Comparison of Contact and Damage to Anatomic Structures in the Fixation of Zone II Fifth Metatarsal Fractures with an Intramedullary Screw or an Intramedullary Nail

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Introduction/Purpose: Percutaneous intramedullary screw fixation of Zone II fifth metatarsal fractures has become commonplace. The potential for injury to the important surrounding anatomy has not been well documented, though some authors have reported unexplained postoperative pain and paresthesia over the lateral aspect of the foot despite hardware removal. The purpose of this study was to determine the contact and injury rate of surrounding anatomic structures with either the use of the traditional intramedullary screw (IMS) inserted “high and inside” or a novel intramedullary nail (IMN) inserted “low and outside” through a relative “safe-zone.”

Methods: Zone II fifth metatarsal fractures were created in ten cadaver matched-pairs using a 1mm thick saw through a small incision. Fractures were randomized to receive either an IMS or an IMN. The surgical technique was performed in accordance with the manufacturer’s instructions. For the IMS group, the guide pin was inserted percutaneously according to the “high and inside” starting point on the base of the fifth metatarsal using fluoroscopy; followed by insertion of the 3.5mm drill, tissue protector, tap, and screw. For the IMN group, the guide pin was inserted percutaneously “low and outside,” positioned slightly medial and dorsal to the tip of the tuberosity of the fifth metatarsal; followed by the 5.2mm reamer, tissue protector, and IMN. Dissection was performed to identify damage or contact to the peroneus brevis tendon (PB), peroneus longus tendon (PL), sural nerve (SN), lateral insertion of the plantar fascia (PF) and cuboid-fifth metatarsal jointspace.

Results: There were significantly more episodes of PB injury, PL contact, SN contact, and presence in the cuboid-fifth metatarsal jointspace for the IMS group. There were significantly more episodes of contact of the PF with the IMN group but no episodes of damage. The results are summarized in Table 1. Images of contact and damage are shown in Figure 1. Fluoroscopic images of the IMN inserted through the “low and outside” position are shown in Figure 2.

Conclusion: We have demonstrated significant contact and injury to surrounding structures with the placement of a “high and inside” IMS for the fixation of Zone II fifth metatarsal fractures. We believe there is a relative safe zone at the “low and outside” position that affords less potential damage to the important surrounding structures. Consideration should be given to the development of implants inserted through the relative safe zone.
Table 1. Episodes of Contact or Damage to Each Structure

<table>
<thead>
<tr>
<th></th>
<th>PB Contact</th>
<th>PB Injury</th>
<th>PL Contact</th>
<th>PL Injury</th>
<th>SN Contact</th>
<th>SN Injury</th>
<th>PF Contact</th>
<th>PF Injury</th>
<th>Cuboid-5th Metatarsal Joint</th>
</tr>
</thead>
<tbody>
<tr>
<td>IM5</td>
<td>10</td>
<td>8</td>
<td>9</td>
<td>0</td>
<td>8</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>IMN</td>
<td>9</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>9</td>
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<tr>
<td>p value</td>
<td>0.31</td>
<td>0.002</td>
<td>0.002</td>
<td>NA</td>
<td>&lt;0.001</td>
<td>0.06</td>
<td>&lt;0.001</td>
<td>NA</td>
<td>0.001</td>
</tr>
</tbody>
</table>

Episodes are out of a maximum of 10
IM5 = Intramedullary Screw
IMN = Intramedullary Nail
Bold = significant difference between groups

Figure 1. Examples of: A) IM5 damage to PB; B) IM5 presence in cuboid-fifth metatarsal jointspace; C) IM5 contact with SN; D) IMN damage to PB and contact with PF.

Figure 2. Oblique (A) and lateral (B) fluoroscopic images of the IMN through the “low and outside” position.