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VARIATIONAL ANATOMY OF PROFUNDA FEMORIS ARTERY AND ITS BRANCHES: A CADAVERIC STUDY

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ABSTRACT: BACKGROUND: Accurate knowledge of anatomical variations regarding origins of the profunda femoris, medial and lateral femoral circumflex femoral arteries are important for clinicians in the present modern era of interventional radiology. Our aim of this study was to observe and identify the variations in origin of the Profunda femoris artery and its circumflex branches. **MATERIALS & METHODS:** 66 femoral triangles were dissected on 33 cadavers (Both sides). The profunda femoris vessel and its medial and lateral circumflex arteries were dissected and identified. The distance of the site of origin of Profunda Femoris Artery was measured from mid- inguinal point (MIP) in centimetres with scale, thread, and digital callipers. The sites of origin of Medial Circumflex Femoral Artery and Lateral Circumflex Femoral Artery were also studied and the distances of origin of each of them were measured from the origin of the Profunda Femoris Artery and from the mid- inguinal point. All the data were interpreted in tables.

RESULTS: The data from the study was analyzed using statistical methods and analyzed by using the statistical package SPSS (Statistical Package for Social Sciences) version 16.0 for windows in present study for analyzing the data contingency table were created first and then analyzed by using the Pearson's chi-square test. The present study encountered that, in approximately 50% cases the profunda femoris artery originated from the lateral aspect of the common femoral artery. The lateral and medial circumflex femoral artery commonly originated from the profunda femoris nearly close to its origin from common femoral artery. **CONCLUSION:** This knowledge of variation and position would be very useful in preventing the iatrogenic injury to these vessels during surgical procedures of the femoral triangle. So, this study would be useful for the clinician for surgical and therapeutic intervention.

KEYWORDS: Cadavers, Arteria profunda femoris, lateral and medial circumflex femoral arteries, Measurements.

INTRODUCTION: The proper knowledge of the course and ramification of the blood vessels of the lower limb is very important for surgeons and interventional radiologists.^{1,2}

This is because the lower limb arteries are commonly involved with peripheral occlusive arterial diseases and the femoral artery (FA) at the femoral triangle is widely used for certain clinical procedures like arterial catheterization. Accurate knowledge of anatomical variations regarding origins of the profunda femoris, medial and lateral femoral circumflex femoral arteries are important for clinicians in the present modern era of interventional radiology.^{1,2}

The profunda femoris artery (PFA) is the largest branch of the femoral artery. This vessel is useful for the doppler imaging, ultrasound, arteriography, angiography and also magnetic resonance imaging (MRI).^{1,2,3,4,5,6} The profunda femoris artery usually arises from the

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posterolateral aspect of the femoral artery. The medial and lateral circumflex femoral arteries normally arise from the profunda femoris artery near to its origin.^{1,2}

The above mentioned arteries have many implications in clinical practice. The branches of the Lateral Circumflex Femoral Artery are used in anterolateral thigh flap,^{3,6} aortopopliteal bypass,⁷ coronary artery bypass grafting (CABG),⁸ an extracranial-intracranial (EC-IC) bypass surgery,⁹ The descending branch of the artery can act as a collateral. The ascending branch of the artery can be used as a supply for vascularised iliac transplantation.

So, the knowledge of variations in height of origin of profunda femoris artery and its branches has a great significance preventing necrosis of tensor fascia lata flap when used in plastic and reconstructive surgery.^{6,10}

MATERIALS AND METHOD: The materials used for this study were Scale, thread. Digital calliper, Colour paint, Painting brush etc.

66 femoral triangles were dissected on 33 cadavers (Both sides) used for teaching undergraduate and postgraduate students of the Department of Anatomy. By the standard incision, femoral triangles were exposed. The contents of femoral triangle including the branches of femoral arteries were identified.

The profunda femoris vessel and its medial and lateral circumflex arteries were dissected and identified. Damaged femoral arteries, Profunda Femoral Artery and its branches were excluded in this procedure. Only the properly preserved and intact vessels were considered for this study purpose.

The distance of the site of origin of Profunda Femoris Artery was measured from mid-inguinal point (MIP) in centimetres with scale, thread, and digital callipers (Fig. 1). The sites of origin of Medial Circumflex Femoral Artery and Lateral Circumflex Femoral Artery were also studied and the distances of origin of each of them were measured from the origin of the Profunda Femoris Artery and from the mid-inguinal point. After that, the artery was coloured with red, vein with blue, nerve with yellow and mid-inguinal Point with green and then photographs were taken.

RESULTS: The Profunda Femoris Artery generally originated from Common Femoral Artery between 3-4cm from the mid inguinal point. The distances of PFA were taken in different ranges in 33 cadavers on both sides. In case of 5 specimens on both sides it was less than 3 cm, and in 19 on the left and 15 on the right sides it was ranged between 3 to 4 cm and it was above 4 cm in case of 9 left and 13 right limbs (Table-1).

The distances of LCFA from the origin of profunda femoris artery were taken in three groups it was less than 2 cm in 8 cases, 2 to 3 cm was seen in 17 on right side and 14 on the left side and above 3 cm were seen in 9 on left and 8 on right (Table-2).

The distances of MCFA from the origin of profunda femoris artery were taken in three groups of ranges in 33 cadavers on both sides, it was less than 2 cm in 4 cases on left side and 3 on the right side, 2-3 cm was seen in 10 on left side and 11 on the right side and above 3 cm were seen in 19 on both sides (Table -3).

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The position of origin of the Profunda femoris artery were recorded in 33 cadavers on both sides, it was lateral in 14 cases on left side and 19 on right side, posterolateral was seen in 11 on right side and 6 on the left side and posterior in 8 cases on both sides (Table - 4).

The distances of LCFA and MCFA from the mid inguinal point were taken in three groups of ranges in 33 cadavers on both sides, it was less than 4 cm in 5 cases, 4 to 6 cm was seen in 20 on right side and 21 on the left side and above 6 cm were seen in 7 on left and 8 on right (Table 5 and 6).

The comparison of the origin of LCFA and MCFA with the distance of origin of PFA was taken in three groups of ranges in 33 cadavers on both sides. (Table 7 and Table- no 8).

The data from the study was analyzed using statistical methods and analyzed by using the statistical package SPSS (Statistical Package for Social Sciences) version 16.0 for windows. Mainly the frequencies, standard deviation and chi-square test which are non-parametric test were used for analyzing the data. All the data were interpreted in tables.

THE CHI-SQUARE (X²) TEST: In present study for analyzing the data contingency table were created first and then analyzed by using the Pearson's chi-square test. Pearson's chi-square test is by far the most common type of chi-square significant test. This statistics is used to test for the hypothesis of no association of columns and rows in tabular data. A chi-square probability of 0.05 or less is commonly interpreted as significant and justification for rejecting the null hypothesis. The null hypothesis assumes that there is no association between the variables; the chi-square test is based on a test of statistics that measures the divergence of observed data from the values that would be expected under the null hypothesis of no association. The chi-square value is not interpretable directly but must be compared to a table of the chi-square distribution. Degree of freedom (df) was calculated as: $df = (r-1) \times (c-1)$, where 'r' is the number of rows and 'c' is the number of columns.

DISCUSSION: In a study done by M B Samarawickrama et al 23% (6/26) Profunda Femoris Artery originated from the lateral aspect and 46% (12/26) from the posterior aspect¹. In the present study, the profunda femoris artery was originating from the posterior side of the common femoral artery in 16/66 cases (25%), posterolaterally in 17/66 (26%) and mostly from the lateral side in 33/66 cases (50%) on both sides (Figure 2 and 3). In 15% cases the origin of profunda femoris artery was close to the mid inguinal point. M B Samarawickrama et al showed an interesting feature that when the artery originated close to the inguinal ligament, it originated from the lateral side of the common femoral artery¹. The knowledge of the side of origin of the Profunda Femoris Artery helps in avoiding iatrogenic femoral arterio-venous fistula while performing femoral artery puncture & it enables to identify the correct site of making incision for surgical exposure of the common femoral and profunda femoris junction.

The lateral circumflex femoral artery (LCFA) originated from the profunda femoris artery (PFA) in all cases on each side (Figure 4). That was the commonest pattern of origin of this artery sited in the previous studies.^{1,11,12} Present study did not encounter any lateral circumflex femoral artery originating from the common femoral artery. M Uzel et al found that few Lateral Circumflex Femoral Arteries directly originated from the main femoral artery.³ In this study no any significant variation of this kind was seen.

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The medial circumflex femoral artery (MCFA) originated from the Profunda Femoris Artery. In the present study 91% cases it was originating from the profunda femoris artery (Figure-5), but in 7% cases on left side the origin was from the main common femoral artery. (Figure-6) This was comparable to some other studies where in most of the times the Medial Circumflex Femoral Artery originated from Profunda Femoris Artery.^{1,2}

CONCLUSION: In conclusion, the origin of profunda femoris artery and its branches were similar to that of other studies except with some minor variations. The present study encountered that, in approximately 50% cases the profunda femoris artery originated from the lateral aspect of the common femoral artery. The lateral and medial circumflex femoral artery commonly originated from the profunda femoris nearly close to its origin from common femoral artery but, interestingly in this study 7% cases (3 out of 33) on left side the medial circumflex femoral artery directly originated from the common femoral artery and it was more proximal than the origin of profunda femoris from common femoral artery.

This knowledge of variation and position would be very useful in preventing the iatrogenic injury to these vessels during surgical procedures of the femoral triangle. Also the aforesaid anatomical facts should be considered before planning different diagnostic and therapeutic interventions on the femoral artery and its branches. So, this study would be useful for the clinician for surgical and therapeutic intervention. Further the same study can be carried out in large number of sample in the future.

ABBREVIATIONS: FA=Femoral Artery, FV=Femoral Vein, FN=Femoral Nerve, PFA=Profunda Femoris Artery, MCFA=Medial Circumflex Femoral Artery, LCFA=Lateral Circumflex Femoral Artery, DFA=Deep Femoral Artery, ASIS=Anterior Superior Iliac Spine, MIP=Mid Inguinal Point, df=Degree of Freedom, P value=Probability value, X^2 =Chi Square Test.



Figure 1: Picture showing taking of distances by digital caliper. (*= Digital Caliper)

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Figure 2: Picture showing the origin of Profunda Femoris Artery from the Common Femoral Artery.(FN= Femoral Nerve, PFA= Profunda Femoris Artery, FA= Femoral Artery, FV= Femoral Vein)



Figure 3: This picture also shows the origin of Profunda femoris artery from the Femoral artery.(FV= Femoral Vein, PFA= Profunda Femoris Artery, FV= Femoral Vein)

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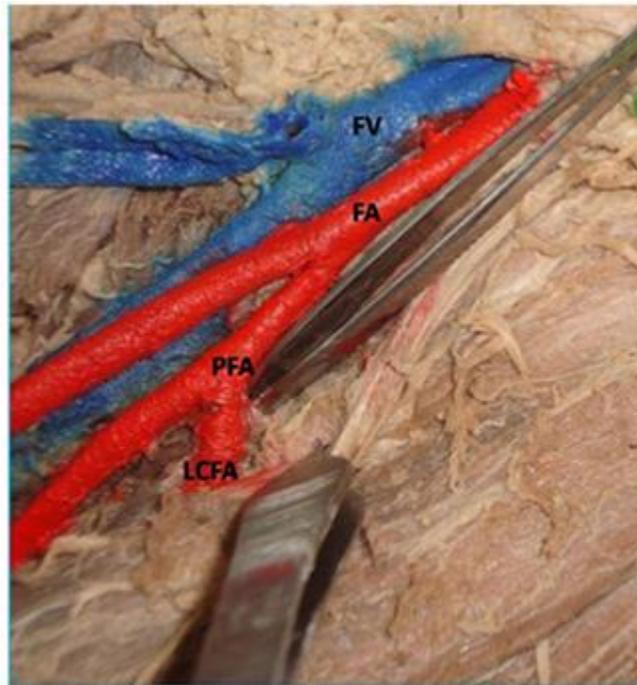


Figure 4: Picture shows the origin of the lateral circumflex femoral artery (LCFA) from the profunda femoris artery (FV= Femoral Vein, PFA= Profunda Femoris Artery, FV= Femoral Vein LCFA= Lateral Circumflex Femoral Artery)

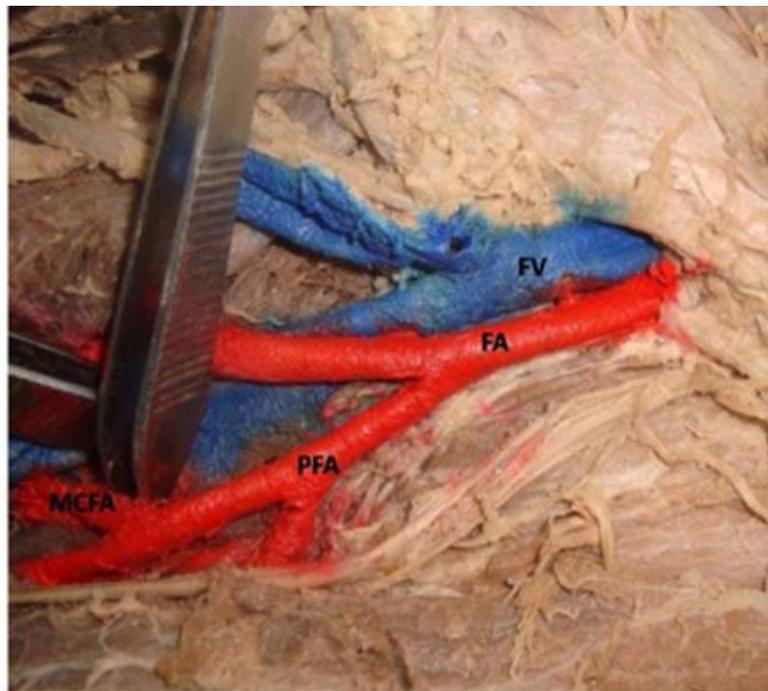


Figure 5: Picture showing the origin of the Medial circumflex femoral artery (MCFA) from the Profunda femoris artery. (FV= Femoral Vein, PFA= Profunda Femoris Artery, FA= Femoral Artery, MCFA= Medial Circumflex Femoral Artery)

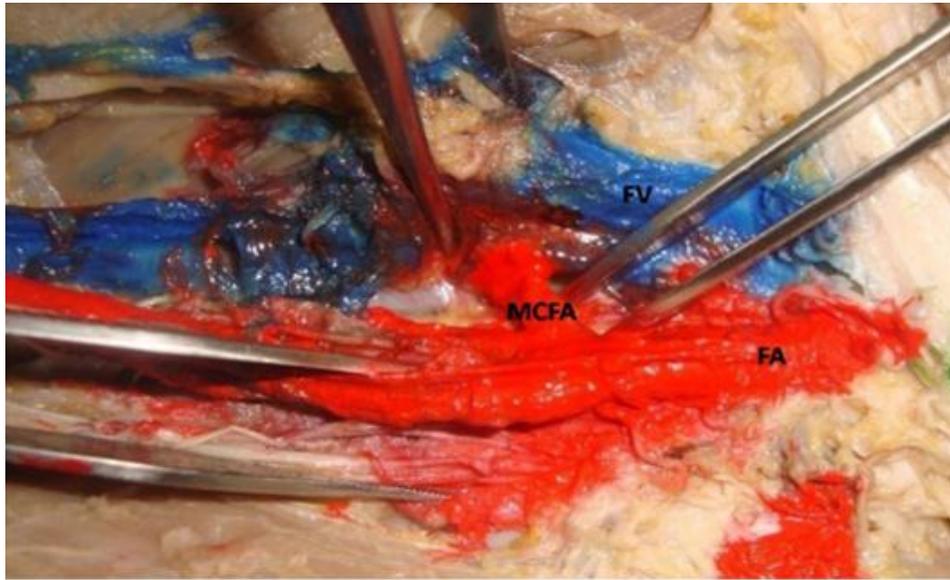


Figure 6: This picture shows the MCFA directly originated from the Common Femoral Artery. (FV= Femoral Vein, FA= Femoral Artery, MCFA= Medial Circumflex Femoral Artery)

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Side of Artery	Distance of origin of PFA from mid inguinal point(MIP)			Total	X ² ,df & P
	Less than 3cm	3 to 4cm	Above 4cm		
Left	5	19	9	33	X ² =1.198 df=2 P=0.549
Right	5	15	13	33	
Total	10	34	22	66	

Table 1: Showing the comparison between the distances of origin of PFA from mid inguinal point on both sides

Where X²=chi-square test, df=degree of freedom, P=probability, PFA=profunda femoris artery.

Side of Artery	Distance of origin of LCFA from the origin Of PFA			Total	X ² ,df & P
	Less than 2cm	2 to 3cm	Above 3cm		
Left	10	14	9	33	X ² =0.571 df=2 P=0.751
Right	8	17	8	33	
Total	18	31	17	66	

Table 2: Showing the comparison between the distances of origin of LCFA from the origin of PFA on both sides. (LCFA=lateral circumflex femoral artery)

Side of Artery	Distance of origin of MCFA from the origin Of PFA			Total	X ² ,df & P
	Less than 2cm	2 to 3cm	Above 3cm		
Left	4	10	19	33	X ² =0.190 df=2 P=0.909
Right	3	11	19	33	
Total	7	21	38	66	

Table 3: Showing the comparison between the distances of origin of MCFA from the origin of PFA on both sides. (MCFA=medial circumflex femoral artery)

Side of Artery	Position of the origin of PFA			Total	X ² ,df & P
	Lateral	Posterolateral	Posterior		
Left	14	11	8	33	X ² =2.228 df=2 P=0.328
Right	19	6	8	33	
Total	33	17	16	66	

Table 4: Showing the comparison between the positions of origin of pfa on both sides

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Side of Artery	Distance of origin of MCFA from the origin of MIP			Total	X ² , df & P
	Less than 4 cm	4 to 6 cm	Above 6 cm		
Left	5	21	7	33	X ² =0.091 df=2 P=0.955
Right	5	20	8	33	
Total	10	41	15	66	

Table 5: Showing the comparison between the distances of origin of MCFA from the mid inguinal point (MIP) on both sides

Side of Artery	Distance of origin of LCFA from the MIP			Total	X ² , df & P
	Less than 4cm	4 to 6cm	Above 6cm		
Left	6	18	9	33	x ² =0.144 df=2 P=0.931
Right	5	18	10	33	
Total	11	36	19	66	

Table 6: Showing the comparison between the distances of origin of LCFA from the MIP on both sides

Distance of origin of PFA from MIP	Distance of origin of MCFA from MIP			Total	X ² , df & P
	Less than 4cm	4 to 6cm	Above 6cm		
Less than 3 cm	0	8	2	10	X ² =13.289 df=4 P=0.010
3 to 4 cm	6	25	3	34	
Above 4 cm	4	8	10	22	
Total	10	41	15	66	

Table 7: Showing the comparison between the distances of origin of MCFA from MIP with the distance of origin of PFA from MIP

Distance of origin of PFA from MIP	Distance of origin of LCFA from MIP			Total	X ² , df & P
	Less than 4 cm	4 to 6 cm	Above 6 cm		
Less than 3 cm	4	4	2	10	X ² =6.478 df=4 P=0.166
3 to 4 cm	6	19	9	34	
Above 4 cm	1	13	8	22	
Total	11	36	19	66	

Table 8: Showing the comparison between the distances of origin of LCFA from MIP with the distance of origin of PFA from MIP

Distance of origin of PFA from MIP	Distance of origin of LCFA from MIP			Total	X ² , df & P
	Less than 4cm	4 to 6cm	Above 6cm		
Lateral	5	13	15	33	X ² =9.250 df=4 P=0.055
Posterolateral	3	12	2	17	
Posterior	3	11	2	16	
Total	11	36	19	66	

Table 9: Showing the comparison between the distances of origin of LCFA from MIP with position of the origin of PFA

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