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Original Article

Midterm experience of Scarf osteotomy as a new technique in a General Orthopaedic Department

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ABSTRACT

Scarf osteotomy has become popular as a versatile procedure that could correct most cases of hallux valgus. The purpose of this study is to report the experience with scarf osteotomy performed as a new technique by different surgeons of a general orthopaedic department. This study reviewed the outcome of 67 patients with 78 feet with hallux valgus deformity treated by scarf osteotomy at our institution, with an average follow-up of 24 months (12–84). Results were analyzed by clinical examination, a questionnaire including the American Orthopaedic Foot and Ankle Society (AOFAS) forefoot score and plain radiographs. The mean AOFAS score increased from 35 points (range, 15–50) preoperatively to 87 points (range, 73–100) at the final follow-up. The radiological angles Hallux Valgus Angle (HVA), 1–2 Intermetatarsal Angle (IMA) and Tibial Sesamoid Position (TSP) improved significantly. Among the 7 recurrences and 15 complications recorded, seven required an additional procedure. Multiple potential pitfalls can occur with scarf osteotomy. Although soft tissue dissection is relative extensive, adherence to careful technique and endurance to the learning curve can produce effective radiological correction of hallux valgus and good clinical results.
Level of clinical evidence: III.

1. Introduction

Scarf or Z osteotomy of the first metatarsal was first described in 1926 by Meyer, but due to insufficient osteotomy and fixation techniques its use was limited [1]. In 1983 Gudas and Zygmund began to perform Z step osteotomies with lateral shift of the plantar fragment, which includes the metatarsal head [2]. In 1984 Weil named it "scarf" because the cuts were the same with those used in carpentry, when two beams of wood were jointed to make a longer beam. Since 1991, Barouk has studied the anatomy and blood supply of the first metatarsal, and designed internal fixation instruments and materials, making the procedure popular worldwide [3].

The indications of scarf are extensive, from mild deformities to more severe ones. Barouk and Toullec limited the contraindications in "extremely impaired or painful 1st metatarsophalangeal joint and long lasting failed bunionectomy with overcorrection" [4]. Trnka mentioned as contraindications a narrow thin metatarsal, an IM angle exceeding 23° and a mild hallux valgus deformity [5]. Wagner et al. considered severe osteoporosis a contraindication to the scarf osteotomy due to the increased risk of intra- or post-operative fractures and the potential loss of metatarsal height leading to metatarsalgia [6].

Its abiility to carry out lateral displacement, shortening, rotation and lowering of the metatarsal head made the Scarf osteotomy a versatile procedure for moderate to severe hallux valgus deformities. The aim of this study is to evaluate the midterm results of the osteotomy and to report complications during our early experience (including the learning curve) with the technique.

2. Patients and methods

Seventy patients (65 women and five men) with mean age of 53.6 years (18–78) underwent 82 scarf osteotomies (5 patients had bilateral

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Table 1
Subjective results.

	n = 78 feet
Pain relief	
Improved	64
Same	11
Worse	3
Cosmesis	
Improved	71
Same	7
Worse	0
Gait	
Improved	52
Same	24
Worse	2
Comfort in trade shoes	
Better	69
Same	9
Worse	0
Overall satisfaction	
Satisfied	69
Dissatisfied	9

procedures simultaneously, 7 in two stages) by four senior surgeons, between the time period of 10/2002 - 10/2010. The procedure was new for the surgeons who had until then enough experience in distal osteotomies such as Mitchell or Chevron and in proximal crescentic osteotomies. The outcomes were reviewed through radiographic and clinical assessment at an average time of 24 months (12–84 months) postoperatively. Three patients were lost to follow up leaving 67 patients (78 feet) in the study.

Radiographic measurements, completion of the American Orthopaedic Foot and Ankle Society Clinical Rating Scale (AOFAS score) and of a questionnaire with subjective parameters as pain relief, cosmesis, gait, easiness with footwear and overall satisfaction (Table 1) were made by one of the authors (who was not a treating surgeon).

2.1. Radiographic evaluation

Standardized radiographic projections, non-weight bearing in the majority of cases (due to technical reasons and inability of the radiology department to provide weight-bearing foot radiographs on many occasions), were taken, centered on the mid tarsal joint, at a distance of 100 cm, with the beam inclined at 15° in the sagittal plane. The radiographic features measured were hallux valgus angle (HVA), first-second intermetatarsal angle (IMA) using the center of head method to determine the longitudinal axis of the metatarsals, tibial sesamoid position (TSP) with grades 0–3 according to the position of the medial sesamoid related to the longitudinal axis of the first metatarsal and distal metatarsal articular angle (DMAA) determined by the method of Rush and Banks [7–10].

2.2. Surgical technique

All operations were performed under regional anesthesia (popliteal nerve block with nerve stimulation) with the tourniquet applied at the mid-calf, except for the bilateral procedures where spinal anaesthesia was used [11]. Prophylactic antibiotics (second-generation cephalosporins and aminoglycosides) were administered prior to the procedure. One or two more doses of cephalosporin were administered postoperatively.

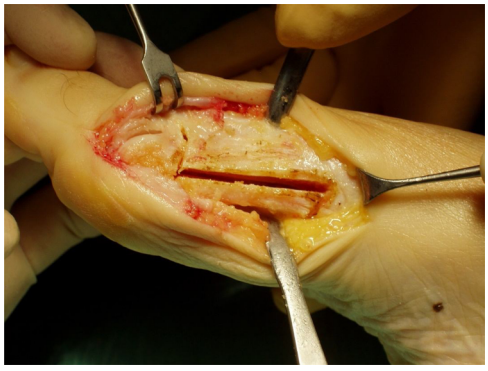

Fig. 1. Osteotomy completed.

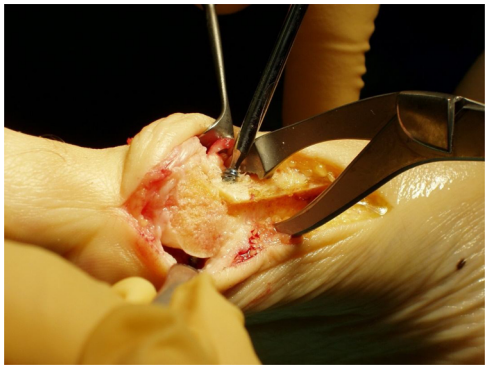

Fig. 2. Distal fixation.

The Scarf osteotomy included eight consecutive steps: lateral release, excision of exostosis, osteotomy, displacement, fixation, evaluation of necessity of additional procedures (e.g. Akin), resection of residual eminence and medial capsular repair with plication.

The phalangeal insertion of adductor hallucis tendon and the hallucal sesamoid suspensory ligament were released through a separate dorsal intermetatarsal incision. Through a medial midline approach and a longitudinal capsular incision, excision of exostosis was performed in line with the medial border of the first metatarsal. The longitudinal osteotomy, that was performed first, was oblique from the longitudinal axis of the first metatarsal, with the proximal and distal ends located 1 cm proximal to the metatarso-cuneiform and metatarso-phalangeal joints respectively. It was sloped plantarwards with 20° inclination to the inferior border of the metatarsal, above and parallel to the plantar surface, thus respecting the lateral surface. This surface functioned as a strong beam allowing lateral shift up to 2/3 of the diameter of the metatarsal [4]. There were cases where the longitudinal cut was short in the diaphysis because the surgeon considered it enough for fixation and correction of the deformity. The transverse cuts were made at an angle 60°–80°, the distal one dorsally and the proximal one plantarly (Fig. 1). Lateral shift was obtained by pushing the plantar fragment and pulling the dorsal fragment with the use of a clamp. Then the fixation should be ideally performed with two screws; one distal oblique through the metatarsal head and one proximal in an oblique lateral plantar direction so as to avoid a secondary stress fracture (Fig. 2). Among the different fixation techniques proposed for the scarf osteotomy [double threaded cannulated compressive screws or cortical

Fig. 3. Ideal position, length and sinking of double threaded cannulated screws in anteroposterior (A) and lateral (B) views.

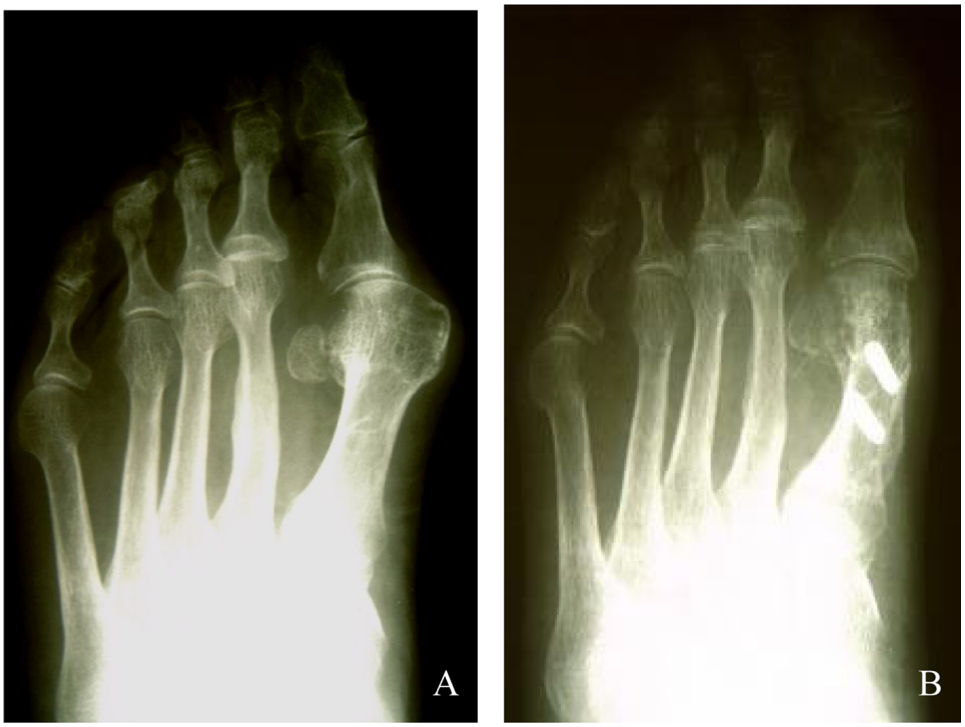

Fig. 4. (A) 66-year old female with symptoms of 6 years duration. (B) 3 years follow-up after scarf osteotomy with cannulated headless screws. Congruent 1st MTP joint with correction of the angles.

screws or even Kirschner–Wires (K–W)] in our series 3 mm double threaded screws (Biotech®, Wiesbaden, Germany) were used in 43 feet (Fig. 3), conical compressive (mini Acutrac™, Acumed®, Oregon, USA) screws were used in 9 feet (Fig. 4), low profile mini screws (Leibinger™, Stryker®, Kalamazoo, MI, USA) were used in 18 feet (Fig. 5), 3,5 mm cortical screws in 10 feet, while K–W were only used in 2 early cases [3,12,13]. After clinical evaluation of the correction of the deformity, additional procedures on lesser metatarsals or toes were performed: Akin (medial closing wedge) osteotomy of the proximal phalanx in five cases and 42 lesser metatarsal osteotomies (35 Helal, 7 Weil in 30 feet).

Fig. 5. (A) 60-year old female with Sjögren syndrome. (B,C) Two years after scarf osteotomy with 4 low-profile screws there is sufficient correction.

Table 2
Summary of results.

	Mean Preoperative	Mean Postoperative	Mean Correction	p Value (*t*-test)
HVA	36°	17°	19°	< .0001
IMA	14.7°	8.4°	6.3°	< .0001
TSP	2.1	0.8	1.3	< .0001
DMAA	15.7°	13.3°	2.4°	0.03
AOFAS	35	87	52	< .0001

Toe deformities were corrected in 18 cases. Excision of Morton's neuroma was necessary in one patient. Finally trimming of the residual eminence and medial capsulorrhaphy was performed. The mean length of the procedure was 75 min (60–90). All operations were performed as inpatient surgery with a mean hospital stay of 1.8 days [1–3].

2.3. Postoperative treatment

Acetaminophen was administered in the first 24 h postoperatively and then in a maximum dose of 3 g per day. Opioid analgesics (Pethidine 50 mg) were administered in case of severe pain, on average 1.2 times/patient (range 0–5).

Thromboprophylaxis with low molecular weight heparin (LMWH) was prescribed for 3 weeks. Postoperatively, immediate weight bearing was allowed in a heel wedge shoe that protected the forefoot for 6 weeks and use of crutches initially. Then, taking into account the progress of union of the osteotomy by radiographs, partial weight bearing on an ordinary shoe was instructed, until full weight bearing in 8–10 weeks.

Fig. 6. (A,B) 51-year old female with rheumatoid arthritis. (C,D) 6 months follow-up. Failure of osteosynthesis due to incorrect screw position and length in a short Scarf occurred within 3 weeks of the procedure. The patient denied reoperation and not weight-bearing was instructed for 2 months, leading to union.

3. Results

Follow-up was made at 3, 12, 24 months for all patients and consisted of clinical and radiographic evaluation. Longer follow-up with examination by one of the authors was available in 44 patients whilst 23 patients completed only the questionnaire via telephone. There was decrease of HVA from 36° (16° to 57°) preoperatively to 17° (−6° to 40°) postoperatively and decrease of IMA from 14,7° (6°–27°) to 8,4° (2°–18°) respectively. TSP was reduced from grade 2.1(1–3) to 0.8 (0–2). DMAA changed from 15.7° (5°–30°) preoperatively to 13.3°(2°–39°) postoperatively. The forefoot AOFAS score improved from 35 (15–50) to 87 (73–100) (Table 2). In 69 feet there were satisfaction and in 9 dissatisfaction.

The 15 (19%) recorded complications were of 2 types: general [one confirmed DVT, four type I complex regional pain syndrome (CRPS), two superficial wound infections that were successfully managed] and complications related to the surgical technique, including 3 intraoperative fractures, 3 cases of failure of osteosynthesis (Fig. 6) and

Fig. 7. Prominent screw one year post operation.

two cases of prominent screws (Fig. 7) that required removal. Recurrence of the deformity (Fig. 8) was observed in 7 feet.

4. Discussion

Unlike many publications from high volume and highly specialized orthopaedic foot and ankle surgeons, this study aimed to present the early cases outcomes of the scarf osteotomy in a pragmatic context and criticized them from the perspective of a new technique in a general orthopaedic department performed by different surgeons. In these early cases we observed a 9% deformity recurrence at 2 years, a 3.8% rate of intraoperative fractures and a 3.8% fixation failure postoperatively, whereas in the last 28 cases of this series, no complications were observed. The afore-mentioned rates confirm what is already known about scarf osteotomy, that it is technically demanding and that complications are unavoidable during the learning curve [14]. On the other hand, 88.5% of the patients were fully or partially satisfied, and the forefoot AOFAS improved dramatically after surgery.

There was a concern about the angle measurements because many of the radiographs were non-weight bearing, although the difference between weight-bearing and non weight-bearing radiographic views has been shown to be inconsistent [7]. In a recent study, 21 foot and ankle surgeons were asked to measure 3 standard angles on weight and non-weight bearing antero-posterior plain foot views of patients with hallux valgus and to select the most appropriate procedure. The authors concluded that the different views did not affect significantly the measurement of the angles nor the choice of the procedure [15].

Another issue that could raise objections was the kind of anesthesia used (popliteal block with nerve stimulation) and the application of the tourniquet at the mid-calf level. No adverse reactions were observed and no issues related to the site of tourniquet application had risen, proving these as safe procedures [11]. Furthermore, the analgesia effect lasted for many hours post-operatively reducing dramatically the need for opioid analgesics.

The high frequency of type -1 CRPS was attributed to the more extensive approach comparing to other types of hallux valgus procedures [17,18]. These patients were treated with Bier's block using lidocaine and methylprednisolone in four consecutive weekly sessions. Weight bearing was delayed to 5 months and total recovery needed 8–9 months. At 2 years follow-up, there were no residual complaints of CRPS.

The recurrence of the deformity was attributed to under-correction due to insufficient lateral release or medial capsulorraphy or inadequate lateral displacement. All cases with failure of osteosynthesis appeared in short Scarf osteotomies.

Comparing to other studies our overall complication rate of 19%, (all occurred in the first 50 cases), seems high but it can be explained taking into consideration the number of surgeons and the steep learning curve of the procedure [14,19,20]. In addition, only half the complications were related to the osteotomy itself. Barouk in 682 feet had 3.5% fractures [16]. Kristen et al. reported 5.4% complications in 111 feet which included superficial wound infections, "traumatic" fractures and hallux limitus, while Coetzee, in a series of 20 feet emphasized the difficulties of the technique (troughing, rotational malunion, proximal fracture and early recurrence) [1,21].

Finally, the concomitant procedures to the lesser rays represent one additional limitation of our study, since the effect of the scarf osteotomy on the outcome cannot be isolated. However, additional surgeries are very often needed as hallux valgus deformities are associated with other forefoot pathologies (e.g. toe deformities, transfer loading metatarsalgia, Morton's neuroma). Osteotomies in 2nd to 5th metatarsals were performed in only 37% of the feet in our series. Since pain and palmar calluses can affect AOFAS score enough, we feel that more procedures in lesser metatarsals should have been performed.

In conclusion, scarf is an invasive and technically demanding osteotomy. Complications regarding the cuts and the osteosynthesis are easy to occur. These seem unavoidable during the learning curve which has been estimated to a minimum of 15 cases [3]. However, it proved to be effective in the correction of moderate to severe hallux valgus deformities, with significant improvement of radiographic indices and good clinical results in patients followed for two years.

Financial disclosure

None.

Fig. 8. (A,B) Preoperative views of a 46-year old female with hallux valgus and Morton's neuroma in second intermetatarsal space. (C,D) One month postoperative radiographs. (E) At 14 months postoperative follow-up there is recurrence of the deformity with HVA angle 25°.

Declarations of interest

None.

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