

# Evaluation of the surgical treatment of subtle cavovarus foot

## Avaliação do tratamento cirúrgico do pé cavo varo sutil

Otaviano de Oliveira Júnior<sup>1</sup>, Gustavo Araújo Nunes<sup>1</sup>, Fabrício Melo Bertolini<sup>1</sup>, Matheus Levy Almeida Taveira de Souza<sup>1</sup>, Thales Sousa Lamac de Carvalho<sup>1</sup>

1. Hospital Universitário Ciências Médicas, Belo Horizonte, MG, Brazil.

### ABSTRACT

**Objective:** To evaluate, using a case series, the results of the surgical treatment of subtle cavovarus foot with extension osteotomy of the first metatarsal and release of the plantar fascia.

**Methods:** Eleven patients and 12 feet, including five males and six females with a mean age of 40 years and minimum follow-up of 12 months. All patients had a diagnosis of subtle cavovarus foot with associated pathologies that did not improve with conservative treatment and were subjected to surgical correction. The patients were evaluated through a clinical examination, the American Orthopedic Foot and Ankle Society (AOFAS) scale, the visual analog scale (VAS) of pain in the pre- and postoperative period, and assessment of the degree of satisfaction and clinical correction of the deformity.

**Results:** The mean AOFAS score increased from 44.4 to 80. The mean pain VAS score decreased from 8.7 to 2.0. Seven patients rated the result as excellent, two patients as good and the other two as regular. Two patients had dehiscence of the surgical wound, one presented a neuropathy in the fibular nerve, and another presented transfer metatarsalgia; all were treated clinically with resolution of the clinical picture. There was no recurrence of deformities or associated pathologies.

**Conclusion:** Surgical treatment of subtle cavovarus foot through first metatarsal osteotomy in combination with plantar fascia release showed good clinical results.

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

**Keywords:** Talipes Cavus; Foot deformities; Diagnosis; Treatment.

### RESUMO

**Objetivo:** Série de casos com o objetivo de avaliar os resultados do tratamento cirúrgico do pé cavo varo sutil com osteotomia de extensão do primeiro metatarso e liberação da fásia plantar.

**Métodos:** Foram avaliados 11 pacientes e 12 pés, com média de idade de 40 anos, acompanhamento mínimo de 12 meses, sendo cinco do sexo masculino e seis do sexo feminino. Todos apresentavam diagnóstico de pé cavo varo sutil, com patologias associadas que não melhoraram com o tratamento conservador e foram submetidos à correção cirúrgica. Os pacientes foram avaliados através do exame clínico, do questionário da *American Orthopaedic Foot and Ankle Society Score* (AOFAS), da escala visual analógica (EVA) da dor no pré e pós-operatório, da avaliação do grau de satisfação e da correção clínica da deformidade.

**Resultados:** O AOFAS médio passou de 44,4 para 80. A EVA da dor média passou de 8,7 para 2,0 pontos. Sete pacientes classificaram o resultado como excelente, dois pacientes como bom e os outros dois como regular. Dois pacientes tiveram deiscência da ferida operatória, um apresentou uma neuropatia no nervo fibular e um outro metatarsalgia de transferência, todos foram tratados clinicamente com resolução dos quadros. Não houve recidiva da deformidade e das patologias associadas. **Conclusão:** O tratamento cirúrgico do pé cavo varo sutil através da osteotomia do primeiro metatarso em associação à liberação da fásia plantar mostrou bons resultados clínicos.

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

**Descritores:** Pé cavo; Deformidades do pé; Diagnóstico; Tratamento.

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Work performed at the Hospital Universitário Ciências Médicas, Belo Horizonte, MG, Brazil.

**Correspondence:** Otaviano de Oliveira Junior. Rua dos Aimorés, 2896 – Santo Agostinho. CEP: 30140-073 – Belo Horizonte, MG, Brazil. E-mail: [ooliveirajr@hotmail.com](mailto:ooliveirajr@hotmail.com)

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## INTRODUCTION

Cavovarus foot is a complex deformity characterized by an increase in the medial longitudinal plantar arch, plantar flexion of the first metatarsal and varus of the hindfoot. Its prevalence is high, estimated at approximately 25% of the population. This high percentage includes a broad spectrum of deformities that require different approaches<sup>(1,2)</sup>. Although cavovarus foot is generally associated with neurological diseases with gross alterations of the biomechanical axis and severe muscle imbalances, there is an idiopathic variant with discrete varus and cavus, flexible on the Coleman test, initially described in 2005 by Manoli and Graham as subtle cavovarus foot (SCVF)<sup>(3)</sup>.

The diagnosis of SCVF is essentially clinical because it is a discrete deformity in which the angles measured in radiographic examinations are normal or have minimal changes<sup>(4)</sup>. With regard to its presentation, there are some important considerations. According to Manoli et al., the peek-a-boo sign (Figure 1) is considered a very sensitive test for the diagnosis of SCVF<sup>(5)</sup>. This sign consists of viewing the medial heel pad in the previous inspection. Another important diagnostic test is the Coleman test (Figure 2), originally described in 1977 with only one phase, in which a block is placed under the ankle and the lateral region of the foot, leaving the hallux and the second and third rays in contact with the ground. This test is useful for assessing the flexibility of the deformity and guiding treatment. If it is reducible, according to Coleman, it is possible to infer that the deformity occurs due to excessive plantar flexion of

the first ray and that first metatarsal extension osteotomy would be sufficient to correct the cavovarus foot<sup>(6)</sup>.

SCVF typically presents symptoms related to lateral spine overload, usually identified in patients with fibular tendinopathy, ankle ligamentous instability, stress fractures, plantar fasciitis and metatarsalgias. Because it is a discrete deformity with a broad clinical spectrum caused by these secondary lesions and without objective diagnostic parameters, SCVF is usually neglected<sup>(3)</sup>. Treatment of secondary lesions alone or without adequate biomechanical correction may lead to worse outcomes and a greater predisposition to relapse<sup>(3,4,7)</sup>.

This article presents a case series with the objective of evaluating the clinical results of surgical treatment of SCVF through extension osteotomy of the first metatarsal and plantar fascia release.

## METHODS

This work was approved by the Research Ethics Committee with registration in the Brazilian Platform under CAAE number 78393517.8.0000.5134.

The study presents a series of cases treated and evaluated by the authors in the period from February 2014 to August 2017.

Eleven patients (five males and six females, with a mean age of 40 years) and 12 feet were included in the study. All had flexible, symptomatic SCVF that did not improve with six months of conservative treatment. These patients sought the orthopedic service because of clinical complaints related to secondary pathologies and not to the cavovarus



**Figure 1.** Anterior view of the foot showing the peek-a-boo sign in detail on the right side.

**Source:** Author's personal archive



**Figure 2.** Coleman test showing reducibility of the varus of the hindfoot.

**Source:** Author's personal archive

deformity of the feet. The diagnosed lesions were fibular tendinopathy, lateral ligament instability, plantar fasciitis, metatarsalgia and stress fracture (Table 1).

Exclusion criteria were rigid cavovarus foot, presence of neuromuscular pathologies and degenerative changes.

### Clinical examination

Patients were assessed clinically through an anamnesis and orthopedic physical examination, including the American Orthopedic Foot and Ankle Society (AOFAS) scale for hindfoot and ankle pathologies and the visual analog scale (VAS) for pain.

During the examination, the peek-a-boo sign, which was present in all patients, was evaluated. The flexibility of the deformity was measured by the Coleman test and by manual reduction by the attending physician. All patients had a flexible cavovarus foot that was corrected during the examination.

The associated lesions were examined individually, according to the complaints of each patient and complemented with radiographic analysis and magnetic resonance imaging.

### Surgical procedure

Surgical treatment began with a soft tissue approach through a plantar fasciectomy of the centromedial band

(Figure 3), followed by a V-shaped extension osteotomy of the base of the first dorsal metatarsal (Figure 4). The distal segment of the osteotomy was elevated and embedded in the apex of the proximal fragment, resulting in the extension of the metatarsal. The osteotomy was fixed with a 3.0-mm dual-compression cannulated screw. Then, an intraoperative clinical evaluation of the correction obtained was performed. Despite being a flexible deformity on the Coleman test and that, theoretically, only the first metatarsal osteotomy would be sufficient for correction, two patients required osteotomy of the calcaneus to complement the treatment of the residual cavovarus.

The associated lesions were treated individually, according to each patient's clinical picture. The complementary procedures performed were arthroscopic ligament reconstruction, gastrocnemius elongation, tenoplasty and fibular tendon ligation, in addition to bone grafting for the patient who had osteonecrosis of the intermediate cuneiform bone.

### Postoperative protocol

The postoperative protocol consisted of immobilization with an orthopedic boot and no load allowed for three weeks. After this period, a partial load was allowed for another three weeks, followed by physical therapy rehabilitation and full load at six weeks.

**Table 1.** Patient data and individual results

Patient	Sex	Side	Age	Associated lesions	Surgery	AOFAS pre	AOFAS post	VAS pre	VAS post	Would I Repeat Surgery?
1	F	R	29	LLI	Ost 1 <sup>st</sup> mtt + PF + Brostrom	50	93	6	0	Yes
2	F	R	49	FT + plantar fasciitis	Ost 1 <sup>st</sup> mtt + PF + Tenoplasty + GS	60	88	8	0	Yes
3	F	L	44	FT + plantar fasciitis	Ost 1 <sup>st</sup> mtt + PF + Tenoplasty	43	80	10	1	Yes
4	M	R	33	Chronic tibial sesamoiditis	Ost 1 <sup>st</sup> mtt + PF + Tenoplasty + GS	55	72	8	4	No
5	F	L	46	FT + Plantar fasciitis + LLI	Ost 1 <sup>st</sup> mtt + PF + Brostrom + Calc Ost	37	65	10	5	Yes
6	M	L	35	FT	Ost 1 <sup>st</sup> mtt + PF + Tenoplasty	63	83	8	3	Yes
7	F	L	47	LLI	Ost 1 <sup>st</sup> mtt + PF + Brostrom + Calc Ost	26	70	9	5	Yes
8	M	R/L	20	Plantar hyperkeratosis	Ost 1 <sup>st</sup> mtt + PF	68	93	8	0	Yes
9	M	R	24	Cuneiform Osteonecrosis	Ost 1 <sup>st</sup> mtt + PF + Bone grafting	27	81	10	1	Yes
10	F	R	67	FT	Ost 1 <sup>st</sup> mtt + PF + Tenoplasty	39	80	9	1	Yes
11	M	R	47	FT	Ost 1 <sup>st</sup> mtt + PF + Tenoplasty	21	75	10	3	Yes

LLI: lateral ligament instability; FT: fibular tendinopathy; Ost 1<sup>st</sup> mtt: first metatarsal osteotomy; PF: plantar fasciectomy; GS: gastrocnemius stretching; Calc Ost: calcaneal osteotomy.

### Evaluation after 12 months of follow-up

After 12 months, the patients again answered the AOFAS questionnaire and the pain VAS, being questioned about the degree of satisfaction and if they would undergo the procedure again. The clinical correction of the deformity, postoperative complications and recurrence of lesions were



**Figure 3.** Intraoperative image of plantar fasciectomy. **Source:** Author's personal archive.



**Figure 4.** Intraoperative image of first metatarsal extension osteotomy. **Source:** Author's personal archive.

also evaluated. The results were compared, evaluating the efficacy of this surgical approach.

### RESULTS

The mean AOFAS score increased from 44.4 to 80.0. The mean pain VAS score decreased from 8.7 to 2.0. Seven patients rated the result as excellent, two as good and two as regular. Two patients developed wound dehiscence, and one developed a fibular nerve neuropraxia; both were treated clinically with good results. The only patient who would not undergo the procedure again presented improvement of the deformity and the initial clinical complaint but developed transfer metatarsalgia to the central rays, which limits him from practicing high-impact physical activities.

On clinical examination, deformity correction was observed in all patients through inspection and absence of the peek-a-boo sign. There were no relapses or clinical complaints related to the associated lesions (Figure 5).



**Figure 5.** Photograph of patient #8 one year after surgical treatment. A: Anterior view showing improvement of the hindfoot varus, with absence of the peek-a-boo sign; B and C: Anteroposterior and lateral X-rays of the feet after surgery showing consolidated osteotomy of the first metatarsal. **Source:** Author's personal archive.

## DISCUSSION

SCVF is a pathology that has been neglected for several years. Surgical treatment aimed only at addressing secondary lesions has poor results with a high relapse rate<sup>(3)</sup>. After the description of SCVF by Manoli and Graham, several studies addressing the deformity and associated injuries at the same time have shown better results and lower rates of recurrence<sup>(4,8)</sup>. Maskill et al.<sup>(9)</sup> evaluated 13 patients with SCVF associated with lateral ligament instability or post-traumatic fibular tendinopathy. The authors achieved excellent results by jointly addressing the lesions, obtaining a postoperative AOFAS score of 92 and a high rate of satisfaction, and achieving no relapses. Fortin et al.<sup>(10)</sup> showed that SCVF associated with insufficiently treated chronic lateral ligament injury may evolve to degenerative changes. This reinforces the importance of correcting hindfoot alignment in conjunction with ligament reconstruction. We also performed the joint approach, which achieved good functional results in this series of cases, with no recurrence thus far. We believe that the joint intervention is essential for good results. When correcting the hindfoot alignment, we are treating the cause of these lesions and will have better functional results.

Surgical treatment still has some important issues and controversies regarding the choice of osteotomy. Several studies<sup>(1,2,4,9)</sup> guide their treatment using the Coleman test. When the varus of the hindfoot is corrected with the test, it is inferred that it is secondary to excessive flexion of the first ray, and extension osteotomy of the first metatarsal is considered sufficient to realign the biomechanical axis. By contrast, patients with a residual varus on this test require a calcaneal osteotomy. In our study, the Coleman test

was also used preoperatively to plan the surgery and was found to be a good parameter for choosing the osteotomy. However, in two cases, addressing the first metatarsal did not ensure complete correction, and calcaneal osteotomy was necessary to complement the treatment. This leads us to question the degree of predictability of the Coleman test. Although we know that addressing the first ray would theoretically suffice in flexible cavovarus feet on the Coleman test, we believe that correction of the deformity should always be re-evaluated intraoperatively. If a residual cavovarus is left after addressing the first metatarsal, calcaneal osteotomy should also be performed. We suspect that this is due to subjectivity in the interpretation of the traditional Coleman test, which demonstrates the importance of an intraoperative clinical assessment to ensure the success of the correction. This is a subjective evaluation, making the treatment of this pathology challenging.

In our study, we considered a short follow-up of 12 months, and further monitoring is desirable to confirm the permanence of the results. Another limitation of the study is the absence of a control group of patients who were subject only to the surgical treatment of secondary lesions.

## CONCLUSION

Surgical treatment of SCVF through extension osteotomy of the first metatarsal and plantar fasciectomy was able to realign the mechanical axis in most cases and presented good clinical results.

The intraoperative clinical evaluation after the osteotomy of the first metatarsal was essential to evaluate the need to complement the procedure and achieve success in all cases.

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