

# Correction of hallux valgus and forefoot alignment based on the Chevron, Akin and Weil techniques

## Correção do hálux valgo e alinhamento do antepé baseado nas técnicas de Chevron, Akin e Weil

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### ABSTRACT

**Objective:** To perform an evaluation, based on the 36-Item Short Form Health Survey (SF-36) quality of life questionnaire and American Orthopedic Foot and Ankle Score (AOFAS), of the clinical outcome of patients with a diagnosis of hallux valgus and with hallux and lesser toes surgically treated using the Chevron, Akin and Weil techniques.

**Methods:** Eleven patients with a diagnosis of hallux valgus, treated using the aforementioned techniques between January 2005 and December 2009 and with a minimum follow-up of 24 months, were evaluated. All patients completed the SF-36 and AOFAS questionnaires for the hallux and lesser toes.

**Results:** According to the SF-36, nine patients had good general health, six performed all types of physical activities, six had no problems with physical activities, six had no problems as a result of emotional aspects, eight performed their normal social activities, seven had no pain or limitation of activities due to pain, seven felt excited and full of energy, and seven felt at peace, happy and calm. According to the AOFAS, six good and excellent results were obtained for the lesser toes, and eight good and excellent results were obtained for the hallux. The only significant difference observed in the SF-36 score was for Vitality and Mental Health in patients over 60 years of age, and no differences were observed in regard to patient gender. No differences were observed between age groups or genders in regard to the AOFAS.

**Conclusion:** According to the SF-36 and AOFAS, the combined techniques achieved good results and are therefore recommended for the treatment of hallux valgus and foot alignment.

**Level of Evidence III; Retrospective Comparative Study.**

**Keywords:** Osteotomy; Hallux valgus; Human forefoot.

### RESUMO

**Objetivo:** Avaliar o resultado clínico dos pacientes com o diagnóstico de hálux valgo tratados cirurgicamente com as técnicas de Chevron, Akin e Weil baseando-se no questionário de qualidade de vida SF-36 (Short Form 36) e na escala AOFAS (*American Orthopaedic Foot and Ankle*) para hálux e dedos pequenos.

**Métodos:** Foram avaliados 11 pacientes com o diagnóstico de hálux valgo tratados com as técnicas citadas, de janeiro de 2005 a dezembro de 2009, com o seguimento mínimo de 24 meses. Todos os pacientes foram submetidos ao questionário de qualidade de vida SF-36 e AOFAS para hálux e dedos pequenos.

**Resultados:** Segundo o SF-36, nove pacientes apresentavam bom estado geral de saúde, seis realizavam todos os tipos de atividades físicas, seis não apresentavam problemas com atividades físicas, seis não apresentavam problemas em consequência de aspectos emocionais, oito

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realizavam as atividades sociais normais, sete não apresentavam dor ou limitação de atividades pela dor, sete sentiam-se animados e cheios de energia e sete sentiam-se em paz, felizes e calmos. Segundo o AOFAS, foram obtidos 6 bons e excelentes resultados para os dedos pequenos e 8 bons e excelentes resultados para o hálux. Foi observada uma diferença significativa no resultado do questionário SF-36 apenas para Vitalidade e Saúde Mental para os pacientes acima de 60 anos, não havendo diferença quanto ao sexo do paciente. Quanto ao questionário AOFAS, não foi observada diferença entre grupos etários, nem entre os sexos.

**Conclusão:** As técnicas combinadas apresentam bons resultados segundo o questionário SF-36 e AOFAS sendo, portanto, recomendadas para o tratamento de hálux valgo e para a harmonização do pé.

**Nível de Evidência III; Estudo Retrospectivo Comparativo.**

**Descritores:** Osteotomia; Hallux valgus; Antepé humano.

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## INTRODUCTION

Hallux valgus is a complex deformity that affects the first toe and may also involve the lesser toes<sup>(1)</sup>. It is a highly prevalent disease, affecting 23% of adults in the 18-65 age range and 35.7% of seniors over 65, and it is more common in females<sup>(2)</sup>.

There are many explanations for its etiology. Sixty-eight percent of patients have a familial tendency toward occurrence of the disease<sup>(2)</sup>. However, behavioral changes, such as the use of high heels, and anatomical changes, such as hypermobility of the first tarsometatarsal joint, are also associated with hallux valgus<sup>(3)</sup>.

Clinically, 83% of patients experience pain in the first metatarsophalangeal joint, and 30% find it difficult to put on their shoes<sup>(4)</sup>.

Radiographic diagnosis is performed with X-rays in the anteroposterior and lateral positions under load. This involves a change in the angles between the first and second metatarsal (normally <9°) and of the distal metatarsal joint angle (normally <6°) and valgization of the first metatarsophalangeal joint (normally <15°)<sup>(5)</sup>.

There are more than 130 surgical techniques for the treatment of hallux valgus. Distal soft tissue procedures can be performed, as well as proximal, distal and diaphyseal metatarsal osteotomies and arthrodesis, among others. Chevron osteotomy is indicated for moderate deformities (hallux valgus with a metatarsophalangeal angle less than 30° or intermetatarsal angle less than 13°)<sup>(6)</sup>. Akin osteotomy is better indicated when the distal metatarsal joint angle is >8°<sup>(7)</sup>. Weil osteotomy is performed when there is transfer metatarsalgia in the second, third or fourth metatarsal<sup>(8)</sup>.

Surgically treated patients show superior pain relief to patients treated with orthoses, and the latter exhibit greater improvement to those who are untreated<sup>(9)</sup>.

The aim of this study was to evaluate the clinical outcomes of patients with a diagnosis of hallux valgus and metatarsalgia, treated surgically with the Chevron, Akin and Weil techniques, based on the 36-Item Short Form Health Survey (SF-36) to assess quality of life and the American Orthopedic Foot and Ankle Score (AOFAS) for the hallux and lesser toes.

## METHODS

This work was approved by the Research Ethics Committee with registration in the Brazilian Platform under CAAE number 61826716.2.0000.0020.

A retrospective study was conducted with patients who attended an orthopedic clinic between January 2005 and December 2009. Patients meeting the following criteria were included: diagnosis of moderate hallux valgus (with a metatarsophalangeal angle greater than 20° and less than 30°, an intermetatarsal angle greater than 9° and lesser than 14° and a distal metatarsal joint angle greater than 8°), interphalangeal valgus and metatarsalgia, treated with the Chevron, Akin and Weil techniques for correction and alignment of the forefoot, with a minimum of 24 months of follow-up and completion of the questionnaires.

After a minimum of one year after surgery, an evaluation was performed using the SF-36 quality of life questionnaire<sup>(10)</sup>, which evaluates a patient's mental and physical health and well-being by means of 36 questions divided into 8 categories, and the AOFAS questionnaire for the hallux and lesser toes<sup>(11)</sup>.

Twenty patients underwent surgery in this period, but only eleven met the inclusion criteria of maintaining the minimum follow-up period of 24 months and agreeing to participate in the study by answering the question-

naires. Patients were heterogeneous with respect to profession (lawyer, soldier, landlady, massage therapist, homemaker and retired) and had different demands in regard to their feet.

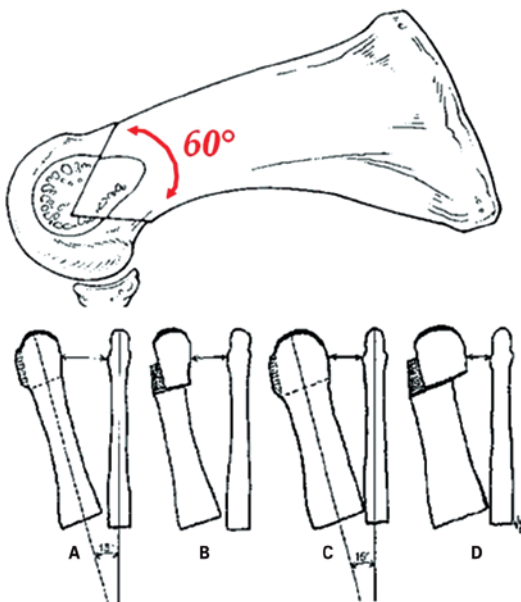
Eight female (72.7%) and three male patients were evaluated. The mean age was 58.7 years (range, 34 to 82 years). The non-parametric Mann-Whitney test for independent samples was applied for comparisons in regard to age and gender.

**Surgical technique**

The procedure was performed with the patient in the supine position under spinal anesthesia and a tourniquet on the limb as routine.

A longitudinal incision of approximately 5cm was made in the dorsal to plantar skin transition centered on the metatarsophalangeal joint. After releasing the capsule and isolating the digital nerve, the capsule was opened in a “Y” with the base attached to the hallux proximal phalanx. Resection of the medial bone eminence was then performed with the help of an oscillating bone saw.

The Chevron technique was performed with a “V” osteotomy with 60° between its arms and centered on the first metatarsal head (Figure 1). Lateral displacement was performed, not exceeding 50% of the metatarsal head diameter. The osteotomy was fixed with one 2.7-mm cannulated screw, and the excess medial triangular bone was resected with a bone saw.



**Figure 1.** Site of Chevron osteotomy performed on the first metatarsal.  
**Source:** Lodispoto, 2013. Available at: <http://www.allucevalgolo dispoto.it/tecniche-triplanari/>.

For the Akin technique, the same skin incision was used, with a longitudinal and subperiosteal opening of the hallux proximal phalanx diaphysis. The first cut was made parallel to the surface of the hallux proximal phalanx base and another 3 mm distal at an angle of 45°, maintaining the lateral cortex intact. Lastly, the wedge osteotomy was closed and fixed with one staple (Figures 2 and 3).

The Weil technique was performed with a dorsal incision into the 2nd intermetatarsal space. After isolating the toe extensor tendon, a longitudinal opening of the capsule was performed, maintaining the collateral ligaments intact. An osteotomy was performed 1mm distal from the joint edge, from dorsal to plantar and from distal to proximal, parallel to the sole. The displacement was from distal



**Figure 2.** Site of Weil osteotomy performed on the remaining metatarsals.  
**Source:** Authors' personal archive.



**Figure 3.** Site of Akin osteotomy performed on the hallux proximal phalanx.  
**Source:** Authors' personal archive.

to proximal and fixation was performed with one mini/micro screw.

Lastly, capsuloplasty of the first metatarsophalangeal joint was performed with absorbable sutures, and the skin was closed with nonabsorbable sutures.

The same surgical procedure was performed on all eleven patients included in the study.

## RESULTS

Evaluation by means of the SF-36 categories revealed that nine patients rated their health as good or believed they would improve. Six patients were able to perform all types of physical activity, including the most demanding ones. Six patients had no problems with work or other physical activities as a result of physical health. Six patients had no problems with work or other physical activities as a result of emotional aspects. Eight patients carried out normal social activities without physical or emotional problems. Seven patients had no pain or limitation of activities due to pain. Seven patients felt excited and full of energy, and seven felt at peace, happy and calm (Table 1).

When dividing patients by age (over or under 60 years of age), significant differences were observed between age groups in the vitality and mental health variables only. The younger group had higher scores on the SF-36 (Table 2).

When dividing patients by gender, no significant differences were observed in the factors evaluated by the SF-36.

In the evaluation using the AOFAS questionnaire, a mean score of 82.5 was obtained for the lesser toes (range, 47 to 100), and for the hallux, the mean score was 93.8 (range, 71-105) (Table 3).

When classifying the AOFAS results by group, six good and excellent results were obtained for the lesser toes, and eight good and excellent results were obtained for the hallux (Figure 5).

When dividing subjects by age group, patients over age 60 showed better results according to the AOFAS, both for the lesser toes and the hallux, compared to patients under 60. However, the differences cannot be considered significant.

According to the AOFAS, female patients showed superior results to males for both the lesser toes and hallux, but the differences were not significant (Table 4).

**Table 2.** Mean values obtained in the SF-36 questionnaire, separating patients by age (over or under 60 years of age)

Variable	<age 60	>age 60	p-value
General state of health	71.7	63.8	0.465
Functional capacity	71.7	42.2	0.269
Physical aspects	50	48.7	0.628
Emotional aspects	55.5	54.7	0.694
Social aspects	77.1	29	0.076
Pain	56.3	46.4	0.306
Vitality	78.3	38	0.006
Mental health	67.3	40	0.022

**Table 3.** Results of the AOFAS questionnaire for the lesser toes and hallux

	Mean	Standard Deviation	Minimum	Maximum
Lesser toes	82.5	18.15	47	100
Hallux	93.8	13.2	71	105

**Table 4.** Classification of results based on AOFAS score

Classification	AOFAS score
Excellent	>90
Good	80 to 90
Reasonable	70 to 80
Poor	<70

**Table 1.** Results of the post-operative SF-36 questionnaire

Variable	Mean	Standard Deviation	Minimum	Maximum	n
General state of health	68.1	17.3	40	92	11
Functional capacity	60.45	35.5	5	100	11
Physical aspects	43.2	43.43	0	100	11
Emotional aspects	48.5	48	0	100	11
Social aspects	62.5	29	25	100	11
Pain	51.8	24.7	20	90	11
Vitality	60	24.5	20	100	11
Mental health	55	20.17	20	88	11

In this study, there were no reports of complications in the observed cases (Figure 4).

## DISCUSSION

Surgical treatment has better results for the treatment of hallux valgus<sup>(9)</sup>, but there are few studies evaluating a combination of techniques, with up to two techniques normally being used.

When evaluating 112 feet over ten years, Schneider et al.<sup>(12)</sup> demonstrated good results with the Chevron technique alone, with a final AOFAS score of 88.8, showing significant improvements in the metatarsophalangeal and first

intermetatarsal angles. In contrast, Trnka et al.<sup>(13)</sup> treated patients with the Chevron technique alone and reported a minimal improvement in satisfaction and loss of range of motion in the first metatarsophalangeal joint in 43 patients (57 feet), with a follow-up of up to 5 years. Saro et al.<sup>(14)</sup> compared pressure overload on the lateral and central forefoot region treated with the Chevron technique and demonstrated a significant improvement in 22 patients evaluated after 12 months, especially in pressure on the central region, and also obtained a significant improvement on the visual analog scale (VAS) for pain.

The Akin technique can be combined with other correction techniques, with osteotomy of the first metatarsal. When combining the Chevron and Akin osteotomy techniques, Carvalho et al.<sup>(15)</sup> obtained 90.9 points on the AOFAS questionnaire. There was, however, suture dehiscence in one case and overcorrection in three cases, but no cases of necrosis of the first metatarsal head.

In the treatment of metatarsalgia and subluxation of the metatarsophalangeal joints, Hofstaetter et al.<sup>(16)</sup> performed Weil osteotomies on 25 feet (24 patients) and obtained 88% good and excellent results and an AOFAS score of 83 points after seven years of follow-up, obtaining reduction of plantar callosity and improved walking capacity in most observed cases. Gibbard & Kilmartin<sup>(17)</sup> also achieved an improvement in AOFAS score, with 83.4 points over a mean follow-up period of 42.4 months, after performing the Weil technique on 39 feet (33 patients). Sharma et al.<sup>(18)</sup> also showed good results with the Weil technique alone, with good final results on the pain VAS (2.2 points) and an AOFAS score of 68.7. Likewise, in the treatment of 25 cases of metatarsalgia of the second ray, Devos Bevernage et al.<sup>(19)</sup> obtained a final result of 93.5 points on the AOFAS. The Weil technique is indicated as it achieves good results, and for this reason, it was combined with other techniques in this study.

The results reported in the literature have shown complications in some procedures but, nonetheless, show a significant improvement in terms of pain, aesthetics and patient satisfaction.

There are few studies that evaluate surgical outcomes based on the SF-36 questionnaire, which is therefore a new parameter explored in this study.

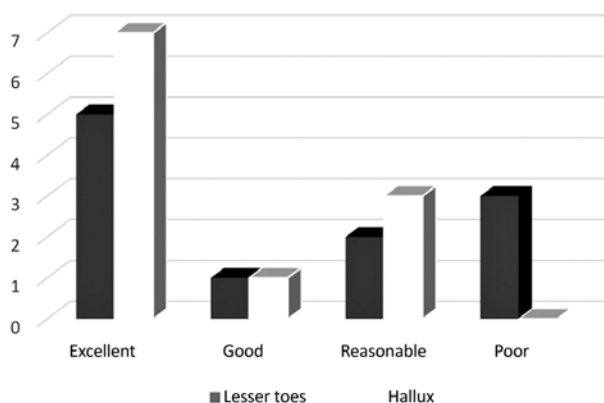
## CONCLUSION

Combining the distal Chevron, Akin and Weil osteotomies on the second metatarsal for the treatment of hallux valgus achieved a high rate of good and excellent results and improved quality of life in patients evaluated using the AOFAS and SF-36 questionnaires.



**Figure 4.** Patient with hallux valgus treated with the Chevron, Akin and Weil techniques. 1. Pre-operative clinical evaluation. 2. Post-operative clinical evaluation.

**Source:** Authors' personal archive.



**Figure 5.** Division of the results obtained according to the AOFAS for the lesser toes and hallux.

**Source:** Authors' personal archive.

**Authors' contributions:** Each author contributed individually and significantly to the development of this article: SSP (<https://orcid.org/0000-0002-6135-772x>): conceived and planned the activities that led to the study, wrote the article, participated in the review process, interpreted the study results and approved the final version; AKJ (<https://orcid.org/0000-0002-3952-3146>): conceived and planned the activities that led to the study and approved the final version; YWS (<https://orcid.org/0000-0002-1515-6062>): conceived and planned the activities that led to the study, performed the surgeries and approved the final version; ESOM (<https://orcid.org/0000-0001-9734-6988>): wrote the article and interpreted the study results; PSA (<https://orcid.org/0000-0003-2658-9565>): wrote the article and interpreted the study results; WGS (<https://orcid.org/0000-0002-1815-6818>): wrote the article, interpreted the study results and approved the final version. \*ORCID (Open Researcher and Contributor ID).

## REFERENCES

- Richardson EG. Disorders of the hallux. In: Canale ST, Beaty JH, editors. *Campbell's operative orthopaedics*. Philadelphia: Mosby; 2008. p. 4471.
- Nix S, Smith M, Vicenzino B. Prevalence of hallux valgus in the general population: a systematic review and meta-analysis. *J Foot Ankle Res*. 2010 Sep 27;3:21.
- Stephens MM. Pathogenesis of hallux valgus. *Eur J Foot Ankle Surg* 1994;1:7-10.
- Robinson AHN, Limbers JP. Modern concepts in the treatment of hallux valgus. *J Bone Joint Surg Br*. 2005;87(8):1038-45.
- Piqué-Vidal C, Vila J. A geometric analysis of hallux valgus: correlation with clinical assessment of severity. *J Foot Ankle Res*. 2009 14;2:15.
- Johnson KA, Cofield RH, Morrey BF. Chevron osteotomy for hallux valgus. *Clin Orthop Relat Res*. 1979;(142):44-7.
- Segal DS. Proximal and distal Akin procedures. *J Foot Surg*. 1977;16(2): 57-8.
- Lunz D, Cadden A, Negrine J, Walsh W. The Weil osteotomy: indications, surgical technique and fixation. *Orthop Proceedings*. 2010;92-B (Suppl 1):179.
- Torkki M, Malmivaara A, Seitsalo S, Hoikka V, Laippala P, Paavolainen P. Surgery vs Orthosis vs Watchful Waiting for Hallux Valgus. A Randomized Controlled Trial. *JAMA*. 2001;285(19):2474-80.
- Brazier JE, Harper R, Jones NM, O'Cathain A, Thomas KJ, Usherwood T, Westlake L. Validating the SF-36 health survey questionnaire: new outcome measure for primary care. *BMJ*. 1992;305(6846):160-4.
- Ibrahim T, Beiri A, Azzabi M, Best AJ, Taylor GJ, Menon DK. Reliability and validity of the subjective component of the American Orthopaedic Foot and Ankle Society clinical rating scales. *J Foot Ankle Surg*. 2007;46(2):65-74.
- Schneider W, Aigner N, Pinggera O, Knahr K. Chevron osteotomy in hallux valgus. *J Bone Joint Surg Br*. 2004;86(7):1016-20.
- Trnka H, Zembsch A, Easley ME, Salzer M, Ritschl P, Myerson MS. The Chevron Osteotomy for Correction of Hallux Valgus. *J Bone Joint Surg Am*. 2000;82(10):1373-8.
- Saro C, Andrén B, Felländer-Tsai Li, Lindgren U, Arndt A. Plantar pressure distribution and pain after distal osteotomy for hallux valgus. A prospective study of 22 patients with 12-month follow-up. *The Foot*. 2007;17 (2):84-93.
- Carvalho PF, Frizzo GG, Ferreira RC, Santin RAL. Correção do hálux valgo leve ou moderado utilizando as osteotomias de Akin e em chevron combinadas. *Rev Bras Med*. 2010. 67 (supl 6):11-6.
- Hofstaetter SG, Hofstaetter JG, Petroutsas JA, Gruber F, Ritschl P, Trnka J. The Weil osteotomy: a seven-year follow-up. *J Bone Joint Surg Br*. 2005;87(11):1507-11.
- Gibbard KW, Kilmartin TE. The Weil osteotomy for the treatment of painful plantar keratosis. *The Foot*. 2003;13(4):199-203.
- Sharma DK, Roy N, Shenolikar A. Weil Osteotomy of lesser metatarsals for metatarsalgia: A clinical and radiological follow-up. *The Foot*. 2005;15(4):202-5.
- Devos Bevernage B, Deleu PA, Leemrijse T. The translating Weil osteotomy in the treatment of an overriding second toe: A report of 25 cases. *Foot Ankle Surg*. 2010;16(4):153-8.