Outcome of a Modified Mitchell Osteotomy for Severe Hallux Valgus Deformity

Pieter van der Woude*, Stefan B Keizer, Rudolf E van der Flier and Bregje JW Thomassen

Department of Orthopaedic Surgery and Traumatology, Medisch Centrum Haaglanden, P.O. Box 4322501 CK THE HAGUE, Netherlands

*Corresponding author: Department of Orthopaedic Surgery and Traumatology, Medisch Centrum Haaglanden, P.O. Box 4322501 CK THE HAGUE, Netherlands, Tel.: +31-6-43542572; E-mail: pvdwoude@gmail.com

Received date: Oct 16, 2015; Accepted date: Nov 27, 2015; Published date: Dec 08, 2015

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 peristeal 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 diaphysial osteotomy for moderate to severe deformities has been published in literature [17].

Because of the lack of evidence of superiority of a proximal, diaphysial 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...
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 metatarsal osteotomy according to Mitchell [8], yet it was directed malunion of the osteotomy.

The operated foot was placed in a cast with a small pipe around the halluc for 6 weeks. Patients were allowed to bear weight immediately in the cast on a wedge shoe with two crutches. No standard prophylaxis for trombo-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 halluc 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<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.
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.

### 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 ostetomy 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 modified McBride procedure. 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 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

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

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

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

| Outcome                          | Median postoperative score (IQR) |
|----------------------------------|----------------------------------|
| 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)                      |

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).
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.

References

1. Nix S, Smith M, Vicenzino B (2010) Prevalence of hallux valgus in the general population: a systematic review and metaanalysis. Journal of Foot and Ankle Research 3: 21.
2. Menz HB, Lord SR (2005) Gait instability in older people with hallux valgus deformity. Foot Ankle 26: 483–489.
3. Nikolau VS, Korres D, Xypnitos E, Lazaretos J, Lallos S, et al. (2009) Fixation of Mitchell’s osteotomy with bioabsorbable pins for treatment of hallux valgus deformity. Int Orthop 33: 701-706.
4. Easley ME, Trinka HJ (2007) Current Concepts Review: Hallux Valgus Part II: Operative Treatment. Foot Ankle Int 28: 748-759.
5. Deenik AR, de Visser E, Louwerens JW, de Waal Malefijt M, et al. (2008) Hallux valgus angle as main predictor for correction of hallux valgus. BMC Musculoskelet Disord 9: 70.
6. Ferrari J, Higgins JE, Prior TD (2004) Interventions for treating hallux valgus (abductovalgus) and bunions. Cochrane Database Syst Rev CD000964.
7. Resch S, Stenström A, Reynisson K, Jonsson K (1994) Chevron osteotomy for hallux valgus not improved by additional adductor tenotomy. A prospective, randomized study of 84 patients. Acta Orthop Scand 65: 541-544.
8. MITCHELL CL, FLEMING JL, ALLEN R, GLENNEY C, SANFORD GA (1958) Osteotomy-bunionectomy for hallux valgus. J Bone Joint Surg Am 40-A: 41-58.
9. Wu KK (1987) Mitchell bunionectomy: an analysis of four hundred and thirty personal cases plus a review of the literature. J Foot Surg 26: 277-292.
10. Das De S, Hamblen DL (1987) Distal metatarsal osteotomy for hallux valgus in the middle-aged patient. Clin Orthop Relat Res: 239-246.
11. Dennis NZ, Das De S (2011) Modified Mitchell’s Osteotomy for Moderate to Severe Hallux Valgus An Outcome Study. J Foot Ankle Surg 50: 50-54.
12. Madjarovic M, Kolumbic R, Matek D, Smigovec I, Crnkovic T, et al. (2011) Mitchell and Wilson metatarsal osteotomies for the treatment of hallux valgus: comparison of outcomes two decades after the surgery. Foot Ankle Int 27: 877-882.
13. Meier PJ, Kenzora JE (1985) The risks and benefits of distal first metatarsal osteotomies. Foot Ankle 6: 7-17.
14. Laughlin TJ (1995) Complications of distal first metatarsal osteotomies. J Foot Ankle Surg 34: 524-531.
15. Fokter SK, Podobnik J, Vengust V (1999) Late results of modified Mitchell procedure for the treatment of hallux valgus. Foot Ankle Int 20: 296-300.
16. Mann RA (1989) The great toe. Orthop Clin North Am 20: 519-533.
17. Park CH, Jang JH, Lee SH, Lee WC (2013) A comparison of proximal and distal chevron osteotomy for the correction of moderate hallux valgus deformity. Bone Joint J 95-95B: 649-656.
18. Choi YR, Lee HS, Jeong JJ, Kim SW, Jeon IH, et al. (2012) Hallux valgus correction using transarticular lateral release with distal chevron osteotomy. Foot Ankle Int 33: 838-843.
19. Coughlin MJ, Saltzman CL, Nunley JA (2002) Angular measurements in the evaluation of hallux valgus deformities: a report of the ad hoc committee of the American Orthopedic Foot & Ankle Society on angular measurements. Foot Ankle Int 23: 68-74.
20. Coughlin MJ, Shurnas PS (2003) Hallux rigidus: demographics, etiology, and radiographic assessment. Foot Ankle Int 24: 731-743.
21. Zlotoff H (1977) Shortening of the first metatarsal following osteotomy and its clinical significance. J Am Podiatry Assoc 67: 412-426.
22. Roos EM, Brandson S, Karlsson J (2001) Validation of the foot and ankle outcome score for ankle ligament reconstruction. Foot Ankle Int 22: 788-794.
23. Ware Jr, Kosinski M, Keller SD (1996) A 12-Item Short-Form Health Survey: construction of scales and preliminary tests of reliability and validity. Med Care 34: 220-233.
24. SooHoo NF, Shuler M, Flemming IL, American Orthopedic Foot and Ankle Society (2003) Evaluation of the validity of the AOFAS Clinical Rating Systems by correlation to the SF-36. Foot Ankle Int 24: 50-55.
25. Park CH, Ahn JY, Kim YM, Lee WC (2013) Plate fixation for proximal chevron osteotomy has greater risk for hallux valgus recurrence than Kirschner wire fixation. Int Orthop 37: 1085-1092.
26. Markbreiter LA, Thompson FM (1997) Proximal metatarsal osteotomy in hallux valgus correction: a comparison of crescentic and chevron procedures. Foot Ankle Int 18: 71-76.
27. Lee KB, Seo CY, Hur CI, Moon ES, Lee JJ (2008) Outcome of proximal chevron osteotomy for hallux valgus with and without transverse Kirschner wire fixation. Foot Ankle Int 29: 1101-1106.
28. Moon JY, Lee KB, Seon JK, Moon ES, Jung ST (2012) Outcomes of proximal chevron osteotomy for moderate versus severe hallux valgus deformities. Foot Ankle Int 33: 637-643.
29. Mostafa MF, El-Adl G (2012) Distal soft tissue realignment and proximal metatarsal countersinking osteotomy for moderate to severe hallux valgus. Foot (Edinb) 22: 186-193.
30. Lui TH, Ng S, Chan KB (2005) Endoscopic distal soft tissue procedure in hallux valgus surgery. Arthroscopy 21: 1403.
31. Campbell DA (1992) Sensory nerve damage during surgery on the hallux. J R Coll Surg Edinb 37: 422-424.
32. Bock P, Kluger R, Kristen KH, Mittlböck M, Schuh R, et al. (2015) The Scarf Osteotomy with Minimally Invasive Lateral Release for Treatment of Hallux Valgus Deformity: Intermediate and Long-Term Results. J Bone Joint Surg Am 97: 1238-1245.
33. Vopat BG, Lareau CR, Johnson J, Reinert SE, DiGiovanni CW (2013) Comparative study of scarf and extended chevron osteotomies for correction of hallux valgus. Foot Ankle Spec 6: 409-416.
34. Lambers Heerspink FO, Verburg H, Reininga IH, van Raaij TM (2015) Chevron versus Mitchell osteotomy in hallux valgus surgery: a comparative study. J Foot Ankle Surg 54: 361-364.