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Three-Year Follow-Up Results of Combined Short Scarf Osteotomy With Akin Procedure for Hallux Valgus

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ABSTRACT

The short scarf osteotomy has been developed as a less-invasive method of preserving the soft tissue envelope, at the same time maintaining the strength, correction, and utility of a classic long scarf osteotomy. We carried out a review of 166 short scarf osteotomies performed combined with the Akin procedure with a mean follow-up of 34.6 (range 28 to 38) months. These radiographic parameters were evaluated preoperatively, at 6 weeks, and at 3 years. The functional evaluation was based on the American Orthopaedic Foot and Ankle Society hallux metatarsophalangeal interphalangeal scale score. At follow-up, the mean American Orthopaedic Foot and Ankle Society hallux metatarsophalangeal interphalangeal scale score improved from a preoperative average of 54.6 to a postoperative average of 92.8 ($p < .001$). The radiographic evaluation gave the following results: the preoperative hallux valgus angle of 27.92° improved to an average of 11.85° ($p < .001$); the preoperative inter metatarsal angle of 14.03° improved to an average of 9.64° ($p < .001$). There were no fractures during the procedure. There were no incidences of infection or recurrence of deformity. Three patients have to undergo metatarsophalangeal joint fusion because of progression of osteoarthritis of the joint. No avascular necrosis of the metatarsal head was seen. The short scarf osteotomy along with Akin procedure is minimally invasive compared to the standard scarf osteotomy. It is a simple technique with good mechanical strength, signifying excellent patient satisfaction while reconstructing normal anatomy and restoring radiological measurements with fewer complications.

The correction of Hallux valgus deformity has been challenging procedure. Several methods have been described in the literature for the correction of this deformity with varied success. In a recent Cochrane review, a high percentage of patients, 25% to 33%, are not satisfied with the final outcomes (1).

Scarf osteotomy was used as a definitive procedure for the correction of hallux valgus in the 1980s (2–4). This procedure involves both soft tissue and osteotomy of the first metatarsal bone. It was first described and introduced by J. M. Burutaran in 1976 (5).The correction of hallux valgus requires soft tissue release and osteotomy of the first metatarsal bone (6). However, scarf osteotomy procedures involve an extensive surgical exposure of the entire first metatarsal ray and are technically demanding. They also involve the stripping of soft tissues around the first metatarsal bone, which jeopardizes the blood supply and increases the risk of avascular necrosis and iatrogenic fractures (7). The study by J. C. Coetzee in 2003 concluded that scarf osteotomy had multiple potential pitfalls and complications. He also concluded that the procedure should be reserved for moderate bunions in young patients with good bone quality and that salvage from a failed scarf osteotomy was difficult (8).

In the past, various modifications of the scarf osteotomy were carried out with good outcomes (9,10). We combined a short scarf osteotomy with an Akin procedure of the proximal phalanx through a short incision with minimal soft tissue dissection, use of few metal works at the same time preserving all the advantages of a long scarf osteotomy with good clinical, radiological, and functional outcomes at 3-year follow-up.

Materials and Methods

We reviewed all the patients who underwent a combined short scarf osteotomy with the Akin procedure between January 2014 and December 2016. The exclusion criteria were previous or simultaneous forefoot surgery, peripheral vascular disease, diabetes mellitus, smoking, inflammatory arthropathies, and neuromuscular disease. A total of 136 patients (166 feet) were included after applying the exclusion criteria. The mean follow-up period was 34.8 (range 28 to 38) months.

All patients had preoperative and postoperative weightbearing radiographs (Figs. 1 and 2). The radiological assessment included measurement of the hallux valgus angle (HVA), which is measured based on the angle formed by the intersection of the lines drawn through the long axis of the first metatarsal and the proximal phalanx (Fig. 3*A*). (The normal value is <16°.) The intermetatarsal angle (IMA) is formed at the intersection of the longitudinal lines of the shafts of the first and second metatarsals (Fig. 3*B*). (The

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Fig. 1. Preoperative anteroposterior and lateral radiographs of hallux valgus deformity.

Fig. 2. Postoperative radiographs showing good correction of hallux valgus deformity after short scarf osteotomy and Akin procedure.

normal value is 0° to 14°.). The proximal articular segmental angle (PASA) is the angle formed by a line defining the true articular cartilage of the first metatarsal head and a perpendicular line to the bisection of the shaft of the first metatarsal (Fig. 4). (The normal value is <8°.) The distal articular segmental angle (DASA) is the angle formed by the bisection of the shaft of the proximal phalanx and the line defining the true articular cartilage of the base of the proximal phalanx (Fig. 5). (The normal value is <8°.) The hallux valgus interphalangeus angle (HVI) is the angle formed at the intersection between 2 longitudinal lines of the proximal and distal phalanges (Fig. 6). (The normal value is 0° to 10°.) The positions of the tibial sesamoids measured preoperatively and postoperatively are described by Smith et al (11). It is a simple method of measuring the tibial sesamoid position using gradations 0, 1, 2, and 3 .The 4-grade system was adequate and easy to use. All the radiological measurements were done by a single observer to reduce the interobserver error.

Classification of the severity of hallux valgus was done by using Mann's criteria (Table 1). The functional outcome scoring was done via postal questionnaire using the American Orthopaedic Foot and Ankle Society hallux metatarsophalangeal interphalangeal (AOFAS-HMI) scale score (12). The statistical analysis was done by using paired-samples Student's *t* test and Wilcoxon signed-rank test to evaluate the statistical significance. The mean and standard deviation (SD) values were also measured. A value of $p \leq .05$ is considered to be statically significant.

The operative technique consisted of a straight 5-cm incision centered over the midline of the first metatarsal head and first metatarsophalangeal joint. The capsule is opened, and exostosis is removed. The longitudinal cut starts proximally above the medial edge in the metaphyseal–diaphysis junction and distally in the dorsal third of the first metatarsal head and at 10 mm from the articular surface. The proximal cut is made on the plantar cortex at an angle of 60° to the longitudinal cut. The distal cut is made on the dorsal cortex and proximal to the insertion of the capsule at the same angle (Fig. 7). The 2 fragments are then displaced with proximal pulled medially and distal pushed laterally. The osteotomy is fixed with 1 Barouk screw. The procedure is completed with an Akin osteotomy of proximal phalanx. Postoperatively, the patients were given a plaster boot. The patients were seen at 6 weeks, and radiography was performed to ensure the osteotomy has healed and allowed full weightbearing.

Results

The mean age at the time of operation was 59.8 (range 27 to 77) years. At the 3-year follow-up, 93% of the patients were satisfied with the results of the outcomes of short scarf osteotomy. According to Mann's classification, there were 40 (24%) cases of mild deformity, 96 (58%) cases of moderate deformity and 30 (18%) cases of severe deformities.

The overall AOFAS-HMI scores for the forefoot improved from a preoperative average of 54.6 (range 28 to 82 [SD ±17.98]) points to a postoperative average of 92.8 (range 54 to 100 [SD ±14.268]), which is significant ($p < .001$). The mean pain scores improved from 24.81(range 18 to 31 [SD ±8.842]) to 33.60 (range 25 to 39 [SD ±8.001], $p < .001$). The mean functional scores improved from a preoperative value of 30.63 (SD ±9.720) to 39.57 (SD ±7.220). The mean alignment scores also improved from 3 points preoperatively to 15 points at the last follow-up (range 3 to 15 [SD ±5.230], $p < .001$) (Table 2).

The radiographic evaluation gave the following results: preoperative HVA of 27.92° (range 17.31° to 42.29° [SD ±8.43°) improved to an average of 11.85° (range 8° to 19.2° [SD ±4.78°], $p < .001$); preoperative IMA of 14.03° (range 9.92 to 21.38 [SD ±3.65]) improved to an average of 9.64° (range 6.49° to 13.96° [SD ±2.880°], $p < .001$); preoperative HVI of 12.8° (range 10.8° to 15.6° [SD ±2.64°], $p < .001$) improved to an average of 7.7° (range 6.7° to 9.4° [SD ±2.61°], $p < .001$); preoperative DASA of 11.4° (range 9.1° to 13.3° [SD ±2.24°]) improved to an average of 7.6° (range 6.4° to 8.8° [SD ±2.32°], $p < .001$); and preoperative PASA of 11.1° (range 9.3° to 12.8° [SD ±2.21°]) improved to an average of 8.1° (range 7.1° to 9.6° [SD ±2.6°], $p < .001$). The mean tibial sesamoid position improved preoperatively from grade 2.06 (range 1 to 3) to grade 0.88 (range 0 to 2) postoperatively (Table 3). There were no iatrogenic fractures during the procedure. None of the patients had an infection or recurrence of deformity. Three patients have to undergo

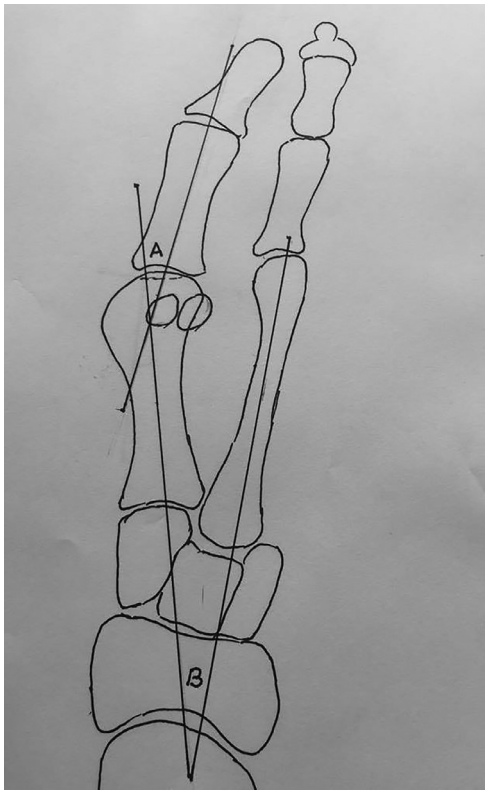

Fig. 3. (*A*) Hallux valgus angle. (*B*) Intermetatarsal angle. Used with permission.

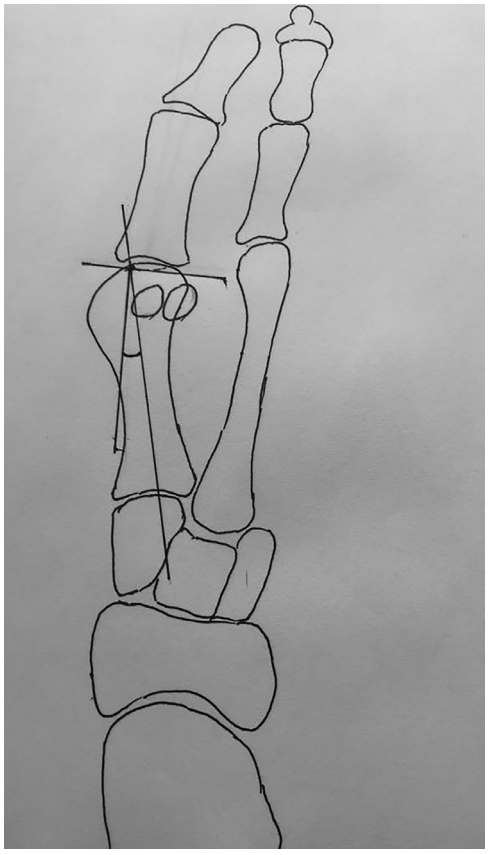

Fig. 4. Proximal articular segmental angle. Used with permission.

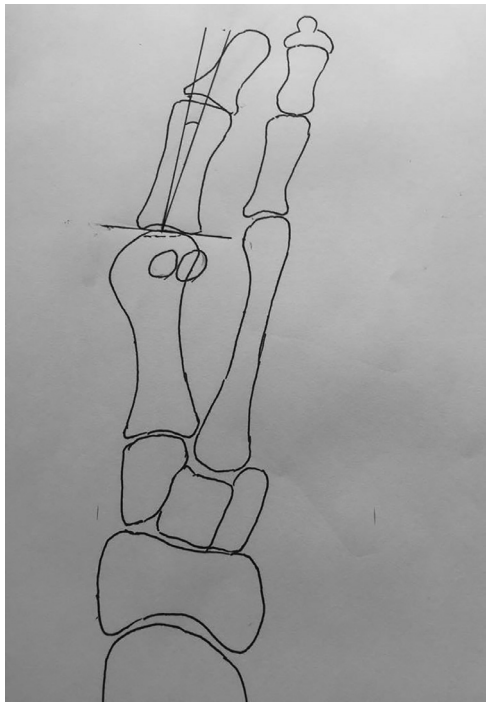

Fig. 5. Distal articular segmental angle. Used with permission.

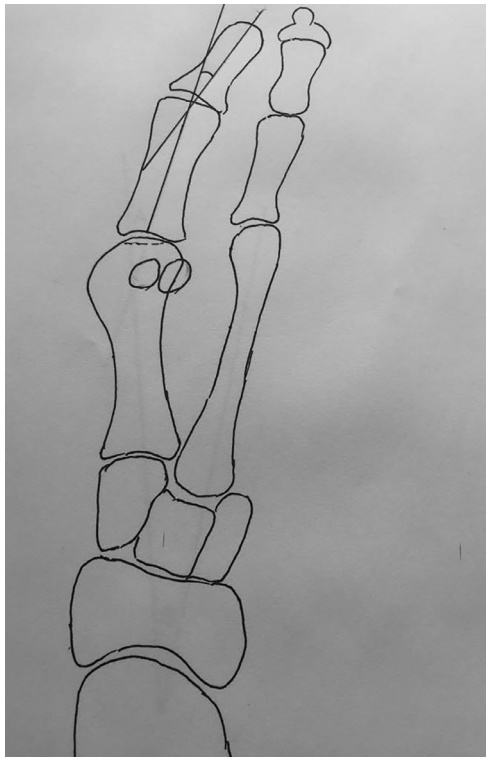

Fig. 6. Hallux valgus interphalangeus angle. Used with permission.

Table 1
Mann's classification of hallux valgus deformity

Deformity	Hallux Valgus Angle (°)	Intermetatarsal Angle (°)
Mild	0 to 19	0 to 13
Moderate	20 to 40	14 to 20
Severe	>40	>20

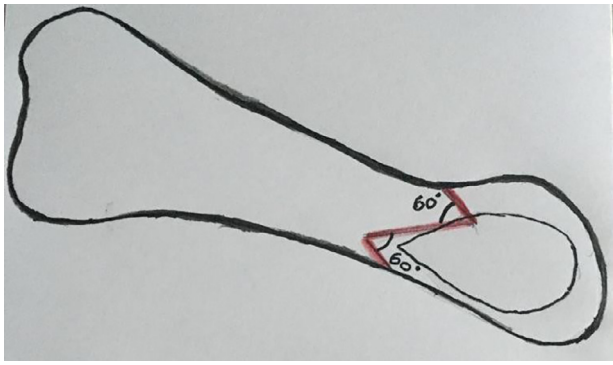

Fig. 7. Diagrammatic representation of the angles and location of short scarf osteotomy of first metatarsal. Used with permission.

Table 2
American Orthopaedic Foot and Ankle Society hallux metatarsophalangeal interphalangeal scale score preoperatively and at 3-year follow-up

AOFAS-HMI Scores	Preoperative Mean Values	Mean Values at 3-Year Follow-Up	*p* Value
Overall scores	54.6	92.8	<.001
Pain	24.81	33.60	<.001
Function	30.63	39.57	<.001
Alignment	3	15	<.001

Abbreviation: AOFAS-HMI, American Orthopaedic Foot and Ankle Society hallux metatarsophalangeal interphalangeal scale.

Table 3
Radiological measurements preoperatively and at 3-year follow-up

Radiological Measurements (°)	Preoperative Mean Values	Mean Values at 3-Year Follow-Up	*p* Value
HVA	27.92	11.85	<.001
IMA	14.03	9.64	<.001
HVI	12.8	7.7	<.001
DASA	11.4	7.6	<.001
PASA	11.1	8.1	<.001
Tibial sesamoid position	2.06	0.88	<.001

Abbreviations: HVA, hallux valgus angle; IMA, intermetatarsal angle; HVI, hallux valgus interphalangeus angle; DASA, distal articular segmental angle; PASA, proximal articular segmental angle.

metatarsophalangeal fusion because of progression of osteoarthritis of the joint. No osteonecrosis of the metatarsal head was recorded.

Discussion

The short scarf osteotomy was popularized in the 1980s with mixed results (2,3,13,14). The procedure was reported as technically demanding and not devoid of complications. Both Glickman and Zahari (14) and Schwartz and Groves (3) used Kirschner wires to fix the distal metatarsal osteotomy and encountered wires backing out, after which the first metatarsal developed shortening. In our study, we used Barouk screws to fix the osteotomy site, which gave excellent stability and no failure of the metalware.

The vascularity of the first metatarsal is mainly through the plantar bundle to the metatarsal head. The dorsal bundle is less significant (15). The short scarf osteotomy avoids both these bundles and thus preserves the blood supply to the head of the first metatarsal, minimizing the incidence of avascular necrosis. In our series, we had no any incidence of avascular necrosis of the first metatarsal head.

The most common intraoperative and early postoperative complication is fracture around the screw used for fixation (16). Barouk noticed troughing followed by short scarf osteotomy, which leads to pronation and elevation of the head of first metatarsal (6). Troughing can lead to stiffness of the first metatarsophalangeal joint with the development of arthritis, transfer metatarsalgia, and stress fracture (8).In our group of patients, we had no iatrogenic intraoperative or perioperative fractures.

Transfer metatarsalgia of lesser toes after hallux valgus surgery is a late complication of scarf osteotomy. It is not particularly specific with scarf osteotomies but also seen in other osteotomies of first metatarsal (17). Park et al (18) recently reported transfer metatarsalgia as one of complications after scarf osteotomy. They suggested that shortening of first metatarsal bone length should be minimized within −2 mm and second metatarsal protrusion relative to first metatarsal kept within +1.9 mm (18). In the short scarf osteotomy, the shortening of first metatarsal is minimum and there were no developments of late metatarsalgia in our series.

Scarf osteotomy can still be done in early degenerative arthritis of metatarsophalangeal joint associated with hallux valgus. It helps to diminish the intra-articular pressure and thus relieve the pain and arrests the progression of arthritis (19). In our study, 3 patients went on to develop severe arthritis of the first metatarsophalangeal joint that reuired arthrodesis

The role of Akin osteotomy in combination with first metatarsal osteotomy has been reported in the past (20,21). The correction of hallux valgus deformity occurs as a result of reducing the metatarsus primus varus (22). Scarf osteotomy does not seem to have an influence on the alignment of the first interphalangeal joint. The Akin osteotomy has a predictable and direct correction of the hallux (23). That is the reason we combined short scarf osteotomy with an Akin procedure. Freslon et al (24) claimed a superior correction of hallux valgus angle in patient who had undergone an Akin procedure.

In a recent retrospective study of 42 patients treated with short scarf osteotomy for moderate hallux valgus, Chung (25) concluded that this technique gave good correction of IMA and HVA .The AOFAS-HMI scale score also improved at the mean follow-up of 27.4 months.

The advantages of short scarf osteotomy are that it is less invasive and preserves the soft tissue envelope, while also maintaining the strength, correction, and utility of a classic long scarf osteotomy. It is a simple technique with good mechanical strength, signifying excellent patient satisfaction while reconstructing normal anatomy and restoring radiological measurements with fewer complications. The limitations of this study are that it is a retrospective study and the follow-up period is only 3 years.

The short scarf osteotomy combined with Akin osteotomy can be a successful surgical procedure for hallux valgus with the advantage of minimal soft tissue dissection while maintaining the stable architecture of the classic scarf osteotomy. It gives good and predictable results and has a low potential for recurrence.

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