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Title: THE RESULTS OF SCARF OSTEOTOMY COMBINED WITH DISTAL SOFT TISSUE PROCEDURE ARE MOSTLY SATISFACTORY IN SURGICAL MANAGEMENT OF MODERATE TO SEVERE HALLUX VALGUS



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THE RESULTS OF SCARF OSTEOTOMY COMBINED WITH DISTAL SOFT TISSUE PROCEDURE ARE MOSTLY SATISFACTORY IN SURGICAL MANAGEMENT OF MODERATE TO SEVERE HALLUX VALGUS

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Highlights

- Hallux valgus surgeries are increasing, and intrinsically stable and powerful osteotomies should be
- preferred, for early rehabilitation.
- Scarf type osteotomy is a powerfull and stable osteotomy , and with distal soft tissue release in
- moderate to severe cases are mostly satisfactory with predictable results.
- For satisfactory results, a high level of coordination with patients is mandatory.

Abstract: Abstract

Background

Intrinsically stable diaphyseal osteotomy gained popularity in recent years for symptomatic hallux valgus deformities. In this study, Scarf osteotomy results, in surgical management of moderate to severe hallux valgus, are presented.

Methods and Patients

Study group consisted of 40 feet of 32 (28 females, four males) patients surgically managed by Scarf osteotomy between September 2009 and 2011, with a mean age of 52,98 (range, 31 to 75) years at the time of surgery. Patient satisfaction and VAS were used for subjective evaluation while for objective measures AOFAS score, first metatarsophalangeal joint ROM and radiological measurements (intermetatarsal, hallux valgus and distal metatarsal articular angles) were evaluated.

Results

Mean follow-up period was 38 (range, 24 to 60) months. Sixteen feet (40%) were reported as very satisfied, 19 (47,5%) as satisfied and the remaining five (12,5%) as unsatisfied resulting with a total of 35 (87,5%) satisfaction. The mean preoperative VAS and AOFAS forefoot scores improved from $8,13 \pm 0,791$ to $2,68 \pm 1,228$ ($p=0,0001$) and from $58,25 \pm 6,15$ to $78,25 \pm 8,13$ ($p=0,0001$) on the final follow-up, respectively. The postoperative change of first metatarsophalangeal joint ROM was not statistically significant ($p=0,281$). On the radiological evaluation; intermetatarsal and hallux valgus angles improved from a mean value of $14,77 \pm 1,76$ to $8,13 \pm 1,52$ degrees ($p=0,0001$) and from $35,28 \pm 5,86$ to $20,10 \pm 5,55$ degrees ($p=0,0001$), respectively. Distal metatarsal articular angle did not show any statistically significant change ($p=0,195$).

Conclusion

Scarf osteotomy combined with distal soft tissue procedure is a technically demanding procedure. The osteotomy is intrinsically stable and the correction power is high and the results are mostly satisfactory.

Keywords: Hallux valgus, bunion, surgical management, scarf osteotomy, diaphyseal osteotomy

Introduction

Hallux valgus (HV) is one of the most common forefoot deformities but the absolute incidence is not known accurately [1,2]. Myerson suggested that deformity is seen in 2-4 % of the population [3]. In North of Europe, HV surgery is one of the most commonly performed orthopaedic surgeries [4,5]. In USA, Thompson and Coughlin's paper about its impact on health sources, reported an estimation of more than 200,000 surgeries per year [6]. Menz et al. and Lazarides et al. studied the impact of HV severity on general and foot-specific health-related quality of life and concluded the negative effect [7,8]. It was also concluded that HV surgery has a positive impact effect on the health related quality [9,10].

Pain and difficulty with shoe-wearing at the first metatarsophalangeal joint (MTP) is the main indication for surgery. Shoe wearing exacerbates pain and treatment modalities should be

directed to relieve pain and to use shoes more comfortably as well as a functional and plantigrade foot.

There is no known prophylaxis method to prevent the deformity, conservative measures may help only to relieve pain temporarily and surgical procedures are complex and complications as well as dissatisfactions are not infrequent [11]. In the literature, many surgical techniques are described, osteotomies combined with soft tissue procedures are general preferred surgeries [2,5].

Osteotomies may be undertaken distally or proximally, the distal osteotomies are considered in mild to moderate deformities, require a less invasive approach and a shorter recovery period while proximal ones are mostly preferred for severe deformities and have more frequent healing problems. Generally, the distal osteotomies has limitations while the

proximal osteotomies carry the instability risk, so in recent years diaphyseal osteotomies like Scarf have gained popularity. The scarf osteotomy -a diaphyseal powerful, z-shaped intrinsically stable osteotomy, is preferred to correct moderate to severe deformities [12-14].

In symptomatic adult bunion deformities -with no metatarsocuneiform instability and degenerative changes of the first MTP joint, intermetatarsal angle (IMA) more than 11 and hallux valgus angle (HVA) bigger than 20 degrees, Scarf osteotomy combined with distal soft tissue release is our preferred surgery.

In this paper, the HV patients treated by Scarf osteotomy combined with distal soft tissue procedure with a mid-term follow-up are presented and the pre- and postoperative results are discussed.

Materials and Methods

The results of 40 feet of 32 patients (28 women, 4 men) with a mean age of 52,98 (range, 31 to 75) years, who underwent scarf osteotomy for symptomatic hallux valgus deformity (pain and

difficulty with shoe wearing) between September 2009 and September 2011, were retrospectively reviewed. The mean follow-up was 38 (range, 24 to 60) months.

Subjects gave informed consent to participate in the study which was approved by the institutional review board. All patients with a code of HV surgery were reviewed and only scarf osteotomies were included. Others, who had previous HV or first ray surgery, bunion surgeries other than scarf, severe degenerative arthritis of the first MTP joint, first tarsometatarsal (TMT) instability and patients younger than 18 years old were excluded. None had rheumatoid disease history.

All the subjects were invited for the last follow-up; questionnaires were completed and recent x-rays were ordered. In the final follow-up, to eliminate bias previous scorings were not available both to the patient and the assessor.

Subjective and objective measures were used to evaluate each foot pre- and postoperatively. For subjective evaluation; satisfaction (as very satisfied, satisfied and not satisfied) and for pain visual analogue scale (VAS) grading were noted [15].

Objective evaluation parameters were; American Orthopedic Foot and Ankle Society forefoot (AOFAS) scoring and hallux goniometric range of motion (ROM) measurement and x-ray measurements [16,17].

Great toe motion occurs through the metatarsophalangeal (MTP) and the interphalangeal (IP) joints, and both have extension (dorsiflexion, DF) and flexion (plantar flexion, PF) ranges in the sagittal plane. The senior surgeon measured former joint's ROM by goniometer, before the surgery and during the last follow-up visit.

Radiological measurements were determined on weight-bearing dorso-plantar (antero-posterior) and lateral x-rays of the foot by Orthoroentgen programme (Sectra Workstation

IDS7 Version: 16.1.10.1375 Ortho Toolbox, Linköping, Sweden). Preoperative as well as follow-up x-rays (6 weeks as early post operative and latest follow-up) were reviewed.

All statistical analyses were performed using IBM SPSS Statistics software, version 22 (IBM, Somers, NY, USA). Variables were analyzed using the Kolmogorov-Smirnov test to determine whether or not they were normally distributed. Data for continuous variables were presented as mean $\pm$ standard deviation. Data for categorical variables were presented as frequencies and percentages. Paired sample t test was used to compare the measurements before and after the surgery. Spearman's correlation coefficients were calculated to show the relationships between variables. A p-value < 0.05 was considered to be statistically significant.

Surgical technique

Patients were informed about the postoperative rehabilitation protocol and the preoperative questionnaires completed and consulted with the anesthesia team in the surgery morning. Twenty seven patients were operated under general anesthesia while other five preferred regional anesthesia. Thigh pneumatic tourniquet after exsanguination was routine as well as a single dose of IV antibiotic prophylaxis (cephalosporin 1000 mg) about 30 to 60 minutes before surgical incision. An ankle-foot block with a combination of long and short-lasting local anesthetics was performed just before beginning the closure of the surgical wound. Anti-embolic prophylaxis was not routine except patients with risk factors.

The surgical technique was very much similar to Molloy and Widnall and also Easley et al's detailed explanations in comprehensive reviews about scarf osteotomy [19,20]. In the surgical technique, after skin incision and capsulotomy, the third step was distal soft tissue release procedure. Then, as a fourth stage metatarsal osteotomy and fixations were performed, at the fifth stage of the surgery capsuloraphy was added.

The distal soft tissue release procedure (DSTR) from the dorsal first web space or intraarticular release was a crucial step, to release adductor hallucis tendon and lateral partial capsulotomy

of the first MTP joint. Release sufficiency decision was 10 degrees (passive) varus of the hallux after soft tissue procedure.

A medial longitudinal straight incision while passively keeping proximal phalanx aligned by medial shaft of the first metatarsal was preferred with special attention to protect the dorsomedial cutaneous nerve. After longitudinal capsulotomy and subperiosteal dissection, pre-planned z-shaped osteotomy was performed. Care was taken, not to damage the plantar artery travelling to the neck of the first metatarsal [21]. Before the osteotomy, the medial eminence was removed and the distal and proximal arms and longitudinal osteotomy lines were marked by electrocautery, as in the distal it is approximately 7-10 mm proximal to the joint line in the junction of the dorsal one-third and plantar two-thirds of the distal metaphysis, and in the proximal about 10 mm distal of the TMT joint in the junction of plantar one third to dorsal two thirds of the metatars. The tranverse limbs should be paralel to each other, perpendicular to second metatars and about 70 to 80 degrees orientated to longitudinal osteotomy line. A microsagittal saw is used for the osteotomies. We, first prefer to perform the longitudinal osteotomy and than the distal and proximal limbs. Translation of the head fragment laterally should be about 70-80 % of the metatarsal body width. Usually the length of the osteotomy is about 3-5 cm, whenever more translation is needed, a longer osteotomy line extending to the diaphyseal flare of the metatars is performed. After osteotomy, translation should be completed without need of excessive force. Intraoperative observation of DMAA is important and if altered some rotational correction may be considered. The translated osteotomy is held provisionally by K-wires and under scope control headless 2,0 mm cannulated compressive screws are driven. C-arm is used to control the displacement as well as the screw lengths. Then, capsulorrhaphy (capsule imbrication) was performed to obtain a more congruent and soft tissue balanced first MTP joint.

Akin proximal phalanx closing wedge osteotomy is used whenever necessary for HV interphalangeus or any residual valgus. Approximately 1 to 1,5 mm of bone wedge is removed, and osteotomy is manually closed and fixed by 1,8 mm cancellous headless screws.

The wounds are closed, compressive bandages are preferred. The patients allowed to stand as soon as tolerated, and discharged on the next day and invited back for follow-up in 1 and 6 weeks. Weight bearing with postoperative shoe and rehabilitation is began as soon as possible.

Results

The descriptive statistics are summarized in Table 1. There were 28 women and four men (28:4), while 40 feet had surgery, 31 (77,5 %) of the surgeries were bilateral, five (12,5 %) were on the right side and the remaining four were on the left (10 %) . Thirty-six women feet (90 %) were surgically treated (9 times more than the men feet).

Twenty six feet (65 %) had additional hammer-toe surgery, 18 feet (55 %) had bunionette reconstruction and 30 (75 %) had Akin proximal phalanx closing wedge osteotomy.

Sixteen feet (40 %) were reported to be very satisfied, 19 (47.5 %) satisfied with a total of 35 (87.5 %) and the other five (12.5 %) were nonsatisfied. Table 2 summarizes the results. VAS grading was the other subjective criteria; the median pre operative pain score was $8,13 \pm 0,791$ and the postoperative was $2,68 \pm 1,228$ and this change was statistically significant ($p=0.0001$).

AOFAS for forefoot scores (calculated global mean) were used. The preoperative AOFAS score of $58,25 \pm 6,15$ points (range, 50 to 75) improved significantly to $78,25 \pm 8,13$ (range, 60 to 90) at the final follow-up ($p=0,0001$).

The mean pre-op first MTP ROM was $66,25 \pm 4,63$ (range, 60 to 75), and changed to $67,50 \pm 6,79$ (range, 50 to 75) degrees at the final follow-up. This change was not found to be statistically significant ($p=0,281$). X ray measurements were as follows. The preoperative mean IMA value significantly changed from $14,77 \pm 1,76$ degrees (range, 11 to 19) to $8,13 \pm 1,52$ (range, 6 to 12).

($p=0,0001$). The HVA also improved significantly from a mean of $35,28\pm5,86$ (range, 26 to 46) to

$20,10\pm5,55$ degrees (range, 12 to 30) ($p=0,0001$). The mean DMAA angle change was not statistically significant ($p=0,195$), from preoperative $7,78\pm1,85$ (range, 3 to 9) to postoperative $8,13\pm1,94$ degrees (range, 3 to 9).

Complications

In one foot (2,5 %) , intraoperative nondisplaced fissure type fracture during osteotomy translation developed, so a third screw was used to strengthen the fixation (Figure 1). This complication occurred in the beginning of the learning curve. The routine post operative rehabilitation programme was not modified in this particular case. All osteotomies, including the one mentioned above, healed satisfactorily.

Sesamoid pain due to irritation by one long distal screw developed in a female patient. The screw was removed after radiological healing of the osteotomy Iatrogenic hallux varus developed in two feet (5 %), one was flexible and resolved by conservative measures in about 8 weeks after surgery. The other needed surgery.

Transfer metatarsalgia developed in two feet (5 %) with stress reactions of the third and fourth metatarsal area continued for about 6 months and both were prescribed to use an orthotic with a prolonged rehabilitation programme.

In three feet (7,5 %) recurrences occurred, two were asymptomatic and did not need any revisions. However, one was symptomatic which ended with an arthrodesis of the first MTP joint

Discussion

As no effective prophylaxis measures to prevent the development of hallux valgus deformity is known and effectiveness of watchful waiting and use of orthotic devices in management could not be clearly demonstrated, surgery in symptomatic HV management is the only choice [22]. A precise decision period is essential, a good correlation and cooperation of the patient and the surgeon is mandatory. The foot surgeon should understand the patient's considerations and satisfaction points. Though patients will be satisfied with a less painful or pain free foot while shoe wearing after surgery but they will still consider the gross appearance of their feet, full satisfaction can only be achieved by a pain-free and good looking, plantigrade foot [1-3,19,23,24].

Even in mild deformity with congruent joint, only medial eminence resection is not recommended, as this procedure does not correct IMA or HVA and is prone to recurrence. In HV, only bunionectomy and medial capsular plication results are unsatisfactory, Kitaoka et al, reported nearly 41% of the patients were dissatisfied and both IMA and HVA increased in five years postoperatively [25]. In scarf osteotomy, medial eminence resection is part of the procedure, but great care is needed that the osteotomy line should not pass to the lateral of the sulcus to avoid iatrogenic hallux varus. Overresection of the eminence also affects the osteotomy configuration. In one of the first cases (early phase of learning curve), this overresection was probably the reason of the fissure happened during translation. The third screw fixation, -to achieve additional stability, was needed (in routine two screws for the fixation of the osteotomy) intraoperatively and modification of the routine rehabilitation programme was not mandatory (Fig 1). Two iatrogenic hallux varus (5 %) developed due to excessive resection, one of them resolved by conservative measures while the other needed extensor hallucis longus split tendon transfer surgery.

The distal soft tissue procedure is the release of adductor hallucis and partial lateral joint capsulotomy and combined with osteotomy, but when used alone will not give satisfactory

results. Mann and Coughlin reported an iatrogenic hallux varus rate of 11 % after isolated distal soft tissue release with sesamoid excision even though some improvement of both IMA and HV angles [23]. In our surgical technique, lateral release with sesamoid reduction (not excision) was crucial and manual great toe adduction about 10° was the criteria in decision of release sufficiency. Patients were more satisfied from the intrarticular release only from medial incision instead of an additional dorsal incisional scar.

For mild to moderate deformities distal Chevron osteotomy is usually recommended. This osteotomy lateralizes the metatarsal head and narrows the foot with an IMA reduction. Smith et al, in a meta analysis reported a mean IMA reduction of 5.33 degrees after Chevron osteotomy. They also compared the IMA reduction results of Chevron versus Scarf osteotomy and concluded that the latter corrects better with a median of 0.88 degrees [26]. Proximal osteotomies are more powerful to correct the severe deformities, but they have more complicated problems of healing [27,28].

For moderate up to severe HV cases diaphyseal osteotomies are also, described. Scarf type osteotomy is basically a diaphyseal powerful intrinsically stable osteotomy with a reliable rigid fixation allowing early mobilization and rehabilitation. Leemrijse et al, in a technical note, even referred Scarf type osteotomy without internal fixation with referring to the stability of the osteotomy [29]. In the presented group, we all fix the osteotomy by 2 cannulated screws (except the one described above) and never observed instability in the early or intermediate follow ups. Inherent stability of the osteotomy is an advantage for early rehabilitation.

Jones et al, studied the results of Scarf osteotomy and concluded 92 % satisfaction of the patients and showed improvements of HVA and IMA, similar to this study as satisfaction rate of 87,5 % and significant improvements of VAS and AOFAS [30].

After HV surgery one of the complications is a stiff first MTP joint with loss of ROM. This may be secondary to a malunion of the osteotomy or soft tissue contracture. In our study there was

no statistically significant difference between the pre- and postoperative measurements of hallux movement so at least the patients reserved their first MTP joint ROMs.

Scarf osteotomy is a technically demanding z-osteotomy so a thorough surgical technique is mandatory. Coetzee in 2003, named his manuscript as "dark side" with a complication rate of about 25 % recurrence and 35 % of troughing after Scarf osteotomy [31]. Troughing is the dorsal migration with a rotational malunion and functional unloading of the first ray which may be prevented. In this group we had no troughing. Bock et al. in a recent publication reported none, also [13].

The radiological measurements were used for the decision making as well the follow ups in HV management. Basically on plain dorso-plantar (antero-posterior) weight bearing x-rays IMA, HVA and DMAA measurements were studied. While the mean IMA and HVA were improved significantly, DMAA change was statistically insignificant in our study group while Bock et al. concluded improvement of all three angles [13]. Recurrence after HV deformity correction has been reported in a wide range [13,15,31-33], but all of them are not symptomatic. Even though in the presence of regression in clinical symptoms, still radiographic recurrences are possible. Fuhrmann et al. prefers revalgisation terminology for radiographic recurrences which are silent and asymptomatic [32]. In this reported study, the recurrence was 7,5% , and 75 % of these were asymptomatic in mid-term follow ups. Only 1 symptomatic recurrence needed an arthrodesis of the first MTP joint. Referring to Bock et al's conclusion that the recurrences develop within the first 1,5 to 2,8 years after surgery, as our results were medium term, so we would not expect new recurrences [13].

This study has several limitations, eg, the retrospective nature of the study, the lack of a comparison group managed by a different method, and only mid term results are available at this time. But this is a clinical research and the results are in consistent with the literature.

As a conclusion, Scarf type osteotomy is a powerfull and stable osteotomy with predictable results. Intermediate-term results are mostly satisfactory, and in the absence of complications allows early active rehabilitation.

Conflict of interest : None

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References

1. Coughlin M J, Mann RA Hallux Valgus In: Surgery of the Foot and Ankle eds Coughlin M J, Mann RA, Saltzman CL, 183-362, MosbyElsevier, 2007, Philadelphia.
2. Mann RA Hallux Valgus In: Operative Foot Surgery ed Gould JS WB Saunders Co Philadelphia, 1994
3. Myerson MS Hallux valgus In: Foot and Ankle Disorders, WB Saunders Philadelphia, 2000; 213-89.
4. Saro C, Bengtsson AS, Lindgren U, Adami J, Blomqvist P, Fellander -Tsai L Surgical treatment of hallux valgus and forefoot deformities in Sweden: a population based study Foot Ankle Int 2008; 29 (3): 298-304
5. Torkki M, Seitsalo S, Paavolainen P Chevron osteotomy for correction of hallux valgus: a long term follow-up study. Foot 2001; 11: 91-3
6. Thompson FR Coughlin MJ The high price of high-fashion footwear J Bone Joint Surg 1994; 74 A (10): 1586-93.
7. Menz HB, Roddy E, Thomas E, Croft PR. Impact of hallux valgus severity on general and foot-specific health-related quality of life. Arthritis Care Res 2011; 63(3): 396-40.
8. Lazarides SP, Hildreth A, Prassane V, Talkhani I. Association amongst angular deformities in hallux valgus and impact of the deformity in health related quality of life. Foot Ankle Surg 2005; 11: 193-6
9. Saro C, Jensen I, Lindgren U. Quality of life outcome after hallux valgus surgery. Quality Life Res 2007; 16(5): 731-8.
10. Thordarson DB, Rudicel SA, Ebrahimzadeh E, Gill LH Outcome study of hallux valgus surgery-an AOFAS multi-center study. Foot Ankle Int 2001; 22(12): 956-9.
11. Chong A, Nazarian N, Chandrananth J, Tacey M, Shepherd D, Tran P. Surgery for the correction of hallux valgus. Bone Joint J 2015; 97-B: 208-14.

12. Barouk LS. Scarf ostetomy for hallux valgus correction: Local anatomy, surgical technique and combination with other forefoot procedures. *Foot Ankle Clin* 2000; 5: 525-58.
13. Bock P, Kluger R, Kristen K-H, Mittlböck M, Schuh R, Trnka H-J. The scarf osteotomy with minimally invasive lateral release for treatment of hallux valgus deformity. *J Bone Joint Surg Am* 2015; 97: 1238-45.
14. Borrelli AH, Weil LS. Modified scarf bunionectomy. Our experience in more than 1000 cases. *J Foot Surg* 1991; 30: 609-12
15. Hawker GA, Mian S, Kendzerska T, French M. Measures of Adult Pain. *Arthritis Care and Res* 2011; 63 (11); 240-252.
16. Kitaoka HB, Alexander IJ, Adelaar RS, et al. Clinical rating systems for the ankle, hindfoot, midfoot, hallux and lesser toes. *Foot Ankle Int* 1994; 15: 349-53
17. Nestor BJ, Kitaoka HB, Lstrup DM, Berquist TH, Bergmann AD. Radiological anatomy of painfull bunionette. *Foot Ankle* 1990; 11: 6-11.
18. Coughlin MJ, Saltzman C, Nunley JA II. Angular measurements in the evaluation of hallux valgus: a report of the Ad Hoc Committee of American Orthopaedic Foot and Ankle Society on Angular Measurements. *Foot Ankle Int* 2002; 23: 68-74.
19. Easley ME, Darwish HH, Schreyack DW, DeOrio JK, Trnka H-J. Hallux valgus: proximal first metatarsal osteotomies Saxena A (ed) *Int Adv in Foot Ankle Surg* 2012: 11-24, Springer, London
20. Molloy A, Widnall J. Scarf Osteotomy. *Foot Ankle Clin North Am* 2014; 19: 165-180
21. Shereff MJ, Yang QM, Kummer FJ. Extraosseous and intraosseous arterial supply to the first metatarsal and metatarsophalangeal joint. *Foot Ankle* 1987; 8: 81-93
22. Torkki M, Malmivaara A, Seitsalo S, Hoikka V, Laippal P, Paavolainen P. Surgery vs

orthosis vs watchfull waiting for hallux valgus: a randomized controlled trial. JAMA

2001; 285 (19): 2474-80.

23. Mann R A, Coughlin MJ. Hallux valgus: etiology, anatomy, treatment and surgical considerations. Clin Orthop 1981; 157: 31-41

24. Wagner E, Ortiz C. Osteotomy considerations in hallux valgus treatment : improving the correction power. Foot Ankle Clin 2012; 17(3): 481.

25. Kitaoka HB, Franco MG, WeaverAL, Ilstrup DM. Simple bunionectomy with medial capsulorrhaphy. Foot Ankle 1991; 12: 61-8

26. Smith SE, Landorf KB, Butterworth PA, Menz HB. Scarf versus Chevron osteotomy for the correction of 1-2 Intermetatarsal Angle in Hallux Valgus: a systematic review and meta-analysis. J Foot Ankle Surg 2012; 437-44.

27. Glazebrook M, Copithorne P, Boyd G, Daniels T, Lalonde K-A, Francis P, Hickey M
Proximal opening wedge osteotomy with wedge-plate fixation compared with proximal chevron osteotomy for the treatment of Hallux Valgus J Bone Joint Surg Am ;2014 ; 96 :1585-92

28. Iyer S, Demetracopoulos CA, Sofka CM, Ellis SJ High rate of recurrence following proximal medial opening wedge osteotomy for correction of moderate hallux valgus
Foot Ankle Int 2015 ; 36(7) : 756-63

29. Leemrijse T, Maestro M, Tribak K, Gombault V, Bevernage BD, Deleu P-A. Scarf

osteotomy without internal fixation to correct hallux valgus. Orthop Trau Surg Res391 2012; 98: 921-7.

30. Jones S, Al Hussainy HA, Ali F, Betts RP Flowers MJ. Scarf osteotomy for hallux valgus. J Bone Joint Surg 2004; 86- B: 830-6.

31. Coetzee JC. Scarf osteotomy for hallux valgus repair: the dark side. Foot Ankle Int 2003; 24 (1): 29-33.

32. Fuhrmann RA, Zollinger -Kies H, Kundert HP. Mid-term results of Scarf osteotomy in hallux valgus. Int Orthop 2010; 34 (7): 981-9.

33. Weil LS. Scarf osteotomy for correction of hallux valgus. Historical perspective, surgical technique and results. Foot Ankle Clin 2000; 5: 559-80.

Figure 1

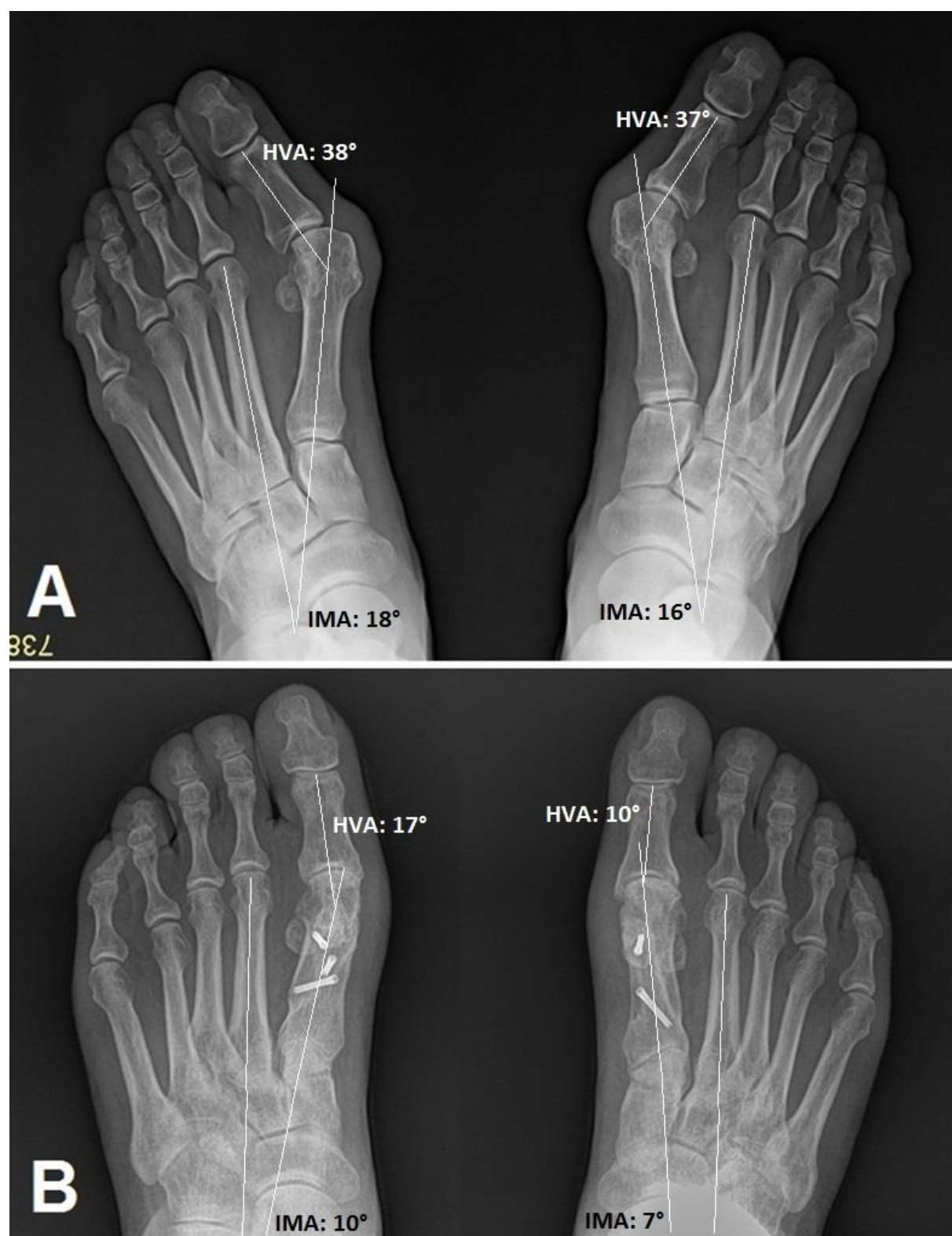


Table 1: The frequencies indicate the surgically treated feet

	Frequency	Percent
Gender		
Female	36	90,0
Male	4	10,0
Total	40	100,0
Surgical side		
Right	5	12,5
Left	4	10,0
Bilateral	31	77,5
Total	40	100,0
Akin	30	75
The 2nd hammer toe		
Number	14	35,0
Yes	26	65,0
Total	40	100,0
Bunionette		
Number	18	45,0
Type 1	9	22,5
Type 2	3	7,5
Type 3	3	7,5
Type 4	3	7,5
Total	40	100,0

Table 2: Pre and postoperative statistical results of evaluation parameters

	Preoperative value	Postoperative value	p value
VAS	8,13 ± 0,791 (6-9)	2,68 ± 1,228 (1-6)	0.0001
ROM (1. MTP)	66,25° ± 4,63° (60°-75°)	67,50° ± 6,79° (50°-75°)	0.281
AOFAS	58,25 ± 6,15 (50-75)	78,25 ± 8,13 (60-90)	0.0001
HVA	35,28° ± 5,86° (26°- 46°)	20,10° ± 5,55° (12°-30°)	0.0001
IMA	14,77° ± 1,76° (11°-19°)	8,13° ± 1,52° (6°-12°)	0.0001
DMAA	7,78° ± 1,85° (3°-9°)	8,13° ± 1,94° (3°-9°)	0.195