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Percutaneous Oblique Distal Osteotomy of the Fifth Metatarsal for Bunionette Correction

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Abstract

Background: Bunionette is a common foot disorder, and several types of corrective surgery have been described. With the popularization of minimally invasive surgeries, the forefoot region has become a suitable area for this type of technique. The aim of this study was to evaluate the results of oblique distal osteotomy of the fifth metatarsal adapted for a percutaneous approach.

Methods: We prospectively evaluated 31 consecutive tailor's bunion patients who underwent operative correction on a total of 42 feet between 2017 and 2019 after failure of conservative treatment. Clinical outcomes such as pain (visual analog scale [VAS]), function (American Orthopaedic Foot & Ankle Society [AOFAS] Lesser Toe Metatarsophalangeal-Interphalangeal Scale scoring system), personal satisfaction, and complications were evaluated. Radiographic aspects were also examined. Shapiro and Mann-Whitney statistical tests were conducted. The average age of the patients was 69.5 years, and the average follow-up was 13.1 months.

Results: After the operative procedure, there was a decrease of 6.6 points on the VAS for pain ($P < .001$) and an increase of 34.9 in the AOFAS score ($P < .001$). Radiographic correction was achieved for both the fifth metatarsophalangeal angle ($P < .001$) and the intermetatarsal angle ($P < .001$), which showed decreased values. There was 1 case of superficial infection and 2 cases of nonunion (asymptomatic). A large majority of patients regarded the procedure outcome as satisfactory.

Conclusion: This percutaneous oblique distal osteotomy of the fifth metatarsal for bunionette deformity produced improvements in pain and function and a high rate of satisfaction, with a low incidence of complications and a high capacity for correcting the deformity.

Level of Evidence: Level II, prospective cohort study.

Keywords: minimally invasive surgery, percutaneous, bunionette deformity

Introduction

The tailor's bunion, also known as a bunionette, is defined as a painful bony prominence on the lateral aspect of the fifth metatarsal head.[11] There are some anatomical variations that can lead to this deformity, revealing a greater complexity than previously thought.[15] The initial treatment is conservative, such as changes in footwear or the use of a bunion protector, padding, and orthoses. The patient needs to be aware that the use of narrow footwear is a significant cause of the symptoms because these put increased pressure on the fifth metatarsal head.[10] There are certain types of conservative treatment for which the goal is symptom relief; these treatments mainly involve changes in footwear or the use of insoles and/or orthoses.[24]

Operative treatment is widely used by orthopedic surgeons, and several techniques have been described in the literature:

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lateral condylectomy,[24,28,32] distal osteotomy,[5-7,12,18,19] diaphyseal osteotomy,[16,31,46] proximal osteotomy,[3,21] and resection of the fifth metatarsal head,[23] among other techniques. Sponsel et al[42] described in 1976 the oblique distal osteotomy of the fifth metatarsal, without fixation, showing good results. However, this treatment is an open surgery, which is more invasive than other treatment options might be for patients. Thus, with the advances in percutaneous surgery, the opportunity arose to perform the same procedure in a minimally invasive way, through small incisions, with the use of burrs and the control of alignment with specific dressings, as described for other techniques.[13] The aim of the present study was to evaluate the clinical and radiographic results of patients diagnosed with bunionette who underwent operative treatment using percutaneous oblique distal osteotomy of the fifth metatarsal.

Methods

The study was approved by the local ethics committee. It followed the Declaration of Helsinki and the Guidelines for Good Clinical Practice. We prospectively evaluated 31 patients (42 feet) diagnosed with bunionette who consecutively underwent operative treatment using percutaneous oblique distal osteotomy of the fifth metatarsal from December 2017 to February 2019. All patients were operated by the senior author (M.V.P.F.), experienced in minimally invasive foot and ankle surgery. The operative correction of the deformity was only performed after exhaustive conservative treatment for at least 6 months, without improvement of symptoms.

The bunionettes were radiographically classified according to Coughlin[9] as type 1: enlargement of the fifth metatarsal head; type 2: lateral bowing of the distal aspect of the fifth metatarsal; type 3: increased intermetatarsal angle between the fourth and fifth metatarsal (IMA). The inclusion criteria were patients diagnosed with bunionette undergoing operative treatment for correction of the deformity by percutaneous oblique distal osteotomy of the fifth metatarsal. Exclusion criteria were neuropathy, skin lesions, degenerative lesions, previous surgeries, age less than 16 years, and sequelae from fractures of the tibial pilon, ankle, or foot.

Thirty-one patients participated in the study, totaling 42 feet (11 bilateral cases). During the follow-up of the cohort, 3 patients were lost to follow-up, all bilateral cases. Thus, the final evaluation consisted of 28 patients and 36 feet (8 bilateral). Most of the included patients were female, representing 93% of the total sample. The mean age of the patients was 69.5 years (SD 13.4). The mean follow-up time was 13.1 months, with an SD of 4.1. Regarding laterality, in most cases the right foot was the one affected, totaling 19 feet (53%). Most deformities of the fifth metatarsal were classified as type 1, representing 53% of the sample. The second-most frequent was type 3, with 30%, and type 2 was the least common, with 17% of the feet.

Outcome Measures

The outcomes evaluated in this study were clinical and radiographic outcomes. Preoperative clinical assessment included the pain visual analog scale (VAS)[14] and the Lesser Toe Metatarsophalangeal-Interphalangeal Scale scoring system of the American Orthopaedic Foot & Ankle Society (AOFAS).[22] In the last postoperative evaluation, a minimum of 8 months after the preoperative, the researchers again took the AOFAS and VAS scores.

The radiographic evaluation[34,39,43] was performed preoperatively and at the last postoperative visit through 3 angles measured on the anteroposterior radiograph of the weight-bearing foot: the IMA, the fifth metatarsophalangeal angle (MPA), and the fifth metatarsal length (FML). The FML was measured from the most proximal point to the most distal point of the fifth metatarsal. Furthermore, the bone union of osteotomies was assessed in the last medical evaluation of patients included in the study.

The Coughlin score[8] was used to evaluate the final outcome of personal satisfaction with the operative procedure. The questionnaire was used at the last visit of the study participant. The score was divided into 4 grades: excellent, good, fair, and poor. Excellent was assigned when the patient was very satisfied, without complaints, and could walk normally. Good was for those with few problems but satisfied, with mild pain, and able to walk without or with little difficulty. Fair was for patients with limited walking, associated with moderate pain and with doubt about the success of the operative procedure. The poor grade was assigned to those who were dissatisfied, who had continuous pain, and who regretted having undergone the procedure.

Operative Technique and Postoperative Care

Patients undergoing the operative procedure were in a supine position without a tourniquet. In percutaneous surgeries, the tourniquet was not used because the bleeding helps to prevent an increase in the temperature of the burr, protecting the skin and surrounding soft tissues. Spinal anesthesia was used, and patients were admitted in a day hospital. The postoperative routine consisted only of recommending early ambulation as a prophylactic measure.

Initially, we made a small fluoroscopy-guided incision in the skin (3-mm) over the fifth metatarsal head (Figure 1A). The osteotomy was performed using a long Shannon burr (12×2-mm) from distal, lateral, and dorsal in the proximal, medial, and plantar directions at a mean angle of 45 degrees, completing the osteotomies through both cortical surfaces (Figure 1B). After the osteotomy, the area was cleaned with saline solution, and the incision was closed with simple skin sutures using 4-0 nylon. No internal fixation was performed. Fluoroscopy (Figure 2A and 2B) was used to confirm that the osteotomy was complete rather than partial. The sterile

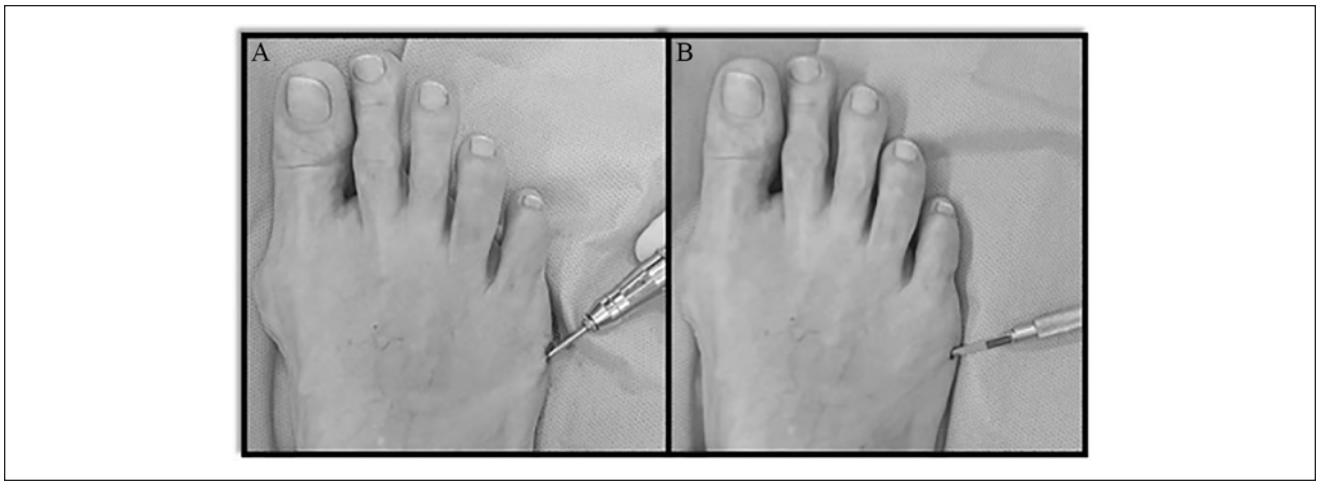

Figure 1. (A) Placement of the burr to perform the osteotomy. (B) Fluoroscopy-guided skin incision for percutaneous surgery.

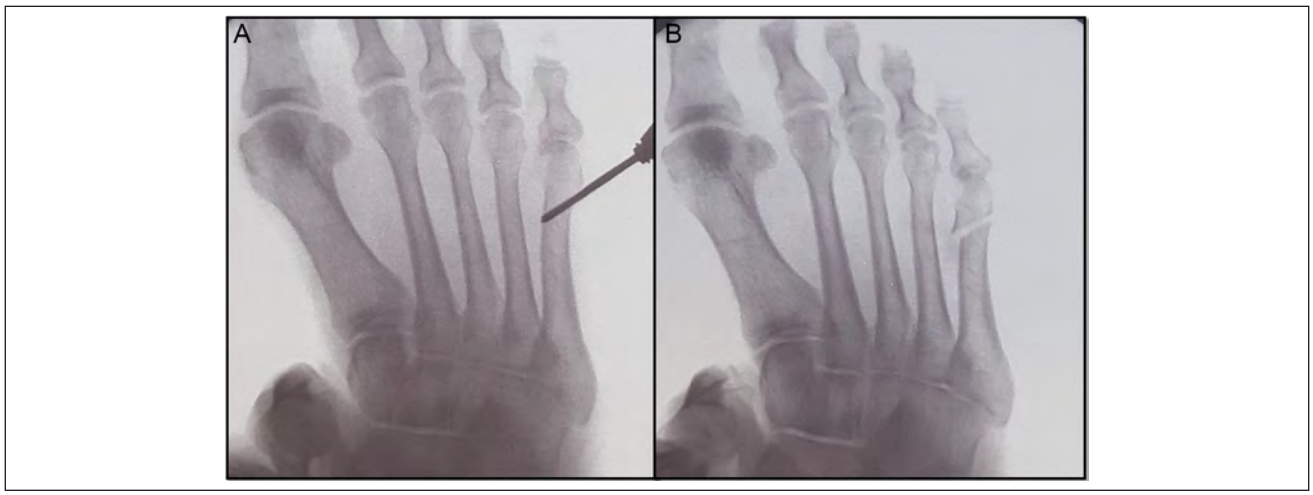

Figure 2. (A) Visualization before osteotomy on a fluoroscopic image. (B) Visualization after osteotomy on a fluoroscopic image.

dressing was constructed from gauze strips to keep the osteotomy in the desired place and was covered by a small bandage wrap. Finally, small strips of adhesive elastic bandage were applied with the aim of medializing the distal fragment.

Regarding postoperative care, the patients were instructed to start full weight bearing immediately using rigid-sole sandals for at least 6 weeks. The dressing was changed weekly by the medical team for 3 weeks, and then the patient was instructed to change it at home up to 6 weeks. Bone union following osteotomy was assessed using routine radiographs (Figure 3).

Statistical Data Analysis

The statistical analysis was performed using the *Stats* package of R.[44] The mean, SD, maximum, and minimum were calculated for numerical variables, and descriptive statistics were used for the nominal variables. The Shapiro test[40] was performed to determine whether the data were parametric or nonparametric, and then the means were compared with the nonparametric Mann-Whitney *U* test.[35] $P \leq .05$ was adopted as the statistical level of evidence.

Results

Clinical Outcomes and Radiographic Assessment

The continuous variables VAS, AOFAS, IMA, FML, and MPA pre- and postoperatively were deemed nonparametric by the Shapiro test ($P < .001$). Thus, preoperative and postoperative values were compared using the Mann-Whitney

Figure 3. (A) Preoperative radiographic image. (B) Radiographic image obtained 4 weeks after the procedure. (C) Radiographic image obtained 6 months after the procedure, showing bone union following osteotomy.

Table 1. Results of the Pre- and Postoperative Clinical and Radiographic Evaluation.

Outcome	Preoperative, Mean (SD)	Postoperative, Mean (SD)	Preoperative and Postoperative Difference	*P* Value
IMA	11.4 (3.0)	3.7 (3.1)	7.7	<.001
MPA	16.5 (5.8)	4.8 (3.7)	11.7	<.001
FML	7.1 (0.5)	6.8 (0.5)	0.3	<.05
AOFAS	58.8 (12.2)	93.7 (9.9)	–35.0	<.001
VAS	7.7 (1.3)	1.0 (1.8)	6.7	<.001

Abbreviations: AOFAS, American Orthopaedic Ankle & Foot Society Lesser Toe Metatarsophalangeal-Interphalangeal Scale scoring system; FML, fifth metatarsal length; IMA, intermetatarsal angle; MPA, metatarsophalangeal angle; VAS, visual analog scale.
Source: Medical Records Department / Prevent Senior São Paulo.

U test, as shown in Table 1. The clinical outcomes, namely, the AOFAS score and the VAS score, showed significant differences between the values collected before and after the operative procedure ($P < .001$), with an average AOFAS increase of 34.9 points and a reduction of 6.6 in the VAS. Personal satisfaction with the end result of surgery was rated as follows: 89% excellent, 7.5% good, 3.5% fair, and 0% poor. We did not find any cases of metatarsalgia in the second, third, or fourth metatarsal in the postoperative follow-up.

The difference in radiographic measurements was also statistically significant, with a reduction in the IMA of 7.7 degrees and MPA of 11.7 degrees as a final outcome after surgery. Regarding length, there was a mean postoperative reduction of 2.7 mm in FML ($P < .05$).

Complications

Three complications were observed. In 2 feet, union did not occur. However, the osteotomies were clinically stable, and the patients were asymptomatic and satisfied with the operative procedure. A superficial infection occurred in one case which was treated with antibiotics, without major consequences. Skin necrosis was not observed in any cases. No cases required reoperation. None of the patients presented with deep vein thrombosis or pulmonary embolism. No case of necrosis of the fifth metatarsal head was seen.

Discussion

The bunionette is a well-known deformity commonly seen by orthopedists. Several techniques have been

described for its operative correction, ranging from osteotomies[3,5-7,12,16,18,19,21,31,46] to resection of the fifth metatarsal head.[23] The oblique osteotomy of the fifth metatarsal head described by Sponsel,[42] which is performed using an open approach, has been reproduced by other surgeons, and fixation was added in some series. This surgery was performed in the dorsolateral region of the fifth metatarsal using an approximately 3.0-cm incision. The results presented were good, but complications such as deep infection, osteomyelitis, transfer metatarsalgia, and persistent painful callus were observed.[20,47]

Recently, there has been a major advance in percutaneous surgeries, which now play a prominent role in foot surgeries, especially in the procedures on the forefoot.[37] Percutaneous surgeries have the advantage of small incisions, with smaller scars and less postoperative pain,[26] and weight bearing is allowed immediately after operative correction.[13] These characteristics most likely contributed to a greater demand by both patients and physicians that surgeons learn the technique. Thus, the correction of the bunionette has been studied using the percutaneous technique.

Several studies have used the minimally invasive technique for bunionette correction. Unlike our study, some used osteotomy fixation, in general with a K-wire.[17,27,30] Other authors opted not to perform fixation of the osteotomies, but the type of osteotomy was different from the present one. Lui et al[29] performed it in the diaphyseal region of the fifth metatarsal. Laffenêtre et al[25] performed the cut in the direction opposite to what we propose. The purpose of the osteotomy is to be able to medialize the distal fragment and thus decrease the lateral prominence. Therefore, we believe that the obliquity of osteotomies must be so that the distal fragment slides in the medial rather than the lateral direction.

Another important and recently published study was by Teoh et al[45] in 2018. In their case series, the authors proposed the distal metatarsal metaphyseal osteotomy described by Redfern and Vernois.[38] This kind of procedure is widely used for metatarsalgia, and early and immediate full weight bearing is important for the adjustment of alignment of the metatarsal head. In the study by Teoh et al,[45] there was an average shortening of the fifth metatarsal of 2.0 mm, whereas in our study it presented a similar average of 2.7 mm. This reduction in length contributes to relieving the overload of the fifth metatarsal head without causing transfer metatarsalgia to the other metatarsals. The shortening of the fifth metatarsal seems to be fundamental in the treatment of the bunionette, because about one-third of the patients present with metatarsalgia associated with the deformity.[41]

We believe that the best result for the bunionette is not only to modify the plantar and dorsal axis but also to medialize the fifth metatarsal head, decreasing the size of the forefoot and the lateral prominence, which is the main complaint of patients. We found a significant reduction in IMA of 7.7 degrees (mean final value of 3.6 degrees), higher than other studies using the percutaneous technique without osteotomy fixation.[25,45] This greater reduction is due to the obliquity of the osteotomy, causing a greater shift of the distal fragment and thus a reduction in IMA. Successful radiographic correction was also observed, with decreased values of the IMA and MPA after surgery. These results demonstrate the capability of percutaneous surgery to correct deformities that are at least similar to those using classic open-surgery procedures. Zvijac et al[47] reported a decrease of 4.2 degrees in the IMA and 8.0 degrees in the MPA after performing the same distal oblique osteotomy but with an open approach.

As in our cohort, these cited studies present good results with a low complication rate and high personal satisfaction with the operative procedure. We obtained a high rate of personal satisfaction, with a significant reduction of pain complaints of 6.6 on the VAS, and an increase in function, with an improvement of approximately 34.9 points in the AOFAS score.

One of the main criticisms of percutaneous surgery is the possible skin complications caused by the high temperature of the burr. In our sample, there were no skin lesions, such as necrosis or dehiscence. As a minor complication, we noted only 1 case of superficial infection that was quickly resolved with antibiotics. All the procedures of our study were performed by a surgeon experienced in minimally invasive foot surgery. Perhaps the complications described in other studies in percutaneous surgery may be associated with the learning curve of the technique, which has been reported by some authors as long and time consuming.[2,4,36]

Another important advantage of the technique described in the present study is a lack of osteosynthesis material. Certain other advantages can also be identified: reduced operative time (average surgical time of 30 minutes with the bandage), less dissection of soft tissues, and lower cost. In addition, our technique avoids complications such as the need for an additional surgery to remove osteosynthesis material. Although we did not use osteotomy fixation, only 2 of our cases involved nonunion of the bone. In these cases, the patients were satisfied, and a clinical examination revealed no movement and no signs of instability. We believe that despite nonunion of the bone, a stable fibrous union was eventually formed. This finding has been observed during the postoperative period for certain percutaneous surgeries, most likely because of the preservation of soft tissues.

Distal oblique osteotomy causes a shortening of the fifth metatarsal compared to the central metatarsals, whether it is performed by a percutaneous or open route. Thus, this kind of surgery may cause metatarsalgia with overload of the central metatarsals. However, no patient reported any callus, discomfort, or pain in this region during postoperative follow-up. In addition, the procedure performed in this study contributed to reducing the complaints of some patients who presented with pain and plantar callosities on

the fifth metatarsal head. This reduction was due to the ability of the osteotomies to adapt to the weight that the patient applied in the postoperative period and thus to consolidate in a biomechanically correct position in both the coronal and sagittal axes.

Certain authors have suggested using different techniques for each type of deformity, as defined using the Coughlin classification.[1,33] Patients with type 1 deformity can be treated with exostectomy, patients with type 2 deformity can be treated with distal osteotomy, and patients with type 3 deformity can be treated with proximal osteotomy. Studies involving open oblique distal osteotomies, such as Sponsel's research, have suggested that this approach exhibits sufficient corrective power to treat all 3 types of deformity. Thus, we chose to use this technique with a percutaneous approach for all patients, regardless of the type of deformity.

Our study has some limitations. First, the follow-up time was shorter than in other studies of percutaneous surgery. Second, there was no control group in which to compare our technique with some widely accepted open-surgery technique. Third, the mean age was slightly higher compared to the general population.

Conclusion

The percutaneous oblique distal osteotomy of the fifth metatarsal for bunionette deformity showed improvement in pain and function and a high rate of satisfaction with a low incidence of complications and high capacity to correct the deformity. Comparative prospective and randomized studies with open surgery may better define the advantages and disadvantages of percutaneous surgery compared to conventional surgery.

Author Note

Gabriel Ferraz Ferreira, MD, MSc, and Miguel Viana Pereira Filho, MD, MSc, contributed equally to this work. Tatiana Ferreira dos Santos, MD, and Daniel Oksman, MD, contributed equally to this work.

Declaration of conflicting interests

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