

Morphometric Analysis of the Internal Iliac Artery in Adult Human Pelvis

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Abstract

Background: The internal iliac artery is the principal arterial supply to the pelvic organs, gluteal region, and perineum. Detailed morphometric knowledge of this artery is essential for pelvic surgery, interventional radiology, and obstetric procedures. The objective is to analyze the morphometric characteristics of the internal iliac artery, including vertebral level of origin, distance from the midsagittal plane, length, diameter, and anatomical relationships. **Material and Methods:** Sixty formalin-fixed adult pelvic halves were dissected. Morphometric parameters, including vertebral level of origin, horizontal distance from the midsagittal plane, relationship with the sacroiliac joint, arterial length, and external diameter, were measured and analysed. **Results:** The most common vertebral level of origin was between L5 and S1 (48.3%), followed by S1 (23.3%) and L5 (15%). The most frequent distance from the midsagittal plane was 30–34 mm (21.7%). The internal iliac artery was located medial to the sacroiliac joint in 61.67% of specimens. The most common arterial length was 30–40 mm (40%), while the most frequent diameter range was 7–8 mm (40%). **Conclusion:** The internal iliac artery demonstrates considerable morphometric variability. Knowledge of these anatomical variations is essential for pelvic surgical procedures, vascular interventions, and radiological procedures.

Keywords: Internal iliac artery, pelvic vasculature, morphometry, sacroiliac joint, pelvic anatomy.

Received: 01 July 2026

Revised: 16 July 2026

Accepted: 11 August 2026

Published: 18 August 2026

INTRODUCTION

The internal iliac artery is the principal arterial trunk responsible for supplying blood to the structures of the pelvic cavity, gluteal region, and perineum. It plays a vital role in maintaining the vascular supply to several pelvic organs, including the urinary bladder, rectum, reproductive organs, and associated musculature. Anatomically, the internal iliac artery originates from the common iliac artery at the level of the lumbosacral junction, typically opposite the intervertebral disc between the fifth lumbar vertebra and the first sacral vertebra. After a short course within the pelvic cavity, it usually divides into anterior and posterior divisions, which further give rise to several branches supplying both visceral structures (such as pelvic organs) and parietal structures (including muscles and bones of the pelvic wall and gluteal region).^[1,2]

Due to its strategic anatomical location and close relationship with important pelvic organs, nerves, and veins, the internal iliac artery is frequently encountered during various pelvic surgical procedures. These include pelvic fracture repair, gynaecological and obstetric surgeries, urological procedures, and interventional radiological techniques such as arterial embolisation. In some of these, accurate understanding of the course and branching pattern of the artery is essential to prevent complications. There is, however, considerable variation in the origin, branching pattern, length, diameter and course of the internal iliac artery. Such variations can have a significant impact on surgical approaches and can make therapeutic procedures such as embolisation more likely to injure blood vessels, cause haemorrhage or fail to embolise blood vessels.^[3,4]

Hence, the morphometric features of the internal iliac artery, such as its vertebral level of origin, the distance between it and the midsagittal plane, its total length, the luminal diameter and the anatomical relationship to surrounding pelvic structures, are of great clinical importance. This information is especially valuable to surgeons, radiologists, and interventional specialists, aiding in surgical planning, reducing intraoperative risks, and optimizing the safety and efficacy of diagnostic and therapeutic interventions. Therefore the present study was carried out to investigate the morphological and morphometric characteristics of the internal iliac artery in adult cadaveric specimens with special reference to the variation in its origin and branching pattern in which special emphasis was laid on its clinical significance.

MATERIALS AND METHODS

In the present study 60 formalin preserved adult human pelvic halves were collected from the cadaver of routine anatomical dissection from the Department of Anatomy, Index Medical College & Hospital. 26 males and 34 females were sampled, with

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DOI:

10.21276/amit.2026.v13.i2.957

How to cite this article: Patar RP, Gupta M, Singh R. Morphometric Analysis of the Internal Iliac Artery in Adult Human Pelvis. Acta Med Int. 2026;13(2):1787-1790.

30 right and 30 left pelvic halves. The following parameters were examined:

- Vertebral level of origin of the internal iliac artery
- Horizontal distance from the midsagittal plane
- Relation to the sacroiliac joint
- Length of the internal iliac artery
- External diameter of the internal iliac artery

Measurements were obtained using digital callipers and measuring scales. The data were recorded and analyzed using descriptive statistical methods.

RESULTS

Vertebral Level of Origin: The vertebral level of origin of

the internal iliac artery was studied in 60 pelvic halves (26 male and 34 female specimens). The most common level of origin was between L5 and S1, observed in 29 specimens (48.3%), including 12 males (46.2%) and 17 females (50%).

Origin at the S1 vertebral level was seen in 13 specimens (21.7%)—3 males (11.5%) and 10 females (29.4%). The L4–L5 intervertebral level was observed only in male specimens (9 cases, 15%). Origin at the L5 level was noted in 9 specimens (15%), including 3 males (11.5%) and 6 females (17.6%).

The association between the vertebral level of origin of the internal iliac artery and sex was analyzed using the Chi-square test. A statistically significant difference was observed between male and female specimens ($\chi^2 = 13.61$, $df = 3$, $p = 0.003$). [Table 1]

Table 1: Origin of the internal Iliac artery at various vertebral levels

Vertebral level	Male				Female				Total Specimen	
	Right	Left	Total		Right	Left	Total			
	No.	No.	No.	%	No.	No.	No.	%	No	%
B/W L4 &L5	6	2	8	30.8%	0	0	0	0	8	13.3%
L5	2	1	3	11.5%	3	3	6	17.6%	9	15%
B/W L5 &S1	4	8	12	46.2%	9	8	17	50%	29	48.3%
S1	1	2	3	11.5%	5	6	11	32.4%	14	23.3%
Total	13	13	26	100%	17	17	34	100%	60	100%
P-value <0.005										

Distance from the Origin of the Internal Iliac Artery to the Midsagittal Plane

The horizontal distance from the origin of the internal iliac artery to the midsagittal plane was measured in 60 pelvic halves (26 male and 34 female specimens). The values ranged from 22 mm to 44 mm.

The most common range was 30–34 mm, observed in 13 specimens (21.7%), followed by 36–40 mm in 12 specimens (20%). 26–30 mm was recorded in 11 specimens (18.3%),

while 34–36 mm was seen in 10 specimens (16.7%). The 40–44 mm range was noted in 9 specimens (15%), and the least frequent range was 22–26 mm, observed in 5 specimens (8.3%).

Overall, most specimens showed 30–40 mm, indicating that this range represents the most common anatomical position of the internal iliac artery relative to the midsagittal plane in the present study population [Table 2].

Table 2: Distance of the internaliliacartery's origin tothemidsagittalplane

S.no.	Distance from the origin of IIA to the midsagittal plane (mm)	Male		Female		Total Number	Percentage
		Right	Left	Right	Left		
1	22-26	2	1	1	1	5	8.3%
2	26-30	3	2	4	2	11	18.3%
3	30-34	2	4	4	3	13	21.7%
4	34-36	2	2	3	3	10	16.7%
5	36-40	2	2	3	5	12	20%
6	40-44	2	2	2	3	9	15%
	Total (28.73±5.36)	13	13	17	17	60	100%

Relation of the Internal Iliac Artery with the Sacroiliac Joint:

The relationship of the internal iliac artery with the sacroiliac joint was examined in 60 specimens. The artery was found medial to the sacroiliac joint in 37 specimens (61.67%), making it the most common relationship.

In 17 specimens (28.33%), the artery was located anterior to

the sacroiliac joint, whereas a lateral position was observed in 6 specimens (10%), the least frequent.

Overall, the medial position of the internal iliac artery relative to the sacroiliac joint was the predominant anatomical arrangement in this study. [Table 3]

Table 3: Relation of the internaliliacarterywith the sacroiliacjoint

S.No.	Relation	No. of specimens	Percentage
1.	Medialtothesacroiliacjoint	37	61.67%
2.	Anteriottothesacroiliac joint	17	28.33%
3.	Lateralttothesacroiliacjoint	06	10%
	Total	60	100%

Length of the Internal Iliac Artery: The length of the

internal iliac artery was measured in 60 specimens and

grouped into specific intervals. The most common length was 30–40 mm, observed in 24 specimens (40%).

A length of 20–30 mm was recorded in 13 specimens (21.67%), while 40–50 mm was seen in 11 specimens (18.33%). Shorter lengths of 10–20 mm were noted in 4 specimens (6.67%). Longer arterial lengths included 50–60

mm in 5 specimens (8.33%) and 60–70 mm in 3 specimens (5%).

Overall, the findings indicate that the internal iliac artery most commonly measures between 30 mm and 40 mm in length, with shorter and longer variations occurring less frequently [Table 4]

Table 4: length of the internal iliac artery

SNo.	Length of IIA (mm)	No. of Specimen	Percentage
1.	10-20	04	6.67%
2.	20-30	13	21.67%
3.	30-40	24	40%
4.	40-50	11	18.33%
5.	50-60	05	8.33%
6.	60-70	03	5%
	Total	60	100%

Diameter of the Internal Iliac Artery: The external diameter of the internal iliac artery was measured in 60 specimens (26 male and 34 female). The diameters ranged from 3 mm to 9 mm.

The most common diameter range was 7–8 mm, observed in 24 specimens (40%), including 11 males (41.3%) and 13 females (38.24%). A diameter of 6–7 mm was found in 11 specimens (18.33%), while 5–6 mm was recorded in 9 specimens (15%).

Larger diameters of 8–9 mm were noted in 8 specimens (13.33%). Smaller diameters of 4–5 mm and 3–4 mm were observed in 5 specimens (8.33%) and 3 specimens (5%), respectively.

Overall, the most frequent diameter of the internal iliac artery was 7-8 mm, with smaller and larger diameters occurring less commonly [Figure 1].

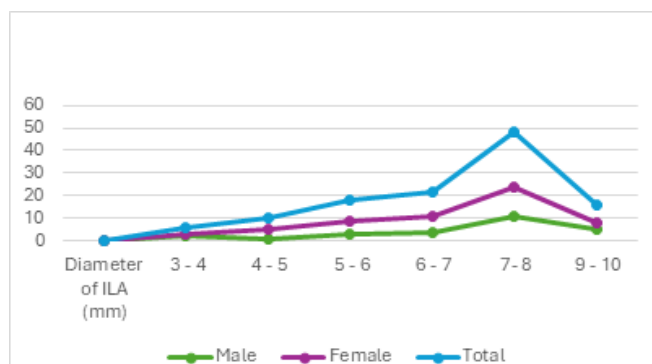


Figure 1: Diameter of internal Iliac artery

DISCUSSION

The internal iliac artery is the main arterial supply to the pelvic viscera, gluteal region and the perineum. Closely located to the pelvic organs, nerves, and sacroiliac joint, variations in the origin, course, and morphometric parameters of this nerve are clinically relevant for surgeries within the pelvis, orthopedic surgeries and interventional radiological techniques. In the present study, the level of the vertebral origin, distance from the midsagittal plane, relation to the sacroiliac joint, length and diameter of the internal iliac artery of 60 pelvic halves were assessed.

In the present study, the most common vertebral level of origin of the internal iliac artery was L5-S1 (48.3%), followed by S1 (23.3%), L5 (15%), and L4–L5 (13.3%). The results suggest that the most common site of origin is at the lumbosacral junction.

Findings are similar to those reported in previous anatomical studies. Ongidi et al. reported that the L5–S1 level is the most frequent site of the origin of the internal iliac artery in approximately 42.1% of cases [5]. The artery originated at L5–S1 level in about 72% of the specimens with other vertebral level origins occurring less frequently as reported by Mamatha et al. [6]. The findings of the present study thus corroborate previous reports and substantiate that the lumbosacral junction is the common site of origin of the internal iliac artery with variations occurring at the adjacent vertebral levels although they are less commonly seen.

The distance from the origin of the internal iliac artery to the midsagittal plane in the present study was found to be from 22 mm to 44 mm with most of the specimens between 30–40 mm. Similar measurements have been reported in previous morphometric studies. In a meta-analysis of the standards in the pelvic arterial anatomy, Koziej et al. noted that the internal iliac artery was typically found to begin 30–35 mm to the lateral side of the midsagittal plane. [7] However, other cadaveric studies of pelvic vascular anatomy yielded similar values. These results are very similar to those from the current study.

This is of great value when performing retroperitoneoscopy, spinal procedures, and pelvic procedures, as it provides a good approximation of the location of the artery in relation to the sacral promontory.

The present study showed that in 61.67% of specimens the internal iliac artery was found to be located on the medial side of the sacroiliac joint, in 28.33% of the specimens it was found to be located anterior to the SIJ and in 10 % of the specimens it was found to be located lateral to the SIJ.

This distribution is similar to that reported in an earlier anatomical study. According to Ongidi et al., the internal iliac artery was found to be medial to the sacroiliac joint in approximately 64.9%, anterior in 30.6% and lateral in a small percentage of specimens. [5] These findings are similar to those reported by the present study.

This relationship has important clinical implications because the artery may be at risk during sacroiliac joint fixation, pelvic fracture repair, and pelvic tumour surgeries.

In the present study, the length of the internal iliac artery ranged from 10 mm to 70 mm, with the most common length being 30–40 mm (40%).

Havaladar et al. reported that the internal iliac artery usually measures 3–5 cm in length before dividing into anterior and posterior divisions.^[8] Similarly, Katara et al. observed that the average arterial length ranged from 3 cm to 4.6 cm, consistent with the findings of the present study.^[9]

These variations in arterial length are clinically important during ligation of the internal iliac artery for pelvic haemorrhage and during endovascular procedures.

In the present study, the internal iliac artery diameter ranged from 3 mm to 9 mm, with the most common diameter being 7–8 mm (40%).

Previous vascular studies have reported comparable measurements. Laine et al. observed The internal iliac artery diameter was found to be on average 5–8 mm in adults,^[10] as was reported in the present study.

Because of the fact that the diameter of the artery dictates the choice of instrument(s) and/or device for use during the angiographic procedure, during catheterisation and embolisation, accurate knowledge of the arterial diameter is particularly important.

Clinical Significance: The present morphometric study emphasises the need of the knowledge of variation in the internal iliac artery. Such changes can be found regarding origin, positioning, length and diameter of this artery and can heavily influence surgical approaches to the pelvis. Comprehensive understanding of these parameters can minimize the risk of vascular injury, haemorrhage and surgical complications in the pelvis and interventional radiological procedures.

CONCLUSION

The present study shows that there is a great variation in the origin of the internal iliac artery, its morphology, and its relationships. The most frequent origin was at L5–S1 level and the artery was most commonly found medial to the sacroiliac joint. The average length of the arteries was

between 30–40 mm, while the most common was the 7–8 mm diameter arteries.

These knowledge findings are useful for anatomical details which could be helpful in surgery in the pelvis, vascular interventions and radiology techniques on reducing the risk of iatrogenic vascular injury.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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