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Case Study

ANATOMICAL VARIATIONS OF THE PROFUNDA FEMORIS AND CIRCUMFLEX ARTERIES: A CADAVERIC INSIGHT

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ABSTRACT

The femoral artery is a critical vascular structure supplying the lower limb, and its branching pattern, particularly that of the profunda femoris artery (PFA), plays a vital role in surgical, diagnostic, and emergency settings. This cadaveric study was undertaken in the Department of *Sharir Rachana*, National Institute of Ayurveda, Jaipur, wherein an anatomical variation was identified during routine dissection of a formalin-fixed male cadaver of North Indian origin. Notable asymmetries in the femoral artery's branching pattern were found on the right and left sides. On the right side, the upper lateral circumflex femoral artery (LCFA1) and PFA arose from a common trunk, 6cm below the mid-inguinal point, with an additional lower LCFA (LCFA2) branching 1.5 cm below. The medial circumflex femoral artery (MCFA) was absent on this side. On the left side, the MCFA was present and originated 4cm below the mid-inguinal point, while the PFA and superficial femoral artery (SFA) bifurcated 5cm below this point. The LCFA originated from the PFA immediately after this bifurcation. These findings highlight the clinical significance of arterial variations, which may impact orthopaedic surgeries, vascular interventions, and trauma management. Accurate preoperative identification using imaging modalities such as Doppler ultrasound, CTA, MRA, and DSA is crucial for minimizing complications[1]. This study emphasizes the necessity for surgeons and clinicians to be aware of such anatomical differences to improve surgical outcomes and ensure patient safety.

INTRODUCTION

The femoral artery, the chief arterial supply of the lower limb, arises as a direct continuation of the external iliac artery at the level of the inguinal ligament. As it courses through the femoral triangle, its superficial position renders it highly accessible, making it a frequent site for clinical interventions such as catheterization and vascular access. One of its key branches, the profunda femoris artery (deep femoral artery), further subdivides into the medial and lateral circumflex femoral arteries and four perforating arteries. These branches play a vital role in vascularizing muscles across all three fascial compartments of the thigh, including the adductor magnus, hamstrings, and vastus lateralis.

The medial and lateral circumflex femoral arteries form a vascular loop around the proximal femur, providing essential blood flow to the thigh musculature and the femoral head. Notably, the medial circumflex femoral artery is the dominant supplier to the femoral head and neck via its posterior retinacular branches—vessels that are particularly vulnerable to injury in femoral neck fractures and hip dislocations, often resulting in avascular necrosis. In contrast, the lateral circumflex femoral artery primarily supports the lateral thigh musculature and contributes less to the femoral head's vascularization.

Distally, the femoral artery passes through the adductor hiatus and continues as the popliteal artery. Given the clinical importance of its anatomical course and branching patterns, a detailed understanding is crucial during surgical procedures such as bypass grafting, orthopedic reconstruction, and trauma

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management. Anatomical variations, particularly in the profunda femoris and its branches, can pose significant challenges during such interventions, underscoring the importance of thorough preoperative vascular assessment.

Case Report

The dissection was carried out in the department of Sharir Rachana, National Institute of Ayurveda, Jaipur during the routine dissection of a formalin-fixed male cadaver of North Indian origin, wherein variations in the course of the femoral artery branches were observed on both sides of the cadaver.

MATERIAL AND METHODS

During routine dissection, it was observed that the branching pattern of the profunda femorisarteries on the left and right was different.

1. COURSE OF FEMORAL ARTERY ON RIGHT SIDE

Case1: Duplication of lateral circumflex femoral artery (LCFA):

The femoral artery originates at the inguinal ligament and gives rise to the upper lateral circumflex femoral artery (LCFA1) laterally, approximately 6 cm below the mid-inguinal point, as a common trunk with the profunda femoris artery (PFA), as shown in Figure 1.1. At this same point, the superficial femoral artery (SFA) also emerges alongside the PFA. The SFA courses through the thigh in association with the femoral vein and proceeds into the adductor canal. The PFA gives rise to the lower lateral circumflex femoral artery (LCFA2) about 1.5 cm distal to the origin of LCFA1.

Case2: Different branching pattern of lateral circumflex femoral artery

LCFA2 branches into three divisions, whereas LCFA1 gives off five branches, as illustrated in Figure 1.3.

Case 3: Absence of Medial circumflex femoral artery (MCFA)

In this cadaveric specimen, the medial circumflex femoral artery (MCFA) was absent, as shown in Figure 1.5.

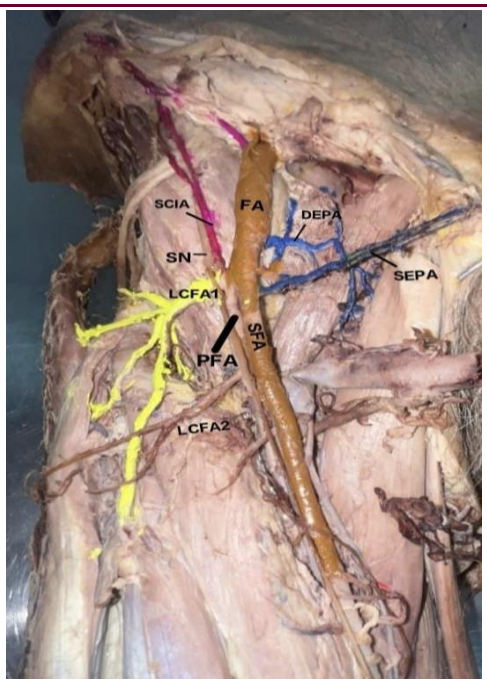

Fig. 1.1 Duplication (LCFA1 & LCFA2) of LCFA originating from PFA at different levels

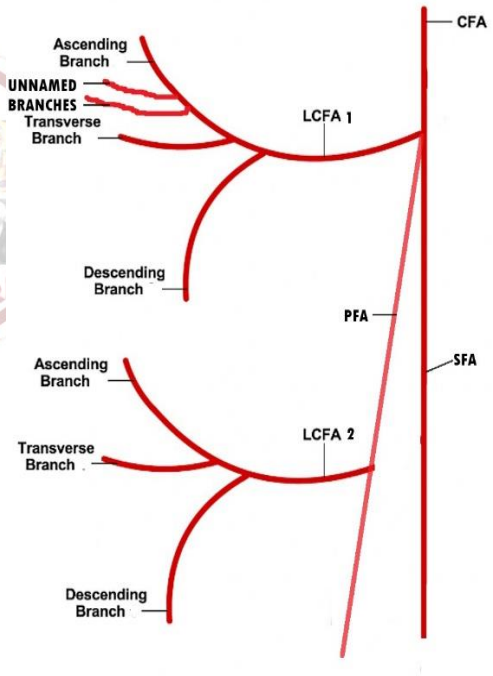

Fig. 1.2 Image showing the variant pattern

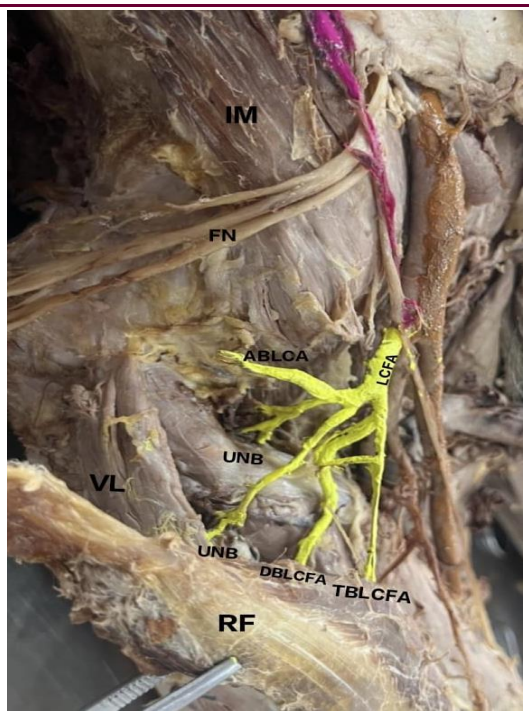

Fig. 1.3 LCFA1 with its 5 branches, i.e., ascending (AB), descending (DB), transverse branches (TB), with 2 unnamed branches (UNB).

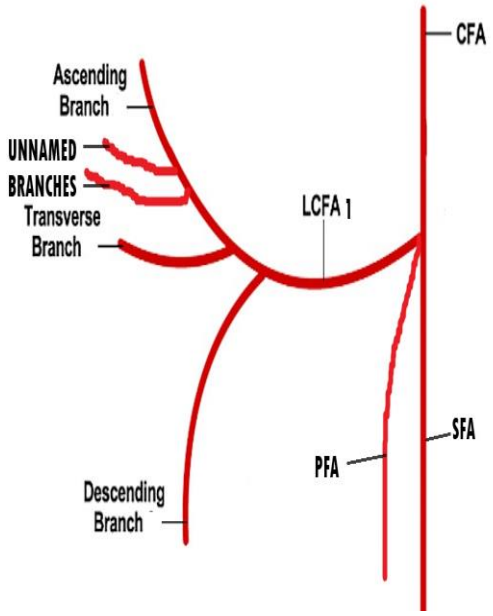

Fig. 1.4 branching pattern of LCFA1

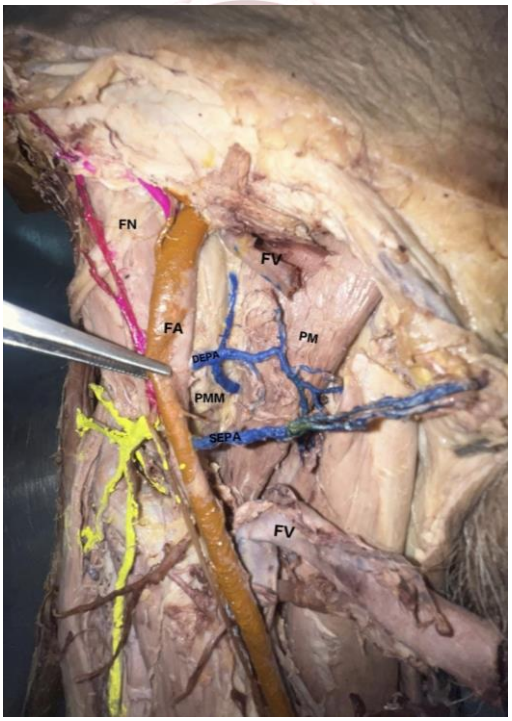

Fig. 1.5 MCFA absent Image showing medial side DEPA (deep external pudendal artery) & SEPA (superficial external pudendal artery)

Course of Femoral Artery on Left Side

The femoral artery originates at the inguinal ligament and gives off the MCFA approximately 4 cm inferior to the mid-inguinal point. FA extends down and bifurcates into the PFA laterally and the SFA medially 5cm below the mid-inguinal point. The SFA descends through the thigh in relation to the femoral vein and continues into the adductor canal. LCFA takes origin from PFA immediate after bifurcation.

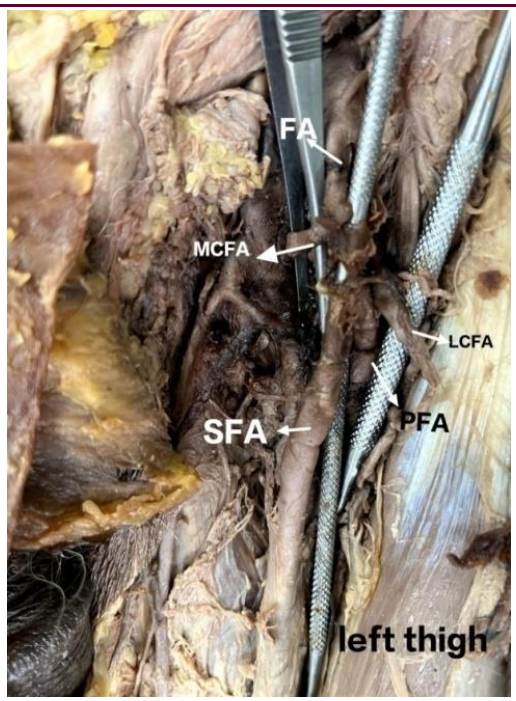

Fig 2.1 (Left thigh) showing the origin of MCFA, LCFA, and PFA

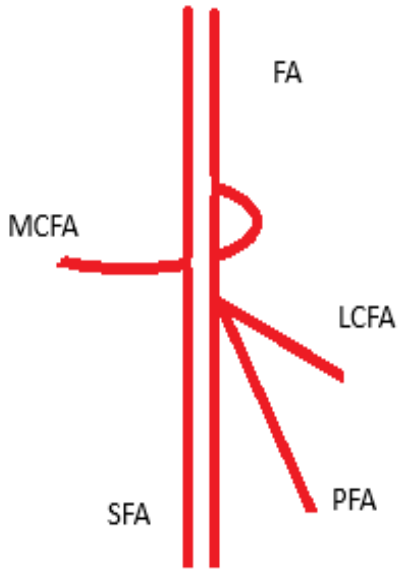

Fig 2.2 Image showing the pattern of MCFA, LCFA & PFA

Comparison B/W Both Sides

Table 3.1 Distance of origin point of different arteries from mid-inguinal point

S.No.	Artery	Left Side	Right Side	
1.	LCFA	5cm	6cm	7.5cm
2.	MCFA	4cm	Absent	
3.	PFA	5cm	6cm	

RESULT

The clinical significance of variations in the branching pattern of the femoral artery, particularly the profunda femoris artery (PFA), is crucial due to its role in supplying blood to the thigh and hip [1]. These variations can significantly impact surgical outcomes, especially in orthopaedic and vascular surgeries, where unrecognized differences in arterial branching can lead to complications such as artery damage, haemorrhage, or ischemia. In procedures like hip replacements or femoral artery bypasses, a thorough understanding of the PFA's anatomy is necessary to avoid inadvertent injury, ensure effective collateral circulation, and minimize postoperative risks.[2]

Variations also play a vital role in trauma management, where accurate knowledge of the PFA's branching pattern is crucial in controlling haemorrhage, particularly in femoral fractures or penetrating injuries. Emergency interventions rely on identifying the correct anatomical layout for effective bleeding control and rapid vascular repairs.

In angiographic and imaging procedures, such as those used to treat peripheral arterial disease (PAD), variations in PFA branches can affect the success of interventions like angioplasty and catheterization[3]. Clinicians must account for these variations in ultrasound-guided procedures and during the placement of grafts or stents to prevent complications.

Detecting these variations is critical for surgical and diagnostic precision. Several methods are employed[4]:

- Doppler Ultrasound: A non-invasive way to visualize blood flow and identify arterial variations.
- CT Angiography (CTA) and Magnetic Resonance Angiography (MRA): These provide detailed, 3D views of the vascular system, allowing precise identification of arterial patterns.
- Digital Subtraction Angiography (DSA): The gold standard for detailed mapping of arterial structures, especially in pre-surgical planning.
- Cadaveric Dissection: Used for direct visualization in anatomical studies.
- 3D Printing: Combining advanced imaging with 3D modelling to create detailed anatomical representations for educational or surgical planning.

DISCUSSION

The present cadaveric study highlights the clinical significance of variations in the branching pattern of the femoral artery, particularly the profunda femoris artery (PFA) and its branches. The study observed asymmetrical branching in a formalin-fixed male cadaver, with notable differences between the right and left femoral artery patterns. Such variations can have profound implications for orthopaedic and vascular surgeries, as unrecognized anatomical differences may lead to serious complications such as haemorrhage, artery damage, or ischemic injury during procedures like hip replacements or femoral artery bypasses[5].

In trauma management, especially in cases of femoral fractures or penetrating injuries, understanding these variations is essential for effective haemorrhage control and rapid vascular repair. Furthermore, in angiographic and imaging-guided interventions, like those for treating peripheral arterial disease (PAD), awareness of arterial branching variations can improve the success of procedures such as angioplasty and catheterization.

CONCLUSION

Detecting these variations through modern imaging techniques like Doppler ultrasound, CT angiography (CTA), magnetic resonance angiography (MRA), and digital subtraction angiography (DSA) is crucial for precise surgical and diagnostic planning. Overall, this study emphasizes the importance of anatomical knowledge in minimizing operative risks, improving surgical outcomes, and optimizing patient care.

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