Surgical technique tip: Using reaming systems for joint surface preparation for first metatarsophalangeal joint arthrodesis

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Various techniques have been described for joint preparation when performing a first metatarsophalangeal joint arthrodesis. These include power saw resection of the cartilage and subchondral bone, curettage, rongeur, osteotome, and power joint reamers. The reaming systems have the advantage of maintaining the convexity of the first metatarsal head and the concavity of the base of the proximal phalanx of the hallux. Unfortunately, these systems have been the target of criticism in that they can be quite aggressive leading to overzealous bone resection causing excessive shortening and possible fractures, especially in the presence of osteopenic bone. We present a technique tip which will offer the surgeon more control of the power instrumentation and subsequently less risk of intraoperative complications.

**Keywords:** first metatarsophalangeal joint, joint preparation, reaming, arthrodesis, fusion

Arthrodesis of the first metatarsophalangeal (MTP) joint is a procedure that is utilized successfully for the treatment of various pathologies involving the hallux. These include arthrosis of the first MTP joint, severe hallux valgus deformities, hallux rigidus, hallux varus, neuromuscular disorders, and as a salvage procedure for failed first MTP joint procedures [1,2]. As with any arthrodesis procedure, the success relies on proper joint preparation and satisfactory fixation in adequate alignment. Maintaining the convexity of the head of the first metatarsal and concavity of the base of the proximal phalanx of the hallux yields several advantages. Shortening of the first ray is minimized compared to power saw resection of the cartilage and subchondral bone. In addition, surface area of the opposing osseous surfaces is maximized. Moreover, the convex and concave surfaces of the first metatarsal head and base of the proximal phalanx respectively allow the surgeon to “dial-in” the alignment of the proposed arthrodesis in all three body planes prior to final fixation.

**Surgical Technique**

The first metatarsophalangeal joint is accessed in the usual fashion. Any loose bodies may be removed and osteophytic lipping over the doral, medial and lateral aspects of the first metatarsal head and base of the proximal phalanx of the hallux is resected with a rongeur.

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A guide pin is inserted into the first metatarsal head and shaft with care taken to drive the pin down the center of the medullary canal of the first metatarsal (Figure 1). This may be verified with anterior-posterior and lateral views utilizing intraoperative fluoroscopy. The appropriate size reamer for the head of the first metatarsal is selected. The sizes vary depending upon the manufacturer, but usually range from 16 mm to 22 mm in 2 mm increments. The reamer is placed onto a rotary drill/reamer. We used a Stryker® System 7 single-trigger rotary drill (Figure 2). Any system that has a separate setting for drill and ream will suffice. The device is placed in the ream position and the cartilage and subchondral bone at the head of the first metatarsal is removed (Figures 3).

<table>
<thead>
<tr>
<th>SETTING</th>
<th>SPEED (RPM)</th>
<th>TORQUE (LBS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DRILL</td>
<td>1200</td>
<td>41</td>
</tr>
<tr>
<td>REAM</td>
<td>270</td>
<td>157</td>
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Table 1 Specifications for the Stryker® System 7 Rotary Drill.
A guidepin is then placed into the base of the proximal phalanx of the hallux (Figure 4). The pin is driven down the shaft of the medullary canal and satisfactory placement may be confirmed with anterior-posterior and lateral views utilizing intraoperative fluoroscopy.

The appropriate size reamer for the base of the proximal phalanx of the hallux is selected. This matches the size used for the head of the first metatarsal. Once again, the reamer is inserted into the rotary drill/reamer. The cartilage and subchondral bone at the base of the proximal phalanx is resected (Figure 5). The reader is encouraged to view the video demonstrating the difference between the ream and drill settings on the rotary power instrument (online). A rongeur may be used to remove any remnants of subchondral bone.

The position of the proposed arthrodesis is finalized by placing the head of the first metatarsal and the base of the proximal phalanx of the hallux in the desired alignment [3]. This is easily achieved due to the convexity of the first metatarsal head and concavity of the base of the proximal phalanx of the hallux. It is generally agreed that the toe should be arthrodesed in approximately 10 to 15 degrees of valgus and should not touch the second toe. In addition, the toe should be in about 10 to 15 degrees of dorsiflexion relative to the weightbearing surface of the foot in the sagittal plane. Temporary fixation with Kirschner wires is performed (Figure 6) and the alignment is checked with fluoroscopy. Final fixation is achieved depending on surgeon preference [4–8].

**Discussion**

The main advantages of the presented technique tip are intraoperative time saving, minimal resection of cartilage and subchondral bone, decreased shortening of the first ray, and the maintenance of the convexity.
at the head of the first metatarsal and the concavity at the base of the proximal phalanx of the hallux which allows for greater bone to bone contact area and the ability for the surgeon to “dial-in” the desired position of the proposed arthrodesis [9]. Moreover, placing the power rotary instrument in the “ream” setting, allows the surgeon to have more control of the device given the decreased speed and increased torque compared to the “drill” setting. One must still be cautious when addressing bone with cystic changes and osteopenia.

References