

# Variation in the *Obturator* Vasculature During Routine Anatomy Dissection of a Cadaver

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## تباين الأوعية الدموية لعضلات المسد خلال عملية تشريح جثة روتيني

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**ABSTRACT:** The *obturator* artery normally originates from the internal iliac artery while the *obturator* vein drains into the internal iliac vein. During a routine gross anatomy dissection class for undergraduate students at the All India Institute of Medical Sciences, New Delhi, India, in 2016, a rare unilateral variation in the *obturator* vasculature was found in a female cadaver of approximately 55 years of age. In this case, the left *obturator* artery originated from the superior gluteal artery and the left *obturator* vein drained into the external iliac vein. Knowledge of such variations is necessary during hernia procedures, ligation of the internal iliac artery and muscle graft surgeries.

**Keywords:** Iliac Artery; Anatomic Variation; Dissection; Case Report; India.

**المخلص:** ينشأ انسداد الشريان عادة في الشريان الحرقفي الداخلي عندما يصب وريد المسد في الوريد الحرقفي الداخلي، خلال حصة تشريح روتينية لطلاب المرحلة الجامعية في معهد عموم الهند للعلوم الطبية، نيودلهي، الهند، في عام 2016م تم العثور على اختلاف نادر من جانب واحد في الأوعية الدموية لعضلة المسد في جثة لأنثى يقارب عمرها 55 عاماً. في هذه الحالة المعروضة، الشريان الأيسر المسد نشأ من الشريان الألوي العلوي ووريد المسد يصب في الوريد الحرقفي الخارجي، ويعد معرفة هذه الاختلافات أمراً ضرورياً خلال عمليات الفتق وربط الشريان الحرقفي الداخلي وعمليات ترقيع العضلات.

**كلمات مفتاحية:** الشريان الحرقفي؛ الإختلافات التشريحية؛ تشريح؛ تقرير حالة؛ الهند.

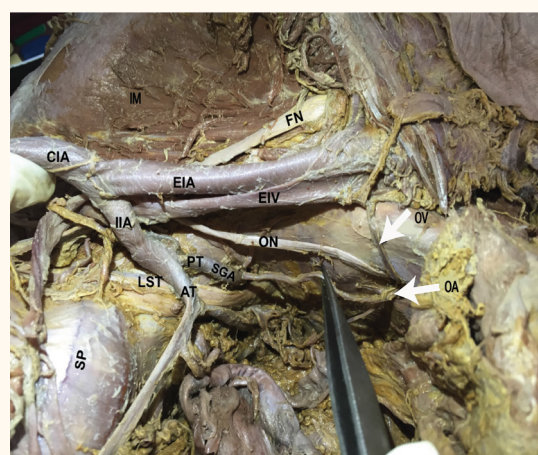
THE ABDOMINAL AORTA DIVIDES INTO THE right and left common iliac arteries which are anterolateral to the left side of the fourth lumbar vertebral body. Both of these arteries divide into the external and internal iliac arteries at the level of the sacroiliac joints. The external iliac artery mainly supplies blood to the lower limbs, whereas the internal iliac artery delivers the principal blood supply to the walls and viscera of the pelvis, perineum and gluteal region.<sup>1</sup> The *obturator* artery is a medium-sized muscular artery which usually arises from the anterior trunk of the internal iliac artery. It then runs anterolaterally on the lateral pelvic wall and is crossed by the *ureter* at its medial aspect, before entering into the adductor compartment of the thigh after passing through the *obturator* canal.<sup>1</sup>

The *obturator* artery has a variable origin—sometimes it originates as a direct branch of the internal iliac artery and at other times from one of the other branches of the internal iliac artery, namely the superior gluteal, inferior epigastric and inferior gluteal arteries.<sup>2</sup> The *obturator* artery provides the iliac branches to the iliac *fossa* and *iliacus* muscle. Occasionally, the *obturator* artery is replaced by an enlarged pubic branch of the inferior epigastric artery—an accessory

*obturator* artery—which descends almost vertically to the *obturator* foramen.<sup>1</sup> The *obturator* vein begins in the proximal adductor compartment and enters the pelvic cavity via the *obturator* foramen. It runs in a posterosuperior direction, below the *obturator* artery and between the *ureter* and internal iliac artery, before finally draining into the internal iliac vein.<sup>1</sup> Anatomical knowledge of the pelvic viscera and the vasculature of the retropubic pelvic region is vital for endoscopic inguinal hernioplasties, laparoscopic herniorrhaphies and during bilateral internal iliac artery ligation, a life-saving procedure to control haemorrhage following complications in gynaecological and obstetric procedures.<sup>3,4</sup>

## Case Report

A routine educational gross anatomy dissection of a female cadaver of approximately 55 years of age was conducted at the All India Institute of Medical Sciences, New Delhi, India, in 2016. The cadaver had no pathological or traumatic lesions and there were no signs of any previous surgical procedures in the pelvic and perineal region. Both of the internal iliac arteries were divided at the level of the sacroiliac joints in front



**Figure 1:** Photograph showing the abnormal origin and drainage pattern of *obturator* vessels on the left side of the pelvic wall of a female adult cadaver.

IM = iliacus muscle; FN = femoral nerve; CIA = common iliac artery; EIA = external iliac artery; EIV = external iliac vein; IIA = internal iliac artery; OV = obturator vein; ON = obturator nerve; PT = posterior trunk; SGA = superior gluteal artery; LST = lumbosacral trunk; OA = obturator artery; AT = anterior trunk; SP = sacral promontory.

of the anterior margin of the greater sciatic notch and proceeded into the anterior and posterior trunk. The anterior trunk continued into the pelvis and supplied blood to the pelvic viscera through its branches. The posterior trunk divided into the iliolumbar, lateral sacral and superior gluteal arteries. The superior gluteal artery passed along the upper margin of the *piriformis* through the greater sciatic foramen.

The left *obturator* artery originated from the superior gluteal artery in the pelvic cavity and passed along the lateral pelvic wall to enter the *obturator* canal, below the *obturator* nerve. The left *obturator* vein, instead of draining normally into the internal iliac vein, drained into an external iliac vein and crossed the pelvic brim [Figure 1]. The right-sided anatomy of the *obturator* vasculature was normal, as were relations between the vasculature and *obturator* nerve in the *obturator* foramen and canal. No variations were observed in any of the other arteries, nerves or muscles.

## Discussion

Anatomical knowledge of the *obturator* vasculature is important in surgeries related to the pelvic brim and the gluteal and adductor compartments of the thigh.<sup>3,4</sup> The *obturator* artery chiefly supplies blood to the adductor compartment of the thigh as well as the smaller pelvic branches. Generally, the *obturator* artery originates from the anterior trunk of the internal iliac artery and follows the normal route along the lateral pelvic wall, to enter the thigh through the *obturator*

canal.<sup>1</sup> However, the origin of the *obturator* artery is highly variable.<sup>5</sup> In a study of 50 cadavers, Rajive *et al.* found *obturator* arteries arising from various locations, including the common trunk of the internal iliac artery (4%), anterior trunk of the internal iliac arteries (54%), inferior epigastric artery (22%), superior gluteal artery (2%), internal pudendal trunk (2%), inferior gluteal artery (2%) and the external iliac artery (4%).<sup>6</sup> Bilgiç *et al.* reported a female newborn with a common arterial trunk arising from the medial side of the external iliac artery which subsequently divided into the *obturator* and inferior epigastric arteries.<sup>7</sup>

In more than one-third of cases, the anastomotic connection between the pubic branch of the inferior epigastric and *obturator* arteries can become enlarged; this is known as an “abnormal” *obturator* artery.<sup>8</sup> Jusoh *et al.* reported that the origin of the *obturator* artery was the posterior division of the internal iliac artery in approximately 5.8% of cases and that this anomalous artery divided into an inferior vesical branch leading to the prostate.<sup>9</sup> In the present case, the *obturator* artery originated from the superior gluteal artery on the left side and traversed the lateral pelvic wall along with the *obturator* nerve to enter the *obturator* canal. An abnormal origin of the *obturator* artery from the superior gluteal artery may have important surgical implications, particularly for female patients undergoing superior gluteal artery perforator flap surgery for breast augmentation/construction or to treat sacral pressure sores.<sup>10</sup> Usually, veins in the pelvis and in the lower limbs follow the same course as the arteries; Nagabhooshana *et al.* reported a case wherein the *obturator* artery arose from the external iliac artery and the *obturator* vein drained into the external iliac vein, implying that the arteries were followed by the veins.<sup>11</sup> However, in the present case, the artery arose from the superior gluteal artery while the left *obturator* vein drained into the external iliac vein and crossed the pelvic brim before termination. This type of vasculature may affect laparoscopic surgeries or open pelvic brim surgeries.<sup>3</sup>

The embryological basis for such variations in the vasculature of the limbs depends on the selection of the channels from the primary capillary plexus; the most appropriate channels will enlarge while others will retract and gradually disappear, thus establishing the final vascular pattern.<sup>12,13</sup> Another explanation for abnormal vasculature could be angiogenesis as a result of hypoxia.<sup>14</sup> Low oxygen saturation leads to the stabilisation of hypoxia-inducible factor 1- $\alpha$  which upregulates vascular endothelial growth factor A and nitric oxide synthase expression. Subsequently, the production of nitric oxide causes dilatation of the existing vessels and extravasation of plasma proteins,

leading to protease and matrix metalloproteinase expression.<sup>14</sup> These plasma proteins then play an important role in the proliferation and angiogenesis of endothelial cells which leads to the formation of abnormal vasculature.<sup>14</sup> The *obturator* artery is formed relatively late during development, joining with an axial artery of the lower limb that accompanies the sciatic nerve.<sup>15</sup> The origin of the *obturator* artery from the superior *gluteal* artery is due to the remains of the vascular channels related to the posterior trunk of the internal iliac arteries in circumstances where the vascular channels related to the anterior division predestined for the *obturator* artery may have degenerated.<sup>16</sup>

The *obturator* artery is an important source of collateral circulation for patients with aortoiliac and femoral arterial occlusive diseases.<sup>16</sup> Femoral head ischaemia can sometimes occur due to decreased blood flow through the *obturator* artery due to trauma, a tumour or tuberculosis because of decreased blood flow through the branch of the *obturator* artery, which supplies blood to the femoral head via the *ligamentum teres* of the femur.<sup>16</sup> During graft surgeries, additional advantage can be obtained in cases where the left *obturator* artery is longer than the right *obturator* artery, as with the present case.<sup>16</sup>

## Conclusion

During a routine dissection of a female adult cadaver, a rare unilateral variation in the *obturator* vasculature was observed. The variation was found to lie in the origin of the *obturator* artery and termination of the *obturator* vein. Knowledge regarding potential variations in the *obturator* vasculature is important during pelvis and pelvic brim surgeries, particularly hernia surgeries. Furthermore, anatomical information regarding the *obturator* vasculature is also important when performing superior *gluteal* muscle grafts during breast augmentation surgeries in female patients. Documenting such variations is crucial and will help surgeons when considering various surgical approaches.

## References

1. Borley NR. True pelvis, pelvic floor and perineum. In: Standring S. *Gray's Anatomy: The anatomical basis of clinical practice*, 40th ed. London, UK: Churchill Livingstone, 2008. Pp. 1083–98.
2. Pai MM, Krishnamurthy A, Prabhu LV, Pai MV, Kumar SA, Hadimani GA. Variability in the origin of the obturator artery. *Clinics (Sao Paulo)* 2009; 64:897–901. doi: 10.1590/S1807-59322009000900011.
3. Lau H, Lee F. A prospective endoscopic study of retropubic vascular anatomy in 121 patients undergoing endoscopic extraperitoneal inguinal hernioplasty. *Surg Endosc* 2003; 17:1376–9. doi: 10.1007/s00464-003-8800-y.
4. Havaladar PP, Taz S, Angadi AV, Saheb SH. Morphological study of obturator artery. *Int J Anat Res*, 2014; 2:354–7.
5. Pick JW, Anson BJ, Ashley FL. The origin of the obturator artery: A study of 640 body-halves. *Am J Anat* 1942; 70:317–43. doi: 10.1002/aja.1000700206.
6. Rajive AV, Pillay M. A study of variations in the origin of obturator artery and its clinical significance. *J Clin Diagn Res* 2015; 9:AC12–15. doi: 10.7860/JCDR/2015/14453.6387.
7. Bilgiç S, Sahin B. Rare arterial variation: A common trunk from the external iliac artery for the obturator, inferior epigastric and profunda femoris arteries. *Surg Radiol Anat* 1997; 19:45–7. doi: 10.1007/BF01627734.
8. Basmajian JV. *Grant's Method of Anatomy: By regions, descriptive and deductive*, 8th ed. Philadelphia, Pennsylvania, USA: Williams & Wilkins Co., 1971. Pp. 306–7.
9. Jusoh AR, Abd Rahman N, Abd Latiff A, Othman F, Das S, Abd Ghafar N, et al. The anomalous origin and branches of the obturator artery with its clinical implications. *Rom J Morphol Embryol* 2010; 51:163–6.
10. Mu LH, Yan YP, Luan J, Fan F, Li SK. [Anatomy study of superior and inferior *gluteal* artery perforator flap.] *Zhonghua Zheng Xing Wai Ke Za Zhi* 2005; 21:278–80.
11. Nagabhooshana S, Vollala VR, Rodrigues V, Bhat S, Pamidi N, Lobo SW. Anatomical variation of obturator vessels and its practical risk: A case report from an anatomic study. *J Vasc Bras* 2008; 7:275–7. doi: 10.1590/S1677-54492008000300015.
12. Arey LB. The development of peripheral blood vessels. In: Smith JL, Orbison DE, Eds. *The Peripheral Blood Vessels*. Baltimore, Maryland, USA: Williams & Wilkins Co., 1963. Pp. 1–16.
13. Fitzgerald MJ. *Human Embryology: A regional approach*, 1st ed. New York, USA: Harpercollins College Div., 1978. Pp. 38–56.
14. Schoenwolf GC, Bleyl SB, Brauer PR, Francis-West PH. *Larsen's Human Embryology*, 4th ed. London, UK: Churchill Livingstone, 2008. Pp. 396–7.
15. Sañudo JR, Roig M, Rodriguez A, Ferreira B, Domenech JM. Rare origin of the obturator, inferior epigastric and medial circumflex femoral arteries from a common trunk. *J Anat* 1993; 183:161–3.
16. Kumar D, Rath G. Anomalous origin of obturator artery from the internal iliac artery. *Int J Morphol* 2007; 25:639–41. doi: 10.4067/S0717-95022007000300028.