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Research Article

Morphometric Analysis and Clinical Significance of the Anterior Tibial, Posterior Tibial and Fibular Arteries.

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Abstract: ***Introduction:*** Arising from the popliteal fossa, the branches of the popliteal artery, the anterior tibial, posterior tibial and fibular arteries provide the primary vascular supply to the leg and foot. Obstruction of this pathway via peripheral arterial stenosis or occlusion typically caused from systemic atherosclerosis or thromboembolism, as well as localized trauma in younger demographics. Understanding these anatomical and pathological variations is clinically vital, as delayed diagnosis of lower limb ischemia significantly escalates the risk of irreversible tissue loss, major amputation, and systemic cardiovascular mortality.**Objectives:** To study the morphometry of anterior tibial, posterior tibial and fibular (Peroneal) arteries and evaluate their clinical significance**Methods:** The study was carried out in 50 lower limbs of 25 cadavers fixed in 10% formalin, in the division of Anatomy, Rajah Muthiah Medical College, Annamalai university Chidambaram. The study was conducted irrespective of age and sex. None of the limbs showed any evidence of previous knee surgery. The gross dissection was done by following the guidelines of Cunningham`s manual.**Results:** External diameter of anterior tibial artery at origin ranged from 0.36 – 0.62cm. External diameter of posterior tibial artery at origin ranged from 0.28 – 0.51cm. External diameter of peroneal artery at origin ranged from 0.15 – 0.41cm.**Conclusion:** Diameter of anterior tibial artery was found to be greater than Posterior tibial artery in 39 (78%) cases and the diameter of anterior tibial artery was found to be less than Posterior tibial artery seen in 6 (12%) cases and it was found to be equal in 5 (10%) cases. In 49 (98%) cases the diameter of anterior tibial artery was found to be greater than Peroneal artery and in 1 (2%) case it was equal to Peroneal artery.

Keywords: anterior tibial artery, posterior tibial artery and fibular arteries, anatomical variations.

INTRODUCTION

Arising from the popliteal fossa, the branches of the popliteal artery, the anterior tibial, posterior tibial and fibular (peroneal) arteries provide the primary vascular supply to the leg and foot. At the lower border of the Popliteus , popliteal artery usually divides into anterior and posterior tibial arteries. The anterior tibial artery passes forward through the aperture in the upper part of the interosseous membrane and enters and supplies the anterior compartment of the leg. It continues inferiorly onto the dorsal aspect of the foot. The posterior tibial artery supplies the posterior and lateral compartments of the leg and continues into the sole of the foot. The posterior tibial artery descends through the deep region of the posterior compartment of the leg on the superficial surfaces of the tibialis posterior and flexor digitorum longus muscles. It passes through the tarsal tunnel behind the medial malleolus and into the sole of the foot.

MATERIALS AND METHODS

The study was carried out in 50 lower limbs of 25 cadavers fixed in 10% formalin, in the division of Anatomy, Rajah Muthiah Medical College, Annamalai university Chidambaram. The study was conducted irrespective of age and sex. None of the limbs showed any evidence of previous knee surgery. The gross dissection was done by following the guidelines of Cunningham`s manual. After the skin was incised the popliteal fossa was exposed through the posterior approach by identifying the muscles forming the boundaries of the fossa. The tibial nerve, common peroneal nerve, popliteal vein were identified and then popliteal artery was traced up to its terminal branches on both sides.

The study was carried out under the following parameters,

1. External diameter of anterior tibial at its origin
2. External diameter of posterior tibial artery at its origin
3. External diameter of fibular artery at its origin
4. Relation of diameter of Anterior tibial artery (ATA)with Posterior tibial artery
5. (PTA)and Fibular artery (FA)
6. Comparison of diameter of Anterior tibial artery, Posterior tibial artery and Fibular artery

Materials Used

1. Dissecting instruments
2. Scale
3. Thread
4. Vernier caliper

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RESULTS

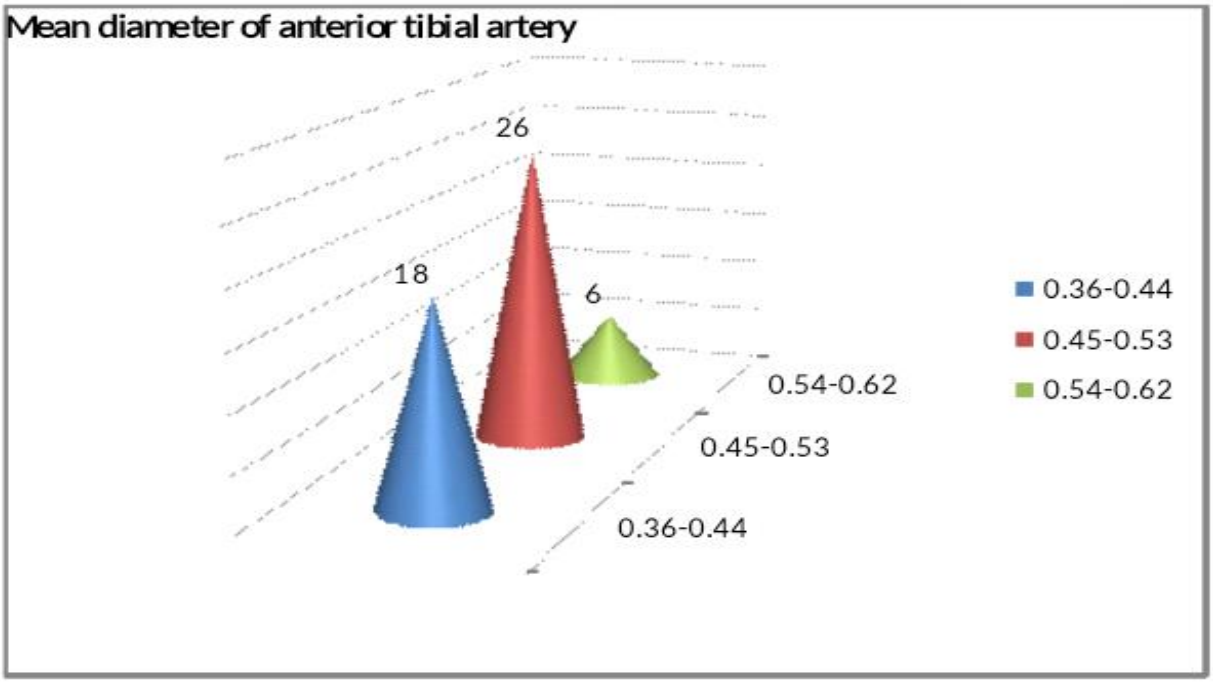
External diameter of anterior tibial artery at its origin

External diameter of anterior tibial artery was measured at the origin by using sliding calipers was found to be 0.36 – 0.44 cm in18 (36%) cases, 0.45 – 0.53 cm in 26 (52%) cases ,and 0.54 – 0.62 cm in 6 (12%) cases.

Table 1: Mean diameter of anterior tibial artery at the origin.

Ext diameter of anterior tibial artery (cm)	Mean diameter in cm +/_ sd	No. of specimen	Percentage
0.36-0.44	.403 +/_ 0.021	18	36
0.45-0.53	.488 +/_ 0.02	26	52
0.54-0.62	.600 +/_ 0.000	6	12
Total		50	100

Fig 1 : Cone diagram showing mean external diameter of anterior tibial artery.



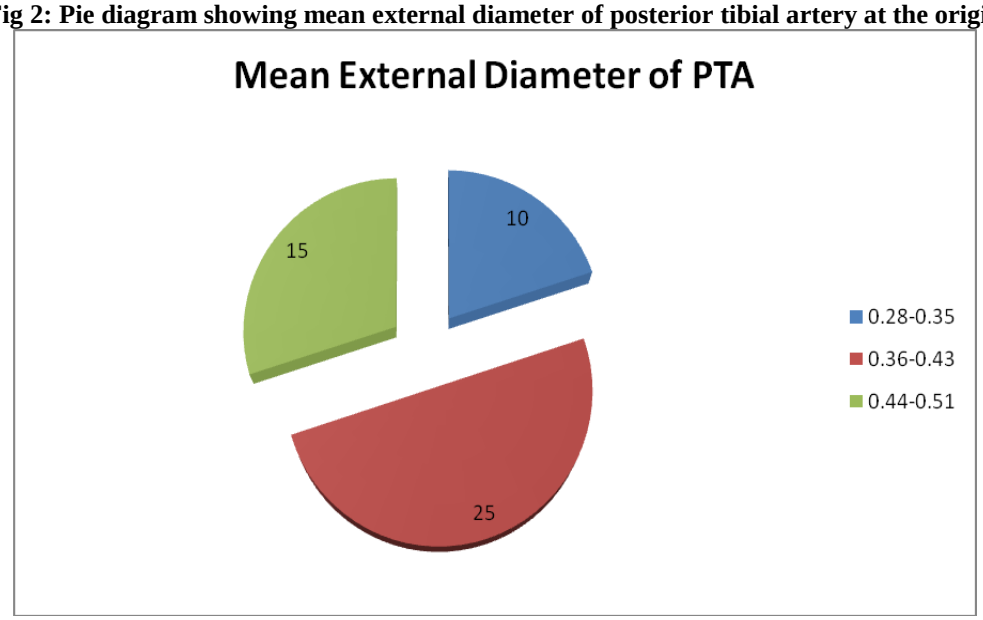
External diameter of posterior tibial artery at its origin

In the present study the external diameter of posterior tibial artery at its origin was found to be 0.28 – 0.35 cm in 10 (20%) cases ,0.36 – 0.43 cm in 25 (50%) cases and 0.44 -0.51 cm in 15 (30%) cases.

Table 2: Mean diameter of posterior tibial artery at the origin

Ext diameter of posterior tibial artery(cm)	Mean diameter in cm +/_ sd	No. of specimen	Percentage
0.28-0.35	.310 +/- 0.018	10	20
0.36-0.43	.397 +/- 0.018	25	50
0.44-0.51	.492 +/- 0.017	15	30
Total		50	100

Fig 2: Pie diagram showing mean external diameter of posterior tibial artery at the origin



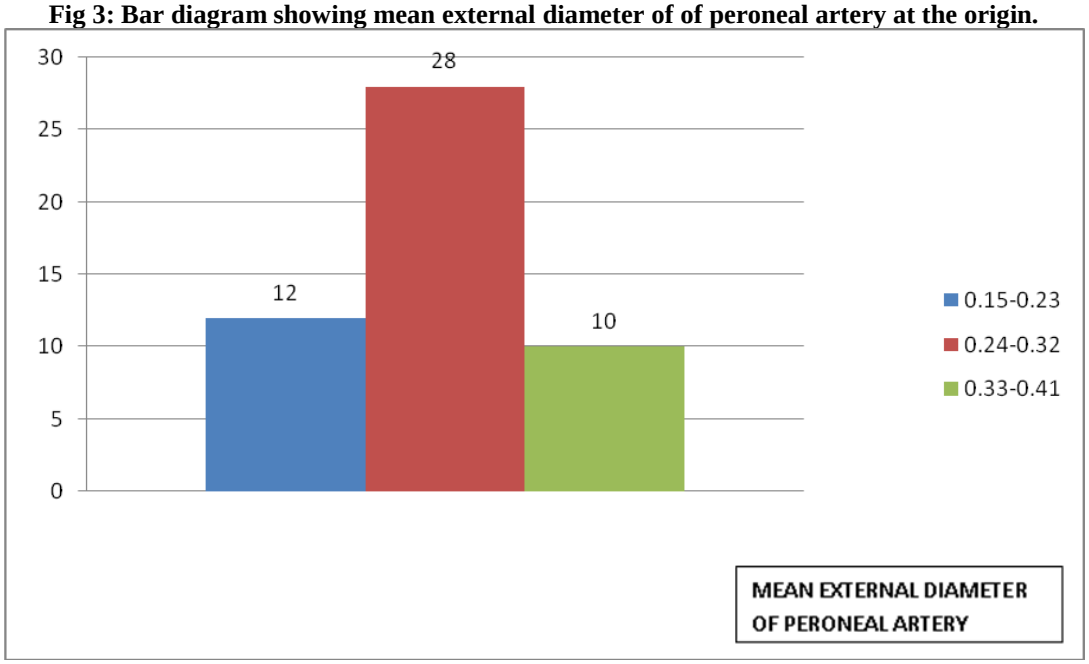
External diameter of peroneal artery at its origin

External diameter of peroneal artery at the level of its origin was found to be 0.15 -0.23 cm in 12 (24%) cases , 0.24 – 0.32 cm in 28 (56%) cases and 0.33 -0.41 cm in 10 (20%) cases.

Table 3: Mean external diameter of peroneal artery at the origin

External diameter of peroneal artery	Mean diameter in cm +/_ sd	No. of specimen	Percentage
0.15-0.23	.195 +/- 0.017	12	24
0.24-0.32	.287 +/- 0.024	28	56
0.33-0.41	.392 +/- 0.016	10	20
Total		50	100

Fig 3: Bar diagram showing mean external diameter of of peroneal artery at the origin.



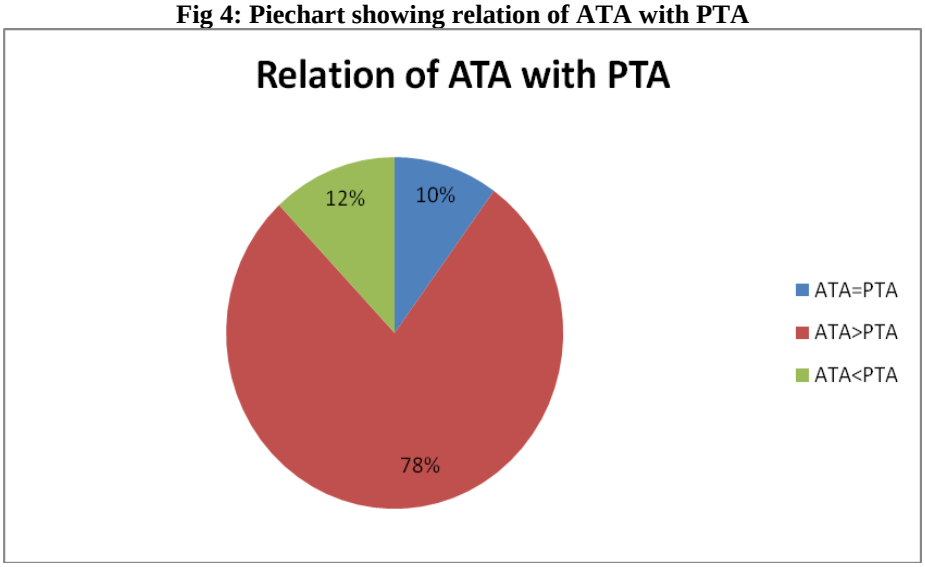
Relation of diameter of Anterior tibial (ATA) with Posterior tibial artery(PTA) and Peroneal artery (PeA)

Relation of diameter of anterior tibial artery with Posterior tibial artery and Peroneal artery was studied in 50 specimens and tabulated as below.

Table 4: Relationship of diameters of ATA, PTA and PeA

Type of relation	No. of specimens	Percentage
ATA=PTA	5	10%
ATA>PTA	39	78%
ATA<PTA	6	12%
ATA=PeA	1	2
ATA>PeA	49	98
PTA=PeA	1	2
PTA>PeA	49	98

Fig 4: Piechart showing relation of ATA with PTA



Diameter of anterior tibial artery was found to be greater than Posterior tibial artery in 39 (78%) cases and the diameter of anterior tibial artery less than Posterior tibial artery was seen in 6 (12%) cases and in 5 (10%) cases it was found to be equal .

In 49 (98%) cases the diameter of anterior tibial artery was found to be greater than Peroneal artery and in 1 (2%) case it was equal to Peroneal artery .

Out of 50 specimens studied 49 (98%) showed that the diameter of Posterior tibial artery was greater than Peroneal artery.

Comparison of diameter of Anterior tibial , Posterior tibial artery and Peroneal artery.
The crural arteries were classified as strong, intermediate and small after analyzing their diameter

- For anterior tibial artery,

a diameter of 0.54 – 0.62cm was considerd as strong ,
0.45 –0.53cm as intermediate and 0.36 -0.44cm as small.

- For Posterior tibial artery,

a diameter of 0.44 – 0.51cm was considerd as strong, 0.36 – 0.43cm as intermediate , and 0.28 – 0.35cm as small.

- For Peroneal artery,

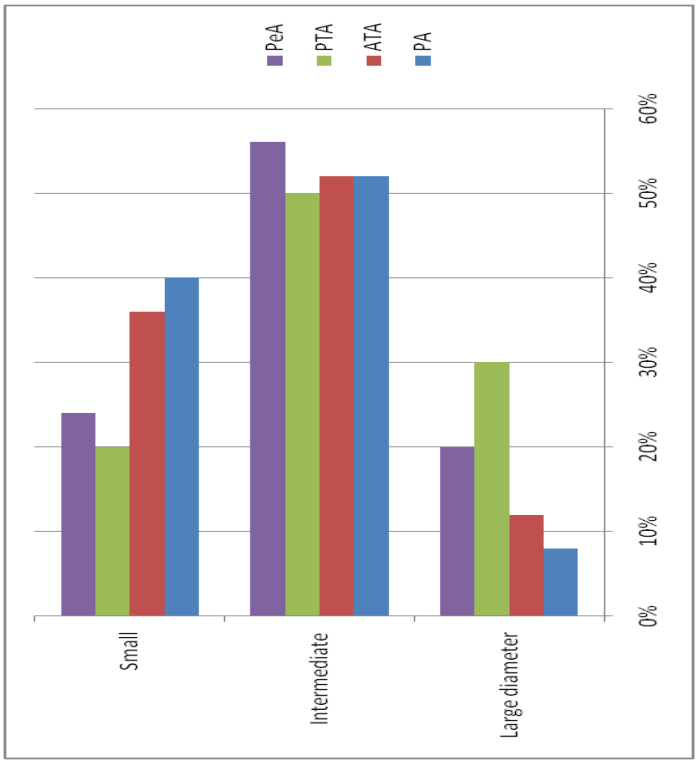
a diameter of 0.33 – 0.41cm was considerd as strong ,
0.24 – 0.32cm as intermediate, and 0.15 – 0.23cm as small.

Crural arteries showed individual variability with respect to diameter. It was tabulated as below :

Table 5: Showing the individual variability of diameter (%) of crural arteries

Artery	Large diameter	Intermediate diameter	Small diameter
ATA	12%	52%	36%
PTA	30%	50%	20%
PeA	20%	56%	24%

Fig 5: Bar diagram showing comparison of individual variability of diameter (%) of crural arteries in the present study.



DISCUSSION

Ozgur et al found out that on high division popliteal arteries the diameter of posterior tibial artery was smaller than the fibular artery in a significantly high ratio(4.5%)**Selda YILDIZ et al** reported in their study that the diameter of posterior tibial artery was smaller than fibular artery.In the present study the diameter of posterior tibial artery was larger than the fibular artery.

External diameter of peroneal artery at its origin
In the present study mean diameter of peroneal artery was 287 +/- 0.024cm.

Branches
Cross et al determined normal branching pattern of the popliteal artery in 92% of the specimens in their study. Zuhal Ozgur et al observed the same pattern in 90% of their study.

Romiti et al noted in their study that a bypass to a perigeniculate branch artery may be a valuable alternative in surgery.

Sanders RJet al and Kim Det al reported that failure to recognize the variation in branching of the popliteal artery resulted in unsatisfactory arterial anastomosis in patients who required femorodistal bypass graft procedures.

Kim D et al The risk of vascular trauma during orthopoedic procedures may be increased when an abnormal branching of the popliteal artery with an aberrant anterior tibial artery originating above the popliteus muscle and coursing between the posterior tibial cortex and ventral surface of the popliteus muscle. Distal popliteal arterial variations may influence the success of femorodistal popliteal and tibial arterial reconstructions. Preoperative identification of this anatomical variant may help to avoid these complications.

Klecker et al performed a retrospective review of 1,116knee magnetic resonance imaging to evaluate the prevalence of an aberrant anterior tibial artery. They found a 2.1% prevalence. The aberrant anterior tibial artery originated above the popliteus muscle and then it coursed anterior to the popliteus muscle and immediately

against the posterior tibial cortex. Because of its proximity to the tibia, there is high risk of vascular injury in orthopedic procedures, including lateral meniscal repair, posterior cruciate ligament reconstruction, revision total knee arthroplasty, high tibial osteotomy, and tubercle osteotomy, there fore Preoperative identification of this anatomical variant may help to avoid these injuries.

Despite improvements in vascular surgical techniques, popliteal vascular injuries and popliteal artery aneurysms continue to be potentially dangerous lesions with high percentage of leg amputations .When the branching pattern is variant in one extremity, there is a 28% probability the opposite side will also contain a variation. Awareness of these variations is important for evaluation of the lower extremity arteriograms and has clinical implications for vascular surgeons and interventional radiologists.

In the present study the superior lateral genicular artery originated from the anterior tibial artery in a case of high bifurcation. No such aberrant anterior tibial artery giving lateral geniculate artery was found in this study.

Absence / agenesis of anterior tibial artery

The anterior tibial artery may be smaller than usual but is rarely absent as reported in literature. In this situation, its function may be replaced by perforating branches from the posterior tibial artery or by perforating branch of the peroneal artery. Occasionally it deviates laterally, regaining its usual position at the ankle. It may also be larger than normal, in which case its territory of supply in the foot may be increased to include the plantar surface.

Colborn GL et al reported the agenesis of the popliteal artery. In this case, the anterior tibial and peroneal arteries originated distally from multiple collateral channels around the knee.

Day and Orme investigated that the angiographic figures that had hypoplastic – aplastic infra popliteal vessels with altered arterial supply to the foot were lower than previous studies. They believed that the reason might be due to a genuine difference in racial population or more probably a reflection of the diffculty in distinguishing between congenital and acquired arterial abnormalities in the setting of patients with atherosclerotic disease.

CONCLUSION

Study of variation in the branching pattern of popliteal artery was carried out and the following results were concluded.

1. External diameter of anterior tibial artery at origin ranged from 0.36 – 0.62cm.
2. External diameter of posterior tibial artery at origin ranged from 0.28 – 0.51cm.
3. External diameter of peroneal artery at origin ranged from 0.15 – 0.41cm.

Diameter of anterior tibial artery was found to be greater than Posterior tibial artery in 39 (78%) cases and the diameter of anterior tibial artery was found to be less than Posterior tibial artery seen in 6 (12%) cases and it was found to be equal in 5 (10%) cases. In 49 (98%) cases the diameter of anterior tibial artery was found to be greater than Peroneal artery and in 1 (2%) case it was equal to Peroneal artery .

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