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Morphological study on branching pattern of Femoral artery: A Cadaveric study

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Abstract

Background: Femoral artery is commonly utilized for angiographies, insertion of central lines, ultrasound & Doppler imaging, digital subtraction angiography, magnetic resonance imaging and other various investigative and diagnostic procedures. The anatomical knowledge of variations of femoral artery and its branches is important as it is frequently accessed by surgeons and radiologists for number of procedures. Accurate knowledge of anatomical variations regarding origins of the profunda femoris, medial and lateral femoral circumflex arteries are important for clinicians in the present modern era of interventional radiology.

Methods: We studied femoral artery and its branches on 60 embalmed and formalin fixed cadavers by dissection method. We observed that profunda femoris artery, largest branch of femoral artery arises from posterolateral aspect in majority of the cadavers. Lateral circumflex femoral artery originates from femoral artery in nearly 70% of the cadavers.

Conclusion: Anatomy of the femoral artery and its branches is crucial from point of view of surgeons, interventional radiologist, and physicians etc. so this study will be very useful in reducing the chances of intra-operative secondary haemorrhage and post-operative complications.

Keywords: Circumflex, Interventional, Cannulation, Ontogeny, Phylogeny.

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INTRODUCTION

The femoral artery, the principal artery of thigh is continuation of external iliac artery. Femoral artery is the chief artery of lower limb that supplies blood to the muscles of anterior, medial and lateral compartments of thigh. The femoral artery enters the thigh midway between the anterior superior iliac spine and the pubic symphysis. Here it lies on the psoas major tendon, which separates the artery from capsule of the hip joint. At this point, its pulsation can be felt and where it can be utilized for arterial catheterization. For cannulation, the femoral artery is second only to the radial as the site of choice for the placement of an arterial line[1].

This artery is commonly utilized for angiographies, insertion of central lines, ultrasound & doppler imaging, digital subtraction angiography, magnetic resonance imaging and other various investigative and diagnostic procedures. The anatomical knowledge of variations of femoral artery and its branches is important as it is frequently accessed by surgeons and radiologists for number of procedures. Accurate knowledge of anatomical variations regarding origins of the profunda femoris, medial and lateral femoral circumflex arteries are important for clinicians in the present modern era of interventional radiology. The profunda femoris artery is frequently incorporated in vascular reconstructive procedures in the proximal leg. The knowledge of variations in origin of profunda femoris artery and its other branches distribution is of utmost significance for preventing flap necrosis, particularly tensor fascia lata, when used in plastic and reconstructive surgeries[2].

A combined study on the anatomical variations of the origins of the femoral, profunda femoris, medial and lateral femoral circumflex arteries is scarce in the literature. Hence, this work was undertaken to study the prevalence of origins of the Femoral artery and its main branches in the Indian population to help interventional radiologist to study possible variations in its branching pattern. This will be again more beneficial to the vascular surgeons to properly understand and take necessary precautions while dealing with abnormal branching pattern of femoral artery.

MATERIALS AND METHODS

This was the cadaveric study carried out on 60 (38 male and 22 female) embalmed and formalin fixed cadavers from department of anatomy of our medical colleges. 120 femoral triangles were dissected as follows. The skin and superficial fascia was incised and reflected from the front of thigh. The superficial inguinal lymph nodes and great saphenous vein were removed and the fascia lata was cut to expose the femoral triangle. Inguinal ligament was identified and preserved. The femoral sheath was dissected to clear the femoral artery and its major branches. The profunda femoris artery with its medial and lateral circumflex femoral branches were dissected carefully and identified. Their origin and courses were recorded. The relation of profunda femoris artery at its origin to the femoral artery was also noted. The distance of the site of origin of profunda femoris artery from the midpoint of the inguinal ligament was measured in mm with a scale and recorded. The sites and modes of origin of medial and lateral circumflex femoral arteries were studied and the distance of their site of origin from the origin of profunda femoris artery was measured and recorded. The diameter of profunda femoris artery near its origin from the femoral artery was measured in millimeters with the help of vernier calipers and recorded.

The findings were recorded in tabulated form and statistical analysis was done using Microsoft Excel.

RESULTS

Out of 120 femoral triangles (from 60 cadavers) dissected; various findings noted were as follows-

1. Distance of origin of profunda femoris artery (PFA) from the midpoint of the inguinal ligament: Beginning from the midpoint of the inguinal ligament, the distance of origin of profunda femoris measured was mostly between 31 and 40 mm on the right as well as on left side (Table I).

Distance in mm	Cases on right side	Cases on left side
0-10	7 (11.67%)	6 (10%)
11-20	11 (18.33%)	10 (16.67%)
21-30	14 (23.33%)	13 (21.67%)
31-40	16 (26.67%)	19 (31.67%)
41-50	6 (10%)	7 (11.67%)
51-60	6 (10%)	5 (8.33%)
Total	60	60

Table 1: showing distance of origin of profunda femoris artery (PFA) from the midpoint of the inguinal ligament

2. Site of origin of profunda femoris artery: It was observed that profunda femoris artery (PFA) originated from posterolateral aspect of femoral artery in 48.33% on right side and 46.67% on left side, from posterior aspect in 20% on right and 23.33% on left side (as seen in Table II).

3. Site of origin of lateral circumflex femoral artery (LCFA): the origin of lateral circumflex femoral artery

from profunda femoris artery on the right and left side is depicted in table no. III. LCFA originated from PFA in 70 % cases on right side and 66.67% cases on left side.

Site of origin from femoral artery	Right side		Left side	
	No. of cases	Percentage	No. of cases	Percentage
Posterolateral aspect	29	48.33%	28	46.67%
Posterior aspect	12	20%	14	23.33%
Lateral aspect	11	18.33%	9	15%
Medial aspect	8	13.33%	9	15%

Table 2: showing origin of profunda femoris artery from femoral artery

Site of origin of LCFA	Right side		Left side	
	No. of cases	Percentage	No. of cases	Percentage
From profunda femoris artery	42	70%	40	66.67%
From femoral artery in association with PFA	10	16.67%	11	18.33%
From femoral artery above PFA	5	8.33%	5	8.33%
From femoral artery below PFA	3	5%	4	6.67%

Table 3: Showing site of origin of Lateral circumflex femoral artery (LCFA)

4. Distance of origin of Lateral Circumflex Femoral Artery (LCFA) from origin of Profunda Femoris artery: Table IV shows that distance of origin of LCFA from PFA varies on both sides and generally lies between 21 and 30 cm.

Distance in mm	Right side		Left side	
	No. of cases	Percentage	No. of cases	Percentage
0-10	8	13.33%	7	11.67%
11-20	17	28.33%	12	20%
21-30	22	36.67%	26	43.33%
31-40	9	15%	11	18.33%
41-50	3	5%	3	5%
51-60	1	1.67%	1	1.67%

Table 4: showing distance of origin of Lateral Circumflex Femoral Artery (LCFA) from origin of Profunda Femoris artery

5. Site of origin medial circumflex femoral artery (MCFA):

Origin of MCFA on right side was from medial aspect of PFA in 65% of cases, from FA along with PFA in 15% cases, from FA above PFA in 8.3% and from FA below PFA in 11.67% of cases. Site of origin of MCFA on left side was from medial aspect of PFA in 60% of cases, from FA along with PFA in 16.67% cases, from FA above PFA in 13.33% and from FA below PFA in 10% of cases (Table V)

6. Distance of origin of Medial Circumflex Femoral Artery (MCFA) from Profunda Femoris artery (PFA): Table VI is showing the details of origin of MCFA from PFA.

Site of origin of MCFA	Right side		Left side	
	No. of cases	Percentage	No. of cases	Percentage
From medial aspect of profunda femoris artery	39	65%	36	60%
From femoral artery in association with PFA	9	15%	10	16.67%
From femoral artery above PFA	5	8.3%	8	13.33%
From femoral artery below PFA	7	11.67%	6	10%

Table 5: showing sites of origin of Medial circumflex femoral artery (MCFA) on both sides

Distance in mm	Right side		Left side	
	No. of cases	Percentage	No. of cases	Percentage
0-10	27	45%	29	48.33%
11-20	12	20%	12	20%
21-30	9	15%	7	11.67%
31-40	5	8.33%	6	10%
41-50	6	10%	4	6.67%
51-60	1	1.67%	2	3.33%

Table 6: showing distance in mm of origin of Medial Circumflex Femoral Artery (MCFA) from Profunda Femoris artery (PFA) on both sides

7. Diameter of Profunda femoris: Mean diameter of PFA in our study was found to be 10.6 mm on right side and 10.9 mm on left side. Two PFA had diameter of 16 mm and one had diameter of 2.5mm. Four femoral arteries showed presence of aneurysm in its wall.

DISCUSSION

The knowledge of the femoral artery and its branches is important while performing clinical procedures in the femoral region and hip joint replacement and also for avoiding iatrogenic arterio-venous fistula or severe secondary haemorrhage while performing femoral artery puncture[3]. It can be used as an anterolateral thigh flap and in Coronary artery bypass grafting (CABG) [4].

The various variations in the origin of profunda femoris and its branches are described in the literature. Anatomical variations reported at the level of the division of the femoral artery can be explained in the following manner. In the lower animals, the profunda femoris artery is a branch of the internal iliac artery. During course of evolution, the origin shifted distally from the femoral artery. Ontogeny repeats phylogeny. Hence, developmental arrest at different stages may lead to anatomical variations related to the division of the femoral artery[2]. The development of the vasculature in the lower limb precedes the morphological and molecular changes that occur in the limb mesenchyme, hence vascular variations are more of a rule than an exception[11]. Parasa Savithri[1] recoded that PFA acts as a collateral vessel when main trunk of

femoral artery is occluded. Because of this reason PFA has a larger lumen.

In the present study, distance of origin of profunda femoris as measured from midpoint of inguinal ligament was mostly between 31 and 40 mm on both sides. Generally PFA arise from femoral artery about 3.5 cm distal to the inguinal ligament[5]. Dixit et al[3] observed distance 31-40 mm on right side and between 41-50 mm on the left side. Prakash et al[2] noted this distance to be 4.2 cm. Siddharth P et al[6] observed as 4.4 cm. Vedat Sabancıogulları et al[7] recorded the distance of the originating point to the midpoint of the inguinal ligament was found to be 5.6 cm in the right and 2.2 cm in the left. This distance is very important from the point that while performing cannulation of femoral artery you will not encounter the PFA.

The site of origin of PFA from femoral artery as described in Grays Anatomy is from lateral aspect[5]. In the present study, PFA originated from postero-lateral aspect in 48.33% on right side and 46.67% on left side. Its origin from lateral aspect on right side was in just 18.33% and on left side in 15% of cases. The site of the origin of the deep femoral artery in also important in catheter application, in making flaps with pedicles in reconstructive surgery and by-pass procedures made to supply the lower extremity[7].

In our study, the lateral circumflex femoral artery commonly originated from femoral artery in most of the cases, 70% on right side and 66.67% on left side. Uzel M et al[8] studied Turkish population and found that LCFA arises from PFA in 77.3% and from femoral artery in 22.7% of cases. Angiographic study by Fakuda et al[9] showed origin of LCFA from PFA in 78.6%and from Femoral artery in 21.4% of cases. Hollinshead[10] reported that LCFA arises from the femoral artery proximal to the origin of Profunda femoris artery in 15% of cases. In the present study, LCFA arisen from the femoral artery proximal to the origin of Profunda femoris artery in 8.33% of cases. Tanyeli E et al[11] recorded the origin of LCFA from the femoral artery inferior to the profunda femoris artey. We found it in just 5% cases on right side and 6.67% on left side.

In the present study, Medial circumflex femoral artery (MCFA) originated from the medial aspect of profunda femoris artery in 65% on right side and 60% on left side; and from femoral artery in 15% on right side and 16.67% on left side. Dixit DP et al[12] stated that medial circumflex artery on an average was arising in 62.5% of cases from the profunda and in 20.63% of cases from the femoral artery. These findings are comparable to 59% and 36% found by Lipshutz[13] and 53% and 40% reported by Clarke and Colborn[14].

The diameter of profunda femoris artery is important parameter. In the present study, mean diameter of PFA was found to be 10.6 and 10.9 mm on right and left side respectively. Ultrasound study by Minami et al stated that female patients have comparatively smaller femoral and radial arteries as compared to males of controlled age and body mass index[15].

Thus femoral artery and its various branches are crucial as they are likely to get damaged in various invasive procedures of this region. So studying normal anatomy of femoral artery and its branches is important to avoid such mishaps.

The limitation of our study was that comparative study involving radiology department utilizing angiography should also be merged, so that larger study population can be involved.

CONCLUSION

The sound anatomical knowledge of femoral artery and its branches is important while performing clinical procedures in the femoral region and hip joint replacement and also for avoiding iatrogenic arterio-venous fistula or severe secondary haemorrhage while performing femoral artery puncture. This study will be very helpful to the surgeons, radiologist and plastic surgeons to understand possible variations.

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