



## RESEARCH ARTICLE

### VARIATIONS IN THE ORIGIN OF PROFUNDA FEMORIS ARTERY AND ITS BRANCHES - A CADAVERIC STUDY

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#### ABSTRACT

**Introduction:** Profunda femoris is the largest branch of femoral artery. It gives branches including lateral circumflex artery, medial circumflex artery and three perforator branches and subsequently continues as fourth perforating artery.

**Objective:** To study the location of origin of profunda femoris artery and correlate it clinically.

**Materials and Methods:** The present study was done on 40 embalmed limbs (20 cadavers – 12 males and 8 females) for identifications of the origins of profunda femoris artery.

**Results:** In the present study posterolateral and posterior side of origin was established as most common site of origin of profunda femoris artery. High level of origin of profunda femoris artery was found to be quite recurrently. Double lateral circumflex artery was also discovered in one lower limb with high origin of profunda femoris artery. Such variation is very rare.

**Conclusion:** Current study will help the clinicians to avoid iatrogenic complications during surgery and also help them in various clinical procedures for interventional radiology in this region.

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#### INTRODUCTION

Variations in pattern of femoral artery and its branches are clinically very important. Hence, it has received immense attention from various anatomists and surgeons. Profunda femoris artery is the largest deep branch of femoral artery, which provides the principal supply to the extensors, adductors and flexors muscles of thigh (Mamatha *et al.*, 2012). It arises laterally from the femoral artery about 3.5 cm distal to the inguinal ligament, then it spirals posterior to the artery and femoral vein to reach medial side of femur (Standring, 2008). Lateral circumflex femoral, medial circumflex femoral and perforating arteries originate from profunda femoris artery. The Lateral circumflex femoral artery, medial circumflex femoral artery anastomoses with branches of the internal and external iliac arteries. Perforating arteries supply the muscles of thigh and anastomose with popliteal artery (Standring, 2008; Shankar and Roopa, 2009). The anatomical knowledge of the level of origin of profunda femoris artery is important in avoiding iatrogenic femoral arterio-venous fistula formed during accidental puncture of femoral artery (Prakash *et al.*, 2010). Profunda femoris artery is also used for haemodialysis, vascular reconstructive procedures and various radio imaging techniques like ultrasound doppler Imaging and magnetic resonance imaging (Phalgunan *et al.*, 2013; Chitra, 2008).

Precise anatomy of profunda femoris artery forms a strong foundation to minimize complications during invasive interventions. This study was undertaken to find out the site as well as level of origin of profunda femoris artery and correlate it clinically.

#### MATERIALS AND METHODS

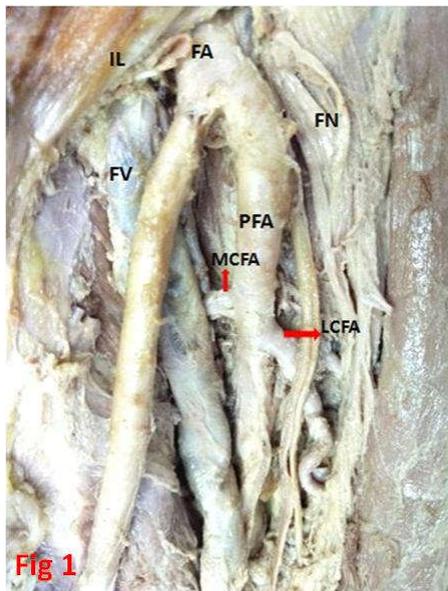
The study was undertaken during the period of July 2014 to May 2017, on forty adult lower limb specimens available in the department of anatomy, used for routine dissection for teaching undergraduate medical students. There were 12 male (24 sides) and 8 female (16 sides) cadavers with the age range between 50-70years. Femoral triangle region was dissected according to steps given in Cunningham's manual in all the limbs. Dissection was done after raising the skin flap followed by superficial fascia. The superficial inguinal lymph nodes in vicinity of superficial vessels were identified and removed and the fascia lata was incised thereby exposing the femoral triangle. The femoral artery and its major branches were identified. The distance of origin of profunda femoris artery from the mid inguinal point was measured using a measuring tape.

#### RESULTS

The profunda femoris artery originated from the posterolateral side of the femoral artery in 25 limbs (62.5%), from the

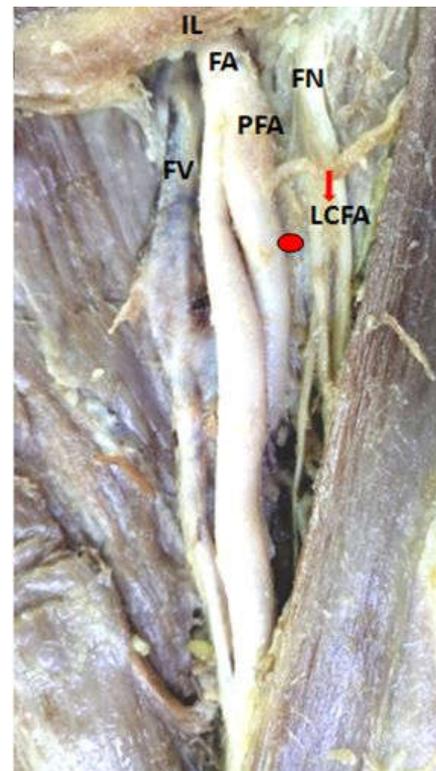
posterior aspect of the femoral artery in 10 cases (25%) and from the lateral aspect of the femoral artery in 4 limbs (10%) and in one limb (2.5%) profunda femoris artery originated from anterolateral aspect of femoral artery which is uncommon. Out of 40 limbs studied, in 35 limbs profunda femoris artery originated from femoral artery at an average of about 3.76cm from mid-inguinal point. In 3 cases (7.5%) the origin of profunda femoris artery from the mid inguinal point was less than 2 cms and in one case profunda femoris artery took origin 5.7cm below the inguinal ligament. In another case there was direct origin of Lateral circumflex femoral artery and Medial circumflex femoral artery from femoral artery. The description of these atypical cases is as follows:

In a 60 year old male cadaver an unusual origin of profunda femoris artery on the left side was noted. Profunda femoris artery, the biggest branch of femoral artery took very high origin i.e., just 1cm below the inguinal ligament from the lateral aspect. This high origin profunda femoris artery subsequently had routine branching pattern including lateral, medial circumflex femoral artery and perforator branches (Fig. 1).



**Fig. 1.** Dissection of left femoral triangle illustrating high origin of the Profunda femoris artery from the femoral artery 1cm distal to the inguinal ligament. IL-Inguinal ligament, FV -Femoral vein, FA-Femoral artery, PFA-Profunda femoris artery, FN-Femoral Nerve, MCFA-Medial circumflex femoral artery, LCFA-lateral circumflex femoral artery

In another female cadaver in the left lower limb, high origin of profunda femoris artery was observed. It sprouted from the anterolateral side of femoral artery 1.5cm below the inguinal ligament. The caliber of this profunda femoris artery was much larger as compared to the main femoral artery. Also, this high originating profunda femoris even gave two distinct lateral circumflex arteries, one medial circumflex femoral artery and usual perforator branches (Fig. 2). Apart from this unusual double lateral circumflex femoral artery, rest of the branching pattern of femoral artery was normal. In another female cadaver on right side the origin of profunda femoris artery was also high. It was around 1.7cm below the inguinal ligament from the lateral side of femoral artery. Immediately after emergence, profunda femoris artery traversed posteromedial to femoral artery (Fig. 3). Rest of the course and branching pattern of profunda femoris was usual.

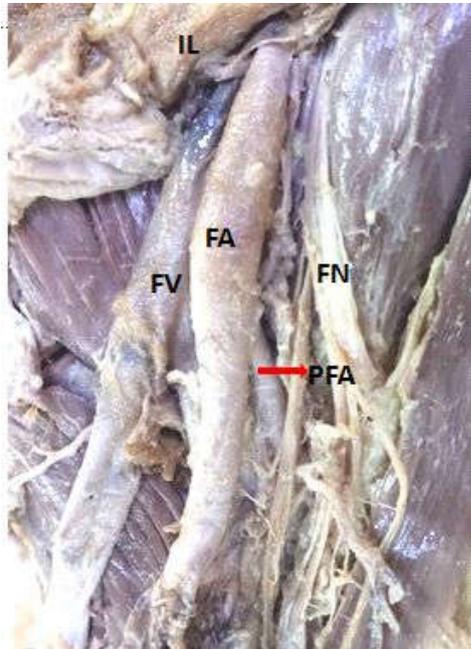


**Fig. 2.** Dissection of left femoral triangle illustrating high origin of the Profunda femoris artery from the anterolateral aspect of femoral artery 1.5cms distal to the inguinal ligament with double lateral circumflex femoral artery. IL-Inguinal ligament, FV -Femoral vein, FA-Femoral artery, PFA-Profunda femoris artery, FN-Femoral Nerve, LCFA-lateral circumflex femoral artery (superficial), deep lateral circumflex femoral artery is not visible in the present view (shown as red circle)

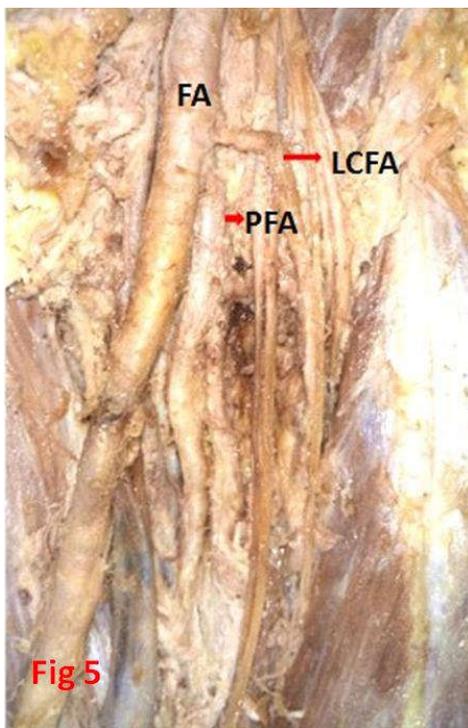


**Fig. 3.** Dissection of right femoral triangle illustrating high origin of the Profunda femoris artery from the femoral artery 1.7cms distal to the inguinal ligament. IL-Inguinal ligament, FV -Femoral vein, FA-Femoral artery, PFA-Profunda femoris artery, FN-Femoral Nerve

In one of the male cadaver, extraordinarily low level origin of profunda femoris artery in the left lower limb was observed. In this case profunda femoris artery originated from posterior aspect of femoral artery, 5.7cm below the inguinal ligament which is much lower than the regular 3.7 cm distance (Fig. 4). Rest of the course and branching pattern of this profunda femoris was normal.



**Fig. 4.** Dissection of left femoral triangle illustrating low level origin of the Profunda femoris artery from the femoral artery 5.7 cms distal to the inguinal ligament. IL-Inguinal ligament, FV - Femoral vein, FA-Femoral artery, PFA-Profunda femoris artery, FN-Femoral Nerve



**Fig. 5.** Dissection of left femoral triangle illustrating direct origin of Medial circumflex femoral artery and Lateral circumflex femoral artery from femoral artery and profunda femoris artery dividing in to two. IL-Inguinal ligament, FV -Femoral vein, FA-Femoral artery, PFA-Profunda femoris artery, FN-Femoral Nerve, LCFA-lateral circumflex femoral artery

In another male cadaver on left side there was strange origin of lateral circumflex femoral artery as well as medial circumflex femoral artery from femoral artery much above the origin of profunda femoris artery. The profunda femoris artery arose at usual distance i.e., 3.7cm below inguinal ligament, from posterior aspect of femoral artery and then it bifurcated into two separate and prominent profunda femoris arteries (Fig. 5).

## DISCUSSION

Arteriography still remains the main line of investigation in peripheral occlusive arterial diseases even decades after the advent of highly advanced imaging techniques. Peripheral angiograms are used to evaluate peripheral occlusive arterial diseases, suspected congenital vascular anomalies, arterial status in trauma, imaging of vascular malignancies, demonstration of the vascularity of malignancies and for identifying diseases inherent to the arterial system. The femoral artery and profunda femoris artery is frequently used for arteriography, ultrasound and doppler imaging, digital subtraction angiography and magnetic resonance imaging (Dixit *et al.*, 2001). Now a days profunda femoris artery is also used for haemodialysis apart from femoral artery. Also in cases of carcinoma breast during breast reconstruction surgery the perforators of profunda femoris artery are used (Kaplan and Allen 2000). The average distance of origin of profunda femoris from the midpoint of inguinal ligament was found to be 3.76cm in the present study which is in conformity with average distance found by Bannister *et al.*, (1995) and Vuksanovic *et al.*, (2007) who found it to be 3.5 cm and 3.7 cm respectively. This distance was less than the average distance of origin reported by Dixit *et al.*, (2010), Siddharth *et al.*, (1985) and Prakash *et al.*, (2001) who found it to be 4.75 cm, 4.4 cm and 4.2 cm respectively.

The profunda femoris artery arose from the posterolateral aspect of the femoral artery in 62.5% of cases in the present study. While in the study of Suthar *et al.*, (2012), Prakash *et al.*, (2001) and Dixit *et al.*, (2010) the origin of profunda femoris artery from the posterolateral aspect of the femoral artery were found to be 52%, 50% and 42.1% respectively. The profunda femoris artery originated from the posterior side of the femoral artery in 31.25% and 44.64% cases in Dixit *et al.* (Prakash *et al.*, 2010) and Siriporn *et al.*, (2012) studies respectively. In the present study it arose from the posterior side of the femoral artery in 25% of cases. The profunda femoris artery arose from the lateral side of the femoral artery in 10% of cases in the present study while Siriporn *et al.*, (2012) reported incidence of lateral origin of the profunda femoris artery to be much more i.e., 21.43%. The profunda femoris artery originated from the anterolateral aspect of the femoral artery in 2.5% of cases in the present study which was comparable with the study of Sangeeta *et al.*, 2015 study who reported it to be 3%. Development arrest at different stages of vascular system leads to anatomical variations that are clinically significant. Variations in the origin of profunda femoris artery is described in the literature. The highest origin of profunda femoris at or above the inguinal ligament has been described by various authors (Siddharth *et al.*, 1985). Shankar in his study noted the distance of profunda femoris artery from inguinal ligament was less than 1cm (Shankar and Roopa, 2009). In a study conducted by Quain (Quain, 1844) on 430 thighs, it was found that the origin of the profunda femoris artery was less than 1.3 cms from the midinguinal point in 20 thighs (4.7%). Another study by Siddharth *et al.*, (2012) on

100 cadavers revealed that the profunda femoris artery originated at an average distance of 4.4 cms from the inguinal ligament. Only in one case (1%) profunda femoris artery arose at the level of the inguinal ligament. In the study conducted by Vedat Sabanciogullari *et al.*, (2009) the profunda femoris artery originated at a distance of 2.2 cms from the midpoint of the inguinal ligament from the femoral artery. Nachikat Shankar *et al.*, (2009) reported that the profunda femoris artery originated from the lateral side of the femoral artery at a distance of less than 1 cm from the inguinal ligament. In the present study in three cases (7.5%) there was high origin of profunda femoris artery which was higher than any of the previous reports. This highest origin of profunda femoris artery is a threat to procedures like femoral vessel puncture and nerve block.

In the present study the most common site of origin of lateral circumflex femoral artery and medial circumflex femoral artery bilaterally was from the lateral aspect of profunda femoris artery. Only in one case (2.5%) there was direct origin of lateral circumflex femoral artery and medial circumflex femoral artery from the femoral artery proximal to the origin of profunda femoris artery. Eswasri *et al.*, 2013 have described the origin of lateral circumflex femoral artery and medial circumflex femoral artery directly from femoral artery in 10% and 12.5% of cases respectively. Dixit *et al.*<sup>7</sup> observed that origin of lateral circumflex femoral artery and medial circumflex femoral artery from femoral artery above the origin of profunda femoris artery in 5.2% and 18.4% respectively. Uzel *et al.*, (2008) studied 110 inguinal regions and found lateral circumflex femoral artery arising from profunda femoris artery in 85 cases and from femoral artery in 21 cases (19.1%). Baptist M *et al.* have also reported the origin of lateral circumflex femoral artery from the femoral artery (Baptist *et al.*, 2007). The position of lateral circumflex femoral artery is an important landmark for femoral nerve block as it passes between its divisions, so the varied origins of lateral circumflex is clinically important (Orebaugh, 2006). Knowledge of varied origins of medial circumflex femoral artery is essential to avoid iatrogenic vascular necrosis of head of femur in reconstructive surgery of hip (Gautier *et al.*, 2000).

## Conclusion

According to present study the most common site of origin of profunda femoris artery was from posterolateral side of femoral artery. High origin of profunda femoris artery from anterolateral site of femoral artery with two distinct and equally prominent lateral circumflex femoral arteries arising from profunda femoris artery was also discovered in the present study. Such finding is very rare. Finally we found very high incidence of high origin of profunda femoris artery. So the knowledge of variations in the level of origin and branching pattern of profunda femoris artery is important for surgeons to avoid iatrogenic complications during surgery in this region. Also these types of variations are not only important for anatomists for research purposes but also for radiologists in interpreting radiographs with new variations.

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