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Correction of Moderate to Severe Hallux Valgus Deformity by a Modified Chevron Shaft Osteotomy

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ABSTRACT

Background: Hallux valgus is one of the most common foot deformities in women. Despite the large number of techniques described for hallux valgus correction, there has been much controversy regarding the best procedure to use, especially for severe deformities. Proximal osteotomies have long been done for severe deformities; however, diaphyseal osteotomies have gained popularity because of the greater degree of correction and stability obtained. **Methods:** This study retrospectively assessed the radiographic and clinical outcomes in 50 feet (34 patients) that had a modified chevron shaft osteotomy for moderate to severe hallux valgus. Additionally, an Akin medial closing wedge osteotomy of the proximal phalanx was done in most patients. Mean followup was 30 months (minimum 13 months). All patients in the study had either moderate or severe deformities. Patients with mild deformities had correction by other techniques. **Results:** There was a mean AOFAS score improvement of 39.6 (44.5 to 84.1) points. The hallux valgus angle and intermetatarsal angle improved a mean of 22.7 degrees and 10.4 degrees, respectively. Hallux valgus persisted in one foot; however, the patient was not dissatisfied. Two feet developed hallux varus. Revision was necessary in two patients; one needed revision because of loss of fixation and the other because of symptomatic hallux varus. **Conclusion:** Based on radiographic correction and clinical outcomes, this procedure is indicated for the treatment of moderate to severe hallux valgus deformities.

Key Words: Akin Osteotomy; Bunion; Chevron Osteotomy; Hallux Valgus; Metatarsal Osteotomy

INTRODUCTION

Mild hallux valgus deformities can be successfully corrected by distal osteotomies; moderate and severe

deformities, however, are better corrected by proximal osteotomies,^{2,8,10,12,16,18} which are more unstable and often associated with delayed healing and malunion.²¹ Diaphyseal osteotomies, including the osteotomy presented in this study, aim to correct moderate and severe deformities with less morbidity and fewer complications than proximal osteotomies. The osteotomy described represents a modification of the chevron technique.^{2,7} The osteotomy angle change, from 60 degrees to 30 to 40 degrees, increases the stability and corrects larger deformities (Figure 1).²⁰ Because of the increased stability afforded by this osteotomy, cast immobilization is not necessary and early postoperative hallux mobilization is possible. The results of a modified chevron shaft osteotomy, with an Akin osteotomy¹ in most patients, are presented.

MATERIALS AND METHODS

From April, 1998, to October, 2001, 212 feet (156 patients) had surgical correction of hallux valgus deformity. Fifty feet of 34 patients were included in this study. One hundred and sixty two feet (122 patients) were excluded from the study because the deformity was corrected by another surgical technique or adequate documentation was not available. Of the 34 operated patients, 26 were reassessed during followup; eight were interviewed by telephone, because they were unable to return to our clinic. Those eight patients sent their radiographs by mail, and we included the data in the radiographic analysis. Only patients with moderate or severe deformities (intermetatarsal angle of more than 13 degrees) were included in this study. The primary reasons for surgery were pain and difficulty in wearing closed shoes.

Operated feet included 22 on the right side and 28 on the left side. The study included one man and 33 women. Mean age at the time of surgery was 47.3 years (range 13 years and 5 months to 69 years and 11 months). Three feet (two patients) previously had hallux valgus correction using a different technique. Forty-four of 50

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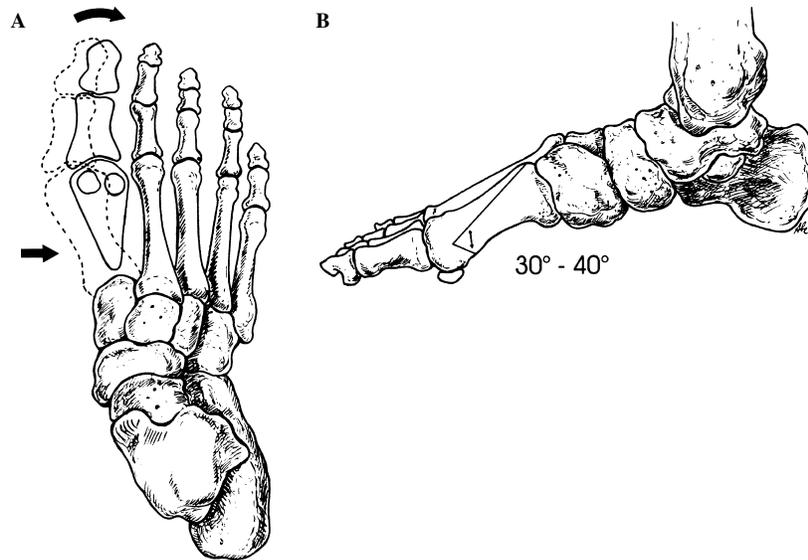


Fig. 1: Schematic representation of the chevron shaft osteotomy. **A,** Dorsal view, the association of displacement and rotation allows significant correction of the metatarsus primus varus. **B,** Lateral view, note the dorsal limb reaching the proximal metaphyseal area.

feet had one or more additional procedures. Akin proximal phalangeal osteotomy¹ was added in 41 of 50 feet when valgus deformity of the interphalangeal joint was present after the metatarsal osteotomy and metatarsophalangeal joint congruity was ascertained.

American Orthopaedic Foot and Ankle Society (AOFAS) scores at followup were compared with preoperative AOFAS scores. Patients were questioned about their overall satisfaction with postoperative foot appearance. For both outcome measures, patients stated they were “satisfied,” “satisfied with reservation,” or “not satisfied.” Objectively, range of motion of the first metatarsophalangeal joint, hallux alignment, and the presence of calluses were assessed by the AOFAS questionnaire. Weightbearing, anteroposterior, and lateral radiographic views were obtained from all patients and compared to preoperative examinations regarding the hallux valgus angle, intermetatarsal angle, and sesamoid position. Wilcoxon nonparametric test was used for comparison of preoperative and postoperative data and the Mann-Whitney nonparametric test was used for comparison of the Akin and non-Akin osteotomy groups.

Surgical Technique

All surgical procedures were done using regional anesthesia. An Esmarch tourniquet was applied above the ankle joint. A longitudinal medial incision at the junction of plantar and dorsal skin traversed the first metatarsophalangeal joint. Lateral release was done through the medial incision to reduce the sesamoids (Figure 2).

The first metatarsal medial eminence was removed, and the osteotomy completed with its apex centered in the metatarsal head. The arms of the osteotomy angle are 30 to 40 degrees (Figure 3, A). The distal osteotomy fragment was rotated laterally to correct the intermetatarsal



Fig. 2: Lateral release performed through medial incision (From Sammarco GJ, Russo-Alesi FG: Bunion correction using proximal chevron osteotomy: A single incision technique. *Foot Ankle Int.* 19:430–437, 1998; with permission).

angle. The osteotomy was provisionally fixed with Kirschner wires (Figure 3, B). Radiographs were taken and 2-mm screws were placed plantar to dorsal either using a lag technique or a partially threaded screw (Figures 3, C and D). After the metatarsophalangeal joint was reduced, the interphalangeal joint was examined for valgus deformity and, if necessary, corrected with a diaphyseal medial wedge resection of the proximal phalanx (Akin osteotomy).

Postoperative protocol consisted of 1 to 2 days of hospitalization. On the day after the operation, the patient was allowed to bear weight to tolerance in a firm sole shoe that was worn for 6 weeks.

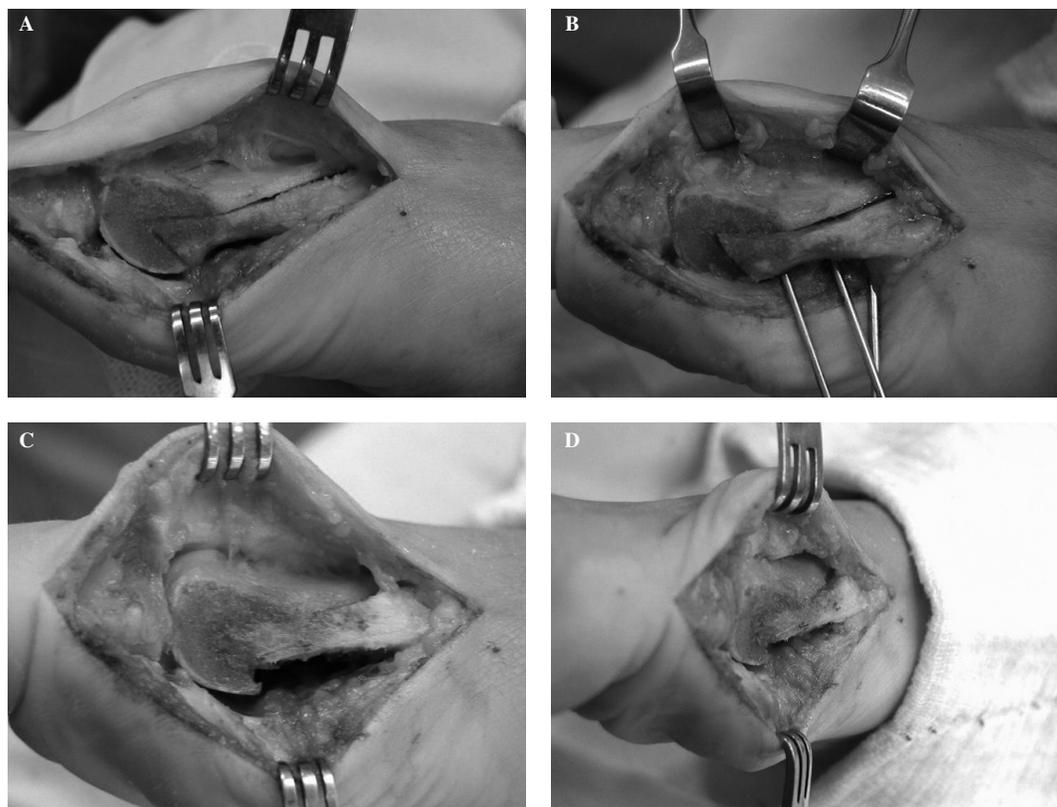


Fig. 3: A, Modified osteotomy with “V” arms forming a 30 to 40 degree angle. B, Kirschner wire osteotomy temporary fixation. C and D, Final appearance of osteotomy after mini-screw fixation.

RESULTS

Clinical Evaluation

Patients reported complete satisfaction in 39 feet (78%), satisfaction with minor reservations in nine feet (18%), and dissatisfaction in two feet (4%). No pain was noted in 31 feet (62%), and 17 feet (34%) were occasionally mildly painful usually with confining footwear. Two feet (4%) were mildly painful with any kind of footwear. In 44 feet (88%), patients were completely satisfied with the appearance. Regarding the appearance of the foot, in four feet (8%), the patients were satisfied with reservation and in two (4%) were not satisfied with the appearance. Footwear was unrestricted in 31 feet (62%); in 19 feet (38%) certain shoe styles, particularly high-heeled shoes and narrow toe boxes, caused symptoms.

The AOFAS overall scoring improved from a preoperative mean of 44.5 (range 25 to 65) to a mean of 84.18 (range 43

to 100) postoperatively. When the Akin osteotomy was done, the AOFAS mean overall score improvement was 40.43, from a preoperative mean of 43 to a postoperative mean of 83.43. In feet in which the Akin osteotomy was not done, the AOFAS mean overall scoring improvement was 36.22, from a preoperative mean of 51.33 to a postoperative mean of 87.55 (Table 1). No patient needed hardware removal. Most patients reported that the pain was less than expected for the type of procedure; the swelling, however, was more intense and prolonged than expected and was mainly responsible for the postoperative complaints.

Radiographic Evaluation

The deformity was measured according to AOFAS guidelines.⁴ Final preoperative and postoperative radiographs were done with the patient standing, following already established recommendations.⁴ Radiographic criteria assessed included

Table 1: Correlation of groups and AOFAS scores obtained

Aofas Score	Preop AOFAS	Postop AOFAS	Improvement
GROUP OF 50 FEET	44.5 (25–67)	84.18 (43–100)	39.68
41 FEET, AKIN	43.00	83.43	40.43
9 FEET, NON-AKIN	51.33	87.55	36.22

the hallux valgus angle, intermetatarsal angle, and sesamoid bone positioning. Bone healing was observed on plain, nonstanding radiographs taken between 6 and 8 weeks after surgery, as shown in Figure 4.

The hallux valgus angle of 50 operated feet improved from a preoperative mean of 27.6 (range 12 to 44) degrees to 4.84 (−9 to 18) degrees, yielding a mean correction of 22.76 degrees. The intermetatarsal angle of the total patient group improved from a mean of 15.54 (14 to 22) degrees to a mean of 5.06 (0 to 11) degrees, leading to a mean correction of 10.48 degrees (Table 2). Sesamoid positioning improved a mean grade of 2.4 from 3.8 on preoperative radiographs to 1.4 on postoperative radiographs, according to Maldin’s criteria.¹⁴

Of the 41 feet that had an Akin osteotomy, the hallux valgus angle improved from a preoperative mean of 28 (14 to 44) degrees to 4.19 degrees during followup, thus providing a mean correction of 23.8 degrees. The intermetatarsal angle in this group improved from a preoperative mean of 15.43 (14 to 20) degrees to a followup mean of 5.29 (0 to 11) degrees, thus producing a mean correction of 10.14 degrees.

In the nine feet that did not have an Akin osteotomy the hallux valgus angle improved from a preoperative mean of 25.77 (12 to 36) degrees to 7.77 (−9 to 18) degrees at followup, thus yielding a mean correction of 18 degrees. The intermetatarsal angle in this group improved from a preoperative mean of 16 (14 to 22) degrees to a followup mean of 4 (0 to 9) degrees, thus producing a mean correction of 12 degrees.

No patient had radiographic signs of metatarsal head osteonecrosis.

Statistical Analysis

The comparison of preoperative data to followup results using the Wilcoxon nonparametric test, with a significance level set at 5%, demonstrated a significant reduction of the hallux valgus angle and intermetatarsal angle values, and significant improvement of AOFAS scores, representing $p < 0.05$ for all three tests.

The comparison of the Akin osteotomy group to the non-Akin osteotomy group, performed by the nonparametric test



Fig. 4: A, Preoperative anteroposterior (AP) radiograph of hallux valgus deformity. B, Postoperative anteroposterior radiograph of the same deformity after modified chevron shaft osteotomy and Akin procedure.

Table 2: Correlation of groups and radiographic results obtained

Radiology	Preop HVA	Preop IMA	Postop HVA	Postop HVA	HVA Correction	IMA Correction
GROUP OF 50 FEET	27.6 (12.44)	15.54 (14–22)	4.84 (−9–18)	5.06 (0–11)	22.76	10.48
41 FEET, AKIN	28.0 (14–44)	15.43 (14.20)	4.19 (−8–17)	5.29 (0–11)	23.80	10.14
9 FEET, NON-AKIN	25.7 (12–36)	16.0 (14–22)	7.7 (−9–18)	4.0 (0–9)	18.00	12.00

of Mann-Whitney, using a 5% level of significance, demonstrated no significant difference ($p > 0.05$) regarding correction, both for the hallux valgus angle and intermetatarsal angle. The AOFAS score improvement between both groups did not present significant differences when the same test was used ($p > 0.05$).

Complications

The most common complication in this series was hallux varus (two feet; 4%); however, only one remained symptomatic and required extensor hallucis brevis transfer to the neck of first metatarsal.⁹

Only one foot (2%) had persistent or recurrent hallux valgus deformity; however, no further procedure was necessary, because symptoms were not severe.

Another patient needed intervention because of loss of fixation of the osteotomy; the incident occurred 8 weeks after surgery and was caused by an exaggerated effort placed on the operated lower limb. It was successfully treated by screw implant exchange and fixation of the osteotomy.

No patient in this series had either a superficial or deep infection.

DISCUSSION

The success of distal osteotomies for mild hallux valgus deformity correction has been well established;^{8,12,16} the chevron type osteotomy is one of the most commonly used.^{2,10,18} The technique has become the procedure of choice for many surgeons because of the increased stability it provides, but its inability to correct more severe deformities has mandated the development of other techniques.^{7,13,17} Severe deformities historically have been corrected by proximal osteotomies, which are less stable and pose more fixation difficulties, thus often leading to delayed healing or malunion.^{15,21} Diaphyseal osteotomies, including the osteotomy used in this study, fill the gap between limitations of distal osteotomies and instabilities of proximal osteotomies because they have more correction capacity than distal osteotomies and lend themselves by surface area to easier fixation.^{3,5,11,20,22}

The modified chevron osteotomy dorsal limb reaches the proximal metaphyseal region and maintains cortical contact after first ray varus correction. The radiographic correction obtained by the modified chevron osteotomy with or without an Akin osteotomy was satisfactory, correcting angles to normal parameters and favorably comparing to the literature.^{6,7,17,19,20,21,22} Comparison of results between those who had an Akin osteotomy and those who did not demonstrated that the Akin osteotomy, as already observed in other studies, did not significantly alter the correction of the hallux valgus angle or intermetatarsal angle or influence the AOFAS score improvement.

This modification of the distal chevron type osteotomy is an effective procedure for the treatment of moderate to severe hallux valgus.

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