Reduction of the Intermetatarsal Angle after First Metatarsophalangeal Joint Arthrodesis in Patients with Moderate and Severe Metatarsus Primus Adductus

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A radiographic review of first metatarsophalangeal joint (MPJ) arthrodesis in patients who had preoperative intermetatarsal angles greater than 15° is presented. The average reduction of the intermetatarsal angle was measured. Twenty-one patients with 22 fusions, with ages ranging from 43 to 79 years old, underwent first MPJ arthrodesis with screw or pin fixation as determined appropriate by their age and bone quality. Preoperative intermetatarsal angles averaged 17.27° with a range of 15°–21°. An overall reduction in the intermetatarsal angle of 6.41° was noted. Mechanical factors affecting the reduction of the intermetatarsal angle following first MPJ arthrodesis are discussed. (The Journal of Foot & Ankle Surgery 41(5):316–319, 2002)

Key words: first metatarsophalangeal joint, fusion, intermetatarsal angle, reduction

First metatarsophalangeal joint (MPJ) arthrodesis is effective in providing correction of a variety of deformities and derangement. Angular and rotational deformities can be addressed, as well as joint subluxation, dislocation, and hallux varus. It is also effective for pain relief in hallux rigidus, salvage for failed implant arthroplasty, and the arrest of any inflammatory or infectious process (1). Although arthrodesis has utility in the treatment of hallux valgus, many surgeons have not considered it a viable option for correction of this deformity. Additionally, a secondary osteotomy of the first metatarsal for correction of an increased intermetatarsal (IM) angle has been advocated when metatarsus primus adductus is present (2). It has been our experience that an osteotomy is not required to correct the intermetatarsal angle after first MPJ arthrodesis for moderate and severe bunion deformities. It is intrinsic to the procedure that the hallux valgus can be alleviated and correction maintained. We present a radiographic review of first MPJ arthrodesis for moderate to severe hallux valgus and metatarsus primus adductus (IM angle 15°–21°), and quantify the average reduction in the IM angle that can be expected postoperatively in this group.

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Received for publication March 20, 2001; accepted in revised form for publication May 6, 2002.

The Journal of Foot & Ankle Surgery 1067-2516/02/4105-0316$4.00/0

Materials and Methods

Patients with primary hallux valgus deformity undergoing fusion of the first MPJ were considered in this study. Eligible patients had degenerative changes about the first MPJ both clinically and radiographically. Clinical features determined by the authors to indicate degenerative changes included decreased range of motion, painful range of motion, crepitation, and increased circumferential prominence of the joint. Radiographic findings consistent with osteoarthritis were considered. Only those patients with IM angles greater than 15° were included in the study.

Weightbearing dorsoplantar radiographs were utilized to evaluate preoperative IM angles and the hallux abductus (HA) angle. The same measurements were taken postoperatively when patients were able to bear full weight and demonstrated solid clinical and radiographic union. All measurements were compiled by the senior author (P.D.). The longitudinal bisectors of the first and second metatarsals were utilized to establish the IM angle (Fig. 1). The longitudinal bisectors of the first metatarsal and the proximal phalanx represented the hallux abductus angle.

The patients included in this study had bunion deformities with IM angles ranging from 15° to 21°, with HA angles of between 25° and 52°. The operative technique utilized a dorsal approach, medial to the extensor hallucis longus tendon in all cases. Direct exposure of the joint with

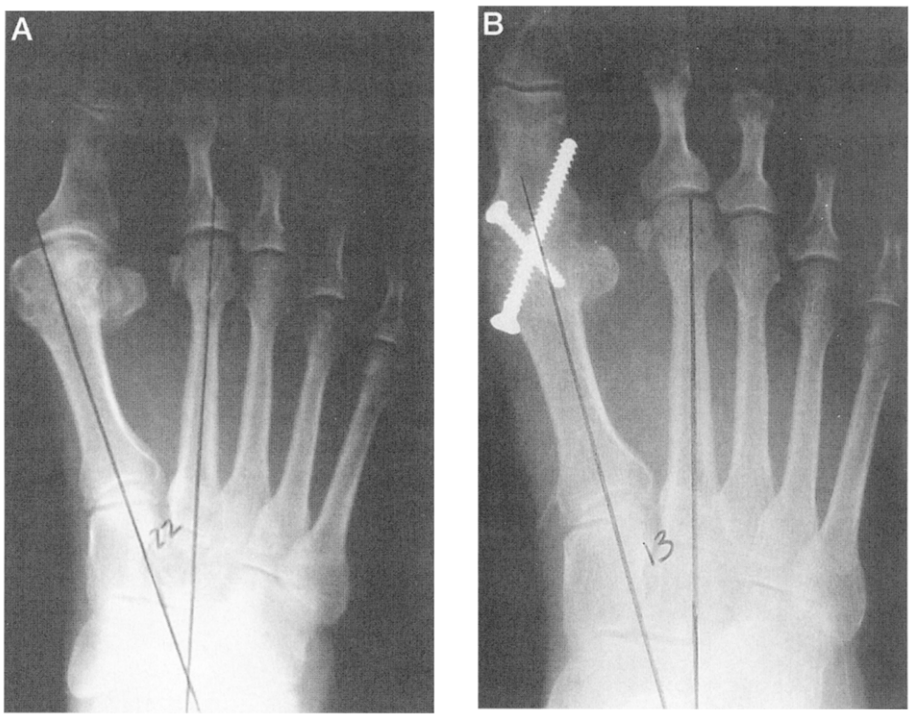

FIGURE 1 A, Preoperative weightbearing AP radiograph of a 60-year-old female with high intermetatarsal angle and degenerative changes of the first MPJ. B, 4-month postoperative weightbearing radiograph after first MPJ fusion illustrating the reduction in intermetatarsal angle.

minimal subcutaneous separation to preserve the perforating blood supply was accomplished. Fusion surfaces were developed with standard hand instrumentation.

Two different fixation techniques were utilized depending on a radiographic and intraoperative clinical assessment of the patient's bone stock. Patients with osteopenic or clinically softer bone underwent fusion with axial pin fixation, whereas younger patients with adequate bone stock had fixation with either crossed screws or crossed K-wires. No specialized jigs, reamers, or other unique equipment were utilized.

Postoperatively, all patients were instructed to remain nonweightbearing for 3–7 days and then progressed to full weightbearing in a postoperative shoe. Return to a walking shoe was approximately 5–6 weeks postoperative for the patients fixated with screws, whereas the patients with axial pins returned to a walking shoe after pin removal which was between 8 and 10 weeks postoperative.

Results

The data collected for each patient are summarized in Table 1. Of the 21 patients included, all were female except one. Patient age ranged from 43 to 79 with an average age of 62.45. Preoperative IM angles ranged from 15° to 21°, and HA angles were 25°–52°. The average reduction in the IM angle was 6.41° with a range of 4°–13° on weightbearing radiographs. The HA angle showed an average reduction of 19.64° with a range of 4°–40°. All patients had radiographic signs of union at the time of final radiographic evaluation and all exhibited stable fusion sites without motion or pain on clinical exam.

Discussion

Arthrodesis provides correction of a wide variety of deformities and derangements of the first MPJ. In our practice we have observed many benefits that can be offered by arthrodesis. First and foremost, arthrodesis produces permanent correction of both hallux valgus and metatarsus primus adductus with extremely low likelihood for revision surgery. This is a distinct advantage in patients with first MPJ arthrosis associated with hallux valgus, and patients with instability, joint laxity, or severe contracture. Second, pain associated with arthrosis as well as that caused by sesamoid derangement is relieved, which produces more consistent results. Third, arthrodesis preserves the weightbearing function of the hallux and produces more consistent hallux purchase than other joint destructive methods such as resection arthroplasty or implant (3). We feel this reduces lateral weight transfer and reduces the incidence of lesser metatarsalgia.

Our observations support the hypothesis that osteotomy to address the moderate and high intermetatarsal angle is not needed when fusing the first MPJ in patients with

TABLE 1 Patient data

Patient	Age (yr)	Pre-IM (°)	Post-IM (°)	Reduction (°)	Pre-HA (°)	Post-HA (°)	Reduction (°)
MC	54	15	8	7	45	18	27
LB	50	16	10	6	35	24	11
AC	52	16	12	4	33	20	13
ES	79	19	14	5	35	15	20
EP	67	16	12	4	40	20	20
FW	79	21	16	5	36	9	27
PR	59	21	16	5	37	27	10
JB	52	17	11	6	38	18	20
SM R	79	15	9	6	52	12	40
SM L	79	15	9	6	41	10	31
MS	61	16	11	5	45	17	28
RH	71	15	9	6	30	5	25
PK	59	19	14	5	30	14	16
AB	74	16	9	7	31	10	21
BH	74	15	11	4	28	13	15
KZ	56	17	11	6	32	11	21
BB	61	19	12	7	32	13	19
SG	56	19	8	11	38	23	15
CS	50	18	9	9	30	3	27
VK	59	17	11	6	25	21	4
SS	43	17	9	8	30	19	11
LS	60	21	8	13	28	17	11
Avg	62.45	17.27	10.86	6.41	35.05	15.41	19.64

hallux valgus. Other authors have made similar observations. Mann (4) noted reduction in the IM angle with first MPJ arthrodesis and states that the change in the intermetatarsal angle is directly proportional to the preoperative intermetatarsal angle. He noted that concomitant first metatarsal osteotomy is not indicated for IM angle reduction. Our findings are consistent in that our patient population had a high IM angle range of 15°–21° and our results showed average reduction of 6.41, which is higher than other investigators reporting reduced IM angle. Humbert presented a group of 31 patients with hallux abducto valgus (HAV) and first MPJ degenerative changes that underwent a "tongue-and-trough" arthrodesis without internal fixation (5). They reported an average reduction of the IM angle of 5.7°. They also stated that the IM angle would decrease further with time, but gave no statistical data to support this claim. Giorgini presented 12 end-to-end first MPJ fusions using axial K-wires with a reported average reduction in the IM angle of 3.45° (6). Harkless fused the first MPJ of 25 patients (totaling 32 procedures) with HAV and secondary degenerative changes (7). Ball and socket-type fusions were utilized with crossed 4.0-mm cancellous screw fixation. They reported an average drop in the IM angle of 4.2° and a reduction of the HA angle of 16.3°. Tourne et al. performed 42 first MPJ fusions on 33 patients utilizing a 4.0-mm cancellous screw across the fusion site for compression with a dorsal 1/4-inch tubular plate stabilized with 2.7-mm cortical screws (8). They reported an average reduction of the IM angle of 4°.

Our results seem to be quite comparable to the existing studies, even though methods of fixation and fusion techniques differed. The results also suggest a proportionate increase in intermetatarsal correction in higher preoperative IM angles. Although we did not study patients with lesser IM angles, our large deviation of IM angle correction supports this notion. Our observations also support the idea that secondary osteotomy is not required to correct an increased intermetatarsal angle. Our data do not permit statistical conclusions regarding the influence that the chosen procedure has on the final reduction in IM angle. This may be a topic for further research. Comparison of the IM and HA angle reductions with fusion to those noted with resection arthroplasty with or without implant would also be interesting.

There are relatively few mechanical concepts and anatomic structures that have an impact on hallux position. Reduction of the IM angle in arthrodesis may be secondary to reduction in retrograde hallux force pushing the first metatarsal medially. Mann (3) has observed that with a valgus position of the hallux, lateral bow stringing of the extensor hallucis longus and flexor hallucis longus occur and accentuate the valgus position. Over time, the lateral joint capsule and conjoined tendon contract, pushing the first metatarsal into further varus. After first MPJ arthrodesis, bow stringing of the long flexor and extensor tendons are all but eliminated as deforming forces. Also, the conjoined tendon of adductor hallucis may provide an active corrective force toward the midline of the foot, which would act to decrease the intermetatarsal

angle, instead of accentuating the lateral deviation of the hallux. This, however, has not been proven. We believe that the reduction of the retrograde or medial force from the hallux on the metatarsal is the main reason that the IM angle decreases. This is because the correction is visualized immediately postoperatively and appears to be maintained consistently on postoperative clinical and radiographic exam. Theoretically, flexibility of the proximal first ray articulations would be required for this correction to take place. We did not evaluate or address, this parameter in this observational review.

Conclusion

In our series of patients with hallux valgus and moderate and high metatarsus primus adductus, first MPJ arthrodesis produced consistent reduction of intermetatarsal angles. Secondary first metatarsal osteotomy was not required. Conclusions of previous authors are supported by our findings.

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