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Variation in Branching Pattern of Dorsalis Pedis Artery- A Cadaveric Study

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KEYWORDS

Dorsalis Pedis Artery (DPA), Flaps Supplied, Morphometry, Rare Variations, Sexual Dimorphism, Vascular Diseases, Reconstruction Surgeries.

ABSTRACT:

Background: The main artery in the lowermost part of the foot is the Dorsalis Pedis Artery (DPA). It feeds the foot's dorsum with nourishment. Peripheral vascular disorders must be diagnosed with DPA palpation. Various reconstructive techniques use dermatological flaps from DPA branching.

Methodology: The morphometry, asymmetry, and gender differences of DPA and its branching structures were examined in 50 meticulously dissected lower limbs from both sides and individuals of known sex. We searched for variations such as additional lateral tarsal arteries and lack semi-circular arteries.

Results: In 12% of cases, there was no arcuate artery. In 4% and 16% of cases, correspondingly, there were three and two tarsal plantar arteries identified. Two limbs showed an exceptionally unusual instance of a U-shaped loop connecting two tarsal metatarsal arteries.

Conclusion: Uncommon abnormalities such as the absence of the arcuate artery and the many tarsal arteries connected by a U-shaped loop seen in our research are significant for reconstructive procedures using DPA flaps.

INTRODUCTION

The artery that goes through the dorsalis pedis is the main blood vessel supporting the dorsum of the foot. The artery of the dorsalis pedis is a readily accessible artery that may be used to measure pedal pulsations [1, 2]. The ideal site for the dorsalis pedis artery is next to the navicular bone, however it may also be felt from the centre of the malleoli to the distal end of the initially formed intermetatarsal gap [2]. The dorsalis pedis artery, [2, 3], often referred to as the ventral artery of the foot, serves as the main circulatory supply of the forefoot [4].

It continues through the anterior tibial artery at the talocrural joint, which is located immediately distal to the inferior plantar retinaculum [5]. The space between each of the first and two metatarsals is where the deep pyramidal artery and the first lateral metatarsal artery emerge [6].

The arc-shaped artery, median and laterally tarsal arteries, deep forefoot artery, and first dorsal metatarsal artery are the branches of DPA [7]. The cutaneous branches of the first dorsal metatarsal artery create the cutaneous flaps that feed the dorsum of the foot among the extensor retinaculum, or extensor retina and the first webbing space or intermetatarsal gap between fingers. For a variety of reconstructive procedures, such as vascular procedures in diabetic foot sufferers who need amputation, this skin flap may be helpful [7, 8].

Although other research have refuted the concept, [9], it has been suggested that DPA is located near the mid-malleolar position. Earlier studies have highlighted

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variations such as many lateral tarsal arteries, non-existent arcuate artery, [10], and absent DPA. Research has shown that DPA's source from the peroneal artery varies [11, 12]. In musculocutaneous flap procedures, preoperative angiography to check for aberrant branch is highly suggested in situations of diabetic foot ulcers that do not heal.

Understanding the many DPA branches is crucial for individuals undergoing face rebuilding methods, including as lip and oral cavity repair. Soft-tissue repair uses the dorsalis pedis fascial flap [12, 13]. DPA provides axial or islands flaps that are utilised for heel repair. Identifying variations prior to the treatment aids in the revascularization of diabetic foot patients.

The purpose of this research is to ascertain the branching pattern, morphometry, and symmetry of DPA.

I. MATERIALS AND METHODS

For this investigation, fifty lower limbs from typical first-MBBS dissection room from Department of Anatomy, Krishna Institute of Medical Sciences, Karad were employed. A thorough dissection of 20 male and five female human remains was performed in order to ascertain the morphology, imbalance, and look for variances in DPA. There were 25 lower limbs on the left side and 25 on the right. The DPA's branch pattern was observed. We investigated for sexual dimorphism, morphological asymmetry, and any abnormal branching. As a pioneering work, gender variation of the morphological characteristics and differences in branching pattern were investigated [14, 15]. Variable arteries were coloured and captured on camera. A Vernier calliper was used to measure the branches' distance from the malleoli and the length of the DPA. The Institution Ethical Council granted this project ethical approval [15, 16].

- **Parameters used:**

1. How far away is the medial malleolus [1] (M) – Length from the beginning of the DPA to the medial malleolus parallel point [Figure 1]
2. How far away is the lateral malleolus [1] (L) – Length from the DPA's beginning to the lateral malleolus's tip [Figure 1]
3. Length of DPA [1] – Beginning at the mid-malleolar point and going to the DPA bifurcation
4. The arcuate artery's presence.
5. The quantity of tarsal lateral arteries.

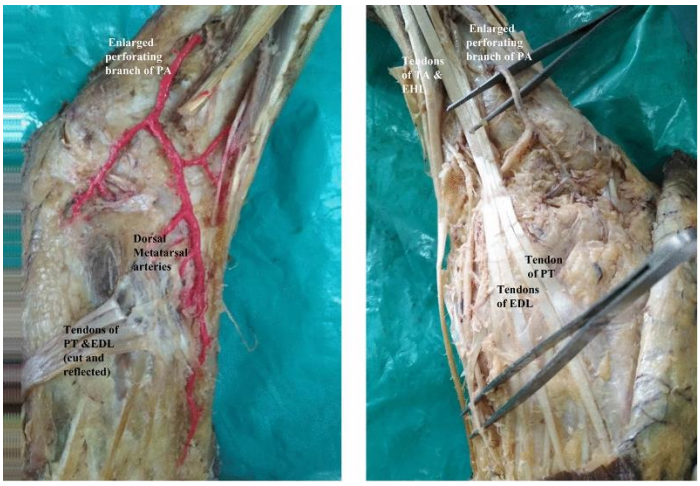

Fig. 1 Absence of arcuate artery in tortuous dorsalis pedis artery. L: Lateral malleolus to DPA, M: Medial malleolus to DPA, and A: Dorsalis pedis artery [17].

- **Criteria for inclusion:**

Lower limbs of adults without obvious injury to DPA and its attachments.

- **Criteria for Exclusion:**

Grossly damaged lower limbs to DPA and its branches.

II. RESULTS

We looked at the morphometry and imbalance of DPA in fifty lower limbs.

The lower limbs of 40 men and 10 women were examined for sexual dimorphism.

DPA was found in every limb during investigation. Six limbs (five on the right side and one on the left) lacked an arcuate artery. This mutation was seen in two female and four male limbs. Of the 50 lower limbs, 6 limbs had no arcuate artery, or 12%. Two lateral tarsal arteries are seen in 8 limbs, or 16%. There are 3 lateral tarsal capillaries in 2 limbs, or 4%.

Eight limbs—three on the left and five on the right—showed evidence of two lateral tarsal arteries. Two left-side limbs were discovered to have three posterior tarsal arteries. Only male's cadavers showed evidence of having 3 and 2 posterior tarsal arteries, respectively. One male the body's left side revealed the unusual discovery of a unique U-shaped loop formed by the

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union of the second and third lateral metatarsal arteries [Figure 2]. The uncommon U-shaped loop between lateral tarsal arteries 1 and 2 was observed in a right-sided limbs [Figure 3].

Fig. 2 There are three lateral tarsal arteries, the second and third of which have a U-shaped loop connecting them. The first, second, and third lateral tarsal arteries are denoted by the letters A, B, and C.

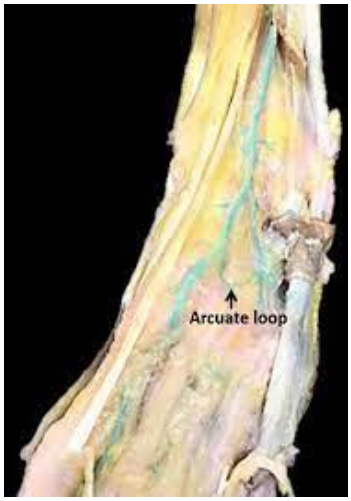

Fig. 3 The first and second lateral tarsal arteries form a U-shaped loop. A stands for the first lateral tarsal artery, and B for the second.

Table 1 contains all of the DPA morphometry data, while Table 2 contains the results of the branching pattern variants.

Table 1 Comparing dorsalis pedis artery observations (cm) with findings from previous studies.

Parameter	Vengadesan B, 2020 (cm)	Current study 2023
Length of DPA	8.3	7.69
Distance from medical malleolus	3.1	6.19
Distance from lateral malleolus	5	6.39
DPA: Dorsalis Pedis Artery		

Table 2 Comparing the dorsalis pedis artery's branching pattern and origin (%) with findings from previous research.

Parameter	Ntuli S, 2018	Barot PJ, 2019	Vengadesan B, 2020 (cm)	Hemamalini, 2021	Current study 2023
Normal DPA	54	45.69	96	89	64
Absent DPA	9	6.97	46	3.9	0
Absent AA	3	15.69	9	16	19
3 lateral tarsal A		6.98	1	3.9	2
2 lateral tarsal A		14.69	6	8.9	36

III. DISCUSSION

When reconstructive surgery is performed for illnesses including burn injuries, varicose vein-caused venous ulcers, and lacerated wounds after auto accidents, DPA is crucial. Variations in the DPA branching pattern have been seen in various regions throughout India and other nations [18]. Our findings are contrasted with those of previous investigations in Tables 1 and 2. During the careful dissecting of 50 lower-body parts in Nasik, [19], we discovered variances. In 12% of limbs, the most frequent change we found was the absence of the arcuate artery. Male cadavers were the only ones with 3 and 2 dorsal tarsal arteries, respectively [20]. Two cadavers

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have a novel form of the U-shaped loop between the lateral tarsal arteries.

Discovered differences in DPA morphometry during a multiple research [21]. The average length of DPA was reported by the authors to be 7.8 cm. We discovered that 12% of limb had an arcuate artery, while just 3% of them had one [22]. They discovered that the DPA had an average separation of 3.9 cm from the centre malleolus and 6 cm from the malleolus on the left side. Thus, DPA is not always near the mid-malleolar position, according to the authors. Table 1 presents a comparison of the DPA morphometry data. Our research yielded results of 2.86 and 5.72, which is cm, hence we agree with the statement made.

Pedal revascularization operations are the most prevalent usage of DPA because it is the biggest branch at the ankle. Variations in DPA were detected in 13 out of 40 lower extremities in a cadaveric research. The authors reported rare instances of dual DPA and DPA trifurcation. Seven lower limbs lacked an arcuate artery [23]. This result was likewise seen in 12% of the limbs in the study that we conducted. A single lower limb displayed twisted DPA. On a male's right side of the body, we also reported this. Said that before undergoing surgery, preoperative angiography should be performed to check for changes in the branching of DPA.

There were 6.06% of limbs in a research involving South Africans that had no DPA. Nine variants of the DPA branching pattern were recorded by the authors. 36.6% of them said that the most typical appearance for them was conventional branching. They claim that changes in the course and branched had an impact on the DPA pulse [24].

The most commonly performed clinical test for suspected instances of arterial problems is DPA palpation. Differences were seen in the DPA branching during standard cadaveric dissection. Before splitting into middle and branches that are lateral they describe a single instance of DPA that had a very brief path [25]. They also state that one lower leg is devoid of an arcuate artery. The author claims that before undergoing microvascular foot surgery, angiography was always recommended to check any abnormalities in the morphological characteristics of DPA and its branches.

IV. CONCLUSION

For reconstructive and restorative methods, understanding DPA morphology and branched differences is crucial. DPA was seen to exhibit morphometric variability, asymmetry, and gender differentiation. A difference in the number of arcuate arteries was observed; in 16% and 4% of cases, there were two or three lateral tarsal arteries, accordingly. Only the left side had three lateral tarsal arteries present, whereas the right side had more arcuate arteries than the left. Only male cadavers had several lateral tarsal arteries. At the midway of the line connecting the malleoli, the DPA had not been visible. We discovered a unique U-shaped loop made up of the connections between two limbs' lateral tarsal arteries. Surgeons find it very helpful to use prior angiography to look for these variations when choosing the skin flap for reconstructing treatments.

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