Scarf osteotomy in severe hallux valgus deformity

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Context
Hallux valgus is one of the most common forefoot deformities. Multiple operative techniques are described for the correction of this deformity. Diaphyseal osteotomies like scarf osteotomy proved to improve from moderate to severe degrees.
Aims
The aim of this study was to evaluate the results of scarf osteotomy over a minimum 1-year follow-up for patients with severe hallux valgus.
Settings and design
A case series study held at Alexandria University, El-Hadra University Hospital.
Patients and methods
Forty-one osteotomies in 37 patients were done from February 2012 to October 2014. The mean follow-up was 14 months (12–18 months). The mean intermetatarsal angle was 20.4°. The mean hallux valgus angle was 43.5°. The patients were evaluated using the American Orthopaedic Foot and Ankle Society score.
Results
The average follow-up was 1 year. All cases achieved radiological union at an average of 2.5 months. The mean AOFAS score improved from 58 to 95 points. The mean intermetatarsal angle improved from 20.4° to 12.1°. Two patients reported postoperative stiffness of the metatarsophalangeal joint. There were no cases of pseudarthrosis or osteonecrosis of the metatarsal head.
Conclusion
Scarf osteotomy for moderate to severe degrees of hallux valgus had very good results over 1 year follow-up with a low complication rate.

Keywords:
forefoot deformity, hallux valgus, scarf osteotomy

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Introduction

Hallux valgus deformity consists of lateral subluxation of the first metatarsophalangeal (MTP) joint, metatarsus primus varus, and lateral deviation of the sesamoids [1]. Surgical treatment of this deformity involves correction of alignment with an appropriately chosen metatarsal osteotomy and soft tissue releases [2]. Distal osteotomies of the first metatarsal are primarily advocated for mild to moderate hallux valgus deformities. For more severe deformities, more proximal first metatarsal osteotomies have been performed like Scarf osteotomy [3].

Biomechanical studies suggest that the scarf procedure provides more mechanical stability than distal chevron osteotomy or a proximal crescentic osteotomy. Rigid compression and a large surface area for bone healing may be responsible for this solidity. Given the stability of the construct, early passive ROM followed by active mobilization to minimize postoperative scarring in and around the first MTP joint are highly emphasized [3,4]. The term 'scarf' is a carpentry term referring to a joint created by notching two pieces of wood [5].

The indications for the scarf osteotomy are wide ranging, from mild to severe deformities. Specific contraindications are severe: first, tarsometatarsal instability, osteoarthritis of the first MTP joint, and severe osteoporosis. The advantages of this osteotomy over other shaft osteotomies are its inherent stability and rigid compression at the osteotomy site, which allows for immediate weight-bearing and the option for bilaterally [6–8].

This study was conducted to evaluate the results of Scarf osteotomy in patients with moderate to severe hallux valgus deformity. We hypothesize that Scarf osteotomy would have good clinical results in patients with severe hallux valgus deformity.

Table 1 Demographic data of the participants

Number of patients (*n*)	41
Sex [*n* (%)]	
Females	34 (82)
Males	7 (18)
Side [*n* (%)]	
Left	24 (58.8)
Right	17 (41.2)
Symptoms (%)	
Transfer metatarsalgia	85
Bunion pain	29
Cosmesis	73
Occupation (%)	
Housewives	76
Manual worker	12
Office work	12
Age (years)	
Mean	47.64
Range	42–59
Follow-up (months)	
Mean	14
Range	12–18

Table 2 Preoperative radiographic data of the participants

	Mean	Range
Intermetatarsal angle	20.4°	18°–24°
Hallux valgus angle	43.5°	39°–46°
Proximal phalangeal articular angle	15.4°	12°–17°
Distal metatarsal articular angle	21.4°	15°–24°

Patients and methods

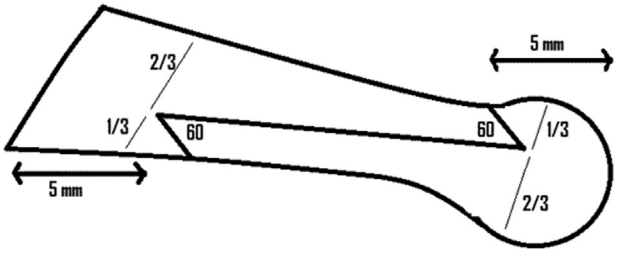
Forty-one osteotomies in 37 patients were analyzed from February 2012 to October 2014. There were four bilateral cases. The mean follow-up was 14 months (12–18 months). The average age at the time of intervention was 47.6 years (range: 42–59 years). The left side was the more affected (*n*=24 patients, 58.8% of the cases). The main symptom was pain due to the bunion and transfer metatarsalgia in 85% of the cases. Thirty-four (82%) patients were women and most of them were housewives (Table 1).

Radiologically, the mean intermetatarsal angle was 20.4° (range: 18°–24°). The mean hallux valgus angle was 43.5° (range: 39°–46°). The mean sesamoid subluxation was 60% (range: 50–75%). The mean proximal phalangeal articular angle was 15.4° (12°–17°). The mean distal metatarsal articular angle was 21.4° (range: 15°–24°). MTP joint was incongruent in 80% of the cases (Table 2).

The surgical technique

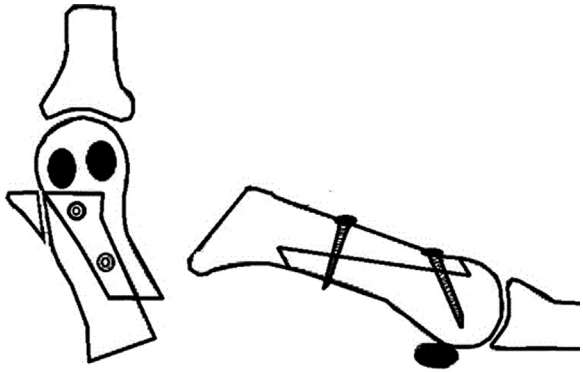
All the cases were operated under general anesthesia. High thigh tourniquet was applied after antibiotic prophylaxis in the form of 2 g third-generation cephalosporin. All cases were operated in the supine position. A standard medial incision over the first MTP joint was made. The capsule was resected and elevated from the bone to expose the lateral aspect of the joint. The lateral sesamoid was exposed from the same incision. A lateral soft tissue release was performed. The medial bunion was resected using a saw blade. Standard scarf osteotomy cuts were made in the first metatarsal (Z-shaped osteotomy, Fig. 1).

Figure 1



Technique of Z-shaped Scarf osteotomy. First K-wire (KW) inserted 5 mm from the MTP joint, second KW inserted 5 mm from the metatarsocuneiform joint. The first KW inserted more proximal in the head in the junction between superior one-third and inferior two-thirds. The second KW inserted more inferior at the junction between superior two-thirds and inferior one-third.

Figure 2



Displacement of osteotomy fragments to achieve correction and position of the seasmoids under the head of the first metatarsal. Usually two screws are sued to fix the osteotomy in the illustrated direction.

The two fragments were mobilized to achieve acceptable correction of the deformity. The position was checked with intraoperative fluoroscopy until the exact alignment was achieved. Once this was established, a bone clamp was used to secure the construct and provisional Kirschner wires were drilled proximally and distally.

The final position was secured with two or three 2.7 mm cortical screws (Fig. 2). The inferior proximal and distal dorsal residual prominences were resected to allow a flush medial border. Congruency of the joint and the position of the sesamoid sling relative

Figure 3

Preoperative anteroposterior weight-bearing view of the left foot showing severe hallux valgus deformity with intermetatarsal (IM) angle of 21.4° and hallux valgus (HV) angle of 43.1°.

to the metatarsal head were restored. At the end of the operation, the capsule was sutured back together with 0 Vicryl under sufficient tension to maintain congruency of the sesamoid joint (Figs 3–5).

The decision to perform Akin osteotomy (Fig. 6) of the proximal phalanx was done intraoperatively. Twelve cases underwent Akin medial closing wedge osteotomy. The Akin osteotomy was performed using a saw blade to cut from medial to lateral. The soft tissues were protected with a small retractor. The two opposing surfaces were then pinned using a K-wire, and clinical and fluoroscopic evaluations were used to determine that proper alignment had been achieved. Once the accepted position was achieved, the osteotomy was fixed with one 2.7 mm cortical screw.

Postoperatively, no cast was done. A well-padded bandage was applied. The patients were encouraged to be non-weight-bearing for 48–72 h after surgery with aggressive antiedematous measures to reduce swelling, and thereafter allowed to increase heel weight-bearing gradually according to pain tolerance.

Figure 4

Complete correction of the deformity after closure of the wound.

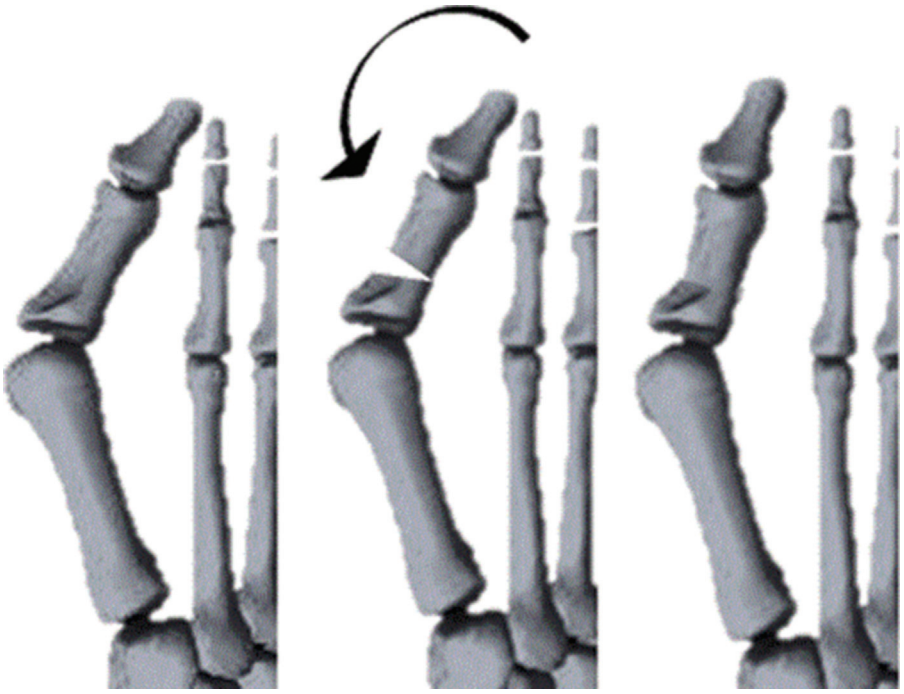
Figure 5

Anteroposterior radiograph showing complete correction of the deformity with healing of scarf osteotomy 2 months postoperatively.

At 2 weeks, sutures were removed and the patient was allowed to ambulate as tolerated.

Preoperative and postoperative clinical data were assessed and analyzed. The American Orthopaedic Foot and Ankle Society (AOFAS) forefoot score was completed by all patients preoperatively and at

Figure 6



An illustration showing the Akin osteotomy. A medial closing wedge is performed at the base of the proximal phalanx of the hallux. It is usually fixed by a K-wire or an oblique screw.

2, 6, and 12 months postoperatively. ROM was measured at the time of follow-up visits using a standard goniometer. Radiologically, all patients were submitted to anteroposterior and lateral views of the affected foot preoperatively, immediate postoperatively, and 2 and 6 months postoperatively to asses union of the osteotomy and measure angles of deformity.

Statistical analysis

Data were calculated and statistically analyzed with SPSS software (version 20.0; SPSS Inc., Chicago, Illinois, USA). The results were analyzed using the appropriate statistical test. Comparison between preoperative and postoperative results was done using Wilcoxon's signed-rank test. Fisher'sexact test was used for nominal data. A *P* value of 0.05 was considered statistically significant.

Results

The average follow-up was 1 year. All cases achieved radiological union at an average of 2.5 months (range: 2–3 months). The mean AOFAS score improved from 58 points (range: 52–61 points) preoperatively to 95 points (range: 73–96 points) at the final follow-up (Fig. 7).

At the final follow-up, the mean intermetatarsal angle improved from 20.4° (range: 18°–24°) to 12.1° (range: 10°–13°). The mean hallux valgus angle improved from 43.5° (range: 39°–46°) to 15.3° (range: 13°–17°). The mean proximal phalangeal articular angle improved from 15.4° (range: 12°–17°) to 8.7° (range: 7°–9°). The mean distal metatarsal articular angle improved from 21.4° (range: 15°–24°) to 12.2° (range: 11°–14°). All these improvements were statistically significant with *P* values of less than 0.05 (Table 3).

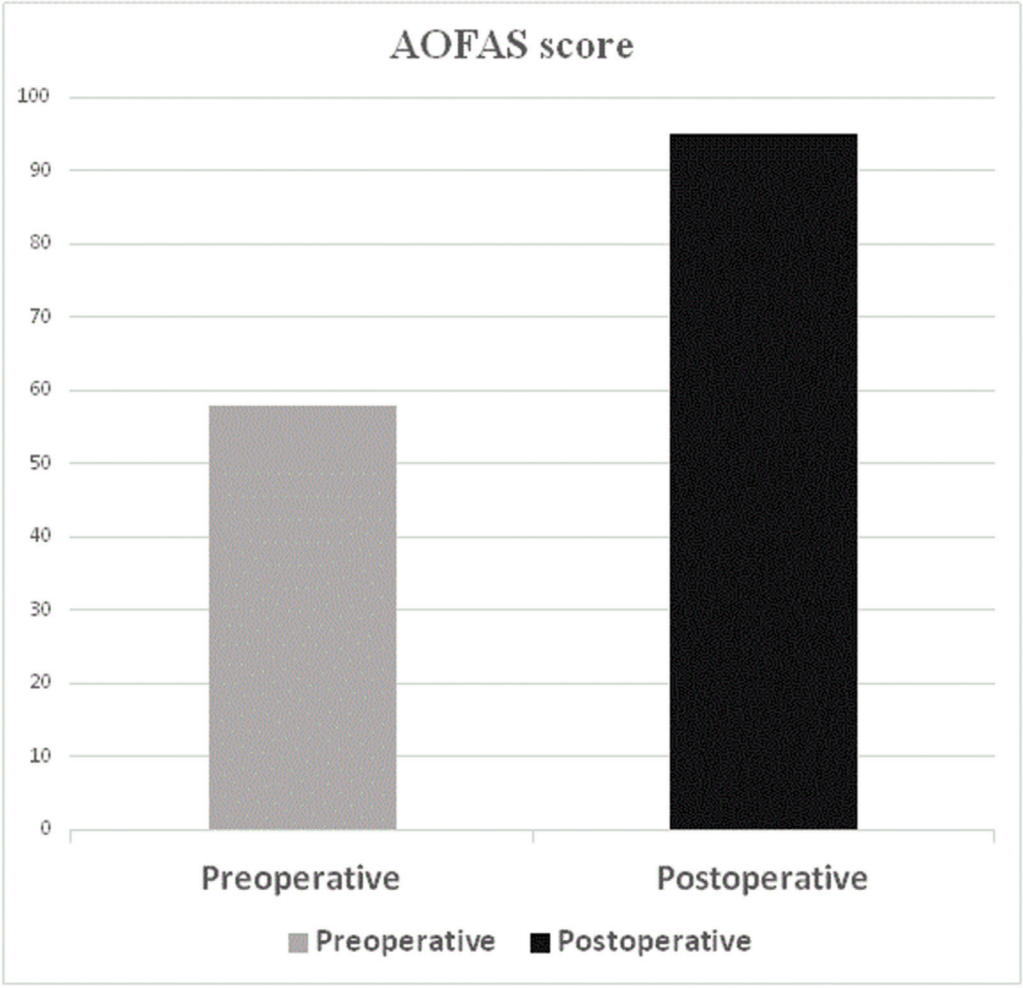
Two patients reported postoperative stiffness. One of them improved on physiotherapy and the other needed additional manipulation under anesthesia. No cases of overcorrection were reported. Two patients had superficial wound infections that improved on conservative therapy. There were no cases of pseudarthrosis or osteonecrosis of the metatarsal head. One case reported neuroma in the wound scar.

Discussion

Several procedures have been described for operative management of hallux valgus. Diaphyseal osteotomies have become popular for the more severe deformities because they allow greater correction than distal osteotomies [9]. Procedures in this category are the scarf, or Z osteotomy [10], the Mau and Lauber [11], and the Ludloff osteotomy [12].

The scarf procedure is a multiplanar osteotomy that allows intermetatarsal angle reduction, metatarsal

Figure 7



Improvement of the AOFAS score from preoperative 58 to 95 points postoperatively.

Table 3 Comparison between the preoperative and postoperative radiographic values

	Preoperative	Postoperative	*P* value
Intermetatarsal angle	20.4°	12.1°	<0.05
Hallux valgus angle	43.5°	15.3°	<0.05
Proximal phalangeal articular angle	15.4°	8.7°	<0.05
Distal metatarsal articular angle	21.4°	12.2°	<0.05

shortening, and distal metatarsal articular angle correction all at the same time. It has been established that the scarf osteotomy associated with lateral soft tissue release and, when indicated, the Akin osteotomy are suitable in the treatment of moderate and severe hallux valgus deformities [8].

Sarrafian [13] analyzed the mathematical possibilities in distal lateral displacement osteotomies such as Mitchell and Chevron using a geometric model. His calculation showed that there is a limit for the possible correction. This is due to the fact that there must always be bony contact to avoid osteonecrosis or instability.

With the scarf osteotomy, due to the 'Z' shape of the cut, a contact zone between the two parts as narrow as one-third of the diaphyseal broadness seems to provide sufficient primary stability without the risk of osteonecrosis. This makes it possible to achieve an important lateral translation and consequently a greater correction of the intermetatarsal angle [14].

In the present study, the mean intermetatarsal angle improved from 20.4° to 12.1° ($P<0.05$). The mean hallux valgus angle improved from 43.5° to 15.3° ($P<0.05$). There was no loss of correction till the final 1 year follow-up. All patients improved according to AOFAS score from the preoperative mean of 58 points (range: 52–61 points) to a postoperative mean of 95 points (range: 73–96 points) at the final follow-up ($P<0.05$).

Regarding complications, only two patients had postoperative stiffness and one patient had postoperative scar neuroma. No cases of undercorrection or persistent pain were reported till the final follow-up. Fixation was done using two or three screws and the patients were allowed to bear weight as tolerated after the third postoperative day, and no loss of fixation was seen.Adam *et al.* [5] found the preoperative AOFAS score improved postoperatively by 40 points, with 85% of patients stating that they would have the procedure again and 94% of patients being satisfied. Other studies have shown similar improvements in AOFAS scores: Kristen *et al.* [8] from 50.1 to 91 points, Lipscombe *et al.* [15] from 47.9 to 96.1 points, and Jones *et al.* [16] from 52 to 89 points.

A proximal phalanx medial closing wedge osteotomy (Akin) has been reported to be combined with scarf osteotomy and distal soft tissue realignment in 70–100% of cases [7,17]. In this study, only 12 cases needed Akin osteotomy. The decision was made intraoperatively.

Smith *et al.* [18] reported a 6% perioperative complication rate from their early experience to create awareness for those beginning to master scarf osteotomy. Coetzee and Rippstein [19] reported a complication rate of 47%.

Murawski *et al.* [20] reported postoperative metatarsophalyngeal stiffness in six (4%) patients, three of whom had an additional manipulation under anesthesia in the postanesthesia care unit for recurrent symptoms after a period of deep tissue massage and class IV laser therapy. The reported incidence of stiffness after a scarf osteotomy is between 11 and 41.7% [16,21].

The limitation of this study is the short follow-up (1 year) and limited number of patients with lack of control group.

Conclusion

The short-term results of scarf osteotomy combined with distal soft tissue release and eventually with the Akin osteotomy for severe hallux valgus deformities are generally good and the complication rate is very low.

Conflicts of interest

The study was approved by the institutional ethics committee in the Department of Orthopaedic Surgery and Traumatology, El-Hadra University Hospital, Alexandria University, Alexandria, Egypt.

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