

Original Article

Hallux interphalangeal involvement after metatarsophalangeal joint arthrodesis. Treatment and results

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Abstract

Objective: To assess the involvement of the hallux interphalangeal (IP) joint after first metatarsophalangeal joint (MTPJ) arthrodesis and propose a treatment consisting of MTPJ resection arthroplasty associated with phalangeal osteotomy or IP joint arthrodesis.

Methods: We retrospectively analyzed 9 patients treated with MTPJ resection arthroplasty associated with phalangeal osteotomy or hallux IP joint arthrodesis from November 2006 to January 2017.

Results: The main causes of MTPJ arthrodesis that subsequently evolved to IP involvement were severe hallux valgus and sequelae or complications of previous hallux valgus operations. Additionally, the reasons leading to rescue surgery were pain, deformity, and/or discomfort.

Conclusion: This therapeutic modality is able to relieve symptoms by a simple procedure, with acceptable functional and esthetic results.

Level of Evidence IV; Therapeutic Studies; Case Series.

Keywords: Arthrodesis; Metatarsophalangeal joint; Toe joint; Hallux; Arthrosis.

Introduction

First metatarsophalangeal joint (MTPJ) arthrodesis is a procedure commonly used for the treatment of severe hallux valgus, hallux rigidus, rheumatoid arthritis, hallux varus, and recurrence or failure of previous operations⁽¹⁻¹³⁾. Reported complications include nonunion, malposition, consolidation defects, hardware-related pain, dissatisfaction due to loss of joint mobility, difficulty in wearing shoes, and interphalangeal (IP)

joint arthrosis^(2,3,8-11,13-18). The latter is one of the major causes of discomfort after first MTPJ arthrodesis in the long term^(16,17).

The IP joint may also be affected by pain, dislocation, or instability (Figure 1), but the literature on the treatment of these conditions is scarce. In the present study, we assessed hallux IP involvement after first MTPJ arthrodesis and proposed a treatment consisting of first MTPJ resection arthrodesis combined with phalangeal osteotomy or IP arthrodesis.

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Methods

This study was approved by the Institutional Review Board.

Of 180 first MTPJ arthrodeses performed between November 2006 and January 2017, 9 patients were retrospectively evaluated for IP involvement after first MTPJ arthrodesis requiring surgical treatment (Table 1).

Eligible participants were patients aged 18 years or over who had undergone first MTPJ arthrodesis and evolved with pain or deformity in the IP joint of the hallux on the consolidated

first MTPJ arthrodesis and who did not respond favorably to conservative treatment (analgesics, finger separators, and changes in footwear).

Assessment was based on clinical history, imaging scans, and telephone questionnaire. Information was entered into a table according to the following criteria: postoperative pain according to a visual analog scale, forefoot function, esthetics, possibility of wearing shoes, and patient's overall satisfaction (Table 2).

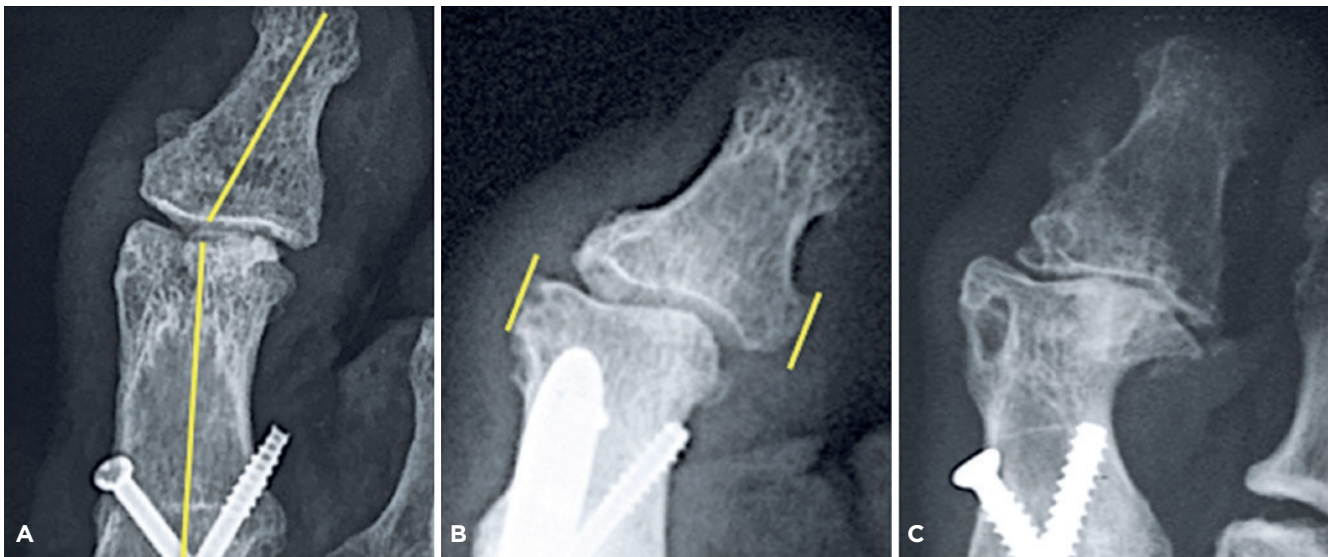


Figure 1. Types of interphalangeal involvement. A. Dislocation. B. Instability. C. Arthrosis.

Table 1. Patients' characteristics

Pt	Age	Foot	Reason for MTPJ arthrodesis	Date of MTPJ arthrodesis	Date of disarthrodesis	IP	IP observation	Result
1	66	L	Failed HV operation	February 99	December 16	Arthrodesis	Arthrosis	Good
2	56	L	HV	November 03	November 06	None	Hyperextension	Good
3	45	L	Post-treatment deformity	April 09	September 09	None	Pain	Good
4	61	R	Failed HV operation	June 09	May 10	Arthrodesis	Instability	Very good
5	61	R	Failed HV operation	March 09	October 13	Akin	Instability	Good
6	68	L	Rheumatoid arthritis	October 99	November 14	Arthrodesis	Arthrosis	Very good
7	64	L	Severe HV	August 09	October 15	Arthrodesis	Instability	Good
8	65	R	Severe HV	February 15	February 16	Arthrodesis	Instability	Fair
9	76	L	Failed HV operation	March 08	January 17	Arthrodesis	Instability	Good

Pt: patient; L: left; R: right; HV: hallux valgus; MTPJ: metatarsophalangeal joint; IP: interphalangeal.

Table 2. Result evaluation chart

Result	Pain	Function	Esthetics	Footwear	Satisfaction
Very good	0, 1, 2	Very good	Very good	Fashionable shoes	
Good	3, 4, 5	Good	Good	Wide range of shoes	Satisfied
Fair	6, 7, 8	Fair	Fair	Orthopedic shoes	
Poor	9, 10	Poor	Poor	Not wearing shoes	Dissatisfied

Surgical technique

All patients were operated by the same surgical team, after outpatient hospitalization, under local/regional anesthesia of the ankle combined with intravenous sedation, in supine position, with sterile drapes covering leg, ankle, and foot, and a hemostatic cuff placed at the supramalleolar level.

A medial or dorsomedial metatarsophalangeal approach was used, depending on where the previous incision was located, the initial scar was resected, and the surgical field was distally expanded to include IP joint in cases requiring some procedure on this joint, with caution not to injure the dorsomedial cutaneous nerve.

After the capsule was longitudinally incised and periarticular adhesions were released, the previously used hardware was identified and removed.

On the arthrodesis site, which was determined by radioscopy, a bone resection of approximately 0.5 to 1cm was performed to restore mobility, and caution was taken not to over resect in an attempt to not shorten the first ray. At this last moment, we considered second toe length as a reference. Subsequently, an oblique dorsal incision was made at the level of the first metatarsal bone at an angle from 30° to 40° with respect to the diaphyseal axis in the sagittal plane to simulate cheilectomy so that to allow at least 40° of dorsiflexion of the metatarsophalangeal joint (Figure 2). In cases requiring IP arthrodesis (Table 3), it was routinely performed with an intramedullary screw at a neutral position regarding varus-valgus, flexion-extension, and rotation angles (Figure 3).

Surgical closure was performed by planes, with the capsule being closed with absorbable multifilament suture and the skin with non-absorbable multifilament suture.

Postoperative management consisted of complete support according to patient's tolerance to forefoot postoperative foot 48 h after initial rest with the foot elevated and the heel supported.

After sutures were removed, from 15 to 20 days after surgery, patients were allowed to use normal shoes and started with assisted active and passive mobilization of the forefoot, with kinesiologic assistance when necessary.

Results

Mean age at the time of surgery was 62 years (range, 45 to 76 years). Among the participants, 8 were women and 1 was a man, with involvement of the right foot in 3 patients and of the left foot in 6.

The reason for the initial first MTPJ arthrodesis was severe hallux valgus in 3 patients (33.33%), failure of previous hallux valgus surgery in 4 patients (44.44%), rheumatoid arthritis in 1 patient (11.11%), and post-traumatic deformity in 1 patient (11.11%).

The reason for rescue surgery were IP dislocation and/or instability in 5 cases (55.55%), IP arthrosis in 1 case (11.11%), IP pain in 1 case (11.11%), and malposition of first MTPJ arthrodesis in 2 cases (22.22%).

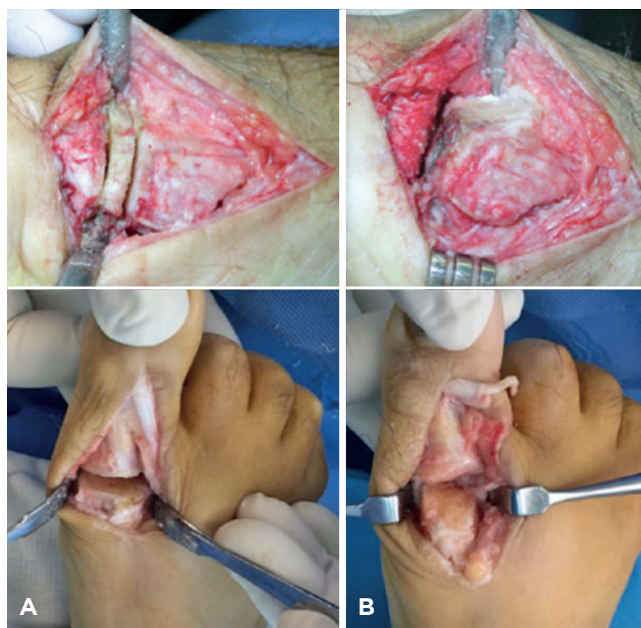


Figure 2. Intraoperative image. A. Bone resection. B. Dorsal remodeling.

Table 3. Involvement and treatment

Involvement	Treatment
IP pain with radiographic involvement	Isolated MTPJ resection arthroplasty
IP dislocation	MTPJ resection arthroplasty + Akin phalangeal osteotomy
IP instability	MTPJ resection arthroplasty + Arthrodesis
IP arthrosis	MTPJ resection arthroplasty + Arthrodesis

IP: interphalangeal; MTPJ: metatarsophalangeal joint.

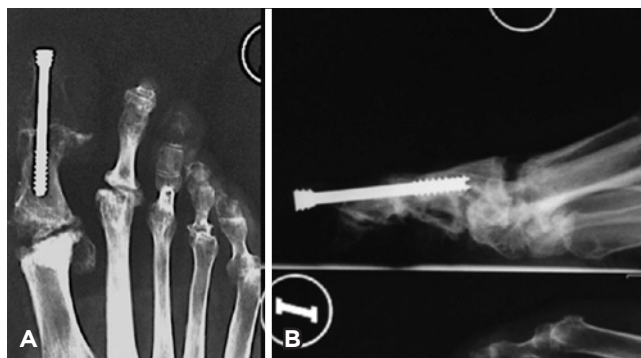


Figure 3. Postoperative radiograph. Metatarsophalangeal arthroplasty combined with interphalangeal arthrodesis.

The percentage of IP involvement requiring surgical treatment was 5% (9 rescue operations among 180 first MTPJ arthrodeses).

Mean time elapsed from initial to rescue surgery was 6 years and (range, 5 months to 17 years).

IP arthrodesis was performed in 6 cases (66.66%), Akin phalangeal osteotomy in 1 case (11.11%), and the IP joint was not addressed in 2 cases (22.22%).

Mean follow-up was 5.4 years (range 1 to 12 years). Seven patients (77.77%) did not report pain, and 2 (22.22%) presented with intermittent mild pain. IP function was very good in 3 cases (33.33%), good in 5 (55.55%), and fair in 1 (11.11%). The esthetic result was good in 7 patients (77.77%) and fair in 2 (22.22%) due to over-shortening of the first ray. The 9 patients could wear standard shoes, 4 of them (44.44%) with fashionable shoes. 8 patients (88.8%) expressed satisfaction with the procedure, and 1 patient (11.11%) did not.

Overall assessment was very good in 3 cases (33.33%), good in 5 cases (55.55%), and fair in 1 case (11.11%).

Discussion

First MTPJ arthrodesis is a procedure described for the treatment of many painful conditions of this joint when its involvement prevents joint preservation surgery, and most authors agree that it is a safe procedure with high rates of success and patient satisfaction. There are several forms and systems of joint preparation. Likewise, several methods or configurations of osteosynthesis have been described to achieve a higher consolidation rate on the arthrodesis site and to promote the ability to bear weight and early rehabilitation^(1,4,6,7,9,11,12,14,15).

The following complications were observed after first MTPJ arthrodesis: nonunion, malposition, pain related to hardware requiring reintervention for removal, discomfort due to loss of mobility, metatarsalgia, and IP joint arthrosis or pain^(1-3,8-11,13,14-18). IP joint involvement is one of the most frequent complications, with a prevalence ranging from 30 to 60%^(10,13,16,17). This condition is not always symptomatic, and one third of patients are estimated to present with painful symptoms beyond radiographic involvement⁽¹⁷⁾.

A number of studies have evaluated the functional results of first MTPJ arthrodesis and its complications, and all of them mention IP involvement as a frequent and disabling complication^(10,13,16). However, only a few studies have proposed or described specific treatment procedures for this particular condition⁽¹⁷⁾.

Most authors agree that IP involvement is closely related to the position of arthrodesis, and it is well known that this complication may be mitigated by reducing overload or stress on the IP joint and that the fixation angle of MTPJ should be from 15° to 30° of valgus in the sagittal plane and from 15° to 30° of dorsiflexion in the lateral plane^(7,10,13,14,16). Moreover,

these authors found that a dorsiflexion angle below 20° was associated with a greater rate of IP arthrosis^(7,14,16).

We believe that, besides the final fusion position, the pre-existing disease that motivated initial arthrodesis, associated diseases, such as neurological disorders, and chronic medications may also have an influence on changes in IP joint, thus contributing not only to the percentage of onset but also to the time when these changes develop. The IP joint may condition the final results of first MTPJ arthrodesis, and this conditioning not only results from the development of arthrosis but may also manifest as pain, dislocation, and instability. We believe that it is an evolutionary process in which arthrosis and/or deformity is the final result of disease progression.

Coughlin described a classification of hallux IP joint arthrosis according to the degree of radiological involvement⁽¹³⁾. We consider that determining the overall problem occurring in the joint by performing an imaging and clinical assessment provides greater information and guides decision-making (Table 3).

The literature describes the following treatment options for failed first MTPJ arthrodesis: corrective osteotomies, rescue surgery with MTPJ prosthesis, rescue surgery with resection and interposition of tissues (either local or obtained from distant areas), and IP arthrodesis^(1,17,19,20). Studies that compared long-term results in primary surgery between prosthetic implants and first MTPJ arthrodesis showed controversial results, with no study being categorically favorable to arthroplasty^(8,21). Only one study describes an option for the treatment of hallux IP arthritis after first MTPJ arthrodesis consisting of rescue surgery arthroplasty of the MTPJ with arthrodesis resection combined with interposition of soft tissue (semitendinosus tendon) obtained from the ipsilateral knee and IP fusion⁽¹⁷⁾.


According to the advantages and disadvantages of each therapeutic option described here and based on the evaluation of each particular case, we propose the following treatment algorithm: isolated MTPJ resection arthroplasty in cases of IP pain with no radiological involvement; MTPJ resection arthroplasty associated with Akin phalangeal osteotomy when there is IP dislocation; and MTPJ resection arthroplasty and IP joint arthrodesis in cases of IP instability or arthrosis (Table 3).

CONCLUSION

We believe that the described procedure is useful for selected patients who present with pain, dislocation, instability, or arthrosis of the hallux IP joint after first MTPJ arthrodesis. This therapeutic modality makes it possible to relieve pain symptoms, deformity, and discomfort by a simple procedure that allows early weight-bearing with no need of excessive postoperative protection and with acceptable functional and esthetic results (Figure 4).



Figure 4. A. Initial severe hallux valgus. B. Short-term postoperative image. C. Long-term postoperative image showing interphalangeal dislocation and instability. D. Metatarsophalangeal resection arthroplasty combined with interphalangeal arthrodesis. E. Hallux deformity. F. Final correction. G. Postoperative passive mobility.

Authors' contributions: Each author contributed individually and significantly to the development of this article: AMV *(<https://orcid.org/0000-0002-0384-4044>) conceived and planned the activities that led to the study, interpreted the results of the study, performed the surgeries, approved the final version; ES (<https://orcid.org/0000-0001-5028-9584>) conceived and planned the activities that led to the study, interpreted the results of the study, approved the final version, performed the surgeries, approved the final version; MR *(<https://orcid.org/0000-0003-1947-8218>) interpreted the results of the study, performed the surgeries, approved the final version; AB (<https://orcid.org/0000-0003-1690-025X>) interpreted the results of the study, performed the surgeries, approved the final version; MI *(<https://orcid.org/0000-0002-6336-6080>) interpreted the results of the study, performed the surgeries, approved the final version; IT *(<https://orcid.org/0000-0001-9210-9051>) bibliographic review, clinical examination, approved the final version. *ORCID (Open Researcher and Contributor ID) 

References

1. Roukis TS. First metatarsal-phalangeal joint arthrodesis: primary, revision, and salvage of complications. *Clin Podiatr Med Surg.* 2017;34(3):301-14.
2. DeOrto JK. Technique tip: arthrodesis of the first metatarsophalangeal Joint - Prevention of excessive dorsiflexion. *Foot Ankle Int.* 2007; 28(6):746-7.

3. Cullen NP, Angel J, Singh D, Smith J, Dudkiewicz I. Clinical tip: revision first metatarsophalangeal joint arthrodesis for sagittal plane malunion with an opening wedge osteotomy using a small fragment block plate. *Foot Ankle Int.* 2005;26(11):1001-3.
4. Brodsky JW, Passmore RN, Pollo FE, Shabat S. Functional outcome of arthrodesis of the first metatarsophalangeal joint using parallel screw fixation. *Foot Ankle Int.* 2005;26(2):140-6.
5. Campbell B, Schimoler P, Belagaje S, Miller MC, Conti SF. Weight-bearing recommendations after first metatarsophalangeal joint arthrodesis fixation: a biomechanical comparison. *J Orthop Surg Res.* 2017;12(1):23.
6. Claassen L, Plaass C, Pastor MF, Ettinger S, Wellmann M, Stukenborg-Colsman C, et al. First metatarsophalangeal joint arthrodesis: a retrospective comparison of crossed-screws, locking and non-locking plate fixation with lag screw. *Arch Bone Jt Surg.* 2017;5(4):221-225.
7. Doty J, Coughlin M, Hirose C, Kemp T. Hallux metatarsophalangeal joint arthrodesis with a hybrid locking plate and a plantar neutralization screw: a prospective study. *Foot Ankle Int.* 2013;34(11):1535-40.
8. Voskuil T, Onstenk R. Operative treatment for osteoarthritis of the first metatarsophalangeal joint: arthrodesis versus hemiarthroplasty. *J Foot Ankle Surg.* 2015;54(6):1085-8.
9. Patel A, Baumhauer J. First metatarsophalangeal joint arthrodesis. *Oper Tech Orthop.* 2008;18:216-220.
10. Stevens BW, Anderson JG, Bohay DR. Hallux metatarsophalangeal joint fusion for the rheumatoid forefoot. *Foot Ankle Clin.* 2007;12(3):395-404.
11. Korim MT, Allen PE. Effect of pathology on union of first metatarsophalangeal joint arthrodesis. *Foot Ankle Int.* 2015;36(1):51-4.
12. Harris E, Moroney P, Tourné Y. Arthrodesis of the first metatarsophalangeal joint-A biomechanical comparison of four fixation techniques. *Foot Ankle Surg.* 2017;23(4):268-74.
13. Coughlin MJ. Rheumatoid forefoot reconstruction. A long-term follow-up study. *J Bone Joint Surg Am.* 2000;82(3):322-41.
14. Latif A, Dhinsa BS, Lau B, Abbasian A. First metatarsophalangeal fusion using joint specific dorsal plate with interfragmentary screw augmentation: Clinical and radiological outcomes. *Foot Ankle Surg.* 2017;14. pii: S1268-7731(17)31292-4.
15. Chien C, Alfred T, Freihaut R, Pit S. First metatarsophalangeal joint arthrodesis in hallux valgus versus hallux rigidus using cup and cone preparation compression screw and dorsal plate fixation. *Cureus.* 2017;19(10):e1786.
16. Fitzgerald JA. A review of long-term results of arthrodesis of the first metatarso-phalangeal joint. *J Bone Joint Surg Br.* 1969;51(3):488-93.
17. Babazadeh S, Su D, Blackney MC. Hallux IP arthritis after MP arthrodesis managed with interpositional arthroplasty of MP joint and IP fusion: case report. *Foot Ankle Int.* 2011;32(9):900-4.
18. Hahn MP, Gerhardt N, Thordarson DB. Medial capsular interpositional arthroplasty for severe hallux rigidus. *Foot Ankle Int.* 2009;30(6):494-9.
19. Izquierdo Cases JA, Costa Martiniano JA, Goncalves da Rocha AS, Izquierdo Santiago I. Reversal of an arthrodesis in the first metatarso-phalangeal joint by total implantation. *Rev Esp Podol.* 2017;28(2):113-8.
20. Mizel MS, Alvarez RG, Fink BR, Temple HT. Ipsilateral arthrodesis of the metatarsophalangeal and interphalangeal joints of the hallux. *Foot Ankle Int.* 2006;27(10):804-7.
21. Beekhuizen SR, Voskuil T, Onstenk R. Long-term results of hemiarthroplasty compared with arthrodesis for osteoarthritis of the first metatarsophalangeal joint. *J Foot Ankle Surg.* 2018;57(3):445-50.