

# Subtle cavus foot: prevalence of associated injuries

## Pé cavo sutil: prevalência de lesões associadas

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### ABSTRACT

**Objective:** To identify the prevalence of ankle and foot disorders in patients with subtle cavus foot (SCF).

**Methods:** This was a retrospective case series. Patients with lower limb disorders who upon clinical examination were also diagnosed with SCF were evaluated. Patients diagnosed with disorders that could lead to this deformity, such as trauma sequelae and neurological disorders, and those with the presence of cavovarus foot with severe deformity were excluded. Correlations between ankle and foot disorders and the presence of SCF were evaluated.

**Results:** A total of 119 patients (67 males/52 females) were evaluated, totalling 238 feet. One hundred forty-one feet had subtle cavus, and 97 feet had physiological alignment. Of the 141 SCF, 76 feet were right feet, and 65 were left feet. Twenty-two patients had bilateral SCF. One hundred forty complaints were identified, which led to 18 diagnoses: ankle instability (37 cases/26.2%), peroneal tendon tendinopathy (31 cases/22.0%), plantar fasciitis (18 cases/12.8%), Achilles tendon tendinopathy (10 cases/7.1%), osteochondral talar lesion (7 cases/5.0%), mechanical metatarsalgia (6 cases/4.3%), hallux sesamoid disorders (5 cases/3.5%), Morton's neuroma (5 cases/3.5%), hallux valgus (5 cases/3.5%), pain in the lateral side of the foot (4 cases/2.8%), anterior impact (3 cases/2.1%), pain in the medial side of the tibia (2 cases/1.4%), plantar plate injury (2 cases/1.4%) and other disorders with a prevalence <1%.

**Conclusion:** We found a clear correlation between SCF and acute and chronic ankle instability, peroneal and Achilles tendon tendinopathy and plantar fasciitis.

**Level of Evidence IV; Therapeutic Studies; Case Series.**

**Keywords:** Talipes Cavus; Ankle injuries; Tendinopathy; Fasciitis, plantar; Foot injuries.

### RESUMO

**Objetivo:** Identificar a prevalência de patologias do tornozelo e pé nos pacientes com Pé Cavo Sutil (PCS).

**Métodos:** Esta é uma série de casos retrospectiva. Foram avaliados pacientes com patologias do membro inferior e que ao exame clínico também tiveram o diagnóstico de PCS. Foram excluídos os pacientes com diagnóstico de patologias que poderiam levar a essa deformidade, como seqüela de trauma e patologias neurológicas, além da presença de Pé Cavo Varo com deformidade intensa. Foram avaliadas as correlações entre as patologias do tornozelo e pé com a presença do PCS.

**Resultados:** Foram avaliados 119 pacientes (67 do sexo masculino/52 do sexo feminino), totalizando 238 pés. Cento e quarenta e um pés apresentavam Cavo Sutil e 97 pés tinham alinhamento fisiológico. Dos 141 PCS, 76 pés eram à direita e 65 pés à esquerda. Vinte e dois pacientes tiveram PCS bilateral. Foram identificadas 140 queixas, que levaram a 18 diagnósticos: instabilidade de tornozelo (37 casos/26,2%), tendinopatia dos tendões fibulares (31 casos/22,0%), fascite plantar (18 casos/12,8%), tendinopatia do tendão calcâneo (10 casos/7,1%), lesão osteocondral do tálus (7 casos/5,0%), metatarsalgia mecânica (6 casos/4,3%), patologias do sesamoide do hálux (5 casos/3,5%), neuroma de Morton (5 casos/3,5%), Hálux Valgo (5 casos/3,5%), dor na face lateral do pé (4 casos/2,8%), impacto anterior (3 casos/2,1%), dor na face medial da tíbia (2 casos/1,4%), lesão da placa plantar (2 casos/1,4%) e outras patologias com prevalência <1%.

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**Conclusão:** Encontramos correlação evidente entre o PCS e a instabilidade aguda e crônica do tornozelo, a tendinopatia dos tendões fibulares e do tendão calcâneo e a fascite plantar.

**Nível de Evidência IV; Estudos Terapêuticos; Série de Casos.**

**Descritores:** Pé cavo; Lesões do tornozelo; Tendinopatia; Fascite plantar; Traumatismos do pé.

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## INTRODUCTION

Cavus or cavovarus foot is a deformity that is commonly related to neuromuscular disorders. However, in recent years, the occurrence of its subtle form has become an object of study. In such cases, the deformity is less clear, and the factors that lead to this structural change are unknown<sup>(1-4)</sup>.

In 2005, Manoli et al. were the first to address this subject in the literature<sup>(1)</sup>. The authors coined the term subtle cavus foot (SCF), defined as cavovarus foot with very mild deformities, which is quite often underdiagnosed. Manoli et al. consider that this subtle foot deformity is idiopathic, familial and has an unclear intrinsic genetic trait. It is best described as a deviation from normal, except that there are a number of pathological conditions associated with this type of foot.

SCF is diagnosed by observation of the “peek-a-boo” sign (from an anterior view of the patient with feet flat on the floor, the outline of the calcaneus is observed medially to the ankle, demonstrating hindfoot varus), plantar flexion of the 1<sup>st</sup> ray and lack of claw toe in most cases. It is differentiated from other types of cavovarus feet due to its subtle changes, absence of obvious varus of the calcaneus in the posterior observation of the feet (hindfoot in neutral position or with slight varus that is difficult to evaluate in the posterior view) and absence of neuromuscular disorders or trauma sequelae (Figures 1 and 2)<sup>(1-7)</sup>.

The importance of performing this diagnosis is the fact that SCF involves anatomical changes that become functionally more rigid, and as a result, there are changes to normal gait biomechanics, causing overload in unusual places and a predisposition to injury. This is explained by the fact that the talonavicular and calcaneocuboid joint axes become oblique when the hindfoot is positioned in varus, limiting hindfoot mobility<sup>(1-10)</sup>.

SCF can therefore be associated with disorders that affect the foot and ankle, due to overload on the tendinous and ligamentous structures, as well as the transfer of non-physiological demands to the osteoarticular systems, as occurs



**Figure 1.** “Peek-a-Boo” sign.

**Source:** Author’s personal archive.



**Figure 2.** Posterior view.

**Source:** Author’s personal archive.

in cases of severe cavovarus foot. Awareness of this association should make the general orthopaedic surgeon and foot and ankle specialist actively look for this alignment variation and related complaints, in order to act early in providing patients with appropriate footwear and clinical hindfoot realignment (insoles) or, where these are insufficient, to use surgery to address the associated injuries and also correct the alignment variation in order to improve symptoms and prevent the progression of secondary degenerative injuries<sup>(1,2,5,6,10)</sup>.

The objective of this study was therefore to identify the prevalence of ankle and foot disorders in SCF patients.

## METHODS

This study was approved by the Research Ethics Committee with registration in the Brazil Platform under CAAE number 82636518.0.0000.0071.

This was a retrospective and descriptive case series in which a search using the keyword “subtle cavus” was carried out in the electronic medical records of patients of the doctors/authors participating in this study, using the treatment period of 01/01/2007 to 31/12/2017. The study included patients of both genders, between 18 and 80 years of age, who had any lower limb disorder and who upon clinical examination were also diagnosed with SCF (presence of the peek-a-boo sign, increased plantar arch height and first ray equinus). In terms of exclusion criteria, the medical records of patients with a diagnosis of other conditions that could lead to such a deformity, such as trauma sequelae and neurological disorders, or the presence of cavovarus foot, that is, the form with more severe deformities, were disregarded. Correlations between ankle and foot disorders and the presence of SCF were evaluated. Categorical variables are described as frequencies and percentages. The main prevalences observed are described, accompanied by 95% confidence intervals obtained using the Wilson method.

## RESULTS

After insertion of the keyword “subtle cavus” in the electronic medical records of the authors of this study and respecting the inclusion and exclusion criteria described previously, we obtained a return of 119 patients (67 males, 56% and 52 females, 44%), totalling 238 feet. Of the total number of feet, 141 (59.2%) had subtle cavus, and 97 (40.8%) had physiological alignment. Of the 141 feet with a subtle cavus diagnosis, 76 feet (53.9%) had the deformity on the right side, while the left side was affected in 65 cases (46.1%). Only 22 patients (18.5%) of the total 119 evaluated had the bilateral presence of SCF (Table 1).

After a thorough evaluation of the records of these patients with a clinical diagnosis of SCF, we found patients with bilateral deformity with complaints on both feet and others with bilateral deformity with complaints on only one foot. We also evaluated medical records that had more than one complaint per foot in cases both of unilateral and bilateral deformity. As a result, we identified a total of 140 complaints, which led us to 18 main diagnoses, which

**Table 1.** Description of findings of subtle cavus foot

Characteristics	n	%	95% CI
Subtle cavus foot (N=238 feet)			
Present	141	59.2	52.9-65.3
Absent	97	40.8	34.7-47.1
Laterality (N=141 SCF)			
Right	76	53.9	45.7-61.9
Left	65	46.1	38.1-54.3
Bilaterality (N=119 patients)			
Unilateral	97	81.5	73.6-87.5
Bilateral	22	18.5	12.5-26.4
Complaints (N=141 SCF)			
Ankle instability	37	26.2	19.7-34.1
Chronic instability	25	17.7	12.3-24.9
Acute instability	12	8.5	4.9-14.3
Peroneal tendon tendinopathy	31	22.0	15.9-29.5
Plantar fasciitis	18	12.8	8.2-19.3
Achilles tendon tendinopathy	10	7.1	3.9-12.6
Osteochondral talar lesion	7	5.0	2.4-9.9
Hallux sesamoid disorders	6	4.3	2.0-9.0
Morton's neuroma	5	3.5	1.5-8.0
Neuroma de Morton	5	3.5	1.5-8.0
Hallux valgus	5	3.5	1.5-8.0
Pain in lateral side of foot	4	2.8	1.1-7.1
Anterior impact	3	2.1	0.7-6.1
Pain in medial side of tibia	2	1.4	0.4-5.0
Plantar plate injury	2	1.4	0.4-5.0
Osteochondral tibial lesion	1	0.7	0.0-3.9
Stress fracture	1	0.7	0.0-3.9
Claw toes	1	0.7	0.0-3.9
Partial medial gastrocnemius rupture	1	0.7	0.0-3.9
Hallux rigidus	1	0.7	0.0-3.9

95% CI: 95% confidence interval; SCF: subtle cavus foot.

**Source:** Prepared by the author based on the results of the study.

were as follows: ankle instability (37 cases/26.2%), peroneal tendon tendinopathy (31 cases/22.0%), plantar fasciitis (18 patients/12.8%), Achilles tendon tendinopathy (10 cases/7.1%), osteochondral talar lesion (7 cases/5.0%), mechanical metatarsalgia (6 cases/4.3%), hallux sesamoid disorders (5 cases/3.5%), Morton's neuroma (5 cases/3.5%), hallux valgus (5 cases/3.5%), pain in the lateral side of the foot (4 cases/2.8%), anterior impact (3 cases/2.1%), pain in the medial side of the tibia (2 cases/1.4%), plantar plate injury (2 cases/1.4%), osteochondral tibial injury (1 case/0.7%), stress fracture at the base of the 4<sup>th</sup> metatarsal (1 case/0.7%), claw toe (1 case/0.7%), partial tear of the medial gastrocnemius (1 case/0.7%) and hallux rigidus (1 case/0.7%) (Table 1).

## DISCUSSION

Subtle cavus foot is a recent term in orthopaedics and has been widely discussed in the scientific community with regard to its diagnosis and its impact on ankle and foot disorders. We know that the more severe cavovarus foot has a high propensity to generate secondary injuries. However, it is questionable as to whether more subtle deformities are also able to contribute to the incidence of new injuries or to perpetuate a condition when the deformity is not included in the treatment. Added to this misunderstanding of the condition is diagnostic difficulty. Under less watchful eyes, the condition may go unnoticed because the diagnosis is clinical and involves subtle changes, such as an increase in the medial longitudinal arch at the expense of first ray flexion, a neutral or slightly varus hindfoot during posterior alignment evaluation or observation of the medial calcaneal edge during the anterior evaluation of the patient with feet flat on the floor (peek-a-boo sign)<sup>(1-7,11)</sup>.

Given the above, we know that even subtle changes in anatomy that are considered normal lead to changes in gait biomechanics and consequently result in a more functionally rigid hindfoot than normal, leading to overloading of the ankle and foot structures. With this information in mind, we performed a retrospective evaluation of the medical records of patients with subtle cavus foot and the presence of associated injuries<sup>(12,13)</sup>.

A total of 18 conditions were found in 119 patients with symptomatic SCF. The disorders encountered included ankle instability, which comprised a total of 26.2%, of which 1/3 had primary treatment for an acute sprain and the remaining 2/3 were related to chronic instability. Peroneal tendon tendinopathy appeared in second place, with 22% of the evaluated SCF, and could be associated with complaints of ankle instability. The next most common findings were plantar fasciitis (12.8%) and Achilles tendon tendinopathy (7.1%). Due to the increased cavism and overload of the lateral structures, the literature relates an increased incidence of these disorders to patients with severe cavovarus foot, which also coincides with more subtle deformities, as seen in our epidemiological survey<sup>(4,7)</sup>. There was a lower incidence of the other disorders found in our study and therefore a weaker association with SCF. However, we know that stress fractures in the lateral rays (in our sample, the fracture occurred at the base of the 4<sup>th</sup> metatarsal), mechanical metatarsalgia, hallux sesamoid disorders, pain in

the lateral side of the foot and claw toe are changes related to severe cavovarus foot<sup>(12,13,14)</sup>.

Another issue that should be taken into account when evaluating a patient with SCF and with acute instability is the possibility of occurrence of associated acute injuries (fractures/tendinous lesions/osteochondral lesions) or that a poor prognosis may lead to chronic instability (there was a two times greater occurrence of chronic instability than acute instability). Chronic instability, in turn, also overloads and endangers the peroneal tendons; moreover, it can lead to microtrauma and eventually to the occurrence of osteochondral talar lesions. In our study, three feet showing instability due to acute events also had peroneal tendon lesions (tendinosis/intrasubstance rupture), and three feet with chronic instability were diagnosed concomitantly with osteochondral talar lesions<sup>(2,5,15)</sup>.

Some recent studies have highlighted the importance of including hindfoot realignment in conservative and surgical treatment as a way of increasing the chance of treatment success and preventing the occurrence of new injuries<sup>(1-3,9,12,13,15)</sup>.

The authors have diagnosed SCF in several patients in the last 10 years, and there has been a gradual increase in the incidence of this disorder, both due to the attention paid and the experience gained. After analysis of the injuries of the studied patients and a brief elucidation of the current scenario in regard to this deformity, we found a strong correlation between SCF and some of the ankle and foot injuries diagnosed. We therefore believe that realignment of this deformity should be included in the treatment of SCF patients. As described by Manoli, "Subtle cavus foot is best described as a deviation from normality, except that there are a number of pathological conditions associated with this type of foot."

Our main limitations arise from the retrospective nature of the data evaluation and the lack of a comparative control group.

## CONCLUSION

We found a clear correlation between SCF and some ankle and foot disorders, in particular, acute and chronic ankle instability, peroneal and Achilles tendon tendinopathy and plantar fasciitis.

**Author contributions:** Each author contributed individually and significantly to the development of this article: ASOJ \*(<https://orcid.org/0000-0002-7348-4697>) wrote the article, interpreted the results of the study; ALGS\*(<https://orcid.org/0000-0002-6672-1869>) interpreted the results of the study, participated in the review process; CASN\* (<https://orcid.org/0000-0002-9286-1750>) participated in the review process; approved the final version; JFMA \*(<https://orcid.org/0000-0002-7664-2064>) interpreted the results of the study, participated in the review process; MPP \*(<https://orcid.org/0000-0003-0325-8050>) conceived and planned the activities that led to the study, approved the final version. \*ORCID (Open Researcher and Contributor ID).

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