ABSTRACT

_Hypothesis/Purpose:_ The Scarf osteotomy has gained popularity as treatment of choice in parts of Europe and is based on sound structural principles. The excellent results reported by others could not, however, be reproduced by the author and the results are presented.

_Methods:_ From January 1997 to June 1997 the Scarf osteotomy was selected in 20 consecutive patients (12 female and eight male patients, ages 18 to 60, mean: 41 years) with moderate metatarsus primus varus (IMA 13 to 20°) and hallux valgus deformities (less than 40°). The AOFAS Hallux Metatarsophalangeal-Interphalangeal Scale, visual analog scale and patient satisfaction were monitored prior to surgery, six and 12 months post-op. The patients were treated in a short leg cast, non-WB for two weeks followed by four weeks partial WB in a cast shoe. Routine post-bunion rehabilitation followed once the radiological and clinical diagnosis of healing was made.

_Results:_ Multiple complications were encountered. The most common was “troughing” of the metatarsal with loss of height. This occurred in seven patients (35%). Other complications include delayed union (5%), rotational malunion (30%), proximal fracture (10%), infection (5%) and early recurrence of deformity in 25%. All 20 patients were available for follow-up at six months, and 19 of 20 at 12 months. The AOFAS score pre-op was a mean of 53. At six months a mean of 54 (19 to 69) and at 12 months 62 (24-100). Forty-five percent (9/20) were unsatisfied at one year and would not recommend the surgery to a friend.

_Conclusions/Significance:_ The Scarf osteotomy has multiple potential pitfalls and should probably be reserved for moderate bunions in young people with good bone quality. There are multiple potential problems and the salvage of a failed Scarf osteotomy is difficult.

INTRODUCTION

The interlocking or Scarf joint has been used for many centuries in the carpentry. It is used for example to extending purlins and beams in the roof of a house or in boat construction. It is useful because of its inherent stability and ability to distribute load and strength.

In 1984, Charles Gudas, D.P.M. started to experiment with the idea of using a Z-cut osteotomy of the first metatarsal to gain correction of a metatarsus primus varus and bunion deformity (Fig. 1). Since then the osteotomy has gained significant popularity, especially in Europe.

Fig. 1: Different options for Z-osteotomy.

The hypophyses for this study was that the Scarf osteotomy would be:
- simple to do
- reproducible
- reliable

in correcting and maintaining correction of hallux valgus deformities.

MATERIALS AND METHODS

From January 1997 to June 1997 the Scarf osteotomy was used in 20 consecutive patients with moderate metatarsus primus varus and bunion deformities. A moderate deformity was classified as one with an IMA of 13 to 20° and HVA less than 40° on X-rays taken in a standing position. The lines bisected the proximal and distal articular surfaces of the respective metatarsal or phalanges (Fig. 2a, 1b). The decision to
do a Scarf osteotomy was made on the sound engineering principle of the procedure and deformity that required something more substantial than a distal osteotomy.

All 20 patients had “idiopathic” bunions. There were no cases of rheumatoid arthritis, diabetes or other systemic abnormalities. None of the patients had previous bunion surgery. All patients failed nonsurgical management that included shoe modifications and/or orthotic devices. Orthotic devices were used in eight of the 20 patients.

Twelve female and eight male patients, ages 18 to 60, were assessed (mean 41 years).

The AOFAS Hallux Metatarsophalangeal-Interphalangeal Scale, visual analog pain scale and patient satisfaction were monitored prior to surgery, as well as six and 12 months post-op. All 20 patients filled out their own AOFAS forefoot questionnaire, visual analog scale and satisfaction rating.

A two-tailed P-value was obtained using the unpaired t-test, Welch corrected.

Patient satisfaction was assessed for overall satisfaction, function, appearance, whether they would have the surgery again and if they would recommend it to a friend. Visual analog pain scale was used at the same three time intervals.

Weightbearing AP, lateral and sesamoid radiographs were obtained prior to surgery, and at the six and 12 month follow-up visits. Measurements included the intermetatarsal angle, hallux valgus angle and sesamoid position. Hallux valgus angle of more than 32° and an intermetatarsal angle of more than 10° were considered a recurrence.

Surgical Technique

The patient was placed in a supine position with a thigh tourniquet. Anesthetic of choice was given. The lower extremity was sterilely prepped and draped and the tourniquet inflated to 250 mmHg after gravity exsanguination.

A 6 cm straight medial incision was made to expose the medial aspect of the 1st metatarsal and metatarsophalangeal joint (MPJ) capsule. The MPJ capsule was incised longitudinally to expose the medial eminence and joint. A 2 cm incision was made between the 1st and second metatarsals to visualize the lateral joint capsule. The lateral MPJ capsule was incised longitudinally to allow the sesamoids to reduce under the metatarsal head.

With the lateral aspect of the first metatarsal exposed, the three cut Z osteotomy was performed. The distal cut was made 5 mm proximal to the articular surface of the 1st metatarsal. This cut was made from dorsal to plantar while the proximal cut was made from plantar to dorsal. The proximal cut began approximately 4 cm more proximal in the metatarsal shaft. The longitudinal osteotomy corrected the two other limbs. The plantar/distal portion was translated laterally to close the intermetatarsal gap.
Two minifragment screws (2.0 or 2.7) were used to secure the osteotomy. The exposed medial eminence and dorso-medial metatarsal shaft were removed. The medial joint capsule was repaired, tourniquet deflated, hemostasis obtained and the wound closed.

Post-op management was two weeks non-weight-bearing in a short leg cast, followed by four weeks partial WB in a cast shoe before starting a rehabilitation program. The goal was for the patient to jog by three months. Three patients also underwent an Akin procedure to correct a Hallux interphalangeus.

RESULTS

All 20 patients were available at six months and 19 of 20 at 12 months follow-up. There were 12 female and eight male patients. One male patient, with a satisfactory result at six months, was lost to follow-up when he moved away. The average age was 41 years (18 to 60). There were no worker’s compensation claims.

Forty-five percent (9/20) were unsatisfied with the surgical result at six months and 47% (9/19) at 12 months (Table 1).

The AOFAS forefoot score was completed by the patient prior to surgery, and then at six and 12 months after surgery.

The AOFAS score pre-op was a mean of 53 (44-62). At six months a mean of 54 (29-69) with a P-value 0.2. At 12 months the mean score was 62 (24-100) and P-value 0.97. The unpaired t-test, Welch corrected, was used and there was no significant improvement as evidence by the P-values (Table 2).

Multiple complications were encountered. The most common was “troughing” of the metatarsal with loss of height. This was often accompanied by a rotational deformity due to the loss of stability though the metatarsal (Figs. 3, 4a, 4b).

The average preoperative Intermetatarsal angle was 16° (13 to 20°). At the 12-month follow-up, or the last follow-up before re-operation, the average IMA was 13° (8 to 20°). The mean Hallux valgus angle was 40° (28 to 50°). Preoperatively and at 12-month follow-up it was a mean of 34 (15 to 45).

Four patients could not return to their previous occupation due to ongoing foot pain and inability to wear shoes appropriate for their work. At one-year

<table>
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<th>Table 1: Patient satisfaction.</th>
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<td>Patient satisfaction rating</td>
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<tr>
<td>Not satisfied</td>
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<tr>
<td>Satisfied with reservations</td>
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<tr>
<td>Satisfied</td>
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<td>Will recommend procedure to a friend or have it again</td>
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follow-up only 53% (10/19) had returned to unrestricted recreational activities.

Thirty-seven percent (7/19) had unrestricted use of shoes at one year. At the 12-month follow-up 42% (8/19) were limited to running shoes or similar comfortable shoes, and seven of the eight still used an orthotic in their shoes.

Seven patients had repeat procedures done to correct the deformities. The remaining two dissatisfied patients elected not to have surgery done in the first year. One of them had a salvage done almost 2.5 years after the index surgery (Fig. 5).

One patient developed a wound infection that resolved with oral antibiotic treatment. There was no apparent difference in using 2.0 vs. 2.7 mm screws. The decision to use a specific size was based on the available bone for fixation.

**DISCUSSION**

Even though the Scarf osteotomy is rational from a mechanical standpoint, it is not without multiple problems. The most common problem is “troughing” of the two halves of the metatarsal shaft. This happens when the cortices wedge into the softer cancellous bone of the metatarsal shaft (Figs. 3, 4a, 4b). This causes a functional elevation or dorsiflexion of the first ray that inevitably led to a pronated foot and lesser metatarsal overload.

Limiting the distal and proximal step-cut to 2-3 mm and therefore avoiding cutting into the cancellous bone could probably minimize this problem. A further measure is to limit this procedure to young people with strong healthy bone that would prevent the troughing.

The rotational deformity usually goes hand in hand with “troughing.” This combination leaves a deformity that is very difficult to salvage indicating that the more complex the initial procedure, the more complex the complications and salvage.
Dereymaeker\textsuperscript{7} states that the Scarf osteotomy is “certainly a more extensive surgical procedure, with a longer learning curve than a distal Chevron osteotomy.”

Barouk\textsuperscript{6} states, “At first, Scarf osteotomy can be technically demanding. Whatever the indication, the Scarf first metatarsal osteotomy is only one of the four steps necessary for correcting hallux valgus deformity:

a. MTP lateral release  
b. Scarf osteotomy  
c. medial capsulorraphy, and  
d. great toe proximal osteotomy. Complications are rare and avoidable.”

Of Barouk’s four steps, only the proximal phalangeal osteotomy was not done. Different lengths of the long arm of the Z did not appear to make a difference in the stability, but Barouk advocates that the long arm should go from the head/neck to the base of the metatarsal.

The use of a non-compressing screw could also limit the troughing effect. It is possible that the above-mentioned factors could have played a role in the poor results of this study compared to the literature.

Even though these authors confirm that the procedure is technically demanding and has a steep learning curve, their learning curve didn’t include any of the complications this author encountered. They also didn’t elaborate on the problems they faced during the learning curve.

Crevoisier\textsuperscript{8} in December of 2001 reported that 39% of their patients were very satisfied and 50% satisfied with the Scarf osteotomy. They recorded a 19% complication rate. Eight percent were minor and nine (11%) required an additional procedure. They also mentioned the significant loss of MTP motion due to the extent of the procedure. It is important to note that they did the procedure for mild (IMA 11 or less, HVA under 20°) and moderate (IMA 11-18, HVA 20-40) deformities. An 11% reoperation rate in an average of 22 months is quite high for this population group.

The Scarf osteotomy may work well in some hands, but the learning curve is steep, and there may be simpler and more predictable ways to solve the problem.

REFERENCES

5. Steel, MW; Johnson, KA; DeWitz, MA; Ilstrup, DM: Radiographic measurement of the normal adult foot. Foot Ankle Int, 1:151-158, 1980.