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Clinical results of scarf osteotomy

Klinički rezultati *scarf* osteotomije

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Abstract

Background/Aim. There are a few research papers in Serbia that report on the clinical results of scarf osteotomy (SO) and its long-term effects. The aim of this retrospective study was to evaluate the efficacy of SO in hallux valgus (HV) deformity correction, as well as the degree of recurrence and its possible causes. **Methods.** The study included 48 patients (52 feet) who underwent SO. The average follow-up time was 103.9 (63–156) months. In order to clinically evaluate the results, the American Orthopedic Foot and Ankle Society (AOFAS) scale and the Visual Analog Scale (VAS) of pain were used. In order to radiographically determine the degree of deformity, preoperative and postoperative radiographs of the feet were taken in the standing position, and the following parameters were determined: HV angle (HVA), intermetatarsal angle, distal metatarsal articular angle, and sesamoid position. **Results.** The AOFAS scores increased from 19 (5–45) points preoperatively to 92 (54–100) points at the time of the latest follow-up examination ($p < 0.001$). The VAS values significantly improved from 10 (8–10) preoperatively to 0 (0–6). The average HVA correction was 24.8°. The recurrence rate in patients in whom the HVA was greater than 20° was 26.9%. **Conclusion.** Although SO is a proven procedure for the correction of HV, long-term results still show a relatively high rate of recurrence.

Key words:
hallux valgus; orthopedic procedures; osteotomy; recurrence; serbia; treatment outcome.

Apstrakt

Uvod/Cilj. U Srbiji ima vrlo malo radova u kojima se opisuju klinički rezultati i dugoročni efekti *scarf* osteotomije (SO). Cilj ove retrospektivne studije bio je da se utvrdi efikasnost SO kod *hallux valgus* (HV) deformiteta, kao i stepen recidiva i njihovi mogući uzroci. **Metode.** Studijom su bila obuhvaćena 48 bolesnika (52 stopala) kod kojih je izvršena SO. Prosečno vreme praćenja bilo je 103,9 (63–156) meseci. U cilju kliničke procene rezultata korišćena je skala američkog ortopedskog udruženja za skočni zglob i stopalo (*American Orthopedic Foot and Ankle Society* – AOFAS) i Vizuelna analogna skala (VAS) bola. U cilju radiografskog utvrđivanja stepena deformiteta, preoperativno i postoperativno su rađene radiografije stopala u stojećoj poziciji i određivani su sledeći parametri: HV ugao (HVU), intermetatarzalni ugao, distalni metatarzalni artikularni ugao i pozicija sezamoida. **Rezultati.** Vrednosti skora AOFAS povećane su sa 19 (5–45) poena preoperativno na 92 (54–100) poena u trenutku poslednjeg kontrolnog pregleda ($p < 0,001$). Vrednosti VAS su se značajno poboljšale sa preoperativnih vrednosti 10 (8–10) na 0 (0–6). Prosečna korekcija HVU bila je 24,8°. Stepen recidiva kod bolesnika gde je HVU bio veći od 20° iznosio je 26,9%. **Zaključak.** Iako je SO dokazana procedura za korekciju HV, ipak dugotrajni rezultati govore u prilog relativno visokog stepena recidiva.

Ključne reči:
haluks valgus; ortopedske procedure; osteotomija; recidiv; srbija; lečenje, ishod.

Introduction

Hallux valgus (HV) is a progressive deformity of the foot characterized by the abduction and/or pronation of the proximal phalanx of the big toe, as well as by the adduction, pronation, and elevation of the first metatarsal (MT) bone, with the increase of the intermetatarsal angle (IMTA) and with capsular and ligamentous derangement of the first metatarsophalangeal (MTP) joint, accompanied by painful bunions. More than a hundred different surgical procedures for the correction of HV have been described; however, the scarf procedure is one of the most commonly applied

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techniques. Scarf osteotomy (SO) was first described by Meyer [1] in 1926 and then applied by Burutaran [2] in 1976. After that, osteotomy was popularized and modified by Borrelli and Weil [3] in the United States and by Barouk [4] in Europe.

SO is a horizontally positioned Z dislocation osteotomy of the diaphysis of the first MT bone fixed by two screws. In relation to the anatomical position of correction, it is categorized as a midshaft osteotomy [5].

The most common indication for performing SO is a painful HV deformity of a variable medium to a severe degree. In addition, this procedure can also be used in cases where revision surgery of this deformity is necessary [6]. An absolute contraindication for performing SO is an active infection. Other contraindications are severe neuropathic changes in the foot as well as vascular compromise and severe arthrosis of the first MTP joint. Relative contraindications include hypermobility of the first tarsometatarsal joint [7].

With osteotomy, it is possible not only to correct IMTA but also to dictate the shortening or lengthening of the first MT bone.

Additionally, by a lateral translation and medial rotation of the plantar fragment, the correction of the distal MT angle is also made possible in SO [8].

The advantages of SO are the following: reliability, the possibility of correcting more severe deformities, good healing, stable osteotomy, and immediate postoperative walking without immobilization.

Different types of complications of this procedure have been described. The most common long-term complication is the recurrence of the deformity. Bock et al. [9] reported on recurrence of HV in 30% of patients after a 10-year follow-up.

The aim of the study was to evaluate the efficiency of the SO procedure in HV deformity corrections, its long-term results, as well as the risk factors for the recurrence of the deformity.

Methods

The indication for SO was a painful HV deformity greater than 20°. Patients with systemic diseases such as rheumatoid arthritis, as well as those with a complex deformity or severe osteoporosis, were not considered. No patient had hypermobility of the first tarsometatarsal joint.

Clinical and radiographic evaluation of the results was performed preoperatively, six weeks after surgery, and then once a year. The American Orthopedic Foot and Ankle Society (AOFAS) scale and Visual Analog Scale (VAS) were used. Radiographs were taken in two standard planes. A four-stage system was used to determine the degree of sesamoid lateral migration.

Surgical technique

The patient was lying on his back. A tourniquet was placed on the middle of the upper leg after exsanguination. A medial longitudinal incision was made over the first MTP (I MTP) joint, distally extending about 1 cm from the joint (extended if AO is required) and proximally extending to the middle of the diaphysis of the first MT (I MT) bone (if greater deformity, the incision extends more, to 1 cm proximal to the first metatarsocuneiform joint). Subcutaneous tissue and capsule of the I MTP joint were cut and peeled off subperiosteally to free the joint and the shaft (except for the plantar side to avoid damage of the I MT bone head vascularization). After approaching the joint and shaft, a longitudinal cut of the I MT bone was made. The cutting angle in the frontal plane was inclined towards the plantar. Longitudinal resection ended proximally 1.5 cm from the metatarsocuneiform joint and distally 6–8 mm from the I MTP joint line. After that, transversal cuts were made, which must be parallel and at an angle of 60° to the longitudinal axis. The correction is then achieved by moving the plantar fragment laterally for 65–75% of the shaft diameter, and the osteotomy is fixed with two cortical screws. By reverse rotation of the I MT bone head after described osteotomy, the distal MT articular angle can be corrected. After correction, the medial bony prominence was removed, and a capsulorrhaphy was performed. If the deformity is larger, soft tissue release of the lateral side of the I MTP joint was performed before this osteotomy. This release is done through a special dorsal approach to the first MT space or if there is a residual HV after correction, an additional AO was performed.

Postoperative wound control was performed on the third day, and the sutures were removed on the 14th day after surgery. Postoperatively, all patients walked without weight bearing on the forefoot. A specially designed orthosis was used. After six weeks, weight-bearing was allowed on the operated foot at the time when the radiographic and clinical evaluations were performed again. Clinical and radiographic assessments were then performed at 6 months, 12 months, and once a year thereafter. In this study, it was considered that recurrence of the deformity occurred if the HV angle (HVA) exceeded 20°. There were possible risk factors for the recurrence of HV analyzed in this study: age, gender, body mass index, side of surgically treated feet, bilaterality, the preoperative AOFAS score, as well as the preoperative values of HVA, IMTA, and the sesamoid position.

The study was approved by the Ethical Committee of the Institute for Orthopedics “Banjica” (No. I–97/30, from December 16, 2022).

Statistical analysis

All data were processed using the IBM SPSS Statistics 22 software (SPSS Inc., Chicago, IL, USA) or in the R Programming Environment (R Core Team, 2019). Depending on the type of variables and the normality of distribution, the Wilcoxon and Friedman tests were used. Logistic regression was used to analyze potential predictors on binary variables (the existence of recurrence) and potential predictors. Due to the unfavorable number of outcomes, multivariate analysis was not performed. The level of significance was set at 0.05.

Results

We evaluated 48 (52 feet) patients who underwent SO between February 2009 and December 2016. There were 40 female and 8 male patients (Table 1). The average age of the patients was 51.2 years, and the average follow-up time was 103.9 months. As an additional procedure, when necessary, an Akin osteotomy (AO) was performed in nine (18.7%) patients.

Clinical assessment

According to HVA criteria (normal if the angle was < 15°, mild if HVA was 15–20°, moderate if HVA was 20–39°, and severe if HVA was > 40°), 25 feet had a moderate deformity, while 27 had a severe deformity.

The median preoperative AOFAS score was 19 (5–45), while it was 92 (54–100) at the latest follow-up examination ($p < 0.001$) (Figure 1).

All the AOFAS subscores (pain, function, and alignment) improved significantly (Table 2).

The median scores on the VAS were 10 (8–10) preoperatively, decreasing to 0 (0–6) after surgery ($p < 0.001$) (Figure 2). The average HVA correction was 24.8°.

Radiological assessment

According to the radiographic assessment, a significant improvement ($p < 0.001$) occurred regarding the HVA, IMTA, and the position of the sesamoid (Table 3).

Table 1

Demographic and baseline characteristics of patients who underwent scarf osteotomy

Parameter	Values
Gender	
female	40 (83)
male	8 (17)
Foot side	
left	27 (52)
right	25 (48)
Age at the time of surgery, years	51.2 ±10.3
Clinical follow-up, months	103.9 (63–156)

Values are expressed as numbers (percentages), average ± standard deviation, or average (minimum – maximum).

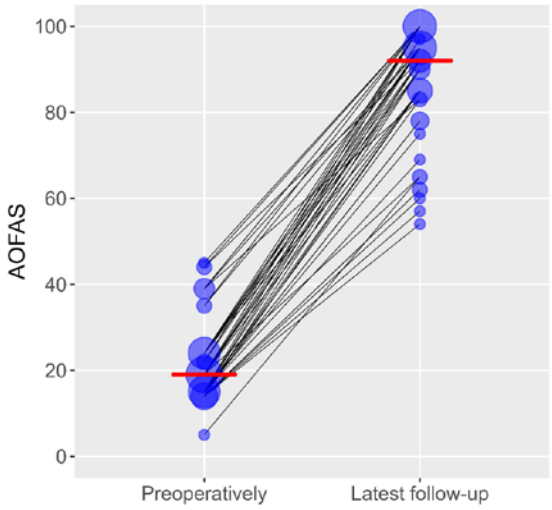

Fig. 1 – Frequencies of individual values and median values of the hallux valgus angle, preoperatively and at the latest follow-up. AOFAS – American Orthopedic Foot and Ankle Society.

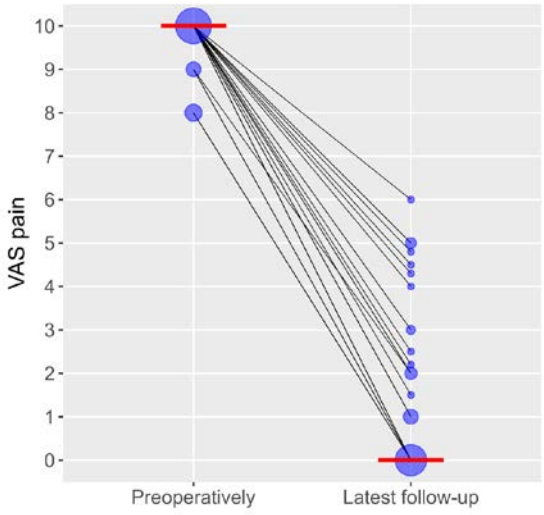

Fig. 2 – Frequencies of individual values and median scores on the Visual Analog Scale (VAS) for measuring pain preoperatively and at the latest follow-up.

Table 2

AOFAS subscores in patients who underwent scarf osteotomy

AOFAS categories	Preoperatively	Latest follow-up	*p*-value*
Pain	0 (0–20)	40 (20–40)	< 0.001
Function	19 (5–24)	40 (34–45)	< 0.001
Alignment	0 (0–0)	15 (0–15)	< 0.001

AOFAS – American Orthopedic Foot and Ankle Society; * Wilcoxon test.
All values are expressed as median (minimum–maximum).

Recurrence

Radiographic recurrence of HV occurred in 14 (26.9%) out of 52 feet at the latest follow-up examination. During the early postoperative period, recurrence was not registered. Recurrence occurred in two (8.0%) feet with primary moderate deformity and in 12 (44.4%) feet with severe deformity (Table 4). The results of the risk factor analysis are presented in Table 5. The results show that preoperative values of HVA, IMTA, and AOFAS, as well as the sesamoid position, were presented as risk factors for the recurrence of HV.

Complications

In addition to the recurrence of HV, other complications were registered. In four (7.7%) cases, the wound took longer to heal. In one (1.9%) case there was a superficial infection, which was resolved with an antibiotic. In one (1.9%) case, the screw impeded movement that was resolved by the removal of the screw. In two (3.8%) cases, limitation in plantar flexion was present.

Discussion

It has been approved that SO is a reliable procedure for correcting a moderate to severe HV deformity of the foot [10]. However, there is a relatively small number of studies reporting on long-term results [6].

Significant improvement after surgery to HVA, AOFAS score, and IMTA, as well as reduction of pain, was presented in our study, and it is in accordance with other studies from the literature [3, 6, 10, 11].

With SO, the positional correction can be made in all three planes, although it is technically demanding and requires a lot of time to learn and perfect. Due to its complexity, significant complications can be possible [12, 13].

Table 3

Comparison of preoperative and postoperative radiographic results

Parameters	Preoperative	Six weeks after surgery	Latest follow-up	*p*-value*
HVA (degrees)	40 (29–62)	9 (6–13)	13 (8–35)	< 0.001
IMTA (degrees)	14 (11–17)	8 (6–10)	9 (7–13)	< 0.001
Sesamoid lateral migration grade	3 (2–3)	0 (0–1)	1 (0–3)	< 0.001

HVA – hallux valgus angle; IMTA – intermetatarsal angle; *Friedman test.
All values are expressed as median (minimum–maximum).

Table 4

Recurrence of different grades of deformity after scarf osteotomy performed

Grade	Recurrence	Without recurrence
Mild	0 (0)	0 (0)
Moderate	2 (8)	23 (92)
Severe	12 (44)	15 (56)
Total	14 (27)	38 (73)

All values are expressed as numbers (percentages).

Table 5

Possible risk factors for recurrence of deformity after scarf osteotomy performed

Variable	Recurrence (n = 14)	Without recurrence (n = 38)	*p*-value*
Age (years)	51.4 ± 12.3	49.1 ± 11.0	0.522
Gender			
male	1 (7.1)	7 (18.4)	0.336
female	13 (92.9)	31 (81.6)	
Body mass index, kg/m^2	26.8 ± 3.5	26.0 ± 2.8	0.415
Side			
left	7 (50)	20 (52.6)	0.866
right	7 (50)	18 (47.4)	
Bilateral	2 (14.3)	6 (15.8)	0.894
AOFAS preoperatively	14.5 (5–39)	22 (14–45)	0.013
HVA degrees preoperatively	47.5 (35–62)	38.5 (29–52)	0.001
IMTA degrees preoperatively	16 (13–17)	13.5 (11–17)	0.002
Sesamoid lateral migration grade preoperatively			
2	0 (0)	13 (34.2)	0.008
3	14 (100)	25 (65.8)	

HVA – hallux valgus angle; IMTA – intermetatarsal angle; AOFAS – American Orthopedic Foot and Ankle Society; *logistic regression.

All values are expressed as mean ± standard deviation, numbers (percentages), or median (minimum–maximum).

Although this study reports on significant clinical and radiographic improvement, the fact that it also reports on a relatively high recurrence rate has to be noted. On the other hand, although the recurrence rate is relatively high, it seems to be at a degree that does not cause difficulty to most patients. In the group of patients with recurrence of the deformity, eight (57.1%) patients were symptomatic, while only one (7.1%) patient required a secondary surgical procedure [14]. The most common surgical treatment of an HV deformity relies mostly on the correction of the deformity in the transverse plane [15]. However, an HV deformity is characterized by changes in all three planes. Therefore, it is better to correct the deformity not only in the transverse plane but also to take into account the pronation of the first MT bone as well as the position of the sesamoid bones [16, 17]. Inadequate pronation of the first MT bone and insufficient reduction of the sesamoid bones can be significant risk factors for a recurrence [17–20].

A high recurrence rate of the deformity following SO [9] may be the reason for performing an AO. In this study, we considered an additional AO necessary in 17.3% of cases. Although some authors consider an AO mandatory when performing an HV correction [21, 22] clear guidelines about adding an AO are not yet defined.

Some complications, such as nonunion, unsuccessful osteosynthesis, and clawing of the big toe, are mostly associated with inadequate following of the surgical technique and lack of surgeon experience. Other possible complications, followed by very low incidence, are as follows: infection, fracture of the first MT bone due to weight bearing, deep vein thrombosis, complex regional pain syndrome, and osteonecrosis of the first MT head [23]. A stiff I MTP joint remains the most frequent complication. In our study, only two (3.8%) feet had this type of complication, while superficial infection was more frequent.

Based on our study, factors including preoperative HVA, IMTA, AOFAS, and the position of the sesamoid bones have a significant impact on the recurrence of the deformity in long-term follow-up. Whether additional AO was performed or not, it did not affect the recurrence.

Study limitations

There were difficulties in calling each patient individually to come for follow-up, especially those whose surgery was performed a long time ago. Some patients did not report for check-ups regularly, which is why they were called to come in after the time for follow-up had passed, which caused problems in accurately determining the time of recurrence of the deformity.

Conclusion

In general, moderate to severe HV foot deformities can be resolved quite successfully with SO. However, there is a significant degree of deformity recurrence. Patients with a case of recurrence rarely have symptoms requiring revision surgery. Large HVA and IMTA angles preoperatively, along with preoperative AOFAS and significant subluxation of the sesamoids, are considered risk factors for the recurrence of the deformity.

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