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A variant of screwless scarf osteotomy for hallux valgus: Clinical and radiographic outcomes

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Scarf osteotomy is a versatile procedure for the correction of moderate and advanced hallux valgus. This technique has benefited from many improvements to allow translation and angulation correction of the deformity. We describe in our study a scarf variant without osteosynthesis material in which proximal fixation is made by interlocking and distal fixation with nonabsorbable suture. We retrospectively reviewed 33 feet in 30 patients with an average follow-up duration of 35 months (range: 4-60 months). On the latest follow up, 94 % of the patients were satisfied with the result. American Orthopaedic Foot and Ankle Society (AOFAS) score improved from 56/100 to 87/100. The average improvement of HV angle was from 35° to 12°. The intermetatarsal angle improved from 19° to 7°. The DMAA improved from 27° to 8°. Neither delayed union nor osteonecrosis were observed. This variant of screwless scarf technique gives very good results in severe Hallux valgus by safe and large translation authorizing rotation and supination with low iatrogenicity.

Keywords: hallux valgus, scarf osteotomy, screwless

Hallux valgus (HV) is the main forefoot deformity. Non-operative treatment may relieve symptoms but the basis of management is surgery. The HV corrective surgery history is marked by various surgical techniques that currently enumerate over 150 procedures [1].

The scarf osteotomy is a powerful and mechanically stable procedure to correct moderate and severe forms of HV. This Z-shaped osteotomy of the first metatarsal was first proposed by Meyer [2]. Weil was the first to use the term 'Scarf' [3] and Barouk popularized it in Europe [4]. The scarf osteotomy is very versatile and stable, therefore it allows rotational and translation corrections. Originally this osteotomy was stabilized with two screws. Maestro proposed eliminating the proximal screw by locking the two fragments distally: a notch was created via a medial extension of the cephalic part of the osteotomy, the plantar fragment was displaced laterally, and the distal end of the proximal fragment was then fit into the notch (secondary cut and interlocking joint technique [5]. In 2012, Leemrijse et al optimized this technique to increase the potential range of translation. The procedure consists of distal locking and proximal stabilization without shortening. This was possible by impaction of a corticocancellous bone graft taken from the medial overhanging edge of the proximal fragment [6].

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Our study presents the results of a retrospective series involving 33 feet (30 patients) operated for HV according to scarf technique without osteosynthesis material with proximal fixation by interlocking and distal fixation with nonabsorbable suture.

The aim of this study is to evaluate the safety, feasibility, and reproducibility of screwless scarf osteotomy by comparing our clinical and radiographic outcomes to the literature data.

Patients and methods:

This is a retrospective study regarding 33 feet of HV from 30 patients treated with Scarf osteotomy without osteosynthesis material and followed in the orthopedic trauma surgery department of the military hospital Moulay Ismail Meknes between January 2014 and December 2018. The average follow-up duration was 35 months (range: 4-60 months). All subjects have given informed consent. Exclusion criteria were; HV treated with other operative techniques than scarf screwless, or a scarf procedure with internal fixation.

Twenty men and ten women had an average age of 37 years (range, 16-65 years) at the time of surgery. Six patients had bilateral HV and only 3 patients have been operated on the two sides by a screwless scarf.

Pain with irritation at the bunion was present in 29 feet (88%). The unaesthetic deformity was a serious reason for consultation in 14 patients (47%). All of our patients had metatarsalgia and difficulty with shoes wear. Finally, 67% of our feet were Egyptian type (22 cases).

A standardised surgical technique was used in all cases. The foot was positioned on the operative table in spontaneous external rotation position, with a thigh tourniquet inflated to 300 mmHg.

The surgical procedure involves a standard medial incision over the first MTPJ and along the shaft of the first MT. Skin incision is done at the dorsal and plantar skin junction, avoiding to extend too far proximally and stopped distally at about 1 cm from the joint. The dorsal collateral sensitive nerve will be visible and protected. It is normally not necessary to visualise the collateral plantar nerve.

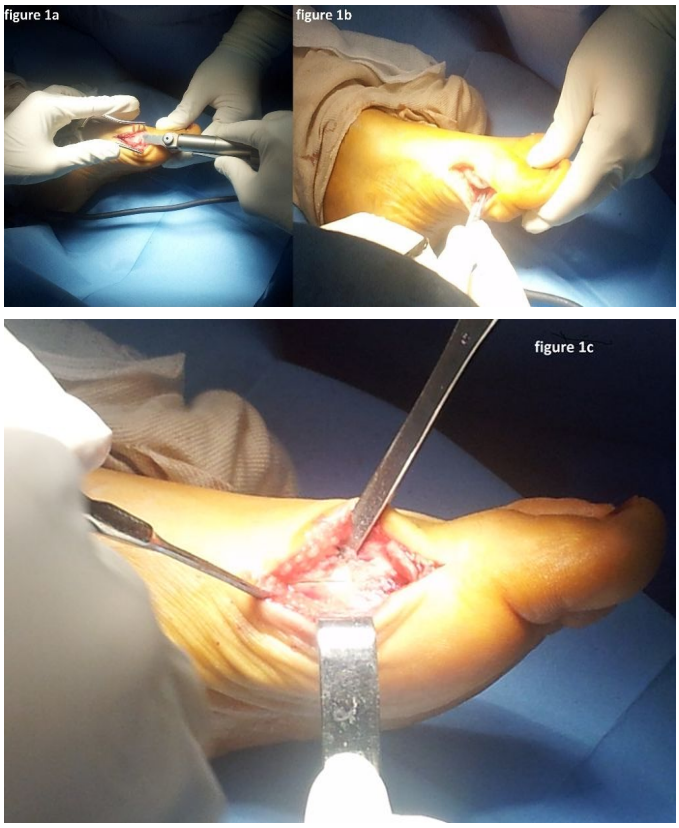

Figure 1 a: The medial capsulotomy with resection of the medial eminence. b: The sesamoid release by medial approach. c: The Z-shaped osteotomy.

After a medial capsulotomy, the medial eminence of the metatarsal head is removed (Figure 1a).

Then, by the same medial approach (Figure 1b). We release and reduce lateral sesamoid according to the Maestro approach; above and under the lateral collateral ligament (LCL) which is respected.

• Above LCL: to free the extensor hallucis longus (EHL), the fibrous sling is cut.

• Under LCL: the metatarso-sesamoïd ligament is cut principally with the lateral part of the conjoint ligament close to the base of the phalanx [7]

The exposure of the plantar aspect of the metatarsal shaft by rugination must respect the soft tissue below the head for blood preservation.

Regarding the scarf osteotomy; the longitudinal section is made along the medial side of M1. The osteotomy begins proximally to 5 mm from the beginning of the proximal plantar exposure and on average at the junction of the dorsal two-thirds and plantar one-third of the shaft. It ends distally at the junction of the dorsal one-third and plantar

two-thirds of the head just proximal to the cartilage of the joint (normally approximately 5mm from the joint surface). In the frontal plane, the osteotomy has an oblique direction downwards and outwards. The degree of dorsoplantar slope is chosen to obtain the desired amount of lowering. The saw is directed generally parallel to the metatarsal plantar surface of which has an average inclination from 40° relative to the horizontal; the focus is to respect the lateral beam from the dorsal fragment, which ensures the stability of the osteotomy. The longitudinal cut must be at least 2cm long to eliminate all risk of secondary displacement.

The distal transverse cut is done just behind the dorsal synovial recessus attachment which is respected. This cut is through the distal metaphysis (presence of spongiosa avoids the dorsal fragment to be fit into the distal fragment). The cephalic cut is dorsal and directed from within outward, proximally oblique and angled at 70°or 80° relative to longitudinal limb. If the distal transverse cut is perpendicular to the axis of the second metatarsal, pure translation is achieved and stabilization is required, either via a screw or via interlocking of the two fragments after a secondary cut, which shortens the first metatarsal bone. Finally the position and the obliquity of this distal cut give the osteotomy more stability (Figure 1c).

The proximal transverse cut is performed, at an angle of 60° relative to the longitudinal limb and perpendicularly to the axis of the second metatarsal bone. A dovetail notch is then created at the proximal part of the plantar fragment to allow interlocking of the proximal plantar part of the osteotomy. This interlocking allows us not to use a proximal screw. This method is mainly used to acquire pure translation without correction of the distal metatarsal articular angle (DMAA). And, as Leemrijse et al recommended, when the DMAA must be corrected, a shorter osteotomy with a greater rotational effect is made and the proximal part of the cut is not impacted, to ensure marked proximal translation.

After a complete Z cut, we translate easily the lower part of the plantar metatarsal associated with medial rotation which allows to correct the orientation of the metatarsophalangeal cartilage (DMAA).

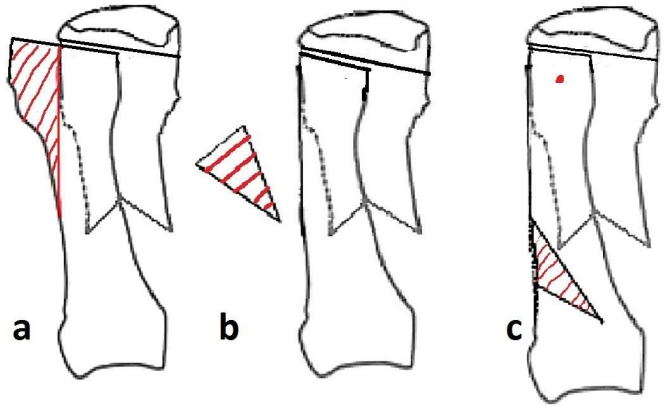

Figure 2 a: Removal of medial overhanging bone. b: Reshaping and rotation of bony wedge. c: Superior view of screwless scarf osteotomy with a proximal fixation by impaction of bony wedge and distal fixation with nonabsorbable suture through a transosseous tunnel.

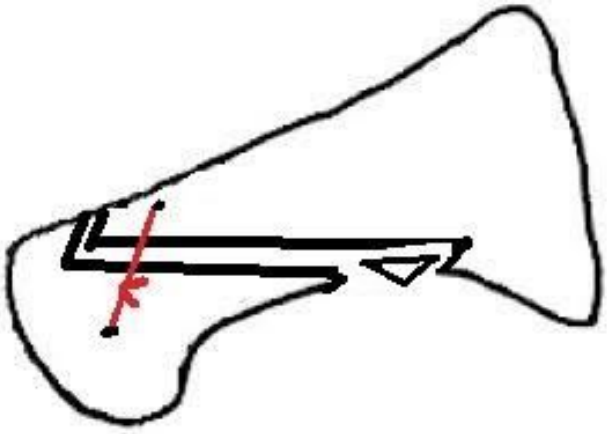

Figure 3 Medial view of first metatarsal showing screwless scarf osteotomy with suture travelling through a transosseous tunnel in distal and proximal stabilisation by interlocking with impaction of the medial overhanging edge.

Once the desired displacement is obtained, the proximal fixation is done by interlocking from the proximal transverse cut, while the distal attachment is held temporarily by a modified Jospin forceps. The 10/10 Kirschner wire is then inserted from top to bottom which will lead the non-resorbable thread N°2 and allows the distal fixation by a transosseous suture under moderate tension avoiding shear of thread in the spongy bone. The medial overhanging wedge of bone is resected and impacted proximally, conferring perfect stability to the construct (Figure 2 and 3). The medial capsulorrhaphy is then performed to center the sesamoid bones which are released by the lateral side.

Figure 4 Postoperative strapping to be kept for 2 weeks.

Primary stability must be compatible with good mobility of the first metatarsophalangeal joint which enables it to maintain satisfying postoperative amplitude. Moreover one patient received an Akin osteotomy of P1 associated with Scarf osteotomy.

Postoperatively, strapping was kept for 2 weeks (Figure 4). Patients were allowed to walk with a Barouk boot for 6 weeks. At week 6, patients were able to walk and stand on the operated foot with full weight bearing.

Patients were assessed preoperatively and postoperatively for clinical and radiological parameters. The clinical evaluation included both subjective and objective assessment with American Orthopaedic Foot and Ankle Society (AOFAS) score. Radiological assessment included IMA (angle M1M2), HV angle (HVA: angle M1P1), DMAA (distal metaphyseal articular angle), angle M1M5 and situation of sesamoids. Measurements were taken with radiographs at weight-bearing dorsoplantar and lateral views.

Statistical analysis was performed using the paired z test to analyze the radiological parameters with the P value set at 0.05 to determine statistical differences.

For the situation of the sesamoids, we used the following classification [8]:

• Grade 0: no dislocation;
• Grade 1: lateral sesamoid beyond the lateral border of the first metatarsal;
• Grade 2: the lateral sesamoid is fully apparent in 1st metatarsal space;
• Grade 3: both sesamoid bones are located in the 1st metatarsal space.

Results

At the time of the latest follow up (mean: 35 months; range: 4-60 months), 94% of the cases were satisfied and very satisfied with the result (64% very satisfied and 30% satisfied), 6% were not satisfied.

The average preoperative AOFAS score was 55 (range: 36-71), postoperative AOFAS score was 87 (range: 63-95),

The average preoperative M1P1 angle of 35.06° (range: 24°-46°) improved to 12° (range: 2° to 22°) postoperatively ($p < 0.001$). The average reduction of M1P1 angle was 23.06 ° (66% from M1P1 angle

The average preoperative M1M2 angle of 19° (range: 12°- 28°) improved to 7.03° postoperatively (range: 4°-16°; $p < 0.001$).The average reduction of the M1M2 angle was 11.96° (63% from M1M2 angle).

The average preoperative DMAA of 27.27 ° (range: 14 °- 32 °) improved to 8.3° postoperatively (range: 3°-16°; $p < 0.001$).The average reduction of the DMAA was 18.96° (70% from DMAA angle).

Preoperatively the average value of the M1M5 angle was 32.51 ° (range: 20 ° to 42 °). While in postoperative, the average value of the angle M1M5 was 20.57 ° (12 ° to 32 °; $p < 0.001$). The average reduction of the M1M5 angle was 11.93° (22% from DMAA angle).

In preoperatively, the grade 2 was predominant with 22 cases (66.67%) followed by grade 3 with 6 cases (18.18%) and finally the grade 1 with 5 cases (15.15%).

Authors	Procedures	*M1P1 Angle* pre-operative	*M1P1 Angle* post-operative	*M1M2 Angle* pre-operative	*M1M2 Angle* post-operative	*DMAA pre-operative*	*DMAA* post-operative
Jardé [12] (1996)	Soft tissue +/- P1	33.3°	24.5°	14.2°	12°	-	-
Coughlin & Carlson [13] (1999)	Double osteotomy	34°	12°	15°	6°	23°	9°
Veri [14] (2001)	Proximal osteotomy	37°	13°	16°	6°	-	-
Bauer [15] (2010)	Reverdin-Isham Percutaneous Osteotomy	30°	15°	14°	11°	15°	7°
Mahadevan et al [16] (2016)	Chevron	32.3°	14.3°	15.2 °	5.8°	16.5°	8.5°
Our series	Screwless scarf osteotomy	35.06°	12°	19°	7°	27°	8°

Table 1 Anatomical results of several series using different techniques.

	Authors	Pre-operative M1P1	Post-operative M1P1	Pre-operative M1M2	Post-operative M1M2	Pre-operative DMAA	Post-operative DMAA
Classical Scarf	Gayet [17]	37°	21°	15°	10°	-	-
	Crevoisier [18]	32°	17°	16°	10°	13°	10°
	Freslon [8]	31.2°	17.5°	12.1°	7.5°	13.3°	11.1°
	Lipscombe [19]	31.4°	11°	13°	6°	-	-
	Law Kin-Wing [9]	37.9°	10°	16.1°	8.4°	-	-
Screwless Scarf	Leemrijse [6]	38.5°	10.6°	15.1°	8.7°	15.4°	5.4°
	Dries Van Doninck [11]	27,9 °	4,2°	13.5 °	4.8°	-	-
	Our series	35.06°	12°	19°	7°	27°	8°

Table 2 Radiographic outcomes in the Scarf osteotomy series of the literature.

Authors	Year	Technique	Number of feet	Follow-up	Satisfaction	Preoperative AOFAS score	Postoperative AOFAS score
Veri [14]	2001	Proximal metatarsal osteotomy	37	12.2 years	90%	37	92
Schneider[20]	2004	chevron	112	12.7 years	-	46.5	88.8
Freslon [8]	2005	Scarf	123	4.8 years	84.6%	-	-
Bauer [15]	2009	Percutaneous Reverdin-Isham osteotomy	104	2 years	89%	49	87.5
Leemrijse [6]	2012	Screwless scarf	12	7.7 years	100%	-	80
K.-W. Law [9]	2014	scarf	31	17 months	77%	-	88
Raymond D. Pollock [21]	2016	Shortening scarf osteotomy	20	25 months	100%	29.2	82.2
Our series	2017	Screwless scarf	33	35.15 months	94%	55	87

Table 3 Comparison of the functional and objectives results of different series.

While in postoperative the grade 0 was found in 18 cases (54%), grade 1 in 13 cases (40%) and grade 2 in 2 patients (6%).

Complications were observed in three patients: Residual pain was reported in two patients (who have been disappointed), while the stiffness of the MP was objectified in one patient. No disorders of consolidation for osteotomy (delayed healing of bone, pseudarthrosis) were noted.

Discussion

Currently, foot surgery requires rapid functional recovery that cannot be conceived without a primary stability and solidity of an osteotomy. Scarf osteotomy is designed to be versatile, authorizing the restoration of multiplanar HV anomaly. It allows horizontal displacement, lengthening, rotation, elevation, and lowering of the MT head [9].

Various modifications of the traditional scarf osteotomy were proposed to improve the biomechanics and to reduce complications. This evolution is motivated by deficiencies and complications of chevron osteotomies, basal osteotomies and Lapidus arthrodesis and by the superiority of scarf osteotomy results compared to these techniques [10] (Table 1).

Many studies have focused on the surgical treatment of hallux valgus by Scarf osteotomy, with or without osteosynthesis material (Table 2). Maestro in 2007 [5] and Leemrijse in 2012 [6] were the first to use the Scarf osteotomy without internal fixation. Leemrijse et al. developed an original technique involving distal locking without shortening and proximal stabilisation by impaction of a cortical-cancellous bone graft [6], whereas in our technique the fixation was ensured proximally by interlocking and distally by nonabsorbable suture. Compared to other series, our results lead to consider this procedure reliable for correction of the significant hallux valgus (Figure 5 and Tables 1-3).

The screwless scarf osteotomy is a diaphyseal-metaphyseal osteotomy which allows a very wide lateral translation; we don't need more space for placing a screw which could limit our translation capacity. It also allows sufficient medial rotation to correct the DMAA [5, 6, and 11].

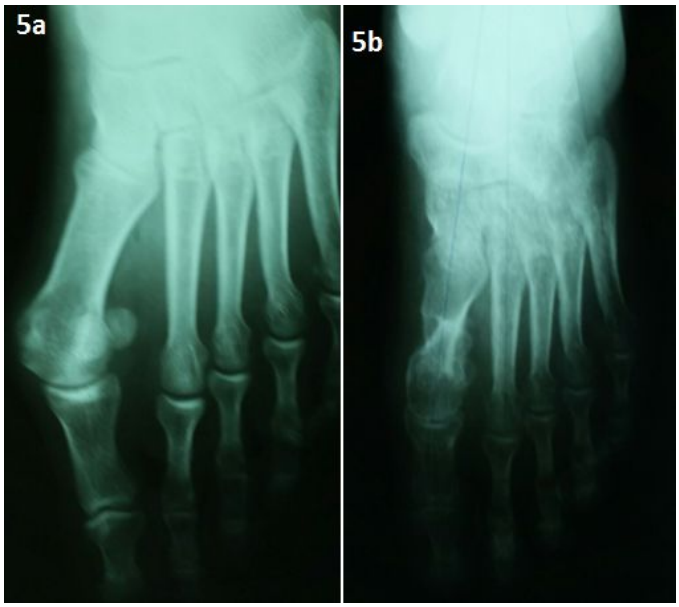

Figure 5 Example of correction of hallux valgus by screwless scarf osteotomy; a: preoperative. b: postoperative.

Figure 6 Scarf osteotomy without internal fixation with 45 days apart, a: preoperative anterior-posterior radiograph. b: Postoperative anterior-posterior radiograph.

This surgical procedure has clear advantages [6, 11]:

- Fewer complications related to screw insertion mostly in porotic bones which can lead to fragility fracture of the 1st metatarsal
- No loss of reduction due to the compressive effect of the screw
- Less risk for complications in case of superficial infection
- Less cost because no screw is used

At last, the screwless technique provides high-quality remodeling at the osteotomy site, without stress shielding [6] (Figure 6). The mean follow-up of our series was 35.15 months which is a significant duration for a procedure whose practice is still recent. However, although this period is sufficient to consider the correction for granted, it would be interesting to pursue the follow up of these patients (as in the case of Leemrijse series [6]) to quantify the importance of late recurrence and whether corrections obtained with this procedure are superimposed in terms of efficiency in time to other techniques with an important follow up.

Conclusion

The screwless scarf osteotomy is the favored technique in moderate and severe hallux valgus, on the condition that technique fundamental principles are respected. The absence of screws allows a wide lateral translation and therefore reduces a considerable preoperative metatarsus varus.

Finally in our study, we confirm the efficiency of this recent technique in the treatment of HV with almost 94% excellent and good results in our series. The learning curve of this surgery remains long. Respect and application of various technical artifices is essential for the realization of this economic, reliable and biological procedure.

References

1. Laffenêtre O, Solofomalala GD, De lavigne C, Bauer T**.** Hallux valgus : définition, physiopathologie, études clinique et radiographique, principes du traitement. Enc. Med. Chir, 2009 ; 14-1236-A10, 9p.
2. Meyer M. Eine neue modifikation der hallux-valgus-operation. Zen Fur Chir. 1926; 53:3265–8.
3. Weil LS, Borelli AN. Modified Scarf bunionectomy, our experience in more than 1000 cases. J Foot Surg. 1991; 30:609–22.
4. Barouk LS. Scarf osteotomy for hallux valgus correction: local anatomy, surgical technique, and combination with other forefoot procedures. Foot Ankle Clin. 2000 Sep;5(3):525–58.
5. Besse JL, Maestro M. Ostéotomie de Scarf du 1er métatarsien. Rev Chir Orthop. 2007; 93:515-23
6. Leemrijse T, Maestro M, Tribak K, Gombault V, Bevernage BD, Deleu PA. Scarf osteotomy without internal fixation to correct hallux valgus. Orthopaedics & Traumatology: Surgery & Research. 2012 Dec 31; 98(8):921-7.
7. Maestro M. The ruled lateral release of the metatarsophalangeal and metatarso sesamoïd joint in hallux valgus by the medial approach. Poster EFAS Paris 23-25 octobre 1997.
8. Freslon M, Gayet LE, Bouche G, Hamcha H, Nebout J. Ostéotomie Scarf dans le traitement de l'hallux Valgus : à propos de 123 cas avec un recul moyen de 4,8 ans. Rev Chir Orthop. 2005 January; 91:257-266.
9. Law Kin-Wing, Li Hok-Yin Alwin, Li Pang-Hei, Qunn Jid-Lee, Wai Yuk-Leung. Scarf Osteotomy in Treating Hallux Valgus: Clinical and Radiographical Outcome and Technical Notes. Journal of Orthopaedics, Trauma and Rehabilitation. 2014; 18 (1):22-26.
10. Trnka HJ, Mühlbauer M, Zembsch A, Hungerford M, Ritschl P, Salzer M. Basal closing wedge osteotomy for correction of hallux valgus and metatarsus primus varus: 10-to 22-year follow-up. Foot & ankle international. 1999 Mar 1; 20(3):171-7.
11. Dries Van Doninck et al. Screwless Scarf osteotomy for hallux valgus: evaluation of radiologic correction. Foot and Ankle Surgery. 2017;23 (4): 255–260
12. Jarde O, Trinquier-lautard JL, Meire P, Gabrion A, Vives P. Hallux valgus traité par ostéotomie de varisation de la première phalange associée à la plastie de l'adducteur. Rev Chir Orthop. 1996; 82:541-548.
13. Coughlin MJ, Carlson RE. Treatment of hallux valgus with an increased distal metatarsal articular angle: evaluation of double and triple first ray osteotomies. Foot Ankle Int. 1999 Dec; 20(12):762-70.
14. Veri JP, Pirani SP, Claridge R. Crescentic. Proximal metatarsal osteotomy for moderate to severe hallux valgus: a mean 12.2 year follow-up study. Foot Ankle Int 2001; 22:817-22.
15. Bauer T, Biau D, Lortat-Jacob A, Hardy P. Percutaneous hallux valgus correction using the Reverdin-Isham osteotomy. Orthopaedics & Traumatology: Surgery & Research. 2010; 96(4):407-416.
16. Mahadevan D, Lines S, Hepple S, Winson I, Harries W. Extended plantar limb (modified) chevron osteotomy versus scarf osteotomy for hallux valgus correction: A randomised controlled trial. Foot and Ankle Surgery. 2016; 22:109–113.
17. Gayet LE, Vaz S, Muller A, Avedikian J, Pries P, Clarac JP. L'ostéotomie Scarf dans le traitement de l'hallux valgus: à propos de 71 cas. Rev Chir Orthop. 1997; 83(suppl II):81.
18. Crevoisier X, Mouhsine E, Ortolano V, Udin B, Dutoit M. The Scarf osteotomy for the treatment of hallux valgus deformity: a review of 84 cases. Foot Ankle Int. 2001; 22:970-976.
19. Lipscombe S, Molloy A, Sirikonda S, Hennessy MS. Scarf osteotomy for the correction of hallux valgus: midterm clinical outcome. J Foot Ankle Surg. 2008; 47:273–277.
20. Schneider W, Aigner N, Pinggera O, Knahr K. Chevron osteotomy in hallux valgus. Ten-year results of 112 cases. J Bone Joint Surg Br. 2004; 86(7): 1016-20.
21. Prasad Karpe, Marie C. Killen, Raymond D. Pollock, Rajiv Limaye. Shortening scarf osteotomy for correction of severe hallux valgus. Does shortening affect the outcome? . The Foot. 2016; 29:45-49.