ORIGINAL ARTICLE

UDC: 617.3
https://doi.org/10.2298/VSP161230105M

Mitchell and Golden metatarsal osteotomies for the treatment of moderate hallux valgus deformity: A comparative analysis

Mičelova i Goldenova metatarzalna osteotomija u lečenju umerenih deformiteta čukljeva: uporedna analiza

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Abstract

Background/Aim. Despite bunion surgery having been performed for more than 100 years, there has yet to be a technique considered as the "Gold Standard". The aim of the study was to compare postoperative results of Mitchell vs. Golden methods of treating moderate hallux valgus deformity. **Methods.**This observational case control study included 49 patients (81 feet) who had the Mitchell distal metatarsal osteotomy performed, and 49 patients (77 feet) that had the Golden proximal metatarsal osteotomy performed. The results of treatment were evaluated using Hellal's modification of the Bonney and McNab classification and the Hallux Metatarsophalangeal Interphalangeal Score (HMIS). The statistical analysis of the results was done, thus the values $p < 0.05$ were considered statistically significant. **Results.** Both operative procedures showed successful and statistically significant postoperative results compared to the preoperative status ($p < 0.001$). Comparative analysis of the results from the Mitchell and Golden procedures, according to the Hellal's modification of Bonney and McNab classification, proved that there was a high statistically significant difference in favor of the Mitchell method ($p < 0.001$), whereas the comparison based on the HMIS showed no statistically significant difference ($p = 0.123$) between the two methods. The estimated results analysis of both procedures, based on the values of hallux valgus angle, intermetatarsal angle, sesamoid position, length of immobilization, treatment duration and complications demonstrated that there was a highly significant difference in favor of the Mitchell method ($p < 0.001$), whereas the value of the shortening of the first metatarsal bone indicated that the shortening was greater in the Mitchell method ($p < 0.001$), which goes in favor of the Golden method. Regarding the flexion of the thumb of the feet operated on, there was no statistically significant difference ($p = 0.723$). **Conclusion.** The examinations performed indicated that both methods showed good postoperative results, but applying the Mitchell method they were better.

Key words:
hallux valgus; osteotomy; surgical procedures, operative; treatment outcome.

Apstrakt

Uvod/Cilj. Mada se operativno lečenje čuklja primenjuje duže od 100 godina, još uvek nije ustanovljena tehnika koja bi se mogla smatrati takozvanim zlatnim standardom. Cilj rada bio je poređenje postoperativnih rezultata postupaka po Mitchell-u i Golden-u u lečenju umerenih deformiteta *hallux valgus*-a. **Metode**. U opservacionoj studiji kontrole slučajeva (*case control*) učestvovalo je 49 pacijenata (81 stopalo) operisanih distalnom osteotomijom I metatarzalne kosti po Mitchell-u i 49 pacijenata (77 stopala) operisanih proksimalnom osteotomijom I metatarzalne kosti po Golden-u. Za procenu rezultata lečenja korišćene su: Klasifikacija po Boney i McNab-u modifikovana po Hellal-u i *Hallux Meta-*

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tarsophalangeal Interphalangeal Score (HMIS). Rezultati su statistički obrađeni, a vrednosti $p < 0,05$ uzete su kao statistički značajne. **Rezultati.** Oba hirurška postupka su pokazala uspešne statistički visoko značajno bolje postoperativne rezultate u odnosu na preoperativne ($p < 0,001$). Poređenjem rezultata Mitchell-ovog i Golden-ovog postupka prema klasifikaciji po Bonney i McNab-u modifikovanoj po Hellal-u pokazano je da postoji visoko statistički značajna razlika u korist postupka po Mitchell-u ($p < 0,001$), a poređenjem na osnovu HMIS-a da nema statistički značajne razlike ($p = 0,123$). Analiza procene rezultata oba postupka na osnovu vrednosti hallus-valgus ugla, intermetatarzalnog ugla, pozicije sezamoida, dužine imobilizacije, trajanja lečenja i komplikacija pokazala je da postoji visoko statistički značajna razlika u korist postupka po Mitchell-u ($p < 0,001$), dok je procena vrednosti skraćenja prve metatarzalne kosti pokazala da je skraćenje izraženije kod postupka po Mitchell-u ($p < 0,001$), što ide u prilog Golden-ovoj metodi. U pogledu pokreta palca operisanih stopala nije postojala statistički značajna razlika ($p = 0,723$) između dva postupka. **Zaključak**. Oba postupka su pokazala dobre postoperativne rezultate. Poređenjem rezultata oba postupka došlo se do zaključka da su rezultati Mitchell-ovog postupka bolji u odnosu na Golden-ov postupak.

Ključne reči:
halkus valgus; osteotomija; hirurgija, operativne procedure; lečenje, ishod.

Introduction

Hallux valgus deformity shows high prevalence among general population. Depending on the age, the incidence rate of the deformity goes from 7.8% among youth under the age of 18, to 35.7% among those over 65 years old. As for the population between the ages of 18 and 65 years, the deformity incidence rate is 27% [1]. The hallux valgus deformity progression can lead to a gradual loss of function of the forefoot, resulting in the decreased quality of a patient's life. The treatment of hallux valgus deformity can be carried out by nonoperative and operative procedures. For a lack of effectiveness of nonoperative procedures, in the majority of cases the treating of deformity concludes with an operative procedure [2]. The objective of the operative treatment of the deformity is to get a pain-free, functioning and aesthetically pleasing foot. A surgical correction of the deformity can relieve the pain, prevent further progression of the condition and restore the function of the foot.

There is a vast number of operative procedures for treating bunions, which clearly supports the observation that there is no single method that could resolve all clinical varieties of this deformity. The osteotomy that is commonly used is made in the distal first metatarsal bone. Distal metatarsal osteotomy is recommended, primarily, to correct the mild to moderate deformities when there are no arthritic malformations of the first metatarsophalangeal joint. This osteotomy manages to correct most of the components of the deformity: hallux valgus angle (HVA), intermetatarsal angle (IMA), sesamoid position and the length of the first metatarsal bone [2, 3]. Proximal metatarsal osteotomy is used in the operative treatment of the moderate and severe hallux valgus deformity [4].

In medical literature, there is no a definite opinion on whether it is better to perform distal or proximal metatarsal osteotomy with the distal soft tissue procedure [5] for treating moderate deformities (HVA of 25° to 40° and IMA of 13° to 20°).

The aim of the study was to estimate the effects of the Mitchell and Golden procedures in order to determine which procedure should be given the advantage in correcting the moderate hallux valgus deformities.

Methods

An observational case control study was conducted in patients with moderate hallux valgus deformity who underwent the procedure at the Clinical Department of Orthopaedics of Clinical Hospital Center, University Medical Center "Zvezdara", during the period from January, 2007 to February, 2013. Two directions were applied: corrective distal metatarsal osteotomy by Mitchell [6] and corrective proximal metatarsal osteotomy by Golden [7] (Figures 1 and 2).

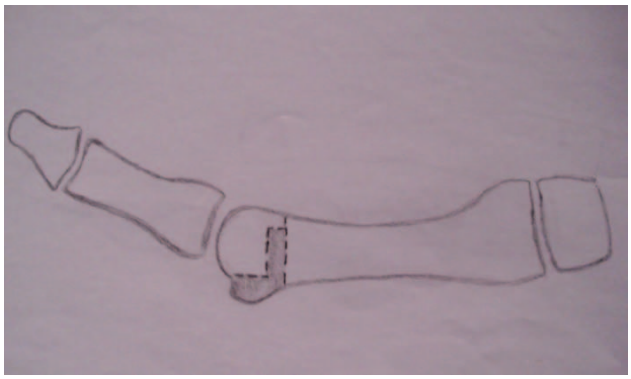

Fig. 1 – Operative technique described by Mitchell (a sketch in the horizontal plane).

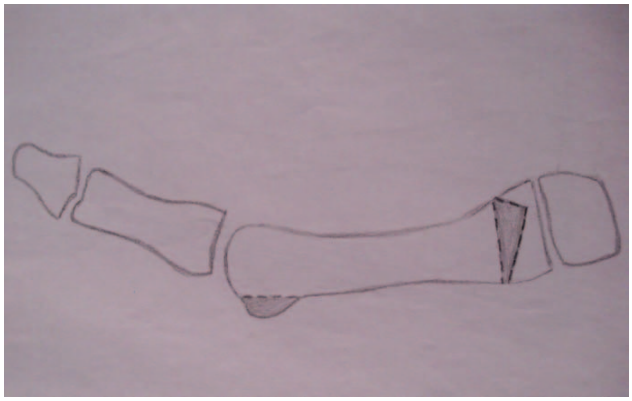

Fig. 2 – Operative technique described by Golden (a sketch in the horizontal plane).

Mitchell method

Distal metatarsal osteotomy was performed according to the Mitchell procedure which includes subcapital osteotomy of the first metatarsal bone with medial translation of the distal fragment with thread fixation in the corrected position. In the postoperative period the operated foot is immobilized with a short walking cast shoe, with an opening in the wound region for the postoperative wound care and check-ups. Decision on removing the cast immobilization is made after the X-ray scan and clinical assessment, in about 5 weeks. After the cast immobilization is removed, the physical therapy may begin.

Golden method

Golden osteotomy includes wedge osteotomy of the base of the first metatarsal bone using wedge base laterally and on the plantar side, where the fragment fixation is enabled by a single Kirschner wire. In addition, a thumb adductor tenotomy of the foot was performed through another approach using a different cut (Figure 3). Postoperatively, a walking cast shoe is placed onto the operated foot and it is removed after 5 to 7 weeks and physical therapy begins (Figure 4).

Fig. 3 – Bilateral Golden osteotomy after the completed procedure.

Fig. 4 – Walking cast shoe after Golden osteotomy (postoperative wound check-up).

The number of patients who were operated on was 110, but 12 of them were not part of the study. Furthermore, 5 of those 12 patients did not get regular check-ups, 4 did not wish to join the study and 3 patients were excluded from the study due to the presence of comorbidity (2 patients with rheumatoid arthritis and 1 patient with neuromuscular disorder).

The research involved two study groups. One study group included 49 patients (81 feet) who had the Mitchell procedure. The other study group included 49 patients (77 feet) who had the Golden procedure applied.

In 49 patients who were operated on by the Mitchell method, 43 (87.8%) patients were females and 6 (12.2%) were males. Mean age was 52 years (range 26–67 years). In 32 (65.3%) patients both feet were operated on. The surgery was performed on the left foot in 43 (53.1%) cases and in 38 (46.9%) cases on the right foot.

In 49 patients who had the Golden procedure performed, 46 (93.9%) were females, and 3 (6.1%) were males. Mean age was 51 years (range 23–77 years).). In 28 (57.1%) patients, both feet were operated on. The surgery was performed on the left foot in 33 (42.9%) cases, and on the right foot in 44 (57.1%) cases (Table 1).

The mean follow-up for all patients was 3 years and 4 months (1.5–6.2 years).

The study was approved by the Ethics Committee of the University Clinical Center "Zvezdara" in Belgrade. The ethical principles of the Declaration of Helsinki were respected in the conduct of this research. Each foot was treated as an independent case. Data were obtained before, during and after the treatment by the recommendations of the American Orthopaedic Foot and Ankle Society (AOFAS) [8].

Inclusion criteria that qualified patients to be the part of the study were determined: the patients with moderate hallux valgus deformity, the presence of hallux valgus deformity which had been previously nonoperatively treated and the patients with no degenerative changes in the first metatarsophalangeal joint. Exclusion criteria were: the patients who had prior hallux valgus deformity procedure, the patients with neuromuscular disorders and rheumatoid arthritis and the patients under the age of 18 years.

The assessment of results was performed according to the Hellal's modification of the Bonney and McNab classification criteria [9] and the Hallux Metatarsophalangeal Interphalangeal Score (HMIS) [10].

The analysis of results was based on the preoperative and postoperative assessment of HVA, IMA, sesamoid position and the first metatarsal bone length, using the lateral and dorsoplantar weightbearing foot radiograph projection. Furthermore, these factors were taken into account: movements in the first metatarsophalangeal joint, length of postoperative immobilization, treatment duration and complications (infections, relapses, pain i.e. – metatarsalgia).

The sesamoid position was determined by the position of the medial sesamoid in relation to a line drawn through the mid-longitudinal axis of the first metatarsal bone on the dorsoplantar radiography (0 normal position, 1 less than 50% overlap, 2 more than 50% overpalo, lateral luxation) [11].

Table 1

General characteristics of the analyzed patients and feet and values of the radiographic outcomes before and after the surgery: Hallux valgus angle (HVA), Intermetatarsal angle (IMTA), sesamoid position, and shortening of the first metatarsal

Parameters	Type of surgery		*p*
	Mitchell	Golden	
Patients, n	49	49	
Bilateral operations, n (%)	32 (65.3)	28 (57.1)	0.407[c]
Feet, n	81	77	
Age at surgery (years), mean ± SD	50.5 ± 11.4	52.4 ± 14.1	0.470[a]
Number fender female, n (%)	43 (87.8)	46 (93.9)	0.487[c]
Number left side, n (%)	43 (53.1)	33 (42.9)	0.980[c]
Number both sides, n (%)	32 (65.3)	28 (57.1)	0.407[c]
Before surgery, mean ± SD	33.99 ± 3.60	34.47 ± 3.71	0.410[a]
After surgery, mean ± SD	12.14 ± 1.80	14.81 ± 1.58	< 0.001[a]
Difference (after – before), mean ± SD	21.85 ± 2.15*	19.66 ± 3.31*	< 0.001[a]
IMA (degrees)			
before surgery	15.10 ± 1.66	15.47 ± 2.08	0.223[a]
after surgery	7.27 ± 1.17	8.61 ± 1.16	< 0.001[a]
difference (after – before)	7.83 ± 1.07*	6.86 ± 1.69*	< 0.001[a]
Sesamoid position (values 0–3)			
before surgery	2.19 ± .17	2.30 ± .19	< 0.001[a]
after surgery	0.90 ± .14	1.09 ± .12	< 0.001[a]
difference (after – before)	1.30 ± .06*	1.20 ± .11*	< 0.001[a]
Shortening of the first metatarsal (mm)			
before surgery, mean ± SD	67.18 ± 6.80	66.90 ± 6.20	< 0.001[b]
after surgery, mean ± SD	62.31 ± 5.00	63.93 ± 6.90	< 0.001[a]
difference (after–before), mean ± SD	4.87 ± 7.20*	2.97 ± 7.70*	< 0.001[a]
Dorsi plantar move. of the thumb (degrees)			
before, mean ± SD	40.41 ± 6.13	39.01 ± 4.64	0.111[a]
after, mean ± SD	76.56 ± 9.64	74.71 ± 6.12	0.017[a]
difference (after-before), mean ± SD	36.15 ± 9.32*	35.70 ± 6.06*	0.723[a]

SD – standard deviation; [a]T-test; [b]Mann-Whitney *U* test; [c]χ^2 test; *Significant difference before-after.

Dorsoplantar movement in the first metatarsophalangeal joint was measured using a goniometer before and after the operative treatment.

The assessment of the subjective well-being of the patients in the postoperative period was conducted by 3 orthopaedic surgeons with more than 6 years of specialist experience in practice, who were not involved in the operative treatment. The aforesaid physicians were not acquainted with the strategy and the results of the study.

The data are presented as a count (%) or mean (± SD), depending on the data type. The χ^2 test, *t*-test and Mann-Whitney *U* test were used to compare the nominal and numerical variables between the groups. Changes in HVA, IMA, sesamoid position, shortening of the first metatarsal bone, movements of the metatarsophalangeal joint were calculated as the difference between the first and the last measurement and then compared to the *t*-test and Mann-Whitney *U* test between the groups, depending on the data distribution. All values of $p < 0.05$ were considered significant. The statistical analysis was performed using the SPSS 20.0 (IBM corp.).

Results

All of the preoperative values classified according to the Hellal's modification of the Bonney and McNab criteria, showed poor results in the patients from both groups. Poor results were indicated as well in the preoperative values classified using the HMIS.

The analysis of results based on the two mentioned scoring systems showed that an improvement was made with both applied procedures compared to the preoperative state/condition. There was a high, statistically significant difference in the scores before and after the procedure in favor of the postoperative findings for both operative procedures ($p < 0.001$).

According to the Hellal's modification of the Bonney and McNab classification, in the patients who underwent the Mitchell procedure, 78 (96%) feet showed improvement postoperatively. Twenty-nine (36%) of that number of feet revealed excellent results, 49 (60%) showed good, and in 3 (4%) feet poor results were noted. The patients who underwent the Golden procedure demonstrated improvement in 71 (92%) feet. Thirty-two (30%) feet showed excellent, 48 (62%) good, and 6 (8%) poor results. The statistical analysis of the significant difference classified by the Hellal's modification of the Bonney and McNab criteria before and after the operation, indicated that when the two surgical procedures were compared, there was a high statistically significant difference in favor of the Mitchell compared to the Golden procedure ($p < 0.001$).

The preoperative score according to the AOFAS scale was 48.46 ± 4.91 points in the Mitchell group, and 48.47 ± 5.08 points in the Golden group ($p = 0.989$). The postoperative results according to the HMIS were improved to 95.85 ± 8.08 in the Mitchell group, whereas in the Golden group, they increased to 93.44 ± 11.48 points ($p = 0.123$). The results in the Mitchell group were excellent in 59 (72.8%) feet, good in 16 (19.8%), satisfactory in 4 (4.9%) and poor in 2 (2.5%). Good and excellent results were revealed in 75 (92.6%) of the operated feet. The results observed in the Golden group were excellent in 53 (68.8%) feet, good in 15 (19.5%), satisfactory in 3 (3.9%), and poor in 6 (7.8%).

The statistical analysis of a significant difference classified by the HMIS score scale before and after the operation, indicated that when the two directions of the procedure were compared, there was no statistically significant difference in the results of both procedures ($p = 0.123$) (Table 2).

The assessment of a significance of the differences in HVA, IMA, sesamoid position, shortening of the first metatarsal bone before and after the operations demonstrated a high statistically significant difference in favor of the obtained postoperative values in both operative procedures ($p < 0.001$).

The analysis of dorsoplantar flexion of the thumb was proven to have statistically significant results in both methods postoperatively ($p < 0.001$).

A bigger correction in the HVA was found in the Mitchell group (21.85 ± 2.15) compared to the Golden group (19.66 ± 3.31) ($p < 0.001$). IMA was more reduced in the Mitchell group (7.83 ± 1.07) in relation to the Golden group (6.86 ± 1.690) ($p < 0.001$). The sesamoid position correction was more improved by the Mitchell method (1.30 ± 0.06) versus Golden method (1.20 ± 0.11) ($p < 0.001$). Shortening of the first metatarsal bone was bigger in the Mitchell group (4.87 ± 0.729) compared to the Golden group (2.97 ± 0.77) ($p < 0.001$).

Using the Mitchell method, dorsoplantar flexion of the thumb was increased from 40.41 ± 6.13° to 76.56 ± 9.64°, and by using the Golden method, it was increased from 39.01 ± 4.64° to 74.71 ± 6.12°. Dorsoplantar flexion of the thumb was more improved by the Mitchell method (36.15 ± 9.32°) compared to the Golden (35.70 ± 6.06°); the difference in results was not statistically significant ($p = 0.723$) (Table 1).

The cast removal and physical therapy in the Mitchell group followed 37.1 ± 1.3 days after the procedure and in the Golden group it was 44.1 ± 1.3 days after the procedure ($p < 0.001$). In the Mitchell group, the patients returned to their regular life activities (the end of the treatment) within the period of 57.1 ± 1.3 days after the beginning of the treatment and in the Golden group, within 68.1 ± 1.3 days ($p < 0.001$) (Table 2).

In the Mitchell group, 2 patients developed superficial wound infections, whereas in the Golden group it was the case with 5 feet ($p = 0.268$).

One patient in the Mitchell group showed a total relapse of their deformity, while in the Golden group, it happened in the case of 3 feet ($p = 0.358$) (Table 3).

The preoperative symptoms of metatarsalgia were observed in 41 (51%) feet in the Mitchell group and postoperatively in 19 (16%) feet ($p = 0.741$). In the Golden group, the preoperative metatarsalgia was observed in 41 (53%) feet and postoperatively in 18 (23%) feet ($p = 0.246$) (Table 4).

The X-ray findings of 2 successfully operated patients, whether by the Mitchell asteotomy or Golden osteotomy, are shown in Figures 5 and 6, respectively.

Table 2

The analysis of preoperative and postoperative results of the Mitchell and Golden osteotomies according to the Hellal's modification of Bonney and McNab classification in percentage, and HMIS in points

Parameters	Type of surgery		*p*
	Mitchell	Golden	
Feet, n	81	77	
Good results (Bonney and McNab), n (%)			
preop	0	0	
postop	78 (96.3)	71 (92.2)	< 0.001[c]
HMIS (points), mean ± SD			
preop	48.47 ± 5.08	48.46 ± 4.91	0.989[a]
postop	95.85 ± 8.08	93.44 ± 11.48	0.123[a]
Postoperative results (Bonney and McNab), n (%)			
excellent	29 (35.8)	23 (29.9)	
good	49 (60.5)	48 (62.3)	0.320[b]
poor	3 (3.7)	6 (7.8)	
HMIS, n (%)			
excellent	59 (72.8)	53 (68.8)	
good	16 (19.8)	15 (19.5)	
satisfactory	4 (4.9)	3 (3.9)	0.323[b]
poor	2 (2.5)	6 (7.8)	
Duration of imobilizzation and beginning of physical therapy (days), mean ± SD	37.1 ± 1.3	44.1 ± 1.3	< 0.001[a]
Returning to regular life activities (days), mean ± SD	57.1 ± 1.3	68.1 ± 1.3	< 0.001[a]

SD – standard deviation; [a]T-test; [b]χ^2 test.
HMIS – Hallux Metotarsophalangeal Interphalangeal Score.

Table 3

Complications after surgery

Parameters	Type of surgery		*p*
	Mitchell	Golden	
Feet, n	81	77	
Superficial infections, n (%)	2 (2.5)	5 (6.5)	0.268 [a]
Recurrence of hallux valgus, n (%)	1 (1.2)	3 (3.9)	0.358 [a]

[a]χ^2 **test.**

Table 4

Pre- and postoperative metatarsalgia comparison

Type of surgery	Total (n)	Preoperative, n (%)		Postoperative, n (%)		
		no metatarsalgia	with metatarsalgia	no metatarsalgia	with metatarsalgia	*p*
Mitchell	49	40 (49)	41 (51)	68 (84)	13 (16)	0.741[a]
Golden	49	36 (47)	41 (53)	59 (77)	18 (23)	0.246[a]

[a]**McNemar test.**

Fig. 5 – X-ray scan of a 53-year-old female patient: left – hallux valgus before surgery; center – postoperative scan of Mitchell osteotomy; right – two years after surgery scan.

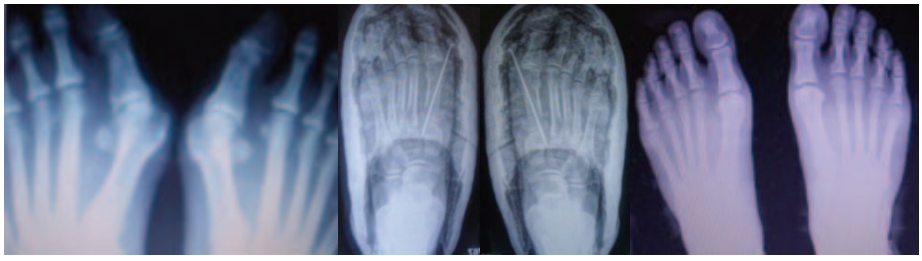

Fig. 6 – X-ray scan of a 49-year-old patient: left – hallux valgus before surgery; center – postoperative scan of Golden osteotomy; right – two years after surgery scan.

Discussion

Hallux valgus is the result of a complex deviation in the structure and the function of the foot. In the operative treatment of moderate hallux valgus deformity, the distal and proximal metatarsal osteotomies are performed, and those procedures enable correction of a majority of components of feet deformities. The purpose of the study was to compare the distal metatarsal osteotomy by the Mitchell to the proximal metatarsal osteotomy by the Golden within roughly similar groups of patients.

Treating moderate and severe hallux valgus using nonoperative methods is, predominantly insufficient. The effects of the treatment of hallux valgus deformity are that much better if the patient undergoes surgery at the early stages of the disease, that is, before any arthritic changes appear in the first metatarsophalangeal joint.

Regardless of the fact that both were introduced the same year (1958.), the Golden method never became widely popular in treating hallux valgus like the method by Mitchel [12]. In scientific literature, we did not find a study that compares these two methods.

Some limitations of this study pertained to the multiple surgeons having performed the procedures as well as the fact that two procedures performed in different rays of the first metatarsal bone were compared.

The general preoperative status evaluation score was poor in all of the feet. Postoperatively, according to the Hellal's modification of the Bonney and McNab classification, the general status was improved in 78 (96%) feet in the Mitchell group. The observed improvement represents the sum of excellent and good outcomes which is in correlation with the results provided by other authors. According to the HMIS, improvement was demonstrated in 79 (97.5%) feet. Other authors indicated that in the patients who had the Mitchell method performed, in 92 % of the cases, good and excellent results were recorded [4, 13].

Using the Hellal's modification of the Bonney and McNab classification, it was observed that general status in the Golden group improved in 71 (92.2%) feet, whereas according to the HMIS, it was the case with 79 (97.4%) feet. Excellent results were obtained in 68 (88.3%) feet. In a study of his own, Golden reported good and excellent outcomes in 78% of cases [7].

In the patients who underwent the procedure by the Mitchell method, the mean HVA correction of 21.85 ± 2.15° was obtained, whereas in the IMA the mean correction was 7.83 ± 1.07° which coincides with the findings of a majority of the authors who reported the correction in the HVA from 10 to 25° and IMA from 5 to 10° [14–17]. In the patients who had the Golden method applied, the mean correction of HVA and IMA was 19.66 ± 3.31°, that is 6.86 ± 1.69°, respectively, which is by 2.19°, that is, by 0,9° less than what was observed in the Mitchell method. The values of obtained results are approximate results of other authors [18, 19].

Malik and Methieson [20] indicated the importance of a role that the sesamoid position played, along with radiographic images and IMA, in estimating hallux valgus deformity. The sesamoid position in the patients who underwent the procedure in the Mitchell group changed from position 2 to position 0, and in Golden group it changed from position 2 to position 1.

Some authors indicated the importance of shortening of the first metatarsal bone in the deformity correction procedure [21]. Shortening of the first metatarsal bone in the Mitchell procedure was 4.87 ± 7.20 mm, whereas in the Golden method, it was 2.97 ± 7.70 mm. As some authors suggested, the shortening of the first metatarsal bone to a greater extent could be one of the main causes of metatarsalgia. Merkel et al. [22] suggested that shortening the bone by more than 10 mm could cause metatarsalgia. Baba et al. [12] observed metatarsalgia in the patients who had the bone shortened by more than 8 mm and chronic pain in the patients who had their metatarsal bone shortened by more than 10 mm. A number of authors do not support a concept that there is a correlation between metatarsalgia and the shortening of the first metatarsal bone [23, 24]. In our study, the preoperative metatarsalgia in the Mitchell group was detected in 51% of feet, whereas in the Golden group, it was found in 53% of feet. Other authors reported the incidence of the preoperative metatarsalgia in 33% of the patients and 40% of the patients, respectively [2, 8]. In the patients who underwent the Mitchell procedure, metatarsalgia was found postoperatively in 13 (16%) feet, and in the patients who underwent the Golden procedure, it was the case with 18 (23%) feet. Some authors indicated the postoperative incidence of metatarsalgia in 27% of cases [25]. During this research, no correlation between the shortening of the first metatarsal bone and the incidence of metatarsalgia was found.

Removal of the cast immobilization and the beginning of physical therapy in the Mitchell group was performed after the mean time of 37.1 ± 1.3 days. The reported outcome was in correlation with the results obtained by other authors who removed the cast in the patients who underwent the Mitchell procedure 5 to 7 weeks after the surgery [10]. Removal of the cast immobilization and the beginning of physical therapy in the Golden group followed after the mean time of 44.1 ± 1.3 days. In his study, Golden indicated that he preferred to remove the cast immobilization and start the physical therapy 6 weeks after the procedure [7]. Longer cast immobilization in the Golden group is required for the relatively poorer fixation stability of the bone fragments secured by the Kirschner wire.

Pain that occurs as a consequence of deformity affects regular life activities of the patients [26], is the main reason they decide to undergo the operative treatment. In 90.1% of the patients who had the Mitchell procedure, the pain disappeared completely. These results are comparable to findings of the other authors who reported the loss of pain in 80%–95% of the operated patients [27–29]. In the patients who underwent the procedure by the Mitchell approach, the chronic pain was observed in 3 cases, while in the patients who had Golden method performed, the chronic pain occurred in 6 feet.

Conclusion

The study indicated that two different osteotomy, by Mitchell and by Golden, can achieve good clinical and radiographic results. The estimated treatment outcomes measured by two scoring systems as well as other observed parameters of HVA, IMA, sesamoid position, metatarsalgia, complications and length of treatment, suggest that the operative treatment of moderate hallux valgus deformity by the Mitchell method provides better results. Whereas the value of the shortening of the first metatarsal bone indicates that the shortening is greater in the Mitchell method, which goes in favor of the Golden method. Regarding the flexion of the thumb of the feet operated on, there is no statistically significant difference between two methods.

Using sutures for maintaining position after Mitchell osteotomy, can eliminate the need for the second surgery (removal of foreign body) which decreases the incidence of infections. In the Golden method, stabilizing the Kirschner wire requires removal at 5 weeks postoperatively, which entails prolonged treatment and additional intervention, thus increased risk of infection.

Incidence of an infection in the Mitchell method was also decreased by using a single-incision in correcting deformity (Golden method uses two–incision technique).

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Received on December 30, 2016.
Revised on March 06, 2017.
Accepted on July 18, 2017.
Online First September, 2017.