

## Profundafemoris Artery and its Branches: A Cadaveric Study in South Indian Population with Clinical Correlations

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### Abstract

*Background and objectives:* Profunda femoris artery (PFA) and its branches are known to have wide range of variations. The objective of this study was to report the variations in site of origin, level of origin of profunda femoris artery and variations in origin of medial and lateral circumflex femoral arteries. *Methodology:* In a descriptive cadaveric study, 64 lower limb specimens of 32 cadavers were studied (27 males and 5 females). After dissecting the femoral triangle, profunda femoris artery origin, distance from inguinal ligament, medial and lateral circumflex arteries were noted. *Results:* Out of 32 cadavers (64 specimens), PFA was arising from the posterolateral aspect of femoral artery in front of iliacus in 33 specimens. In 13 specimens it PFA was arising from lateral side of femoral artery. Mean distance in normal origin of PFA from femoral artery was  $33\pm 7$  mm from inguinal ligament. Only in two specimens, PFA was originating above femoral artery above inguinal ligament. In 49 specimens (76.6%), circumflex arteries were arising separately from PFA. Only in two cases medial, lateral circumflex arteries and PFA was arising from common trunk, forming trifurcation of PFA. *Conclusion:* Profunda femoris artery most commonly arises below the inguinal ligament and posterolateral to femoral artery. Medial and lateral circumflex femoral arteries most commonly arise as separate branches from PFA. This study may be useful for surgeons working in the upper part of thigh either during hip surgeries or during treatment of ischemic lower limb revascularization.

**Keywords:** Deep Femoral Artery; Medial Circumflex Femoral Artery; Lateral Circumflex Femoral Artery; Variations.

### Introduction

As the femoral artery is used for various angiographic procedures, the knowledge about its branches and their variations in the femoral triangle is of importance in radiological and surgical procedures [1]. The largest branch of femoral artery, profunda femoral artery supplies the thigh. The knowledge of its branches and distribution are of

significance in revascularising the ischemic limb [2,3]. During intertrochanteric hip screw fixation for intertrochanteric femoral fracture, profunda femoris artery branches may be damaged [4]. During management of ischemic pressure sore of the thigh in paraplegic patients fasciocutaneous perforator propeller flap obtained from the posterior region having first perforator results in better outcome [5]. Very rarely proximal femoral fractures may lead to pseudoaneurysm of profunda femoris artery [6]. The branches medial and lateral circumflex femoral arteries differentially but significantly contribute to blood supply to femoral head [7].

Developmental variations rete femorale accounts for wide range of variations in the deep arterial supply of thigh [8]. Femoral vasculature is relatively newer offshoot from the axial vessels [9].

There are many reports highlighting variations in profunda femoris artery, concentrating on origin,

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Received | 29.08.2017, Accepted | 14.09.2017

length and branches. Many of the cadaveric studies focus on the metric values. Our study reports profunda femoris artery and its branches variations from the south Indian cadavers. The objective of the study was to describe profunda femoris artery and its branching pattern along with morphometric considerations like, level of origin, the length of main trunk and pattern of branching.

### Methodology

In a descriptive cadaveric study, 64 lower limb specimens of 32 cadavers were studied (27 males and 5 females). All cadavers were unclaimed bodies from district hospital and age range could not be ascertained. All cadavers were formalin fixed via common carotid artery in the neck and femoral triangle was not dissected for the purpose of embalming.

In all cadavers, femoral triangle was dissected and the superficial inguinal lymph nodes along with the superficial vessels were identified and the fascia lata was incised to expose the femoral triangle. The inguinal canal was identified, followed by the adductor longus and sartorius muscles. The femoral sheath was identified and its compartments were dissected thus clearing the femoral artery (FA) and its major branches. The PFA with its medial circumflex femoral (MCF) and lateral circumflex femoral (LCF) branches were dissected and identified, their origin and course were traced. The relationship of the PFA at its origin to the femoral artery was noted. Origin of PFA within 10 mm from inguinal ligament was classified as high origin, from 10 mm to 50 mm was classified as normal and origin beyond 50 mm was classified as low origin. Among

high origin of PFA, origin above and below inguinal ligament was noted.

The distance of the site of origin of the profunda from the midpoint of the inguinal ligament was measured in millimetres with a scale and a calipers. The sites of origin of the MCF and LCF were studied and the distance of site of origin of each of them from the origin of PFA was measured in millimetres. The branches of circumflex arteries were noted.

### Results

#### Origin of PFA

Out of 32 cadavers (64 specimens), PFA was arising from the posterolateral aspect of femoral artery in front of iliacus in 33 specimens. In 13 specimens it PFA was arising from lateral side of femoral artery (Table 1). In 39 specimens, PFA was arising 10 to 50 mm from inguinal ligament. This was the most common level of origin of PFA. Mean distance in normal origin of PFA from femoral artery was 33±7 mm from inguinal ligament. Only in two specimens, PFA was originating above femoral artery above inguinal ligament. Distances were 9 and 14 mm above the inguinal ligament in these two cases.

#### Origin of Circumflex Arteries

In 49 specimens (76.6%), circumflex arteries were arising separately from PFA. Only in two cases medial, lateral and PFA was arising from common trunk (table 1). In cases where MCFA and LCFA was arising separately from PFA, mean distances of origin was 18 (±4) mm and 22 (±5) mm respectively.

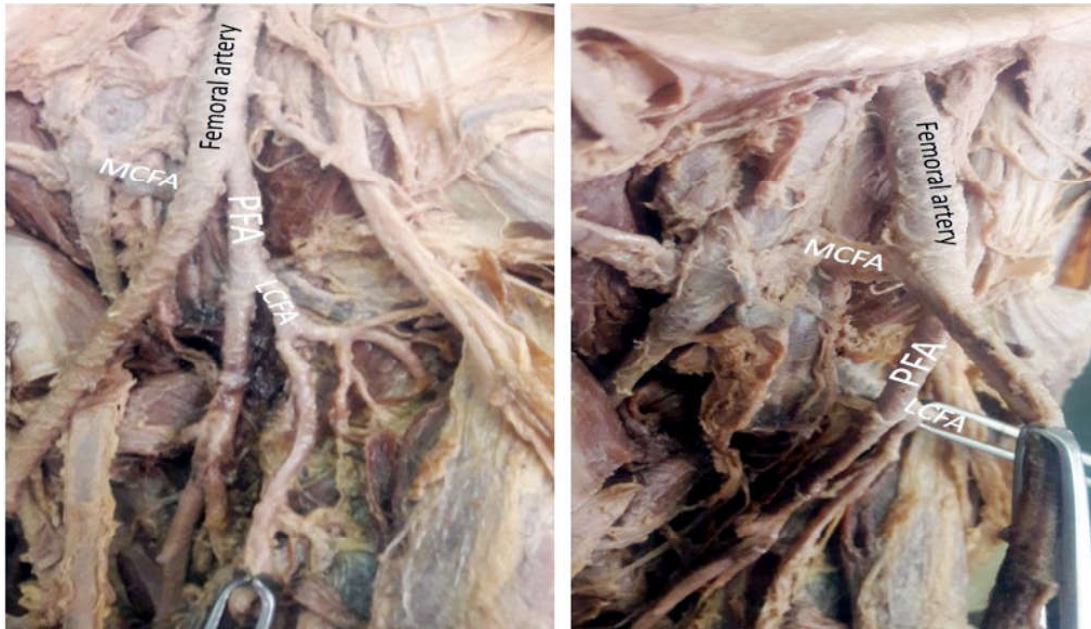
**Table 1:** Profunda femoris artery (PFA) and its branches - medial circumflex femoral artery (MCFA) and lateral circumflex femoral artery (LCFA) parameters observed during study, n=64. (IL - inguinal ligament)

| Parameter                                   | Number of Cases | Percentage |
|---|-----------------|------------|
| <b>Origin of PFA</b>                        |                 |            |
| Posterolateral                              | 46              | 71.9       |
| Lateral                                     | 13              | 20.3       |
| Posterior                                   | 3               | 4.7        |
| Posteromedial                               | 2               | 3.1        |
| <b>Level of origin of PFA</b>               |                 |            |
| High (above IL)                             | 2               | 3.1        |
| High <10mm (below IL)                       | 11              | 17.2       |
| Normal (from 10 - 50 mm from IL)            | 39              | 60.9       |
| Low (> 5mm from IL)                         | 12              | 18.8       |
| <b>Origin of MCFA and LCFA</b>              |                 |            |
| Common origin with MCFA                     | 5               | 7.8        |
| Common origin with LCFA                     | 8               | 12.5       |
| Trifurcation of circumflex arteries and PFA | 2               | 3.1        |

### Course of PFA and Circumflex Arteries

The most common course of PFA and circumflex arteries are as follows: In the femoral triangle, it was giving off its circumflex femoral branches. Then the main trunk of PFA was running above the adductor longus deep to sartorius and the arrangement of

structures were found from superficial to deeply as femoral artery, femoral vein, profunda femoris artery and profunda femoris vein. The distal part of profunda femoris was giving the lateral perforating branches and the medial muscular branches. The artery finally was continuing as the fourth perforator.



**Fig. 1:** Dissected specimens representing origin of profunda femoris artery (PFA) from lateral (A) and posterolateral (B) aspect of femoral artery. Medial circumflex femoral artery (MCFA) is arising from PFA in B and directly from femoral artery in A.

**Table 2:**

| Study                                       | Year | Number of Lower limbs studied |
|---|------|-------------------------------|
| Rathnakar et al. <sup>10</sup>              | 2016 | 73                            |
| Darji et al. <sup>11</sup>                  | 2015 | 130                           |
| Manjappa & Prasanna <sup>12</sup>           | 2014 | 40                            |
| Anwer, Karmalkar & Humbarwadi <sup>13</sup> | 2013 | 60                            |
| Peera & Sugavasi <sup>14</sup>              | 2013 | 40                            |
| Shiny Vinila et al. <sup>15</sup>           | 2013 | 40                            |
| Dixit et al. <sup>16</sup>                  | 2011 | 228                           |
| Prakash et al. <sup>17</sup>                | 2010 | 64                            |
| Dixit, Mehta & Kothari <sup>18</sup>        | 2001 | 48                            |

### Discussion

Profunda femoris artery is extensively studied arteries of lower limb. Variations are common and widely reported. The cadaveric studies reporting PFA and its branching pattern have been tabulated in Table 2. We have studied 64 lower limbs. Dari et al and Dixit et al have studied greater number of lower limbs as they have done a multicentre study involving more teaching institutes.

Most common site of origin of PFA reported by many are posterolateral aspect of femoral artery. All the previous literature have reported the same. The mean distance from inguinal ligament to the site of origin of PFA was 33 mm. Reported distances vary from 2 to 5 cm. However, in a study by Nasr et al, on the right side in male, the distance exceeds 5 cm [19]. We report two cases of PFA origin above inguinal ligament. In the previous reports the incidence of such high origin of PFA varies from 2

to 10% [16-18]. Sangeeta Rajani et al have found PFA arising from anterolateral and medial origin of PFA [20]. Such origin of PFA were not noted in present study.

The knowledge of site of origin, direction of PFA course and distance from inguinal ligament need to be established during intertrochanteric hip screw fixation for intertrochanteric femoral fracture in order to avoid iatrogenic injury to PFA. As noted in the study, mode of origin and distance of origin vary in each individual. At most care is advised while working in femoral triangle.

In 60-75% of the cases, the origins of medial and lateral circumflex femoral arteries in the previous studies are from PFA. Our study goes with the previous report with incidence of 76.6%. However, lower incidences of MCFA origin from PFA is reported by Clark [21] (62%) and Dixit et al [18] (53%).

During development of lower limb bud, the 5<sup>th</sup> lumbar intersegmental artery, being the axial artery forms the arterial patterns in the gluteal region along with sciatic nerve. Femoral artery and its branch, PFA are formed as newer offshoots from the existing vascular network. During this process which is not tightly regulated, many variations in level of origin of PFA, direction of PFA and its branches are subjected to wide variations.

#### *Limitations of Study*

Male and female differences were not noted. Right and left side differences were not accounted in this study. As there were more variations in the branches of circumflex arteries, their distances of origin were not noted. Medial circumflex femoral artery was traced till it gives branches - ascending and descending branches. Acetabular branch, deep and superficial branches of medial circumflex femoral artery are not reported in this write up. Similarly ascending, transverse and descending branches of lateral circumflex femoral artery are also not reported in this report. As the current study is descriptive study, more sample size would have provided a better depiction of variations. It is intended to extend the same study into multiple teaching colleges in the future.

#### **Conclusion**

This study reports that most common site of origin is within femoral triangle, below inguinal ligament and posterolateral to femoral artery. Mode

of origin of medial and lateral circumflex femoral arteries also reported. This study may be useful for surgeons working in the upper part of thigh either during hip surgeries or during treatment of ischemic lower limb revascularization.

#### **Acknowledgment**

Authors are thankful to the attenders of department of anatomy for helping in arranging the lower limb specimens during the study.

#### *Conflict of Interest*

Authors declare no conflict of interest.

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