

INTERPOSITIONAL ARTHROPLASTY WITH AN ACELLULAR DERMAL TISSUE MATRIX FOR LESSER METATARSOPHALANGEAL JOINTS

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INTRODUCTION

The use of orthobiologics for metatarsophalangeal joint osteoarthritis is not a new concept. In fact, the concept has been utilized in knee, hand, and first metatarsophalangeal joints (MPJ) (1,2) with many benefits cited such as preservation of the joint and cellular repopulation and revascularization (3). Symptomatic lesser MPJ osteoarthritis is very difficult to treat in patients who have failed conservative management.

There have been several studies published in regard to joint sparing versus joint destructive techniques to help in the treatment of recalcitrant symptoms of lesser MPJ osteoarthritis or Freiberg's infraction (1,4-11). Most of the studies consist of surgical treatment with implants, arthroplasty, cheilectomy, metatarsal osteotomy, arthrodesis, and even amputation. There are only a few studies that report the use of interpositional arthroplasty for lesser MPJ osteoarthritis with the use of local capsular interposition or tendon (6,9,11). However, there are no studies that investigate the use of interpositional arthroplasty with an acellular dermal tissue matrix for the treatment of lesser MPJ osteoarthritis.

The purpose of our study was to describe a surgical technique for lesser MPJ osteoarthritis or Freiberg's infraction and to report the 2-year follow-up on the subjective outcomes of pain relief on 10 consecutive patients

with advanced osteoarthritic changes in the involved joint or Freiberg's infraction. Our hypothesis was the use of interpositional arthroplasty using an acellular dermal tissue matrix would lead to reliable pain relief. If this treatment option proves to be successful in alleviating pain, then perhaps this is a new technique that may be utilized as a treatment option for lesser MPJ osteoarthritis or Freiberg's infraction.

METHODS

A retrospective single-center investigation was performed in which a consecutive review of the medical databases of all patients who underwent a lesser MPJ interpositional arthroplasty with an acellular dermal tissue matrix between June 2008 to March 2012 by the primary surgeon were enrolled. Electronic databases, radiographs, and medical charts were reviewed. The study was approved by our institutional review board (protocol #10038). The average follow-up period was 24 months (range 12-60 months).

Our study included only lesser MPJ interpositional arthroplasty with an acellular dermal tissue matrix. Inclusion criteria included any patient who had chronic pain surrounding the involved joint who failed conservative treatment such as corticosteroid injections, extra depth shoes, period of immobilization and rest, and anti-inflammatory medications for a minimum of 9 months. Patients with radiographic changes or magnetic resonance images (MRI) consistent with end stage osteoarthritis or Freiberg's disease were enrolled in the study. Any patient with or without concomitant procedures performed on the same foot was included in the study. Exclusion criteria were any patient who had a previous procedure performed on the involved joint, any patient who had an autoimmune connective tissue disorder or contraindication to ST implants, or any patient who was lost to follow-up or did not have at least 12 months follow-up.

After inclusion and exclusion criteria were met, we had a total of 10 subjects (Table 1). Six procedures were performed on the second metatarsophalangeal joint. Four

Table 1

BASELINE CHARACTERISTICS

Demographics	n=10
Male:Female	3:7
Average age (range)	47.8 (15-64) years
Surgical side, R:L	7:3
Involved joint	6 (2nd) 4 (3rd)
Average follow-up (range)	24 (12-60) months

procedures were performed on the third metatarsophalangeal joint. Five metatarsophalangeal joints were diagnosed with osteoarthritis and 5 were diagnosed with avascular necrosis of the metatarsal head via MRI or intraoperative surgical finding. Demographic variables such as age, sex, and surgical side were collected. Electronic medical records were reviewed for preoperative and postoperative clinical examinations, radiographic or advanced imaging, and surgical operative reports.

Patient follow-up was conducted via telephone interview by the primary author in which two validated surveys were used to assess the subjective postoperative outcomes. The American Orthopedic Foot and Ankle Surgery Lesser Metatarsophalangeal-Interphalangeal Scale (AOFAS; total 60 points) (12), which was modified for only subjective measurements and the Manchester-Oxford Foot Questionnaire (MOXFQ; total 64 points) (13). The two surveys entailed questions for preoperative and postoperative pain, activity limitations, foot wear accommodations, and overall satisfaction with the procedure. The MOXFQ is a questionnaire developed to detect outcome measures for clinical trials of surgery. It provides standardized data on reliable and valid patient reported outcome measures in regard to function, pain relief, quality of life, and mobility (13). In addition, each patient was asked to scale their preoperative and postoperative level of pain at the surgical site and if they would undergo the procedure again.

The surgeries for the lesser MPJ interpositional arthroplasty with an acellular dermal tissue matrix were all performed by the same surgeon (AHK). All cases were under general anesthesia with the use of an ankle or thigh tourniquet with the patient in the supine position on the operating table. Below are the specific details showing the surgical technique (Figure 1A-F).

An approximately 3 cm dorsolateral incision was made over the affected lesser MPJ. The incision was deepened down to subcutaneous tissue with all bleeders cauterized as deemed necessary. The incision was then deepened down to the level of the deep fascia and the extensor tendon was identified and retracted. Next, a dorsolateral capsulotomy was performed over the lesser MPJ and the capsular tissue around the periosteum was reflected off the base of the proximal phalanx and the head and the neck of the lesser metatarsal. Any osteophytes over the base of the proximal phalanx and the head and neck of the lesser metatarsal were then removed. Cartilage remaining on the head of the lesser metatarsal was left intact, and any area lacking any cartilage was then fenestrated with a 0.045 Kirschner wire to promote bleeding and to help the tissue adhere to the bone. The surgical site was then flushed with normal sterile saline.

Next, a 2 cm x 2 cm x 1.5 mm thickness acellular

dermal tissue matrix graft was prepared by placing in a saline soak for five minutes for tissue pliability. The graft was then cut into an octagonal shape to facilitate resurfacing of the metatarsal head. The graft was then attached to two different strands of 4.0 fiber wire. A drill hole was created over the neck of the lesser metatarsal with a 0.062 Kirschner wire. The plantar sutures are then routed plantar to dorsal over the drill hole and tied on to the dorsal suture in a parachute/coin-purse fashion around the head and neck of the metatarsal. Any hypertrophied capsular tissue was debrided. The capsular tissue was then re-approximated with 4-0 vicryl suture.

The subcutaneous tissue was closed with 5-0 vicryl suture. The skin was then closed with 5-0 monocryl in a running subcuticular fashion. Postoperative protocol consisted of 2 weeks non-weightbearing in a postoperative surgical shoe, followed by 2 weeks weightbearing as tolerated in a postoperative surgical shoe. By the fifth week, patients were allowed to convert into tennis shoes as tolerated.

RESULTS

The average follow-up time was 24 months (range 12-60 months) and no patients were lost to contact. There were no reoperations performed in the 10 patients. Based upon clinical examination via chart review and subjective postoperative telephone interview, there were no complications such as infection, inflammatory reactions, prolonged edema, or wound healing problems. Preoperative radiographs and advanced imaging were reviewed for the level of arthritic changes in the involved lesser MPJ and the diagnosis of osteoarthritis versus avascular necrosis. Five patients were found to have osteoarthritis of the involved joint and 5 patients had avascular necrosis of the involved metatarsal head.

Analysis of postoperative modified AOFAS Lesser MPJ-IPJ and MOXFQ were obtained. The AOFAS score is a modification of the forefoot score. The score was modified from the original 100 points, to include only subjective outcomes. A total of 60 points was possible in a patient with no pain, no limitation of daily or recreational activities, and no footwear limitations. The higher the AOFAS score, the better the outcome. The con about this study is, if you wear orthotics or any shoe modifications, it automatically deducts 5 points from your total score. All of our patients were provided orthotics for postsurgical daily management.

The MOXFQ is summed to form 3 separate subscales that represent underlying domains: walking/standing problems (7 items), foot pain (5 items), and issues related to



Figure 1A.

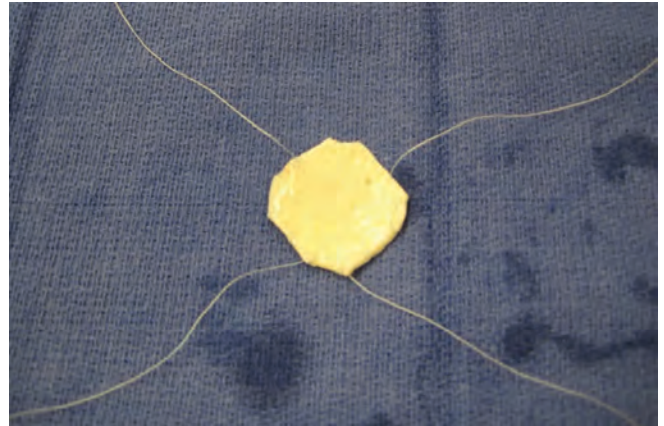


Figure 1B.



Figure 1C.

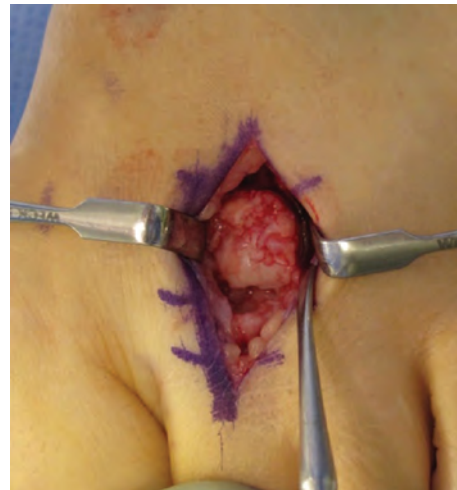


Figure 1D.



Figure 1E.



Figure 1F.

Table 2

MANCHESTER-OXFORD FOOT QUESTIONNAIRE

Domain	Average Score
Walking/Standing Problems (28 points)	9.4
Foot Pain (20 points)	3.8
Social Interaction (16 points)	3.7
MOXFQ-Index Total: (64 points)	16.9

Table 3

SUMMARY OF RESULTS

Patient	Preop Pain Scale (1-10)	Postop Pain Scale (1-10)	Postop Mod AOFAS (60)	MOXFQ (64)
1	10	4	35	39
2	6	2	55	0
3	5	0	47	14
4	6	5	42	34
5	7	2	60	7
6	8	5	32	27
7	10	1	55	12
8	9	3	45	33
9	10	0	60	1
10	5	0	55	2
Avg	7.6	2.2	48.6	16.9

social interaction (4 items) (13) (Table 2). The lower the MOXFQ score, the better the outcome. Preoperative and postoperative pain on a scale of 1-10 with a rate of 1 being the least amount of pain and 10 being the highest amount of pain were also obtained. In addition, patients were asked if they were satisfied with their result and would undergo the operative procedure again. The average postoperative modified AOFAS score was 48.6 (range 32-60). The average MOXFQ score was 16.9 (range 0-39). The average preoperative pain level was 7.6 (range 5-10). The average postoperative pain level was 2.2 (range 0-5). The summary of results is shown in Table 3. There were no subsequent procedures or fusions performed on the MTP joint. All patients were satisfied with their results. Nine of 10 patients

would have the procedure performed again. One patient said that they were undecided on if they would have the procedure performed, as they did not improve significantly from their preoperative pain level and post-operative pain level.

DISCUSSION

Lesser MPJ surgical treatment for osteoarthritis or Freiberg's infraction has been previously described in the literature with no true consensus developed on the most optimal treatment option. There are only a few studies reported that have investigated the use of interpositional arthroplasty for lesser MPJ arthritis such as capsular or tendon interposition. Lavery and Harkless investigated the use of interpositional arthroplasty with the lesser MPJ capsule of the involved joint (6). Nine patients in an average follow-up of 35.5 months were evaluated in a clinical examination and participated in a subjective questionnaire. They reported improvement in postoperative pain and activity levels in all patients. Postoperative follow up resulted in inadequate maintenance of joint space although the limitation in range of motion was without pain or crepitus.

Zgonis et al described a method with the use of peroneus longus tendon as an allograft (11). However, this requires an additional surgical incision. Myerson et al discussed a modification of DuVrie's lesser MPJ arthroplasty with the use of the extensor digitorum brevis tendon and underlying MPJ capsule (8). Ozkan et al also reported on the use of extensor digitorum brevis tendon with interpositional arthroplasty for Freiberg's infraction (9). The results with the use of tendinous or capsular interpositional arthroplasty have ranged from good to excellent. However, there are no studies published on the use of interpositional arthroplasty with an allograft tissue matrix.

The results from our study reveal favorable subjective outcomes with significant improvement in pain. The use of orthobiologics for interpositional arthroplasty is an alternative surgical procedure to treat lesser MPJ osteoarthritis or Freiberg's infraction. There is no donor site morbidity and the involved joint is preserved, thus allowing revisional procedures, if indicated. This is the first study to report on the use of an acellular dermal tissue matrix graft for lesser MPJ osteoarthritis. The longevity of the graft and length of pain relief has yet to be determined. Future studies are needed for further evaluation. However, our initial study findings appear to provide favorable outcomes in regard to patient satisfaction and pain relief. We recommend this surgical technique as an alternative in end-stage osteoarthritis or Freiberg's infraction of lesser MPJs, when conservative treatment has failed.

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