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Original Research Article

A Study on Simple, Effective, Percutaneous Osteotomy for Hallux Valgus: Is Percutaneous the Solution? Our Institutional Experience

Kafeel Khan[1], Ajaz Majeed Wani[2], Mudasir Rashid[3]

[1]Assistant Professor, Department of Orthopaedics, Government Medical College, Srinagar, India
[2]Assistant Professor, Department of Orthopaedics, Government Medical College, Srinagar, India
[3]Assistant Professor, Department of Orthopaedics, HIMSR, Delhi, India

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Corresponding Author: Dr. Ajaz Majeed Wani
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Abstract

Background: Hallux valgus is a common pathological condition affecting the great toe. Although various conservative treatment modalities have been mentioned for the management of hallux valgus, the outcomes are poor. Among the plethora of surgical techniques for the management of hallux valgus, the minimally invasive techniques are gaining importance. These techniques are associated with less surgical burden, lesser operative time, enhanced preservation of biology and a faster recovery time.

Aims and Objective: The aim of the study was to evaluate the radiological and functional outcomes of a simple percutaneous osteotomy of the distal metatarsus in patients with mild to moderate hallux valgus.

Material and Methods: Thirty patients of both sexes, aged 15 to 60 years, with a mild to moderate hallux valgus and a minimum follow up of 1 year after the surgical procedure were included in the study. After satisfying the inclusion criterion, the patients were planned for surgical intervention. The AOFAS (Hallux-metatarso-phalangeal-interphalangeal) scale was used to assess the final outcome.

Results: The preoperative HVA ranged from 16^0 to 38^0, with a mean HVA of 29.6^0. The HVA at final follow up ranged from 10^0 to 30^0 with a mean of 14.7^0. The IMA preoperatively ranged from 9^0 to 16^0 with a mean IMA of 13.4^0. The IMA at final follow up ranged from 7^0 to 15^0 with a mean of 10.6^0, indicating a mean change in IMA of 2.8^0. Width of the feet ranged from 8.2 to 11.5 cms preoperatively (mean 9.6 cms), and 7.7 to 11.1 cms postoperatively (mean 9.1 cms).The mean dorsiflexion and plantar flexion at the metatarsophalangeal joint were 60^0 and 10^0 respectively before surgery and decreased to 55^0 and 8^0 at final follow-up, indicating a decrease in dorsiflexion- plantar flexion arc by a mean of 7^0. The AOFAS score improved from a mean of 49 preoperatively to a final follow-up score of 84 (final grading= good) and was found statistically significant (P value <0.001). Over all 33.33% (n = 10) patients had excellent results, 30% (n = 9) had good results and 33. 66 % (n=11) had fair results at the final follow-up. No poor result was reported.

Conclusion: Minimally invasive linear osteotomy of the distal end of the first metatarsal is a simple, effective and time saving procedure for the correction of mild to moderate hallux valgus.

Keywords: Percutaneous osteotomy, Hallux valgus and deformity.

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Introduction

Hallux valgus is a common pathological condition affecting the great toe. Its prevalence has been found to increase with advancing age [1,2]. Hallux valgus is not a simple deformity, but a complex deformity of the first ray, that frequently is accompanied by deformity and symptoms in the lesser toes. It has been defined by Stamm[3] as a complex progressive deformity affecting the fore-foot which is accompanied by a lateral deviation of great toe. It may be associated with rotation of the hallux, metatarsus primus varus and bunion formation of first metatarsal head. The global prevalence of the condition is approximately 23% in individuals between 18 to 65 years of age and 35% in the population over 65 years[4].

Apart from the obvious cosmetic issues, pain of the hallux arising from the formed bunion at the medial aspect of the first metatarsal head is a frequent issue. There may be difficulties in shoe wear. Furthermore, daily activities may be restricted leading to a decreased quality of life[5]. The predisposing factors for the condition are varied. Heredity, narrow toe shoes, female sex, pronated flat feet, rheumatoid arthritis and neurogenic imbalance of foot are some of the predisposing factors leading to the condition. Although various

conservative treatment modalities have been mentioned for hallux valgus, the outcomes are poor and sooner or later a surgical procedure is needed [6]. A number of surgical techniques have been described for the treatment of hallux valgus [7]. These include soft tissue procedures, bunionectomies, osteotomies, arthrodesis and combined procedures.

Minimally invasive techniques have been gaining popularity for the treatment of hallux valgus. These techniques have the advantage of minimum soft tissue trauma, preservation of the natural biology of the foot and faster rehabilitation.

The aim of the study was to evaluate the radiological and functional outcomes of percutaneous osteotomy of the distal metatarsus in patients with mild to moderate hallux valgus.

Materials and Methods

This prospective study was conducted from October 2021 to March 2023. An institutional ethical committee clearance was sought before the study. Informed written consent was taken from all the patients before participation in the study. Patients of both sexes, aged 15 to 60 years, with a mild to moderate hallux valgus (Table 1) and a minimum follow up of 1 year after the surgical procedure were included in the study.

Patients aged < 15 years and > 60 years, prior surgery for hallux valgus, severe deformity, neuromuscular disorders, peripheral vascular disease, traumatic deformity, 1st metatarso-phalangeal joint arthritis and < 1year of follow up were excluded from the study.

Table 1:

Hallux Valgus (HV) angle	Inter-Metatarsal Angle (IMA)	Grade
< 15 Degrees	< 9 Degrees	Normal
15- 20 Degrees	9-11 Degrees	Mild
21-39 Degrees	12 – 17 Degrees	Moderate
> 40 Degrees	> 18 Degrees	Severe

After admission in the hospital, the patients were thoroughly examined and evaluated. Clinical examination including examination of the bunion, visual appearance of the foot, plantar callosities, range of motion of the metatarso-phalangeal joint and first ray mobility was done. Standard weight bearing antero-posterior, lateral, oblique and sesamoid views of both the feet were taken and the Hallux Valgus angle (HV), Intermetatarsal angle (IMA) and Distal metatarsal articular angle (DMAA) were calculated (Figure1). The longitudinal axis of the first metatarsal was taken as the reference line for the position of the sesamoid. Grade 0 represented no displacement of the medial sesamoid. Grade 1 represented an overlap of < 50 % of the inner sesamoid in relation to the reference line. More than 50 % overlap represented Grade 2, while complete displacement represented Grade 3.

After satisfying the inclusion criterion, the patients were planned for surgical intervention. The AOFAS (Hallux-Metatarsophalangeal-Interphalangeal scale) was used for the quantification of the deformity[8].

Surgical Procedure (Figure 2,3,4,5,6): The procedure was done with the patient in supine position, under regional block or spinal anaesthesia, under tourniquet control. A standard surgical technique as described by Bosch [9] was followed. A skin incision of less than 1 cm was made on the medial aspect, just proximal to the metatarsal head. The dorsal and plantar periosteum was detached using this incision. The osteotomy was then performed through the sub-capital region of the first metatarsal. This was done using a 2 mm bone cutting burr, perpendicular the long axis of the first metatarsal in the sagittal plane. A 2 mm Kirschner wire inserted from the medial aspect of the base of the distal phalanx in an extra-periosteal position was used to stabilize the osteotomy after correcting the deformity by lateralizing the metatarsal head using a curved haemostat / bone lever. In the sagittal plane, correction of plantar and dorsal displacement was obtained by introducing the K wire higher or lower in the soft tissue.

The position of the K wire and the correction of the deformity was confirmed under fluoroscopy. The wound was closed, and an antiseptic dressing applied. The tourniquet was released, and a boot cast was applied.

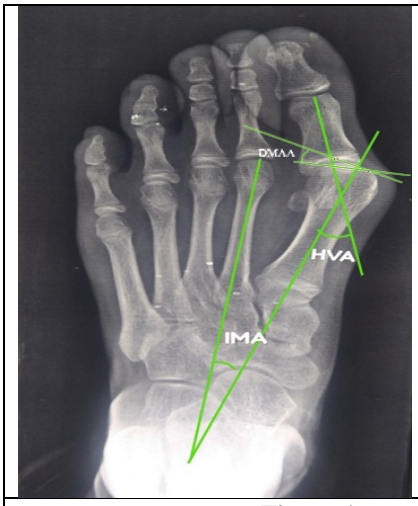

Figure 1:

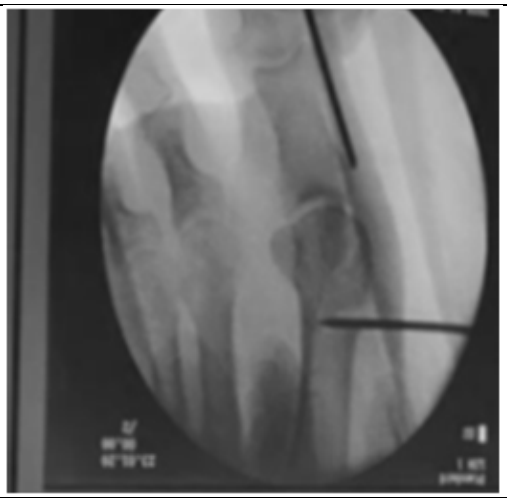

Figure 2: Identification of osteotomy site

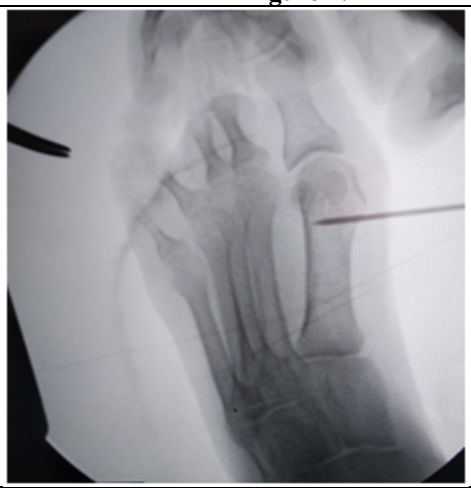

Figure 3: Passage of K wire from distal aspect

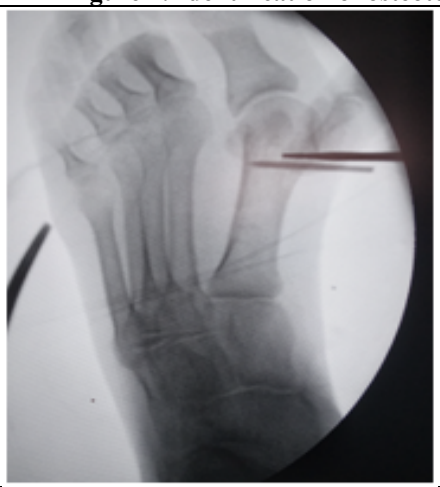

Figure 4: Osteotomy using a small osteotome

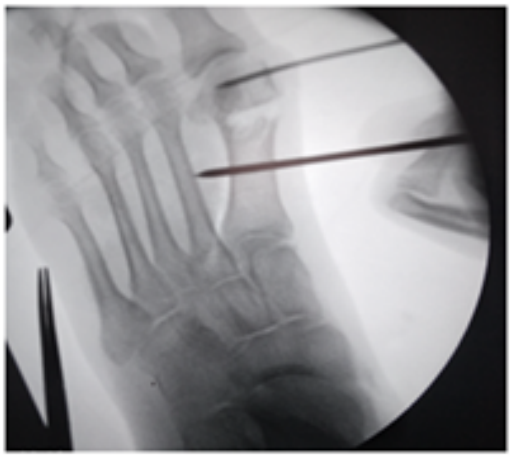

Figure 5: Osteotomy completion

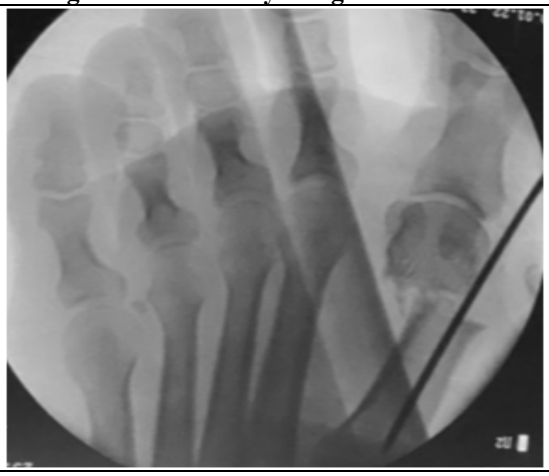

Figure 6: Passage of K wire in the proximal part

Post Operative Protocol: After the surgical procedure, the patients were kept in the recovery area. The foot was elevated and cast complications watched for. Appropriate intravenous antibiotics and analgesia were administered. On post-operative day 1, a window was made on the incision site and thewould examined and dressed. Dorsoplantar and lateral radiographs were taken and the patient ambulated with weight bearing on the heels and knee range of motion exercises. The patients were discharged on the second postoperative day. The patients were then followed at 2 weeks, 6 weeks, 8 weeks, 6 months and one year. At the 2nd postoperative week, the stitches were removed, and check radiographs were done to look for any loss of alignment and K wire back out. At 6 weeks the boot cast was removed, and passive movements at the 1st MTP joint started. The patient was advised

to wear night time hallux valgus splint, along with the use of a broad box shaped shoe. Weight bearing as tolerated was started. At 8 weeks the K wire was removed, active ROM of the 1st MTP joint started and full weight bearing started. At 6 months, a clinic-radiologic evaluation was done to check for alignment and complications. At 1 year follow up, the AOFAS (hallux-metatarso-phalangeal-interphalangeal) scale was used to assess the final outcome. This system is a 100-point scale in which assessment of pain (40 points), function (45 points) and alignment (15 points) was done and final results were graded as excellent (90-100 points), good (80-89 points), fair (70- 79 points) and poor (< 70 points) (8)

Results

A total of 30 patients ranging from 17 years to 56 years of age were enrolled in the study. The mean age was 31.4 years. A total of 24 females were enrolled in the study which constituted a total of 80 % females. The left foot was involved in 63.3 % females, while as there was bilateral involvement in 13.3 % cases. There was a positive family history in only 6 patients (20 %). Most of the patients (90 %, n = 27) presented with complaints of pain over the bunion site. This was followed by problems in foot wear in 60 % patients (n= 18). The duration of symptoms varied from 1 year to 10 years with a mean duration of symptoms of 3.3 years. The preoperative HVA ranged from 16^0 to 38^0, with a mean HVA of 29.6^0. The HVA at final follow up ranged from 10^0 to 30^0 with a mean of 14.7^0. Thus, the mean change in HVA was 14.9^0. The IMA preoperatively ranged from 9^0 to 16^0 with a mean IMA of 13.4^0. The IMA at final follow up ranged from 7^0 to 15^0 with a mean of 10.6^0, indicating a mean change in IMA of 2.8^0. Width of the feet ranged from 8.2 to 11.5 cms preoperatively (mean 9.6 cms), and 7.7 to 11.1cms postoperatively (mean 9.1 cms). This indicates a mean decrease of foot width by 5 mm.Position of the sesamoid was grade 1 in 17 patients (57 %), grade 2 in 7 patients (23%) and grade 0 in 6 patients (20 %). The mean dorsiflexion and plantar flexion at the metatarsophalangeal joint were 60^0 and 10^0 respectively before surgery and decreased to 55^0 and 8^0at final follow-up, indicating a decrease in dorsiflexion- plantar flexion arc by a mean of 7^0.

Amongst our patients, 9 out of the 30 developed complications (30%). 1 patient had under-correction of the deformity (3.34%). 1patient(3.34%) had a surgical site infection where culture was sent, pseudomonas was isolated and was treated with antibiotics. 3 patients (10%) developed bony spur around the osteotomy site at final follow-up which was managed with excision under local anesthesia. 4 patients(13.34%) had metatarsalgia.

The AOFAS score improved from a mean of 49 preoperatively to a final follow-up score of 84 (final grading= good), and was found statistically significant (P value <0.001).Overall 33.33% (n = 10) patients had excellent results, 30% (n = 9) had good results and 33. 66 % (n=11) had fair results at the final follow-up. No poor result was reported. Statistical analysis was carried out using the Statistical Package for the Social Sciences (SPSS) software version 15.0 (SPSS Inc., Chicago, USA)

Discussion

Numerous surgical procedures have been described for the management of hallux valgus, with procedures ranging from resection of portions of the metatarsophalangeal joint, to various types of osteotomies of either the proximal or distal ends of the first metatarsus [10,11]. The percutaneous osteotomies for hallux valgus performed by Peter Bosch [9], in early 1990s became the pivotal point in the development of various minimally invasive techniques for the correction of hallux valgus. These minimally invasive techniques have the advantage of smaller incision size, less operative duration, minimal hardware and faster recovery, because of better preservation of the soft tissue envelope [10,11]. The first generation minimally invasive surgery for correction of hallux valgus involved a simple medial wedge closing osteotomy of the distal 1st MT base. It was used for mild to moderate hallux valgus, but had the drawback of no change in the intermetatarsal angle. The classic Bosch osteotomy is a second-generation osteotomy for hallux valgus, and is a linear sub-capital transverse osteotomy. This is a simple, effective osteotomy which uses a single K wire in the proximal fragment for stabilization. One disadvantage of this osteotomy, is that dorsal or plantar migration of the head can occur, along with limited control of the lateral migration of the head [12]. Third generation techniques include a chevron type osteotomy done percutaneously and stabilization done with either K wires or screws. These techniques can be difficult to perform using a minimally invasive approach and may require sophisticated equipment and expertise. These also have a longer learning curve. We performed a simple second generation linear sub-capital osteotomy in the study.

A total of 30 patients (34 feet) with a mean age of 31.4 years (range 17-56 years) were included in the study. The majority of the patients were females. The age group in our study was lower as compared to other studies but sex distribution was comparable[13-15]. In our study, the left side was predominantly affected. We found predominance of the left side being affected in other major studies [16]. In our study, the average value of hallux angle preoperative was 29.6° (range 16°-38°) and at final follow-up it was 14.7° (range 10°-30°). The

average reduction in the HVA was 14.9°. The change in HVA angle was statistically significant (P value <0.001). Similar changes in the HVA were found by VanGroningen [16] in his study of 438 feet.

The average intermetatarsal angle of the cases included in our study was 13.4° (range 9-16 degrees) preoperatively, which decreased by a mean of 2.8° at the final follow-up (range 7-15 degrees). The change in IMA angle was statistically significant (P value <0.001). The results were similar to other published studies on the topic[17-18]. With regards to the width of the feet, we observed a decrease in the width of the feet by a mean of 5 mm. With a wider, splayed foot, the first metatarsus loses its mobility and leads to the issue to transfer metatarsalgia. Hence a reduction in the foot width, theoretically reduces the incidence of pain in hallux valgus patients.

In a study by W. Schneider et al [19], the authors reported a 5.5 degree decrease in the dorsi-flexion plantar-flexion arc. Another study on the same topic by Ho-Jin Lee et al. [18], reported a 4degree loss of the dorsi-flexion plantar-flexion arc. In our study we had a mean decrease of dorsi-flexion plantar-flexion arc by 7 degrees. We believe that this higher decrease in the arc is attributed to the initiallearning curve of the technique. Also, the lower sample size, lead to an apparent inflation of the mean decrease in the arc.

In our study, the average preoperative AOFAS score was 49, which improved by 35 points to 84 at the final follow-up. The change was found to be statistically significant (P value <0.001). This is comparable to other major studies on the topic [18-19]. This statistically significant improvement in the AOFAS score highlights that success of the minimally invasive surgery.

Like any surgical procedure, we encountered certain complications. We experienced under correction in one patient (3.34%). One patient (3.34 %) had a surgical site infection which settled with antibiotics. Since the K wire used for stabilization in this procedure is anchored in the proximal fragment, the lateral translation of the capital fragment can occur. This can lead to spur formation medially [20-21]. We had 3 patients (10%) with such spurs and needed excision under local anesthesia. Among the complications, we had 4 patients (13.34%) with metatarsalgia.

Although minimally invasive procedures are less likely to cause soft tissue injury, complications can occur. These are mostly related to K wires and can result in pin tract infections and loss of MTP mobility. We believe that these issues can lead to metatarsalgia in a subset of patients. There was no case of non-union or avascular necrosis of the capital fragment in our series.

Conclusion

Minimally invasive linear osteotomies of the distal end of the first metatarsal are simple, effective and time saving procedures for the correction of mild to moderate hallux valgus deformities. These have a minimal learning curve and produce excellent outcomes. Besides, complications related to conventional open procedures for hallux valgus including non-union and avascular necrosis of the capital fragment are minimal with these procedures.

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