OUTCOMES OF MITCHELL'S PROCEDURE IN THE TREATMENT OF HALLUX VALGUS

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ABSTRACT

Background

Hallux Valgus is the commonest foot deformity. It is characterized by lateral deviation of the big toe with the medial shifting of the first metatarsal. Many intrinsic and extrinsic factors are claimed to be a cause and may coexist as multifactorial. Mitchell's distal metatarsal osteotomy is one of the preliminary operations proposed in managing hallux valgus, with 70% to 90% of satisfactory results.

Objectives

To evaluate the outcome of Mitchell's procedure in treating mild to moderate hallux valgus in terms of clinical and radiological outcomes.

Patients and Methods

Sixteen adult patients (26 feet) with mild to moderate hallux valgus were enrolled in this study. They underwent original Mitchell's step-cut distal osteotomy to correct their hallux valgus

Results

At the last follow-up, overall satisfaction was (81.25%) with three patients unsatisfied due to transfer metatarsagia and reflex sympathetic dystrophy. The mean change in hallux valgus angle and intermetatarsal angle were (17.27°) and (4.47°) respectively.

Conclusion

Mitchell's procedure is a distal metatarsal osteotomy which has good results in treating mild to moderate hallux valgus in terms of clinical and radiological appearance and acceptable patient satisfaction. However, transfer metatarsalgia and recurrence of deformity are two more known drawbacks of this procedure.

Keywords: *Hallux valgus, Distal metatarsal osteotomy, Mitchell's procedure, Metatarsalgia.*

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INTRODUCTION

Hallux valgus (HV) is a complex deformity of the medial that often coexists with deformities and symptoms within the other toes [1,2]. The worldwide prevalence is around 23% in people aged between 18-65 years, and 35% in those older than 65, with female predominance [3]. Although the exact etiology till now has not been found, many factors have been claimed to be the original cause. [4]. Risk factors can be grouped into extrinsic factors like shoe wearing and intrinsic factors such as structural abnormalities, genetic predisposition, and secondary to other disorders [5]. The familial tendency of 60% – 70% in HV individuals with almost 84% bilateral bunion formation and female gender dominance up to 90% will explain heredity as a foremost influencing factor with most HV patients [6,7]. Other factors are rheumatoid arthritis, loss of muscle tone, especially in elderlies [1], cerebral palsy, amputated second toe, and iatrogenic causes [5,8].

The pathoanatomical elements of HV are a later deviation of the big toe, increasing the HV angle and medially driving the metatarsal head. [9] (See Figure 1) The most common complaint of symptomatic HV is difficulty wearing shoes, estimated in about 80% of cases. Also, transferred metatarsalgia may be felt under other metatarsal heads in 40%-50% of cases. Some symptomatic patients also worry about the cosmetic appearance of their feet, which may reach up to 60% of cases [6]. On standing anteroposterior X-ray, some variables are calculated to determine the severity of HV deformity. These include hallux valgus angle (HVA), intermetatarsal angle (IMA), hallux valgus interphalangeal (HVI), and distal metatarsal articular angle (DMAA) [10, 11]. (See Figure 2) HVA and IMA are the most used angles for measuring the severity and magnitude of HV deformity and preoperative corrective operation planning [12]. These measures have classified HV as mild, moderate, and severe [13] (See Table 1).

Conservative management is the first-line treatment, especially in adolescents, elderlies, and those with neurological or vascular compromise [14]. Indications of operative management of HV are pain not relieved by conservative means at least after six months of trials [9]. More than 130 types of surgical procedures have been defined in the literature for managing HV; this indicates no accurate operation for all HV types [14]. Mitchell osteotomy is one of the preliminary operations which technically has intrinsic stability. It is characterized by step-cut osteotomy of the distal metatarsal neck through cancellous bone and fixing it by absorbable sutures after deviating the distal fragment laterally and tilting it plantar ward. [15] (See Figure 3) The satisfactory result of the procedure with Mitchell was (82% - 90%) [14, 16]. The only disquiet after Mitchell's operation is metatarsalgia and recurrence of deformity, reported in the original paper to be 32% and 8%, respectively [17]. Patients and Methods: This prospective case series study was done at Sulaimani and Shar teaching hospitals in Sulaimani province between October 2016 and September 2018. Sixteen patients (26 feet) with mild to moderate HV were included in this study. The mean age of participating patients was 50.5 (ranging from 37 to 68 years). Male to female ratio was 1:1 in patients (eight males and eight females), while by the number of feet, there were 12 feet (46.2%) males and 14 feet (53.8%) females. Patients with bilateral HV were ten (62.5%), and right to left feet ratio was 1:1. (Table 2: shows more details on patient demographics.) Inclusion criteria for participating in this study were; Patients with failed at least six months of conservative management, aged more than 18-year-old and with mild to moderately classified HV.

Exclusion criteria were: diabetes mellitus, degenerative MTP joint changes, HVA > 40°, IMA > 20°, patient with hypermobile first TMT joint or generalized ligamentous laxity, Patient with Pes planus and recurrence HV. After a thorough clinical examination and radiological assessment, they were put into conservative management for six months. Mitchell's operation was decided in the case of refractory to conservative management. There was a case of cerebral palsy with bilateral HV. Also, one patient had hammertoe in her second toe, has been operated on in the same session with HV correction. All patients were informed about the study. Later, informed consent was taken from all of them. Surgical Technique: The patient was admitted on the day of surgery. After giving antibiotics 30 minutes before the incision, an above-knee tourniquet was applied. The dorsomedial incision terminal branch of the superficial peroneal nerve was identified and protected throughout the operation.

A joint capsule was found and incised in a Y-shaped flap with a distally located base. Osteotome excised medial eminence in line with the metatarsal shaft. Two drill holes were made on the dorsal metatarsal cortex before osteotomies. The first distal hole was 1.5 cm proximal to the distal articular surface margin and the second hole was lateral and proximal to the first to meet as opposed to each other after shifting the distal

fragment. Two osteotomies (step-cut) were made in the metatarsal cancellous neck bone, first distal osteotomy was incompletely cut with keeping 3-4 mm of lateral bone cortex, and proximal complete cut osteotomy was made a maximum of 3 mm proximal to the first one. The distal metatarsal headpiece was shifted laterally and tilted the plantar ward. Both bone sides were fixed through previously made bone holes by No.1 polyglactin 910 (Vicryl™). The medial capsule was plicated and sutured.

Following surgery, folded gauze pads were put in the first web space, and the foot was put in a non-weight bearing short plaster boot cast for two weeks. All patients were regularly followed up. At two weeks, partial heel weight bearing was advised; at four weeks, full weight bearing was encouraged with a walking cast. At eight weeks plaster cast was removed, and full weight bearing was started without supports. At six months, follow-up patients underwent detailed clinical examination, and radiographs were obtained.

RESULTS

Sixteen patients with 26 feet (50% male, 50% female) were followed up for a mean follow-up time of 15 months (six months to 24 months). There were no cases of lost follow-up. On clinical follow-ups, there was only one case (3.8%) of superficial infection at the incision site, which was treated by oral antibiotics and daily dressing. There was no pain over the MTP joint in 21 feet (80.8%), and the other five feet (19.2%) had mild pain. Three feet (11.5%) lost sensation over their big toe. Five feet (19.5%) in three patients had reflex sympathetic dystrophy, which later all managed accordingly. Postoperative transferred metatarsalgia occurred in five feet (19.2%) of three patients, in which two became bilaterally feeling lesser toe metatarsalgia. We did not observe any cases of postoperative recurrence of HV. (See Table: 3) On the assessment of weight-bearing preoperative and last postoperative radiographs, the mean preoperative HVA was (31.4° ± 7.7° SD) which ranged from (15° - 39°), while the mean postoperative HVA was (14.2° ± 7.5° SD) ranging from (4° - 25°) and the mean change of HVA was (17.27°). The mean preoperative IMA was (13.1° ± 2.5° SD) ranging from (9° - 19°) while the mean postoperative IMA was (8.6° ± 2.6° SD) ranging from (5°- 13°) and the mean change of IMA was (4.47°). (See Table: 4). At the last visit, all patients were asked if they were satisfied with the postoperative results; all except three (81.25%) said that they were satisfied, and the remaining (18.75%) were not.

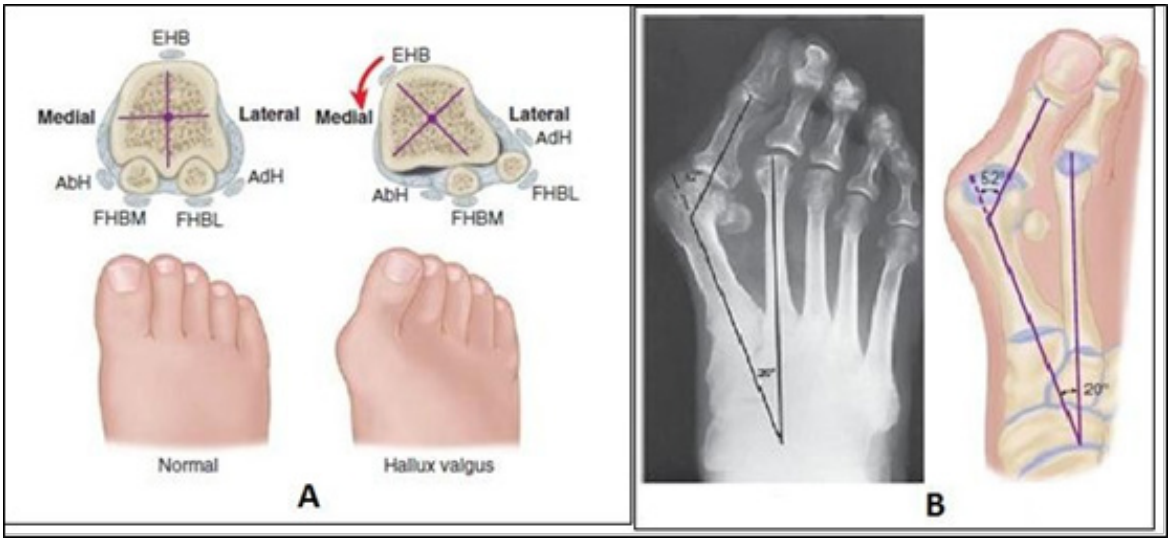


Figure 1. Hallux valgus complex. (A) Note the plantar shift of abductor halluces (AbH) and lateral shift of sesamoids. adductor halluces (AdH); extensor hallucis brevis (EHB); flexor hallucis brevis lateral head (FHBL) and medial head (FHBM) .(B) Note increase in IMA, lateral dislocation of sesamoids, subluxation of first metatarsophalangeal joint, and pronation of great toe (2).

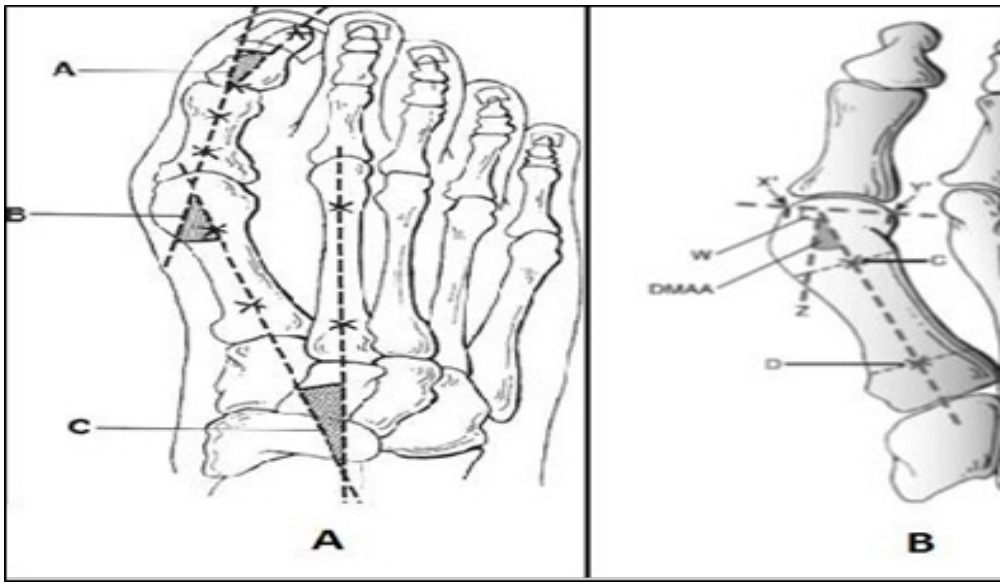
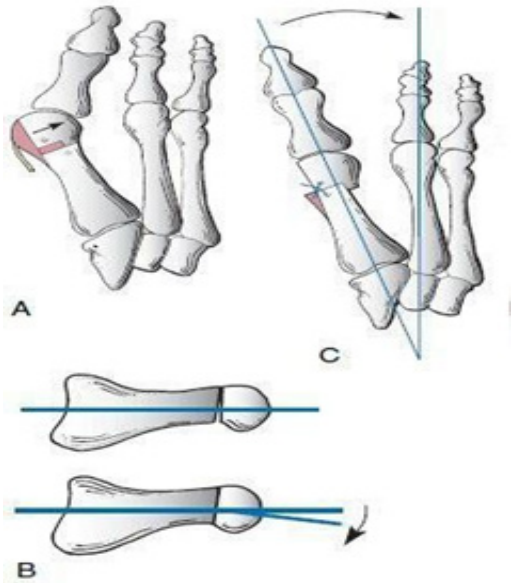


Figure 2. A)Techniques of hallux valgus angular measurements. Angle A: is hallux interphalangeal angle (HVI). Angle. B: is hallux valgus angle (HVA). Angle C: is 1 – 2 intermetatarsal angle (IMA).

B) Distal metatarsal articular angle (DMAA). The X-Y line is a distal metatarsal articular surface line. The C-D line is the longitudinal axis of the first metatarsal bone. The w-Z line is drawn perpendicular to the X-Y , lie and DMAA is subtended by the C-D line and W-Z line (10)



Figures 3. Principles of Mitchell procedure: A. The proposed osteotomy for hallux valgus deformity,

B. Planter tilting of the capital fragment, C. Capital fragment laterally displaced and fixed by absorbable suture (26)

Table 1. Hallux valgus classification according to Coull and Stephens. [16]

	HVA	IMA
Normal	≤ 15°	≤ 9°
Mild	16° - 25°	10° - 13°
Moderate	25° - 40°	14° - 20°
Severe	> 40°	> 20°

Table 2.Patient demographic data (26 feet in 16 patients).

Variables	Results	
Age year (mean ± SD)	50.5±9.05 (37.0 – 68.0) y	
Gender:		
Male (no. & %)	8	50%
Female (no. & %)	8	50%
Side:		
Right (no. & %)	13	50%
Left (no. & %)	13	50%
Bilateral (no. & %)	10 (20 feet)	62.5%
Associated conditions:		
CP	1	3.8%
Hammertoe in 2nd toe	1	3.8%
Classification:		
Mild (no. & %)	12	46.2%
Moderate (no. & %)	14	53.8%
Follow-up mo. (mean ± SD)	15 mo. ± 5 (6-24) mo.	

CP: cerebral palsy. Mo:month. No: Number. SD: standard deviation. y: year

Table 3. Postoperative feet complication list.

Complications	In patients		In feet	
	No.	%	No.	%
Loss of nerve sensation*	2	12.5	3	11.5
Reflex sympathetic dystrophy	3	18.75	5	19.2
Transferred metatarsalgia	3	18.75	5	19.2
Infection (superficial)	1	6.25	1	3.8
Recurrence hallux valgus	0	0	0	0
Hallux varus	0	0	0	0
Malunion	0	0	0	0
Nonunion	0	0	0	0
Avascular necrosis of head	0	0	0	0
Total	**6**	**37.5%**	**9**	**34.6%**

*** Over great toe due to irritation of median division of terminal branch of the superficial peroneal nerve.**

Table 4. Pre and postoperative radiographic comparison.

Measurements	Preoperative	Postoperative	P-values
HVA	31.4° ± 7.7°	14.2° ± 7.5°	0.001
IMA	13.1° ± 2.5°	8.6° ± 2.6°	0.001

Values are given as mean degrees ± standard deviation. HVA, hallux valgus angle. IMA, first and second intermetatarsal angle.

DISCUSSION

There is no general agreement on which type of operation has a better outcome with a minimal complication rate, despite that passing more than a century since the first metatarsal corrective osteotomy for the management of HV and describing more than 130 types till now; this is mostly because HV is a complex and multifactorial deformity. Up to now, several authors have experimented with Mitchell's step-cut osteotomy in the management of mild to moderate HV with excellent to good satisfactory results starting from Mitchell's study (82%) to Shapiro (76%) [18], Asif Baba (85%) [19], Glynn (92%) [7] and our result (81.25%) was close to the native paper.

The proportion of bilaterality was up to 62.5%, comparable with other published studies [17, 19]. Even though some authors recommended that Mitchell's osteotomy be better used in adults no more than 60 years [17], others undertook this procedure in adolescents or populations older than 60 with acceptable results [15, 21]. Likewise, this paper comprises three patients (5 feet) of more than 60-year-old; although degenerative changes had been excluded, two of them were dissatisfied with the final results; this upshot confirms the recommended counsel. The most common drawback of results after Mitchell's operation in nearly all published studies is transferred metatarsalgia.

The result of metatarsalgia in this study was comparable with David-West (10.9%), Asif Baba (8.3%), and Prior (13%) [19, 22, 23]. However, it was lower than the original Mitchell's paper (32%), Shapiro's (33%), and Merkel's (29%) [15, 17]. Another well-known pitfall of Mitchell's operation is the recurrence rate, with high rates in some studies like David-West (26.8%), McDonald's (19%), and Glynn (12.5%) [7, 21, 22]. The recurrence rate in this study was zero. This may be due to sufficient lateralization of the head fragment and preventing early foot mobilization. Regarding other complications in the current study, three feet (11.5%) had numbness over the medial hallux surface; this can be seen in other studies like three cases in Kalender et al. study [20].

Concerning radiological correction, the current study achieved a mean HVA correction of (17.27°) and a mean IMA correction of (4.47°). These results are comparable with other studies with mean correction of HVA (10° - 19°) and mean IMA correction (3° - 7.4°) [20, 24, 25]. While assessing the amount of HV correction by Mitchell's distal metatarsal osteotomy, we can realize that there is a marked reduction in HVA form (mean 31.38° ± 7.72° SD) to (mean 14.11° ± 7.4° SD). However, some operated feet have postoperative HVA of more than 16°, which is still regarded as mild HV. These are seen in preoperative moderately severe cases. This may be evidence that Mitchell's procedure is not applicable in greater HV deformities. Limitations regarding this study are; firstly, this study is a case series and contains no comparison with its modifications or other HV corrective operations; secondly, DMAA was not studied.

In conclusion, Mitchell's distal metatarsal osteotomy is a simple osteotomy that has good results in treating mild to moderate HV in terms of clinical and radiological appearance and acceptable patient satisfaction. However, transfer metatarsalgia due to first metatarsal shortening and recurrence of deformity are two more known drawbacks of this procedure.

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