

## Outcome of a Modified Mitchell Osteotomy for Severe Hallux Valgus Deformity

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### Abstract

**Background:** The choice of procedure for severe hallux valgus deformity is still a matter of debate.

**Objective:** This study presents the outcome of a distal osteotomy combined with a transarticular release in severe hallux valgus

**Methods:** We reviewed the clinical and radiological results of 38 feet in 33 patients treated with a modified Mitchell osteotomy and a transarticular release for severe hallux valgus. After a median follow up of 36 months (IQR, 27-50 months) clinical outcome data were recorded with FAOS, SF-12, VAS-pain and -disability and AOFAS-HMI scores. Radiological data were collected by analysis of the preoperative and late postoperative weightbearing radiograph.

**Results:** Mean achieved correction in IMA and HVA was respectively 7.1 ( $p < 0.001$  95% CI 6.02- 8.1) and 19.5 ( $p < 0.001$  16.8-22.8) degrees, which was statistically significant. Median AOFAS-HMI score was 92 (IQR, 83-100). Median total FAOS score was 89 (IQR, 75- 100), median VAS for pain was 3 (IQR, 1-24), median VAS for disability was 10 (IQR, 1-31). Most encountered complications were dorsiflexion restriction and metatarsalgia. Ninety-one percent would choose the same procedure given the outcome.

**Conclusion:** Despite these complications, modified Mitchell osteotomy combined with a transarticular release yields a satisfying outcome after a median follow-up of 36 months in these patients with severe hallux valgus deformity.

**Keywords** Hallux valgus; Outcome; Severe; Mitchell osteotomy

### Introduction

Hallux valgus deformity is one of the most common chronic foot complaints treated by orthopedic surgeons and is associated with functional disability [1,2]. Approximately one third of the shod population is estimated to have some degree of hallux valgus [3].

Although over 100 different osteotomies have been described for the operative treatment of hallux valgus deformity [4,5], there is still no clear evidence for choosing the correct surgical procedure [6]. Furthermore, whether the addition of a distal soft tissue procedure (Modified McBride procedure) yields a better outcome is also not clear [4,7].

Mitchell first described a step-cut distal metatarsal osteotomy in 1958, which achieved good correction with a satisfying clinical outcome in 74-94% of the treated patients [8], also in larger deformities [9,10]. This classic technique described by Mitchell however is reported to induce some possible adverse effects, in particular osteonecrosis of the metatarsal head due to periosteal stripping, transfer metatarsalgia in 7-15% of the patients as a result from shortening of the first metatarsal bone and a dorsiflexion malunion [11-14]. Also a loss of correction leading to recurrent hallux valgus with medial eminence pain is described [15].

Choosing a distal osteotomy for mild or moderate deformities and a proximal procedure for severe hallux valgus is more or less recommended [4]. At our institution a modified Mitchell osteotomy with a modified McBride procedure is performed regardless of the severity of the hallux valgus deformity (in absence of osteoarthritis of the first metatarsophalangeal joint). Some dated studies report on disappointing results for a Mitchell osteotomy especially in severe deformities [10,16]. Yet, no definite evidence for a superior outcome after a proximal or a diaphyseal osteotomy for moderate to severe deformities has been published in literature [17].

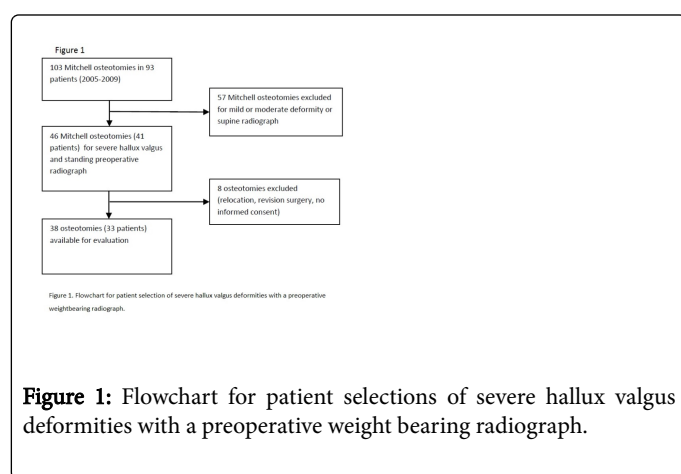
Because of the lack of evidence of superiority of a proximal, diaphyseal or a distal osteotomy, we performed a retrospective study to identify the clinical and radiological outcome of a modified Mitchell osteotomy with a distal soft tissue release for a severe hallux valgus deformity at our institution.

### Materials and Methods

We reviewed 103 consecutive modified Mitchell osteotomies with a modified soft tissue release performed in 93 adult patients for hallux valgus deformity at our hospital in the period 2005-2009. Patients were selected using a specific procedure code. We selected only patients with severe hallux valgus deformity with a minimum follow up of 24 months. Digital patient records and digital radiographs using a picture

archiving and communication system (PACS) were used to assess patient eligibility. An intermetatarsal angle (IMA) >14 degrees and/or a hallux valgus angle (HVA) >35 degrees on a weightbearing radiograph was graded as severe. On this basis we excluded 57 osteotomies in 57 patients. Absolute exclusion criteria were neuromuscular disorders, inflammatory arthropathy and prior surgery to the affected forefoot, therefore 4 patients (4 osteotomies) were additionally excluded.

Thirty-seven patients (42 osteotomies) were contacted by phone and asked to return for clinical and radiological evaluation. Three patients were lost to follow up because of relocation and one patient refused informed consent because of pregnancy. After obtaining informed consent, 38 osteotomies in 33 patients were available for clinical and radiological follow up. Patient selection is shown in Figure 1. This study was approved by the local ethical review board.



**Figure 1:** Flowchart for patient selections of severe hallux valgus deformities with a preoperative weight bearing radiograph.

### Surgical technique

All included patients were operated by one single surgeon. The operation was performed with the use of a tourniquet and a single dose of antibiotics as prophylaxis. All patients had a stepped distal metatarsal osteotomy according to Mitchell [8], yet it was directed slightly oblique (in direction of the third metatarsal head and slightly plantar direction) to correct for the obligatory shortening due to the step-cut and to prevent dorsiflexion malunion, for prevention of transfer metatarsalgia. Before the osteotomy, the lateral capsule and adductor tendon was released transarticularly, as described by Choi [18], to achieve sufficient correction and release of the valgus contracture. The osteotomy was closed with three separate Vicryl No2 sutures (Ethicon, Sommerville NJ). Two sutures were tied dorsally, one was tied on the plantar side for extra prevention of dorsiflexion malunion of the osteotomy. The medial capsuloperiosteal flap was closed with transosseous absorbable sutures in a reefing fashion to keep the hallux into neutral or slightly overcorrected position.

The operated foot was placed in a cast with a small pipe around the hallux for 6 weeks. Patients were allowed to bear weight immediately in the cast on a wedge shoe with two crutches. No standard prophylaxis for thrombo-embolic events was prescribed. After 6 weeks the cast was removed and patients were encouraged to bear weight and move the first ray actively and passively. When the foot was very stiff, patients were referred to the institutional physiotherapist for mobilization therapy. Patients visited the orthopedic outpatient clinic after 2,6 and 12 weeks and longer when there was clinical and radiological necessity.

Depending on the radiologic union of the osteotomy and clinical necessity.

### Radiological and clinical evaluation

Standing standard anteroposterior (AP) and lateral radiographs were obtained. A comparison between the preoperative and final evaluation weightbearing radiographs was made and hallux valgus angle (HVA), intermetatarsal angle (IMA) and distal metatarsal articular angle (DMAA) according to the AOFAS standards [19] were recorded. Radiographic osteoarthritis of the MTP 1 joint was graded according to Coughlin and Shurnas [20].

Shortening of the first metatarsal bone after surgery was also recorded, after correction for magnification described by Zlotoff [21].

Basic demographic data, medical history, treatment data (operation date, operation time, concurrent operative treatment (hammer-toe or claw-toe correction on the same foot) and complications were retrieved from the patients charts. All patients filled in a Foot Ankle Outcome Score (FAOS) [22], a Short Form-12 Health Survey [23] (with subscales for pain, symptoms, activities of daily life, sports and quality of life) and a Visual Analogue Scale "pain and impairment" score prior to the visit. All were clinically examined at our outpatient clinic and AOFAS Hallux MTP IP-Scale form [24] was completed. Patients were binomially scored for symptoms of metatarsalgia. Patients were binomially asked about their satisfaction with the treatment result and whether they would repeat the treatment given outcome.

### Data analysis

Data were analyzed using the statistical software PASW Statistics version 20.0 (IBM® SPSS® Statistics). Data were tested for normality. When data were normally distributed means and standard deviations were given, for non-normal distributed median and interquartile range (IQR) Differences between pre and postoperative angles were tested with a paired t-test. The Spearman rank correlation was used to assess differences between categorical variables and the Pearson's correlation coefficient was used to assess differences between continuous variables. The level of significance was set at P<0.05.

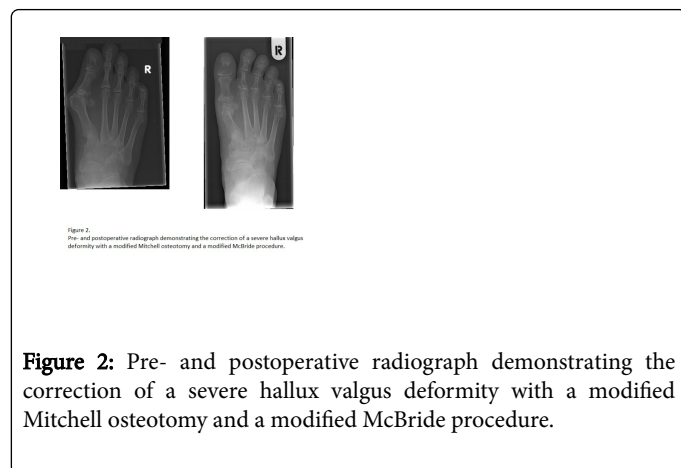
### Results

Thirty-three patients (6% males, 94% females) were evaluated at our outpatient clinic after a median follow up period of 36 months (IQR, 27-50 months). Five patients had bilateral surgery resulting in 38 feet available for follow-up. Mean age at surgery was 56 years (range, 27-82 years). Mean BMI was 27.5 and 5 patients smoked in the treatment period. Twenty-one left feet and 17 right feet were operated on. Ten of the 38 feet had concurrent minor operations on the lesser toes, 9 for hammer-toe correction and 1 for claw-toe correction. Mean anesthesia time was 33 minutes (range, 19-55 minutes). All achieved normal union and no wound problems or infections were reported.

Postoperative IMA and HVA showed a statistically significant decrease in comparison to the preoperative angles. DMAA correction was not statistically significantly decreased. The mean preoperative and follow-up radiological data are summarized in Table 1. Radiographic results of the osteotomy and transarticular release are shown in Figure 2.

	Preoperative	Follow up	Correction	
Mean IMA (range)	17 (14-27)	9.9 (0-21)	7.1 (1-15)	p=0.010
Mean HVA (range)	34 (18-54)	14.4 (-8- 38)	19.5 (6-47)	p=0.024
Mean DMAA (range)	32 (15-53)	11.8 (-14-36)	20.7 (2-47)	p=0.148

**Table 1:** Radiological data comparing preoperative angles and angles at final follow up.



**Figure 2:** Pre- and postoperative radiograph demonstrating the correction of a severe hallux valgus deformity with a modified Mitchell osteotomy and a modified McBride procedure.

Seven feet had symptoms of metatarsalgia on final follow-up (18%). Mean shortening of the first metatarsal due to the Mitchell osteotomy was 4.2 mm (0.8-10.7 mm). In 4 feet (10.5%) progression of osteoarthritis was noted. One patient was treated for a pulmonary embolism. Median AOFAS score on follow-up was 92 (IQR 83-100). Median FAOS was 89 (IQR 75-100). Hallux valgus was clinically noted in five patients (13%), of whom three were recurrent after initial good correction (7.9%). Two patients had a radiological mild varus deformity (5%). Mild dorsiflexion restriction, as defined as a dorsiflexion deficit of less than 10 degrees compared to the other foot, was noted in 15 of 38 feet. Seven patients were not able to wear high heels due to stiffness or pain, five of these patients did not wear high heels before surgery. Eleven patients noted a 100% score on AOFAS. Six patients (18%) experienced pain longer than 3 months after surgery, of whom three were treated for a complex regional pain syndrome (CRPS). These three patients (7.9%) still had some degree of pain at final follow up. These patients reported lower scores on FAOS and SF-12. Thirty patients (34 feet) (91%) would choose to undergo the same treatment again. The outcomes of the FAOS and its subscales, the SF-12 and VAS-scores are depicted in Table 2.

	Median score (IQR) postoperative
AOFAS score	92 (83-100)
FAOS pain	99 (93-100)
FAOS symptoms	71 (64-78)
FAOS activities of daily life	100 (80-100)
FAOS sport	88 (65-100)
FAOS quality of life	87 (73-100)

FAOS overall	89 (75-100)
VAS pain	3 (1-24)
VAS disability	10 (1-31)
SF-12 physical health composite score	81 (50-94)
SF-12 mental health composite score	74 (50-88)

**Table 2:** Clinical outcome data for 38 feet reflected as median scores with their interquartile range in parentheses.

Correlations between the patient-related outcome measures and presence of metatarsalgia and the patient-related outcome measures and the postoperative HVA and IMA were studied. Also, correlations between metatarsalgia and concurrent surgeries on the one hand, and patient-related outcome measures and concurrent surgeries on the other hand, were calculated. Although not statistically significant (p=0.053), more metatarsalgia was encountered in the more shortened metatarsals. Yet, no influence of metatarsal shortening was noted on the outcome of the AOFAS, FAOS, VAS and SF-12. No correlations were either found between the addition of concurrent surgeries and the incidence of metatarsalgia. The clinical outcome scores (FAOS, VAS and SF-12) were not statistically significantly affected by the addition of concurrent surgeries or the presence of metatarsalgia. Finally, no correlation was noted between the length of follow up and the clinical outcome parameters (FAOS, VAS, AOFAS, SF-12 and the incidence of metatarsalgia).

## Discussion

The appropriate operative treatment for severe hallux valgus deformity is still a matter of debate. Based on the radiological and clinical results in this study, a distal metatarsal osteotomy according to Mitchell combined with a distal soft tissue release, yielded predictable outcome and satisfied patients after a median follow up of 36 months.

The radiological part of this study demonstrated that a good correction could be achieved and is still present after median follow-up of 36 months with a modified Mitchell osteotomy and a transarticular lateral release. Both HVA and IMA were significantly downsized, thus restoring the sesamoid-MT-1 complex. The DMAA was not decreased significantly, yet measurement of this angle is reported to be unreliable and insufficiently irreproducible in literature [19].

With a mean IMA correction of 7 degrees (maximum of 15 degrees) and a mean HVA correction of 20 degrees (maximum of 47 degrees), the Mitchell technique in combination with a distal soft tissue procedure allows for a wide range of correction by restoring the position of the metatarsal head over the sesamoids through a lateral shift and creating a narrower foot. All osteotomies consolidated without delay and none showed evidence of osteonecrosis of the

metatarsal head after a median follow up of three years. Recurrent hallux valgus occurred in three patients (7.9%). This percentage is in line with previous but dated reports of Mitchell osteotomy [5,15] and is comparable to the incidence of recurrence of hallux valgus after a proximal osteotomy [25-28,29-32]. Therefore, in this study, securing the osteotomy with sutures was sufficient to keep the correction in this study population, and is a low-cost method with no additional need for plate or screw removal [25].

Median follow up time was only 36 months. A recent study discussing the long-term outcomes of a scarf osteotomy demonstrated that recurrences in hallux valgus occurred within 1.5 to 2.8 years [32].

Two patients had a radiological hallux varus at follow up and still were satisfied with the outcome, as reflected in overall FAOS scores of 92 and 93.

The mean AOFAS-score of 92 is comparable to several studies on the outcome of proximal or diaphyseal osteotomies in severe hallux valgus, reporting AOFAS scores of 89 to 95 [26-29,32]. Stiffness of the MTP1-joint was the most encountered problem in our patients, which was responsible for most of the points lost on the AOFAS scores. It is unclear whether this stiffness is a side effect of the operation or a complication of the casting. Although occurring in almost 40% of this study population, mild loss in first MTP dorsiflexion did not seem to be an important problem in this study population, since mean overall FAOS score was 89 points. Moreover 91% of the patients would choose the same treatment again given this outcome.

We reported prolonged pain in 18% of operated patients. Sensory deficit or dysfunction of the medial plantar hallucal nerve or the dorsomedial collateral nerve after hallux valgus surgery is a frequent complication of hallux valgus surgery resulting in pain or numbness and is reported in up to 45% of the cases [5,6,28, 30,31].

Metatarsalgia is attributed to load transfer to the longer lesser metatarsals after first metatarsal shortening due to metatarsus primus varus or after an osteotomy or fracture. Seven feet (18%) had some degree of metatarsalgia at follow-up. This resolved with the use of orthoses. This incidence is in line with previous reports on Mitchell osteotomy [11-14]. In a recent comparative study between chevron and Mitchell osteotomies 30% of the patients in both groups were not entirely satisfied, mostly due to forefoot pain [33,34]. With a slightly oblique direction of the stepped osteotomy and closing the osteotomy with dorsal and plantar sutures, excessive shortening and elevation of the first metatarsal head could be prevented. We recorded a mean shortening of the first metatarsal bone of 4.2 mm. This is more favorable compared to the originally reported shortening in Mitchell osteotomy of 6-7 mm [8]. Unfortunately this modified technique did not lead to less metatarsalgia after treatment for severe hallux valgus in our patients compared to the original technique [11-14]. Yet, only severe hallux valgus deformities were included in this study, in contrast to previous studies [11-14].

In spite of 18% metatarsalgia, 18% first MTP joint dorsiflexion restriction affecting choice of footwear and 8% CRPS the FAOS scores were high for this study population with a mean of 89 points. These complications are frequently seen in hallux valgus surgery, in both distal and diaphyseal osteotomies [33]. Patients were still highly satisfied with the outcome. Other studies report lower incidence of metatarsalgia, pain and dorsiflexion restriction after diaphyseal osteotomies [32], yet 14 percent of the patients needed surgery for screw removal. Satisfaction rates this study [32] were comparable to our results.

Several weaknesses of this study are to mention. Only 38 feet in 33 patients with severe hallux valgus were available for evaluation, nevertheless, the response rate was high (38 of 46 feet eligible; 83%) and therefore we can present results from a representative sample. Unfortunately no preoperative questionnaire or clinical examination data were available. We cannot present improvements in clinical outcome scores due to treatment. Yet, 92% of the patients were satisfied at final follow up and 91% would repeat the treatment under similar circumstances, which is in line with previous studies reporting on hallux valgus surgery [11]. All patients were operated by or under direct supervision of one single surgeon, which may introduce a performance bias.

In conclusion, the results of this small study indicate that a modified Mitchell osteotomy combined with a distal soft tissue procedure is a predictable and safe alternative for treatment of severe hallux valgus deformity. We achieved and satisfying radiological and clinical correction with content patients after a median follow up of 36 months.

PW, BT, SK and RF designed the study protocol. RF operated on all of the patients or supervised the operation. PW and SK were involved in data collection, data analysis was performed by PW and BT. All authors were involved in writing the manuscript.

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