osteotomies outside the safe zone had a 1.114 relative risk of nerve injury with a 95% CI of 0.191 to 6.500 (p=0.9042).
Results (cont.)

- All injuries occurred with lateral approaches
- 60% (3/5) injuries occurred to a branch of the plantar nerve
- 60% (3/5) injuries occurred to medial branches of either the plantar or calcaneal nerves

<table>
<thead>
<tr>
<th>Relation to Safe Zone</th>
<th>Distance from Line A (mm)</th>
<th>Hindfoot Orientation</th>
<th>Side</th>
<th>Osteotomy type?</th>
<th>Approach for Calcaneal Osteotomy?</th>
<th>Nerve Injured</th>
<th>Complications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anterior</td>
<td>18</td>
<td>Valgus</td>
<td>Right</td>
<td>Medial Slide</td>
<td>Lateral</td>
<td>Medial Calcaneal</td>
<td>Heel numbness</td>
</tr>
<tr>
<td>Anterior</td>
<td>18.8</td>
<td>Varus</td>
<td>Right</td>
<td>Lateral Slide</td>
<td>Lateral</td>
<td>Medial Plantar</td>
<td>Medial plantar neuritis</td>
</tr>
<tr>
<td>Inside</td>
<td>8.5</td>
<td>Varus</td>
<td>Left</td>
<td>Lateral Slide</td>
<td>Lateral</td>
<td>Lateral Plantar</td>
<td>Lateral plantar hypothesia</td>
</tr>
<tr>
<td>Inside</td>
<td>5.5</td>
<td>Valgus</td>
<td>Left</td>
<td>Medial Slide</td>
<td>Lateral</td>
<td>Sural</td>
<td>Sural neuritis</td>
</tr>
<tr>
<td>Inside</td>
<td>5.4</td>
<td>Valgus</td>
<td>Left</td>
<td>Medial Slide</td>
<td>Lateral</td>
<td>Medial Plantar</td>
<td>Medial plantar neuritis</td>
</tr>
</tbody>
</table>
Conclusions

• Nerve injuries occur in a low but relevant number of calcaneal osteotomies
• These injuries appear to most commonly occur in branches of the plantar or calcaneal nerves
Conclusions (cont.)

• The recently reported safe zone does not appear to correlate with clinical outcomes
• A clinical safe zone in calcaneal osteotomies may not exist
• Patients should be properly counseled preoperatively on the low, but seemingly fixed risk of nerve injury before undergoing calcaneal osteotomy

Contact information: ashishshah@uabmc.edu

Disclosures/Financial Conflicts of Interest: None
Acknowledgments: None
References

- Talusan et al. Foot ankle Int. 2015
- Casey et al. J Orthop Trauma. 2004
- Davis et al. Foot ankle Int. 1995
- Didomenico et al. J Foot Ankle Surg. 2011
- Greene et al. Foot ankle Int. 2001