

Original Article

AN ANATOMICAL STUDY ON DORSALIS PEDIS ARTERY

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ABSTRACT

Background: The study of Dorsalis pedis artery and variations in its branching pattern has been reported sporadically. The purpose of this study was to evaluate the arterial supply on the dorsum of the foot.

Materials and Methods: The study was carried out on forty two dissected limbs of unknown sex and age from the department of Anatomy, BMCRI, Bangalore. **Results and Discussion:** The incidence of classical text book description was found to be very less in the present study. In 16.67% of cases the arcuate artery was completely absent, which was compensated by two large lateral tarsal arteries that provided the dorsal metatarsal arteries. In 9.52% of cases the dorsalis pedis artery was absent. **Conclusion:** The findings suggest that the lateral aspect of the dorsum of the foot has a poor nourishment.

KEYWORDS: Dorsalis Pedis Artery; Vascular Anatomy; Flap Reconstruction.

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INTRODUCTION

The main function of the foot is to support the body during locomotion and quiet standing. The evolved human foot is designed in such a way that it is more resilient, can adapt to both even and uneven surfaces. The foot is more prone for injuries in day to day life like diabetic foot, peripheral arterial disease, industrial hazards, etc., where a need may arise for a vascular surgery for amputation. A detailed knowledge about the vessels of the foot and its variations is needed in such situations. The arterial feeders for the foot are derived from dorsalis pedis artery and its branches on the dorsal aspect, and by the medial and lateral plantar artery and their branches on the plantar aspect.

The dorsalis pedis artery is the continuation of anterior tibial artery. It begins on the anterior

surface of the ankle joint, and runs with the deep peroneal nerve, deep to the inferior extensor retinaculum and extensor hallucis brevis, to the proximal end of first intermetatarsal space. Here it divides into arcuate artery and first dorsal metatarsal artery. It gives medial and lateral tarsal branches to the tarsal bones and extensor digitorum brevis. The arcuate artery runs laterally across the bases of the metatarsals deep to the extensor tendons, and gives a dorsal metatarsal artery to each of the other intermetatarsal spaces. Each of these communicates through the proximal end of the intermetatarsal space with the perforating branches of plantar arch. Each dorsal metatarsal artery runs forwards on the corresponding dorsal interosseous muscle and forms the dorsal digital artery in each of adjacent toes [1].

MATERIALS AND METHODS

Forty two dissected lower limbs of unknown sex and age were obtained in a span of two years from the Department of Anatomy, Bangalore Medical College and Research Institute, Bangalore, Karnataka, India. The limbs were dissected lower down from the level of the ankle joint on the dorsal aspect till the level of the web space, the long tendons were severed, anterior tibial artery was identified and traced down, interestingly different varieties in the origin of dorsalis pedis artery, its branching pattern and the course were noted.

OBSERVATIONS & RESULTS

1. Normal course and branches of Dorsalis pedis artery:

In the present study in 54.76% of cases the anterior tibial artery continued as the dorsalis pedis artery and gave the lateral tarsal artery, medial tarsal artery, arcuate artery and first dorsal metatarsal artery and continued as the deep plantar artery after piercing the first dorsal interosseous muscle. (Fig: 1)

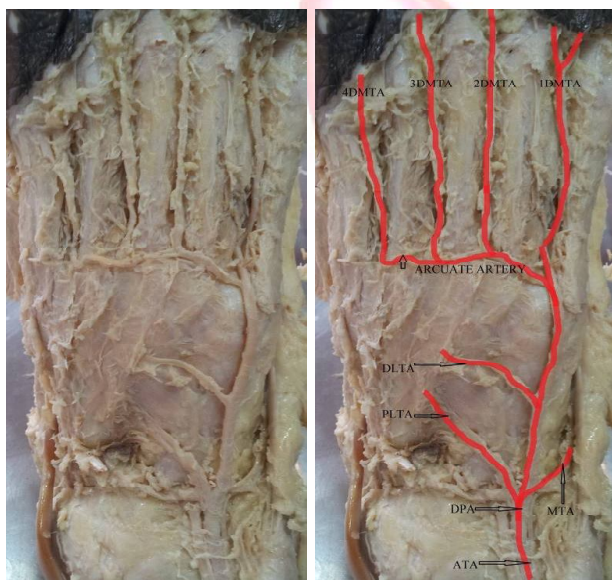


Fig-1: Normal course and branching pattern of Dorsalis pedis artery.

2. Absence of Dorsalis pedis artery:

The anterior tibial artery bifurcated into two terminal branches as medial and lateral tarsal arteries in front of the ankle joint; the caliber of the artery was very small. In this, the dorsalis pedis artery and the first dorsal metatarsal arteries were completely absent. The second and third dorsal metatarsal arteries came from

the lateral tarsal artery and the fourth dorsal metatarsal artery was absent. (Fig: 2)

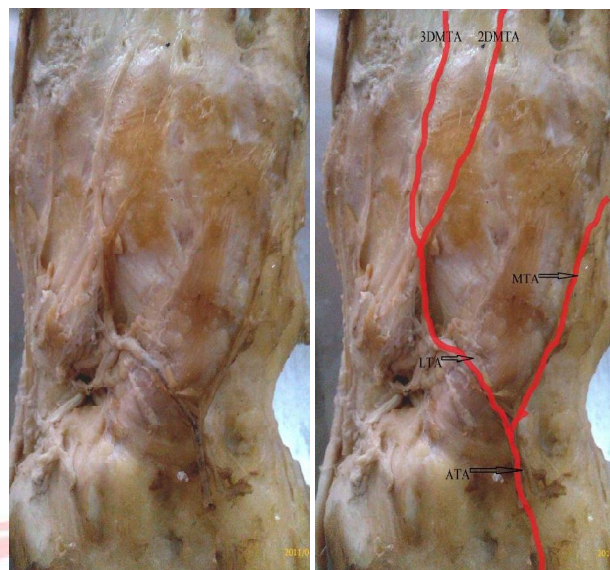


Fig-2: Absence of dorsalis pedis artery.

3. Absence of arcuate artery and variation in the number of lateral tarsal arteries:

Dorsalis pedis artery began as the continuation of anterior tibial artery and coursed to the posterior end of the first interosseous space, in its course it provided from its lateral aspect three lateral branches called as proximal, intermediate and distal lateral tarsal arteries. The dorsalis pedis artery before piercing the first dorsal interosseous muscle provided the first dorsal metatarsal artery, the arcuate artery being completely absent. The distal lateral tarsal artery continued as the second dorsal metatarsal artery



Fig-3: Absence of arcuate artery and variation in the number of lateral tarsal arteries.

and the intermediate lateral tarsal artery continued as the third dorsal metatarsal artery, which also provided a small twig to the fourth intermetatarsal space as the fourth dorsal metatarsal artery, the proximal lateral tarsal branch anastomosed with the lateral malleolar branch of anterior tibial artery. The medial tarsal artery arose opposite to the proximal lateral tarsal artery as a single branch. (Fig: 3)

4. Absence of dorsalis pedis artery with variation in the origin of dorsal metatarsal arteries:

The anterior tibial artery divided into medial and lateral tarsal arteries in front of the ankle joint. The lateral tarsal artery being larger in size provided three branches, the first branch arose as a common trunk which later divided into two branches the medial and lateral branch, the medial branch continued as first dorsal metatarsal artery with an oblique course to reach the posterior end of first intermetatarsal space, the lateral branch continued as the second dorsal metatarsal artery. The second branch from the lateral tarsal artery reached the third intermetatarsal space and continued as the third dorsal metatarsal artery and the third branch from the lateral tarsal artery reached the fourth intermetatarsal space to continue as the fourth dorsal metatarsal artery (Fig:4).

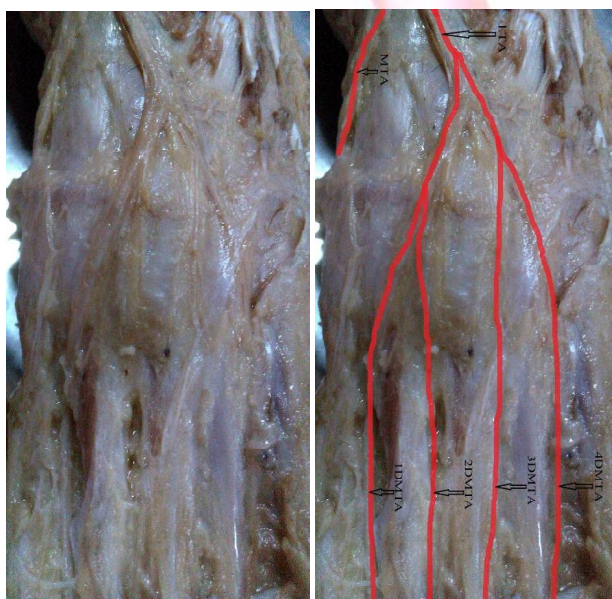


Fig-4: Absence of dorsalis pedis artery with variation in the origin of dorsal metatarsal arteries.

5. Variation in the origin of second dorsal metatarsal artery:

The anterior tibial artery continued as the dorsalis pedis artery in front of the ankle joint, it provided a lateral tarsal artery which divided into two branches to continue as third and fourth dorsal metatarsal artery. The dorsalis pedis artery in its course provided medial tarsal artery, first dorsal metatarsal artery and second dorsal metatarsal artery. (Fig: 5)

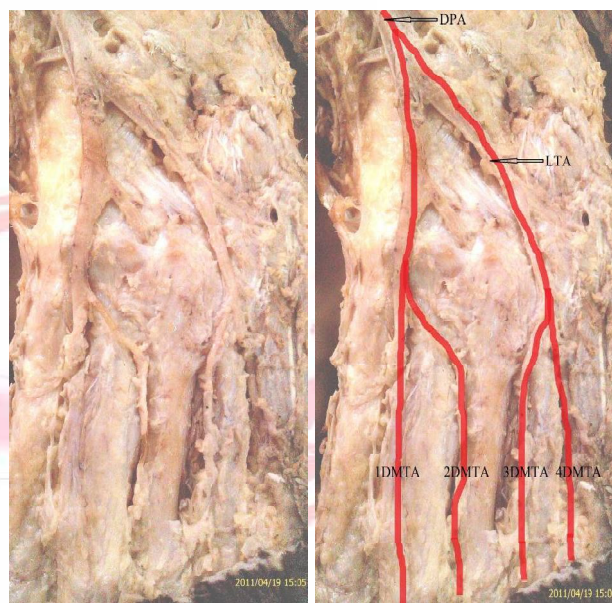


Fig-5: Variation in the origin of second dorsal metatarsal artery.

6. Arcuate artery replaced by U shaped loop:

Dorsalis pedis artery in the course provided proximal lateral tarsal artery, medial tarsal artery, distal lateral tarsal artery; then it reached the first intermetatarsal space and gave the first

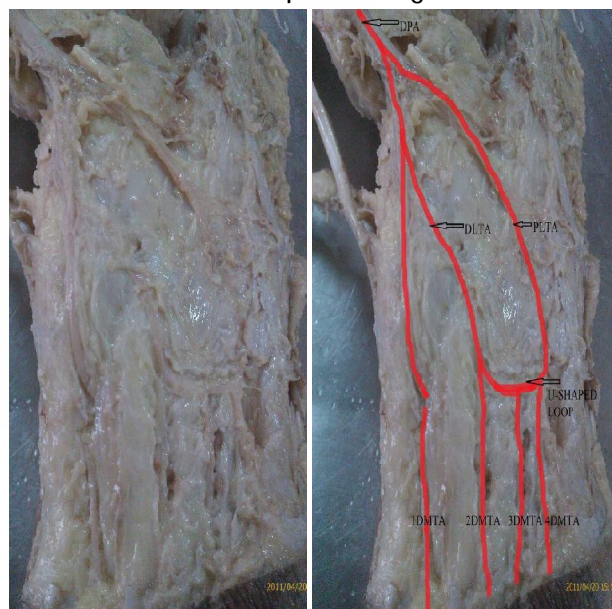


Fig 6: Arcuate artery replaced by U shaped loop.

dorsal metatarsal artery; the proximal and distal lateral tarsal arteries united together to form an 'U' shaped loop. From the loop it gave origin to the second, third and fourth dorsal metatarsal arteries. (Fig: 6)

DISCUSSION

The arterial supply to the developing lower limb starts as a capillary plexus off the dorsal side of the umbilical artery and internal iliac artery. The artery formed from this plexus is the axial artery and is located in the dorsal aspect of the leg. The axial artery terminates by passing through the sinus tarsi and forming a plantar capillary network. The femoral artery forms from the external iliac artery, descends along the ventral aspect of the thigh and terminates on the dorsum of the foot. During its development the femoral artery communicates with the axis artery distally. At the proximal border of the popliteus muscle it provides primitive posterior tibial and primitive peroneal arteries which run distally to gain the sole of foot. At the distal border of popliteus the axis artery gives off the perforating branch and passes ventrally between the tibia and fibula and then courses to the dorsum of foot, forming the anterior tibial and arteria dorsalis pedis. The proximal parts of the primitive posterior tibial and peroneal arteries fuse, but remain separate distally. Gradually between the end of the embryonic period and birth the axial artery degenerates and persists as the popliteal and peroneal arteries [1].

Dorsalis pedis artery is the main source of artery to the dorsum of the foot. In its course it provides the medial tarsal artery, lateral tarsal artery, first dorsal metatarsal artery, arcuate artery and deep plantar artery which enters the sole after passing between the two heads of first dorsal interosseous muscle and takes part in the formation of the plantar arch [2].

In 54.76% of cases the anterior tibial artery continued as the dorsalis pedis artery and had its course and branches as the classical text book description. In 9.52% the anterior tibial artery bifurcated just below the level of ankle joint as medial and lateral tarsal artery, the dorsalis pedis artery being completely absent. Yamada et al [3] in their study reported absence of dorsalis pedis artery in 6.7% of cases and the dorsal

metatarsal arteries were supplied by the plantar arteries.

In 16.67% of cases dorsalis pedis artery failed to provide the arcuate branch. Yamada et al in his study found 33% of absence of arcuate artery, Dilandro et al [4] reported 83.3% of absent arcuate artery suggesting that the arcuate artery is not the primary blood supply to dorsal metatarsal artery as is commonly described and the lateral tarsal artery provided 2nd, 3rd and 4th dorsal metatarsal artery more frequently in 47.2% than the arcuate artery. In our study, out of 16.67% of dissected specimens in 2.38% of cases this was compensated by three lateral tarsal arteries which are the branches of dorsalis pedis artery called as the proximal, intermediate and distal lateral tarsal artery and continued over the metatarsals as the 2nd, 3rd and 4th dorsal metatarsal artery. In the remaining 14.29% of cases the lateral tarsal arteries were two in number, the proximal and distal providing the dorsal metatarsal arteries. The caliber of 3rd and 4th dorsal metatarsal arteries was very small. Yamada et al reported in their study the presence of proximal and distal lateral tarsal artery which gave the dorsal metatarsal arteries. This was similar to the study done by Saeed et al [5] and Hamada et al [6] who opined that lateral tarsal artery was always double in all the specimens they studied, but the intermediate branch found in our study has not been reported in any literature.

In 14.29% of cases the second dorsal metatarsal artery originated from the dorsalis pedis artery, which is not infrequent. Mitra [7] in his study in one case found this pattern during routine dissection.

Lee et al [8] in their study reported the origin of first dorsal metatarsal artery from the dorsalis pedis artery in 90.6% of cases and in 9.4% of cases it came from the lateral tarsal artery. In the present study in one case i.e. in 2.38%, the first dorsal metatarsal artery arose from the lateral tarsal artery which is similar to our study. Gabrielli & Olave et al [9] in their study which included fifty feet found that first dorsal metatarsal artery originated from dorsalis pedis artery in 86%, from plantar network in 10% and mixed in 4%.

The second, third and fourth dorsal metatarsal arteries arose from the arcuate artery in 10%, 6% and 10% respectively. In their study they reported the absence of arcuate artery, the lateral tarsal artery provided the dorsal metatarsal arteries which holds good with our study.

In 2.38% the arcuate artery was replaced by a U-shaped loop formed by the union of proximal and distal lateral tarsal artery which provided the second and third dorsal metatarsal arteries and the fourth dorsal metatarsal artery was completely absent.

This variety has not been reported in the literature.

CONCLUSION

Pulsations of dorsalis pedis artery at the 1st intermetatarsal space is an indicator of its patency, which is usually obliterated or even absent in ThromboAngitisObliterans. The absence of arterial pulse in the first intermetatarsal space does not imply that there is ThromboAngitisObliterans disease, as dorsalis pedis artery is frequently absent in many instances. Arcuate artery is not the principal artery which gives out dorsal metatarsal arteries, as in majority of the cases the dorsal metatarsal arteries are derived from the lateral tarsal artery in the absence of arcuate artery.

The caliber of the dorsal metatarsal artery in the third and fourth spaces is very small or they may be completely absent. It was however observed that lateral 1/3 rd of the dorsum of the foot has a very poor blood flow, hence these areas either not supplied at all or with insufficient blood supply are frequently the sites of non-healing ulcers especially in the diabetic foot and also more prone for gangrene. The grafts done in these areas may not be successful. Hence a thorough knowledge of the arterial pattern depicted by an arteriography is important, before attempting any surgical procedures.

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