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To study of popliteal Artery and its variations in origin, Division and Branches with clinical applications.

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Abstract:
Introduction: *Due of its proximity to the popliteal fossa, knee surgery marks it. Popliteal artery* ***(PA)*** *changes effect most knee surgeries. Variation is usually trifurcation. Aim: The aim of the present study will be to identify the popliteal artery and its variations in terms with course of the artery, genicular branches, and level of terminal division of popliteal artery with clinical applications.* ***Materials & methods:*** *Before any work could start, the study had to be approved by the institution's ethics board. The project has been given the green light by the institution's ethics board. The project has been given the green light by the institution's ethics board. Fifty human shins will be dissected according to established protocols. Index Medical College & Hospital in Indore's first-year MBBS and BDS students dissected embalmed adult lower limb specimens. We took samples from the legs and feet of the dead. Specimens were obtained by dissecting the embalmed bodies. The dissection of the popliteal fossa was guided by the relevant chapters in Cunningham's anatomy textbook.* ***Results:*** *The course of PA when each and every specimen was dissected, the course of PA was discovered to be normal in each and every one of them. 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 present investigation involved the inspection of fifty lower limb specimens, which made it possible to view the terminal branches, muscle branches, genicular branches, and cutaneous branches (Table No. 1). Only one of the fifty specimens taken from the lower limbs tested positive for the presence of inferior lateral genicular artery (ILGA), and it is suspected that ATA, and not PA, was the agent that caused the sickness.*
Conclusion: *Vascular surgeons must know the PA bifurcation's locations and patterns to avoid problems during treatments. This area can undergo many surgeries. Knee surgeons must have it. The second section is for the PA aneurysm surgeon and angiographer.*

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I. Introduction:

After the sixth Osseo-aponeurotic opening in the adductor magnus muscle, the popliteal artery (PA) remains part of the Femoral artery (FA) [1-13]. It connects to the popliteal fossa and is a crucial marker for knee surgery [10]. Most knee joint surgeries are affected by popliteal artery anatomy [11]. High division and trifurcation occur most often [12]. The soleus fascia and adductor magnus hiatus connect the popliteal artery's proximal and distal ends [1]. This artery is near the femur and tibia in the knee [8]. This joint's fractures and dislocations often cause vascular damage. It also increases knee arthroscopy bleeding [4]. Poor popliteal artery-musculotendinous connection can cause entrapment syndrome. Classical form [3]. Understanding popliteal artery development [1] can help explain aneurysm and entrapment syndrome. Exercise-induced gastrocnemius muscle hypertrophy may develop functional popliteal artery entrapment syndrome (PAES) [6]. Additionally, anticipate PAES difficulties. Both above and below-knee bypass grafts can use the popliteal artery [2]. Arthroscopy, vascular grafting, direct surgical repair, transluminal angioplasty, embolectomy, and arterial injury detection require knowledge of popliteal artery branching changes [6]. Vascular grafting requires this understanding too. Examine the Popliteal artery and variations before knee diagnostic, interventional, or surgical treatments [7]. Pre- or post-knee surgery procedures are possible [8]. Despite advancements in vascular surgery, patients with a posterior popliteus high anterior tibial artery (ATA) origin are at risk of arterial

problems include fistula, transection, pseudo-aneurysm, and thrombosis [9]. Angioplasty and embolectomy are difficult if the popliteal artery trifurcates [10]. The peroneal artery perforator flap reconstructs leg abnormalities in the intermediate and distal thirds, ankle, and Achilles tendon. If the ATA and posterior tibial artery (PTA) are hypoplastic, do not harvest the PRA [4-8]. As an artery, the PRA exclusively supplies distal extremities [11]. The superior lateral genicular artery supports the lateral thigh flap. It treats superior and lateral knee deformity [12]. Atherosclerosis causes most solitary occlusive peripheral arterial disease. Rare causes include cystic adventitial disease [13]. The adventitial layer of the blood vessel wall has a cyst, and PA is the most affected arterial type. It narrows the artery lumen, causing intermittent claudication [14]. Due of its proximity to the popliteal fossa, knee surgery marks it. PA changes effect most knee surgeries. Variation is usually trifurcation. The popliteal artery links to the adductor magnus hiatus and soleus fascia at its proximal and distal ends [1]. This artery is near the knee. This joint often ruptures blood vessels. Knee arthroscopy blood loss rises. Incorrectly connecting the popliteal artery to the local musculotendinous system causes entrapment syndrome.

The aim of the present study will be to identify the popliteal artery and its variations in terms with course of the artery, genicular branches, and level of terminal division of popliteal artery with clinical applications.

II. Materials & Methods:

Before any work could start, the study had to be approved by the institution's ethics board. The project has been given the green light by the institution's ethics board. The project has been given the green light by the institution's ethics board. Fifty human shins were dissected according to established protocols. Index Medical College & Hospital in Indore's first-year MBBS and BDS students dissected embalmed adult lower limb specimens. We took samples from the legs and feet of the dead. Specimens were obtained by dissecting the embalmed bodies. The dissection of the popliteal fossa was guided by the relevant chapters in Cunningham's anatomy textbook. For an understanding of the popliteal fossa's structure. An initial transverse incision was made where the middle and lower halves of the thigh meet, followed by a second incision in the back of the lower leg. After the incision had been made transversely, something happened. This cut joins the two transverse ones. When the skin flap was lifted, incisions were created simultaneously on the skin's surface and deeper fascia. These cuts happened at the same time. Distinct cutaneous structures are visible. The popliteal fossa's borders and contents are mirrored in the deep fascia. The gastrocnemius muscle may be able to separate from the femur if its two bellies are able to communicate with one another. Bellies of both gastrocnemius muscles sagging. We could see the popliteal TN and the lower vasculature. After distancing from the tibia, the soleus muscle and intermuscular septum reflected laterally. Concurrently. The apex of the popliteus muscle has been located. In order to gain access to the popliteal vessels, the fascia covering them had to be removed. This allowed the terminal branches, such as the anterior and posterior tibial arteries, to be located and followed. The Anterior Tibial Artery (ATA) enters the anterior compartment of the lower leg in place of the Popliteal Artery (PA). It all began in PA with ATA. The origin of the Posterior Tibial Artery (PTA) may lie in the flexor retinaculum. The PRA developed from the PTA and was located posterior to the flexor hallucis longus muscle on the fibula. The truth will be uncovered. The fate of the debate rests on the upcoming clause. Once the examination had begun, the peroneal artery (PA) muscle branches could be seen and evaluated. After fat was shaved off the popliteal area, the femoral genicular branches were identified. It was determined how far apart the adductor Magnus's terminal insertion and origin were. The time frame for this analysis began with the adductor magnus muscle's dissection.

Statistical analysis:

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

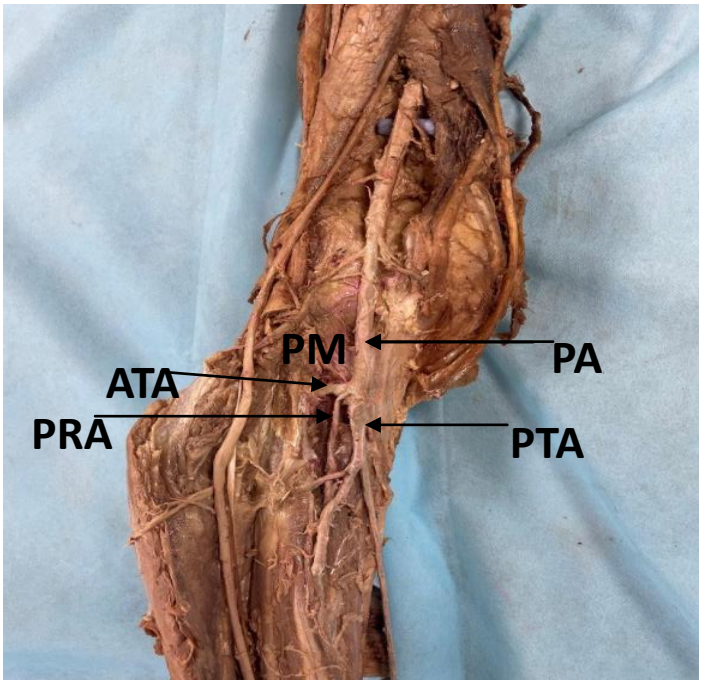
III. Results:

The course of PA when each and every specimen was dissected, the course of PA was discovered to be normal in each and every one of them. 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 present investigation involved the inspection of fifty lower limb specimens, which made it possible to view the terminal branches, muscle branches, genicular branches, and cutaneous branches (Table No. 1). Only one of the fifty specimens taken from the lower limbs tested positive for the presence of inferior lateral genicular artery (ILGA), and it is suspected that ATA, and not PA, was the agent that caused the sickness.

Table1–BranchesofthePoplitealArtery

BranchesofPoplitealArtery	Specimens(n=50)	Number(%)
Normalbr Branchingpattern fromPA	49	98
OriginofILGAfromATA	1	2



Trifurcation of popliteal artery

In this investigation, there were a total of fifty specimens, and out of those fifty specimens, there were a total of forty-eight specimens that demonstrated a typical pattern of terminal division of PA. In total, there were fifty specimens that demonstrated a typical pattern of terminal division of PA. To put it another way, the vast majority of the specimens examined in this study were within the usual range. It was revealed that there was a high division of PA in one of the samples that were taken. It was discovered that a third individual also have a trifurcation of PA somewhere within their body (Table No. 2).

Table2-Thevariationsintheterminaldivisionofpoplitealartery

S. No	TerminationofPoplitealartery	No. ofspecimens	Totalnumberofspecimens	Percentage(%)
1.	NormalTermination ofPA	48	50	96
2	Highdi Divisionof PA	1	50	2
3.	TrifurcationofPA	1	50	2

IV. Discussion:

Course of the popliteal artery: Each of the 50 specimens that were examined for this inquiry revealed a progression of PA that was consistent with what is the norm. It is conceivable for the PA to pass medially beneath the medial head of the gastrocnemius or beneath an aberrant strip of muscle in the popliteal fossa. If this happens, the artery may become clogged due to the contraction of the muscles surrounding it. This results in the PAES. It has the potential to cause claudication in young male patients during periods of physical activity. When an adult's lower extremities obtain their primary blood supply via the sciatic artery, this sort of vascular anomaly is highly rare because it is such an unusual circumstance. If the persistent sciatic artery is not recognized as the primary input into the lower limbs, an improper bypass of apparent superficial FA occlusive disease may ensue as a result. This can be avoided by recognizing the persistent sciatic artery as the primary input. The persistent sciatic artery has a predisposition for aneurysm, and this predisposition can lead to critical

limb ischemia as a result of thrombosis or embolization of aneurysmal thrombus. The persistent sciatic artery also has a susceptibility for aneurysm.

Branches of popliteal artery: Holinshead., (1969) [16] has said that he PA gives five genicular branches and muscular branches to muscles of popliteal fossa. Gray's et al., 2012 [19],indicated that PA has five genicular branches; Superior muscular branches: to adductor magnus and hamstrings; Inferior muscular branches : sural arteries are two in number and supplies; Gastrocnemius, soleus and plantaris (they are used in gastrocnemius musculocutaneous flap); Cutaneous: the superficial sural arteries. (fascio cutaneous free and pedicled flaps may be raised on the superficial sural arteries). Ozgur et al., 2009 [17], did a study on 40 lower limb samples from 19 male and 21 female cadavers, observed that found that the ILGA arise from ATA. The IMGA arise from common tibioperoneal trunk. Singla et al., 2012 [18], observed in 60 specimens that there is a common trunk for MGA, SLGA in 1.6 % of the specimens. Bettaiah et al., 2016 [19], dissected 40 specimens of the lower leg. In 5% of the specimens, a common trunk was discovered that gave rise to MGA, SLGA, and SMGA. In the present study, outoffiftyspecimens,fortyninespecimensshowedusualbranchingpattern.InonespecimenILGAarosefromATAinsteadofPA.(PerforatorsofPAanditsbranchesareoftwotypesmusculocutaneousandcutaneousperforators. Lateralgenicular arteryflapisafasciocutaneousflapusedforkneereconstruction with low donor site morbidity. This flap showed constant anatomyandis reliablefor coverage of defects atsuperior andlateral portionof the kneeand proximal part of the lower leg. In ATA, 2 perforators may be present in theanteriorcompartmentof theleg.PTA perforatorsmay emergebetweenflexordigitorum hallucisandsoleus.A Sciaticblockperformedintheareajust abovethe poplitealfossaiscalled Poplitealorlowsciaticblock., PRA perforator flap is used in reconstruction of defects in the lateral aspectof the middle and distal third of leg and ankle. If there is hypoplasia of both ATAand PTA, harvesting of PRA is contraindicated since, PRA is the only artery thatfeedsthe distalpartsofthelowerlimb. An arteriogram done before approaching the popliteal region for vascularsurgeriesmaygiveadequateinformationaboutthebranchingpatternofPA.Knowing the possible variations in prior reduces time spent on exploring occludedarteries. PA pulse may be absent when there is occlusion of the FA.Distal footpulsewillbeabsentintibioperonealdiseases.

Terminal division of the popliteal artery:

Kim et al., 1989 [20], investigated in his angiographic study of 605 extremities described 92.2% of normal pattern. Tindall et al., 2006 [21], observed in his angiographic study of 100 knees, 94% normal pattern was observed. Ozgur et al., 2009 [17], did a study on 40 lower limb samples from 19 male and 21 female cadavers and observed 90% showed normal pattern. Kil et al., 2009 [22], in his angiographic study on 1242 limbs, found 89.2% of normal pattern.

Mavilli et al., 2011 [23], In his angiographic investigation of 535 extremities, reported 88.1% of normal pattern. Gray's et al., 2012 [24], suggested that stated that PA divides at distal border of popliteus in 90% of specimens. In the present study out of the fifty specimens, normal branching pattern was observed in 48 specimens (96%).

Diabetic patients more prone to occlusive lesions in the tibial arteries, so it is essential that arteriogram incorporate the complete infrapopliteal circulation including the foot vessels. Normal level of division occurs in the lower border of Popliteus muscle. The normal branching pattern is PA dividing into ATA and PTA. PRA arises from PTA in (90%) of subjects. In 5% of PA shows high division proximal to lower border of popliteus, or it may trifurcate into ATA, PTA, PRA. Either the ATA or the PTA may be reduced or increased in caliber. The caliber of the PRA is usually inversely related to that of ATA and PTA. Rarely, the ATA is the source of PRA, in which case PA shows high division. Variations in the branching pattern of PA will influence the surgical approach and choice of suitable arterial graft sites. Trifurcation is a challenge during angioplasty or embolectomy. In the absence of PTA and ATA, the PRA becomes only source of blood supply to the foot.

High division of popliteal artery: Piersol wrote in 1916 [25] thatdissected 106 specimens and observed HDPA in 8.2%. Adachi., 1928 [26]defined HDPA as any terminal division of PA, which takes place at a level above the middle of the posterior surface of POP. He observed HDPA in 2.8% of total 770 specimens. Trotter et al., 1940 [27] in 264 samples, detected 6.2% of HDPA. Keen et al., 1961 [28] discovered 5% HDPA in 280 samples. Bardsley et al., 1970 [29] in their angiographic investigation, documented 5.9% HDPA. Kim et al., 1989 [36], investigated 1,000 femoral angiograms and identified a 4.6% incidence of HDPA. Mauro et al., 1988 [30], examined 421 angiograms of the lower extremities and reported 2.3% of HDPA. Colborn et al., 1994 [31], examined 42 specimens and found 7% HDPA.

Somayaji et al., 1996 [32], dissected 250 lower limbs and found HDPA in 25% (ten percent) of the specimens. Singla et al., 2012 [34], found 3.3% HDPA in 60 samples. Billakanti., 2014 [33], in his normal cadaveric examination discovered HDPA in a right-sided cadaver. Oztekin et al., 2015 [34], reported a single instance of HDPA in 495 extremities (0.2%) Hemalatha et al., 2016 [35], took apart 40 lower limbs and found that their study identified 7.5% of HDPA in 40 extremities. In the present study, out of fifty specimens, one specimens showed high division of PA (2%). High origin ATA is surgically important as it is in direct contact

with posterior surface of tibia . It has high risk of injury during knee arthroplasty, high tibial osteotomy and total knee replacement procedures. When a transverse tibial cut is made through the tibial cortex using osteotomy drill, ATA is more prone to injury. The knowledge of variation of termination of PA is important during arthroscopic knee surgery to minimize the surgical complication.

Trifurcation of popliteal artery: Quain., 1844[36], reported 2.3% trifurcation in 258 specimens. Adachi., 1928 [26], stated that when all three terminal branches arise together at the level of lower border of the POP, it can be considered as trifurcation. He observed 0.8% of trifurcation in 770 specimens. Trotter et al., 1940 [27], reported 0.5% trifurcation in 1168 specimens. Keen et al., 1961 [28], observed 4.3% trifurcation in 280 specimens. Morris et al., 1962 [37], They used angiography to look at the lower limbs of 246 people and found that the ends of the limbs followed the following pattern: The same old thing -88.6%; Pattern with three branches is 2.9%; anterior tibio-peroneal trunk is 1.2%. Bardsley et al., 1970 [29], mentioned that in 235 specimens, 0.4% of trifurcation was observed. Lippert et al., 1985 [53] found thatreported 4% of trifurcation in his study. Kim et al., (1989) [20], studied 605 specimens and observed 2% of trifurcation. Mauro et al., 1988 [30], looked at 343 angiograms in 1989 and found that 4.1% of them had a trifurcation. Neville et al., 1991 [38], reported 1.9% trifurcation in 4108 lower limb specimens. Ozgur et al., 2009 [17] dissected 45 specimens and reported 2.5% trifurcation.

Sawant et al., 2013 [54], studied 120 specimens and reported 5% trifurcation. Oztekin et al., 2015 [34], reported trifurcation in 3 specimens out of 495 extremities (0.6%). In the present study out of fifty specimens observed, one specimen showed trifurcation (2%).

V. Conclusion:

Vascular surgeons and angiographers should grasp these differences while considering surgical options. Plastic surgeons will gain help finding healthy artery transplant sites. Surgeons may need to adapt their methods due to anatomical differences. The ATA goes down and across the popliteus muscle before making direct contact with the posterior tibia. High tibial osteotomy and knee arthroscopy make it vulnerable. Vascular surgeons must know the PA bifurcation's locations and patterns to avoid problems during treatments. This area can undergo many surgeries. Knee surgeons must have it. The second section is for the PA aneurysm surgeon and angiographer.

Conflict of interest:

None declared.

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