

Unusual course of the superior gluteal artery between the roots of the lumbosacral trunk: case report and potential clinical implications

Silvio A. Garbelotti Jr¹, Osvaldo Pelozo J¹, Paulo L. Cândido¹, Marcelo C. Burihan^{1,2}, Aluisio Andrade Jr^{1,2}, Marco A. De Angelis¹

¹Discipline of Descriptive and Topographic Anatomy, Santa Marcelina Medical College, São Paulo, Brazil

²Department of Surgery, Santa Marcelina Hospital, São Paulo, Brazil

SUMMARY

The superior gluteal artery is the largest branch of the internal iliac artery and usually runs posteriorly between the lumbosacral trunk and the S1 root of lumbosacral plexus, medially to the sacroiliac joint. It emerges from the pelvis through the greater sciatic foramen, superior to the piriformis muscle, and immediately splits into superficial and deep branches for the gluteal region. During routine academic activities, the course of the superior gluteal artery differed from the usual pattern. In this case, the artery passed between L4 and L5 roots of the lumbosacral plexus. The union of these roots to form the lumbosacral trunk, which typically occurs above the sacroiliac joint, occurred below this limit, that is, inside the pelvic cavity. This case is relevant because of its proximity to the sacroiliac joint, which may lead to iatrogenic complications in routine procedures such as percutaneous sacroiliac joint fusion. Anatomical variability among individuals should

be considered in preoperative planning, as deep branches of the superior gluteal artery may be located within the safe zone for screw insertion.

Key words: Anatomical variation – Superior gluteal artery – Lumbosacral trunk – Sacroiliac joint – Pelvis

INTRODUCTION

The superior gluteal artery is the largest branch of the internal iliac artery (Moore et al., 2023) and, in most cases, extends posteriorly between the lumbosacral trunk and the S1 root, medially to the sacroiliac joint in 60 to 80% of cases (Anetai et al., 2017). This artery leaves the pelvic cavity through the greater sciatic foramen, superior to the piriformis muscle, and immediately divided into superficial and deep branches for the gluteal region (Anetai et al., 2017; Hamabe et al., 2020; Moore et al., 2023). Occasionally (17%) it assumes a lateral position to the lumbosacral trunk (Hamabe et al., 2020).

Corresponding author:

Silvio Antonio Garbelotti Junior. Discipline of Descriptive and Topographic Anatomy, Santa Marcelina Medical College, Rua Cachoeira Utupanema, 40 – Vila Carmosina – São Paulo – Brazil, CEP: 08270-140. Phone: (+55 11) 2217-9110. E-mail: silviogarbelotti@gmail.com

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It is reported by Kang et al. (2015) that the number of iatrogenic complications is increasing, and a case of superior gluteal artery injury during bilateral percutaneous sacroiliac screw fixation is presented. This fact demonstrates that anatomical variability among individuals should be considered a rule in preoperative planning (Garín et al., 2020; Maled et al., 2007). This statement is corroborated by Zhao et al. (2018), who found that deep branches of the superior gluteal artery coursed into the safe zone for screw insertion in 45.1% of cases.

This study presents a rare case of anatomical variation of the superior gluteal artery and, besides its academic aim, holds fundamental importance in daily clinical practice. Due to situations like this, surgeons should always bear in mind that possible variations in the course of this artery may occur, highlighting the importance of a comprehensive imaging study in surgical planning and avoiding multiple repositions of the guide or screw during the procedure (Garín et al., 2020).

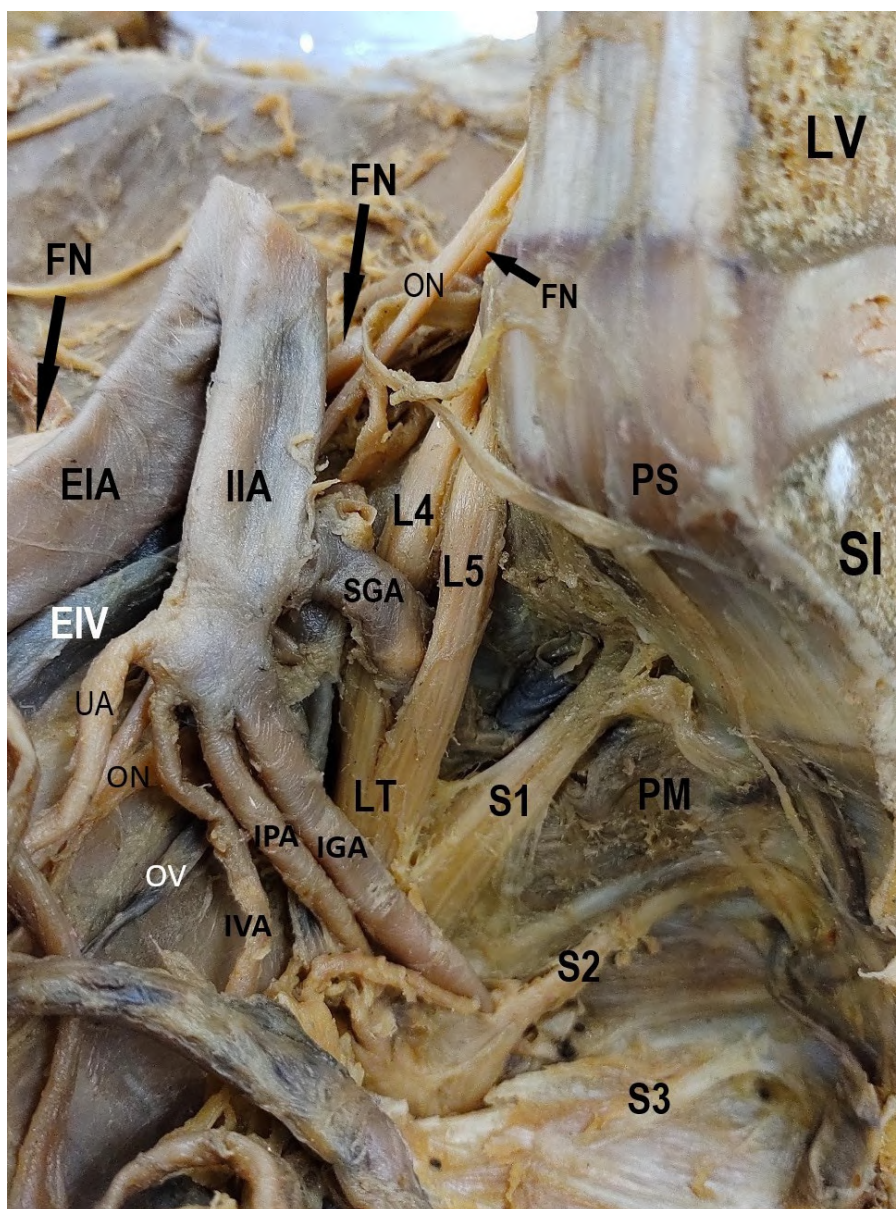


Fig. 1.- Internal view of the right half of the pelvic cavity. FN – Femoral nerve; EIA – External iliac artery; EIV – External iliac vein; IIA – Internal iliac artery; L4 – Root; L5 – Root; SGA – Superior gluteal artery; LT – Lumbosacral trunk; UA – Umbilical artery; ON – Obturator nerve; OV – Obturator vein; IVA – Inferior vesical artery; IPA – Internal pudendal artery; IGA – Inferior gluteal artery; LV – Fifth lumbar vertebra; SI – First sacral vertebra; PM – Piriformis muscle; PS – Sacral promontory; S1 – Root; S2 – Root; S3 – Root.

CASE REPORT

During the routine dissection process, anatomical variation with an irregular course of the superior gluteal artery and its relation to the lumbosacral trunk was observed. Initially, we observed that in this case, the superior gluteal artery was a direct branch of the internal iliac artery, with no distinct anterior and posterior divisions. As a result, the usual branches arose directly from a single main trunk. This case falls under Type III, according to the classification proposed by Adachi (1928), where the superior and inferior gluteal arteries, along with the internal pudendal artery, all originate independently from the internal iliac artery.

The superior gluteal artery, after its origin from the internal iliac artery, followed an unusual course between L4 and L5 roots forming the lumbosacral trunk (Fig. 1). It was also noted that the fusion of the L4 and L5 roots to form the lumbosacral trunk, which normally occurs above the sacral wing, occurred below this limit, inside the pelvic cavity, which fits our case in Group 3 of the classification proposed by Waikakul et al. (2010). Despite this unusual and low formation of the lumbosacral trunk, we did not observe any alteration in the formation of either the femoral nerve or the obturator nerve, which despite having contributions from the anterior division of the L4 root, presented normal formation and pathway. Furthermore, no other type of variation was observed in either adjacent or contralateral structures. This case report was approved by the Institutional Ethics Committee (No: 6.640.386/2024).

DISCUSSION

Although the literature on the origin and course of the superior gluteal artery from the internal iliac artery is extensive (Anetai et al., 2017), variations of the latter have been widely discussed since Adachi published a comprehensive study on the subject in 1928 (Al Talalwah & Soames, 2014), few articles document the relationship between this artery and the roots of the lumbosacral plexus (Anetai et al., 2017).

Adachi was the first to classify the internal iliac artery into five types and described its branching pattern based on four major branches: the

umbilical, superior gluteal, inferior gluteal, and internal pudendal arteries (Al Talalwah and Soames, 2014). In our case, the superior and inferior gluteal arteries and the internal pudendal artery arise independently from the internal iliac artery, corresponding to Type III of Adachi's classification. This system has remained standard for many years. While numerous studies have analyzed the variability of internal iliac artery branching patterns in different populations using Adachi's classification, their findings often diverge, particularly regarding the incidence of Type III, which has been reported to range from 9.6% to 34.8%.

Our case is highly unusual and of significant clinical interest. For example, in their study of 162 hemipelvs, Hamabe et al. (2020) observed that 82% of superior gluteal arteries pass between the L5 and S1 branches, while 17% course laterally to the L5 branch. Although they identified some rare patterns, none corresponded to the one reported in this case. On the other hand, Anetai et al. (2017) conducted an extensive study on the relationship between the superior gluteal artery and the roots of the lumbosacral plexus. Although they stated that the most common course of the superior gluteal artery is between L5 and S1, with a prevalence ranging from 60% to 80%, they identified several variations, which were categorized into five groups, each with three types of relationship.

Our case corresponds to Group 1 – Type A, as described by Anetai et al. (2017) in their new classification of superior gluteal artery variations in relation to the lumbosacral plexus. In this study, the authors observed that when the superior gluteal artery passes between L5 and S1, the femoral nerve predominantly originates from L4 and exhibits a slight caudal deviation. Furthermore, they proposed that the course of the superior gluteal artery changes in a cranial or caudal direction, corresponding to the cranial or caudal deviation of the femoral nerve. Thus, variations in the course of the superior gluteal artery appear to be correlated with the segmental origin of the femoral nerve from the plexus. In our case, no changes were observed in the formation or course of the femoral nerve. What was noted, however, was another characteristic described by Anetai et al. (2017) regarding the junction of the L4 and

L5 roots. Specifically, the fascicle from L4 to the lumbosacral trunk was thicker than the other fascicles, a feature referred to by the authors as the “large lumbosacral trunk type”. Furthermore, using the most anterior portion of the sacroiliac joint at the upper pelvic rim as a reference point, the L4 and L5 nerve roots joined below this reference point, aligning with Group 3 of the classification proposed by Waikakul et al. (2010).

However, according to Anetai et al. (2017), most studies have mainly focused on the morphological variations in the artery and statistical analysis of its course and have not examined the course of the artery in relation to peripheral nervous structures. The relationship between variations in the superior gluteal artery and variations in the segmental origin of the lumbosacral plexus has not been well analyzed in previous studies.

This fact is relevant because, due to its proximity to the sacroiliac joint, iatrogenic complications may occur in routine procedures such as percutaneous fusion of that joint. Although our case did not present variations in the extrapelvic branches of the superior gluteal artery, changes in its origin and course may alter the patterns of its terminal branches. In other words, variations in lumbosacral anatomy can also modify the course of the superior gluteal artery and its branches. It is well-established that there is a high risk of accidental injury to the deep superior branches of the superior gluteal artery during sacroiliac screw insertion, particularly in patients with altered lumbosacral anatomy (Garín et al., 2020; Maled et al., 2007; Maxwell et al., 2021; Zhao et al., 2018). Zhao et al. (2018) reported that in 45.1% of cases, the deep superior branch of the superior gluteal artery passes through the safe zone of the entry point for the screw in S1, and in these cases, no distinguishing characteristics or rules were identified regarding the overlap of the deep superior branches and the safe zone. Maxwell et al. (2021) described a case in which sacral sexual dimorphism contributed to the accidental injury of the superior gluteal artery by altering sacral anatomy and, consequently, the safe implant zones in the joint.

Given these factors, reports of anatomical variations of structures located in the pelvic region

should be encouraged and widely disseminated through scientific channels. Such variations must be identified before surgical procedures and always considered during surgery to enhance safety in the treatment of pelvic instabilities.

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REFERENCES

- AL TALALWAH W, SOAMES R (2014) Internal iliac artery classification and its clinical significance. *Rev Arg Anat Clin*, 6(2): 63-71.
- ANETAI H, TOKITA K, KOJIMA R, AIZAWA Y, KAGEYAMA I, KUMAKI K (2017) Variations in the course of the superior gluteal artery in relation to the lumbosacral plexus. *Okajimas Folia Anat Jpn*, 94(2): 45-54.
- GARÍN A, ABARAS, HERRERA C, ACUÑA I, CANCINO J, BETTANCOURT S, ALVAREZ J, VIGUERAS C, LARA J, DEL RÍO J (2020) Delayed lower extremity paresis following iliosacral screws: Atypical complication and treatment. *Trauma Case Rep*, 31: 100380.
- HAMABE A, HARINO T, OGINO T, TANIDA T, NOURA S, MORITA S, DONO K (2020) Analysis of anatomical variations of intrapelvic vessels for advanced pelvic surgery. *BMC Surg*, 20: 47.
- KANG S, CHUNG PH, KIM JP, KIM YS, LEE HM, EUM GS (2015) Superior gluteal artery injury during percutaneous iliosacral screw fixation: a case report. *Hip Pelvis*, 27(1): 57-62.
- MALED I, VELEZ R, LOPEZ R, BATALLA L, CAJA VL (2007) Pseudoaneurysm of the superior gluteal artery during iliosacral screw fixation. *Acta Orthop Belg*, 73(4): 544-547.
- MAXWELL G, LYON KA, BHENDERU LS, SCHUCHART G, DESAI R (2021) Sacral dysmorphism increases the risk of superior gluteal artery injury in percutaneous sacroiliac joint fusion: case report and literature review. *Cureus*, 13(11): e19532.
- MOORE KL, DALLEY AF, AGUR AMR (2023) *Clinically oriented anatomy*. Wolters Kluwer, USA, pp 505, 2241-2242.
- WAIKAKUL S, CHANDRAPAK S, SANGTHONGSIL P (2010) Anatomy of L4 to S3 nerve roots. *J Orthop Surg (Hong Kong)*, 18(3): 352-355.
- ZHAO Y, YOU L, LIAN W, ZOU D, DONG S, SUN T, ZHANG S, WANG D, LI J, LI W, ZHAO Y (2018) Anatomical relation between S1 sacroiliac screws' entrance points and superior gluteal artery. *J Orthop Surg Res*, 13(1): 15.