

Study of Variations in Branching Pattern of Popliteal Artery**Jalpa N. Desai¹, Naimish R. Bhojak², Samir Ram³, Jitendra P. Patel⁴**¹Associate Professor, Department of Anatomy Ananya College of Medicine & Research, Kalol, Gandhinagar, Gujarat, India^{2,3}Assistant Professor, Department of Anatomy, Smt. N.H.L. Municipal Medical College, Ahmedabad, Gujarat, India⁴Professor & Head, Department of Anatomy, Smt. N.H.L. Municipal Medical College, Ahmedabad, Gujarat, India

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Conflict of interest: Nil

Abstract**Background & Objectives:** Peripheral vascular disease increasing in modern era so knowledge of normal and variation in popliteal artery is important for vascular surgeon for various vascular procedures. In this study we observed the branching pattern of popliteal artery in North Indian Population.**Material and Method:** study carried out on 100 limbs (50 cadavers) obtained from anatomy Department during period of 3 years.**Result:** In 92% specimen's popliteal artery terminated below the popliteus in anterior tibial artery and tibioperoneal trunk. In 2% specimen popliteal artery divides below the popliteus into posterior tibial artery and anterior tibioperoneal trunk. In 4% specimens, trifurcation of popliteal artery observe. In 2% specimens cadaver popliteal artery terminated above popliteus muscle. In 84% specimens branching pattern of collateral branches are normal. Double middle genicular arteries found in 6% specimen common trunk for superior and middle genicular found in 10% cases.**Conclusion:** Knowledge regarding variation in popliteal artery important for surgeon and radiologist to perform various clinical procedures so they can avoid injury to artery.**Keywords:** Popliteal Artery, Higher Division. Genicular Artery, Popliteus Muscle.

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Introduction

Variations in arterial network of lower limb are area of interest for anatomist and surgeons because variation have an impact in the field of surgery and during catheterization procedures of the lower limb. The embryological abnormalities of the arterial pattern of the lower limb result in variation in arterial network. From clinical point of view knowledge of anatomic variations in the branching pattern of the popliteal artery is important

The popliteal artery, which is the continuation of the femoral artery, crosses the popliteal fossa. The artery may divide into its terminal branches proximal to popliteus, in which case the anterior tibial artery sometimes descends anterior to the muscle. In the most common pattern of bifurcation of the popliteal artery is gives a branch the anterior tibial artery at the lower border of the popliteus then continues as tibioperoneal trunk and divided into posterior tibial artery and peroneal artery. [1]

There may be a true 'trifurcation' into anterior and posterior tibial and peroneal branches. The artery

sometimes divides into the anterior tibial and peroneal, the posterior tibial being wanting, or very small. [1] There are many variations to the terminal branches of the popliteal artery. The popliteal artery may divide a branch proximal to the popliteus above the middle portion of the posterior surface of the popliteus. This is defined as 'high branch'. [1]

Popliteal artery gives off muscular, cutaneous and genicular branches. Genicular branches are: 1] superior medial genicular artery 2] inferior medial genicular artery 3] superior lateral genicular artery 4] inferior lateral genicular artery 5] middle genicular artery. [1]

The anatomical variation in the bifurcation of the popliteal artery may have an embryological basis. In developing embryos, the axis artery of the lower limb arises from the dorsal root of the umbilical artery, then runs through the thigh, knee, and leg, and lies between the tibia and popliteus below the knee. The femoral artery passes along the ventral surface of the thigh to become the main artery of the

lower limb. At the distal border of the popliteus, the axis artery gives off a perforating branch—the ramus communicans—that communicates with the femoral artery. Failure of formation of the ramus communicans results in persistence of the axis artery, which becomes a high-origin anterior tibial artery passing anterior to the popliteus. [1,2]

Material and Method

This study was conducted on 50 cadavers with an age range of 50 – 90 years in dissection laboratories

of Medical Colleges, Ahmedabad. Dissection done according to Cunningham's Manual of Practical Anatomy³, popliteal artery exposed in popliteal fossa and detailed study of branching pattern of popliteal artery done.

Result

In present study total number of cases was 100.(50 cadavers out of that 37 males and 13 females).

Table 1: Variation in Collateral branches of popliteal artery

	Total	Percentage
Normal	42	84%
CT for SLGA and MGA	5	10%
Double MGA	3	6%

Variation in origin and disposition of the collateral branches of the popliteal artery were observed in 16 specimens as follow: 84 cases (84%) branching pattern of collateral branches are normal (Fig:1). Common trunk for superior lateral genicular artery and middle genicular artery found in 10 specimen (5 cadavers-10%) out of that 3 male and 2 female cadavers (Fig:2) and (Fig:3). Double middle genicular arteries found in 6 specimens (6%) out of that 2male and 1 female cadavers (Fig:4). In one case double middle genicular artery we found one of that arise from trunk of popliteal artery and other from common trunk for superior lateral genicular artery and middle genicular artery (Fig:3).

Variation in terminal branches of popliteal artery as follow:- In 46 cadavers (92 specimens) popliteal artery terminated below the popliteus in anterior tibial artery and tibioperoneal trunk. Tibioperoneal

trunk divide into posterior tibial artery and peroneal artery (Fig:5).

In 1 cadaver (2 specimens) popliteal artery divide below popliteus into posterior tibial artery and anterior tibioperoneal trunk. Anterior tibial peroneal trunk bifurcate into anterior tibial artery and peroneal artery (Fig:6).

In 2 cadavers (4 specimen) trifurcation of popliteal artery. Popliteal artery terminated into anterior tibial, posterior tibial, peroneal artery together no tibioperoneal trunk (Fig: 7).

In 1 cadaver popliteal artery terminated above popliteus muscle. Anterior tibial artery and tibioperoneal trunk arise above popliteus and running on posterior surface of popliteus muscle (Fig: 8)

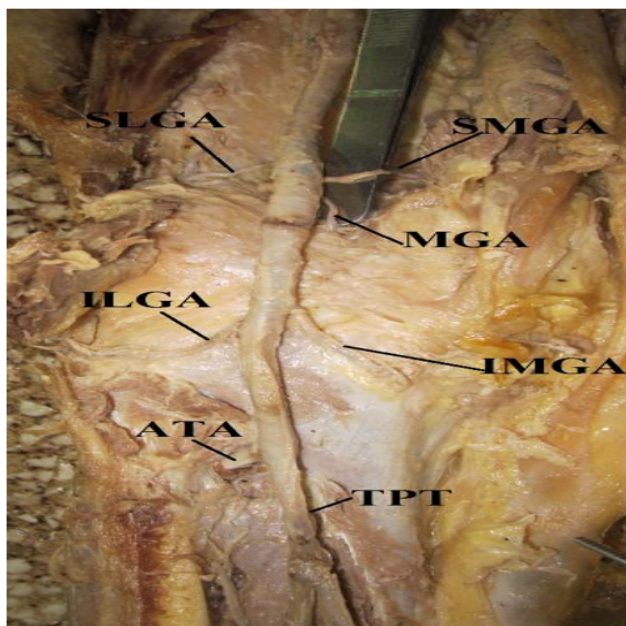


Figure 1: Normal genicular branching pattern

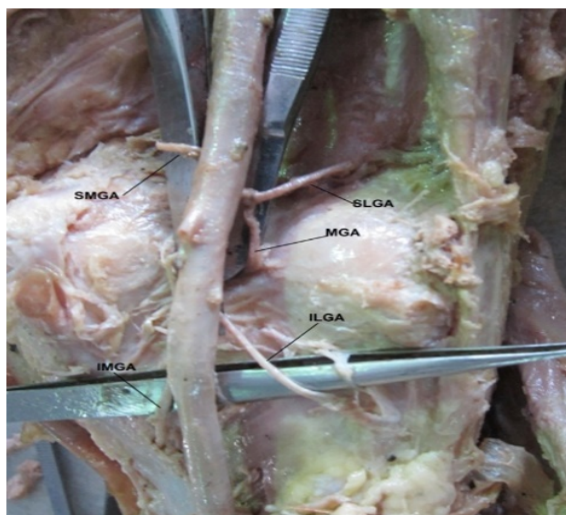


Figure 2 Common trunk for Superior lateral genicular artery (SLGA) and middle genicular artery (MGA)

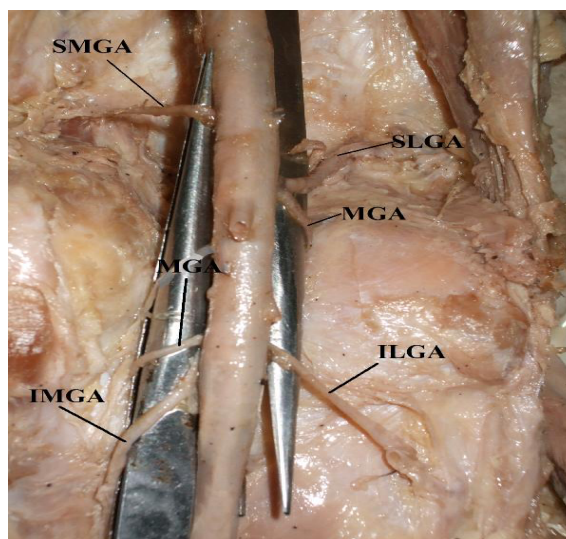


Figure 3: Double middle genicular (MGA) one of that arise from superior lateral genicular artery (SLGA) and other directly from popliteal artery

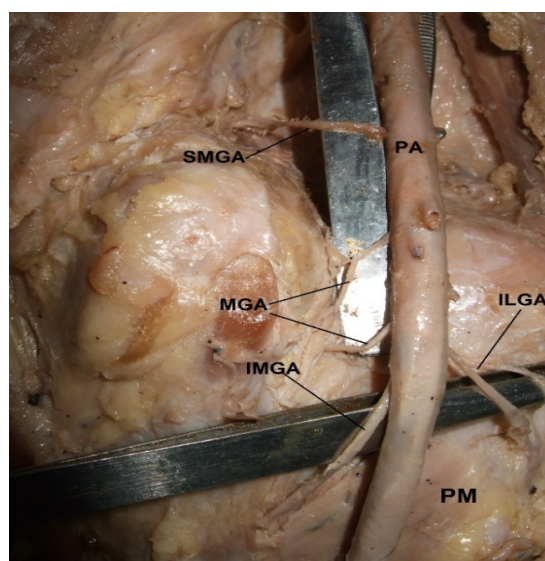


Figure 4: Double middle genicular artery (MGA).



Figure 5: Usual pattern of terminal branching, anterior tibial artery (AT) first branch, tibioperoneal trunk follows and bifurcate into posterior tibial artery (PT) and peroneal artery (PR) below popliteus.

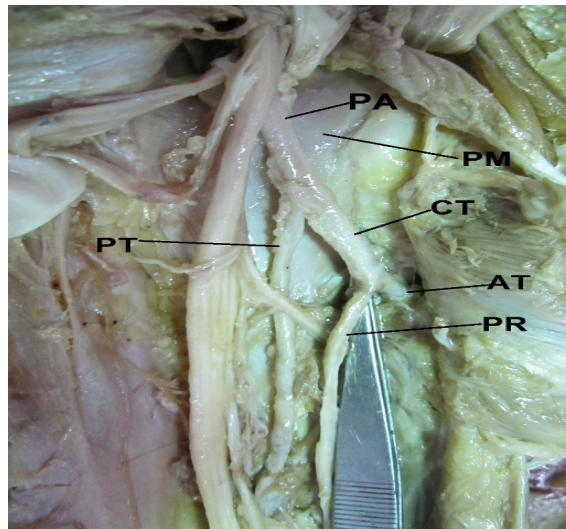


Figure 6: Popliteal artery (PA) terminated below popliteus into posterior tibial artery (PTA) and anterior tibio-peroneal trunk which divide further into anterior tibial artery (ATA) and peroneal artery (PR).

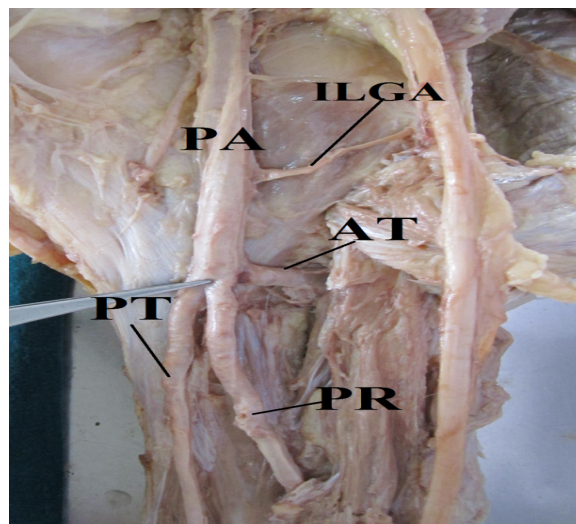


Figure 7: Trifurcation anterior tibial artery (AT), posterior tibial artery (PT) and peroneal artery (PR) arises at one point

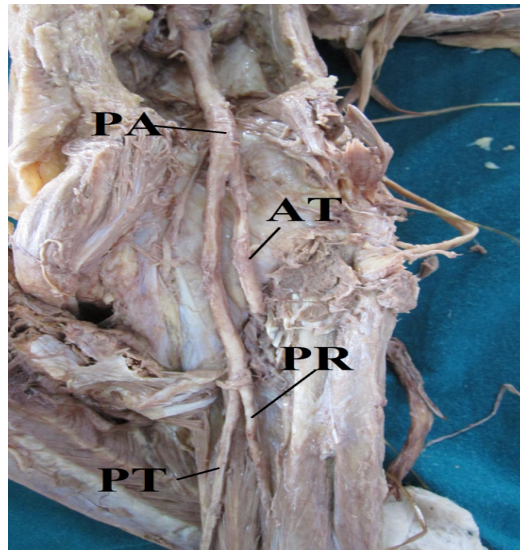


Figure 8: PA terminated above popliteus into anterior tibial artery (AT) and tibioperoneal trunk which bifurcate into posterior tibial artery (PT) and peroneal artery (PR).

Discussion

Variations in origin and disposition of the collateral branches of the popliteal artery were observed as a common trunk for superior lateral genicular and middle genicular artery in 11.67% by Reena singla et al [4] (2012). Similar findings have been observed by Salaria and Atkinson [5] (2008) during the dissection of 8 cadavers (4 males and 4 females). In present study 10 specimens (10%) found with common trunk for superior lateral genicular and middle genicular artery. Study performed by Scapinelli (1997) [6] reported that the middle genicular artery may show variations in its origin and is frequently double. Double middle genicular arteries were reported by Reena singla et al [4] (2012) in 1.67% cases. In present study, double middle genicular artery found in 6% cases. One case (3.33%) out of 30 specimens show inferior medial genicular artery originated from tibioperoneal trunk and inferior lateral genicular artery originated from anterior tibial artery reported by Rao S.N et al [7]

Normal bifurcation of popliteal artery below popliteus muscles into anterior tibial artery and tibioperoneal trunk found commonly in population range 88% to 96% found in various studies.

In present study 92 extremities popliteal artery follow usual pattern of terminal branching, anterior tibial artery first branch, tibioperoneal follows and bifurcates into peroneal artery and posterior tibial artery. This finding similar to that Kim et al [9], Bardsley et al [8], Day CP et al [11] and Ozgur Z et al [12] Bose E [16] during their studies.

In present study, trifurcation into anterior tibial, posterior tibial, and peroneal artery arises within 0.5cm found in 4 extremities (4%). This finding similar to that Mauro et al [2], Day CP et al [11], Siriporn et al [14] and Bose E [16]. Reena singla et al [4] not found trifurcation variation during their studies.

In present study anterior tibioperoneal trunk found. Posterior tibial artery is first branch, tibioperoneal trunk follow and bifurcates into the peroneal and anterior tibial artery found in 2 extremities (2%). This finding is similar to that Mauro et al [2] and Kim et al [9] and Szpinda et al [10] during dissection.

In case of higher division of popliteal artery, anterior tibial artery arise above or at knee joint found in 2 extremities (2%) in present study. In this condition, anterior tibial artery run posterior to popliteus muscle and enters in anterior compartment below the popliteus muscle. Similar finding reported by Mauro et al [2], Day CP et al [11], and Reena Singla et al [4] during their studies.

Selda Y et al [19] reported unilateral higher division of popliteal artery, in which anterior tibial artery course between popliteus and posterior surface of tibia. Similar variation is found by Sharma K et al [20] bilaterally in a cadaver during routine dissection. Similar variation found by Kim et al [9], Szpinda et al [10], Day CP et al [11] and Siriporn et al [14]. Similar variation not found in present study. Hypoplastic or aplastic branching with altered distal supply not found in present study.

Table 3: Frequency of Popliteal Arterial Variations

Author	Source	Extremities Examined	Usual pattern (%) 1A	Tri-furcation (%) 1B	Anterior tibio-peroneal trunk (%) 1C	AT arises at or above the knee Joint (%)		PT arises at or above the knee joint 2B	PR arises at or above the knee joint. 2C
						2AI (normal course)	2AII (Medial initial curve)		
Bardaley [8] 1970	Angio-graphy	235	92.8	0.4	--	4.2			
Mauro [2], 1988	Angio-graphy	343	88	4.1	1.2	2.3			
Kim, Orros [9] 1989	Angio-graphy	605	92.6	2	1.2	3	0.7	0.8	≤0.2
Szpinda M [10], 2005	Dissection	152	87.5	2.63	1.97	1.32	0.66	5.92	
Day CP [11]. 2006	Angio-graphy	1037	90.7	3.2	0.3	2.1	2.4	1.1%	0.2%
Zuhul ozgur [12] 2009	Dissection	40	90	2.5	2.5	5			
Ertugrul Mavili [13] 2010	Angio-graphy	535	82.4	5.4	0.4	2.6	1.3	1.5	0.1
Reena singla [4] 2012	Dissection	60	96.67	-	-	1.67			
Siriporn [14] 2013	Dissection	230	88.7	4.8	0.4	0.9	1.3	0.9	
Wanderley APB [15] 2017	Dissection	21	80.95	14.28	4.77	00			
Bose E [16] 2017	Dissection	50	90	4	2	00	00	2	2
Khalkho RK [17] 2020	Dissection	72	87.5	5.6	2.8	00	1.4	1.4	1.4
Singh H [18] 2023	Dissection	50	96	2	00	2			
Present study	Dissection	100	92	4	2	2	00	00	00

Conclusion

A high-origin anterior tibial artery is surgically important because it is thus vulnerable during knee arthroplasty. Arterial complications including transection, fistula formation, pseudoaneurysm, and thrombosis can be limb- or life-threatening.

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