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Original Research Article

INVESTIGATING THE CLINICAL RELEVANCE OF THE POPLITEAL ARTERY'S RESEARCH OF ITS ORIGIN AND BRANCHING PATTERN IN RELATION TO THE POPLITEAL FOSSA

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ABSTRACT

Background: A branch of the femoral artery that branches out in the popliteal fossa, the popliteal artery supplies blood to the lower extremities. In the popliteal fossa, the popliteal artery reaches the popliteus muscle's inferior border. The purpose of this CT angiography investigation was to identify the various popliteal artery branching patterns in a large population.

Materials and Methods: Twenty lower limb specimens were collected from the Department of Anatomy, A.C.S.R. Government Medical College, Nellore, and Government Medical College Ongole, Andhra Pradesh, India. The 10 lower limb specimens were acquired from unclaimed foetal cadavers. This study was done between the January 2021 to December 2023.

Results: In this study, all specimens showed that the popliteal artery originated at the same level and in the same way as the femoral artery, which is the common pattern. There was no change in the present investigation regarding the popliteal artery's origin. The popliteal artery length was measured in 40 limbs in a cadaveric investigation. From the adductor opening to the origin of the anterior tibial artery, the average length of the popliteal artery in his study was 191.1mm. The popliteal artery averaged 173.5 mm in length throughout the research. It lines up with principles.

Conclusion: The results of the present study's observatory were in good agreement with those of previous studies. Vascular and reconstructive surgeons rely on anatomical understanding of the popliteal artery and its variants.

Keywords: Clinical relevance, popliteal artery, branching, popliteal fossa.

INTRODUCTION

What makes the foundation of anatomy so impressive is how consistent and long-lasting it is. Since its beginning, this field has undergone significant evolution. One of the bigger peripheral arteries located in the lower extremity is the popliteal artery. It connects the lower extremities to the rest of the body via the arteries.[1,2] This artery is most often affected by peripheral vascular disorders, particularly in people with diabetes or a history of smoking.[3]

Therefore, the surgical strategy and radiological interventional treatments will be significantly impacted by the popliteal artery anatomy investigation. Following the femoral artery in an oblique fashion is the popliteal artery. This line begins at the sixth Osseo aponeurotic aperture of the adductor magnus and continues all the way to the lower border of the popliteus. Along the inferior border of the popliteus, it branches off into the anterior and posterior tibial arteries. The total length of this artery is approximately 20 centimetres.[4,5]

Fascia of popliteus, capsule of knee joint, and femoral popliteal surface are its anteriorly connected structures. On the back, you'll find the popliteal vein, the tibial nerve, the fascia, and the skin. Semimembranosus and semitendinosus are close relatives on a supramedial level. It is connected to the biceps femoris superolaterally. It has a connection to the medial head of the Gastrocnemius inferomedially. Attached ferolaterally to the gastrocnemius and plataris muscles.[6,7]

Medial to the popliteal vein and tibial nerve in the upper portion of the popliteal fossa is the popliteal artery. It is lateral to the popliteal vein and the tibial nerve in the lower section of the popliteal fossa. The popliteal vein and the tibial nerve cross lateral to medial in the popliteal fossa's centre. Located between the popliteal artery and the tibial nerve, the popliteal vein runs the length of the course.[8,9]

Peripheral arterial aneurysms most frequently involve the popliteal artery. The popliteal artery is the site of 70–80% of peripheral arterial aneurysms. The superficial femoral and popliteal arteries have seen a dramatic surge in endovascular treatments performed in the past ten years. It will be helpful for surgical techniques to investigate the popliteal artery and its branches. An appropriate arterial graft is another use for it.[10,11]

When dealing with peripheral vascular illnesses or performing orthopaedic surgery on the lower limbs, it is crucial to understand the anatomical variation of the popliteal artery. A potentially fatal condition known as popliteal artery entrapment syndrome can develop when the popliteal artery follows an irregular path. Entrapment of the popliteal artery by surrounding muscles is a symptom of this illness.[12,13]

Transplants placed above or below the knee often end up in the popliteal artery. Penetrating and blunt damage to the lower limbs also tend to impact it. Surgeons and orthopaedicians can better prevent unanticipated arterial damage during surgical procedures by being knowledgeable of the popliteal arterial study's origin, branching pattern, and variations. During radiological interventional procedures, it is also useful for radiologists. In light of the foregoing, I am thrilled to learn more about the popliteal artery and its intricate network of branches.[14,15]

MATERIAL AND METHODS

Twenty lower limb specimens were collected from the Department of Anatomy, A.C.S.R. Government Medical College, Nellore, and Government Medical College Ongole, Andhra Pradesh, India. The 10 lower limb specimens were acquired from unclaimed foetal cadavers. This study was done between the January 2021 to December 2023.

Methods

The procedures outlined in Cunningham's Manual of Practical Anatomy were followed during the dissection. On the back, from the middle of the thigh to the heel, a longitudinal incision was made in the skin. Reflected were the dermal layer and the superficial fascia. The biceps femoris muscle and its tendon to the insertion were exposed after a cut was made into the deep fascia along its length. Two muscles, including the gracilis and its tendon, were revealed when a comparable incision was made over the semimembranosus and semitendinosus. In order to expose the tibial nerve, the deep fascia from the back of the politeal fossa was cut.

After identifying the two gastrocnemius bellies, we removed them from their respective attachments. We were able to see the popliteal artery. Afterwards, the skeletal claps were made note of. The lower border of the popliteus was detected, and the soleus was detached from the tibial connection. The lower fascia of the popliteal vessels was lifted, revealing their terminal branches.

In the upper region of the popliteal fossa, the tibial nerve was located medial to the popliteal artery during this dissection. Afterwards, the nerve makes a shallow crossing of the artery. In the middle and lower section of the popliteal fossa, on the lateral side of the artery, was located the tibial nerve. It was observed during the aforementioned surgery that the popliteal artery is continuous with the femoral artery above and begins at the osseoaponeurotic orifice in the adductor magnus muscle.

Foetal Specimens

The technique used to dissect foetal cadavers was quite comparable to that used on adult specimens. In our investigation, we tracked down the starting point, pattern of branches, and endpoint. Also noted was the connection between the popliteal artery, vein, and tibial nerve.

Radiological Procedure

The patient was asked to lie down on the patient's back while the computerized tomography gantry stretched the limb under examination within the computerized tomography X-ray oscillation preview. A venflon was used to cannulate the cephalic vein, and a third-generation water-soluble iodinated contrast agent called Omni phage was injected into the vein at a rate of 2 mg/kg. A series of images were taken seven minutes after the contrast was administered for the arterial phase and five minutes for the venous phase. We analysed the popliteal artery's origin, branching pattern, and termination from the computerized tomographic series of images.

RESULTS

Researchers looked examined the popliteal artery's beginning, diameter, length, branching pattern, end, and relationships. All of the data was compiled according to the study's specifications. The present investigation found that the popliteal artery originated from the femoral artery in every single patient. The popliteal artery originated from the femoral artery in every single specimen, whether it was an adult or a foetal one.

Table 1 includes the origin of the femoral artery in 20 adult individuals and 10 foetal individuals. [Table 1]

According to Table 2, the origin level of the fifth osseoaponeurotic aperture in the adductor magnus was 20 in adults and 10 in foetuses. [Table 2]

Table 3 shows the popliteal artery branches; 19 specimens followed the conventional pattern, while 1 specimen had an unusual origin for the inferior lateral and medial genicular branches from the anterior tibial artery and the tibioperoneal trunk. [Table 3]

A total of 19 adults in Table 4 had a single popliteal vein, and 1 adult in Table 4 had a pair of veins that ran alongside the popliteal artery. [Table 4]

The popliteal artery originated at the adductor hiatus in every case of the present investigation. In both the adult and foetal specimens, the level of origin at the adductor hiatus occurs in 100% of cases. There were a number of musculature branches that led to the popliteal muscles. Anterior and posterior muscle branches are their original forms. Genitourinary branches were noted. Different genicular branches—superior, medium, and inferior—gave rise to them. Additionally, one or two branches of the skin were noted. The anterior tibial artery was the origin of the inferior lateral genicular artery in a single instance. From the same tibioperoneal trunk, the inferior medial genicular artery was born. A total of 29 adult specimens showed the typical presence of a branching popliteal artery. In an unexpected finding, one specimen had the medial genicular artery originating from the tibioperoneal artery and the inferior lateral artery from the anterior tibial artery.

Table 1: Mode of Origin

Sr. No.	ode of origin	Adult -20		Foetal -10	
		No.	%	No.	%
1	Following femoral artery	20	100	10	100
2	Other modes of origin	-	-		-

Table 2: Level of Origin

Sr. No	Level of origin	Adult 20		Foetal 10	
		No.	%	NO.	%
1	Regarding adductor magnus fifth osseo-aponeurotic opening	20	100	10	100
2	High level of origin	-	-	-	-
3	Low level of origin	-	-	-	-

Table 3: Popliteal artery branches

No	The popliteal artery branches on	Adult (20)	
		No.	%
1	Popliteal artery typically follows this pattern	19	96.7
2	Popliteal artery typically follows this pattern	1	3.3

Table 4: Existence of duplicated popliteal veins

Sr. No	There are two popliteal veins.	Adult (20)	
		No.	%
1	Single popliteal vein	19	96.7
2	There are two popliteal veins.	1	3.3

DISCUSSION

The popliteal artery's variations in beginning, length, diameter, branching pattern, relation, and termination were examined and contrasted with those previously reported by certain researchers. Nine of the ten pictures were in the typical pattern, showing the popliteal artery branching out into the arteries that run along the inside of the legs. The trifurcation pattern was only visible in a single photograph. Approximately 10% of cases showed variations in the branching pattern of the popliteal artery.[16,17]

According to the description, the popliteal artery is a continuation of the femoral artery that starts at the adductor hiatus. Up above, the popliteal artery becomes the femoral artery. He went on to say that it can also develop from the sciatic artery, a branch of the inferior gluteal artery, rather than the femoral artery, another possible origin. In this study, all specimens showed that the popliteal artery originated at the same level and in the same way as the femoral artery, which is the common pattern. There was no change in the present investigation regarding the popliteal artery's origin.[18,19]

The popliteal artery length was measured in 40 limbs in a cadaveric investigation. According to his research, the average length of the popliteal artery was 191.1+/- 34.7 mm, measured from the adductor opening to the origin of the anterior tibial artery. The popliteal artery averaged 173.5 mm in length throughout the research. It lines up with principles.[20,21]

There are three or four branches that originate in the hamstring muscles, two or three inferior branches that go to the calf muscles, five branches that go to the genicular vessels, and one or two branches that go to the cutaneuos vessels. One of the 40 lower limbs cadavers studied had the inferior medial genicular artery originating from the common

tibioperoneal trunk and the inferior lateral genicular artery from the anterior tibial artery. The present investigation found that the popliteal artery exhibited the typical pattern of branching within the popliteal fossa in 29 cases. According to one specimen, the common tibioperoneal trunk was the origin of the inferior medial genicular artery and the anterior tibial artery was the origin of the inferior lateral genicular artery. This occurrence, which had an unexpected source, exceeded the incidence.[20-22]

Of the cases, 92.2% had the Type IA - normal pattern. A typical pattern was seen in nearly all cases (97%). Ninety percent of the limbs in this investigation were kind IA, which is the usual kind. Trifurcation pattern was observed in 2.2% of instances in an angiographic investigation. Trifurcation of the popliteal artery into anterior tibial, posterior tibial, and peroneal arteries was observed in 10% of the specimens in this investigation. Approximately 5% of the samples had the posterior tibial artery's high origin above the popliteus's inferior border. Adult cadavers did not show a high level of origin of the posterior tibial artery in this study. Described a case study in which two foetuses were born with the posterior tibial artery located high on the body, just outside the popliteus. Ten percent of the limbs in this foetal investigation had a high level of posterior tibial artery origin.[21-23]

Two percent of the samples examined had an aberrant connection, meaning the popliteal artery had gone superficially into the popliteal vein. The usual relation was followed by 96.7% of the specimens in the present investigation. A small percentage of specimens (3.3%) had the popliteal artery located deep to the tibial nerve rather than superficial to the popliteal vein. His research indicated that 40% of his participants had a twin popliteal vein. A trio of superficial femoral veins and a twin popliteal vein were observed in 3.3% of the specimens analysed in this investigation. Compared to the incidence, it is lower.[22-24]

Research examining lower leg angiograms to determine the variability and pattern of branching of the popliteal artery. Trifurcation of the popliteal artery, high origin of the posterior tibial artery, and high origin of the anterior tibial artery were the most often seen patterns of branching. Nine pictures showed a typical branching pattern in our investigation. A trifurcation pattern was detected in just one picture. In this investigation, deviations occurred at a rate of 10%. The incidence quoted by the aforementioned writers was lower; it was greater.[24-26]

CONCLUSION

Several researchers in the past and present century have studied the popliteal artery, its origin, length, diameter, branching pattern, relation, and termination. Standard dissection and radiological analysis were the tools of choice for this investigation. The popliteal artery was examined in thirty lower limb specimens from adults, ten from fetuses, and ten CT angiograms. The results of the present study's observatory were in good agreement with those of previous studies. Vascular and reconstructive surgeons rely on anatomical understanding of the popliteal artery and its variants. Additionally, it helps radiologists prevent unanticipated vascular damage during treatments. Surgeons and radiologists can use the results of this study to better comprehend the popliteal artery's variability.

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Conflict of Interest

None.

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