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A cadaver study on anatomical variations in the origins of lateral circumflex femoral arteries

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Abstract---Background: The recent use of lateral circumflex femoral artery (LCFA) in coronary artery bypass grafting as well as anterolateral thigh cutaneous flaps for oral and oropharyngeal reconstructions has further enhanced the relevance of normal and variant anatomy of LCFA. In view of anatomical variations, preoperative angiographic evaluation of femoral arterial system becomes mandatory in surgical procedures involving the LCFA. Objectives of this study: The objective of the study is to explore the variations of in LCFA in Cadavers of Anatomy Dissection. Materials and Methods: This study was conducted at the Department of Anatomy S Shri Balaji Institute of Medical Sciences, Mowa Raipur. A standard dissecting method was developed and applied to all the cadavers used in this study. The skin overlying the anterior compartment of the thigh was incised, dissected and reflected medially. The subcutaneous fat, translucent fascia and superficial vessels were fully dissected and the Sartorius muscle and quadriceps muscle identified. The Sartorius muscle and the rectus femoris muscle were transacted, to further expose the CFA, SFA, PFA and the LCFA. The FA, PFA and their branches were identified and the LCFA followed along its course. Results: Out of total 50 legs, 80% of the cadavers (left leg) had origin from PFA and 20% from SFA, similarly in the right leg 88% of the cadavers had origin from PFA and 20% had origin from SFA. With respect to gender, 84% of male cadavers had origin from PFA and 16% had origin from SFA similarly in female cadavers 80% had origin from PFA and 20% from SFA. Discussion &

Conclusion: In our study, the most common origin of the LCFA was found to be PFA. Variations in the branching pattern of the LCFA is common in various populations. Knowledge of these variations related to the LCFA are important in clinical practice during vascular diagnostic intervention and surgeries as the unusual origin of the LCFA may cause accidental injury during surgery. The frequency of variations relating to vessels in the anterior proximal thigh implies that surgeons working with this sample should exercise caution when performing procedures such as total hip arthroplasty.

Keywords---lateral circumflex femoral artery, anatomical variations, cadaver, profunda femoris artery.

Introduction

Arterial variations of lower limb have always been of utmost importance due to their involvement in vascular reconstructive surgeries, catheterization procedures and in raising myocutaneous flaps with vascular pedicles. The recent use of lateral circumflex femoral artery (LCFA) in coronary artery bypass grafting as well as anterolateral thigh cutaneous flaps for oral and oropharyngeal reconstructions has further enhanced the relevance of normal and variant anatomy of LCFA. In view of anatomical variations, preoperative angiographic evaluation of femoral arterial system becomes mandatory in surgical procedures involving the LCFA.¹⁻² The descending branch of the lateral femoral circumflex artery (LFCA) has found recent use as a new arterial graft for coronary artery bypass grafting (CABG). Anatomical variants of the LFCA were assessed by various studies done in different populations on femoral arteriograms obtained before CABG. Studies have found that the most common pattern, found in 78.6% of extremities, consisted of the LFCA arising from the deep femoral artery, and the arterial graft was selected from this pattern in 92.3% of patients in whom the descending branch of the LFCA was used for CABG.³⁻⁵

The lateral circumflex femoral artery (LCFA) is an artery that branches from the profunda femoris artery (PFA) and at times directly from the superficial femoral artery (SFA) (Fig. 1a and b). The LCFA is known for contributing to the blood supply of the muscles in the lateral aspect/compartments of the thigh, and to a lesser degree contributes to the blood supply of the neck of the femur and femoral head. Around the shaft of the femur, the LCFA encircles the superior part of the femoral shaft and anastomoses with the medial circumflex artery of the thigh (MCFA). In its course, the LCFA passes laterally deep to the sartorius and rectus femoris muscles, dividing into the ascending, transverse and descending arteries (Fig. 2). The ascending branch supplies the anterior part of the gluteal region, transverse branch winds around the femur, while the descending branch joins genicular peri-articular anastomosis. Therefore, the LCFA gives blood supply to the head and neck of the femur, greater trochanter, the vastus lateralis and the knee. In a study conducted by Metwally et al., the LCFA was found to be a contributing source of blood supply to the sciatic nerve in 25% of the 20 dissected cadaver legs.⁶⁻⁹

In clinical practice, the branches of the LCFA have a variety of functions where it is used in anterolateral thigh flaps [7], aortopopliteal bypass [8,9] coronary artery bypass grafting [10] and extracranial-intracranial bypass surgeries [11]. Arterial grafts provide better patency rates for coronary artery bypass grafting than saphenous veins in both the short and long term [12]. Sound anatomical knowledge of the branching patterns of the CFA, SFA, PFA and LCFA is imperative in order to perform the aforementioned procedures, to ensure better clinical outcomes and reduced intraoperative complications. Literature reports several variations in origin of LCFA hence we have taken up this study to evaluate the variations of origin of lateral circumflex arteries in our population.

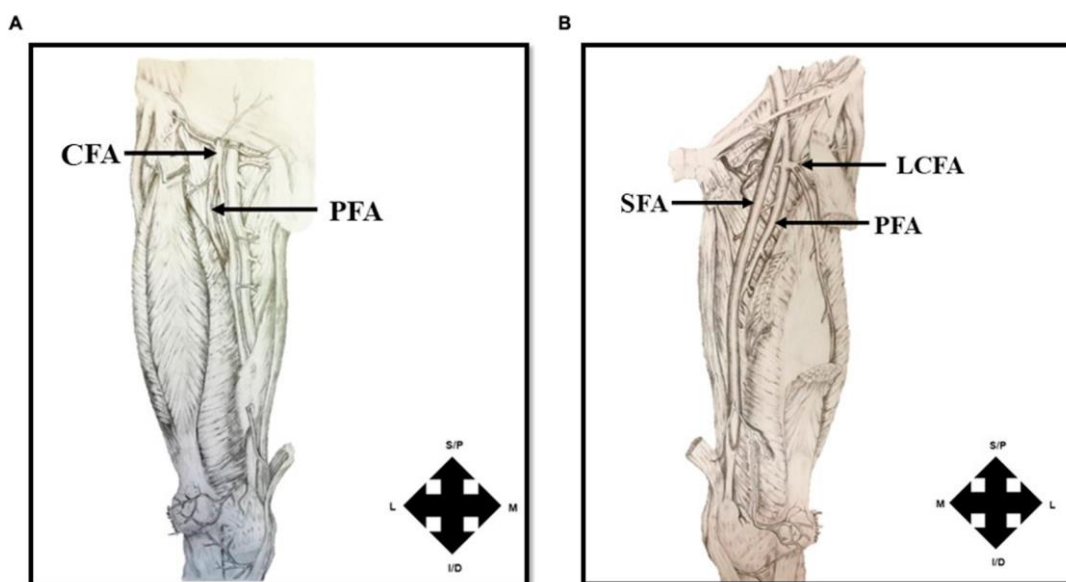


Figure A and B shows the View of the anterior compartment of the thigh showing the common femoral artery (CFA), superficial femoral artery (SFA), profunda femoris artery (PFA) and the lateral circumflex femoral artery (LCFA). Key: I- Inferior; D-Distal; M-Medial; L-Lateral; S-Superior; P-Proximal

Objectives of the study

The objective of the study is to explore the variations of in LCFA in Cadavers of Anatomy Dissection.

Materials and Methods

Study site: This study was conducted at the Department of Anatomy S Shri Balaji Institute of Medical Sciences, Mowa Raipur

Study population: 30 cadavers

Time frame to address the study: January 2021 to December 2021

Inclusion Criteria: cadavers of both the genders in anatomy dissection hall of shri Balaji institute of medical sciences.

Exclusion Criteria:

- Cadavers bearing any visible trauma in the hip joint region,

- Cadavers bearing any conspicuous scars in the anterior thigh compartment (due to surgery),
- CFA, SFA, PFA and/or the LCFA has been transacted or removed by previous dissectors.

Technique and Tools & Data collection

All the adult cadavers used in this study were obtained and dissected under the rules and regulations. All data was collected from full body cadavers. The cadavers were handled with respect and care at all times, and properly safeguarded. No information which could possibly reveal the identities of the cadavers was obtained. Access to personal information regarding the cadaver's age, sex, and ancestry was obtained from hospital records and noted, this information was restricted to the author. The height and weight of each cadaver was obtained post-mortem, prior to embalming and should therefore be as accurate a reflection of the height and weight of the individual. In this study, 30 embalmed formalin fixed adult cadavers were dissected from the Department of Anatomy, Shri Balaji Institute of Medical Sciences, Mowa, Raipur. Cadaver shortages are a common challenge currently experienced by medical schools, thus in some cadavers only one limb was useable. The study sample was therefore combined to make a total of 50 legs.

A standard dissecting method was developed and applied to all the cadavers used in this study. The skin overlying the anterior compartment of the thigh was incised, dissected and reflected medially. The subcutaneous fat, translucent fascia and superficial vessels were fully dissected and the Sartorius muscle and quadriceps muscle identified. The Sartorius muscle and the rectus femoris muscle were transacted, to further expose the CFA, SFA, PFA and the LCFA. The FA, PFA and their branches were identified and the LCFA followed along its course.

Various measurements were taken with Vernier callipers and recorded. These measurements, recorded in mm, were taken in relation to the CFA where it is first visualised entering the anterior compartment of the thigh, coursing posterior to the inguinal ligament, and lying within the femoral triangle. The first measurement was taken from the entry of the CFA into the anterior compartment of the thigh to where the PFA branches from the CFA. The second set of measurements included the distance from the pubic tubercle to the branching of the LCFA from the PFA or the SFA origin. The third set of measurements were taken as the distance from the origin of the PFA to the branching of the LCFA. The other measurements included the distance from the origin of the LCFA to the trifurcation into ascending, descending and/or transverse branch. Lastly, the distance from LCFA trifurcation to where the transverse branch emanated from the ascending and/or descending branch. The last set of measurements were not taken in all cases, as the transverse branch was not always the main source for the ascending branch.

Statistical Analysis

Data were expressed as mean $\pm$ SD. The Student *t* test was used for the comparison. Statistical analysis was done using Microsoft Excel spreadsheet, and statistical package for the social sciences (SPSS) version 20.0 software.

Results

Table 1: Shows the origin of the lateral circumflex femoral artery in the cadaver sample

Side	Origin of LCFA		Origin of LCFA	
	PFA		SFA	
Left leg	20/25	80%	5/25	20%
Right leg	22/25	88%	3/25	12%

Table 2: Shows the prevalence of LCFA in the male and female cadaver

Side	Origin of LCFA		Origin of LCFA	
	PFA		SFA	
	Male		Female	
Left leg	21/25	84%	4/25	16%
Right leg	20/25	80%	5/25	20%

It is evident from the above table 1 & 2 that out of total 50 legs, 80% of the cadavers (left leg) had origin from PFA and 20% from SFA, similarly in the right leg 88% of the cadavers had origin from PFA and 20% had origin from SFA. With respect to gender, 84% of male cadavers had origin from PFA and 16% had origin from SFA similarly in female cadavers 80% had origin from PFA and 20% from SFA.

Discussion

In performing surgical procedures relating to the femoral triangle and hip replacement, knowledge of the origin and distribution of the PFA, are critical as injury to these vessels have clinical implications. Injury to the vessels in this region may lead to severe secondary haemorrhage while performing femoral artery puncture. In our study, the most common site of origin of the PFA was found to be CFA in 96% of cases (48/50 limbs) dissected. The variation was found in two limbs, one female (left limb) and the other a male cadaver (right limb), in these two cases the PFA was found branching directly from the external iliac artery. Knowledge of the site of origin of the PFA is important for clinicians as it assists in avoiding iatrogenic femoral arterio-venous fistula while performing femoral artery puncture.⁶⁻¹⁰

out of total 50 legs, 80% of the cadavers (left leg) had origin from PFA and 20% from SFA, similarly in the right leg 88% of the cadavers had origin from PFA and 20% had origin from SFA. With respect to gender, 84% of male cadavers had origin from PFA and 16% had origin from SFA similarly in female cadavers 80% had origin from PFA and 20% from SFA. The left side origin is similar to the pooled prevalence of 77.6% documented by Tomaszewski et al. following a

systematic review of 26 articles, however, a lower right percentage of 73.9% was documented. The transverse branch of the LCFA was absent in 4.4% of the limbs dissected.

The most common site of origin for the LCFA was found to be the PFA, this is in line with published literature. Our findings are closely related to those of Fukuda et al., Uzel et al., Boonkham and Plakornkul and Rajani et al., who found these results to be 78.6%, 77.3%, 77% and 75.8%, respectively. Knowledge of the site of origin of the LCFA is important as this vessel contributes to the blood supply of the femoral neck, muscles and skin over the thigh. The increased blood supply to this region may decrease the incidence of flap necrosis. The uses of the LCFA also extend to the reconstruction of large defects in the face, secondary to gunshot wound. A variation was noted in two cadavers, where the branches of the LCFA had different points of origin. In the female cadaver, this variation was found on the left limb, where the descending branch was noted as emanating from the CFA, while the two ascending branches had both a CFA and PFA origin. Another variation was noted on a male cadaver, the left limb had two different branching points for the ascending and descending branches of the LCFA, a common trunk was absent.¹⁰⁻¹³

Rajani et al. mentions such a variation in their study, where a separate descending branch of the LCFA was found originating from either the CFA or PFA in six limbs. The descending branch of the LCFA has been used successfully as a high flow circuit for extra intracranial bypass surgery, it is therefore worth noting the variations that exist in the origin of these vessels. In this study, it was further noted that at the trifurcation of the LCFA, the transverse branch either originated from the ascending or descending branch, therefore an extra set of measurements was taken. The distance from the LCFA trifurcation to the origin of the transverse branch was recorded and the data analysed. We noted that in 65.6% (59/90) of the recorded cases, the transverse branch originated from the ascending branch of LCFA while in 10% (9/90) of the limbs dissected, the transverse branch originated from the descending branch of the LCFA. Our results also showed that the transverse branch of the LCFA was not always present as was the case in 4.4% (4/90) of the limbs dissected. The trifurcation of the LCFA is therefore only noted in 20% (19/90) of the limbs dissected. The study findings are comparable to the results documented by Gremigni, who found the trifurcation occurring in only 16% of the study sample. The findings relating to the origin of the transverse branch of the LCFA could not be compared to published literature as the research on this origin is absent. Knowledge of variations relating to the positioning of the LCFA are of utmost importance to vascular surgeons carrying out diagnostic and therapeutic procedures around the femoral triangle, to radiologists for avoiding misinterpretations of radiographs and anatomists for rare variations relating to the anterior compartment of the thigh.¹⁴⁻¹⁶

Conclusion

In our study, the most common origin of the LCFA was found to be PFA. Variations in the branching pattern of the LCFA is common in various populations. Knowledge of these variations related to the LCFA are important in clinical practice during vascular diagnostic intervention and surgeries as the

unusual origin of the LCFA may cause accidental injury during surgery. The frequency of variations relating to vessels in the anterior proximal thigh implies that surgeons working with this sample should exercise caution when performing procedures such as total hip arthroplasty.

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