Modified Wilson's versus scarf osteotomy for treatment of hallux valgus: a prospective clinical randomized controlled study

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Background
A prospective randomized controlled comparative trial formulated to compare modified Wilson's osteotomy and scarf osteotomy in treatment of cases of hallux valgus deformity in terms of operative time, functional, radiological outcomes, and complications.
Methods
Forty cases with hallux valgus were divided randomly into 2 groups; 37 reached the final follow-up (18 underwent scarf and 19 underwent modified Wilson's osteotomy), average age 37.34 years. Average follow-up period was 24.13 months. Patients were assessed clinically and radiologically, in addition to preoperative and postoperative functional scoring system of American College of Foot and Ankle Surgeons (ACFAS).
Results
Operative time was 64.91 min in the scarf group compared to 65.63 min in the modified Wilson's group; x-ray evaluation showed no statistically significant difference between both groups. ACFAS score showed functional improvement in both groups but the improvement was superior in the modified Wilson group 71.17% compared to the scarf group 59.23%.
Conclusions
Both modified Wilson's and scarf osteotomies showed nearly same efficacy regarding correction of deformity of the intermetatarsal angle and comparable results clinically but somewhat shorter operative time for the scarf group and personal impression of technical simplicity for the modified Wilson's osteotomy

Keywords:
hallux valgus, scarf osteotomy, Wilson osteotomy

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Introduction

Hallux valgus is a common orthopedic clinical problem [1]. More than 130 different surgical methods have been described for correction of hallux valgus since the first introduction of bunions surgery in 1871, and osteotomies of the first metatarsal bone have been elaborated in various ways and sites [2]. Surgery is intended to more than appealing correction of the deformity, that is, pain free and good functioning foot. However, there has been no considerable evidence of superiority of any of those types of surgeries over the other types [3].

Nowadays, one of the popular surgeries in treatment of hallux valgus deformity is scarf osteotomy. Nevertheless, it is agreed on to be a technically demanding procedure. It became a popular alternative by which stable osteotomy is achieved to attain better correction of the intermetatarsal angle (IMA) [4]. Scarf osteotomy retains some disadvantages, for example, extensive surgical exposure and surgical high technicality [5]. It can be considered as a versatile procedure that carries multiple potential disadvantages [6].

Osteotomy of the first metatarsal bone as described by Wilson is another established procedure for the treatment of the adult hallux valgus deformity. It is relatively fast and easy to perform and have been used for many years. One of the drawbacks of Wilson's osteotomy is postoperative shortening of the first metatarsal bone [7].

Wilson, in 1963, described an oblique osteotomy of first metatarsal bone. He presented a simple and stable technique in which he displaced and realigned the metatarsal head without using internal fixation. Nonunion rates were low because of the wide osteotomy surfaces. Avascular necrosis rate was diminished because of the large metatarsal head fragment. Originally, Wilson described a technique of oblique osteotomy through the distal third of the first metatarsal bone, followed by makeover of medial exostosis. He started his osteotomy line on the medial side at the proximal end of the exostosis, going laterally at an angle of 45°. Translation of the distal fragment and excision of the remaining prominent bone is done after insuring that the osteotomy is in its proper alignment [8]. In 1974, Helal *et al.* introduced a change in the orientation of the osteotomy by sloping it to be in plantar–proximal orientation instead of dorsal distal position [9]. Davis and Litman [10] in 1976 utilized Wilson's technique but they did not excise the medial exostosis, which gave the advantage of undisturbing the first metatarsophalangeal (MTP) joint. Another modification of the original Wilson's oblique osteotomy for hallux valgus was introduced in 1985 by Telfer. His modification of oblique osteotomy at the neck of the first metatarsal bone produces a maximum lateral displacement of the distal fragment, and the best position is then maintained by means of internal fixation [11]. Klareskov *et al.* in 1988 introduced a modification on Wilson's osteotomy by flexing the first metatarsal head planterward while it is shifted laterally. The aim of this plantar flexion of the distal fragment was to increase the force that is applied to the first metatarsal bone during weight bearing, thus lateral metatarsal heads from excessive pressure [12].

The aim of this study is to make a comparison regarding operative time, functional and radiological outcomes, and complications in cases treated by the two types of osteotomies.

Patient and methods

Study design

This is a prospective randomized controlled study intended to compare two types of osteotomies used to treat patients with hallux valgus. The study was conducted in Badr University Hospital. It was accomplished in the period between January 2016 and January 2019. All patients included in this study were aged between 18 and 80 years. They are included only if they are still suffering from painful hallux valgus after failure of all trials of different conservative measures of treatment for 6 months. Cases included in this trial had IMAs between 10 and 20°. Exclusion criteria included patients with MTP joint arthrosis, inflammatory arthritis, paralytic hallux valgus, or patients who did not show up during follow-up period.

MedCalc1 Statistics Software version 15.8 (bvba, Ostend, Belgium) was used to perform power analysis, using data provided by Bai *et al.* [13] and Kerr *et al.* [14] in earlier studies which predicted that 12 subjects should be sampled for each group. But to overcome any loss of follow-up and to grasp more solid evidence, we considered including more than 24 patients for each group. We included 40 consecutive patients with hallux valgus, who were randomized using computer-generated randomization by Random Allocation Software Version 4.5 (Asfahan, IR) into two groups: 'W' (patients for modified Wilson's osteotomy) and 'S' (patients for scarf osteotomy).Informed written consents were obtained from all patients.

Operative techniques

Standard sterilization and draping techniques of Badr Hospital were used in all cases. All surgeries were conducted in supine position and spinal anesthesia was given. Tight pneumatic tourniquet was applied to all cases. All cases were given. Mobility of the first MTP joint was assessed under anesthesia.

Incision: A medial skin incision was made in line with the medial border of the first metatarsal bone extending from the base of the proximal phalanx to about the 1 cm proximal to the first tarso metatarsal joint (TMTJ). Blunt dissection was then performed to prevent medial cutaneous nerve injury. The capsule was opened in line with skin incision ensuring intact cuff of tissues to perform capsular repair later on.

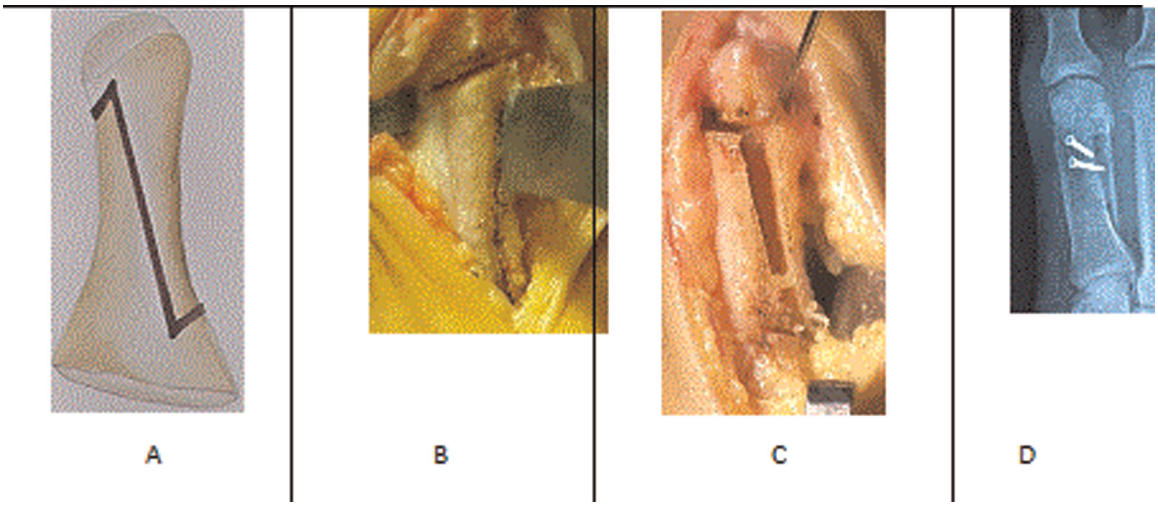
Before performing the osteotomy, if there is limited abduction of first MTP joint lateral capsular release was carried out with adductor hallucis tenotomy of the lateral sesamoid to achieve at least 30° of abduction. Ultimate care was taken to avoid injury of the major blood supply of the head near the plantar aspect of the metatarsal neck during lateral release [15].

Bunionectomy was performed in all cases. It was carried on directly medial to the sulcus by the use of an oscillating saw. Then osteotomy was carried on as planned.

The scarf osteotomy was performed as introduced by Coetzee and Rippstein [16], a 'Z'-shaped osteotomy line is marked by the diathermy on the first metatarsal shaft (Fig. 1a). The proximal part of the 'Z' was placed at the diaphyseal metaphyseal junction around 15 mm distal to the first TMTJ and 5 mm from the planter cortex. The distal part of the 'Z' was located 10 mm proximal to the first MTPJ and 5 mm from the dorsal cortex. After cutting the osteotomy using a fine oscillating saw blade (Fig. 1b), both fragments are separated, translated (Fig. 1c), and fixed with two 1 mm k. wires. Adequate correction and proper sesamoid position is now checked by fluoroscopic image. Then fixation of the osteotomy is done by using two or three 2.7 mm screws. Finally, excision of the remaining medial overhanging bone was carefully done with the saw (Fig. 1d). Now repair of the medial capsule using absorbable sutures was carried out followed by skin closure.

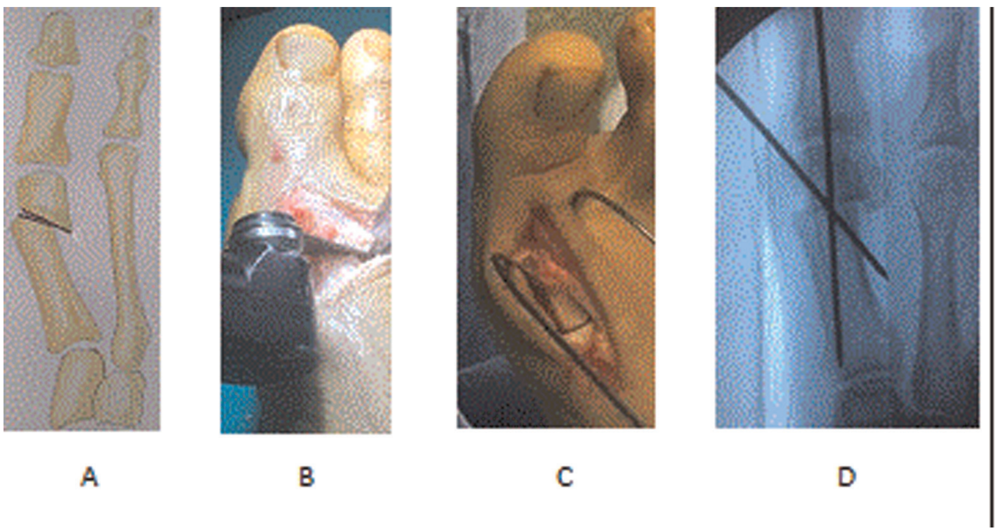
In modified Wilson's osteotomy, a flap of the capsule and the medial collateral ligament were dissected from the medial exostosis, which was resected later on. A 45° oblique osteotomy was performed through the distal metatarsal shaft using an oscillating saw (though Wilson himself used an osteotome) (Fig. 2a, b). The distal fragment was then displaced laterally and proximally by about half the width of the bone, with minor translation plantarwards. Two crossing k. wires were used to achieve fixation of the osteotomy. The wires were kept hanging out through the skin for easy removal later on (Fig. 2c). The overhanging bone was then carefully removed by oscillating saw. The final position was confirmed intraoperatively using fluoroscopic image (Fig. 2d). Then the medial capsule is sutured under tension to the periosteum, which might add a degree of stability (Fig. 3).

Figure 1



First metatarsal SCARF osteotomy. (a) Animated SCARF osteotomy, (b) intraoperative osteotomy using saw blade, (c) osteotomy finalized, (d) post osteotomy x-ray image showing fixation by two screws.

Figure 2



First metatarsal distal oblique osteotomy 'modified Wilson's'. (a) Animated Wilson's osteotomy, (b) intraoperative osteotomy using saw. (c) osteotomy fixed by 2k. wires, (d) post osteotomy fluoroscopic image showing fixation by k. wires.

Postoperative protocol

Both groups of patients underwent the same postoperative protocol. A crepe bandage was applied for rapping the hallux in corrected position for 24 h. An adduction splint was used for 4 weeks nonweight bearing (Fig. 4a). Stitches were removed on day 14 postoperative. Partial weight bearing was allowed on metatarsal offloading shoes starting 4 weeks postoperative for 2 weeks (Fig. 4b). After 6 weeks, the offloading orthosis was removed and full weight bearing was allowed in a rigid insole. The rigid insole was removed after 12 weeks. Patients were then followed up in outpatient visits at 2-week, 1-month, 3-month, 6-month, and 1-year intervals.

Figure 3

Medial capsule is sutured under tension to the periosteum, which might add a degree of stability.

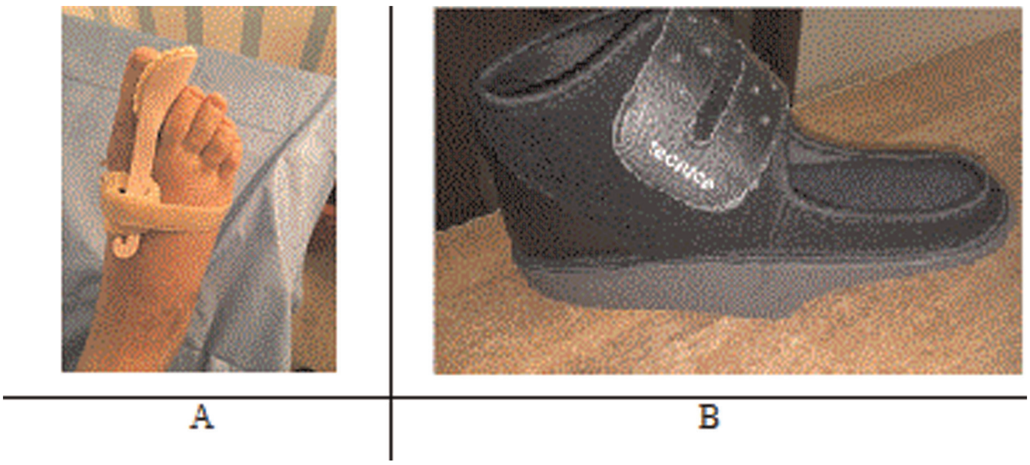
Clinical outcome measures

Scoring and monitoring of patient satisfaction 2 years after the surgery was documented by applying The American College of Foot and Ankle Surgeons Scoring Scaling (ACFAS) [17]. One hundred points were collected by applying the scale to each patient. Data were collected by personnel other than members of the surgical team who conducted the procedures.

Radiological outcome measures

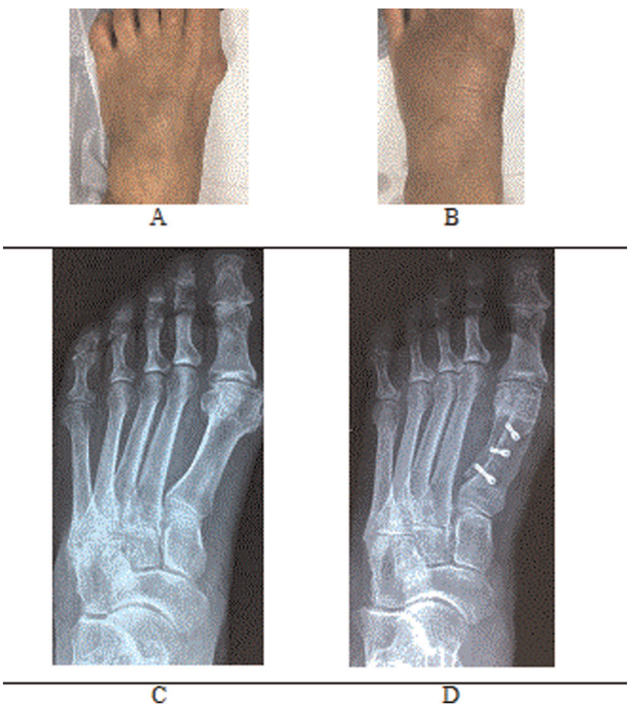
Two years after surgery, weight bearing x-rays were obtained. Angles measured on the x-rays are: (1) hallux valgus angle (HVA): it is the angle formed between the long axis of the first metatarsal and the proximal phalanx of the hallux, (2) IMA;: it is the angle formed between the long axes of the first and second metatarsal bones, (3) distal metatarsal articular angle (DMAA): it is defined as the angle formed between a line perpendicular to the long axis of the firsts metatarsal and another representing the distal articular surface in the antero-posterior x-ray view, and (4) first metatarsal declination angle (FDMA): it is the angle formed between the long axis of the first metatarsal bone and the horizon in the lateral x-ray view. Positions of the sesamoid were recorded. Monitoring of any complication or other data, for example, metatarsal head avascular necrosis, failure or migration of the hardware, infection, or wound complications, were carried out (Figs 5 and 6).

Figure 4



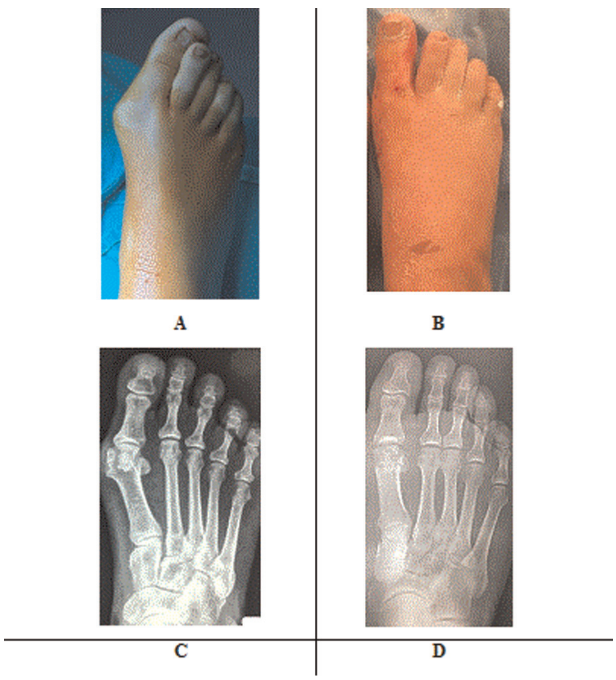
(a) Postoperative adduction splint used for 4 weeks non-weight bearing, (b) offloading shoes used for weeks 5 and 6 with partial weight bearing.

Figure 5



Scarf osteotomy case example. (a) Preoperative, (b) 6 weeks post-operative, (c) preoperative x-ray, and (d) postoperative x-ray.

Figure 6



Modified Wilson's case example. (a) Preoperative, (b) 6 weeks postoperative, (c) preoperative x-ray, and (d) postoperative x-ray.

Statistical analysis

A computer software 'IBM1 SPSS1 Statistics version 21' (IBM Corporation, Armonk, NY, USA) was used for analyses of the collected data. Our statistical analysis targeted two main points: primarily, the chosen sample analysis for each surgery and confirmation of the similarity of both clinical and radiological parameter to escape any selection bias, and secondarily, analyzing clinical and radiological outcome data as well as other data, such as operative time and complications. Analysis and comparison of scores, medians, and means took place. Wilcoxon Signed-Rank Test was used to test significances for related samples, and Mann–Whitney test for independent samples, and Pearson's correlation test for bivariate variables. Results were considered significant at the 95% confidence interval level for all statistical analyses.

Results

Demographic data

Recruitment of 40 patients with hallux valgus took place in this study; only 37 patients reached the final follow-up (19 in the modified Wilson's group and 18 in the scarf group). Regarding age, it was 37.34 years in average, ranged from 19 to 65 years with an SD of 13.72 years. Cases were divided into 21 females and 16 males. Regarding the side, 20 of the feet were right and 17 were left. The deformity was symptomatizing for 28 months in average, ranging from 11 to 56 with an SD of 12.84; 3 patients were not compliant and missed their follow-up visits and were thus excluded from the study.

Operative time

Scarf group showed mean operative time of 64.91 min, ranging between 53 and 92 with an SD of 10.79. On the other hand, modified Wilson's group showed mean operative time of 65.63 min, ranging from 44 to 81 min with an SD of 10.28 and with a P-value of 0.753

Radiological outcomes

Preoperative IMA comparison

Only 3 mild (IMA less than 14) cases were included in this study according to the severity of IMA (divided into 2 cases in the scarf group and 1 in the modified Wilson's group), moderate cases (IMA 14:20) were 16 (divided into 9 cases in the scarf group and 7 in the modified Wilson's group), and severe cases (IMA more than 20) were 18 (divided into 8 in the scarf group and 10 in the modified Wilson's group). When studying this data, it is clear that almost a uniform sample of selected cases per osteotomy exists. Table 1 and Fig. 7 summarize spectrum of cases according to IMA severity.

Postoperative radiological outcomes

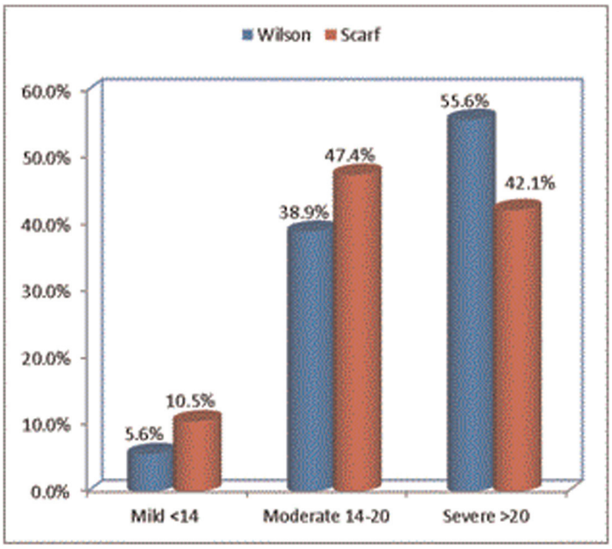
Analysis of the two samples regarding their radiological parameters showed indistinguishable postoperative

Table 1 Summary of cases classified according to the IMA severity (S stands for the scarf group and W stands for the modified Wilson's group)

	W	S	Total
Preoperative IMA severity			
Mild			
Count	1	2	3
Percentage within the procedure S/W	5.6%	10.5%	8.1%
Percentage of total	2.7%	5.4%	
Moderate			
Count	7	9	16
Percentage within the procedure S/W	38.9%	47.4%	43.2%
Percentage of total	18.9%	24.3%	
Severe			
Count	10	8	18
Percentage within the procedure S/W	55.6%	42.1%	48.6%
Percentage of total	27.0%	21.6%	
Total			
Count	18	19	37
Percentage within the procedure S/W	100%	100%	100%
Percentage of total	48.6%	51.4%	

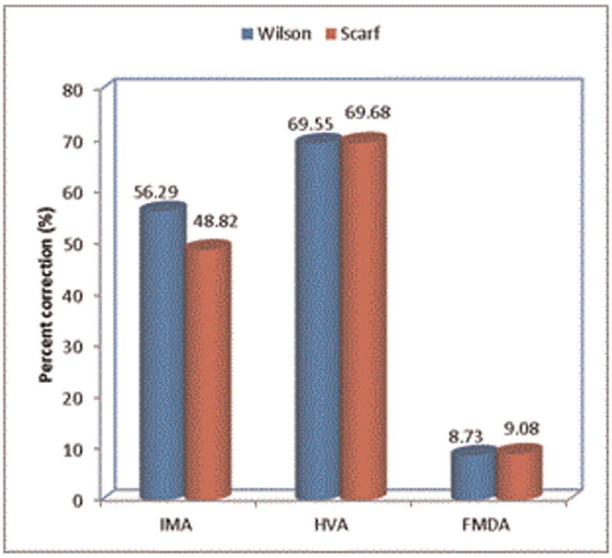
IMA, intermetatarsal angle.

Figure 7



Comparison of the two groups according to IMA severity in percentage.

Figure 8



Percentage of radiological correction of each osteotomy (IMA=intermetatarsal angle, HVA=hallux valgus angle, and FDMA=first metatarsal declination angle).

results when it comes to IMA, HVA, and FDMA (Fig. 8). The *P*-value of this data is not sufficiently low to make it statistically significant (Tables 2 and 3).

Follow-up period

The mean follow-up period was 24.13±2.76 months (range 22–29).

ACFAS score analysis

ACFAS mean score for the modified Wilson's group preoperatively was 49.81/100 (9.35 SD), on the other hand, in the scarf group it was 52.38/100 (9.88 SD). The average change in percentage of ACFAS score was 71.17% in the modified Wilson's group against 59.23% for the scarf group showing *P*-value=0.324 (Table 4).

Summary of the results

The two osteotomies showed nearly equal clinical outcome scores and similar main radiological angles, for example, the mean postoperative IMA of the modified Wilson's group was 9.37±2.38 versus 9.52 ±3.07 for the scarf group (*P*-value=0.791) and the HVA was 9.18±1.85 versus 10.40±5.31 for the scarf group (*P*-value=0.304) (Table 3 and Fig. 8).

Table 2 Comparison between preoperative and postoperative values of IMA, HVA, and FDMA

	Parameter	Wilson	Scarf	*T*-test	*P*-value
Preoperative data	IMA	20.97±3.65	19.03±4.64	0.478	0.129
	HVA	33.48±13.19	35.85±13.82	0.524	0.524
	FMDA	21.59±2.49	21.77±3.09	0.212	0.754
Postoperative data	IMA	9.37±2.38	9.52±3.07	0.166	0.791
	HVA	9.18±1.85	10.40±5.31	0.092	0.304
	FMDA	19.67±2.36	19.62±2.16	0.064	0.902

Note that there are no significant differences between the two techniques. FDMA, first metatarsal declination angle; HVA, hallux valgus angle; IMA, intermetatarsal angle.

Table 3 Comparison of the 2 osteotomies in terms of amount and percentage of radiological correction

	Wilson	Scarf	*T*-test	*P*-value
IMA correction	11.61±3.51	9.52±5.38	0.469	0.129
Percent correction	56.29±13.26	48.82±19.00	0.451	0.138
HVA correction	24.35±13.25	25.45±12.32	0.258	0.718
Percent correction	69.55±17.14	69.68±17.25	0.028	0.902
FMDA correction	2.01±2.98	2.20±3.04	0.193	0.764
Percent correction	8.73±13.68	9.08±13.87	0.074	0.856

FDMA, first metatarsal declination angle; HVA, hallux valgus angle; IMA, intermetatarsal angle..

Table 4 Relationship between post-operative clinical and radiological data in relation to the preoperative IMA severity

	N	Mean±SD	SE	95% confidence interval for mean		Minimum	Maximum	Pearson's correlation	*P* value
				Lower bound	Upper bound				
Postoperative ACFAS score/100									
Mild	3	77.1±6	3	67.5	86.7	71	85	0.027	0.792
Moderate	16	79.7±8.7	2	75.4	84.1	69	98		
Severe	18	78.5±7.4	1.6	75.2	81.8	64	91		
Total	37	78.9±7.8	1.2	76.5	81.2	64	98		
Postoperative pain									
Mild	3	24.2±4	2	17.7	30.6	22	30	0.133	0.328
Moderate	16	27.1±4	0.9	25.1	29.1	22	30		
Severe	18	24.9±3.9	0.8	23.1	26.6	22	30		
Total	37	25.7±4	0.6	24.5	27	22	30		
Postoperative appearance									
Mild	3	3.5±1	0.5	1.9	5.1	3	5	0.128	0.341
Moderate	16	4.1±0.9	0.2	3.6	4.5	3	5		
Severe	18	4.1±0.8	0.2	3.8	4.5	3	5		
Total	37	4±0.9	0.1	3.8	4.3	3	5		
Postoperative functional capacity									
Mild	3	8.9±2.5	1.3	4.8	12.8	5	10	0.102	0.426
Moderate	16	10.4±4	0.9	8.4	12.4	5	15		
Severe	18	8.7±3.2	0.7	7.2	10.1	5	15		
Total	37	9.4±3.5	0.5	8.3	10.5	5	15		
Postoperative HVA									
Mild	3	5.3±1.5	0.8	2.9	7.7	3	6	0.247	0.093
Moderate	16	6±0	0	6	6	6	6		
Severe	18	6±0	0	6	6	6	6		
Total	37	5.9±0.5	0.1	5.8	6.1	3	6		
Postoperative limp on walking									
Mild	3	5±0	0	5	5	5	5	0.094	0.453
Moderate	16	4.7±1.2	0.3	4.1	5.3	0	5		
Severe	18	5±0	0	5	5	5	5		
Total	37	4.9±0.8	0.1	4.6	5.1	0	5		

ACFAS, American College of Foot and Ankle Surgeons; HVA, hallux valgus angle; IMA, intermetatarsal angle.

Table 5 Summary of the complications

	Scarf	Wilson
Infection	1 (superficial)	1 (superficial)
Hardware failure	0	0
Non-union	0	0
AVN	0	0
Wound dehiscence	1	1

AVN, avascular necrosis.

Complications

Only one superficial infection was diagnosed in each group. Both cases showed complete eradication of infection after the use of antibiotic, with one mild wound dehiscence in each group (Table 5).

Discussion

Hallux valgus deformity is a frequently seen clinical condition in everyday orthopedic practice. Many surgical techniques have been anticipated to correct the deformity and indications have been proposed for the selection of the suitable technique according to each case. Special types of anatomic plates and operative tools have been designed and surgical skill fundamentals have widely increased by time.

The goal of this randomized controlled trial (RCT) was to compare the results of the scarf and modified Wilson's osteotomies with regard to IMA, HVA, and AOFAS score. In both groups, good-to-excellent results were found regarding improvement of AOFAS scores and reduction of the HVA and IMA. We found differences between both groups, but these were not statistically significant. The complication rates in the modified Wilson's and scarf groups were equal.

According to literature, larger correction of the IMA would be possible using a scarf osteotomy [6]. Therefore, we did not expect to find a comparable IMA correction in both patient groups. Lateral translation in both osteotomies is limited because bony contact is essential for adequate fixation.

Wilson's osteotomy with the proposed modifications is a technically straightforward approach, requiring minimum and easily accessible surgical tools and materials and has provided predictable and well-accepted results in our practice. We consider it gives a foothold, even for young orthopedists, to address a good range of hallux valgus deformity patients. Stiffness might be expected to occur more often after Wilson's osteotomy because the joint capsule is disturbed. However, the range of dorsiflexion was similar after both osteotomies. The obliquity of the Wilson's osteotomy might be expected to shorten the first metatarsal more than scarf osteotomy.

Sagittal plane angulation is another problem with the scarf osteotomy where the cortical ends deeply imbed themselves into the cancellous bone on both ends resulting, mostly, in elevation of the capital fragment, which does not happen with the modified Wilson's osteotomy due to presence of cortex-on-cortex contact proximally despite any degree of displacement [18].

This study has shown that both osteotomies have nearly similar clinical and radiological outcomes and corrective power. However, the technical simplicity reported subjectively by the surgeons performing both osteotomies and shorter operative time favor the modified Wilson's osteotomy.

Clinical outcome scores and patient satisfaction surveys revealed no statistically significant differences. We used written questionnaires as well as verbal questioning of the quality of life parameters. Interestingly, we have found a correlation of favorable postoperative parameters with less severe preoperative IMAs. However, this correlation was not statistically significant due to the relatively small sample sizes (Table 4).

Mahadevan *et al*. [18] have conducted a similar RCT on 84 patients (109 feet) with encouraging results in favor of the modified Wilson's osteotomy (significantly lower IMA 5.8 versus 6.9, P-value 0.045, and similar other radiological and clinical parameters). Vopat *et al*. [19] have conducted a retrospective comparative study between the scarf and modified Wilson's osteotomies on 70 patients. There were no statistically significant differences between the two osteotomies regarding the HVA preoperatively and postoperatively. The DMAA was statistically significantly higher for the modified Wilson's both preoperatively (P=0.0403) and postoperatively (P<0.0001). The differences in HVA correction and IMA correction were not statistically significant. There were no statistically significant differences with regard to postoperative stiffness, pain, and satisfaction. Limitation of our study is the relatively short-term follow-up of patients. Longer-term studies are needed to fortify the results of the study.

Conclusion

We have found out that the two osteotomies possess almost identical corrective power of the IMA and similar clinical outcomes with slightly shorter operative time and subjective technical simplicity for the modified Wilson's osteotomy.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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