

# Anatomical variations of the vessels in the femoral triangle – A case report

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## Abstract—

**The femoral triangle is an important site for various clinical procedures. A sound knowledge about the anatomical variations of femoral vessels and their branches in the femoral triangle is important to prevent inadvertent damage to these vessels during surgical procedures and for successful arterial and venous cannulation for various purposes.**

**This case report describes the clinically important abnormal vascular patterns of the left femoral region of a middle aged Sri Lankan man observed during routine dissection. Profundafemoris artery originated 1 cm below the inguinal ligament from the lateral aspect of the common femoral artery at a higher level than that documented in the standard text books and in most of the previous studies. Subsequently femoral artery crossed superficially over the femoral vein and the femoral vein was lying deep to the femoral artery in most part of the femoral triangle.**

**The profunda femoral vein drained into the femoral vein as described in the text books nearly 3 - 4 cm below the inguinal ligament. Medial and lateral circumflex femoral arteries originated from profundafemoris artery.**

**Even though the variations are mostly incidental findings and being of general anatomical interest, knowledge of these variations appears to be mandatory for planning surgery and vascular interventions. It also serves as a reminder that constant vascular landmarks can occasionally be subject to marked variability. Ultrasonography should be used particularly for more difficult femoral vascular access.**

Key Words: Femoral triangle, femoral artery, femoral vein, profundafemoris artery

## I. INTRODUCTION

Knowledge of normal anatomy and its variants is vital for safe surgical practice. The femoral artery and vein in the femoral triangle are utilized for various clinical procedures. Complications may arise from accidental puncture of the neighbouring artery or vein. Anatomy text books state femoral artery lies between the femoral vein and femoral nerve in the base of the femoral triangle. The femoral vein usually crosses the femoral artery near the apex of the femoral triangle and lies posterior to it at its apex, 10 cm below the inguinal ligament (Sinnatamby C.S, 2011;

Standring 2016). In the vascular surgical literature, the femoral artery above the origin of the profunda branch (deep femoral artery) is termed the common femoral artery, and the vessel below the profunda branch is the superficial femoral artery (Hughes et al, 2000). Profundafemoris artery which supplies the deep structures of the thigh and femur arises from the lateral side of the femoral artery about 3-4 cm distal to inguinal ligament (Sinnatamby C.S, 2011; Standring S. (ed.), 2016). We report the case of a high origin of profundafemoris artery and abnormal relation of femoral artery and vein within the femoral triangle. Aim of this study is to discuss normal anatomy and the possible variation of femoral vessels and highlight its clinical significance with relevant review of literature

## II. METHODOLOGY

The present report describes an abnormal relationship between femoral vessels and high origin of profundafemoris (PFA) artery from the femoral artery in the left lower limb of a formaldehyde preserved cadaver of a middle-aged Sri Lankan man in a routine dissection for undergraduate teaching. During the dissection, the skin from the front of thigh was incised and reflected followed by the superficial fascia. The great saphenous vein and superficial inguinal lymph nodes were identified and the fascia lata was incised thus exposing the femoral triangle with intact inguinal ligament. The femoral sheath was identified and dissected thus exposing the contents of femoral triangle. The arrangement of structures within the triangle was studied.

## III. RESULTS AND DISCUSSION

In the left femoral triangle, the femoral vein was medial to the femoral artery at the base of the triangle. The profundafemoris artery was arising from lateral aspect of femoral artery just 1cm distal to the lower border of the inguinal ligament (Fig 1). The femoral artery passed superficially and medially over the femoral vein, such that the artery was lying superficial and slightly medial to the vein in the rest of the triangle (Fig 2). The profunda femoral vein drained into the femoral vein as described in the text books nearly 3 cm below the inguinal ligament (Fig 2). Medial circumflex and lateral circumflex arteries were originated from profundafemoris artery as usual. The femoral nerve and its branches maintained a normal relationship with the vessels.

According to the literature femoral vein lies medial to the femoral artery in the base of the femoral triangle and it maintain this side by side relationship in the major part of the triangle. The vein lies behind the artery at or near the apex of the femoral triangle. Femoral vein catheterization is necessary when there is no visible peripheral vein for cannulation or when rapid access to a large vein is needed (Bandyopadhyay et al, 2010). In this case the femoral artery crossed the femoral vein superficially in the proximal part of the femoral triangle and the femoral vein was lying deep to the femoral artery in the major part of the femoral triangle. In a study of 35 cadavers, the average distance from the inguinal ligament to where the vein starts to pass behind the artery was 6.6 cm and the measurement was less than 4 cm in three instances (Bosch et al 1950). In an ultrasonographic study of 50 patients done by Hughes et al (2000) femoral artery was seen frequently overlapping the femoral vein. Moreover, the degree of overlap increases as the vessel descend distally towards the knee but overlapping of femoral artery and vein was not seen in any of the cases. They also observed that at the level of inguinal ligament in 72 % of the patients on the right side and 59 % of the patients on the left side the femoral artery and vein were side by side with vein medial to the artery. In the remaining cases there was partial overlap between the artery and vein. Four centimeters below the ligament there was some degree of overlap in all the patients and in 50 % of them there was complete overlap. They concluded that side by side relationship of the artery and vein is commonest close to the inguinal ligament and to avoid damage to the neighbouring vessel, percutaneous access should be undertaken just below the inguinal ligament. But Bandyopadhyay et al (2010) reported a case of femoral artery crossing the femoral vein just deep to the inguinal ligament and it was lying superficial to the artery at the base of the femoral triangle.

According to Sinnatamby C.S, (2011), profunda femoris artery originate 3 – 4 cm distal to the midpoint of the inguinal ligament. This present case showed that profunda femoris artery originated from the lateral aspect of the common femoral artery 1 cm distal to the midpoint of inguinal ligament. A spectrum of variation in origin of PFA has been reported. Teli et al (2015) reported a similar case, where the PFA originated 1 cm distal to the inguinal ligament from the lateral aspect of the femoral artery. Bandyopadhyay et al (2010) reported a case, where the PFA originated deep to the inguinal ligament in a 42 year old Indian man. Similarly PFA originating from the lower border of inguinal ligament from the lateral aspect of the femoral artery was found in a case reported by Kumar et al (2011). In a Sri Lankan study on 26 femoral triangles by Samarawickram et al (2009) found that PFA origin vary from 3 - 7cm from midpoint of inguinal ligament with a mean value of 5cm, which is higher than that reported in standard text books and the literature. They also added in most of the time PFA on left side tend to originate from a point proximal

to that of origin on the right side. A study of PFA by Prakash et al (2010) in Indian population revealed PFA originated from proximal 3<sup>rd</sup> in 29, middle 3<sup>rd</sup> in 25 and distal 3<sup>rd</sup> of femoral triangle in 10 out of 64 lower limbs studied.

The distance between midpoint of inguinal ligament and origin of PFA is clinically important. It enables to identify the correct site of making incision for surgical exposure of the junction of femoral artery and profunda femoris artery (Kumar et al, 2011; Teli et al, 2015). The common femoral artery is usually the site of choice for arterial puncture. Judkins technique for left heart catheterization is undertaken where femoral artery is approached by puncturing the vessel 1 to 3 cm below the inguinal ligament (Teli et al, 2015). Shorter the distance of origin of PFA from femoral artery leads to high risk of damaging it. Knowledge of the site of origin of PFA helps in avoiding iatrogenic femoral arteriovenous fistula and severe secondary haemorrhage while performing femoral artery puncture. Pseudoaneurysms can occur when the puncture site is either at PFA or femoral artery distal to the origin of the PFA (Hughes et al, 2000; Kumar et al, 2011; Teli et al, 2015). Therefore, cannulation of the femoral artery should be done close to the inguinal ligament as possible to prevent inadvertent cannulation of PFA or superficial femoral artery (Hughes et al, 2000).

Teli et al, (2015) also commented that the high origin of PFA can cause problem in procedures like venous puncture and femoral nerve blocks, because of close relationship of vessels and nerve in femoral triangle.

Samarawickrama et al (2009) stated that PFA commonly originate (46 %) from the posterior aspect of the femoral artery, posterolateral in 30 % and lateral in 23 % (in 6 out of 26). This present case showed a lateral origin of PFA from the common femoral artery. Kumar et al (2011) also pointed out that the PFA originate from the lateral aspect of the femoral artery when its origin is close to the inguinal ligament. The direction of origin of PFA is important in catheter application, in making flaps with pedicles in reconstructive surgery and bypass procedures made to supply the lower extremity (Samarawickrama et al, 2009; Kumar et al, 2011)

In the present case both medial and lateral circumflex femoral arteries originated from the PFA, as described in the standard text books (Sinnatamby C.S, 2011; Strandring S. (ed.), 2016). Perera (1995) had studied the variability of the level of origin of the PFA in relation to the different pattern of origin of the circumflex femoral arteries in 124 femoral triangles of Sri Lankan cadavers. Accordingly in 'group A', where the mean distance of origin of PFA was 3.43 cm from inguinal ligament, in which case both the medial and lateral circumflex femoral arteries originated from the PFA. In 'group B' where the mean distance of origin of PFA was 4.21 cm, either one or both circumflex femoral arteries originated from the common femoral

artery instead of from PFA. He concluded that site of origin of circumflex femoral vessels depend on the level of origin of PFA from femoral artery and when it migrates distally from inguinal ligament either one or both circumflex femoral arteries originated from the common femoral artery instead of from PFA.

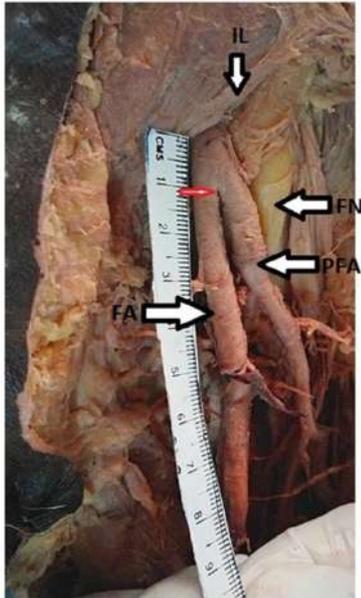


Figure 1: Showing Profunda Femoris Artery [PFA] from lateral aspect of femoral artery (FA) 1 cm distal to inguinal ligament at the mid inguinal point [IL]. FN= Femoral nerve

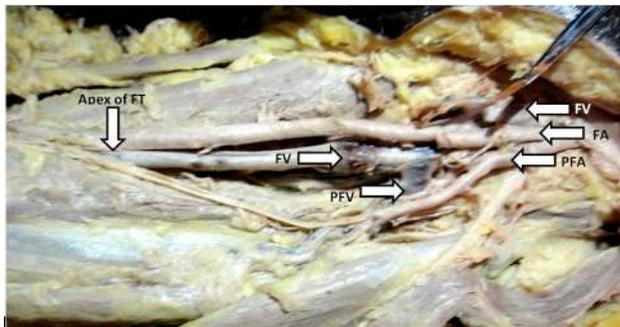


Figure 2: Showing the crossing of femoral artery (FA) over femoral vein (FV) at a higher level and profunda femoris vein (PFV) draining into femoral vein at a lower level than the origin of profunda femoris artery (PFA). FT – Femoral triangle

Previous documented studies also commented that the diameter of PFA decreases as the site of its origin becomes more distal from the inguinal ligament. The anatomical knowledge of the relationship of femoral vessels in femoral triangle, site and direction of origin of PFA and the diameter of PFA is needed for the safe medical and surgical practices. It prevents the necrosis of flap, when used in plastic and reconstructive surgery (Prakash et al., 2010; Kumar et al 2011).

#### IV CONCLUSION

Even though the variations in femoral triangle are mostly incidental findings, knowledge of these variations appears to be mandatory for planning the surgery and determining the optimum site for vascular interventions. It will reduce the complication rates of blind techniques used to cannulate femoral artery and femoral vein. Ultrasound guidance of surgical intervention reduces the incidence of complications.

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