

## To study of popliteal artery and its variations in origin, length and diameter with clinical applications

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### ABSTRACT:

**Introduction:** Because there are so many surgical and radiological procedures that involve the knee joint, it is essential for day-to-day practice to have a solid understanding of the possible anatomical abnormalities that can occur within the PA and its branches. **Aim:** The aim of the present study was to identify the popliteal artery and its variations in origin, course, length and diameter with clinical applications. **Material & methods:** The Institutional Ethics Committee approved the study before work began. The initiative has Institutional Ethics Committee approval. This activity has Institutional Ethics Committee approval. This study will dissect fifty adult human lower legs using standard methods. First-year MBBS and BDS students at Index Medical College & Hospital in Indore dissected embalmed adult lower limb specimens. Decedents' lower extremities were sampled. Dissecting the embalmed corpses yielded specimens. Cunningham's anatomy textbook's dissection chapters guided the popliteal fossa dissection. **Results:** The Popliteal artery (PA) was found to be the continuation of the femoral artery in each and every one of the fifty specimens of the lower leg that were examined during dissection. This proportion was one hundred percent. The shortest length of PA was 16.9 centimeters, and the largest length of PA measured 21.5 centimeters. The length that was measured most frequently was the average length, which was 18.8 centimeters. **Conclusion:** This topic has been explored in greater depth by previous researchers. As a result of our investigation, we can conclude with reasonable certainty the following. First, it may be stated that all PA samples have something in common due to the presence of FA in each. PA had an average length of 21.5 centimeters. The average diameter of PA was 7.9 millimeters.

### INTRODUCTION:

It is much more likely for arteriosclerotic alterations to develop in the upper limbs [1] than they do in the lower limbs. In addition, changes in the vascular network of the lower limb are frequently linked to the femoral artery and the major branches that it has [2]. On the other hand, the anterior and posterior tibial arteries as well as the fibular arteries show less variation [1,2]. After travelling through the adductor hiatus, the popliteal artery, which is a branch of the femoral artery, continues its course below the knee Popliteal artery (PA) [3]. The anterior tibial artery (ATA) naturally separates into the posterior tibial artery (PTA) and the fibular artery at the popliteus

muscle's inferior border [4]. This is called the popliteal division (FA). Through the top hole of the interosseous membrane, the anterior tibial artery (ATA) enters the anterior chamber of the leg, which contains the extensors, and exits the posterior chamber, which contains the flexors, between the tibia and the fibula. The posterior tibial artery (PTA) and the fibular artery do not shift from their sites at the confluence of these arteries in the posterior chamber [1-8]. This is a crucial fact to keep in mind (FA). In addition to the knee, the joint capsule and ligaments in the lower leg and foot are nourished by blood that comes from the popliteal artery [9]. Because there are so many surgical and radiological procedures

that involve the knee joint, it is essential for day-to-day practice to have a solid understanding of the possible anatomical abnormalities that can occur within the PA and its branches [10-15]. This knowledge is absolutely necessary for orthopedic surgeons to have in order to perform proximal osteotomies, as well as femoropopliteal and tibial reconstructive procedures [4,6]. Radiologists who do diagnostic angiography, angioplasty, embolectomies, or transluminal stent implantations can benefit considerably from being aware of these polymorphisms [7]. The aim of the present study was to identify the popliteal artery and its variations in origin, length and diameter with clinical applications.

**MATERIAL AND METHODS:**

The Institutional Ethics Committee approved the study before work began. The initiative has Institutional Ethics Committee approval. This activity has Institutional Ethics Committee approval. This study dissected fifty adult human lower legs using standard methods. First-year MBBS and BDS students at Index Medical College & Hospital in Indore dissected embalmed adult lower limb specimens. Decedents' lower extremities were sampled. Dissecting the embalmed corpses yielded specimens. Cunningham's anatomy textbook's dissection chapters guided the popliteal fossa dissection. To grasp the popliteal fossa's anatomy. First, a transverse incision was made at the junction of the middle and lower thirds of the thigh, and then another at the back of the leg. This followed the transverse incision. This incision connects the two transverse incisions. After lifting the skin flap, surface and deep fascia incisions were made

concurrently. These incisions occurred simultaneously. Skin structures can be distinguished. Reflecting the deep fascia establishes the popliteal fossa's borders and contents. If the gastrocnemius muscle's two bellies saw each other, they could be able to split from the femur. Both gastrocnemius muscles' bellies pointing down. Popliteal TN and lower vasculature were evident. The soleus muscle and intermuscular septum mirrored laterally after detaching from the tibia. Concurrently, The popliteus bottom was found. After removing the fascia covering the popliteal vessels, the terminal branches—including the anterior and posterior tibial arteries—were found and followed. Accessing the popliteal vessels required this. The Popliteal Artery (PA) is replaced by the Anterior Tibial Artery (ATA), which enters the anterior leg compartment. ATA started from PA. The Posterior Tibial Artery (PTA) might be traced back to the flexor retinaculum. The PRA evolved from the PTA and was tracked down the back of the fibula under the flexor hallucis longus muscle. Discovery was occurred. The next clause were decided. The Peroneal Artery (PA) muscle branches were revealed and examined once the exam began. The lateral, medial, and middle genicular branches of the femur were traced after fat was removed from the popliteal surface. The adductor magnus origin to the terminal division was measured. This measurement started when the adductor magnus divided. Vernier caliper measured the PA diameter at each level. (adductor magnus anatomical centre, bifurcation point).

**STATISTICAL ANALYSIS:**

Using Microsoft Excel, tabular records are made of the data, and the results were analyzed statistically.

**RESULTS:**

The PA was found to be the continuation of the FA in each and every one of the fifty specimens of the lower leg that were examined during dissection. This proportion was one hundred percent. (Table No 1)

**Table No: 1 Origin of Popliteal Artery**

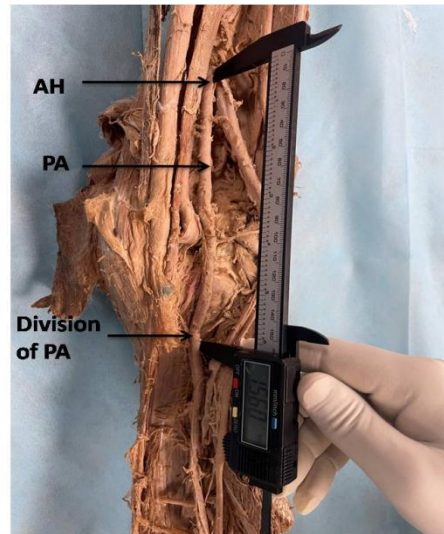
S.No	Origin of PA	Frequency( n=50)	Percentage (%)
1	From femoral artery	50	100
2	Other source of origin	-	-

When each and every specimen was dissected, the course of PA was discovered to be normal in each and every one of them. To determine how long the PA is, start measuring at the point where the AH begins and go up until you reach the level where it divides into the ATA and PTA. The shortest length of PA was 16.9 centimeters, and the largest length of PA measured 21.5 centimeters. The length that was measured most frequently was the average length, which was 18.8 centimeters (Table No. 2)

**Table No.2- Length of Popliteal Artery**

<b>Minimum length</b>	16.9cm
<b>Maximum length</b>	21.5cm
<b>Mean length</b>	18.8cm

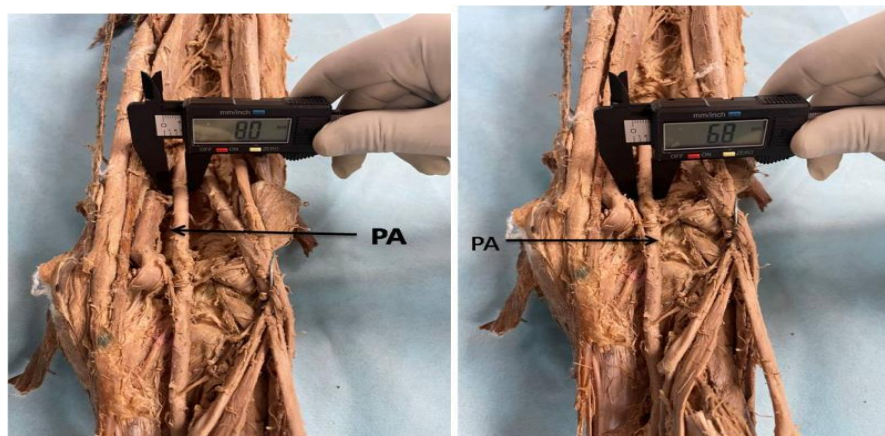
The diameter was measured using standard vernier calipers and the results are given in millimeters. In the present study the minimum diameter of the popliteal artery was observed to be 6.8 mm, maximum diameter was 8.8 mm and the average diameter was 7.8mm (TableNo3).



**Measuring the length of PA**

**Table No.3–Diameter of the Popliteal Artery**

<b>Minimum diameter</b>	6.8mm
<b>Maximum diameter</b>	8.8mm
<b>Average diameter</b>	7.8mm



**Measuring diameter of PA**

**Measuring diameter of PA at the Centre**

at the adductor hiatus



**Measuring diameter of PA at the level of bifurcation.**

## **DISCUSSION:**

### **Origin of the popliteal artery:**

According to Holinshead., (1969) [16] FA passes through the AH and reaches the posterior aspect of the lower thigh, where it is known as PA. Neville et al., 1990 [17] in their study reported congenital absence of PA, which was discovered during operative exploration after a traumatic injury to the lower extremity. Last, 1999 [18], according to his research, the PA is the deepest of the neurovascular structures in the fossa. It runs from the adductor magnus hiatus to the soleus muscle's fibrous arch. Kadasne., 2009 [19], according to his research the PA runs as a continuation of the FA beyond the opening of the artery in the adductor magnus. Snell in 2010 [20], in his article demonstrated that the PA enters the popliteal fossa through the opening in the adductor magnus as a continuation of the FA. It terminates at the level of the lower border of the popliteus into the ATA and PTA. Gray's et al., 2012 [21], observed that the PA is the continuation of FA. It can appear as a continuation of the sciatic artery, which is a branch of the inferior gluteal artery. Instead of the FA, the PA could be a continuation of the sciatic artery (a branch of the inferior gluteal artery). When this happens, the PA may form an abnormal relationship with the popliteus, running deep into the muscle before dividing into its terminal branches.

### **Length of the popliteal artery:**

Gaylis 1974 [22] in his arteriographic study found that the average length of the PA was 17.5 mm. Ozgur et al., 2009 [23], did a study on 40 lower limb samples from 19 male and 21 female cadavers. They used different anatomical landmarks to measure the length of PA. They

found that the length of the PA from the AH to the beginning of the ATA was  $191.1 \pm 34.7$  mm, and the length from the AH to the FCs was  $138.1 \pm 23.8$  mm. Barut et al., 2009 [24], in their study took apart the popliteal fossa in 28 lower limbs. On the right side, the average length of the PA from the AH to the FCs was found to be  $92.6 \pm 16.3$  mm, and on the left side, it was  $100.8 \pm 21.2$  mm. On the right side, the mean distance from the FCs to the end was  $72 \pm 19.8$  mm, and on the left side, it was  $66.9 \pm 11.5$  mm. On the right side, the length of the artery from the level of the FCs to where the PRA starts was  $100.1 \pm 17.8$  mm, and on the left side, it was  $91.8 \pm 10.7$  mm. Khandelwal et al., 2014 [25], in a study of 40 lower limbs done by the average length of the PA was found to be 11.2 cm, while the normal length is between 18 and 20 cm and also found 5% HDPA in forty samples. Telang et al., 2016 [26], dissected 50 dead humans in 2016 and found that the average length of the PA from the top of the AH to the end of the FCs was 149.7 mm on the right side and 149.2 mm on the left. From the end of the FCs to the end of the PA, on the right side it was 59.2 mm and on the left side it was 60.6 mm. From AH to where PA ends on the right and left sides, the average length was 208.7 mm and 208.8 mm, respectively. Oner et al., 2020 [27], in a study on lower limbs done by the average length of the PA was found to be 12.12 cm. In a leftward course, the average distance from the top of AH to the end of PA on the right side was 208.7 millimeters, while on the left it was 208.8 millimeters. Vascular surgeons and radiologists will benefit from knowing the whole extent of PA, from its origin to its termination. Knowing how the PA typically looks is crucial when dealing with vascular injury in the popliteal fossa, surgical endoscopic repair of a popliteal aneurysm, or a femoro-popliteal bypass graft.

**Conflict of interest:** None declared.

### **Diameter of the popliteal artery:**

Zierler et al., 1983 [28] reported that PA had a mean diameter of 5.2 ± 1.1 mm. Johnston et al., 1991 [29], said that PA had a mean diameter of 9.1 ± 2.1 mm. Macchi et al., 1994 [30], used duplex ultrasound scanning to look at 50 healthy men and women. They found that the average diameter of the PA was 5.1 ± 0.4 mm in men and 5.0 ± 0.4 mm in women. Sandgren et al., 1998 [31], looked at 121 healthy volunteers and found that the PA diameter ranged from 6.9 to 8.4 mm in men and from 5.7 to 7.2 mm in women, depending on their BMI and age. Crawford et al., 1998 [32], did a sonography study and found that the mean PA diameter for men was 7.2mm and for women it was 6.1mm. Ozgur et al., 2009 [23], did a study on 40 lower limb samples from 19 male and 21 female cadavers. They used different anatomical landmarks to measure the length of PA. They found that the length of the PA from the AH to the beginning of the ATA was 191.1 ± 34.7 mm, and the length from the AH to the FCs was 138.1 ± 23.8 mm. The tibio-peroneal trunk was between 30.3 and 16.2 mm long. Their study also reported found that the diameter of the PA 5 cm from the AH was 8.2 ± 1.6 mm. At the end of the FC, the diameter was between 7.5 and 1.3 mm. Gajbe et al., 2020 [33], reported In males the mean diameter of popliteal artery at its origin is 6.7 ± 0.7mm on right and 6.6 ± 0.6 mm on left respectively In the present study the mean diameter of the PA was 7.8 mm. The diameter of the normal PA is not uniform throughout the length. In most of the studies, mid popliteal diameter was taken into consideration to assess the risk of development of Popliteal aneurysm. When the PA diameter is more than 2 cm, it is considered as popliteal aneurysm.

### **CONCLUSION:**

Surgeons and anatomists have long been fascinated by the Popliteal artery and its intricate branching structure. For the most part, this is due to the immense significance of this blood artery in both clinical and radiological contexts. Through the dissection of adult human cadavers, this study seeks to describe and provide information on the usual and variable anatomy of the PA. This action was made to achieve the investigation's objectives. This study aimed to elucidate PA's origins, development, trajectory, diameter, branches, terminal branching pattern, and links to neighboring neurovascular structures. This topic has been explored in greater depth by previous researchers. As a result of our investigation, we can conclude with reasonable certainty the following. First, it may be stated that all PA samples have something in common due to the presence of FA in each. PA had an average length of 21.5 centimeters. The average diameter of PA was 7.9 millimeters.

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