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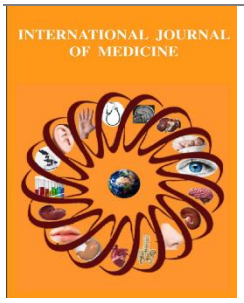

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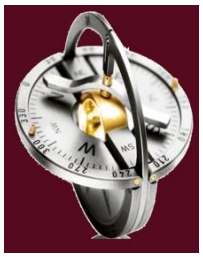

Research Article

Anatomical Variations in the Profunda Femoris Artery in Femoral Triangle: A Cadaveric Study with Implications for Vascular and Surgical Procedures

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Abstract

Background: The femoral artery (FA) is the primary artery of the lower limb and a critical site for numerous clinical procedures, including arterial catheterization, coronary angioplasty, and embolectomy. The Profunda Femoris Artery (PFA), also known as the Deep Femoral Artery, is a major branch of the FA and is frequently involved in vascular reconstruction procedures in the proximal leg. Considering the clinical importance of the PFA and its branches, this study was conducted to document the precise anatomy and variations of the PFA's origin. ***Objectives***: To determine the origin and variations in the branching pattern of Profunda Femoris Artery in the femoral triangle and to determine the distance and side of its origin from the mid-inguinal point. ***Methods***: The study utilized 40 lower limbs obtained from embalmed human cadavers in the Department of Anatomy. Dissection of The Profunda Femoris Artery (PFA) and its branches within the femoral triangle was performed according to standard anatomical manuals, and the origin, distance, and side of the PFA were measured and recorded. ***Results***: The PFA originated as a separate branch from the femoral artery in 97.5% (39 specimens) of the cases. In one specimen (2.5%), the PFA arose from the femoral artery by a common trunk with the Lateral Circumflex Femoral Artery (LCFA). The PFA most frequently originated from the lateral side of the femoral artery (57.5%, 23 specimens). The mean distance of PFA origin from the mid-inguinal point was 3.21 cm. The distance of origin ranged from 0.5 – 5 cm, with 62.5% (25 specimens) arising between 3.1–6 cm12. ***Conclusion***: The high frequency of anatomical variations, particularly in the side and distance of PFA origin, is of critical importance. Knowledge of these PFA variations is essential for surgeons, radiologists, and cardiologists to prevent possible complications during vascular access, surgical revascularization, and diagnostic procedures, thereby achieving optimal clinical results.

Keywords: Femoral artery; Profunda femoris artery; Deep femoral artery; Anatomical variations; Cadaveric study; Femoral triangle.

Introduction:

The femoral artery (FA) is a continuation of the external iliac artery, beginning behind the mid-inguinal point. It descends through the anteromedial thigh, providing several superficial and deep branches within the femoral triangle. The major deep branch is the Profunda Femoris Artery (PFA), which gives off the medial and lateral circumflex femoral arteries.

The FA is a vital site for numerous clinical interventions.1

The profunda femoris artery (deep femoral artery) is a large branch that arises laterally from the femoral artery about 3.5cm distal to the inguinal ligament. At first lateral to the femoral artery, it spirals posterior to this and the femoral vein to reach the medial side of the femur. It passes between pectineus and adductor longus and then between the latter and adductor brevis, before it descends between adductor longus and adductor magnus. It pierces adductor magnus and anastomoses with the upper muscular branches of the popliteal artery. This terminal part is named the fourth perforating artery.1

The profunda is the main supply to the adductor, extensor and flexor muscles; it also anastomoses with the internal and external iliac arteries above and the popliteal artery below. It is readily used for arterial catheterization, coronary angioplasty, and embolectomy in cases of lower limb arterial thromboembolism2. The PFA itself is frequently incorporated in vascular reconstruction procedures in the proximal leg3. However, anatomical variations in its origin's level and spatial relationship (side of origin) are well-documented in the literature. These variations can significantly affect the safety and success of percutaneous procedures (e.g., angiography, cardiac catheterization), vascular surgical procedures (e.g., bypass grafting), and flap harvest procedures that rely on the PFA's branches4. Therefore, this cadaveric study was undertaken to precisely quantify the origin, distance, and variations of the PFA within a specific population, aiming to provide concrete anatomical knowledge necessary to guide surgical and radiological interventions and minimize complications.

OBJECTIVES OF THE STUDY

- To know the origin and variations of Profunda femoris artery in femoral triangle.
- To know the distance of origin from midinguinal point and side of origin of branches of Profunda femoris artery in femoral triangle.

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Materials and Methods

The 40 lower limbs specimens were procured from the Department of Anatomy during the course of study over a period of two years.

Inclusion criteria:

All the cadavers available during study period were included.

Exclusion criteria:

Deformed or traumatized lower extremities were excluded from the study.

Materials:

1. Scalpel and scissor
2. Blunt, sharp and toothed forceps
3. Measuring tape and scale
4. Photography kit

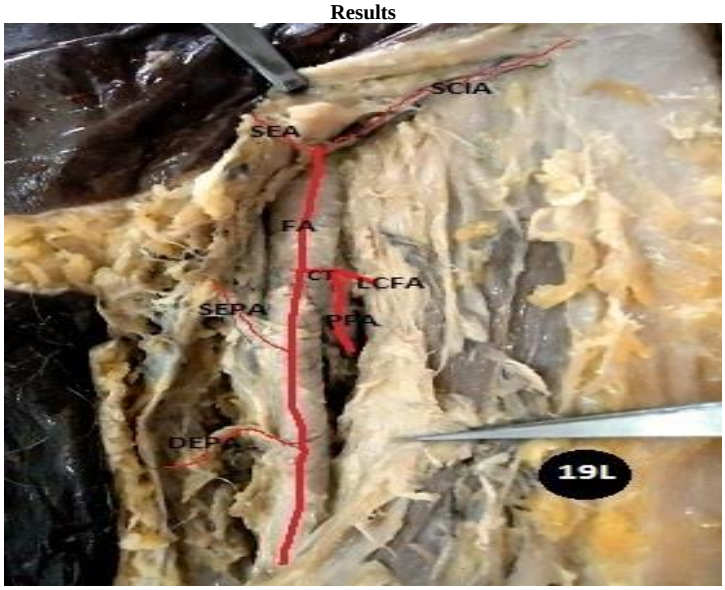
METHODS:

Dissection was done on 40 lower limbs from embalmed cadavers allotted for dissection in the Department of Anatomy. Dissection of femoral artery and its branches was carried out according to Cunningham's manual of practical anatomy.5

Incision was taken on skin from pubic tubercle to the anterior superior iliac spine. Another incision from pubic tubercle downwards and then vertically down to adductor tubercle. Transverse incision from adductor tubercle to lateral side of thigh was done and skin flap was reflected laterally.

The superficial fascia and lymph nodes were cleared and superficial branches of femoral artery were identified and cleaned. Deep branches of femoral artery were identified and cleaned. Site of origin, distance of origin from midinguinal point and side of origin of all branches of femoral artery in femoral triangle were noted. The variations in the origin of branches of femoral artery were noted. Photograph of each specimen was taken after dissection, with digital camera

Results



Remarks :	PFA & LCFA originated from FA by common trunk on posterolateral side at 4 cm from midinguinal point.

Remarks :	SCIA & SEA originated from PFA by a common trunk on lateral side at 1.5 cm from midinguinal point. PFA originated high from FA on lateral side at 0.5 cm from midinguinal point.

Table-1a : Origin of PFA

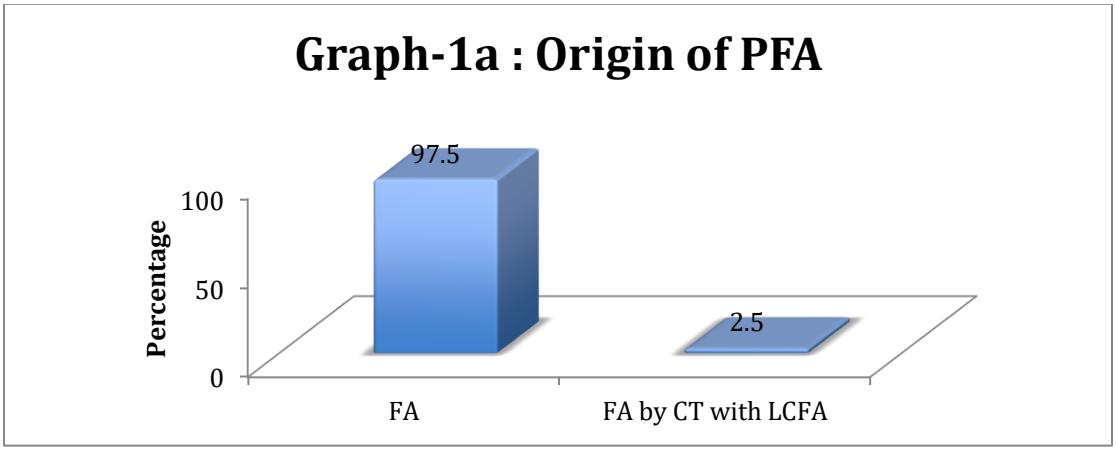
Origin	No.of specimens	Percentage
FA	39	97.5 %
FA by CT with LCFA	1	2.5 %
Total	40	100%

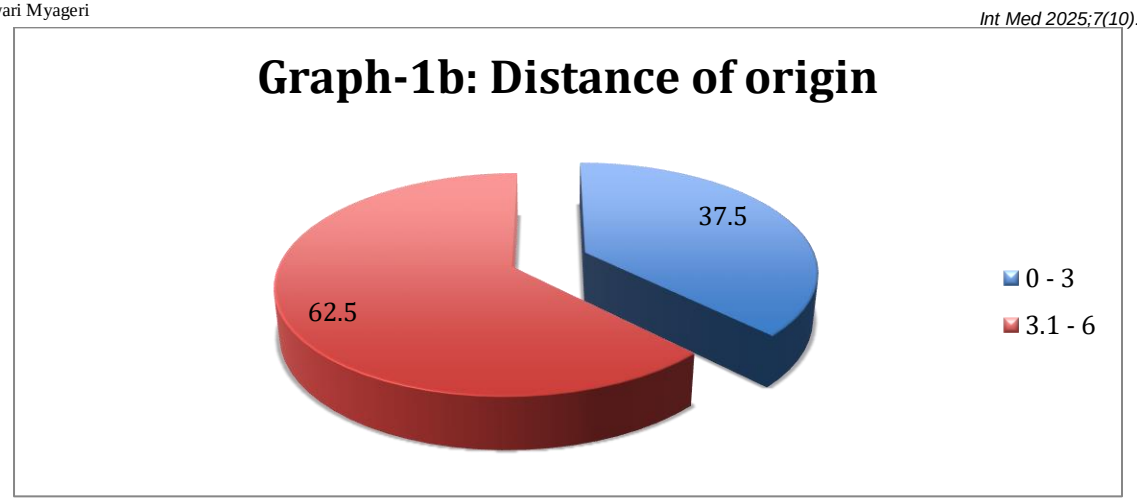
Table-1b : Distance of origin

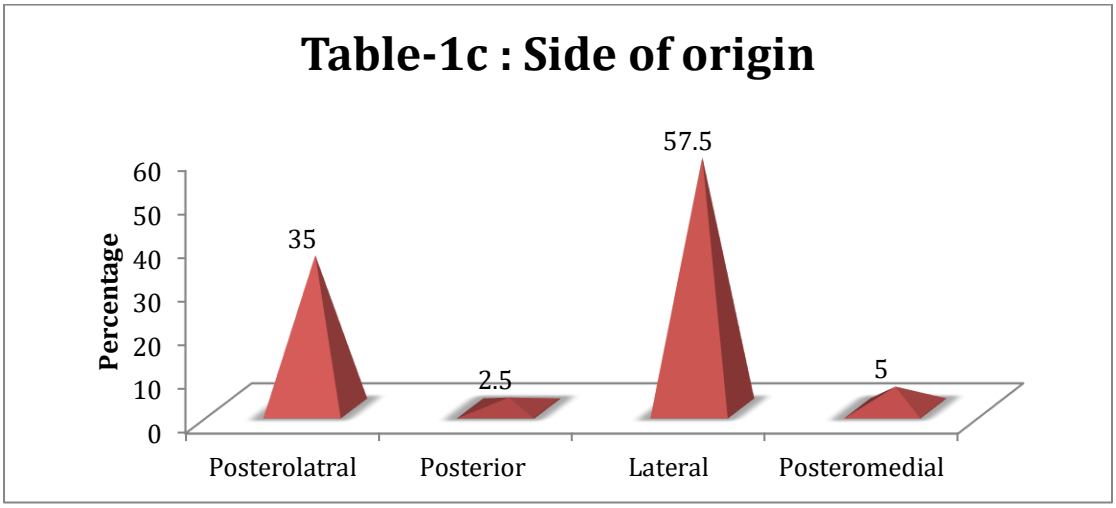
Distance (cm)	No.of specimens	Percentage
0 – 3	15	37.5 %
3.1 – 6	25	62.5 %
Total	40	100%

Table-1c : Side of origin

Side	No.of specimens	Percentage
Posterolateral	14	35 %
Posterior	1	2.5 %
Lateral	23	57.5 %
Posteromedial	2	5 %
Total	40	100%







In present study, out of 40 specimens PFA originated from femoral artery as a separate branch in 39 specimens (97.5%) and from the femoral artery by a common trunk with LCFA in 1 specimen (2.5%) as showed in Table 1a.

The distance of origin of PFA from the mid inguinal point was within 3 cm in 15 specimens (37.5%) and between 3.1 – 6 cm in 25 specimens (62.5%) as showed in Table 1b.

The PFA arises from posterolateral side in 14 specimens (35%), from posterior side in 1 specimen (2.5%), from lateral side in 23 specimens (57.5%) and from posteromedial side in 2 specimens (5%) as showed in Table 1c.

Discussion

A study was conducted on 40 lower limbs of embalmed cadavers, Femoral triangles were dissected and profunda femoris artery with its branches in femoral triangle were traced. The origin, distance from the midinguinal point and side of origin of arteries were noted.

In the present study, 97.5% (39 specimens) of PFA is found to arise from femoral artery as a separate branch and in one specimen (2.5%) it arises from femoral artery by a common trunk with LCFA. Prakash mentions in 29 out of 64 (45.3%) extremities, profunda femoris artery originated in the proximal third, in 25 out 64 (39.4%) extremities it originated in the middle third and in 10 out of 64 (15.1%) specimens' origin was in distal third of the distance from midpoint of the inguinal ligament to the apex of the femoral triangle.6 Mamatha H. gives the following recordings in her study that higher origin of the profunda femoris artery was seen in 5% of the cases.7

In the present study the distance of origin from midinguinal point ranges from 0.5 – 5 cm. It arises within 3 cm in 15 specimens (37.5%) and between 3.1 – 6 cm in 25 specimens (62.5%) whereas Prakash mentions in his study that the mean distance of separation of the profunda femoris artery from the femoral artery was 4.2 cm distal to the midpoint of the inguinal ligament.6 Marina Baptist mentions in her study that the distance of origin of profunda femoris from the femoral artery measured from midpoint of the inguinal ligament, on right side in 40% cases was 30-40 mm, in 30%, 20-30 mm and in 10% cases, 60-70 mm in thigh. On left side, in 35% cases it was 30-40 mm and in 15% it was 50-60 mm.8

Dixit mentions in his study that the profunda femoris artery originated from posterolateral aspect of femoral artery in 17 out of 48 cases i.e. 35.41% and from posterior aspect in 15 out of 48 cases i.e. 31.25%. The profunda was unduly large in 2 limbs, which was unilateral in 2 different cadavers. The distance of origin of profunda femoris from midpoint of inguinal ligament on the right side was 41-52 mm, on left side it was 46-54 mm.9Mamatha H. mentions that the profunda femoris artery originated at about 4.5 cm from the mid inguinal point.7

In the present study, PFA arises from posterolateral side of femoral artery in 14 specimens (35%), from lateral side of femoral artery in 23 specimens (57.5%), from posterior side of femoral artery in one specimen (2.5%) and from posteromedial side of femoral artery in 2 specimens (5%) on the contrary R. Chitra mentions in her study that the rare variation of the profunda femoris artery originating from the medial side of femoral artery to pass in front of the femoral vein was observed on the left femoral triangle. 10 Prakash mentions in 32 out of 64 (50%) extremities, the profunda femoris artery originated from posterolateral aspect of femoral artery, in 30 out 64 (46.9%) from posterior aspect and in 2 out of 64 (3.7%) profunda femoris separated from medical side of femoral artery.6 Daksha Dixit et al mention in their study on 228 lower limbs that the PFA originated from posterolateral aspect of femoral artery in 96 cases (42%), from posterior aspect in 68 cases (28.5%), from lateral side in 43 cases (18.8%) and from medial side in 29 cases (10.5%). The distance of origin from midpoint of the inguinal ligament on right side was 31 – 40 mm and on left side 41 – 50 mm. The PFA and LCFA arose as a common stem from femoral artery in 17.5% (20 cases).11 MB Samasawickrama gave following observations in his study that the PFA originated from posterior (12/26), posterolateral (8/26) or lateral (6/26) aspect of the common femoral artery. The distance of origin of profunda femoris from the midpoint of the inguinal ligament on the right side was 51–70 mm and on left side it was 21 – 50 mm. In 1 case (8%) PFA originated by a common stem with LCFA.2 Tanyeli E mentions in his study that the deep femoral artery was originating from the anterior aspect of the femoral artery.12

Siriporn Thitilertdecha conducted his study on 112 human cadavers and framed the following results; profunda femoris artery separated from posterior aspect of femoral artery in 100 cases (44.64%), posterolateral aspect in 68 cases (30.36%), from lateral aspect in 48 cases (21.43%) and from medial aspect in 8 cases (3.57%) and diameter of profunda femoris artery was about 5.05 mm. They were about 5.42 mm and 4.68 mm in male and female respectively and 5.08 mm on right and 5.01 mm on left side. The average distance of profunda femoris artery origin was 34.61 mm [37.68 mm in males and 31.54 mm in females] and 36.22 mm

on right and 33 mm on left side.13

Femoral artery is important as it is widely used in clinical procedures like arterial catheterization, coronary angioplasty, embolectomy in lower limb arterial thromboembolism.2 Profunda femoris artery is frequently incorporated in vascular reconstruction procedures in proximal leg.3 Medial circumflex femoral artery has important role in supplying blood to the femoral head and neck and fatty tissue in acetabular fossa.14 Lateral circumflex femoral artery is used in an anterolateral thigh flap, aortopopliteal bypass, CABG and extracranial-intracranial bypass surgery (EC-IC).15 A high-lying PFA (closer to 0.5 cm) reduces the safe working length of the CFA. The puncture of the PFA may later on form pseudoaneurysms. In hip arthroscopy, arthrodesis, and internal fixation surgery, PFA can be in a critical location during an anterior (Smith-Petersen) or anteromedial (Weinstein) approach to the hip. The DFA in such a superficial path can be at risk of undesirable surgical intervention. While the majority of PFA pseudoaneurysms occur subsequent to surgery, femur fractures, or penetrating trauma and cases of PFA pseudoaneurysms occurring subsequent to blunt trauma without femur fracture association have been reported.4 Percutaneous access to the common femoral artery must be achieved proximal to the PFA origin (the Common Femoral Artery, or CFA) to avoid dislodging plaques or causing pseudoaneurysm at the PFA branch point.

Conclusion

This cadaveric study of 40 lower limbs provides specific anatomical data on the origin of the Profunda Femoris Artery. The PFA almost exclusively arose as a separate branch from the femoral artery (97.5%). The most common site of origin was the lateral aspect (57.5%) of the femoral artery. The mean distance of origin from the mid-inguinal point was 3.21 cm, but 62.5% of the origins were found between 3.1 cm and 6 cm, confirming significant variability in the level of origin. A rare variation of the PFA originating from the posteromedial side of the femoral artery was observed in 5% of cases. All these anatomical variations are important for surgeons, radiologists, cardiologists, cardiothoracic surgeons and plastic surgeons. Knowledge of these variations, particularly the side and level of origin, is vital for vascular and surgical procedures in the femoral triangle to minimize iatrogenic injury and ensure optimal outcomes for patients undergoing diagnostic and therapeutic interventions.

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