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A Morphological Study on the Course, Branching Pattern and Termination of Peroneal Artery with a Note on the Nutrient Branch to Fibula

C. Jeyanthi Gnanadeepam[1], Anjana T.S.R.[2], T. Preethi Ramya[1], V. Raja Priya[1]

[1]Associate Professor, Department of Anatomy, Govt. Kilpauk Medical College, Kilpauk, Chennai – 600010; [2]Assistant Professor, Department of Anatomy, Govt. Kilpauk Medical College, Kilpauk, Chennai - 600010.

ABSTRACT

Introduction: The vessels of lower limb are prone for thrombosis in conditions such as Diabetes mellitus and Thromboangiitis obliterans. Apart from that, the fasciocutaneous flaps commonly employed in reconstruction procedures are based on the vessels of lower limb. In the wake of such increased importance, the present study is aimed at studying the course, branching pattern and termination of peroneal artery along with nutrient artery to fibula which is useful during fibular bone grafting procedures.

Materials and methods: The study was conducted in forty lower limb specimens from the Institute of Anatomy, Madras Medical College. The origin, course, branches of peroneal artery along with nutrient artery to tibia and fibula, perforating branches were observed in detail.

Results: The average distance of the origin of the peroneal artery from the lower border of popliteus was found to be 5.7 cm. The distance of origin of peroneal artery from the origin of posterior tibial artery was found to be 3.4 cm. The perforators arising from the peroneal artery were located predominantly in the distal two-quarters of the leg. The nutrient artery to fibula arose from the peroneal artery in all the specimens. It was two in number in 5 specimens (12.5%). There were three branches in two specimens (5%).

Conclusion: The knowledge of perforators is essential for raising skin flaps based on these branches. Since the flaps of these regions are considered to be reliable and easy to dissect, they are preferred even in primary centres also..

Key Words: Vessels, Lower limb, Perforator, Fasciocutaneous flap, Wound healing

INTRODUCTION

The arterial revascularization procedures have reinforced the significance of the course and variable branching patterns of vessels. It helps secure successful wound healing in the conduct of vascular and plastic surgery. The branching pattern of the arterial trunks of the lower limb gained importance following increased incidence of vascular diseases affecting lower limb especially in diabetics and smokers. The vessels are easily prone to intractable constriction following trauma. A fasciocutaneous flap brings additional blood supply to an infected area thereby promoting wound healing at the earliest.

A fasciocutaneous flap based on the branches of peroneal artery has been implicated in various reconstruction procedures. The present study aims to study the course, relations, branching pattern and termination of peroneal artery. Developmentally, it is the major artery of the leg. (Russel T Woodburne1961) The peroneal artery usually arises from the posterior tibial artery at about 2.5cm below the distal border of popliteus.(gray, Cunningham) and tendinous arch of Soleus(Keith L Moore, 1980). The artery passes laterally and is found to lie deep to the flexor hallucis longus to reach the back of lateral malleolus. (J D Boyd, 1956). Ben Pansky and E L House (1964), have described the peroneal artery as lying in a fibrous canal between tibialis posterior and flexor

Corresponding Author:
Dr. T.S.R. Anjana, Assistant Professor, Department of Anatomy, Govt. Kilpauk Medical College, Kilpauk, Chennai - 600010.
Ph: 9787884212; Email: tsranjana@gmail.com

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hallucis longus. Throughout its course, it lies in close relation to fibula and transverse crural intermuscular septum in the deep posterior compartment of leg. (Wesley S Moore, 2002).The artery usually terminates on the lateral surface of calcaneal tubercle by dividing into lateral calcaneal branches.(Parson Schaeffer,1953).

This vessel is exceedingly subject to variation and is rarely absent.[3](George a Piersol). A high division of the popliteal artery may be associated with the origin of the peroneal artery from anterior tibial artery rather than the posterior tibial artery.[2] (Trotter.M.1940). David Harvey(1990), has observed cases where the popliteal artery bifurcated into tibioperoneal trunk and anterior tibial artery. When the posterior tibial artery is diminished in size, the peroneal artery is relatively increased and conveys blood to the distal part of posterior tibial artery by means of a communicating branch.[4](Frazer,1937). When the anterior tibial artery is small or absent, the peroneal artery enlarges and its perforating branch replaces the dorsalis pedis artery. (Ronan O Rahily,1986).

In cases where the posterior tibial artery was absent, the peroneal artery was larger than usual and the vessel turned medially at the ankle joint level to resume the functions of posterior tibial artery. (J A Keen, 1961) and continued to form the lateral plantar artery(W H Hollinshead.1969). Piral T, Germain M,(1996) have noticed origin of anterior tibial artery from peroneal artery. Hence the peroneal artery is the most stable cruralartery.(Voboril R) for phylogenetic and embryologic reasons.

MATERIALS AND METHODS

The present study was conducted in forty cadaveric lowerlimb specimens from the Instituite of Anatomy, Madras Medical College, Madras. An incision is made from the middle of popliteal fossa to the heel and then on to the level of middle toe. The skin, superficial fascia and deep fascia were reflected along with both heads of gastrocnemius and soleus. The popliteal artery was identified with its terminal branches, the anterior and posterior tibial artery. The peroneal artery is traced under cover of flexor hallucis longus and the following parameters were observed in relation to the artery.

1. Origin of peroneal artery.
2. Distance of origin of popliteal artery from the commencement.
3. Course of peroneal artery.
4. Origin of terminal branches – Medial and lateral plantar arteries.
5. Nutrient artery to tibia.
6. Nutrient artery to fibula.

RESULTS

The various parameters related to the origin, distance of origin from the commencement of its posterior tibial artery or popliteal artery, nutrient branches to tibia and fibula were observed and the results were tabulated.

Table 1: Origin of Peroneal Artery

S. No.	Origin of peroneal artery	Number of specimens	Total number of specimens	Percentage (%)
1.	From posterior tibial artery	38	40	95
2.	Directly from popliteal artery	2	40	5

Table 2: Distance of Origin of Peroneal Artery from the Lower Border of Popliteus

Specimen number	Distance in cm	Specimen number	Distance in cm
1.	4.8	21.	5.0
2.	6.4	22.	6.8
3.	5.4	23.	4.8
4.	5.6	24.	6.4
5.	4.5	25.	5.0
6.	5.8	26.	5.5
7.	5.8	27.	6.2
8.	6.4	28.	5.8
9.	5.4	29.	6.6
10.	5.6	30.	5.4
11.	6.6	31.	4.6
12.	5.5	32.	4.4
13.	6.4	33.	5.2
14.	5.2	34.	4.8
15.	6.4	35.	4.7
16.	7.2	36.	5.4
17.	6.8	37.	6.3
18.	5.2	38.	5.2
19.	5.6	39.	6.3
20.	6.4	40.	5.5

The average distance of the origin of the peroneal artery from the lower border of popliteus was found to be 5.7 cm and ranging between 4.5cm to 7.2cm. The distance of origin of peroneal artery from the origin of posterior tibial artery was found to be 3.4 cm with the range of 2 – 7.2cm.

Table 3: Course of peroneal artery:(Fig.1,2,3,4)

S. No	Course of peroneal artery	Numberof specimens (n =40)	Percentage (%)
1.	Normal course	34	85
2.	Enlarged and replaced posterior tibial artery distally	4	10
3.	Arising from popliteal artery with absence of posterior tibial artery.	2	5

BRANCHES

CIRCUMFLEX FIBULAR ARTERY:

The circumflex fibular branch arose from the peroneal artery in two of the forty specimens, amounting its incidence to 5%. In 95% of specimens, the circumflex fibular artery was a branch of posterior tibial artery.

ORIGIN OF TERMINAL BRANCHES:

The terminal branches, medial and lateral plantar arteries arose from the peroneal artery in 15% of specimens (six lower limbs). In the remaining thirty four specimens (85%), the terminal branches were found to originate from the posterior tibial artery.

NUTRIENT ARTERY TO TIBIA(Fig.5):

In two specimens, where the posterior tibial artery was absent, the tibia received its nutrient artery from peroneal artery. In rest of the specimens, the tibia derived its nutrient artery from posterior tibial artery.

NUTRIENT ARTERY TO FIBULA(Fig.6):

The nutrient artery to fibula arose from the peroneal artery in all the specimens. It was two in number in 5 specimens (12.5%). There were three branches in two specimens (5%). There was a single nutrient artery in 33 lower limbs. The distance of the nutrient branch from the point of origin of the peroneal artery ranged between 7cm to 12cm. The origin was also measured from the styloid process of fibula and the distance varied between 13cm to 18cm.

PERFORATING BRANCHES(Fig.7):

The perforators arising from the peroneal artery varied between two to three in number. The perforators reached the anterior compartment of leg. The mean $\pm$ standard deviation of the distance of the perforator from the lateral malleolus was 6.6 $\pm$ 9.2cm.

DISCUSSION

The observations made in relation to the origin, course and branches was compared with those of the results of the previous authors. The majority of studies including those by J.E.Frazer (1937), J Parsons Schaffer(1953), Russell T Woodburne(1961) have shown that the peroneal artery arose from the posterior tibial artery. G J Romanes(1964) had described the division of popliteal artery into anterior tibial and peroneal artery. In the present study, the peroneal artery originated directly from the popliteal artery with absence of posterior tibial artery in 6% of specimens. Henry Gray(1858), G J Romanes and Samendra Mitra (1973) had reported incidence of trifurcation of popliteal artery. In the present study, the trifurcation of popliteal artery into posterior tibial artery, peroneal artery and anterior tibial artery was not observed in any specimen.

The distance of the peroneal artery from the origin of posterior tibial artery was compared with those of the previous studies.

Table 4: Distance of peroneal artery from the origin of posterior tibial artery.

S No	Authors	Distance (CM)
1.	Russell T Woodburne(1961)	2-3
2.	Keith.L.Moore (2005)	2-3
3.	BerishStrauch et al(1993)	3
4.	Harold Ellis (1980)	4
5.	Thomas Walmsley (1934)	5
6.	Henry Gray(1858)	7-8
7.	Present study	2-7.2

The present study coincides with that of Henry Gray's observations with regards to the distance of origin of peroneal artery from the commencement of posterior tibial artery. The fibula can be used in bone grafting in avascular necrosis of hip bone, mandibular reconstruction etc. In such instances, the location and distance of nutrient artery to fibula will help surgeons during usage of fibula as a bone graft.

The perforators arsing from the peroneal artery were located predominantly in the distal two-quarters of the leg. The knowledge of perforators is essential for raising skin flaps based on these branches. Since the flaps of these regions are considered to be reliable and easy to dissect, they are preferred even in primary centres also. Sometimes these branches may be enlarged and may continue down as the dorsalis pedisartery. (Taser F).

CONCLUSION

The revascularization procedures done as foot salvage surgeries require a detailed knowledge of the origin, course and relations of the blood vessels of lower limb. The peroneal artery being the predominant source of nutrient supply to fibula gains clinical importance especially during bone grafting procedures. The fibula is one of the bones commonly selected for bone grafting. Accessibility to these vessels is essential for the success of revascularization procedures. Hence the knowledge of the course, branching pattern and location of perforators enables surgeons and radiologists in achieving better results in surgeries or procedures involving the leg.

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Figure 1: Shows normal course of peroneal artery.

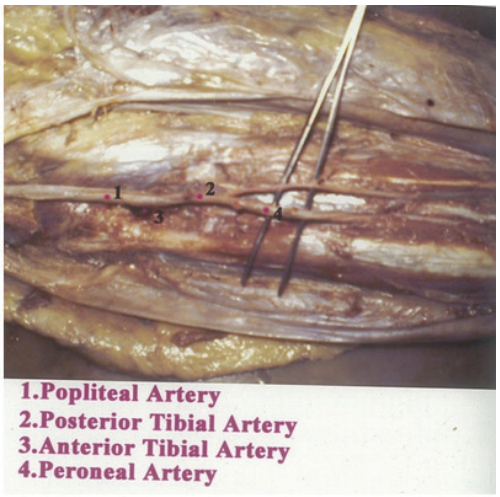

Figure 2: Shows the course of peroneal artery deep to flexor hallucis longus.

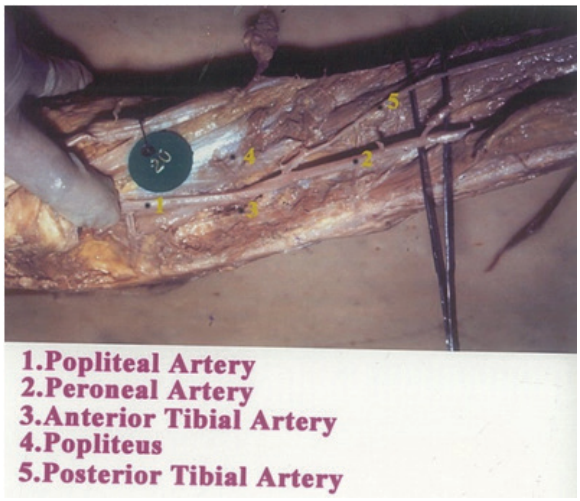

Figure 3: Shows an enlarged peroneal artery and a small posterior tibial artery.

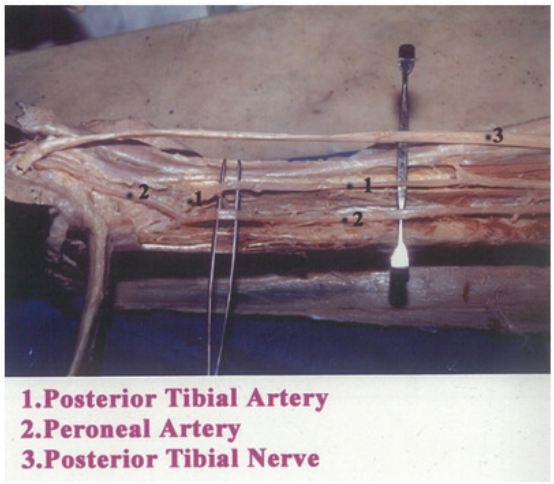

Figure 4: Shows high termination of posterior tibial artery and peroneal artery continuing down to give rise to medial and lateral plantar arteries.

Figure 5: Shows nutrient artery to tibia arising from peroneal artery.

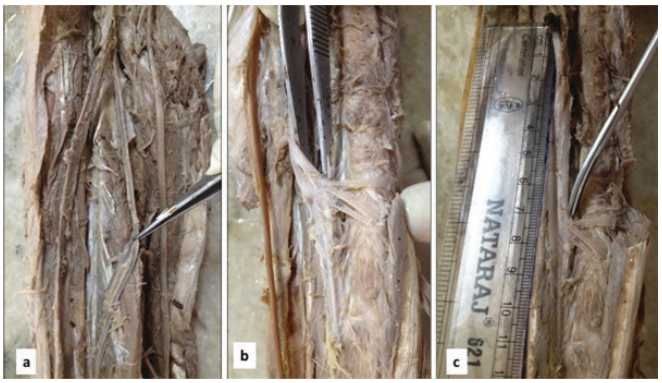

Figure 6: Shows nutrient artery to fibula arising from peroneal artery.

a) a single nutrient artery b) three nutrient arteries c) distance of origin of nutrient arteries from the origin of peroneal artery.

Figure 7: Shows perforating branches arising from peroneal artery.