Optimal fixation of Jones fractures sacrifices the Peroneal Brevis insertion and the Plantar Fascia

Sofie H. Breuking¹, Pim A.D. van Dijk¹ Bryan G. Vopat¹,², Daniel Guss¹, Holly Johnsson¹, Guoan Li¹, Ali Hosseini¹, Christopher W. DiGiovanni¹

¹ MGH, Boston, MA, United States
² Academic Center for Evidence Based Sports Medicine (ACES)
³ Amsterdam Collaboration on Health and Safety in Sports (ACHSS) Amsterdam,
⁴ Department of Orthopaedic Surgery, University of Kansas Medical Center, Kansas City
Disclosures

NO CONFLICT TO DISCLOSURE

Our disclosures are in the Final AOFAS Mobile App

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Introduction

Jones fractures (JF) are among the most common fractures in the foot, mainly occurring in athletes.

To facilitate return to sport and good functional outcomes, management with intramedullary screw fixation is recommended.1-3

Maximal pull-out strength for adequate fracture compression and minimal irritation of the surrounding soft tissue are paramount.

To optimize surgical fixation of JF, better understanding of the the fifth metatarsal and its surrounding anatomy is required.

1 Lawrence SJ, Botte MJ. Foot & ankle (1993)
2 Theodorou DJ et al., Radiology (2003)
3 DeVries JG et al., The Journal of foot and ankle(2015)
Aim

This study aimed to improve guidelines regarding optimal insertion trajectory and screw parameters of JF by more accurately defining the bony and soft tissue anatomy of the fifth metatarsal bone and its intramedullary canal.
Methods

IRB approved study

21 cadaveric fifth metatarsals

1. Placing 3 reference screws in the bone, 2 distally and 1 proximally
2. CT scan
3. 3D reconstruction in Rhinoceros, v5.0
4. Digitization of PB, PF and reference screws on 3D bone model
5. The JF zone was determined based on the classification of Lawrence and Botte.¹

6. Based on bone length, and shape and diameter of the intramedullary canal, an ideal screw was modulated for each bone model.
Methods

1. Reference screws were placed within the bone
Methods

3 and 4.
Reference screws, PB and PF were mapped on the 3D model.

1Lawrence SJ, et. al., Foot & ankle, 1993
Based on bone length, and shape and diameter of the intramedullary canal, an ideal screw was modulated for each bone model.
Ideal screw position was identified as parallel to the cuboid and coaxial with the intramedullary cortex.
The ideal screw position partially sacrificed the PB in 62%, the PF in 33% with an average of respectively 1.6 ± 0.8 and 1.3± 0.8 mm.

The ratio of screw length to the total bone length was 0.64 (range .050-0.72).

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>SD</th>
<th>Range</th>
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</thead>
<tbody>
<tr>
<td>Overall Length bone (mm)</td>
<td>74.4</td>
<td>3.6</td>
<td>67.5-82.5</td>
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<tr>
<td>Overall length screw(mm)</td>
<td>47.8</td>
<td>5.9</td>
<td>36.1-61.3</td>
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<tr>
<td>Ratio of screw length to overall length(%)</td>
<td>64.0</td>
<td>6.0</td>
<td>52.0-72.0</td>
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<tr>
<td>Maximum thread length(mm)</td>
<td>37.4</td>
<td>6.5</td>
<td>22.5-51.09</td>
</tr>
<tr>
<td>Minimum thread length (mm)</td>
<td>28.2</td>
<td>6.9</td>
<td>13.0-42.0</td>
</tr>
</tbody>
</table>
| Narrowest point intramedullary canal (mm) | 4.3  | 0.69| 2.9-5.4
Conclusions

For maximal compression and pull-out strength, with minimal irritation of adjacent soft tissue, JF should be fixed with hardware parallel to the cuboid and collinear with the intramedullary cortex.

This mitigates but not avoids injury to the PB and PF.

Optimal screw length should be 64% of the total bone length, with a minimal diameter of 4.5 mm and 50% thread length.

Given variability in metatarsal anatomy, screw choice should be tailored to the individual.
Clinical significance

JF represent one of the most common foot injuries and also one of the more controversial surgical techniques.

Better understanding of the implications of screw insertion will be paramount in maximizing functional outcomes.

This study guides in providing optimal treatment of JF.