Scarf osteotomy for the correction of moderate and severe degrees of hallux valgus

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Received: 7 July 2017
Revised: 12 August 2017
Accepted: 22 October 2017
Published: 6 January 2022

The Egyptian Orthopaedic Journal 2021, 56:219–224

Aim
The aim of this study was to evaluate the clinical and radiological results of scarf osteotomy in correction of moderate and severe degrees of hallux valgus (HV).
Patients and methods
Between April 2011 and June 2014, 21 patients with 25 feet of moderate to severe HV deformity were included in this prospective study. The study was conducted to evaluate the clinical and radiological results of correction of moderate to severe HV deformity using scarf osteotomy.
While a Z-shaped step-cut osteotomy was used to realign the first metatarsal bone, and another closing-wedge osteotomy of Akin osteotomy may be needed in severe cases to complete the correction of the proximal phalanx of the HV in 15 feet. There were five men and 16 women, with a mean age of 24 years. The mean follow-up time was 24 months.
Results
Overall, 84% of the patients were very satisfied, 12% were satisfied, and 4% were not satisfied. The mean American Orthopedic Foot and Ankle Society score improved significantly from 36 points preoperatively to 94 at the final follow-up. The intermetatarsal and HV angles improved from the mean preoperative values of 18° and 37° to 8° and 13°, respectively. Satisfactory healing time was expressed as an average return back to work after 6 weeks and back to sports after 12 weeks. Persistence or recurrence of HV was seen in one patient; wound infections occurred in two patients, which settled after the administration of antibiotics; and one patient required further surgery to remove a long distal screw.
Conclusion
The scarf osteotomy combined with the Akin closing-wedge osteotomy is safe and effective for the treatment of HV.

Keywords:
hallux valgus, metatarsal Z osteotomy, scarf osteotomy correction

Egypt Orthop J 56:219–224

1110-1148

Introduction

As many procedures are known for the treatment of hallux valgus (HV), these procedures may target soft tissue, bone, or both. Surgical correction has remained a challenge over the past 100 years [1]. The choice of operation depends principally on the severity of the deformity [2]. The corrective osteotomy of the first metatarsal bone to reduce an increased intermetatarsal angle is performed using a Z-shaped step-cut, scarf osteotomy. Meyer [3,4] first described the principle of this osteotomy technique in search for greater stability of the corrective first metatarsal osteotomies. Approximately 70 years later, micro-oscillating saws allowed angulated osteotomy cuts in bone. Early weightbearing owing to great inherent stability and rare postoperative complications have contributed to its frequent application [5,6]. The proximal osteotomy along with a soft tissue procedure and the proximal Akin osteotomy, with their high corrective potential, are excellent procedures in the treatment of moderate to severe HV deformities. However, sagittal-plane instability frequently leads to prolonged osseous healing and first metatarsal dorsiflexion malposition [7,8]. Therefore, midshaft osteotomies may fill the gap between the limitation of distal osteotomies and the instability of proximal osteotomies. An increased intermetatarsal angle (IMA), a normal or increased distal metatarsal articulation angle, adequate bone stock, and symptomatic HV deformity have been established as major indications for the scarf osteotomy [9,10]. The scarf osteotomy has gained popularity because of its inherent stability, minimal shortening of the first metatarsal, and ease of internal fixation [11].

Patients and methods

Between April 2011 and June 2015, 21 patients were treated. Four of them had bilateral affection; therefore, 25 feet underwent scarf osteotomy of the first metatarsal and an Akin closing-wedge osteotomy of the proximal

phalanx of the great toe for creation of a congruent joint, where the midline of the osseous structures crosses the midline of the joint, so the weightbearing forces should pass through or near the center of the joint. The study was approved by the institutional ethics committee in the Orthopedic Department of Orthopaedic Surgery, Seuz canal University, Egypt. The akin osteotomy should be consider after performing the scarf osteotomy if the toe is still deviated.

Preoperative complaints included a bunion, pain, and difficulty with footwear. There were 16 females and five male patients. Only one male patient had bilateral affection. The right side was affected in 13 feet and left side was in 12 feet. The ages of our patients ranged between 19 and 46 years, with a mean of 24 (±4.6) years.

Selection criteria

Only adult patients with moderate to severe hallux valgus deformity were included. We excluded patients with DM, peripheral vascular disease, hallux rigidus, open epiphyseal plates, absent pedal pulses, and local infection.

All patients were subjected to a meticulous general and local examinations before and after surgery, and roentgenographic analyses were performed, including standard dorso-plantar and lateral standing pre- and postoperative radiographs (Fig. 1). The parameters measured included the IMA, the hallux valgus angle (HVA), and assessment of the sesamoid position.

The research committee of American Orthopaedic Foot and Ankle Society has developed a grading scale, using a four-position assessment. Simplified from the approach of Hardy and Clapham, there is no loss of clinical relevance and measurements should have less variability. This method also relates the position of the tibial sesamoid to the longitudinal axis of the first metatarsal. A sesamoid, which has no lateral displacement relative to the bisection line, is deemed as grade 0. Grade 1 occurs when there is an overlap of less than 50% of the sesamoid to the bisection. Grade 2 is when the overlap of the sesamoid becomes greater than 50% of the bisection. Finally, when the sesamoid is completely displaced laterally beyond the reference line, it is called grade 3 [12].

Figure 1

Preoperative radiological assessment.

Assessment of the final outcome

All patients were evaluated before and after operation by a single observer. The clinical evaluation was both subjective and objective. As part of the subjective assessment, the patients were asked if they were very satisfied, satisfied, or not satisfied with the results of surgery:

(1) Relief of the symptoms.
(2) Ability to wear normal shoes.
(3) Good range of motions at the first metatarsophalangeal joint of 40 degree or more (50–55).
(4) Correction of HVA to 20 degrees or less.
(5) Good cosmetic correction.

The presence of all aforementioned criteria means excellent results, whereas the presence of four criteria gives good results, presence of three criteria means fair results, and presence of two criteria or less means poor results.

The scale developed by the American Orthopaedic Foot and Ankle Society (AOFAS score) was used for the objective assessment. The questionnaire was completed at the preoperative assessment clinic and at the final follow-up. The preoperative AOFAS score was not available to the patients or assessor at the final review, thus eliminating bias (Table 1).

Surgery was proposed after failure of a trial of nonoperative treatment, which included using accommodating shoes, orthoses, and nonsteroidal anti-inflammatory drugs.

Follow-up visit after surgery were weekly in the first month, monthly for 5 months, and every 3 months for 1 year. Regular radiological and clinical evaluations were done every visit, The follow-up period ranged between 1 and 3 years.

Table 1 Clinical and radiological result

AOFAS	Preoperative measurements	Postoperative measurements
GLOBAL 100	36 (12–60)	94 (80–100)
PAIN (MAX 40)	11 (0–22)	37 (34–40)
FUNCTION (MAX 45)	16 (8–24)	43 (40–45)
ALIGNMENT (MAX 15)	4 (2–6)	14 (13–15)
RADIOGRAPHIC ANGLES		
IMA	17 (12–22)	7 (4–10)
HVA	35 (22–48)	17 (12–22)
Sesamoid subluxation	68% (25–75)	8% (0–75)

AOFAS, American Orthopaedic Foot and Ankle Society.

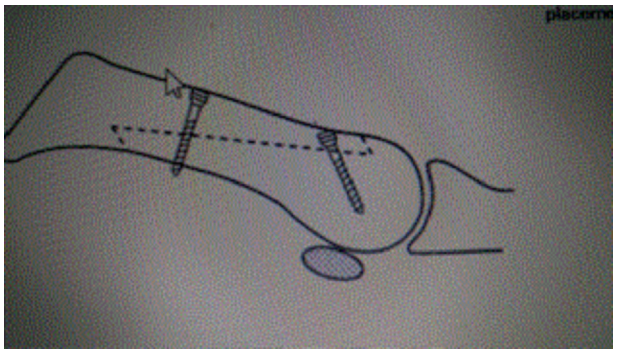
Operative technique

All the operative procedures were carried out by under spinal anesthesia or general. A mid-thigh pneumatic tourniquet (300 mmHg) was used. A lateral soft tissue release was undertaken through a dorsal skin incision between the first and second metatarsal heads. A separate dorsomedial longitudinal skin incision was made over the first MTP joint (Fig. 3). The length of the skin incision varied depending on the length of the first metatarsal Z (Scarf) osteotomy. The medial aspect of the first MTP was exposed after a longitudinal capsulotomy. Using a pneumatic oscillating saw, the medial eminence of the first metatarsal head was resected. The scarf (Z) osteotomy was then cut with the oscillating saw (Fig. 2) [13]. The transversal cuts are chevron-like cuts (45° angle with the longitudinal cut), which are perpendicular to the second metatarsal (slightly backwards). The dorsal aspect of the distal transversal cut should be 5 mm proximal to the cartilage. The proximal transversal cut is placed 10 mm from the cuneometatarsal joint (Fig. 3).

The plantar fragment was translated laterally while holding the dorsal fragment (Fig. 2) [13]. Lateral translation is required, and in addition, lowering, shortening, or lengthening of the first metatarsal may be achieved. Translation and lowering of the first metatarsal were indicated for HV with metatarsalgia and a callosity related to the second metatarsal head. This was achieved by directing the long transverse limb of the osteotomy more plantarward. Shortening of the first metatarsal was obtained by increasing the obliquity of the transverse limbs of the osteotomy with respect to the longitudinal axes of the second Metatarsal.

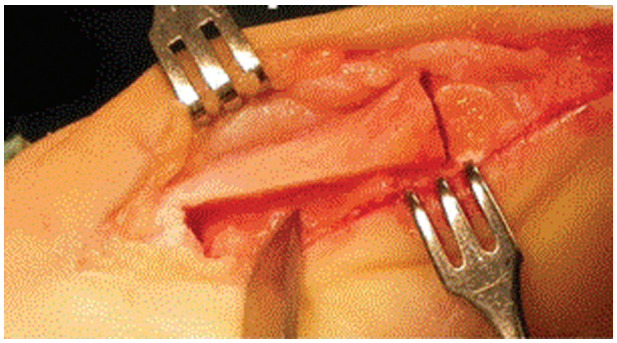
Additional shortening was achieved by resecting small bony fragments at the level of the transverse limbs, 'the Maestro cut.' Lengthening was indicated in patients with a short first metatarsal combined with metatarsalgia. This was obtained by decreasing the obliquity of the transverse limbs of the osteotomy with respect to the longitudinal axes of the second metatarsal. The stabilization of the bone fragments is accomplished with a specific bone clamp. The clamp is designed to allow compression with variable lateral displacement. The osteotomy was stabilized by two screws. The positioning of the K-wires should be performed taking into consideration the following: the proximal K-wire should enter the dorsal

Figure 2



Scarf osteotomy digramatics [13].

Figure 3



Scarf longitudinal and transverse cut.

fragment from mediodorsal to lateroplantar. This way, the lateral sagittal beam is respected. The distal K-wire (less oblique than the proximal one) is positioned so that it enters at the midsection of the dorsal fragment in order to transfix the plantar fragment dorsoplantarly (bicortical) or obliquely (mono cortical fixation). This cannulated drill is applied with the K-wires remaining in place. The distal part of the drill (2.2 mm diameter) is adapted for the body of the screw, whereas the proximal part of the drill (3.0 mm diameter) is designed specifically to countersink the head. The total length of the drill (18 mm) allows an overall use of the drill in most of the metatarsals. to avoid soft tissue interference, care should be taken to ensure the complete countersinking of the screw head. To complete, the medial 'bone-eminence,' created due to the displacement of the bone fragments, is resected. An Akin closing-wedge osteotomy of the proximal phalanx of the great toe was undertaken if at this stage there was any contact between the distal ends of the great and second toes. With the great toe plantar flexed, the medial capsule was repaired (double-breasted) using absorbable vicryl sutures. The skin edges were apposed using absorbable monocryl subcuticular suture. Third-generation cephalosporin (1 mg) was given intravenously at the induction of anesthesia and every 12 h after operation. Thromboembolic prophylaxis was not routinely administered. Postoperatively, all patients wore a forefoot plaster-cast for 3 weeks and were allowed to bear weight on the heel immediately. They were then encouraged to return to normal activities and to wear normal footwear.

Statistical analysis

Students' *t*-test was undertaken using the SPSS 11.5 statistical analysis software (SPSS Inc., Chicago, Illinois, USA).

Results

The average clinical and radiographic follow-up was 24 months (range: 18–36 months) The Scarf osteotomy was done for all the patients, and 15 of them required an Akin closing-wedge osteotomy of the proximal phalanx. At the time of follow-up, 84% of the patients were very satisfied (Figs 4 and 5). 12% were satisfied, and 4% were not satisfied. The mean global AOFAS score improved significantly from a preoperative score of 36 points (12–60) to 94 (75–100) at the follow-up ($P<0.001$). The mean pain subscore improved from 11 points (0–22) before operation to 35 (30–40) at the follow-up ($P<0.001$), the mean function subscore from 16 points (8–24) to 37 (30–45) ($P<0.001$), and the mean alignment subscore from four points (2–6) to 14 (0–15) ($P<0.001$) (Table 1). The radiological results showed significant improvement. IMA improved from average of 17 (12–22) to 7 (4–10), and HVA corrected from 35 (22–48) to 17 (12–22) postoperatively. The sesamoid subluxation was corrected from 68% of the patient having some degrees of subluxation preoperatively to 8% of them still having some degrees of subluxation (Table 1).

Figure 4

Preoperative radiography of bilateral hallux valgus.

Figure 5

Postoperative radiography of bilateral hallux valgus.

Complications

Two patients had superficial wound infections, which settled after administration of appropriate antibiotics. In one patient, the distal screw was prominent and irritated the medial sesamoid, causing pain. The pain

resolved when the screw was removed after the osteotomy had healed. None of the patients had nonunion or bone necrosis.

Discussion

Many surgical procedures and osteotomies are known to be used for the treatment of HV to achieve three main goals: correction of deformity and obtaining a pain-free and fairly mobile first MPJ. Among these procedures comes the scarf osteotomy to correct the first metatarsal bone to reduce an increased intermetatarsal angle, and an Akin proximal osteotomy may be needed as adjuvant procedure to complete full correction of big toe [14–16].

Although it is accepted that no single operative procedure can address the wide range of deformity of HV, the scarf osteotomy has become widely used because of its great versatility. It allows lateral displacement of the plantar bone fragment, thus reducing the IMA, medial displacement of the capital fragment in cases of hallux varus, plantar displacement to increase the load of the first ray and vice versa, elongation in cases of a short first metatarsal, and shortening in cases of a long first metatarsal. In addition, it avoids the complication of metatarsus elevates, associated with other proximal metatarsal osteotomies [13]. Modifications of the scarf osteotomy have been described [14,17–19], but they all have in common a Z-type first metatarsal osteotomy, which is internally fixed, a lateral release, excision of the medial bony eminence, and a medial capsulorrhaphy [10,20,21]. Rigid compression of large areas of bone on bone provides a good environment for primary bone healing, thus allowing early return to normal weightbearing and exercises to prevent stiffness of the joint [18,22]. Cadaver studies have confirmed that under loaded conditions, the Scarf osteotomy has double the stability of a distal Chevron osteotomy or a proximal crescentic osteotomy [18,23]. The patients in our series were allowed to walk on the heel and then immediately return to full weightbearing when the plaster was removed at 6 weeks, without any significant complications.

Results obtained in this study were nearly similar to those reported by Ahmed M., Gibson and peggott, K.H. Kristen, and Jones [17,20,24].

The range of movement of the first MTP joint improved in 84% of cases. These results are comparable to observations by Crevoisier and colleagues [17,20,25], who reported that 71% of the cases had a range of movement greater than 75° at follow-up. We believe that this good range of movement is due to a combination of factors, which include 'pristine-looking' articular cartilage overlying the first MTP joint, early passive, then active mobilization of the first MTP joint, and repair of the capsule with the great toe maximally plantar flexed.

The correction of sesamoid subluxation is an important component of HV reconstruction. The sesamoids can be pulled back under the first metatarsal head when imbricating the medial capsule during surgery. All osteotomies had minimal lateral sesamoid location change relative to the second metatarsal [25].

Conclusion

In our series, the rate of complication was low. and only one patient required further surgery. The patient experienced prominent screw causing irritation, which was removed 4 months postoperatively without complication. There was no screw back-out, postoperative neuralgia, and reflex sympathetic dystrophy. The limitations of our study are that some patients did not have regular follow-up, as they were from a far area, and with a mean follow-up of 24 months, no conclusions could be made about the long-term outcome of the Scarf osteotomy. We conclude, however, that in the short term, the Scarf osteotomy and Akin closing-wedge osteotomy of the proximal phalanx of the great toe appear to be good, safe, and effective procedures for the correction of HV and can be consider among the most stable first metatarsal osteotomies, having minimal complications.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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