First MPJ Proximal Phalanx Hemi Implant Arthroplasty Literature Review and Case Report

by Neil Younce DPM¹, Tuan Pham DPM²

The Northern Ohio Foot and Ankle Journal 1 (3): 6

Abstract: Hallux limitus and hallux rigidus are very common conditions of the first metatarsal phalangeal joint that can cause significant pain and morbidity. Many different procedures have been found to be effective in treating this condition, with a first metatarsal phalangeal joint (MPJ) arthrodesis being the gold standard for this condition. However, another viable option for patients who want an alternative to first MPJ arthrodesis is a hemi arthroplasty. This review looks at the literature available for both first MPJ phalangeal hemi implant arthroplasty followed by a single case report of a BioPro hemi implant arthroplasty.

Key words: Hallux Limitus, Hallux Rigidus, Arthritis, Metatarsal Phalangeal Joint, Hemi Arthroplasty, Hemi Implant,

Accepted: October 2016 Published: November 2016

Arthritis to this joint can be very detrimental to the normal biomechanical function throughout the stance phase of gait. Conservative treatment should be attempted first and includes anti inflammatory medication, icing, custom inserts with or without a Morton’s extension, carbon fiber inserts, stiff soled shoes, rocker bottom shoes, enlarged toe box shoe modification, and physical therapy (7,12). Once conservative measures fail, surgical options are the next best option to alleviate pain and improve function and gait. Surgical options in the past have included resectional arthroplasty, cheilectomy, proximal phalangeal osteotomies, decompression distal and proximal first metatarsal osteotomies, implant arthroplasties, and first MPJ arthrodesis.

First MPJ arthrodesis is the gold standard per literature due to the elimination of pain due to absence of motion and predictable outcome (8,12) however; sometimes a first MPJ arthrodesis is not desired or has complications associated with the...
procedure that patients are not willing to precede with this procedure. Patients who refuse to fuse their big toe joint for various reasons including no longer having the ability to bend the joint, inability to wear certain shoes such as high heels, the required time to be non weight bearing while the joint fuses after the procedure as well as possible complications including delayed union, non union, malposition, and increased pressure to adjacent joints all are possible concerns for not attempting a first MPJ arthrodesis (8).

An alternative as mentioned above is implant arthroplasty. Implants for first MPJ arthroplasties have been around for decades. Initially, these implants were made of silicone, both total and hemi implants, but fell out of favor due to failure of implants and reactions patients were having with the hardware. As time went on and technology advanced, newer and improved implants were introduced and are again used as an alternative to first MPJ arthrodesis.

Total and hemi implants are both available and used to replace the proximal phalangeal base of hallux or the first metatarsal head (5). Hemi implants are typically made of cobalt-chromium. The focus of this literature review is on hemi implants that involve the proximal phalanx. Examples of hemi implants for the proximal phalanx of the hallux include BioPro (BioPro Corporation), Trihedron (Small Bone Innovations), Futura (Tournier), and AnaToemic (Arthrex).

Indications for procedure include grade III or IV hallux rigidus who have failed 6 months to 1 year of conservative treatment. Patients who have low physical demand, are above the age of 65 are ideal candidates for the procedure (2). Although first MPJ implant arthroplasty can be a viable option, it also does not come without it’s own risks and possible complications. These include predictability of survival of the implant, infection, arthrofibrosis, mallet toe, migration of implant, cystic changes, persistent pain, bony overgrowth, radiolucency, dorsal drift of hallux, metatarsalgia, elevation of first ray, subsidence of the implant, need for revisional surgery (4,8).

Contraindications include hallux valgus, inflammatory arthritis, sesamoid arthritis, previous first MPJ infection, failed first MPJ arthrodesis, and impaired peripheral circulation (2). Several articles were found and reviewed that specifically look at success of the proximal phalangeal hemi implant arthroplasty.

Literature

Simons et al performed a retrospective study comparing satisfaction, failure rate, and short-term results of hemiarthroplasty of first MPJ versus first MPJ arthrodesis. 178 patients in total were in the study, 46 of whom underwent a hemiarthroplasty with the Bio Pro implant and the remaining 132 underwent a first MPJ arthrodesis with a plate and possible positioning screw. Average follow up for the hemiarthroplasty group was 38.4 months and for first MPJ arthrodesis group was 39.8 months, however only 78% of hemiarthroplasty and 60% of first MPJ arthrodesis returned their questionnaires. It was found that the satisfaction scores between the two groups were 81.6% and 64% respectively which was not clinically significant. No statistically significant differences were found between the two groups comparing satisfaction, failure and outcome measures. They concluded that for short-term results, both procedures were viable options, but longer studies were needed (8).

A retrospective study by Voskuijl et al reviewed 36 hemiarthroplasty patients versus 58 first MPJ arthrodesis patients on an average of 3.5 years and 4.4 years respectively. All of the hemiarthroplasty group had a Bio Pro implant, where the arthrodesis group had various forms of fixation including Kirschner wires staples, plates, and lag screws. The found similar AOFAS scores of 77.5 +/- 18.5 for the arthrodesis group and 77.8 +/- 12.0 in arthroplasty group. The arthrodesis group reported better function, but the hemiarthroplasty group reported better alignment. Postoperative satisfaction was higher in arthrodesis groups, but both procedures had equal subjective patient recommendations. When compared to other studies, they found greater satisfaction after hemiarthroplasty, which they believe, was due to the fact that gait was less affected since the joint mobility was maintained. They concluded symptom intensity and magnitude of disability for each procedure was similar, but states the
Clement et al reviewed 97 consecutive BioPro metallic implants in 80 patients with a minimum follow up of 5 years. They looked at midterm results including implant survival, functional outcome, and patient satisfaction as well as cost analysis for the procedure. At 5 years they found the overall all cause survival rate for the implants was 85.6%, and the aseptic survival rate was 86.5%. 12 patients underwent 15 revisional surgeries due to 1 deep infection, 2 for osteolysis, and 12 for persistent pain and patients either underwent arthrodesis or excision arthroplasty based on patient expectations. At final follow up, 81 joints had significant improvement in subjective patient scores of the MOFQ and SF-12 PCS scores. 75% of the joints had a satisfactory outcome that they concluded the percentage was low due to the longer follow up and that the patients who reported a neutral improvement were categorized as “dissatisfied.” 90% of patients had significantly satisfactory outcome in range of motion. They concluded that the BioPro hemi implant offers good short to mid term functional outcomes (1).

Salonga et al also performed a retrospective study reviewing 76 consecutive patients undergoing 79 hemiarthroplasties with a BioPro hemi implant with an average follow up of 2.91 years. They found a significant increase in dorsiflexion and plantarflexion pre and postoperatively with an average increase of 20.79° and 6.34° respectively. They also found a statistically significant decrease in the first intermetatarsal angle and patients who had first-ray elevatus. The final postoperative AOFAS Universal Evaluation Scoring Scale for first MPJ and first ray was round to be 94.00. They concluded that the BioPro implant is a viable option for hallux rigidus due to good clinical and subjective results (7).

The largest retrospective study found during the literature review was performed by Townley et al where they reviewed a total of 279 patients who underwent a BioPro implant arthroplasty with an average follow up of 8 months to 33 years. 36% of patients had a follow up greater than 5 years, 22% greater than 10 years, and 8% greater than 20 years. They subjectively evaluated patients based on pain with activity, stiffness, functional disability, overall satisfaction and evaluated range of motion and hallux alignment. They viewed subjective dissatisfaction, pain limiting any activity, loss of motion limiting activity, or hallux malalignment was considered a failure. Overall they found 259 patients (93.1%) with no pain or limitation of activity, good in 7 patients (2.2%) with occasional discomfort with excessive activities, and unsatisfied in 13 patients (4.7%) of which 12 were revised. Correcting for patients whose last follow up was less than 5 years, the 89 patients (88.1%) were excellent, 7 patients (6.9%) reported as good, and 4 (4%) were unsatisfactory. They stated that the degree of preoperative arthrosis did not influence results. They concluded that long-term results provided radiographic and clinical evidence to support use of a low friction phalangeal hemiarthroplasty as an alternative surgical option for first MPJ arthrosis (10).

Sorbie and Sanders reviewed 23 cases in 19 patients of hemiarthroplasty using Trihedron implant into the proximal phalanx. The final follow up visit was between 34 and 72 months, at which time showed AOFAS scores increase on average preoperatively from 56.8 to 88.2 at final visit post operatively. All patients employed prior to surgery return to work in 2-4 weeks, however most patients in this study were retired during procedure. All younger patients returned to their former activities including one patient who ran for several miles a day. The average AOFAS range of motion was 3 prior to surgery and 7 post operatively. In conclusion they conclude that the Trihedron cobalt chrome hemiarthroplasty is a safe and effective alternative to other procedures for hallux rigidus (9).

A prospective study was performed by Roukis et al that compared 16 feet who underwent a periarticular osteotomy (Youngswick-Austin or Green-Watermann) to 9 feet that had a BioPro implant hemiarthroplasty after a 1 year follow up. They looked at subjective evaluation using the modified hallux metatarsophalangeal-interphalangeal AOFAS score, physical exam that looked at pre and postoperative non-weight bearing dorsiflexion and plantarflexion, and radiographic analysis of various parameters. The found no statistical differences for the subjective examination from preoperative to post operative AOFAS score where peri-articular osteotomy group increased from 54.4 to 84.6 and the
BioPro group increased from 51.1 to 77.8. No difference was found between preoperative to postoperative dorsiflexion or plantarflexion between the two groups. They did find that the metatarsal protrusion was significantly reduced in the BioPro group and the lateral talo-first metatarsal angle was significantly increased in the periarticular osteotomy group as well as progressive medicalization of second digit and persistent metatarsus primus elevates and hallux elevatus. They concluded significant improvement in subjective scores, high percentage of patient satisfaction, and a slight increase in first MPJ joint dorsal range of motion. However they concluded that the degree of iatrogenic shortening of first metatarsal for periarticular osteotomies caused instability of the medial column. These findings radiographic findings were not found in the BioPro group and concluded that in the correct patient population, the short-term results show benefit for both procedures (6).

Another prospective study by Kissel evaluated 23 patients for 1 year following a BioPro hemi implant and evaluating and correlating the degree of articular cartilage degeneration and determining effects of joint function, pain, and range of motion. Average AOFAS scores increased from 41.2 +/- 1.6 preoperatively to 80.4 +/- 8.8 postoperatively. The average amount of dorsiflexion and plantarflexion increased as well preoperatively to postoperatively, 37° and 9.5° respectively. They found an average amount of articular cartilage degeneration of 71.8 +/- 21.8%. They found that with the increase in range of motion and decrease in pain following placement of hemi implant regardless of amount of articular cartilage defects, that the BioPro implant is a viable option due to subjective and objective findings and improvement regardless of amount of articular cartilage degeneration (5).

Kim et al had a retrospective study looking at long-term results for hallux rigidus looking at arthrodesis, hemi-implant, and resectional arthroplasty in a multi center study. A total of 158 patients were enrolled with 51 in arthrodesis group, 52 in the hemi-implant group, and 55 in resectional arthroplasty group with an average follow up of 194 weeks, 188 weeks, and 145 weeks of follow up respectively. They found no significant difference between the three groups in terms of median ACFAS scores or medial total modified AOFAS scores. They concluded that multiple factors go into selecting either procedure, but that all procedures had similar satisfaction scores (10).

Case

A 61-year-old female presented with a painful right “big toe joint.” Patient states that the achy and throbbing pain has been present for years and has gotten worse over the past 6 months. She has no history of trauma, new exercise regiment, or new job. The only things that help are Tylenol and when she rests her foot at the end of the day. She states she has tried padding, various shoe gear and inserts that haven’t helped. She was offered a first MPJ arthrodesis, but declined due to her wanting to have motion in her shoes and to be able to wear heels. Patient’s past medical history included migraines, previous pneumonia, cervicalgia, aortic regurgitation, and vertigo. Patient had a history of cervical fusion in the past. Patient never smoked and occasional consumed alcohol.

Clinical exam revealed an unremarkable neurovascular exam with palpable pulses, normal capillary fill time, and intact sensation. Patient had limited first metatarsal phalangeal joint (MPJ) range of motion of twenty-five degrees. Patient had a prominent palpable osteophyte to peri first MPJ. There was no pain to the sesamoids. There was no central grind or palpable clicking within the joint. A pre operative photo demonstrates the patient’s foot in figure 1.

![Figure 1. Pre Operative photograph demonstrating dorsal osteophyte](image_url)
Anterior posterior, oblique and lateral radiographic imaging revealed dorsal spurring with limited joint space of the first MPJ with cystic changes to the base of the proximal phalanx shown in figures 2, 3, and 4.

Patient was diagnosed with hallux limitus and decision was made to proceed with a Bio Pro hemi implant arthroplasty. The following images are intraoperative photos of the Bio Pro hemi implant in Figures 5-9.

Post-operative protocol typically for our patients is protected weight bearing in a post op shoe for 2 weeks at which time range of motion exercises of hallux are initiated. At 2 weeks start gradual transition to regular shoes. However, this patient began full weight bearing in regular shoe gear 2 days post operative and had intense pain. Patient came in at 3 days post op for re-evaluation, which showed no displacement or failure of the implant on radiographs, figures 9-11. Patient went on to heal without any issues and was able to return to regular shoe gear and every day activities without issues or complications.
Figure 7: Chisel inserted into long axis of proximal phalanx of the hallux.

Figure 8: Final picture of 18.5 non-porous BioPro implant in the proximal phalanx of the hallux

Figure 9: AP

Figure 10: Oblique

Figure 11: Lateral
References


