

VARIATION IN THE BRANCHING PATTERN OF THE DORSALIS PEDIS ARTERY: A CADAVERIC STUDY

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ABSTRACT

Dorsalis pedis artery is the main artery of foot. It has been shown to have a variation in its origin, course and branching pattern. The present study aimed to assess the variation in artery and the different branching patterns of the dorsalis pedis artery that exist in a Nepali population. The study was carried out in 52 dissected limbs of 23 males and 3 females all together, in Department of Human Anatomy, Nepal Medical College Teaching Hospital, Attarkhel, Gokarneshwor-8, Kathmandu, Nepal. The dissections were carried out on embalmed cadavers placed in supine position on a dissecting table with the neck in neutral position. After dissection, the status of the artery and the branching pattern was observed and recorded in the predesigned table. All the recorded measurements were analyzed by using descriptive statistics in SPSS-16. The normal pattern was observed on 41 (78.84%) limbs while rest of the limbs showed variations. A missing arcuate artery pattern was observed in six, limbs while an extra lateral tarsal artery was found in three limbs. The mean diameter of the artery with normal branching pattern was 4.24 ± 0.90 mm. and the mean diameter of the artery with variation in branching pattern was 3.80 ± 0.40 mm. In conclusion, this study revealed variations in dorsalis pedis artery. These findings are considered informative and helpful for the orthopedics surgeons and podiatrists performing foot reconstructive procedures.

KEYWORDS

Anatomy, arcuate artery, dorsalis pedis artery, variations

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INTRODUCTION

The main artery supplying the dorsum of the foot is the dorsalis pedis artery (DPA). It is an extension /continuation of the anterior tibial artery (Fig. 1) which originates from the anterior part of the ankle joint.¹ It ends at the proximal region of the first intermeta tarsal space, where it splits into the deep plantar artery and the first dorsal metatarsal artery.²⁻⁴ It continues as the first dorsal metatarsal artery and anastomoses with plantar artery. The arcuate artery, medial and lateral tarsal arteries, deep plantar artery, and first dorsal metatarsal artery are the branches of DPA.⁴

Human are more susceptible to diseases like diabetes and hypertension due to changing lifestyles and increased stress. In the clinical evaluation of the foot's vascular supply, normal pulsation of this dorsalis pedis artery is essential. Between the extensor hallucis longus and extensor digitorum longus tendon, the arterial pulse can be palpated.⁴ Diabetic neuropathy increases the risk of ischemia and foot infections, potentially leading to amputations. The DPA bypass is crucial to attempts to save the ischemic limb. With its main branches, the DPA is the recipient vessels that is used preferentially. When an individual has atherosclerotic disease, it is crucial to palpate the dorsum of the foot for DPA. For ankle surgeries, and in cases of peripheral vascular disease, a thorough understanding of DPA's branching pattern and its presence or absence are crucial.⁵ Vascularized tissue transfer using the first dorsal metatarsal artery as a pedicle is frequently employed in microsurgical restoration of tissue defects. It is safe to employ the myocutaneous dorsalis pedis arterialized flap as an island flap, to cover the heel or ankle or as a free flap for deformities of the palm.⁶ Nonetheless, the artery exhibits significant anatomical differences.⁷

A number of studies have shown anatomical variations in dorsalis pedis artery.⁸⁻¹² The arterial variations around the ankle is important to orthopedic surgeons, vascular surgeons and radiologists to overcome complications during surgical interventions and helpful for avoiding iatrogenic injury during surgical procedures. Therefore a thorough clinical assessment of the arterial supply to the foot is essential in cases of peripheral vascular disease.¹³ Hence, the main aim of this study was to assess the different branching patterns of the dorsalis pedis artery that exist in a Nepali population.

MATERIALS AND METHODS

A descriptive, observational study was conducted on 52 embalmed lower limbs (23-male and 3-female), in the Department of Human Anatomy, Nepal Medical College Teaching Hospital, Attarkhel, Gokarneshwor-8, Kathmandu. Both right and left side of the lower limb with intact ankle joint and foot were included for the study. Cadavers with observable gross and congenital anomalies and acquired deformities of lower limb, damage in the area or amputation of the lower limb, cadavers which had reconstructive operations of the ankle joint and foot and cadavers with ankle replacement were excluded from the study. The study was conducted from February 2024 to January 2025, covering a the study period of one year. Ethical approval of the study was taken from the Institutional Review Committee of NMCTH (Ref. No: 59-080/081).

First, the skin and fascia of formalin preserved cadavers were removed from the anterior compartment of leg and dorsum of foot. All dissections were carried out on the cadaver placed in supine position on a dissection table with the neck in neutral position. The dorsalis pedis artery was exposed leaving the ankle joint intact and the variations of the branching



Fig. 1: Dorsalis pedis artery

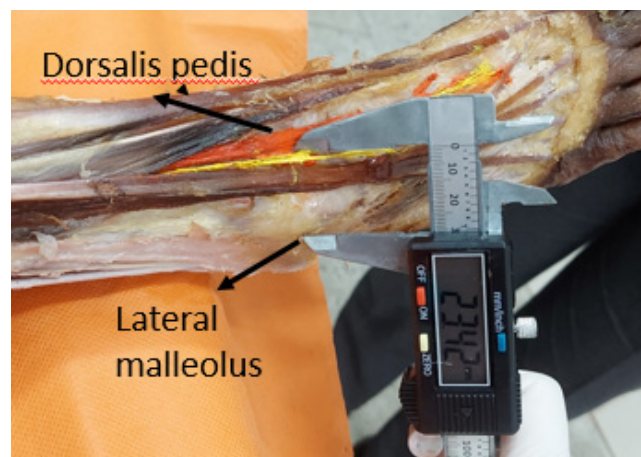


Fig. 2: Distance from lateral malleolus

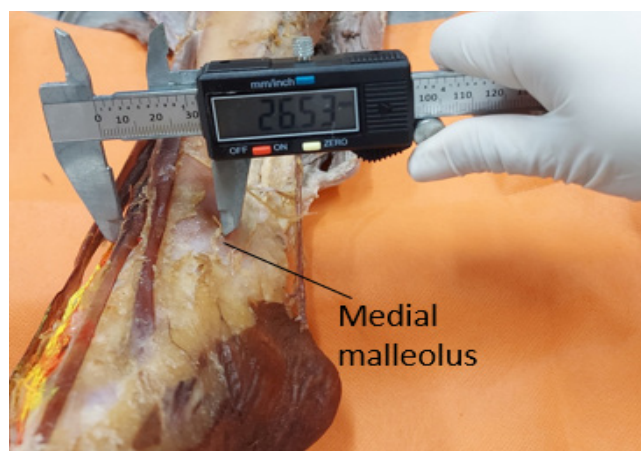


Fig. 3: Distance from medial malleolus

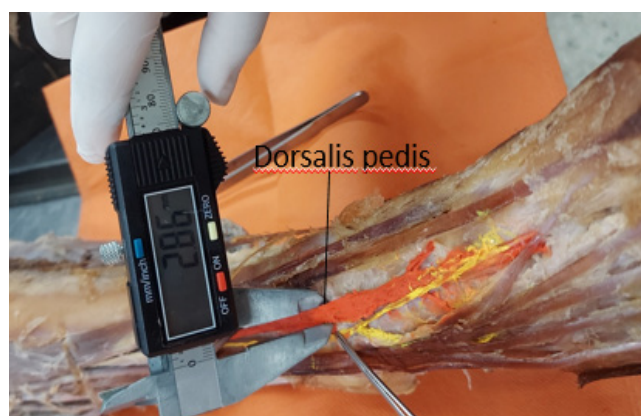


Fig. 4: Measurement of diameter

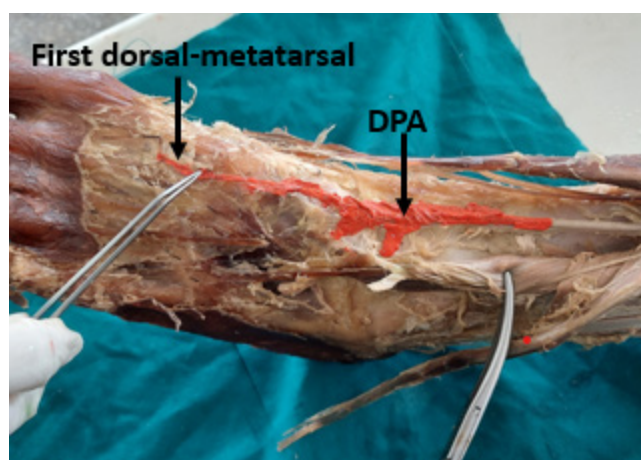


Fig. 5: Missing arcuate artery

pattern and morphological asymmetry was observed.¹⁴ The artery was identified in mid malleolar region and was colored. The variation of the branching pattern was observed and recorded. The measurement of the diameter (Fig. 4) of the artery and distance from the medial malleolus (Fig. 3) and from lateral malleolus (Fig. 2) were recorded using digital Vernier calipers and all the parameters were recorded for analysis by using descriptive statistics and were analyzed in SPSS-16.

RESULTS

In present study, there were 52 lower limbs (limbs of male were 46 and limbs of females were 6). The normal pattern was observed on 41 (78.84%) limbs (Table 1).

Table 1: The presence of normal branching pattern of dorsalis pedis artery

Patterns observed	Right foot	Left foot	n (%)
Normal pattern	18	23	41 (78.84)
Abnormal pattern	8	3	11 (21.16)

The variations status of the limbs that were present in 11 (21.16 limbs). Missing arcuate artery was observed in 6 limbs.

Table 2: Variation of dorsalis pedis artery

Types of variation	On right foot	On left foot	n (%)
Missing arcuate artery	5	1	6 (11.53)
Missing lateral tarsal artery	-	1	1 (1.92)
Missing medial tarsal artery	1	-	1 (1.92)
Extra lateral tarsal artery	2	1	3 (5.76)

The mean distance of artery from medial malleolus was 38.10 ± 5.25 mm, the mean distance of artery from lateral malleolus was 57.83 ± 5.54 mm, the mean diameter of the artery with normal branching pattern was 4.24 ± 0.90 mm. and the mean diameter of the artery with variation in branching pattern was 3.80 ± 0.40 mm.

Table 3: Measurement of dorsalis pedis artery from bony landmarks

Measurement of dorsalis pedis artery	Mean \pm S.D.
Distance from medial malleolus	38.10 ± 5.25
Distance from lateral malleolus	57.83 ± 5.54
Diameter of dorsalis pedis artery (normal)	4.24 ± 0.90
Diameter of dorsalis pedis artery (variation)	3.80 ± 0.40

DISCUSSION

The knowledge of anatomy of any structure of the human body is very important as it plays vital role and is essential during various reconstructive procedures. The present study was conducted on 52 lower limbs (26 of right side and 26 from the left side of intact leg and foot) to assess the branching pattern and variations of dorsalis pedis artery.

In present study the most frequent pattern of DPA found, was where the anterior tibial artery (ATA) continued as the dorsalis pedis artery distal to the inferior extensor retinaculum and then passed between the extensor hallucis longus and extensor digitorum longus tendons. Among them the normal branching pattern was found on 41 (78.84%) and variation was there in the remaining samples 11 (21.16 %). In line with the present study, Patel *et al.*¹⁵ reported missing an arcuate artery (Fig. 5) in six limbs. The extra lateral tarsal artery that is two lateral tarsal arteries were also there in 8 limbs (5 on the right side and 3 on the left side). Similarly, the study conducted in Medical College of Mysuru, India, in 40 formalin fixed lower limbs, Hemamalini and Manjunatha¹⁶ reported variations of dorsalis pedis artery in 13 limbs. In seven specimens the arcuate artery was absent. The findings were similar to the current study where there was missing arcuate artery on 6 (rt-5, lft-1) study samples (11.53%), and extra lateral tarsal branch were on 3 (rt-2, lft-1) study samples (5.76%). The findings show that there are variations in the branching pattern of the dorsalis pedis artery.

In the present study the mean diameter of the DPA with normal branching pattern was found to be 4.24 ± 0.90 mm. In a study, Chitwan, Gautam *et al.*¹⁷ reported the diameter of the DPA ranged from 3.0 to 4.6 mm which was similar to the present study. With a slight difference in measurement, the study by Khan *et al.*¹¹ showed variation in the diameter of DPA. The mean proximal diameter in both male and female on right and left side was lesser than our observation suggesting variation. The study conducted by Gupta *et al.*⁵ showed the average length of the dorsalis pedis artery was 7.8 cm, the average length from the medial malleolus was 3.9 cm, and the average length from the lateral malleolus was 4.5 cm. The findings were similar to the current study where the mean distance of artery from medial malleolus was 38.10 ± 5.25 mm, the mean distance of artery from lateral malleolus was 57.83 ± 5.54 mm. In another study conducted among Thai population, Thunyacharoen *et al.* showed a slight variation in the measurement.

The distance of DPA from the medial malleolus and lateral malleolus were 42.62 ± 11.40 mm and 51.48 ± 7.27 mm, respectively.¹⁸

Anatomy of the DPA is useful for a variety of foot and ankle surgery. In addition, the exact location of DPA is very uncertain owing to this variation.¹⁹ A study conducted in Caucasian cadavers showed that in 90.6% of cases, it was originated from the dorsalis pedis artery and, in 9.4% of cases, from the lateral tarsal artery.²⁰ Similar to this study, the first dorsal metatarsal artery was always present in the study samples and, it was originated from the dorsalis pedis artery.

In another study, conducted by Vazquez *et al.*²¹, the most frequent pattern found was where the anterior tibial artery (ATA) continued as the dorsalis pedis artery (DPA) distal to the inferior extensor retinaculum and then passed between the extensor hallucis longus and extensor digitorum longus tendons (287 cases, 95.7%). The finding was similar to the present study where all the DPA of the study specimen, were continued from the anterior tibial artery and was present distal to the inferior extensor retinaculum and then passed between the extensor hallucis longus and extensor digitorum longus tendons. Unlike to the findings of the present study, the study conducted in 44 lower limbs in Pondicherry, India, Vengadesan *et al.*²² found normal DPA in 5% of cases the dorsalis pedis artery was replaced by the perforating branch of peroneal artery. The study conducted by Mitra *et al.*²³ reported that the arcuate artery on the dorsum of the foot was absent on both sides during normal dissection of the lower limbs of a male corpse aged 60. It was observed from the results of the study that the diameter of the dorsalis pedis artery in variation pattern to be lesser than that of normal pattern.

In conclusion, the knowledge of dorsalis pedis artery is very important due to its variations in measurement and branching pattern. This may be a helpful for the orthopedic surgeons and podiatrists. In the present study, variations was also observed in the DPA of Nepalese population and this information is crucial for surgeons performing foot reconstructive procedures.

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