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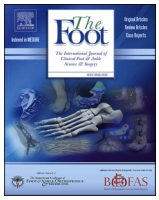

Original Article

Is bilateral hallux valgus chevron osteotomy a safe procedure for ambulatory surgery?

Bruno Morais *, Tiago Botelho, Nuno Marques, Ana Ferrão, João Nóbrega, Frederico Teixeira, André Grenho

Department of Orthopedics, Central Lisbon University Center, 8 Beneficiência Street, 1069-166 Lisbon, Portugal

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ABSTRACT

Introduction: Several osteotomies of the first metatarsal have been described for treatment of hallux valgus but chevron osteotomy is one of the most common and well-established procedure for treating this deformity. Although there is a trend towards considering bilateral surgery there is lack of publications addressing bilateral treatment in ambulatory units. The aim of this study is to analyze results of bilateral and unilateral distal chevron osteotomies associated with lateral soft tissue release as ambulatory procedures.

Materials and Methods: A retrospective review was made about the patients treated at our ambulatory unit over a period of five years. Initially, general information as patient's satisfaction's rate and return to normal activity's time and evaluation of standardized follow-up charts and records made by the surgeon were recorded. Secondly, the hallux metatarsophalangeal interphalangeal scale developed by the American Orthopedic Foot & Ankle Society was used.

Results: A total of 194 patients with 230 feet operated were included in this study. We found 29 patients that didn't meet the inclusion criteria and were excluded. The unilateral group was composed by 139 feet and the bilateral group by 52 feet. The improvement between preoperative and discharge clinical and radiographic results was significant independently in both groups. A total of 14% of complications were found in our study, 19% in the unilateral group and 12% at the bilateral group. None of them required revision surgery.

Conclusion: Bilateral distal chevron osteotomies, associated with lateral soft tissue release, are safe and effective ambulatory procedures. It was found a satisfactory deformity correction in moderate HV. Both patients that underwent unilateral and bilateral procedures had similar clinical and radiological outcomes with no increase in complications or return to normal activity time. With this study it was demonstrated that bilateral chevron osteotomies can be performed as ambulatory procedures.

1. Introduction

Hallux valgus (HV) most commonly affects women and can be found in 23%–28% of adults. When looking at adult females, HV deformity occurs as high as 30%. The prevalence is higher in those who wear shoes or high heels when compared to the barefoot population. Interestingly, when comparing women and men in barefoot populations, women are found to have HV deformity twice as often [1–3].

Surgery for this deformity is one of the most commonly performed foot procedures in orthopedic practice [4]. It is usually recommended for symptomatic patients with moderate to severe deformity. Due to variety in the different elements composing a hallux valgus deformity, different surgical procedures may be performed [5].

More than 130 procedures have been described for treatment of HV deformity [6,7]. Osteotomies of the first metatarsal are the gold standard to correct moderate to severe cases. Chevron osteotomy is one of the most common and well established procedure for treating this deformity [5,7–10].

Although developments have been made in the past decade in anesthetic practice, pain management and hospital organization, there are still concerns about treating these patients as outpatients even though evidence supporting this decision already exists [4,11–13].

Hallux valgus is reported to be bilateral in 84% of cases [9]. The majority of patients require surgical correction on both feet, which can be performed simultaneously or in stages. Although more than 1500 [9] publications concerning hallux valgus correction can be found in the

* Corresponding author.
E-mail address: brunosaraivademorais@gmail.com (B. Morais).

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literature, only a few are dedicated to the possibility of bilateral surgery, and their conclusions are rather controversial. *Sammarco and Russo-Alesi* advocated that patients undertaking corrective hallux valgus surgery on both feet should not have both surgeries performed simultaneously. They believed that in order to adequately protect the operated foot, the patient must be able to bear weight on the contralateral extremity in the immediate postoperative period. The second foot was typically operated, in their series, at least 2 weeks after the first surgery [14].

Nevertheless, there is a trend towards considering bilateral surgery as neither presenting a worse functional or radiographic result, nor increasing complications' rates [9,10,15]. To date, there is only one publication addressing bilateral treatment in ambulatory units [16].

The aim of this study is to analyze results of bilateral and unilateral distal chevron osteotomies associated with lateral soft tissue release as ambulatory procedures.

2. Materials and methods

2.1. Study design

A retrospective review was made about the patients treated at our ambulatory unit over a period of five years (2014–2018). Inclusion criteria were age of 18 years or older, primary procedures, distal chevron osteotomies associated with modified McBride procedure and a minimum follow-up of 24 months. Exclusion criteria were patients submitted to associated osteotomies, procedures on lesser metatarsals or toes, patients with MTP arthrosis, paralytic hallux valgus and patients lost for follow-up.

An evaluation was made of our standardized ambulatory follow-up charts, performed routinely at 24 h and 7 days after surgery, as well as any other follow-up records made by the surgeons.

All patients were reevaluated, after discharge, by an independent surgeon. Final clinical and radiological outcomes were then measured.

2.2. Surgical technique

All surgical procedures were conducted using standard skin preparation with an alcoholic chlorhexidine solution and sterile draping, in the supine position, with a tight pneumatic tourniquet (inflated to 350 mmHg). General or regional anesthesia was used, at the anesthetist discretion.

Chevron osteotomy was performed through a medial approach to the first metatarsophalangeal joint beginning at the mid-portion of the proximal phalanx and extending 2 cm proximal to the medial eminence. A longitudinal midline capsulotomy was performed in the same plane as the incision. The medial eminence resection and chevron osteotomy were carried out in a standard manner: we fashioned a 60° osteotomy centered on the first metatarsal head, displaced the capital fragment by 6–9 mm laterally to achieve a satisfactory first-second intermetatarsal angle and manually impacted the fragment onto the shaft to obtain a stable reduction. The osteotomy was then provisionally stabilized with two medially placed 1.4 mm K-wires, passed from medial to lateral. Then, a 4.0 mm headless compressive screw (*Fixos*® screw, Stryker™) was used for definitive fixation. The small shelf of bone left after displacement of the metatarsal head was removed.

All patients were allowed to stand, using a Barouk postoperative shoe, on the day of surgery, and they were allowed to bear weight on the heel as soon as this could be tolerated. All patients used the Barouk shoe and crutches for a minimum of four weeks after surgery. We had no record of difficulties in ambulation in any group. Clinical and radiographic examination was carried out to decide whether the patients could return to normal shoe wear, with criteria such as wound healing, residual pain and fixation failure being applied.

2.3. Outcome measures

2.3.1. Clinical

Clinical assessment was performed preoperatively, postoperatively and after discharge (Table 4). General information, such as patient's satisfaction's rate and return to normal activities' time were recorded. Secondly, we used the hallux metatarsophalangeal interphalangeal scale developed by the American Orthopedic Foot & Ankle Society (AOFAS score). The 100-point AOFAS scoring system combines subjective and objective data to evaluate clinical parameters: pain (40 points); function (45 points) and alignment (15 points) [17].

Patients also classified their pain on the day of surgery, at 24 h after the procedure, one week later and at discharge from the outpatient clinic, according to the Visual Analog Pain Scale (VAS), ranging from 0 to 10 points, with these values being recorded [18].

2.3.2. Radiographic

Radiographic assessment was performed preoperatively and after discharge. We used weight-bearing anteroposterior (AP) and lateral radiographs to measure hallux valgus, intermetatarsal and distal metatarsal articular angles. The hallux valgus angle (HVA) was defined as the angle formed by the intersection of the longitudinal axis of the proximal phalanx and that of the first metatarsal, which was determined by connecting the centers of the first metatarsal head and the center of the proximal articular surface [19]. The first-second intermetatarsal angle (IMA) was obtained by determining the angle formed by a line bisecting the second metatarsal shaft and a line drawn between the center of the first metatarsal head and the center of the proximal articular surface. Distal metatarsal articular angle (DMAA) was considered as the angle formed between a line perpendicular to the long axis of the firsts metatarsal and another representing the distal articular surface in the antero-posterior view [20]. The sesamoid's positions was also recorded, as was any other relevant data e.g., AVN of the metatarsal head, hardware failure or migration and signs of osteomyelitis.

2.3.3. Statistical analysis

Post-Hoc power analysis was performed to ensure that the study sample size was adequate. Shapiro-Wilk test was used as a normality test.

Independent sample *t* test for parametric data and Mann-Whitney *U* test for nonparametric data were used to compare continuous variables between the study and control groups. Repeated-measures analysis was used for within group comparisons of continuous variables. Fisher's exact test and Pearson $\chi 2$ test were used to compare categorical variables in our study. Statistical significance was defined as a *P* value of less than 0.05.

All statistical analyses were performed using *SPSS Statistics version 23*® (SPSS, Inc, an IBM Company, Chicago, IL™).

3. Results

3.1. Demographic data

A total of 194 patients with 230 feet operated were included in this study. We found 29 patients that did not meet the inclusion criteria and were excluded: 10 were lost during follow up, 12 had associated osteotomies and 7 were submitted to revision surgeries. These surgeries were performed by 6 senior surgeons (Fig. 1).

The unilateral group was composed by 139 feet and the bilateral group by 52 feet. Patients included in the unilateral group were mostly female (93%, n = 126), similarly to the bilateral group (81%, n = 21) (p = 0,138093). The average age on the unilateral group was 56 years old, (Standard Deviation SD = 22,6) and on the bilateral group 51 (SD = 24,1) (p = 0,034).

Presence of comorbidities was also accounted for, with an incidence of 86% in the unilateral group and 81% in the bilateral group

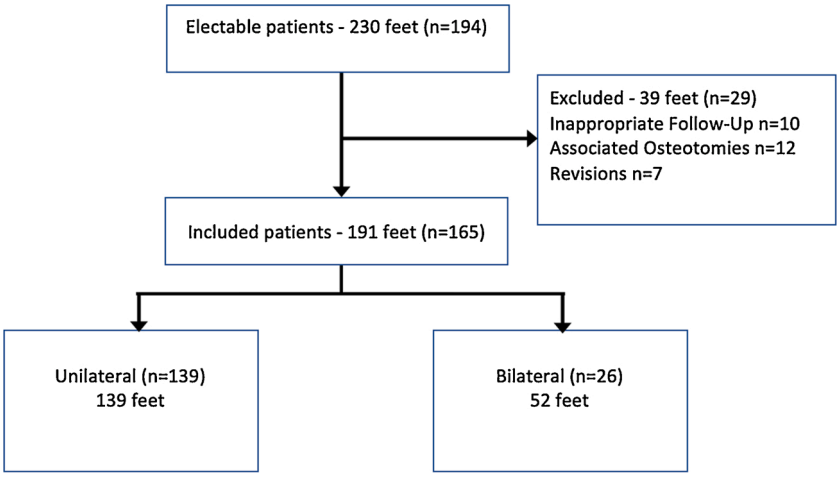

Fig. 1. Participant diagram.

(p = 0,635621) (Table 1).

3.2. Surgical results

Mean duration of surgery for the unilateral group was 59 min (SD = 8,38), compared to 93 min (SD = 8,36) for the bilateral group (p = 0,0001).

The average follow-up time for unilateral group was 28 months (SD = 1,8), compared to 29 months (SD = 4,1) of the bilateral group (p = 0,0948).

In regard of the type of anesthesia, 59 patients on the unilateral group and 16 on the bilateral group were operated under general anesthesia. There were 45 patients on the unilateral group and 8 on the bilateral group operated under sub-arachnoid blockade. The remaining 35 patients on the unilateral group and 2 patients on the bilateral group were operated on peripheral nerve blockade (p = 0,092498). All patients received Just before closure, 5 mL ropivacaine (concentration: 0.75%) that was infiltrated in subcutaneous tissue along each side of the wound edges. In the bilateral cases that dosage was applied on each foot.

Average VAS on the following day (D1) was 2,2 (SD = 1,2) on the unilateral group and 2,6 (SD = 0,9) on the bilateral group (p = 0,0562). One-week post-operative the unilateral group's average VAS was 1,8 (SD = 1,4) and 2,3 (SD = 1,2) on the bilateral group (p = 0,0654).

Concerning the post-operative medication pain protocol (mild pain – analgesics; moderate pain – NSAIDs and analgesics; severe pain – opioids), 88 patients on the unilateral group and 12 on the bilateral group were prescribed mild pain medication. There were 51 patients on the unilateral group and 14 on the bilateral group that received moderate pain medication. No patient on either group received severe pain medication (p = 0,100347).

In terms of complications, 5 patients on the unilateral group and 2 on the bilateral group had what were considered as failed surgeries, due to recurrent deformity, and had to be re-operated (between 12 and 18 months post-op). There were 6 patients on the unilateral group and 1 patient on the bilateral group with a wound dehiscence, but no patient was re-operated because of this. At time of final follow-up, 9 patients on the unilateral group and 3 patients on the bilateral group reported residual pain (p = 0,0798992). Surgery was performed, for all patients in both groups, in the ambulatory unit and there was no need for any patient to be admitted overnight (Table 2).

3.3. Radiographic outcomes

Regarding measurements for HVA, we found no difference between the preoperative, postoperative and discharge results. In the unilateral group we found an improvement of 24,7 degrees (SD = 5,6) in this angle as in the bilateral group of 25,8 degrees (SD = 6,2) (Table 3).

In terms of IMA we found no difference between the preoperative, postoperative and discharge results. In the unilateral group we found an improvement of 5,6 degrees (SD = 2,2) in this angle as in the bilateral group of 5,9 degrees (SD = 2,1) (Table 3).

We found no difference between the preoperative, postoperative and discharge results in the DMAA. In the unilateral group we found an improvement of 1,6 degrees (SD = 1,1) as in the bilateral group that was

Table 1
Patient characteristics.

		Unilateral	Bilateral	p
Gender				
	Feminine	126	21	
	Masculine	13	5	0,138093
Average Age		56 (22,6)	51 (24,1)	0,334
Comorbidities				
	None	21	3	
	Orthopedic	12	2	
	Cardiovascular	63	16	
	Metabolic	23	7	
	Auto-Immunes	9	1	
	Psychiatric	19	5	
	Infectious	6	0	
	Respiratory	8	2	0,635621
N		139	26	

Table 2
Surgery, post-op and complications.

		Unilateral	Bilateral	p
Surgery Duration		59 (8,38)	93 (8,36)	0,00001
Type of Anesthesia				
	General	59	16	
	Sub-Arachnoid Blockade	45	8	
	Peripheral Blockade	35	2	0,092498
Pain Protocol				
	Mild Pain	88	12	
	Moderate Pain	51	14	
	Severe Pain	0	0	0,100347
Complications				
	Recurrence	5	2	
	Infection	6	1	
	Pain	9	3	0,798992
Average Follow-Up		28 (1,8)	29 (4,1)	0,0948
N		139 feet	52 feet	

Table 3
Radiographic outcomes.

		Unilateral	Bilateral	p
Hallux Valgus Angle				
	Preoperative	38,2 (9,1)	39,6 (5,6)	0,203
	Postoperative	12,4 (1,8)	12,6 (1,4)	0,223
	Discharge	14,1 (1,2)	13,8 (1,6)	0,420
	Difference Pre-Discharge	24,7 (5,6)	25,8 (6,2)	0,266
	p*	<0,001	<0,001	
Intermetarsal Angle				
	Preoperative	16,4 (2,1)	16,2 (1,8)	0,516
	Postoperative	10,2 (1,9)	9,8 (1,8)	0,181
	Discharge	10,8 (1,8)	10.3 (1,7)	0,078
	Difference Pre-Discharge	5,6 (2,2)	5,9 (2,1)	0,388
	p*	<0,001	<0,001	
Distal Metatarsal Articular Angle				
	Preoperative	16,9 (3,9)	17,4 (3,2)	0,368
	Postoperative	15,2 (4,0)	15,4 (3,9)	0,755
	Discharge	15,6 (4,2)	15,8 (4,1)	0,766
	Difference Pre-Discharge	1,3 (1,0)	1,6 (1,1)	0,089
	p*	<0,001	0,029	
Lateral Sesamoid Subluxation 0%–50%				
	Preoperative	46	19	
	Postoperative	90	40	
	Discharge	72	29	0,939
	Difference Pre-Discharge	26	10	0,877
	p*	0,002	0,049	
Lateral Sesamoid Subluxation 50%–100%				
	Preoperative	93	33	
	Postoperative	49	12	
	Discharge	67	23	0,602
	Difference Pre-Discharge	26	10	0,849
	p*	0,002	0,005	
N		139 feet	52 feet	

p* - Difference Preoperative-Discharge.

1,3 degrees (SD = 1.0) (Table 3).

As we measured the lateral sesamoid subluxation, we found no difference between the unilateral and bilateral group. Both individually showed statistical reduction either in less severe 0%−50% as in the more severe cases 50%−100% (Table 3).

3.4. Patient-reported outcomes

It was not found any statistical difference in the preoperative, postoperative and discharge results of the AOFAS score between the unilateral and the bilateral group. The improvement between preoperative and discharge points was significant independently in both groups: unilateral 32.7 (SD = 6.5) vs 87.6 (SD = 17.1) points, and bilateral group: 31.4 (SD = 5.8) vs 89.3 (SD = 15.5) points (Table 4).

There was no difference in the analyses of the VAS at day 0, 1, 7 and discharge between groups as well in the patient's satisfaction rate with more than 90% in both groups at discharge. The mean return to activity time was 5,2 (SD = 3,3) weeks in the unilateral group and 5,4 (SD = 3.6) weeks in the bilateral group, with no statistical difference being found (p = 0,794) (Table 4).

Table 4
Clinical outcomes.

		Unilateral	Bilateral	p
AOFAS Score				
	Preoperative	32.7 (6.5)	31.4 (5.8)	0,3104
	Postoperative	78.6 (16.3)	82.1 (14.4)	0,2726
	Discharge	87.6 (17.1)	89.3 (15.5)	0,6168
	Difference Pre-Discharge	54.9 (12.3)	57.9 (18.3)	0,4286
	p*	<0,001	<0,001	
VAS				
	Day 0	0,6 (0,2)	1,3 (0,4)	>0,999
	Day 1	2,2 (1,2)	2,6 (0,9)	0,056
	Day 7	1,8 (1,4)	2,3 (1,2)	0,065
	Discharge	0,4 (0,2)	0,6 (0,4)	>0,999
Return to Activity Time		5,2 (3,3)	5,4 (3,6)	0,794
Patient's Satisfaction Rate				
	Postoperative	85%	83%	0,699
	Discharge	92%	91%	0,800
N		139	26	

p* - Difference Preoperative-Discharge.

3.5. Complications

A total of 26 complications (14%) were found in our study, 20 feet (19%) in the unilateral group and 6 feet (12%) at the bilateral group. None of them required revision surgery. No patient was admitted to the infirmary. Specifically, we found six superficial infections in the unilateral group and one in the bilateral group. Clinically, these led to prolonged wound healing (5–6 weeks) with crust formation. In all cases, no symptoms of infection were found after 3 months and these complications did not influence clinical or radiographic results. We found 9 patients with residual pain on the unilateral group and 3 on the bilateral group at 3 months postoperatively. All patients referred at 12 months that this pain was occasional and didn't affect their everyday activities. Five episodes of deformity recurrence occurred in the unilateral group and 2 on the bilateral group, we relate that to inadequate translation of the osteotomy. Interestingly all these patients were satisfied with the result and refused revision surgery.

4. Discussion

The benefits of simultaneous bilateral surgery seem to be obvious. They include a single anesthesia induction, a single hospitalization, a decreased period of overall rehabilitation, and easier footwear selection [10,16].

One of the most important concerns in the orthopedic community about this procedure is pain management and the possibility of an increase in the complications rate with the bilateral procedure. This is the first study that analyzed the same exact bilateral procedure for hallux valgus correction in ambulatory context.

Our study compared clinical and radiological outcomes of bilateral and unilateral distal chevron osteotomies associated with lateral soft tissue release as ambulatory procedures. We found that both groups had similar demographic characteristics in terms of gender, age and comorbidities. The operative time was obviously shorter in the unilateral group but interestingly the bilateral group recorded less than two folds of the unilateral operative time. The mean return to activity time was similar in both groups being in our view one of the strongest factors in terms of cost effectiveness.

Our study identified mild post-operative pain intensity, with no need to use a severe pain protocol. Actually, the average VAS at one day postoperative was significantly low, with 2,2 on the unilateral group and 2,6 on the bilateral group.

The complications' rate was 14%, but these were mostly self-limited situations with no patient being submitted to a revision surgery or admitted to the infirmary. There was no statistical difference between both groups.

We achieved a good correction of the HVA in both groups, with no statistical difference identified. We showed in our series that we had not only a good radiographic result in the increase of the HVA but also a satisfactory result in IMA, DMAA and lateral sesamoid subluxation. Improvements in these angles were similar in both groups and statistically significant.

We believe that the most important results in our study were the clinical outcomes. Several studies place too much significance in radiological or surgical specificities and fail to prove clinical improvement.

We showed significant improvement in both groups either in the AOFAS score results and in the patient's satisfaction rate when analyzing the differences between preoperative, postoperative and discharge results.

5. Conclusion

Bilateral distal chevron osteotomies, associated with lateral soft tissue release, are safe and effective ambulatory procedures. We found a satisfactory deformity correction in moderate HV. Both patients that underwent unilateral and bilateral procedures had similar clinical and radiological outcomes with no increase in complications or return to normal activity time. We recorded no patient admission to the infirmary.

With this study it was demonstrated that bilateral chevron osteotomies can be performed as ambulatory procedures. However, further studies should be performed in order to identify any patient subgroup that may not benefit from conducting these procedures in an ambulatory setting.

Funding

None.

Conflict of interest

None.

Data availability

Raw data and other supplementary material are available at the following repository: https://osf.io/7zpcj.

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