Short-term evaluation of combined Scarf and Akin osteotomies for treatment of hallux valgus: a prospective study

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Background
Despite Scarf osteotomy was described earlier in the 20th century, it was popularized later in 2000 after modification of the original technique. The combined Scarf–Akin osteotomies were described for surgical correction of the hallux valgus, but with no significant consideration for the patient satisfaction.
Patients and methods
Twenty-three patients with unilateral painful hallux valgus deformity were treated with combined Scarf and Akin osteotomies. All patients were evaluated clinically (using American Orthopedic Foot and Ankle Society-Hallux Metatarsophalangeal–Interphalangeal scale scores) and radiologically (hallux valgus angle, intermetatarsal angle, union, evidence of degenerative changes, and joint congruity) after 12 months of follow-up. All the patients were then asked about their satisfaction and if they would undergo the same surgery under similar circumstances in the future.
Results
There were 15 females and eight males with an average age 38.8 ± 2.4 years. The mean preoperative American Orthopedic Foot and Ankle Society was 55.4 that significantly improved to 87.2 postoperatively (P<0.001). There was a significant reduction of the mean hallux valgus angle and the mean intermetatarsal angle preoperatively and postoperatively (P=0.03 and 0.034, respectively). One patient complained of a prominent screw postoperatively, while two patients suffered from superficial wound infection. At 12 months postoperatively, all operated patients were satisfied with their results and indicated that they would be happy to undergo surgery again under similar circumstances.
Conclusion
Despite the short follow-up period in our study, the combined Scarf and Akin osteotomies are a safe and effective method for treatment for hallux valgus deformity that provides statistically significant clinical and radiographic improvements with excellent patient satisfaction.
Level of evidence
Level-IV case-series study.

Keywords:
Akin osteotomy, hallux valgus, Scarf osteotomy

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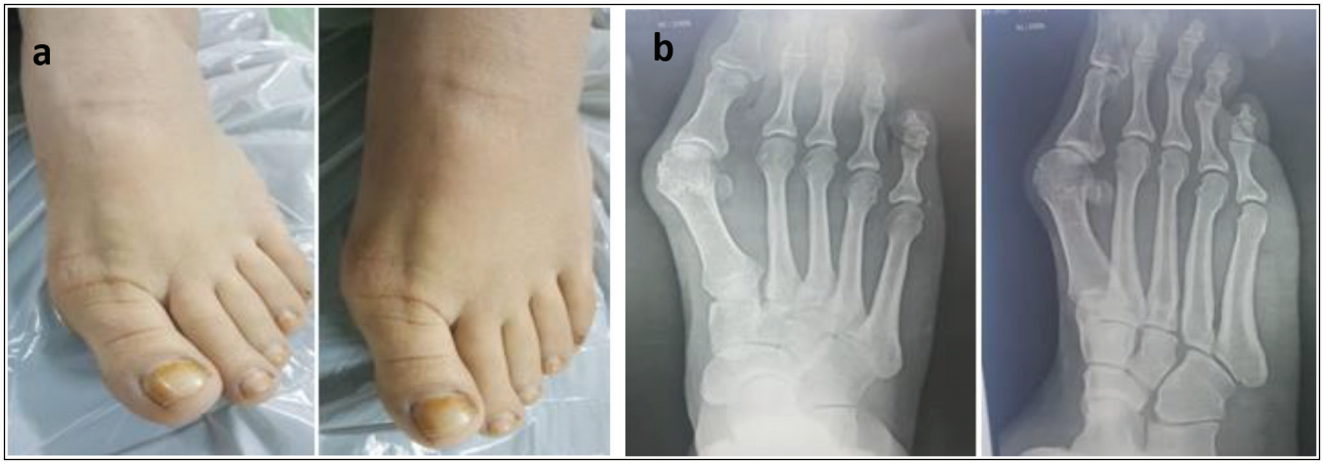
Introduction

Hallux valgus is considered the most common disease that affects the forefoot. It is more common in females than males. More than 130 techniques were described for surgical correction of hallux valgus deformity [1]. Despite the diverse procedures for correction of the hallux valgus, there is no specific procedure that can be considered the gold standard for the treatment [2]. That might be attributed to the complexity of the deformity and the different presentations of cases [3]. Another explanation could be the numerous complications after hallux valgus correction surgeries that include first metatarsophalangeal joint stiffness, recurrence of the deformity, and transfer metatarsalgia [4]. Although Scarf osteotomy was described early in the 20th century, but it has gained its popularity during the last few years as it achieved more satisfactory results attributed to its significant deformity correction with high osteotomy stability [5,6]. This progression in the clinical outcome was due to the modified technique by Weil in 2000. Meyer had described the technique for the first time, but with no method of rigid internal fixation, which negatively affected the results of the technique and consecutively its popularity. In 2000, Weil made the technique more accepted and popular by adding a method for rigid internal fixation with two AO screws [7]. Akin osteotomy was described for correction of the proximal phalanx of the first ray. Akin osteotomy could provide more correction of the

Figure 1



(a) Preoperative evaluation of the deformity, (b) preoperative radiograph of the deformity.

deformity by alignment of the hallux parallel to the second toe [8]. Many studies have evaluated the results of combined Scarf–Akin osteotomies in the treatment of hallux valgus deformity. However, by reviewing Cochrane for hallux valgus procedures, the patient satisfaction was not truly considered in the evaluation of the final outcome of the procedure as most of these studies depended on the radiological and clinical improvement. In our study, we introduce the results of the combined osteotomies for moderate and sever hallux valgus, depending not only on the clinical outcome and the radiological correction, but also on the patients' satisfaction postoperatively using the American Orthopedic Foot and Ankle Society (AOFAS) Hallux Metatarsophalangeal–Interphalangeal scores [9].

Patients and methods

This study was performed in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975. All patients gave informed consent before inclusion in the study; the study was authorized by the Institutional Review Board. This prospective, case-series study was carried out in the Orthopedic Department at Benha University Hospital between March 2012 and June 2016, and included 23 patients with unilateral hallux valgus deformity (23 feet). All patients included in this study were suffering from painful moderate-to-severe hallux valgus deformity, and were initially treated conservatively. Patients with mild hallux valgus, complex forefoot malalignment requiring additional osteotomies at the lesser metatarsals, patients with ligamentous laxity, patients with previous forefoot surgery, patients with rheumatoid arthritis or neurological disorders, and those who are seeking surgery for cosmetic purpose were excluded from the study.

Table 1 Classification of the severity of hallux valgus deformity according to hallux valgus angle and intermetatarsal angle

Severity	HVA	IMA
Mild	<19°	<13°
Moderate	20–40°	14–20°
Severe	>40°	>20°

HVA, hallux valgus angle; IMA, intermetatarsal angle.

All patients were evaluated clinically and radiologically to assess the degree the hallux deformity (Fig. 1). The feet were examined clinically in both standing and nonweight-bearing. All feet were examined to address any peripheral, neurological, or skin disease. Standard preoperative radiographic assessment of the hallux valgus deformity included dorsal–plantar and lateral weight-bearing views of the foot. Severity of the deformity could be determined according to the hallux valgus angle (HVA) (angle of a bisection of the first metatarsal and proximal phalanx) and intermetatarsal angle (IMA) (angle of a bisection of the first and second metatarsal) (Table 1). Also, the first MPJ congruency, first MPJ degeneration, and the position of the sesamoids should be assessed.

Operative technique

All surgeries were done under spinal anesthesia. A medial incision was done extending from the distal end of the proximal phalanx of the hallux proximally to the base of the first metatarsal bone. The medial branch of superficial peroneal nerve was isolated and protected with a rubber band. The incision was deepened and the capsule of the first MTP joint was opened. A blunt bone lever was introduced between the sesamoid apparatus and the metatarsal head, and then the adductor hallucis tendon and the lateral sesamoid ligament were released. For soft-tissue release, the same medial incision was used in 20 cases, while in the other three cases, an additional lateral incision was

Figure 2

(a) Postoperative view of the correction, (b) postoperative radiograph.

used. The bunion was excised just medial to the sulcus groove of the metatarsal head using an electrical saw. A Kirschner wire was introduced just proximal to the articular surface of the metatarsal head and plantar to the metatarsal dorsal cortex, the Kirschner wire was directed plantarly toward the third metatarsal bone and perpendicular to the longitudinal axis of the second metatarsal bone. A Z-shaped Scarf osteotomy was performed with the vertical limbs parallel to the joint lines, while the longitudinal part was done in the middle of the metatarsal bone shaft directed from dorsal distal to plantar proximal. The plantar fragment was rotated laterally to correct the valgus deformity, the two osteotomized fragments were fixed primarily with two Kirschner wires. The position was checked under the image and then fixed with two 2.0 cortical compression screws. The excess bone of the dorsal fragment was cut. A closing-wedge (Akin) osteotomy was done at the base of the proximal phalanx of the hallux and fixed with a single 1.2-threaded Kirschner wire. Excess medial capsular tissue was excised. The capsule was closed using 2/0 vicryl (Fig. 2).

Postoperative follow-up

Patients were reviewed at 2, 6, and 12 weeks, and finally at 12 months. Preoperative and postoperative AOFAS Hallux Metatarsophalangeal–Interphalangeal scale scores were recorded for each patient included in the study. Clinical evaluation at 12 months included assessment of the scar, evidence of nerve damage, evidence of infection, and range of motion of the first MTP joint. Any pain or tenderness of the lesser MTP joints was also recorded. All the patients were then asked if they were completely satisfied, satisfied with reservations, or dissatisfied with the results of their surgery. Finally, the patients were asked would they be happy to undergo the same surgery under similar circumstances in the future. The patients also had preoperative and 12-month postoperative radiographic assessments (HVA, first IMA, union, evidence of degenerative changes, and joint congruity).

Statistical analysis

Statistical analysis was performed using SPSS, version 19.0 (SPSS, Inc., an IBM Company, Chicago, Illinois, USA). Statistical analysis was done using a two-tailed Student *t* test, and *P* value less than 0.05 was considered statistically significant.

Results

This study included 23 cases who underwent surgery for hallux valgus in the form of Scarf osteotomy fixed with two screws and Akin osteotomy fixed with Kirschner wire. There were 15 females and eight males. The average age was 38.8 ± 2.4 years (range, 21–70 years). Fifteen out of 23 cases were right side. None of our patients was diabetic, alcoholic, or smoker.

The mean preoperative AOFAS was 55.4 ± 10.5 (range, 44–69) and the mean postoperative AOFAS at the last follow-up was 87.2 ± 11.4 (range, 73–98), indicating a statistically significant ($P<0.001$) improvement. The clinical outcome of all operated cases can be seen in Table 2.

Regarding the radiological measurement, there was a significant reduction of the mean HVA and the mean IMA preoperatively and postoperatively ($P=0.03$ and 0.034, respectively). The mean preoperative HVA measured on weight-bearing radiographs was 31.4 ± 8° (range, 20.5–45.8°) that decreased postoperatively to 16.1 ± 6.8° (range, 12.3–18.8°). The mean preoperative IMA measured on weight-bearing radiographs

Table 2 The clinical and radiological outcome of the patients

Parameters	Preoperative	Postoperative	*P* value
Total AOFAS score			
Mean±SD	55.4 ± 10.5	87.2 ± 11.4	<0.001
Range	44–69	73–98	
AOFAS alignment score			
Mean±SD	4.2 ± 3.8	9.2 ± 1.5	<0.001
AOFAS pain score			
Mean±SD	22.8 ± 8.6	34.8 ± 7.6	<0.001
AOFAS-function score			
Mean±SD	28.4 ± 5.2	43.2 ± 3.8	<0.001
Hallux valgus angle			
Mean±SD	31.4 ± 8	16.1 ± 6.8	0.03
Range	20.5–45.8°	12.3–18.8°	
Intermetatarsal angle			
Mean±SD	17.8 ± 4	10 ± 4.1	0.034
Range	15.8–23.5°	2.3–10.8°	

AOFAS, American Orthopedic Foot and Ankle Society.

was 17.8 ± 4° (range, 15.8–23.5°) that decreased postoperatively to 10 ± 4.1° (range, 2.3–10.8°).

Intraoperatively, there were no serious complications. Postoperatively, there were two (13.04%) complications in three patients. One patient complained of a prominent screw postoperatively that needed implant removal later. Two patients suffered from superficial wound infection that resolved by sterile daily dressing and a short course of oral antibiotics. Otherwise, there were no nonunion, malunion, delayed unions, avascular necrosis, metatarsal osteotomy fractures, or transfer metatarsalgia within this study, or any hallux valgus reoccurrence at the 12-month follow-up.

At 12 months postoperatively, all operated patients were satisfied with their results. The three patients that developed either metal irritation that required removal or superficial infection were also completely satisfied, even before implant removal. All cases of the study group indicated that they would be happy to undergo surgery again under similar circumstances. All cases were happy with their cosmetic appearance.

Discussion

Many studies have shown satisfactory results with using Scarf osteotomy for correction of moderate-to-severe forms of hallux valgus deformity [6]. In the seventies, Burutaran described the first Z osteotomy for hallux valgus [10]. However, the first Z osteotomy was described by Meyer in the 1920s and it was not described for hallux valgus [11]. Scarf osteotomy is known among other hallux valgus osteotomies to be very stable, one due to its large surface area. This inherent stability also provides the advantage of early mobilization and reduced incidence of postoperative stiffness [12]. The geometric properties of Scarf osteotomy provide other privileges as it allows shortening or lengthening and dorsal or plantar displacement, when needed [9]. The Scarf osteotomy also allows considerably IMA reduction and can be modified to enable the first metatarsal to be lengthened or shortened, and plantarly or dorsally displaced.

Many methods of fixation techniques described for the Scarf osteotomy were described in literature as threaded Kirschner wires' [10] one [13,14] or two screws [6,10,12]. The general consensus is two points of fixation directed from the dorsal cortex toward the plantar cortex [6,9]. There is a common consensus that two compression-screw methods are the most rigid and stable method for fixation [15,16]. Barouk [4] had developed his own screw for the fixation, but later on, he advocated the use of two screws. However, Renee *et al*. [11] placed the distal screw into the metatarsal head as this allowed better fixation, especially in osteoporotic cases. In a study by Law *et al*. [12], distal fixation was achieved via bone cerclage using an absorbable suture and proximal fixation via an impacted autologous bone graft because there was no space left for a screw due to the degree of translation [17].

Akin has described his technique for the first time in 1925 for correction of distal articular angle in hallux valgus deformity [18]. In 2000, Weil published his study in which he followed up 889 patients for 7.5 years after being treated surgically for hallux valgus deformity with Scarf osteotomy. He found that 95% of the patients were fully satisfied from the treatment and even is willing to repeat the same surgery whenever it is indicated [6]. In the same year, Barouk published another study and he has given comparable results to those of Weil. In the same study, Barouk has used Akin procedure as a combining osteotomy to Scarf osteotomy in 80% of his patients [4]. In 2001, Crevoisier and colleagues published their study describing satisfactory

results with Scarf–Akin combined osteotomies for hallux valgus deformity [13]. In 2004, Jones and colleagues also published their study with comparable results for treatment of hallux valgus with Scarf–Akin combined osteotomies [9].

Despite the accepted results of the combined Scarf–Akin osteotomies, some authors described some disadvantages. Weil in his study described three cases of osteonecrosis [6]. Barouk experienced secondary stress fractures in 3% of his patients [4]. However, in a series of 1000 cases of Scarf osteotomies, Dereymaeker had experienced only two cases of stress fractures [5]. Although we did not experience delayed union, malunion, fracture, or early recurrence of the deformity at 12-month follow-up interval, these complications were recorded in one study published in 2003 by Ferrari *et al.* [14]. On the other hand, Weil [6] and Barouk [4] found overcorrection, undercorrection, and postoperative stiffness to be rare complications with Scarf osteotomy.

In our study, the mean postoperative AOFAS score (including the pain score) is 87.2, which is comparable with the results of Maher *et al.* [19] in their study as the mean postoperative AOFAS score was 93.3. The mean postoperative AOFAS score is comparable also to that in Ajay Malviya in their study [20] where it was 92.5.

In the study of Maher *et al.*, the mean reduction of the IMA (from 13.9 to 3.0) is more than that in our study (from 17.8 to 10.0), while our results are more comparable when compared with the study results of Ajay Malviya *et al.* where the mean intermetatarsal-angle reduction was from 15.8 to 7.5.

In our study, the mean HVA reduction was from 31.4 to 16.1, which is comparable to the reduction of mean HVA in the study of Ajay Malviya *et al.* as it was reduced from 37.9 to 16.4 and also comparable to the reduction of the mean HVA in the study of Maher *et al.*, where it was reduced from 31.9 to 9.2.

There are certain limitations of this study as sample size is relatively small, absence of control group, the short-term duration of follow-up, and lack of the use of validated patient-reported outcome measures, such as the Manchester Oxford Foot Questionnaire. However, this has subsequently been adopted to determine more accurately patient satisfaction regarding the final outcome.

Although the duration of follow-up was only 12 months, which is too small to assess for recurrence of deformity, the authors believe that the surgical technique of the combined Scarf and Akin osteotomies and fixation method has provided adequate correction with a relatively low rate of complications with excellent patient satisfaction.

Conclusion

Despite the short follow-up period in our study, the combined Scarf and Akin osteotomies are a safe and effective method for treatment for hallux valgus deformity that provides statistically significant clinical and radiographic improvements with excellent patient satisfaction.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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