Debridement Versus Conical Reamer Preparation for First Metatarsophalangeal Joint Arthrodesis. A Case Study Comparison.

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Statement of Purpose

Arthrodesis of the first metatarsophalangeal joint (MTPJ) is commonly used and is considered the gold-standard procedure for managing advance stages of hallux rigidus, degenerate hallux valgus and inflammatory arthropathy of the 1st MTPJ. The efficacy and predictability of the procedure is well established in the literature, with high patient satisfaction.[1–5]

During 1st MTPJ fusion procedures, surfaces are generally prepared for arthrodesis using two configurations, the flat-on-flat and ball-and-socket type preparation.[6] Flat cuts are made using a power saw whereas the ball-and-socket preparation can be done using conical reamers, burrs or rongeurs. The most reliable technique however, is yet to be established and this is reflected in a large number of published studies with equivocal results.[5]

Flat-on-flat cuts have been shown to cause excessive shortening and difficulty with positioning. Arthrodesis procedures utilizing conical reamers have become a popular technique, as it prevents excessive collapse and shortening of the fusion site. Unfortunately, the benefits of this technique may also lead to decrease in union rates secondary to residual subchondral bone remnants and thermal necrosis.[5]

The aim of this study was to compare our rongeur joint preparation technique with conical reaming to determine which technique has higher union rates for first MTPJ arthrodesis.

Case Study

69 patients from two different facilities were identified who underwent first MTPJ arthrodesis utilizing rongeur joint preparation technique using chart review over the past 3 years. Inclusion criteria included patients over 18 years of age, joint preparation only consisting of rongeur debridement, and fixation including a combination of dorsal plate and cross screw fixation. Exclusion criteria included revision arthrodesis procedures, concomitant midfoot or hindfoot surgery, other forms of fixation not listed above and any form of septic, neurovascular, or neuroarthropathy compromise. Fusions were evaluated using plain radiographs.

Our results were compared to conical reaming results reported in the literature utilizing the same fixation technique. Statistical analysis was performed using t-test to calculate p values where $p<0.05$ was considered statistically significant.

Procedure

Dorsal linear incisions were made with slight medial bias to the extensor hallucis longus tendon. Joints were mobilized and then prepped utilizing rongeur technique as shown below (Figure 1). Following rongeur debridement, joints were further prepped utilizing both fish scaling and subchondral drilling techniques minimally. Joints were then further augmented using fish scaling and subchondral drilling technique(Figure 2).

Upon joint prep completion the joints would be provisionally fixated using k-wires. Once adequate positioning was achieved the joints would be fixated using a locking plate with intra-plate compression screw (Figure 3).

Patients would be protected weight bearing in a CAM walking boot for 6 weeks. After 6 weeks, if patients showed clinical signs of fusion along with equivalent radiographic findings patients were transitioned to a tennis shoe for four weeks (Figure 4). Patients were then transitioned to regular shoe gear and activity going forward.

Figure 1.

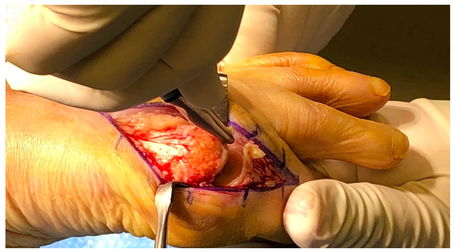
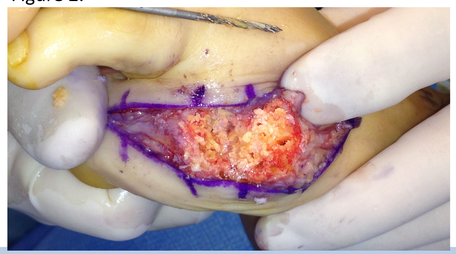


Figure 2.



Results

Of the 69 patients there was 100% successful union with only one patient with broken hardware. All patients showed radiographic fusion of a minimum 50% of the joint by 10 weeks. No delayed or mal-unions were identified. There were 4 patients with wound dehiscence issues which required local wound care. No superficial or deep infections were noted. No revisions were required.

As stated our technique showed a 100% fusion rate with no signs of delayed or malunion. When comparing union rates between our technique and conical reaming within the literature (91.2% fusion rate) our technique was shown to have more optimal results in this study. However this was not statistically significant ($p>0.05$).

Minimal discrepancies were also noted between minor complication rate as stated above as well.

Figure 3.

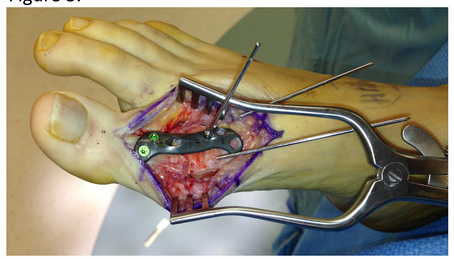


Figure 4.

Discussion

Our results continue to show a trend for lower union rates when using power-assisted tools for joint prep as opposed to non-powered tools such as rongeurs, curettes, and osteotomes.

Within the ball-and-socket configuration with cross screw and locking plate fixation, union rate was highest when only rongeurs were used for surface preparation (100%). Though statistically insignificant, these results were more impressive than the results shown within the literature when bone reamers were used (91.2%). This was also found by Mahadevan et al. in their meta analysis which showed 100% fusion rate with rongeur technique in 21 patients.[5]

Heat is generated whenever bone is cut or instrumented with wires, drills, saws, reamers and burrs. This heat can cause multiple issues at the fusion sight secondary to heat necrosis of the local bone. The higher union rates in the joints prepared with rongeurs may be explained by the phenomenon of thermal necrosis induced by power tools. The risk of thermal necrosis should be considered whenever instrumentation of bone is undertaken. In the literature review in which average fusion site was obtained for conical remaining, saline irrigation was used during all power-assisted joint preparations to reduce this risk.[6-8]

Another reason why there may be a discrepancy between the two joint preparation techniques is the amount of bone resected. Conical reaming leaves a subchondral cortical shelf limiting the ability for fusion to occur. If this subchondral shelf is not adequately prepped the sclerotic bone in this area is difficult to fuse together. Rongeur technique completely resects subchondral bone by directly visualizing the demarcation exposing cancellous bone to fuse on each end of the joint.[9]

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