

Systematic Review

Hallux valgus and percutaneous surgery: treatment evaluation

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Abstract

Objective: Evaluate the treatment of hallux valgus through percutaneous surgery.

Methods: This is a systematic review, and the search was conducted on PubMed/Medline and Virtual Health Library (VHL) databases. The search included studies that addressed percutaneous surgery and analyzed the American Orthopaedic Foot & Ankle Society (AOFAS) score, published between 2013 and 2018, as original studies, in English, Portuguese and Spanish.

Results: One-hundred and eighty-five articles were identified in the databases, 19 were selected for STrengthening the Reporting of OBServational studies in Epidemiology (STROBE) application, and five were included in the systematic review. The majority of the studies were European; the age of the patient was from 17 to 78 years, who suffered from mild to severe deformities, which were evaluated radiographically and through the AOFAS scale, then submitted to minimally invasive surgeries. Postoperative follow-up was from six months to ten years.

Conclusion: The percutaneous technique for hallux valgus correction has shown good results, little surgical trauma, few complications, rapid recovery, return to activities and high satisfaction with the result.

Level of Evidence I; Systematic Review of Level I Studies.

Keywords: Hallux valgus/surgery; Osteotomy; Metatarsophalangeal joint.

Introduction

The hallux valgus (HV) is a multifactorial deformity characterized by a 5° deviation of the first ray and 10° of the first metatarsal, commonly associated with medial exostosis of the first metatarsal and pain in its prominence, being more frequent in women (88%), with a mean age of 55 years⁽¹⁾.

Hallux valgus can result from extrinsic factors, such as inadequate footwear (shoes with narrow anterior chamber), heredity, gender, age, and foot anatomy⁽¹⁾. It presents with pain in the medial eminence of the first ray of the forefoot (70%), associated with metatarsalgia (40% of cases). It can also be associated with “bunion” (medial bone exostosis) and other foot comorbidities, which are evaluated on physical examination^(1,2).

The HV classification and the treatment method choice are made considering radiological evaluation. It will allow the measurement of the altered main angles and assist in classifying the pathology as mild, moderate, or severe⁽¹⁾.

From the classification, the treatment method can be decided, whether conservative, in which the patient will try to acquire new habits, using more appropriate footwear or surgical, which can be open or closed (percutaneous). In this systematic review, the closed treatment will be addressed, represented by percutaneous surgery, which is a minimally invasive treatment, and brings with it the advantage of less surgical time, less surgical trauma (small incisions), and consequently, minor complications and faster recovery⁽³⁾.

Percutaneous surgeries are osteotomies, exostectomy, and soft tissue release through incisions of 1-3mm length, under intraoperative fluoroscopy, using a mini-blade⁽⁴⁾ scalpel^(5,6).

Two main osteotomies are described in the percutaneous approach: Reverdin-Isham and Bösch osteotomies. The first is a distal osteotomy, which corrects mild to moderate deformities. The second is a metaphysis distal osteotomy that corrects severe deformities⁽⁷⁻¹⁶⁾.

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In the literature, few studies address percutaneous techniques associated with HV, as they are relatively new techniques, requiring greater comparisons, studies, and clarifications. In addition, most studies address the method, not considering patient improvement. Therefore, it is necessary to evaluate the percutaneous surgery for HV through an extensive and comparative literature review that confirms the technique's efficacy compared with traditional treatment.

Methods

The question chosen was made through the PICO strategy:

P - POPULATION: people affected by the hallux valgus

I - INTERVENTION: percutaneous surgeries

C - CONTROL: open surgeries or conservative treatment

O - OUTCOME: patient improvement and satisfaction

A systematic review was conducted by searching for articles in the literature on HV associated with percutaneous surgery (observational and cross-sectional studies), where the evidence was synthesized and critically evaluated to determine whether the data were relevant and beneficial enough to apply this technique to the patient.

After data searching, the affected population was separated by age, gender, prevalence of unilateral or bilateral foot involvement, follow-up period, and any withdrawal from the studies due to complications.

It was noted that the percutaneous technique might be different regarding the surgeon's choice. The correction of the main foot angles was also examined by analyzing radiographic data that followed the pre-and postoperative periods. As a result, corrections were verified: hallux valgus angle (HVA), intermetatarsal angle (IMA), and distal metatarsal articular angle (DMAA).

The American Orthopaedic Foot & Ankle Society (AOFAS) score was also analyzed, and the complications of percutaneous surgery were considered.

Systematic data research was performed in PubMed/Medline and Virtual Health Library (VHL) databases from 2013 to 2018, searching for original articles that used percutaneous surgery in HV treatment.

"Hallux valgus" and "percutaneous surgery" were the two terms used in the search, and 185 articles were found. After identifying the titles, the abstract was read, all relevant studies were included to confirm eligibility through the full-text read.

The inclusion criteria were original articles that addressed HV correction through percutaneous surgery, published within the last five years. In addition, articles that included AOFAS score, level of evidence I to IV, and compared open surgical techniques.

The exclusion criteria were systematic reviews, articles describing only the surgical technique or that did not report the perception, improvement, and satisfaction of patients, articles that addressed the open technique exclusively, articles with publication over five years, and studies not

available for a full-text read. In addition, studies with children, cadavers, and animals.

After the selection process, 22 articles were included in the eligibility criteria. Then, the PRISMA protocol was applied, which helped to improve the quality of data extraction. Once the eligible studies were identified, data were extracted and compared following the protocol:

1) number of participants; 2) number of feet on which the surgery was performed; 3) age; 4) gender; 5) surgical techniques and indications (mild, moderate, or severe deformity); 6) follow-up time; 7) improvement of HVA, IMA, and DMAA; and 8) AOFAS score.

The methodology quality was evaluated using STrengthening the Reporting of OBservational studies in Epidemiology (STROBE) application.

Results

The strategies mentioned above were applied to identify and select the studies. In the first stage, the search identified 185 articles, of which 94 were excluded, leaving 91 articles. Then, the title and abstract of each study were read.

In the second stage, 41 duplicates were identified, one was in German, one in Italian, 11 review articles, four experts opinion, and two were excluded, leaving 31 articles to advance to the eligibility stage, where the full-text read was completed. Of these, eight were excluded because they did not use the AOFAS score, and four were not fully available. Thus, 19 articles were selected for STROBE, and five were included in the systematic review after STROBE evaluation.

General characteristics of the selected studies

The study by Faour-Martín et al.⁽¹⁷⁾ was conducted in 2013 in Spain, with 87 patients (115 feet) affected with HV unilaterally and bilaterally. This prospective study aimed to show ten years of follow-up of patients submitted to percutaneous surgery techniques. The same surgeon performed the surgeries using a technique first described by Bösch (percutaneous subcapital osteotomy). The results showed improvement in the AOFAS score, from a mean of 47.1 points in the preoperative to a mean of 89.3 points ten years after surgery. It was also evidenced that there was pain improvement (0 - 40 points) from 18.4 to 36.5 points, functional capacity improvement (0 - 45 points) from 22.5 to 40.6 points, and alignment improvement (0 - 15 points) from 6.2 to 12.2 points. There was also radiographic analysis that showed IMA improvement from a mean of 17.6° (mild deformity) to 8.1° (no deformity/mild deformity), HVA improvement from a mean of 34.2° (moderate deformity) to 14.6° (no deformity/mild deformity), and DMAA improvement from a mean of 15.4° to 7.2°. The study did not indicate limitations in its development.

The study by Biz et al.⁽¹⁸⁾ was conducted in 2016 in Italy, with 80 patients submitted to unilateral surgeries. This prospective longitudinal study aimed to clinically and radiologically evaluate patients affected with mild to severe HV submitted

to minimally invasive surgeries. A sequence of techniques was applied, Reverdin-Isham procedure was the first, followed by Akin osteotomy, and finished with a lateral soft tissue release. The study showed improvement in the AOFAS score, from a mean of 54.1 points in the preoperative to a mean of 87.1 points 45 months after surgery. It also showed pain improvement, angle alignment, and daily activities. There was also radiographic analysis showing IMA improvement from a mean of 12.9° (moderate deformity) to 9.0° (no deformity/mild deformity), HVA improvement from a mean of 26.4° (moderate deformity) to 13.9° (no deformity/mild deformity), and DMAA improvement from a mean of 10.12° to 5.2°. The limitation of the study was the lack of a control group to compare the results of the techniques.

The study by Lucas y Hernandez et al.⁽¹⁹⁾ was conducted in 2016 in France, with 38 patients (45 feet) submitted to percutaneous extra-articular reverse-L Chevron (PERC) osteotomy. This prospective study aimed to describe the prognostic factors and results of PERC in treating moderate HV. The results showed improvement in the AOFAS score, from a mean of 62.5 points in the preoperative to a mean of 97.1 points five years after surgery. There was also radiographic analysis that showed IMA improvement from a mean of 11.8° (moderate deformity) to 7.9° (no deformity/mild deformity), HVA improvement from a mean of 26.2° (moderate deformity) to 9.6° (no deformity/mild deformity), the DMAA analysis was not performed in the study. On the other hand, results were analyzed for proximal articular set angle (PASA), tangential angle of the second axis (TASA), and interphalangeal angle (IPA). The study did not indicate limitations in its development.

The study by Lee et al.⁽²⁰⁾ was conducted in 2017 in Australia. A randomized prospective study comparing the Chevron/Akin percutaneous technique (PECA) and open Scarf/Akin (SA) osteotomies. The study included 50 patients with moderate or severe HV, randomized into two groups. The objective of this study was to observe the results and complications of both techniques. The AOFAS questionnaire, visual analog scale (VAS), and radiographic follow-up were performed to assess the change of angles. The PECA results showed an improvement in the AOFAS score, from a mean of 61.3 points in the preoperative to a mean of 88.7 points six months after surgery. Radiographic evaluation showed IMA improvement from 15.6° to 6.4° and HVA from 31.4° to 7.6°. In comparison, the SA technique showed an improvement in the AOFAS score, from a mean of 58.5 points in the preoperative to a mean of 83.0 points six months after surgery. Radiographic evaluation showed IMA improvement from 15.7° to 7.6° and HVA from 31.2° to 10.1°. The DMAA was not analyzed in any of the techniques. The limitations of the study were a limited sample, with few participants in each group, the non-validation of the analysis method, and the use of a “popular” procedure in the control group; the ideal would have been compared with known techniques for more reliable data.

The study by Kaufmann et al.⁽²¹⁾ was conducted between 2017 and 2018 in Austria. A randomized prospective study

comparing the Open Chevron (OC) technique and the minimally invasive Chevron technique (MIS). The study included 42 patients (47 feet) affected with moderate or severe HV, randomized into two groups. The study aimed to compare the two techniques, and the hypothesis was to find significant differences between the clinical and radiographic results in the range of motion of the first metatarsophalangeal joint and patient satisfaction. The AOFAS score, the VAS score, and the follow-up radiographic evaluation were applied. The OC results showed an improvement in the AOFAS score, from a mean of 66.5 points in the preoperative to a mean of 90 points nine months after surgery. Radiographic evaluation showed IMA improvement from 15.15° to 5.85° and HVA from 28.25° to 8.5°. In comparison, the MIS technique showed an improvement in AOFAS score, from a mean of 65.0 points in the preoperative to a mean of 85.0 points nine months after surgery. Radiographic evaluation showed IMA improvement from 14.0° to 6.8° and HVA from 26.4° to 7.6°. The DMAA was not analyzed in any of the techniques. The limitations of the study were the inclusion of one center with a single surgeon and the preliminary result of nine months of follow-up.

The quality of the selected studies was evaluated based on the STROBE initiative's criteria. Of the 19 articles analyzed by STROBE, ten achieved a 16.5 score, higher than the average. The 2.5 standard deviation was calculated and applied to refine the study better. Thus, five articles were selected to be evaluated in this systematic review. For the selection, 1 point was assigned to articles that fully met the STROBE analyzed criterion, 0.5 to which partially attended, and 0 to those that did not meet the criterion or were not well elucidated.

Discussion

The HV is a multifactorial deformity affecting the forefoot, which is more frequent in women, with a mean age of 55.

To classify HV, a classification system is used and considered mild deformity (HVA <20°, IMA ≤11° and less than 50% of medial sesamoid subluxation), moderate deformity (HVA between 20° and 40°, IMA >11° and <16°, with 50 to 75% tibial sesamoid subluxation), and severe deformity (HVA > 40°, IMA ≥16° and more than 75% tibial sesamoid subluxation)⁽¹⁾.

Clinical evaluation of HV can be done using the AOFAS score, assessing pain, functional capacity, and hallux alignment. This scale ranges from 0 to 100 points, and 100 is the best result⁽⁵⁾.

Radiographic results, in conjunction with the AOFAS score, lead to a conclusion about whether patients improved through conservative or surgical treatments.

In this review, three studies aimed at first analyzing the results of long-term percutaneous surgery with follow-up of at least four years⁽¹⁷⁻¹⁹⁾. Two studies analyzed the results of percutaneous surgery compared with open surgery, including immediate and a minimum period of six months^(20,21).

When comparing the studies, the best mean HVA correction was obtained by Lee et al.⁽²⁰⁾ with 23.8° variation. The best mean IMA correction was obtained by Faour-Martín et al.⁽¹⁷⁾ with 9.5° of variation. The best mean DMAA correction was

obtained by Faour-Martín et al.⁽¹⁷⁾ with 8.2° variation. The highest mean AOFAS score was obtained by Faour-Martín et al.⁽¹⁷⁾, with a variation of 42.2 points from preoperative to postoperative. All results were satisfactory.

The best immediate radiographic/surgical response was found by Lee et al.⁽²⁰⁾. However, in this study, the population sample was limited, including 50 patients submitted to surgery, with 25 patients in each group. The same in Kaufmann et al.⁽²¹⁾, with an improvement of more than 70% in hallux correction, however, its sample was limited to 42 patients, divided into percutaneous and open techniques, and its follow-up time was also short (nine months).

Faour-Martín et al.⁽¹⁷⁾, Biz et al.⁽¹⁸⁾, and Lucas y Hernandez et al.⁽¹⁹⁾ had the best response of AOFAS scores which were the longest follow-up period. As it is a more subjective scale, which has the patient's opinion, it is understandable that the best results are from those with the longest period, because, despite the percutaneous surgery obtaining satisfactory immediate results, it is necessary time to evaluate the improvement of quality of life and functional capacity.

Faour-Martín et al.⁽¹⁷⁾ obtained the best AOFAS score with a ten-year follow-up, achieving a mean improvement of 42.2 points, corresponding to 42.2% on a scale of 100 points. Biz et al.⁽¹⁸⁾ and Lucas y Hernandez et al.⁽¹⁹⁾, in turn, followed for four and five years, respectively, and obtained mean variations above 33% of the preoperative value.

Comparing Lee et al.⁽²⁰⁾ and Kaufmann's⁽²¹⁾ AOFAS, the improvement was significant but represented only 20 to 27%,

and perhaps with a longer study period, they would prove that the percutaneous technique used has better long-term results, after all, both were published in 2017 and 2018.


In the pain assessment, the best response was Faour-Martín et al.⁽¹⁷⁾, with 93% of patients without any or little pain.

The best satisfaction response, which is tied to aesthetics and improved functional capacity, pain, and complications over time, was noticed by Lucas y Hernandez et al.⁽¹⁹⁾, with 97% satisfaction of their patients. However, his sample was small, and paradoxically, many complications were reported in his study.

The limitations of the study were no significant studies included the local population, so the hallux valgus improvement through percutaneous surgery in the Brazilian population could not be studied. In addition, understanding the various techniques in the studies, due to the variety of more than 100 techniques described in the literature, and the choice varies according to the surgeon's abilities, only practice and long-term study can show which is the "best" technique.

Conclusion

Percutaneous surgery techniques for hallux valgus correction have good results regarding the procedure and patient satisfaction. Nevertheless, there are still few studies with a high level of evidence, thus having to use more time and resources to prove this treatment's better efficacy.

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