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Research Article

# Unilateral versus Simultaneous Bilateral Percutaneous Hallux Valgus Surgery

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**Keywords** Bilateral hallux valgus; Percutaneous forefoot surgery; Simultaneous surgery

**Abbreviations** AOFAS: American Orthopaedic Foot and Ankle Society; DMAA: Distal Metatarsal Articular Angle; DMMO: Distal Metatarsal Mini-Invasive Osteotomy; MTP: First Metatarsophalangeal; HVA: Hallux Valgus Angle; IMA: Intermetatarsal Angle; PFS: Percutaneous Forefoot Surgery Techniques; VAS: Visual analog scale

## Abstract

**Introduction:** The purpose of the present study is to evaluate the clinical and radiographic results of simultaneous surgical correction for bilateral hallux valgus compared with unilateral correction using Percutaneous Forefoot Surgery Techniques (PFS).

**Material and methods:** A prospective cohort study of 82 patients (106 feet). The mean follow-up was 58.7 ± 31.5 months (range 22.3 to 112.1). Patients were divided into two groups, unilateral surgical group (group U, 58 feet) and simultaneous bilateral surgical group (group B, 48 feet).

**Results:** Preoperative mean Visual Analog Scale (VAS) was 6.2 points in group U and 6.3 in group B ($p = 0.170$), at the last follow-up it decreased in both groups (1.6 group U and 1.8 group B, $p = 0.277$). American Orthopaedic Foot and Ankle Society (AOFAS) score improved from approximately 50 points preoperative in both groups, to 88 at the last follow-up. Mean hallux valgus angles in groups U and B changed from 34.7 degrees and 34.3 degrees preoperatively ($p = 0.838$), to 21.3 degrees and 22.4 degrees follow-up, respectively ($p = 0.635$). With the numbers available, no significant inter-group differences were observed in clinical and radiographic outcomes.

**Conclusions**: PFS is a valid procedure for outpatient simultaneous surgical correction in patients with bilateral hallux valgus.

**Level of evidence:** II Prospective Comparative Cohort Study

## Introduction

Numerous studies have evaluated bilateral versus unilateral surgery in large joints. However, limited research is available to compare outcomes of simultaneous surgical correction for bilateral hallux valgus compared with unilateral correction [1-6]. Theoretically, a simultaneous surgical correction has lower economic costs and eliminates patients suffering faster.

The work started by several previous authors, produced valuable knowledge and built an anatomic and technical foundation for PFS [7,8]. PFS is performed through 1-3 mm incisions, using a mini-blade for soft tissue and power rotary bur for osseous procedures under image intensification. Theoretical advantages are a potential faster recovery with immediate weight bearing, reduced surgical time, a less painful postoperative period and less stress to the patient. Besides, PFS could be performed as an outpatient procedure. The main disadvantages are the requirement for specific equipment and lengthy learning curve.

The purpose of the present study is to evaluate the clinical and radiographic results of simultaneous surgical correction for bilateral hallux valgus compared with unilateral correction using PFS techniques.

## Materials and Methods

This is prospective study collected from a single surgeon's experience. The surgeon had a previous surgery experience in the PFS technique of 20 cases. All the patients were treated in an outpatient surgery unit.

Between April/2006 and December/2013, 108 patients with bilateral hallux valgus symptomatic deformity were included in the study, 82 of them completed the minimum two-year follow-up period (Mean average; 58 ± 31 months, range 24 to 112). Patients were divided into two groups. Patients who accepted a simultaneous bilateral surgery (Group B; 24 patients, 48 feet) and who did not, for unilateral surgical group (Group U) with 58 patients, with previous informed consent.

The indication for PFS was a painful hallux valgus with or without metatarsalgia, with less than 60 degrees of Hallux Valgus Angle (HVA). All patients had adequate range of mobility of the first Metatarsophalangeal (MTP) joint and all patients reported having pain and difficulty wearing

shoes, with no improvement from conservative treatments. Patients were excluded if they had rheumatoid arthritis or other inflammatory diseases or previously failed Hallux valgus surgery.

A clinical and radiological examination, by a single person, was performed preoperatively, and postoperatively at two months, one year, and final follow up (December/2015). It included Visual Analog Scale (VAS), American Orthopedic Foot and Ankle Society Hallux Valgus Score (AOFAS) [9], HVA, Intermetatarsal Angle (IMA), Distal Metatarsal Articular Angle (DMAA), the metatarsal index (M1>M2, M1 = M2, M1<M2), joint congruency of MTP and complication rate. Besides, VAS was collected one and three weeks postoperative, to assess pain levels at immediate postoperative period. The subjective satisfaction with the outcome (very satisfied, satisfied, dissatisfied, or disappointed) was also recorded.

Anteroposterior weight bearing radiographic angles were measured by the Coughlin et al. method [10]. Joint congruency of the first MTP was assessed using the criteria defined by Pigott [11]. All the radiological measurements were made digitally (Ykonos, Sescam©).

## Surgical Technique

All of the procedures were performed under spinal anesthesia with bupivacaine (0.25%) ankle block for postoperative pain control. At home, patients were recommended to use acetaminophen and/or dipyrone and/or non-steroidal anti-inflammatory agents according to demand.

The surgical procedure is based on the description of Isham and De Prado [7,8]. Percutaneous exostectomy, lateral metatarsophalangeal arthrolysis and osteotomy of the first phalanx were done in all cases [12]. A distal osteotomy of the 1st metatarsal have been never performed. Patients with moderate to severe lateral metatarsalgia underwent Distal Metatarsal Mini-Invasive Osteotomy (DMMO). Those with IMA≥15 degrees underwent proximal closing wedge osteotomy of the first metatarsal. It was performed with minimally invasive surgery, and fixed with a super lateral compression staple. Treatment of lesser toes was determined on a case-by-case basis, with a combination of procedures on the soft tissues (flexor and extensor tendon tenotomies) and bones (phalangeal osteotomies).

In every case, a specific dressing is fashioned at the end of the procedure to maintain the correction. Monitoring of this dressing was done at first and third weeks, and removed at third week.

Immediate full weight bearing was allowed with a rigid, flat-soled postoperative shoe for 6 weeks and no deep venous thrombosis prophylaxis was used.

**Table 1:** Demographics of unilateral (group U) and bilateral (group B) PFS patients.

| | Group U (feet) | Group B (feet) |
|---|---|---|
| Men | 5 (8.6%) | 2 (4.2%) |
| Women | 53 (91.4%) | 46 (95.8%)[a] |
| Total | 58 | 48 |
| Average Age ± SD | 56.3 ± 12.4 years | 55 ± 14.2 years[b] |

a: p = 0.453; b: p = 0.520

**Table 2:** Associated pathologies and surgical procedures of unilateral (group U) and bilateral (group B) PFS patients.

| | Group U | Group B |
|---|---|---|
| Metatarsalgia, DMMO[a] | 19 (32.8%)[a] | 16 (33.3%)[a] |
| 1st Metatarsal proximal osteotomy[b] | 14 (24.1%)[b] | 14 (29.2%)[b] |

a: p = 0.950; b: p = 0.559

## Statistical Analysis

Continuous data were described as means and standard deviations. Categorical data were describe as absolute and relative frequencies. Comparisons between groups (bilateral and unilateral) were performed with the t-student test for quantitative variables and the chi-squared test (or the Fisher's exact test, where appropriate) for qualitative variables. The Wilcoxon signed-rank test was used to compare values before and after surgery and during follow-up. A 0.05 level of significance was used throughout. Statistical analyses were performed with the aid of PASW 18.0 statistical analysis software (SPSS Inc, Chicago, IL, USA).

## Results

The demographics of age and sex are shown in Table 1. The associated pathologies to hallux valgus and surgical procedures performed are listed in Table 2. Main preoperative AOFAS scores were 51.1 ± 11.3 points in group U, and 53.5 ± 10 points in group B (p = 0.248); and at the last follow up they improved to 88.3 ± 11.3 points and 88.3 ± 11 (p = 0.996), respectively. There were no differences between groups in function score (Table 3).

In both groups, the vast majority of patients had a preoperative pain level moderate or severe, with a mean VAS score of 6.2 ± 1.4 points in group U and 6.3 ± 1.7 in group B, (p = 0.170). Only one week after the procedure, mean VAS score had decreased in both groups (2.9 ± 2 in group U and 3.2 ± 2 in group B, p = 0.756). At the third week and second month, pain improvement was continuous until 2.3 ± 1.8 in group U, 2 ± 1.7 in group B (third week, p = 0.654) and 2.3 ± 2 in group U, 1.9 ± 2.1 in group B (2nd month, p = 0.981). The VAS score final follow up was 1.6 ± 2.2 in group U and 1.8 ± 2.2 in group B (p = 0.277).

The radiologic evaluation is show in table 4. The mean HVA improved from 34.7 ± 9.1 degrees (group U) and 34.3 ± 10 degrees (Group B) (p = 0.838), before the operation, to 15.5 ± 7.8 degrees in group U and 16.4 ± 9.2 degrees in group B at 2nd month (p = 0.592). There was a loss of postoperative correction approximately of 30% in both groups between 2nd month and 1st year, but there was not between 1st year and final follow up. Preoperative IMA was approximately 13 degrees in both groups, improving in 2 and 3 degrees at final follow up (p = 0.002) (Figures 1 and 2). There were no differences in the DMAA between groups, 18.1 ± 7.2 degrees (group U) and 19.9 ± 6.6 degrees (group B) preoperative (p = 0.191) and 23 ± 9.5 degrees and 21.4 ± 9.7 degrees at final follow up (p = 0.405), respectively.

The number of cases with metatarsal index M1<M2 was approximately 45% in both groups preoperative (44.8% group U, 45.8% group B, p = 0.918) and at final follow up (45.6% group U, 45.8% group B, p = 0.982).

Preoperative joint congruency of the first MTP was seen in 55.4%

**Table 3:** AOFAS scores.

| | Group U | | | | Group B | | | |
|---|---|---|---|---|---|---|---|---|
| | **Pre-op** | **2nd Month** | **1st Year** | **Final Follow up** | **Pre-op** | **2nd Month** | **1st Year** | **Final Follow up** |
| **Pain** | 19.8 ± 6.3 | 30.6 ± 4.3 | 33.9 ± 8.3 | 35 ± 8.5 | 20.8 ± 7.6 | 31.8 ± 7 | 32.5 ± 10.2 | 34.3 ± 6.8 |
| **Function** | **28.8 ± 3.8** | 39 ± 3.8 | 39.2 ± 5.1 | **40 ± 5** | **29.7 ± 3.8** | 39.2 ± 5.1 | 40.2 ± 6.1 | **41.1 ± 4.3** |
| **Aligment** | 2.4 ± 4.3 | 14.6 ± 2.1 | 13.9 ± 2.5 | 13.6 ± 2.7 | 3 ± 3.9 | 14.5 ± 1.7 | 13 ± 4.2 | 12.9 ± 3.2 |
| **Total** | **51.1 ± 11.3** | 84.3 ± 11.2 | 87 ± 13.8 | **88.3 ± 11.3** | **53.5 ± 10** | 85.6 ± 11.9 | 85.8 ± 16.8 | **88.3 ± 11** |

Values are expressed as the mean and standard deviation
Comparison between groups in all variables; p > 0.05
Comparison between Pre-op and the rest of the follow up; p < 0.05

**Table 4:** Radiologic evaluation.

| | Group U | | | | Group B | | | |
|---|---|---|---|---|---|---|---|---|
| | **Pre-op** | **2nd Month** | **1st Year** | **Final Follow up** | **1. Pre-op** | **2nd Month** | **1st Year** | **Final Follow up** |
| **HVA** | **34.7 ± 9.1** | 15.5 ± 7.8 | 20.9 ± 10.3 | **21.3 ± 10.6** | **34.5 ± 10.2** | 16.4 ± 9.2 | 20.1 ± 10.4 | **22.4 ± 12.9** |
| **IMA** | **13.3 ± 3.5** | 11.2 ± 3.2 | 11.6 ± 3.2 | **11.2 ± 3.2** | **12.9 ± 3.6** | 10 ± 2.6 | 10.1 ± 3.5 | **9.7 ± 2.9** |
| **DMAA** | **18.1 ± 7.2** | 19.8 ± 7.4 | 22.4 ± 8.5 | **23 ± 9.5** | **19.9 ± 6.6** | 18.8 ± 7.3 | 20.2 ± 7.4 | **21.4 ± 9.7** |

Values are expressed as the mean and standard deviation. Comparison between group U and group B; p > 0.05

**Table 5:** Complications.

| | Group U | Group B | |
|---|---|---|---|
| Superficial infection | 3 (5.1%) | 2 (4.1%) | P >0.999 |
| Metatarsalgia after DMMO | 1/19 (5.2%) | 5/16 (31.2%) | P =0 .137 |
| Metatarsalgia without DMMO | 1/39 (2.5%) | 1/32 (3.1%) | P >0.999 |
| Hallux Rigidus | 4 (6.8%) | 0 (0%) | P = 0.125 |
| Reflex sympathetic dystrophy | 1 (1.7%) | 0 (0%) | P >0.999 |
| Neuroma | 1 (1.7%) | 0 (0%) | P >0.999 |
| Revision surgery | 4 (6.8%) | 7 (14.6%) | P =0 .219 |

cases in group U and 43.8% in group B (p = 0. 320). Improving at final follow up in both groups (73.7% and 70.8%, respectively) (p = 0.745).

At final follow up, 79.3% of the subjects were satisfied or very satisfied in group U and 77.1% in group B (p = 0.782). Only 5.2% of cases in group U and 6.3% in group B were disappointed (p = 0.871).

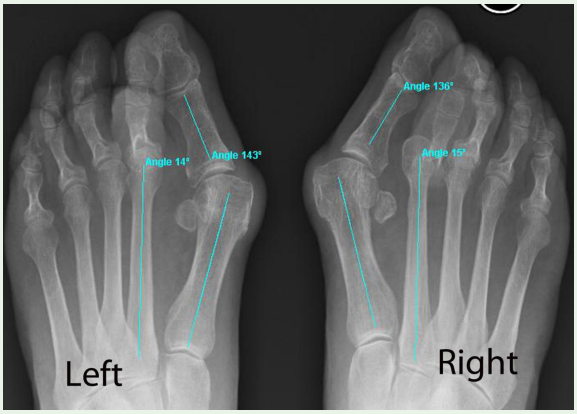


**Figure 1:** Preoperative radiograph of a patient with bilateral hallux valgus and metatarsalgia. Right; HVA 44º, IMA 15º. Left; HVA 37º, IMA 14º.

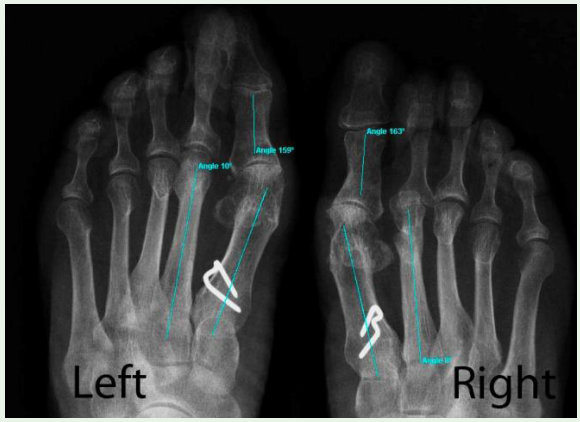


**Figure 2:** Follow up postoperative radiograph. Simultaneous bilateral exostosectomy, lateral metatarso-phalangeal arthrolysis, Akin osteotomy, proximal closing wedge osteotomy of the first metatarsal and 2nd, 3rd and 4th DMMO. Right; HVA 17º, IMA 8º. Left; HVA 21º, IMA 10º.

In group B, patients were surveyed to determine whether they would undergo the simultaneous bilateral procedure again. All patients reported that they would do so.

Recurrence of medial 1st metatarsal head pain happened in 6 cases (10.3%) in group U and 10 cases (20.8%) in group B. (p = 0.133). Complications registered are shown in Table 5.

## Discussion

The unilateral correction in patients with bilateral hallux valgus, is an approach largely guided by consideration for the patient's discomfort in daily activity, concerns about correction, fixation losses and the need for crutch ambulation, for those that have undergone simultaneous bilateral correction. However, several authors consider that bilateral correction shortens the duration of treatment, reduces patient suffering and economic cost, with similar results [4,13].

Dedicated outpatient surgery units are more resource efficient, but require an adequate postoperative analgesia and a low surgery pain to the success of this procedure [14]. Therefore, PFS combined with bupivacaine ankle block could be a good choice for a simultaneous bilateral outpatient surgery if it proves its effectiveness, low postoperative pain levels, functional satisfaction, safety and similar follow up results than unilateral procedures.

In our study, PFS has shown a low immediate postoperative pain level, with a mean VAS score of approximately 3 points at first week, in both groups. The lower pain level was reached at third week, and maintained during follow up, which proves a rapid recovery. The follow up AOFAS scores in our study were 88.3 points in both groups. Previous reports with different procedures presented similar outcomes [3,4,15-17]. Although in our study we have also treated also patients with metatarsalgia, which has shown an increase in pain and recovery time [18,19].

Degree HVA correction was lower in our study (38.6% group U, 35% group B) compared with Murray et al., Lee et al., Bauer et al. and Nedopil et al. reports (about 50-65%), [3,4,15,20]. A similar correction was shown in Giannini et al. report (about 40%) [17]. But better than Pentikainen et al. with chevron osteotomy, that reported 57% of moderate recurrence (>20 or <40 degrees, 28 ± 5.7 degrees) [18]. The HVA lost of correction in our study between 2nd month and 1st year could be explained by the return to the use of constricting footwear [19], since there was not an HVA lost of correction between 1st year and final follow up, in spite of a high DMAA. Follow up IMA in several reports was about 7 and 8 degrees [3,4,16,17,21], which is better than 11.2 to 9.7 degrees of our groups. But, Bauer et al. [15], with PFS, obtained a correction equal to ours. We have to take into account that intraobserver and interobserver reliability rates are high for measuring the HVA and IMA (<5°, 95% confidence interval) [21].

The percentage of cases with medial 1st metatarsal head pain at follow up was 15% of all cases, without statistically significant differences between groups. Medial 1st metatarsal head pain may be in relation to insufficient resection with peripheral bony prominence. Moreover, an inadequate lateral MTP release can cause lack of HVA correction. Both problems are more frequent at the beginning of the learning curve. There was no case of hallux varus deformity or deep venous thrombosis. The most common complication in both groups, was metatarsalgia after DMMO, with a lower rate than that reported by García-Fernández et al. (40%) [23] and similar to Henry et al. (14%) [20] reports. Although Bauer [24] considers DMMO an easily reproducible procedure with a short learning curve, we consider it a technically demanding procedure with a prolonged dorsal forefoot pain and edema. All patients in group B would undergo the simultaneous bilateral procedure again, without differences in functional score with group U.

Level of satisfaction was slightly lower in our study (78% of cases satisfied or very satisfied) compared with Lee et al (95%) [4,16] or Bauer et al (87%) [15].

With the available numbers, we found that all clinical and radiographic outcomes were not different between the two groups. Our initial hypothesis was that PFS is a valid surgical procedure for a simultaneous surgical correction in patients with bilateral hallux valgus, because of a low postoperative pain level. Despite the worse radiographic results in our study, compared with previous reports using different procedures, we present similar clinical outcomes. Something that matches what Thordarson et al. [25] published.

The major limitation of the present study is the difficulty to standardize treatment in hallux valgus surgery, with several additional procedures, that might have some influence on outcomes (metatarsalgia and lesser toes deformities). Also we have not studied how this might impact outcomes. However, the present study represents the first report on the clinical and radiographic outcomes comparing PFS unilateral procedure with simultaneous correction of bilateral hallux valgus. Besides, the surgeon who participated in the study only had twenty cases of surgical experience previous to the study. As a consequence, the results may apply to surgeons with little experience.

PFS requires a learning curve before being able to produce reliably acceptable results. This learning curve may not be so long, because our results are comparable to those obtained by extensive experience surgeons [15].

## Conclusion

PFS is a valid procedure for outpatient simultaneous surgical correction in patients with bilateral hallux valgus, despite having achieved a minor correction of the deformity.

## Disclosure of Interest and Ethical Standers

The author(s) declared no potential conflicts of interests with respect to the research, authorship, and/or publication of this article. This study has been performed in accordance with the pertinent ethical guidelines (i.e. Declaration of Helsinki, as laid down in 1964 and revised in 2008) and patients' informed consent has been obtained.

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