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ANOMALOUS SMALL SAPHENOUS VEIN: ORIGIN BY FENESTRATION AND COMPLEX BIFID TERMINATION – CASE REPORT

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ARTIGO ORIGINAL

RESUMO

Contexto: O sistema venoso dos membros inferiores, vital para o retorno sanguíneo ao coração, é dividido em profundo e superficial. A veia safena parva (VSP) é um componente do sistema superficial, com origem usualmente na veia marginal lateral do pé. Contudo, sua anatomia, especialmente na terminação, é reconhecidamente variável, o que gera a necessidade contínua de estudos morfológicos detalhados para a prática clínica. A classificação de Kosinski (1926) descreve diversos padrões de terminação, mas variações incomuns ainda são observadas. **Objetivo:** O presente estudo teve como objetivo descrever uma variação morfológica rara e incomum da VSP, destacando seus sítios atípicos de origem e padrões complexos de terminação, contribuindo para uma compreensão anatômica mais aprofundada e relevante clinicamente. **Relato de Caso:** Durante uma dissecação de rotina em um cadáver masculino, observou-se uma VSP com origem anômala por fenestração da veia dorsal do dedo mínimo (VDDM). A VSP apresentava um trajeto oblíquo póstero-medial e uma terminação bífida complexa. Emitia um ramo medial de 13 cm, tortuoso e dilatado, que recebia tributárias da coxa e convergia para a veia femoral profunda (VFP). Um segundo ramo, superolateral, cruzava nervos importantes (fibular comum e tibial) antes de se unir ao ramo medial para drenar na VFP, além da terminação na veia poplítea (VP). **Conclusão:** A variação anatômica da VSP descrita, com origem por fenestração da VDDM e terminação bífida complexa na VP e VFP, foge aos padrões clássicos e ressalta a extrema complexidade da anatomia venosa. Esse conhecimento é crucial para profissionais de saúde, permitindo diagnósticos mais precisos e intervenções terapêuticas mais seguras, especialmente em procedimentos que visam tratar varizes, prevenindo complicações como hemorragias e lesões nervosas.

Palavras-chave: Variação anatômica; Veia safena parva; Anormalidades congênitas; Veia poplítea; Cirurgia vascular; Veia femoral profunda; Insuficiência venosa crônica.

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ABSTRACT

Context: The venous system of the lower limbs, vital for blood return to the heart, is divided into deep and superficial. The small saphenous vein (SSV) is a component of the superficial system, usually originating from the lateral marginal vein of the foot. However, its anatomy, especially at its termination, is notoriously variable, which continually necessitates detailed morphological studies for clinical practice. Kosinski's classification (1926) describes various termination patterns, but uncommon variations are still observed. **Objective:** This study aimed to describe a rare and unusual morphological variation of the SSV, highlighting its atypical origin sites and complex termination patterns, thereby contributing to a deeper and clinically relevant anatomical understanding. **Case Report:** During a routine dissection of a male cadaver, an SSV was observed with an anomalous origin via fenestration of the dorsal digital vein of the fifth toe (DDVFT). The SSV presented an oblique postero-medial course and a complex bifid termination. It issued a medial branch, 13 cm long, tortuous and dilated, which received thigh tributaries and converged into the deep femoral vein (DFV). A second, superolateral branch crossed important nerves (common fibular and tibial) before uniting with the medial branch to drain into the DFV, in addition to terminating in the popliteal vein (PV). **Conclusion:** The described anatomical variation of the SSV, with its origin via fenestration of the dorsal digital vein of the fifth toe and complex bifid termination in the PV and DFV, deviates from classic patterns and highlights the extreme complexity of venous anatomy. This knowledge is crucial for healthcare professionals, enabling more accurate diagnoses and safer therapeutic interventions, especially in procedures aimed at treating varicose veins, preventing complications such as hemorrhages and nerve injuries.

Keywords: Anatomical Variation; Small saphenous vein; Congenital abnormalities; Popliteal vein; Vascular surgery; Deep femoral vein; Chronic venous insufficiency.

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Introduction

The venous system of the lower limbs is fundamental for the return of deoxygenated blood to the heart, operating against the gravitational gradient. Classically, this system is subdivided into two main components: the deep venous system and the superficial venous system, both interconnected by perforating or communicating veins (Aragão et al., 2003).

The deep venous system, located beneath the deep fascia of the leg and thigh, is situated between muscle masses and accompanies the main arteries of the lower limbs. Its integrity is crucial for the effectiveness of the calf muscle pump (Meissner, 2005). In contrast, the superficial venous system, positioned above the muscular fascia, is predominantly composed of the great saphenous vein (GSV) and the small saphenous vein (SSV). This system is responsible for draining the skin and subcutaneous tissues, transferring blood flow to the deep system via perforating veins (Aragão et al., 2003; Meissner, 2005).

The SSV, a clinically relevant component of the superficial venous system of the lower limbs, has a conventionally described origin in anatomical literature. Typically, this vein emerges as a continuation of the lateral marginal branch of the dorsal venous arch of the foot. However, its formation can also arise from the confluence of three to four tributary veins originating from the dorsal or plantar regions of the foot, or from the anastomosis between the dorsal digital vein of the fifth toe (DDVFT) and plantar and calcaneal veins (Uhl et al., 2006; Gaye et al., 2019). Its course is ascending on the posterior aspect of the leg, positioning itself laterally to the calcaneal tendon and being accompanied by the sural nerve (Meissner, 2005; Nayak, 2005; Uhl et al., 2006; Gaye et al., 2019).

Although the saphenopopliteal junction (SPJ) is the most frequently observed termination site for the SSV, its terminal anatomy exhibits considerable variability, continuously being a subject of scientific investigation by various authors (de Oliveira et al., 2004; Meissner, 2005; Shetty et al., 2016). Giacomini (1873) and Kosinski (1926) were pioneers in describing the diverse terminations of the SSV, including Giacomini's vein – an oblique intersaphenous communication that connects with the GSV and was subsequently recognized as a cranial extension of the SSV (Caggiati et al., 2002). In turn,

Kosinski (1926) proposed a detailed classification based on the relationships of the SSV with the popliteal vein, the deep veins of the thigh, and the great saphenous vein:

Type I – Termination in the popliteal vein:

(a) Exclusive termination in the popliteal vein;

(b) Bifurcation, with one branch to the popliteal vein and another to the great saphenous vein.

Type II – Termination in thigh veins or great saphenous vein:

(a) Exclusive termination in deep thigh veins;

(b) Bifurcation into two branches, one to deep thigh veins and another to the great saphenous vein;

(c) Exclusive termination in the great saphenous vein.

Type III – Termination in the leg (proximal to the popliteal region):

(a) Termination in the great saphenous vein, at the level of the leg;

(b) Termination in gastrocnemius veins.

In view of the continuous demand for a detailed anatomical understanding, the present study aims to describe an uncommon morphological variation of the SSV, with emphasis on its origin sites and termination patterns.

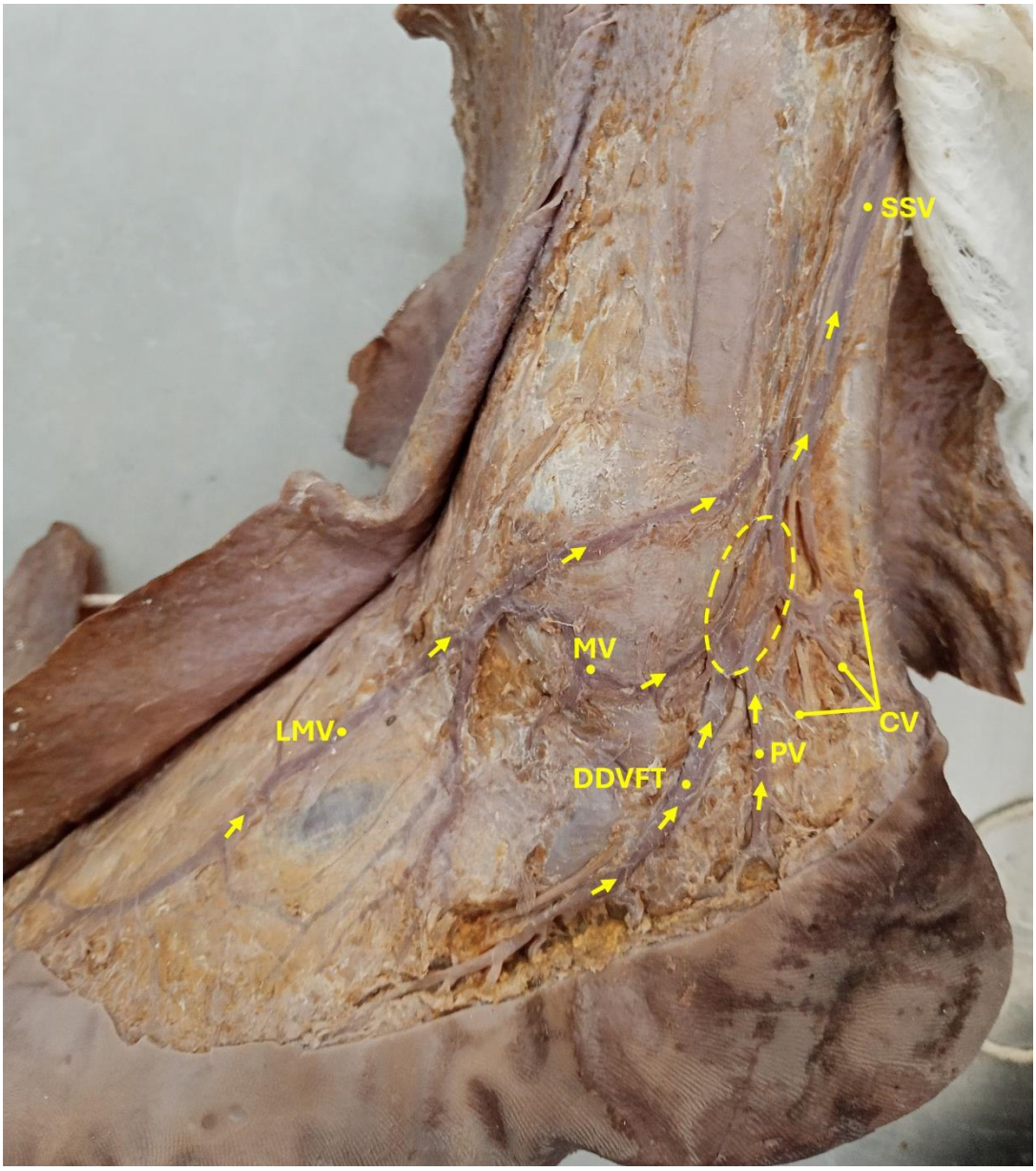
Case Report

During a routine anatomical dissection, conducted at the Human Anatomy Laboratory of the Morphology Department at the Federal University of Sergipe, a variation in the formation and termination of the small saphenous vein (SSV) was observed in a male human cadaver, with an apparent age of 65 years and fixed in a 10% formaldehyde solution.

The SSV presented an anomalous origin, forming from a fenestration of the DDVFT (**Figure** 1). In this vascular arrangement, the DDVFT exhibited a posterior loop that received the plantar and calcaneal veins (**Figure** 1). Its anterior loop, in turn, acted as a primary collector for the malleolar veins. The sural nerve was topographically identified in a medial position to these venous branches, and after the formation of the SSV, its course was oriented anteriorly (**Figure** 2). Additionally, the lateral marginal vein

(LMV) converged into the SSV at a distance of approximately 5 cm from its point of formation (**Figure** 1).

Figure 1 - SSV formed by the fenestration of the DDVFT



Legend

CV - Calcaneal veins; **DDVFT -** Dorsal digital vein of the fifth toe; **LMV -** Lateral marginal vein; **MV -** Malleolar vein; **PV -** Plantar vein; **SSV -** Small saphenous vein

Figure 2 – Topography of the sural nerve in relation to the SSV and the plantar

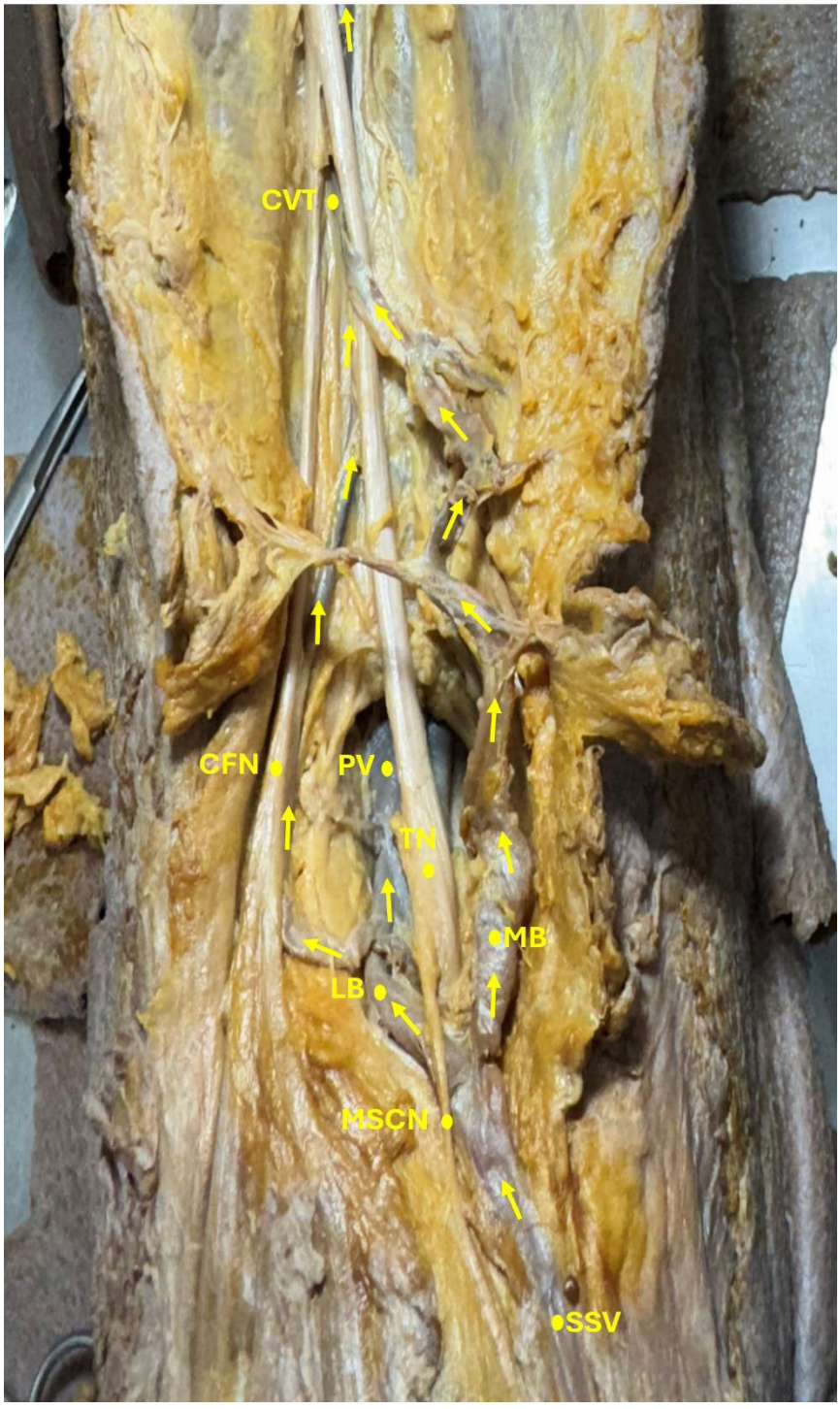
and calcaneal venous branches.

Legend

SN - Sural nerve

After its formation, the SSV emerged on the lateral aspect of the leg and assumed an oblique postero-medial course, remaining medial to the sural nerve. It ascended superficially and, in the proximal third of the leg, perforated the muscular fascia to converge into the popliteal vein (PV) in the popliteal fossa (**Figure** 3). Prior to its termination, the SSV gave off two distinct branches: one medial and one lateral (**Figure** 3).

Figure 3 – Anomalous termination of the SSV

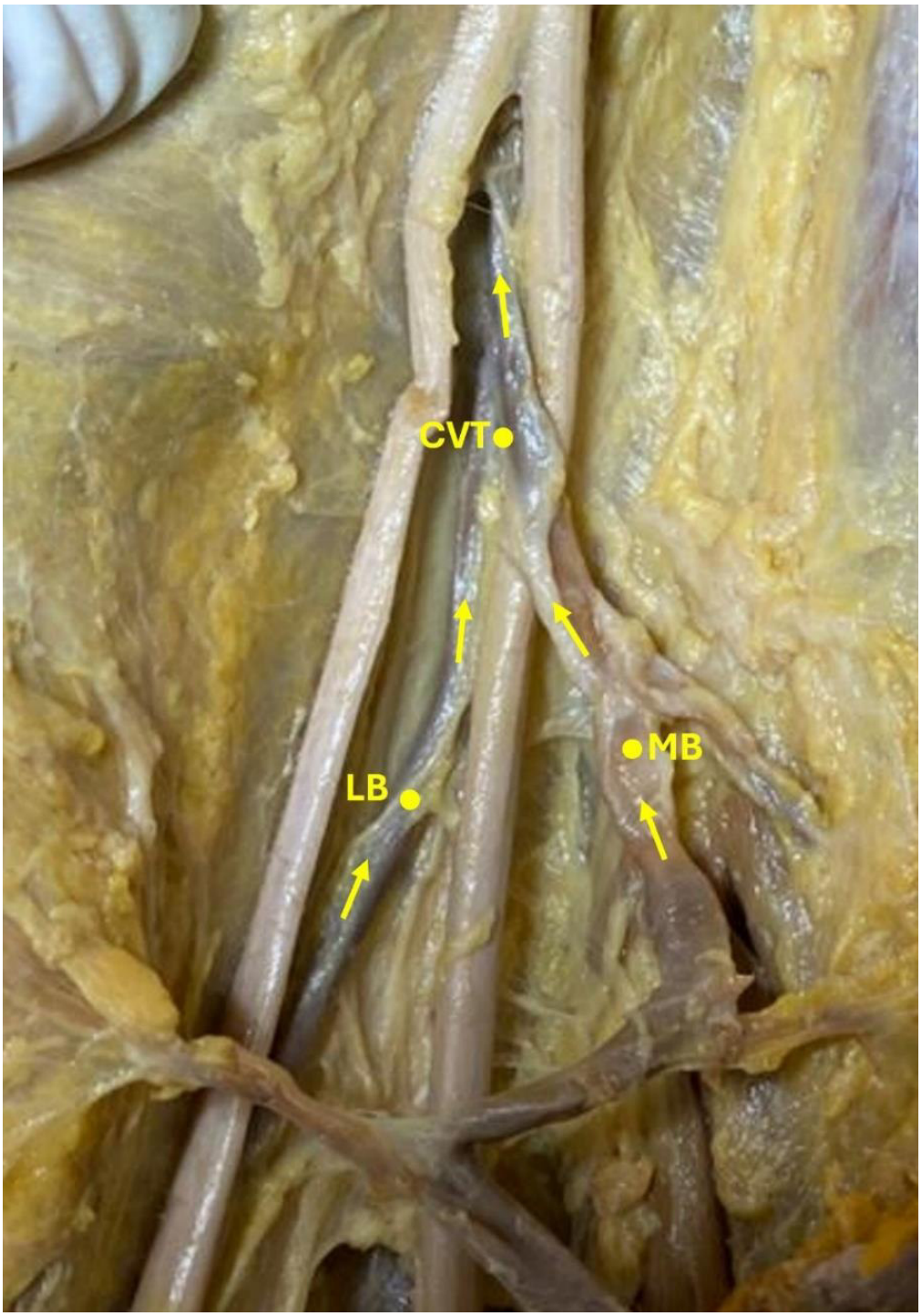


Legend

CFN - Common fibular nerve; **CVT** - Common venous trunk; **LB** - Lateral Branch; **MB** - Medial Branch; **MSCN** - Medial sural cutaneous nerve; **PV** - Popliteal vein; **SSV** - Small saphenous vein; **TN** - Tibial nerve.

The first branch, with an inferomedial orientation, originated near the emergence of the medial sural cutaneous nerve (a branch of the tibial nerve), presenting a dilated initial segment and following a tortuous and ascending course. During its course, this branch received tributaries from four veins of the posterior compartment of the distal third of the thigh: one lateral subcutaneous vein and three medial veins, with two caudal ones of subcutaneous origin and one cranial one originating from the semimembranosus muscle. This medial branch of the SSV extended for 13 cm from its origin until it met the lateral branch, forming a common venous trunk (**Figure** 4) that drained into the deep femoral vein (DFV) (**Figure** 5).

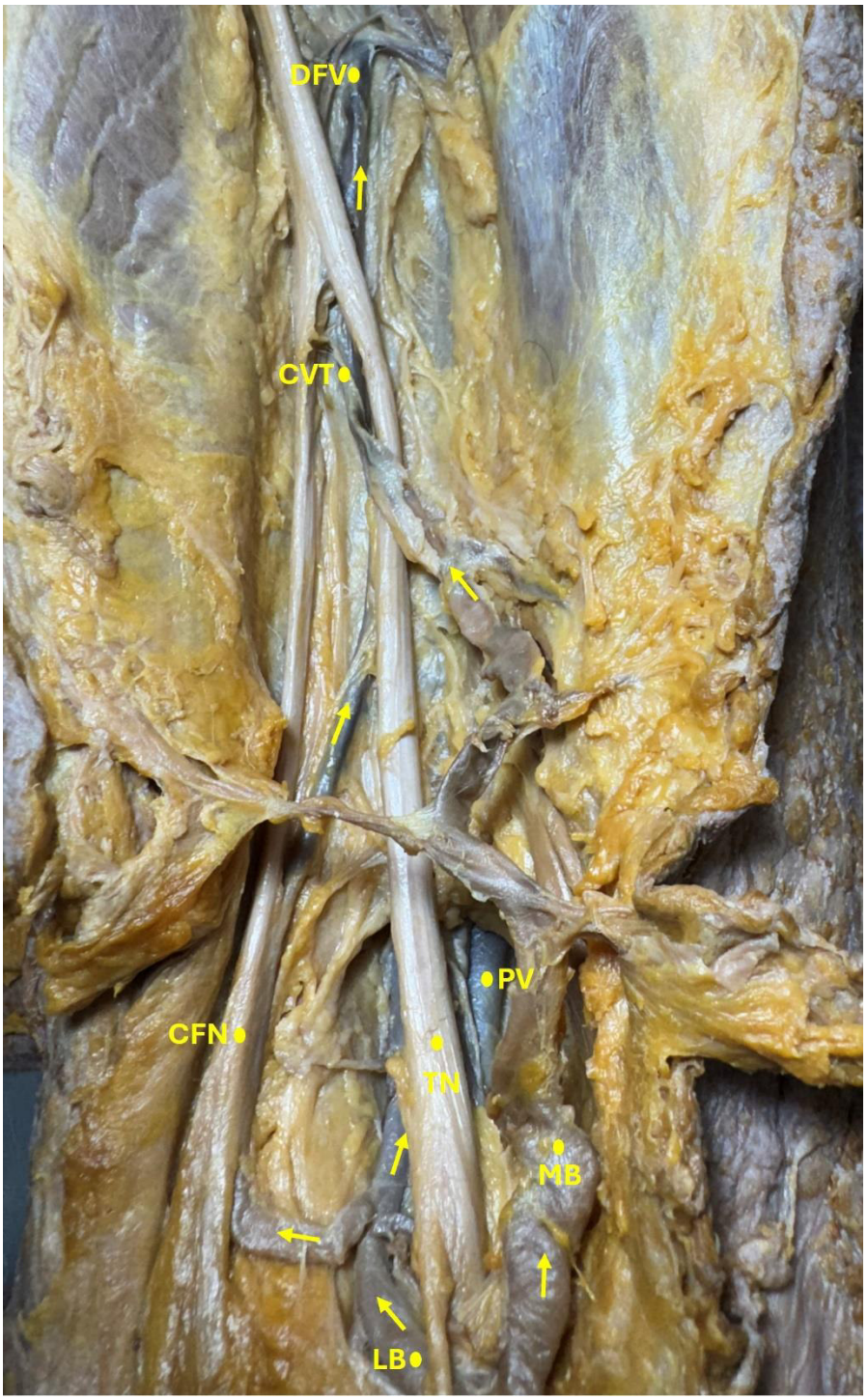
Figure 4 - Formation of the common venous trunk from the medial and lateral branches of the SSV.



Legend

CVT - Common venous trunk; **LB** - Lateral Branch; **MB** - Medial Branch.

Figure 5 - Terminations of the SSV into the deep femoral vein via the common venous trunk.



Legend

CFN - Common fibular nerve; **CVT** - Common venous trunk; **DFV** - Deep femoral vein; **LB** - Lateral Branch; **MB** - Medial Branch; **PV** - Popliteal vein; **TN** - Tibial nerve.

The second branch of the SSV, superolateral, emerged approximately 1.18 cm proximally to the termination of the SSV in the popliteal vein (PV), following a horizontal course of about 1 cm laterally, until it approached the common fibular nerve (CFN). Initially, this branch ran anteriorly to the CFN for 3.63 cm. Subsequently, it inclined obliquely in a craniomedial direction, crossing anteriorly the tibial nerve (TN). Then, it ascended deep to this nerve, where it united with the medial branch to form a common venous trunk. This common venous trunk was positioned deep to the sciatic nerve and drained into the deep femoral vein.

Discussion

The anatomical variability of the origin and termination of the SSV is a widely reported phenomenon; however, the vascular arrangement observed in our case presents peculiarities that deviate from classic descriptions, namely, formation via fenestration of the DDVFT, and a complex bifid termination involving the popliteal and deep femoral veins, which reinforces the need for continuous understanding of venous morphological patterns.

Unlike the conventional origin of the SSV from the dorsal venous arch of the foot, the formation of the SSV from a fenestration of the DDVFT is a rare finding. In anatomical textbooks, the origin of the SSV is described as highly variable but generally centered on the lateral marginal vein of the foot (Testut, Latarjet, 1968; Spence, 1991; Goss, 1998; Moore et al., 2019). However, for Uhl et al., (2006), in addition to the lateral marginal vein (which originates from the perforator of the first intermetatarsal space), it can also originate from the lateral malleolar venous plexus, or through a common vessel from the lateral foot perforators. Gaye et al., (2019), studying the SSV, observed that the number of origin branches ranged from one to five, with an average of two: one origin branch in 10 cases (16.12%), two origin branches in 35 cases (56.45%), three origin branches in 14 cases (22.58%), four origin branches in two cases (3.22%), and in only one case, five origin branches (1.61%). In their study, the number of pre-malleolar ramifications was observed to vary from zero to two branches, and the retro-malleolar from one to four branches. Comparing to our study, the anterior loop of the first fenestration received a pre-malleolar branch originating from the division of the LMV,

while the posterior received four retro-malleolar branches, three plantar and one calcaneal. In the present case, it was also observed that the sural nerve passed medially and deeply to the venous fenestration formed by the branch of the posterior loop of the DDVFT and the calcaneal branches.

In the present study, the termination of the SSV exhibited an atypical morphological pattern that could not be fully classified into a single category, as established by Kosinski's classification (1926). The observed arrangement suggests a combination of types I(b) and II(a), evidenced by a dual drainage: one portion terminating in the PV and another, via a common trunk, converging into the DFV. This anatomical particularity denotes considerable complexity.

The bifid termination found in this case is particularly notable for its dimensions and connections. The medial branch, measuring 13 cm in length with a tortuous and dilated course, close to the emergence of the medial sural cutaneous nerve, bears resemblance to the cranial extension of the SSV. According to Caggiati et al. (2002), the cranial extension is a frequent characteristic, but its drainage into the deep femoral vein, instead of the GSV, represents an atypical deviation in its course. For other authors, this finding demands clinical attention, as these transition and dilation zones are prone sites for valvular insufficiency and persistent venous reflux (Uhl et al., 2006; Bush, Hammond, 2007; Rossi et al., 2013).

The lateral branch, originating 1.18 cm from the SPJ, presents a horizontal course that crosses noble neural structures. According to the three-dimensional study by Uhl et al. (2006), although termination in the popliteal vein is the pattern in 60-70% of cases, the formation of a complex venous trunk that transits deeply to the sciatic nerve, as observed in this study, is a rarely described finding. Georgiev et al. (2003), Uhl et al. (2006), and Prakash et al. (2008) reported that in 62.5% to 83% of cases, the SSV terminates exclusively in the PV. The present report describes a mixed configuration: one termination in the PV and another in the DFV, via a common trunk 3.63 cm anterior to the common fibular nerve, which necessitates meticulous preoperative mapping. As highlighted by Rossi et al., (2013), failure to identify communicators crossing the tibial or common fibular nerve can result in difficult-to-control hemorrhages and permanent nerve damage during venous excision. Shetty et al. (2016) emphasize that variations

where the SSV terminates in the deep venous system create "escape points" that are primary causes of varicose vein recurrence.

Conclusion

The complex and variable venous anatomy of the lower limbs, especially of the SSV in its origin and termination, stands out for its considerable complexity. This knowledge is essential to enable healthcare professionals to make more informed clinical decisions, resulting in more precise diagnoses and safer therapeutic interventions. Valuing this complexity is, therefore, crucial to prevent complications, optimize surgical outcomes, and continuously improve patient management safety and effectiveness.

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CONFLICT OF INTERESTS

The authors declare no conflict of interests.

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