



ATYPICAL TRIPLE CONFLUENCE IN THE TERMINATION OF THE GREAT SAPHENOUS VEIN: A RARE ANATOMICAL VARIATION AT THE SAPHENO-FEMORAL JUNCTION

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ARTIGO ORIGINAL

RESUMO

Contexto: A anatomia venosa dos membros inferiores, particularmente a junção safeno-femoral (JSF) da veia safena magna (VSM), é complexa e exibe notável variabilidade. Essa diversidade anatômica é clinicamente relevante para o manejo da insuficiência venosa crônica (IVC) e para os procedimentos cirúrgicos, pois o conhecimento anatômico inadequado contribui significativamente para as altas taxas de recorrência da doença varicosa. O planejamento pré-operatório detalhado, apesar de utilizar a ultrassonografia Duplex, ainda enfrenta desafios devido à subjetividade e complexidade da anatomia. **Objetivo:** Relatar uma rara variação anatômica de uma tríplice confluência na junção safeno-femoral de tributárias na terminação da VSM, e destacar sua relevância clínica para o diagnóstico preciso e o planejamento terapêutico. **Relato de Caso:** Durante uma dissecação de rotina de um cadáver masculino de 65 anos, uma variação incomum foi observada na terminação da VSM na região inguinal. Uma tríplice confluência da veia pudenda externa superficial (VPES), veia safena acessória medial (VSAM) e veia safena acessória lateral (VSAL) foi identificada, convergindo para um tronco dilatado comum imediatamente antes da JSF. Notavelmente, houve uma ausência marcante da veia circunflexa ilíaca superficial (VCIS) e da veia epigástrica superficial (VES), que classicamente estão presentes nesta região. **Conclusão:** Este relato de caso ressalta a existência de variações anatômicas significativas e, por vezes, raras na JSF. O reconhecimento pré-operatório preciso dessas anomalias é crucial para mitigar o risco de recorrência da doença varicosa, otimizar o planejamento de procedimentos invasivos e garantir a eficácia do tratamento.

Palavras-chave: Variação Anatômica; Veia Safena Magna; Tributárias Superficiais; Cirurgia Vascular; Varizes; Insuficiência Venosa Crônica.

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ABSTRACT

Background: The venous anatomy of the lower limbs, particularly the sapheno-femoral junction (SFJ) of the great saphenous vein (GSV), is complex and exhibits notable variability. This anatomical diversity is clinically relevant for the management of chronic venous insufficiency (CVI) and surgical procedures, as inadequate anatomical knowledge significantly contributes to the high recurrence rates of varicose vein disease. Detailed preoperative planning, despite utilizing Duplex ultrasonography, still faces challenges due to the subjectivity and complexity of the anatomy. **Objective:** To report a rare anatomical variation of a triple confluence at the sapheno-femoral junction of tributaries at the GSV termination, and to highlight its clinical relevance for accurate diagnosis and therapeutic planning. **Case Report:** During a routine dissection of a 65-year-old male cadaver, an unusual variation was observed at the termination of the GSV in the inguinal region. A triple confluence of the superficial external pudendal vein (SEPV), medial accessory saphenous vein (MASV), and lateral accessory saphenous vein (LASV) was identified, converging into a common dilated trunk immediately before the SFJ. Notably, there was a remarkable absence of the superficial circumflex iliac vein (SCIV) and superficial epigastric vein (SEV), which are classically present in this region. **Conclusion:** This case report underscores the existence of significant and sometimes rare anatomical variations at the SFJ. Precise preoperative recognition of these anomalies is crucial for mitigating the risk of varicose vein disease recurrence, optimizing the planning of invasive procedures, and ensuring treatment efficacy.

Keywords: Anatomical Variation; Great Saphenous Vein; Superficial Tributaries; Vascular Surgery; Varicose veins; Chronic venous insufficiency.

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Introduction

The venous anatomy of the lower limbs is remarkably complex, with most anatomical variations concentrated in the proximal portion of the great saphenous vein (GSV). Considered the longest vein in the human body, it originates on the medial aspect of the dorsal venous arch of the foot and drains into the common femoral vein (CFV) through the sapheno-femoral junction (SFJ), distal to the inguinal ligament (Munteanu et al., 2024). Classical literature describes the GSV, at its termination in the SFJ, as receiving five main proximal tributaries: the superficial external pudendal vein (SEPV), the superficial circumflex iliac vein (SCIV), the superficial epigastric vein (SEV), the medial accessory saphenous vein (MASV), and the lateral accessory saphenous vein (LASV) (Souroullas et al., 2017). However, the notable anatomical variability inherent to venous angiogenesis results in a non-standardized configuration of these tributaries, whose number can vary from zero to 10 (Donnelly et al., 2005; Elzawawy, Khanfour, 2018; Munteanu et al., 2024). These vessels can converge to form common trunks, which drain into the GSV or CFV, or emerge as independent vessels with direct drainage into the CFV, such as the deep external pudendal vein (DEPV) (Souroullas et al., 2017). This diversity can lead to a spectrum of up to 28 distinct confluence patterns (Chun et al., 1992).

The clinical relevance of understanding anatomical variations of the GSV extends from the management of chronic venous insufficiency (CVI) to revascularization procedures, such as grafting in coronary artery bypass surgery (Bendelic, Catereniuc, 2020). CVI, with a prevalence between 25% and 33% in Western adults, is primarily caused by valvular incompetence and reflux, with the GSV and its tributaries being the most frequently affected sites (Kim et al., 2017). The therapeutic arsenal aims at occluding or removing insufficient veins to mitigate reflux. While GSV ligation and stripping were, for decades, the gold standard, technological evolution has updated the paradigm, introducing minimally invasive methods such as endovenous ablation (laser or radiofrequency) and foam sclerotherapy. These approaches demonstrate comparable clinical success and complication rates, with the advantage of reduced recovery time (Munteanu et al., 2024; Kim et al., 2017; Pichot et al., 2000).

Therapeutic success, regardless of the modality employed, is intrinsically conditioned by a deep understanding of venous anatomy and the pathophysiological

mechanisms of reflux. In open surgical procedures, the complete ligation of tributaries at the SFJ, concomitant with GSV stripping, constitutes a fundamental pillar (Hemmati et al., 2012; Baliyan et al., 2016). The precise identification of the SFJ is, therefore, a critical step. According to Donnelly et al. (2005), reliance on adjacent anatomical landmarks, such as the external pudendal artery (EPA), can lead to erroneous interpretations due to its highly variable anatomical relationship with the SFJ. Despite diagnostic and therapeutic advances, varicose vein disease presents a relatively high recurrence rate, varying between 15% and 35% after two years (Kim et al., 2017). Inadequate primary surgical approach, often correlated with the complexity and intrinsic variability of the venous system's anatomy, is cited as the main etiology of recurrence (Hemmati et al., 2012). Consequently, recognizing anatomical variations is essential to mitigate postoperative complications.

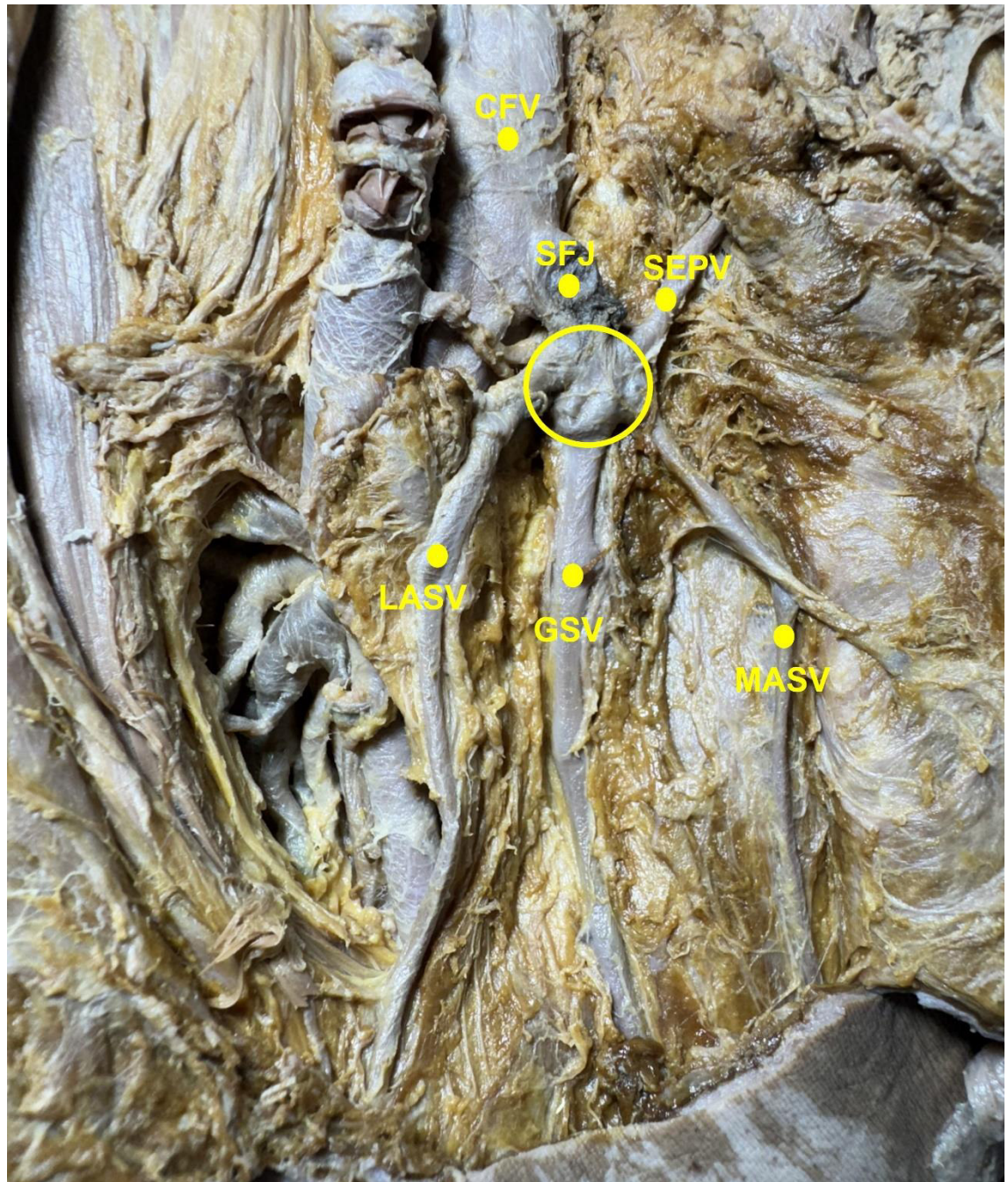
To address the challenges posed by anatomical complexity and minimize disease recurrence, preoperative planning plays a crucial role. In this context, Duplex ultrasonography is the diagnostic method of choice, allowing for the assessment of both venous anatomy and reflux hemodynamics (Baliyan et al., 2016). However, the high post-treatment recurrence rate suggests intrinsic limitations to this modality, given its subjective and operator-dependent nature. In scenarios of complex vascular anatomy, computed tomography (CT) venography with 3D reconstruction emerges as a valuable supplemental tool. This technique provides a comprehensive and objective three-dimensional visualization of the venous network and adjacent structures, optimizing the selection of clinical and surgical strategies (Kim et al., 2017). Given the need for greater diagnostic precision and a deeper anatomical understanding, the objective of the present study is to report a rare anatomical variation of a triple confluence at the sapheno-femoral junction of tributaries at the GSV termination, and to highlight its clinical relevance for accurate diagnosis and therapeutic planning.

Case Report

During a routine dissection, conducted at the Human Anatomy Laboratory of the Department of Morphology at the Federal University of Sergipe, a variation in the termination of the Great Saphenous Vein (GSV) was observed in a 65-year-old male human cadaver.

The GSV presented an unusual termination pattern in the inguinal region. The existence of three main tributaries was observed: the superficial external pudendal vein (SEPV), the medial accessory saphenous vein (MASV), and the lateral accessory saphenous vein (LASV), which converged in the terminal portion of the GSV (**Figure 1**). This confluence was characterized by a venous dilation immediately before the Sapheno-Femoral Junction (SFJ). The drainage of these tributaries into the dilation occurred as follows: the SEPV terminated infero-laterally, the MASV supero-laterally, and the LASV supero-medially into the dilation. The absence of two tributaries frequently present in the SFJ region was also noted: the superficial circumflex iliac vein (SCIV) and the superficial epigastric vein (SEV). The other neighboring vascular structures, including the femoral artery and the external pudendal artery, exhibited courses, calibers, and branching patterns considered usual in human anatomy.

Figure 1 - Dilated common venous trunk at the SFJ, formed by the triple confluence (SEPV, MASV, LASV) of terminal GSV tributaries.



CFV - Common femoral vein

GSV - Great Saphenous Vein

LASV - Lateral accessory saphenous vein

MASV - Medial accessory saphenous vein

SEPV - Superficial external pudendal vein

SFJ - Sapheno-femoral junction

Discussion

The anatomical variation observed in this study – characterized by a triple confluence of the SEPV, MASV, and LASV, culminating in a dilated common trunk immediately proximal to the SFJ – deviates from classical anatomical descriptions (Moore, Dalley, and Agur, 2014; Ellis, 1997; Snell, 2006), while also presenting important points of agreement and contrast with more recent literature. This finding reinforces the inherent complexity of venous anatomy and the need for an in-depth understanding to optimize clinical outcomes.

In a broader context, the robust systematic review and meta-analysis conducted by Cirocchi et al. (2019) synthesized data from 16 studies and 7,433 limbs, providing a statistically powerful overview of the prevalence of SFJ anatomical variations and concluding that high heterogeneity occurred in the prevalence of anatomical variants of the SFJ and in the number of SFJ venous tributaries. This vast heterogeneity, evident both in SFJ duplications (with a pooled prevalence of 9.6% for bifid junctions) and in the significant variation in the number of tributaries, reinforces the central idea of our case report, that SFJ anatomy is characteristically non-standardized.

In contrast to large-scale studies, such as that by Souroullas et al. (2017), which, in 172 procedures, identified the SCIV as the most consistent tributary of the GSV (present in 94.2% of cases), our finding reveals a notable absence of these tributaries (SCIV and SEV) in the main confluence. This divergence is significant, given the predominance of these veins in conventional anatomical series, and aligns perfectly with the high heterogeneity reported by Cirocchi et al. (2019). The absence of usually expected tributaries and the presence of an uncommon triple confluence are precisely the types of variations that contribute to the vast range of anatomical patterns identified in the meta-analysis.

Additionally, although Donnelly et al. (2005) report that the presence of three or fewer GSV tributaries occurs in over 57% of cases, the configuration with multiple tributaries converging into a common trunk is less frequent. The confluence observed in our specimen, while numerically aligned with this minority of cases (three tributaries), stands out due to its atypical vascular composition. Cirocchi et al. (2019) corroborate this numerical variability, indicating that the distribution of the number of SFJ venous

tributaries is approximately normal with a slight right asymmetry, with the highest rate observed for four SFJ venous tributaries (35.7%). For the tributaries of the GSV arch, the highest pooled prevalence was three tributaries (41.4%). However, the concept of a "complete venous star" with five tributaries was found in only 5.9% of cases, a percentage that highlights the rarity of the classical configuration and, by extension, the need to identify the multiple variants.

The study by Bendelic, Catereniuc (2020), conducted on 22 limbs, offers a closer morphological comparison by describing the formation of the "venous star" in cases of duplication or the presence of accessory veins, a concept that echoes the organization of the confluence reported here. However, the specific composition of its tributaries differs substantially. In Bendelic, Catereniuc (2020)'s sample, the SCIV (72.7%), SEV (68.2%), and SEPV (68.2%) constitute the core of the confluence. In contrast, our specimen presents a junction formed by the SEPV, MASV, and LASV, completely replacing the high-prevalence tributaries. This difference in composition, corroborated by divergent quantitative data, underscores the uniqueness of our observation within the spectrum of variations of the proximal GSV confluence. Another relevant contrast emerges from the analysis of Elzawawy, Khanfour (2018)'s findings, who, after dissecting 40 limbs, classified different types of saphenous compartments and reported an average of 5.12 ± 1.95 superficial tributaries on the anterior thigh. Although the number of three tributaries in our confluence falls within the lower end of this average, the formation of a dilated and well-defined common trunk from them represents a morphological feature not commonly quantified in studies primarily limited to vessel counting and nomenclature. The pre-junctional dilation, in particular, adds a layer of morphological complexity that may have hemodynamic implications. Cirocchi et al. (2019)'s meta-analysis, by consolidating the wide variety of studies detailing these nuances, reinforces that the high heterogeneity of SFJ anatomy makes the identification of its variations a critical preoperative issue, even though it is not always considered essential in the common treatment of GSV incompetence. This means that, while identifying all variants may not always be vital, in "particular" cases – such as our report of an atypical and dilated confluence – it becomes crucial.

The clinical importance of Cirocchi et al. (2019)'s work lies in its emphasis that "high heterogeneity" in SFJ anatomy can lead to surgical failures and incomplete ligation

of SFJ tributaries, which can result in persistent flow through the GSV arch and recurrence of lower limb varicose veins. The article highlights the need to improve preoperative and intraoperative strategies to reduce the risk of misidentification of the SFJ during crossectomy in GSV stripping (Cirocchi et al., 2019). This directly underscores the relevance of our case report, where an unexpected SFJ configuration could easily be underestimated without rigorous preoperative mapping. The clear recommendation by Cirocchi et al. (2020) for preoperative Doppler ultrasound assessment of the SFJ and GSV, due to significant anatomical variability, corroborates and strengthens the present finding on the indispensability of accurate venous mapping for surgical planning and interpretation of imaging exams. In summary, this report describes an anatomical variant of the sapheno-femoral junction that distinguishes itself both numerically and qualitatively from the more prevalent patterns. While the literature generally highlights abdominal tributaries as prominent elements in the SFJ region, our finding demonstrates a confluence dominated by the accessory saphenous veins (MASV and LASV) and the SEPV, a configuration poorly represented in existing statistics. This specific combination, along with the pre-junctional dilation, constitutes a distinctive pattern. The recognition of such variations, which transcend expected percentages and are broadly corroborated by the high heterogeneity identified by Cirocchi et al. (2019), is of fundamental importance for accurate and safe venous mapping, being essential for surgical planning, the execution of endovascular procedures, and the precise interpretation of imaging exams in the management of venous disease and the mitigation of recurrence rates. Cirocchi et al. (2020)'s meta-analysis serves as a pillar of evidence that generalizes the need to be aware of these particularities, transforming the singularity of a case report into a relevant piece for the complexity of venous anatomy.

Conclusion

The present study describes a rare anatomical variation of the sapheno-femoral junction, characterized by a triple confluence of the superficial external pudendal, medial accessory saphenous, and lateral accessory saphenous veins, culminating in a dilated common trunk, with the absence of the superficial circumflex iliac and superficial



epigastric veins. Preoperative recognition of these variations is essential to mitigate the risk of varicose disease recurrence and optimize the planning of invasive procedures. This reaffirms the need for precise venous mapping, using advanced diagnostic methods, to ensure treatment efficacy and improve outcomes for patients with chronic venous insufficiency.

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CONFLICT OF INTERESTS

The authors declare no conflict of interests.

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