

Anatomic Study of the Profunda Femoris Artery and its Circumflex Femoral Branches: A Cadaveric Study

Ch Jwalaram Kumar¹, Suresh Babu Kottapalli², Sudhir Modala³, D. Krishna Chaitanya Reddy⁴

¹Assistant Professor, Department of Anatomy, Government Medical College, Ongole, Andhra Pradesh

²Associate Professor, Department of Anatomy, Rohilkhand Medical college & Hospital, Bareilly, Uttar Pradesh

³Assistant Professor, Department of Physiology, Government Medical College, Ongole, Andhra Pradesh

⁴Assistant Professor, Department of Anatomy, Kamineni Academy of Medical Sciences and Research Centre, Hyderabad, Telangana

Received: 26-11-2022 / Revised: 30-12-2022 / Accepted: 20-01-2023

Corresponding author: D. Krishna Chaitanya Reddy

Conflict of interest: Nil

Abstract

Introduction: The successful outcome of any surgical or diagnostic intervention in the femoral region influenced by the knowledge on the anatomical variations of the profunda femoris artery (PFA) and its branches including medial and lateral circumflex femoral artery. The variations of PFA must have been taken in account to prevent unpredicted and unpleasant problems. The present study was designed to identify the anatomical variations of the profunda femoris artery and its branches in terms of their origin and course.

Material and Methods: A source of 52 lower limbs belonged 26 human cadavers were dissected, out of which 20 are male and 06 are females with age ranging from 26 years to 65 years. By following standard dissection procedures, the parameters including site of origin, distance of origin, and variations of profunda femoris artery was collected. Similarly, source, and distance of origin and variations of medial circumflex femoral artery (MCFA) and lateral circumflex femoral artery (LCFA) were recorded.

Results: In 73.08% of limbs, PFA was arising from posterolateral aspect of main trunk of the femoral artery. The interspace between mid-inguinal point to site of origin of PFA was 3-4 cm in 50% of right and 53.84% of left lower limbs. The medial and lateral circumflex femoral artery has been identified as a direct branch from profunda femoris artery. The interspace between origin of LCFA and PFA was 1 to 2 cm and MCFA and PFA was 2-3 cm.

Conclusion: A detailed anatomical knowledge on variations of site, source, and course of origin of PFA and its branches is a fundamental during surgical and diagnostic procedure and catheterization of vessels in the femoral triangle.

Keywords: Profunda Femoris Artery, Anatomical Variations, Medial and Lateral Circumflex Femoral Artery,

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Introduction

The embryological source of lower limb arteries is axis artery, which is emanate from fifth lumbar artery. In order to configure a definitive arterial pattern, few vascular trenches regresses. But persistence of the vascular channels that are supposed to regress leads to vascular anomalies [1]. The femoral artery is a major arterial channel of the lower extremity, which has profund femoris artery or deep femoral artery as a significant branch [2]. The PFA is commonly originates from posterolateral aspects of femoral artery with a distance ranged between 3-4 cm from mid inguinal point [3]. The medial circumflex femoral artery and lateral circumflex femoral artery are the influential branches of PFA and provides blood supply to the muscles of thigh and hip joint. The anatomical knowledge on site of origin of PFA and its branches is of great important in vascular surgeries to proximal leg, preventing flap necrosis, especially tensor fascia lata, during vascular transplantation and reconstruction procedures [4-6]. Knowledge on anatomy of profunda femoris artery and its branches is of great significance in preventing profuse haemorrhage, pseudo aneurysms and traumatic AV fistulae in surgical procedures to femoral region [7]. The variations of the PFA and its branches are numerous and to a considerable extent are largely associated with one another. Hence, this cadaveric study was designed to identify the anatomical variations of the origin of profunda femoris artery and its branches.

Materials and Methods

The present cadaveric study was conducted

Results

Table 1: Site of origin of profunda femoris artery from femoral artery

	Right side (n=26)		Left side (n=26)	
	Frequency	Percentage	Frequency	Percentage
Site of origin from femoral artery				
Posterolateral	19	73.08%	17	65.38%

in the Department of Anatomy at Kamineni Academy of Medical Sciences and Research Centre, Hyderabad and Government Medical College, Ongole during 2020 to 2022. A source of 26 human cadavers including 20 male and 6 female cadavers with ages ranging from 26 to 65 years were included. A total of 52 lower limbs of bilateral sides were dissected for the anatomical variations of Profunda femoris artery and its branches.

The dissection of femoral triangle and its contents was conducted as per Cunningham's manual of practical anatomy. At first, a transverse incision was made from the anterior superior iliac spine to pubic tubercle. The second vertical incision from midpoint of first incision to upper one third of the thigh was made. The covering including skin and superficial fascia was reflected around the incision. The superficial contents, sartorius and adductor longus muscles were separated and femoral sheath was exposed. The femoral sheath and its compartment were exposed for femoral artery and vein and Profunda femoris artery. After dissecting and exposing the Profunda femoris artery and its branches the following details including source of origin, site of origin, interspace from the midpoint of inguinal ligament, course of artery and variations of profunda femoris artery was documented. Similarly, source of origin, site of origin, pattern of origin and variations in above details of medial circumflex artery and lateral circumflex artery are documented. The interspace from the midpoint of inguinal ligament to origin of profunda femoris artery was measured by the transparent measuring scale or thread.

Posteromedial	01	3.84%	-	-
Posterior	04	15.38%	06	23.07%
Lateral	02	7.70%	03	11.53%
Interspace between mid-inguinal point to site of origin.				
<10	01	3.84%	02	7.70%
11-20	03	11.53%	04	15.38%
21-30	02	7.70%	03	11.53%
31-40	13	50%	14	53.84%
41-50	06	23.07%	03	11.53%
> 50	01	3.84%	-	-
Total length of PFA (In cm)				
<10	05	19.23%	07	26.92%
11-12	14	53.84%	13	50%
>12	07	26.92%	06	23.07%

Table 2: Origin of medial and lateral circumflex femoral arteries on both sides.

Origin source	MCFA		LCFA	
	Right side	Left side	Right side	Left side
Origin of medial and lateral circumflex femoral arteries				
Profunda femoris artery	21 (80.76%)	23 (88.46%)	19 (73.08%)	21 (80.76%)
As common trunk from FA	02 (7.70%)	02 (7.70%)	03 (11.53%)	02 (7.70%)
From femoral artery	02 (7.70%)	01 (3.84%)	02 (7.70%)	01 (3.84%)
Dual origin	01 (3.84%)	-	01 (3.84%)	01 (3.84%)
Absent	-	-	01 (3.84%)	01 (3.84%)
Interspace between origin of MCFA and LCFA with origin of profunda femoris artery.				
<10	01 (3.84%)	-	03 (11.53%)	-
11-20	11 (42.30%)	08 (30.76%)	18 (69.23%)	21 (80.76%)
21-30	14 (53.84%)	17 (65.38%)	04 (15.38%)	03 (11.53%)
>30	-	01 (3.84%)	01 (3.84%)	02 (7.70%)

**Figure 1: Site and source of origin of profunda femoris artery.**

*FA- femoral artery, PFA- Profunda femoris artery

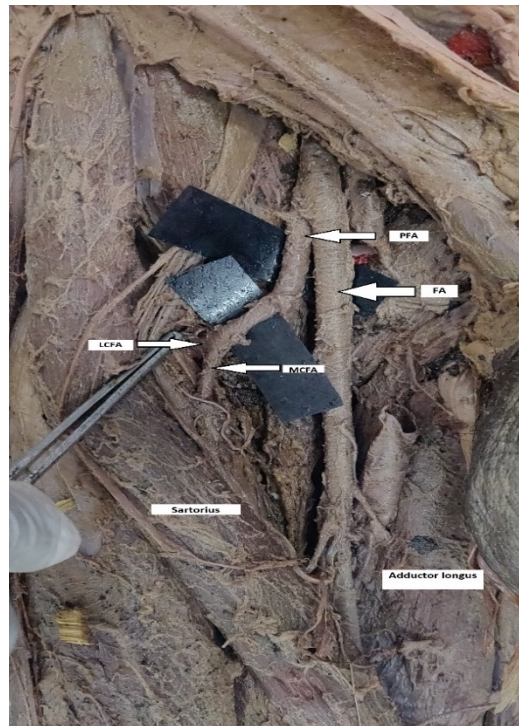


Figure 2: Source of origin of lateral and medial circumflex femoral artery.

***FA- femoral artery, LCFA- Lateral circumflex femoral artery, MCFA- Medial circumflex femoral artery, PFA- Profunda femoris artery**

Discussion

Anatomical knowledge of profunda femoris artery is of great importance anatomists, surgeons and interventional radiologists due to their practical significance while performing surgeries in femoral triangle, femoral puncture and interventional radiological procedures [8]. Knowledge on PFA is important in surgical procedure to hip region to restrict intraoperative haemorrhage, and avascular necrosis of head of the femur [9].

Profunda femoris artery:

Several studies have been reported that the profunda femoris artery commonly arises from posterolateral aspect of main trunk of the femoral artery [9-12] (Table 3). The current study findings were similar to the above findings where in right lower limbs, the profunda femoris artery was arising from posterolateral aspect of femoral artery in

73.08%, posteriorly in 15.38%, laterally in 7.70% and posteromedial aspect in 3.84%. Similarly, in left side, majority lower limbs exhibited posterolateral origin (65.38%), followed by posterior (23.07%) and lateral origin (11.53%) (Table 1).

Majority limbs showed interspace between mid-inguinal point to site of origin of PFA was 3-4 cm (50% on right side & 53.84% on left side) followed by 5-6 cm (23.7%) (Table 1). Gowri *et al.*, found that in majority cases the distance between mid-inguinal point to PFA origin was 3-4 cm (29% right & 43% left) [9]. Rajani *et al.*, found a common range of distance between the origin of PFA and mid inguinl point was 2 to 4 cm in 60% of lower limbs [10]. Manjappa *et al.*, found a mean distance of 3.56 cm on right side and 3.195 cm on left side [11]. A study by Manicka *et al.*, reported 1-2 cm as common distance between PFA origin and mid

inguinal point [13]. Similarly, Dixit *et al.*, found 4 to 5.2 cm (11 on right & 7 on left) and 3 to 4 cm (5 on right & 9 on left) as

commonly observed distance between mid-inguinal point and PFA origin [14].

Table 3: Comparison of origin of PFA between present study with previous studies.

Origin site	Present study (n=52)		Manjappa <i>et al.</i> , 2014 (n=40) [11]		Rajani <i>et al.</i> , 2015 (n=66) [10]	Gowri <i>et al.</i> , 2021 (n=70) [9]		Nasr <i>et al.</i> , 2014 (n=90) [12]	
	Rt	Lt	Rt	Lt	Both sides	Rt	Lt	Rt	Lt
Posterolateral	73.08%	65.38%	50%	70%	53.03%	48.6%	45.8%	44.4%	40%
Posteromedial	3.84%	-	-	-	13.63%	-	-	8.8%	15.5%
Posterior	15.38%	23.07%	40%	10%	10.61%	11.4%	11.43%	24.4%	26.7
Lateral	7.70%	11.53%	5%	15%	18.17%	40%	34.3%	22.2%	17.8%
Absent	-	-	5%	5%	-	-	-	-	-

Medial circumflex femoral artery:

In 80.76% of right side and 88.46% of left side lower limbs, the medial circumflex femoral artery has been identified as a direct branch from profunda femoris artery (Table 2). Several studies have reported similar findings that MCFA artery was commonly arises from profunda femoris artery [11, 12, 15-18]. Whereas, Manjappa *et al.*, found in 50% of right lower limbs MCFA was arising from main trunk of femoral artery [11] (Table 4). Dixit *et al.*, found in 50% on right side and 75% on left side the MCFA was originated from PFA [14]. The interspace between origin of MCFA and origin of PFA was 2-3cm in 53.84% of right limbs and 65.38% of left limbs (Table 2). Maniappa *et al.*, reported a mean distance of 3.96 cm and 4.85 cm from PFA and 2.71 cm and 2.65 cm from femoral artery on right and left lower limbs respectively [11]. Nasr *et al.*, reported a common range of distance between origin of MCFA and PFA was up to 1 cm [7], followed by 1-2 cm [6] on right side and 1-2 cm [7] on left side in males. Whereas in females, 1-2 cm (5 on Right & 6 on left) and 2-3 cm (5 on right & 4 on left) were commonly observed [12]. Dixit *et al.*, reported a common range of distance between origin of MCFA and PFA was 2-3 cm followed by 1-2 cm [14]. Gowri *et al.*, found that distance between origin of

MCFA and PFA was up to 1 cm in 32.9% limbs and 1 to 2 cm in 31.4% of lower limbs [15].

Lateral circumflex femoral artery:

The lateral circumflex femoral arteries were commonly arising from profunda femoris artery in 73.08% of right limbs and 80.76% of left limbs (Table 2). Several studies have reported similar findings that LCFA artery was commonly arises from profunda femoris artery [11, 12, 17, 18] (Table 4). Dixit *et al.*, found in 75% on right side and 91.67% on left side the LCFA was originated from PFA [14].

The interspace between origin of LCFA and origin of PFA was 1 to 2 cm in 69.23% of right limbs and 80.76% of left limbs. Maniappa *et al.*, reported that the mean distance from PFA was 5.63 cm and 5.37 cm and from femoral artery was 4.25 cm and 4.8 cm on right and left lower limbs respectively [11]. Nasr *et al.*, reported a common range of distance between origin of MCFA and PFA was 1-2 cm [12]. Manicka *et al.*, found up to 1 cm distance between origin of LCFA and origin of PFA in majority limbs [13]. Dixit *et al.*, reported a common range of distance from origin of LCFA and PFA was 2.3 to 3.4 cm on both sides [14].

Table 4: Comparison of source of origin of MCFA between present study with previous studies.

Origin	Present study (n=52)		Gowri <i>et al.</i> 2021 (n=70) [15]		Zlotorowicz <i>et al.</i> 2018 (n=100) [16]	Vuksanović-Božarić <i>et al.</i> 2018 (n=60)	Manjappa <i>et al.</i> 2014 (n=40) [11]		Nasr <i>et al.</i> 2014 (n=90) [12]	Prakash <i>et al.</i> 2010 (n=32) [18]
	Rt	Lt	Rt	Lt	Both sides	Both sides	Rt	Lt	M: F	Both sides
PFA	80.76%	88.46%	85.7%	85.7%	65%	78.3%	40%	60%	60%:57.5%	67.2%
As com-mon from FA	7.70%	7.70%	8.6%	8.6%	-	1.6%	10%	5%	18%:15%	32.8%
From FA	7.70%	3.84%	5.7%	-	31%	11.7%	50%	35%	14%:17.5%	-
Dual origin	3.84%	-	-	-	-	-	-	-		-
Absent	-	-	-	-	-	-	-	-		-

Table 4: Comparison of source of origin of LCFA between present study with previous studies.

Origin	Present study (n=52)		Manjappa <i>et al.</i> 2014 (n=40) [11]		Vuksanović-Božarić <i>et al.</i> 2018 (n=60) [17]	Nasr <i>et al.</i> 2014 (n=90) [12]	Prakash <i>et al.</i> 2010 (n=32) [18]
	Rt	Lt	Rt	Lt	Both sides	M: F	Both sides
PFA	73.08%	80.76%	80%	70%	83.3%	74%:65%	81.25%
As common from FA	11.53%	7.70%	-	5%	1.6%	14%:15%	18.75%
From FA	7.70%	3.84%	20%	25%	6.7%	8%:12.5%	-
Dual origin	3.84%	3.84%	-	-	-	-	-
Absent	3.84%	3.84%	-	-	-	-	-

Conclusion

In conclusion, the common site of origin of PFA was posterolateral aspect of FA. The common distance between origin of PFA to mid inguinal point was 3-4 cm. In majority limbs, MCFA and LCFA was originated from PFA, followed by main trunk of femoral artery. A detailed anatomical knowledge on variations of site, source, and course of origin of PFA and its branches is a fundamental during surgical and diagnostic procedure and

catheterization of vessels in the femoral triangle.

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