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Review

Comparison of Chevron and Scarf osteotomies in hallux valgus correction: Functional and radiographic outcomes

Hugo Oikawa[1], **Eric Zaneti Teixeira Baptista**[1]

1. Hospital Alvorada Moema, Sao Paulo, SP, Brazil.

Abstract

Objective: To compare the functional and radiographic outcomes between Chevron and Scarf osteotomies in hallux valgus correction.

Method: A systematic review was conducted in the PubMed/MEDLINE, SciELO, Lilacs, and Embase databases from 2004 to 2024. Inclusion criteria included clinical trials and observational studies that directly compared both techniques.

Results: Both osteotomies showed similar effectiveness in improving functional scores (AOFAS) and correcting hallux valgus and intermetatarsal valgus angles. Chevron osteotomy was more indicated in mild to moderate deformities, while Scarf osteotomy showed greater stability and versatility in severe deformities.

Conclusion: Both osteotomies are effective, with specific advantages. The surgical choice must be individualized.

Level of Evidence Level I; Systematic Review.

Keywords: Hallux valgus; Osteotomy; Orthopedic procedures; Radiography.

Introduction

Hallux valgus deformity is one of the most prevalent deformities of the forefoot, characterized by progressive lateral deviation of the hallux and medial prominence of the head of the first metatarsal[1]. This condition affects predominantly women, being associated with genetic factors, chronic use of inappropriate footwear, and biomechanical changes of the foot. Although the classical literature mentions conservative treatment as an initial approach, in specialized orthopedic practice, most symptomatic cases evolve directly to surgical, given the progressive nature of the deformity and the functional limitation. To date, more than one hundred osteotomy techniques have been described for hallux valgus correction, varying according to the degree of deformity and anatomical characteristics of the patient[2].

Among the most used techniques are distal Chevron osteotomy and Scarf diaphyseal osteotomy, both aiming to correct the intermetatarsal angle (IMA) and hallux valgus angle (HAV), in addition to restoring the biomechanical alignment of the first ray and improving clinical symptoms[3]. Chevron osteotomy, which is simpler to perform, is traditionally indicated for mild to moderate deformities, while Scarf osteotomy, which is more versatile and technically demanding, allows for greater angular correction and is often used in moderate to severe cases[4].

However, there is still controversy in the literature regarding the superiority of one technique over another in terms of clinical, functional, and radiographic outcomes. Comparative analysis between these surgical methods is fundamental to support clinical decision-making, improve therapeutic outcomes, and reduce complication rates or recurrences[5].

In this context, the objective of this study is to compare the functional and radiographic outcomes of Chevron and Scarf osteotomies in hallux valgus correction, to provide scientific support to guide the choice of the most appropriate procedure according to the degree of deformity and anatomical characteristics of the patient.

Study performed at Hospital Alvorada Moema, Sao Paulo, SP, Brazil.

Correspondence: Hugo Oikawa. Alameda dos Arapanés, 309, Indianópolis, Sao Paulo, SP, Brazil. **Email:** oikawahugo@gmail.com **Conflicts of interest:** none. **Source of funding:** none. **Date received:** April 15, 2025. **Date accepted:** July 18, 2025.

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Methods

This systematic review was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The research question was defined based on the acronym PICO, where: P (population) = patients with hallux valgus; I (intervention) = Chevron osteotomy; C (comparison) = Scarf osteotomy; and O (outcomes) = postoperative functional and radiographic results.

Search strategy

A systematic search was conducted in the PubMed/MEDLINE, Scopus, Web of Science, Embase, and Cochrane Library databases, including publications between January 2004 and December 2024. Controlled (MeSH) and uncontrolled descriptors were used, combined by Boolean operators, with the following strategy: ("Hallux Valgus" OR "Bunion") AND ("Chevron Osteotomy" OR "Distal Metatarsal Osteotomy") AND ("Scarf Osteotomy") AND ("Functional Outcome" OR "Radiographic Outcome").

Inclusion and exclusion criteria

Primary randomized controlled trials (RCTs), prospective and retrospective comparative studies, published in English, Portuguese, or Spanish, that directly compared Chevron and Scarf osteotomies in patients diagnosed with hallux valgus, presenting functional outcomes—such as the American Orthopaedic Foot & Ankle Society (AOFAS) score, Visual Analog Scale (VAS), and the 36-Item Short Form Health Survey (SF-36)—and/or radiographic outcomes, including the IMA, metatarsophalangeal angle (MPA), and distal metatarsal articular angle (DMAA), were included.

Studies were excluded if they did not directly compare the two osteotomy techniques, assessed only a single osteotomy in isolation, involved modified techniques lacking a standardized description, presented duplicate data, or were published as abstracts, letters to the editor, review articles, or studies involving animals.

Study selection and data extraction

Two independent reviewers screened titles and abstracts, followed by a full-text read of potentially eligible articles. Disagreements were resolved by consensus or by consultation with a third reviewer. The extracted data included: author, year of publication, type of study, sample characteristics, surgical technique used, follow-up time, functional assessment instruments, radiographic parameters, and main outcomes.

Methodological quality assessment

The quality of the included studies was assessed using the Cochrane Risk of Bias (RoB 2.0) tool for randomized clinical trials and the Newcastle-Ottawa Scale for observational studies.

Data synthesis

Data were organized in descriptive tables and qualitative analysis was performed, comparing the main functional and radiographic outcomes between the techniques. When applicable, the possibility of meta-analysis was considered, provided that the data presented statistical and methodological homogeneity.

Results

This systematic review included six comparative clinical studies, three randomized controlled trials (RCTs), and three retrospective studies, totaling 507 feet submitted to hallux valgus correction. Of these, 261 were operated using Chevron osteotomy and 246 the Scarf osteotomy[6-12]. The studies were mostly conducted in Europe and Asia, with a mean follow-up time ranging from 12 to 48 months. Most participants were women, aged between 36 and 55 years, reflecting the typical epidemiological profile of the deformity.

Regarding functional outcomes, there was a significant improvement in the postoperative scores of both groups, with a mean increase of more than 30 points in the AOFAS score. The meta-analysis demonstrated a weighted mean difference (WMD) of only 0.75 points between techniques (95% CI: -5.32 to 6.82; p = 0.81), indicating the absence of functional superiority of one technique over the other. Similar results were observed for the VAS for pain, with a mean reduction of more than 4 points in both groups. Patient satisfaction, evaluated in three studies, was high (> 85% satisfaction) regardless of the technique used[6,9-10].

In radiographic parameters, the HVA correction was slightly more effective with Chevron osteotomy, which presented a mean correction of 16.2° vs. 14.1° in Scarf osteotomy. This difference was statistically significant (WMD = -1.94°; 95% CI: -2.65 to -1.29; p < 0.00001). On the other hand, the IMA showed similar corrections between the groups, with a mean difference of -0.44° (95% CI: -1.10 to 0.22; p = 0.19), which is not statistically significant. The DMAA was also evaluated in four studies, and although both techniques promoted satisfactory correction, interindividual variations prevented robust statistical conclusions[6,8,11].

As for postoperative complications, the overall rate was low in both groups. There was no statistically significant difference in the total incidence of adverse events (RR = 1.22; 95% CI: 0.65 to 2.27; p = 0.53). The most frequent complications included superficial infection, residual pain, and intolerance to the synthetic material. Scarf osteotomy showed a slightly higher frequency of pain at the site in longer follow-ups, although without a relevant functional impact. None of the techniques presented cases of avascular necrosis or need for digital amputation. The reoperation rate was less than 2% in both groups[7,10,12].

It should be noted that the analysis could have been enhanced with the evaluation of the preoperative angles. The presence of higher angular values, indicative of more pronounced deformities, in cases treated with Scarf osteotomy

could possibly explain a lower functional or radiographic performance compared to Chevron osteotomy. In this sense, the absence of preoperative values may have biased the results, favoring the Chevron technique, often reserved for less severe deformities. This methodological limitation raises the need for a more careful analysis of the surgical indication criteria to avoid disproportionate comparisons between techniques applied to different severity profiles. Perhaps this reflection should be considered by the authors in future reviews or discussions on the data presented[6-12].

The analysis of the methodological quality of the studies, using the RoB 2.0 tool for RCTs and the Newcastle-Ottawa scale for observational studies, indicated a low risk of bias in most of the included publications. The consistency of findings and the statistical homogeneity across the analyzed studies strengthen the reliability and validity of the conclusions presented in this review.

Discussion

This systematic review demonstrated that both Chevron and Scarf osteotomy are effective techniques in hallux valgus correction, promoting significant functional and radiographic improvement. Several studies show that both techniques provide improvement in functional scores, such as AOFAS, without statistically significant differences between groups, as evidenced by Clemente et al.[13] and Ferreira et al.[14] in recent systematic reviews.

Radiographic analysis demonstrated a slight advantage of Chevron osteotomy in HVA correction, as reported by Ma et al.[4], whose meta-analysis indicated that this technique has greater angular correction capacity in mild to moderate deformities. This superiority may be related to the greater predictability of the Chevron technique and its direct effect on angular deformity, as also described by Kuliński et al.[15] in a comparative radiographic study.

On the other hand, Scarf osteotomy demonstrates relevant biomechanical advantages, such as greater contact surface between fragments, greater stability, and the possibility of multiplanar corrections, and is often indicated in moderate to severe deformities. Studies such as Ye et al.[16] and Castioni et al.[17] confirm their effectiveness in more complex cases, including a lower recurrence rate in the medium term. Even so, meta-analyses as of Peng et al.[5] indicate that, in the outcomes related to the IMA correction, there is no statistically significant difference between the techniques.

Regarding safety, both techniques presented similar results. The complication rate was low in all studies reviewed, the most frequent being residual pain and intolerance to the synthetic material. Torrent et al.[18] and Tay et al.[19], when analyzing minimally invasive variants of the techniques, also did not identify significant differences in the incidence of adverse events.

In this context, for those who consider that Scarf osteotomy is preferably applied to more intense and complex deformities, obtaining results comparable to those of Chevron osteotomy, both in terms of angular correction and complications, can be interpreted as a relevant clinical advantage. After all, achieving the same success rates with greater biomechanical and technical requirements may suggest Scarf's practical superiority in more complex scenarios.

The proposal to expand the indications for Chevron osteotomy to cases of moderate hallux valgus, as suggested by Lai et al.[1], should be interpreted with caution. Although the study indicates similar functional and radiographic results between the percutaneous Chevron technique and the open Scarf osteotomy in selected populations, this matching may not reflect the biomechanical complexity involved in moderate deformities. The attempt to extend the applicability of a technique originally indicated for mild deformities, without proper stratification of severity, may compromise the external validity of the results and lead to misinterpretations about the real effectiveness of the Chevron osteotomy in these cases. This evidence reinforces the importance of considering individual variables, such as the degree of deformity, the presence of joint changes, age, and functional demand.

On the other hand, Scarf osteotomy remains the preferred technique in more severe deformities, especially when there is a need for more complex corrections or the presence of significant biomechanical instability, as indicated by Kakwani et al.[20], who highlighted the feasibility of its application even in scenarios of high surgical complexity.

Ferreira et al.[14] and Tay et al.[19] demonstrated that the choice between the Chevron and Scarf osteotomies should consider objective anatomical and clinical criteria, especially the degree of deformity and the complexity of the necessary correction, in addition to the surgeon's familiarity with each procedure. Similarly, while the importance of postoperative follow-up and adherence to functional rehabilitation is well recognized in clinical practice, these factors were not systematically evaluated in the included studies, thereby limiting the ability to draw more definitive conclusions on their impact.

It is important to emphasize that, although the included studies present good methodological quality, limitations such as heterogeneity in the selection criteria, variations in follow-up times, and absence of blinding in some trials should be considered in the interpretation of the findings. Future investigations with robust methodology, larger sample, and long-term evaluation are essential to consolidate current evidence and guide more accurate conduct[21].

Conclusion

The comparison between Chevron and Scarf osteotomies in hallux valgus correction showed that both techniques are effective in improving functional and radiographic outcomes, promoting pain relief, structural realignment, and recovery of foot function, although they have been applied in deformities of different severity. Chevron osteotomy showed satisfactory performance in cases of mild to moderate deformities, with shorter surgical time and less complex surgical technique.

Scarf osteotomy, in turn, was mainly used in more severe deformities and is considered technically more demanding. Its apparent advantages, greater versatility, mechanical stability, and multiplanar correction capability, should be interpreted with caution, as direct comparisons between techniques applied to deformities of differing severity may limit the validity of such conclusions.

Although the analyzed studies do not show clear superiority between the techniques regarding the postoperative function or the magnitude of the angular correction, this equivalence raises questions. If both techniques promote similar angular corrections, the Chevron osteotomy, often applied in less severe cases, may, in practice, demonstrate greater relative effectiveness. On the other hand, Scarf osteotomy, used in more severe deformities, starts from a more challenging point of correction. The comparative analysis of the absolute postoperative angles between the groups could better clarify this issue and provide more robust subsidies for the individualized surgical choice, considering the severity of the deformity, the anatomical characteristics of the patient, and the experience of the surgeon.

Thus, both osteotomies remain viable and effective options for the surgical treatment of hallux valgus, and it is up to the surgeon to choose the most appropriate technique based on specific clinical criteria, such as the degree of deformity, anatomical characteristics of the foot, and the surgical complexity involved. New randomized clinical trials with greater methodological reliability and validity, and prolonged follow-up are recommended to improve surgical decision-making and therapeutic protocols.

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