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# Study of Branching Pattern of Dorsalis Pedis Artery and its Clinical Significance

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## Abstract

**Objective:** To study the branching Patterns of the Dorsalis pedis artery.

**Method:** The study was conducted in the Department of anatomy, TNMC & BYL Ch. Hospital, Mumbai. Sixty cadaveric lower limbs were dissected below ankle and dorsalis pedis artery was traced to all its branches.

**Results:** We observed 10 different branching patterns of dorsalis pedis artery, some of which were not reported in literature.

**Conclusion:** Dorsalis pedis artery have variations in branching patterns. Knowledge of these variations will help surgeons for planning and better outcome of surgeries involving foot.

**Keywords:** Dorsalis pedis artery; Lateral tarsal artery; First dorsal metatarsal artery; Arcuate artery; Ankle anatomy; Foot anatomy; Foot surgery

**Abbreviations:** DPA: Dorsalis Pedis Artery; LTA: Lateral Tarsal Artery; MTA: Medial Tarsal Artery; FDMA: First Dorsal Metatarsal Artery; AA: Arcuate Artery; DMA: Dorsal Metatarsal Artery

## Introduction

Dorsalis pedis artery is the main source of blood supply to the dorsum of foot [1]. Dorsalis pedis artery is an easily accessible artery for assessing pedal pulsations [2]. The most preferred site for palpation of dorsalis pedis artery is against the navicular bone, however it can be palpated from midpoint between the malleoli to the proximal end of first intermetatarsal space. A diminished or absent dorsalis pedis pulse usually suggest vascular insufficiency. However some healthy individuals may have a congenitally non palpable dorsalis pedis pulse [3,4]. In these cases there is a variation in the termination pattern of anterior tibial artery.

Examination of pedal pulses remains a useful clinical tool when evaluating peripheral circulation. The anatomical basis for the absence of its pulsations is the change in the arterial branching pattern, deviant course and its small caliber [5]. The dorsalis pedis flap is one of the most commonly used foot flaps. There is still little detailed information on the arterial supply of the dorsum of the foot [6]. The arterial system of the foot has attracted the attention of anatomists and surgeons for many years because of its importance and extreme variability [7]. As variation in dorsalis pedis artery is common, it is essential to have a sound knowledge about the artery. This study will help to understand the different branching patterns of the dorsalis pedis artery.

## Materials and Methods

Sixty Lower limb specimens were dissected in the dissection room of department of Anatomy. The study was carried out on lower limbs of unknown sex and age from the department of Anatomy.

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 Extensor tendons were severed, dorsalis pedis artery was identified and traced down, the origin, branching pattern and the course were noted.

## Observations and Results

Branching patterns of DPA were observed in the present study and grouped as per their morphological appearance. Total 10 different patterns of branching of DPA were found. They were grouped into Type A, B, C, D, E, F, G, H, I and J with regards to the variations in origin, course and branching pattern of DPA (Figure 1 and Table 1).

Type A: Normal branching pattern of dorsalis pedis artery (Figure 2). In the present study 73.33% cases had normal branching pattern giving all the branches as mentioned in textbooks.

Type B: In the present study 4 cases (6.66%) had branching pattern of this type where 2$^{nd}$ DMA directly arose from DPA and 3$^{rd}$ and 4$^{th}$ DMAs were given by LTA (Figure 3).

Type C: In the present study 5% cases had branching pattern of this type where 2$^{nd}$ DMA directly arose from plantar arch and 3$^{rd}$ and 4$^{th}$ DMAs were given by LTA. AA was absent (Figure 4).

Type D: In the present study 6.66% cases had branching pattern of this type where 2$^{nd}$ DMA directly arose from DPA and 3$^{rd}$ and 4$^{th}$ DMAs were given by plantar arch. AA was absent (Figure 5).

Type E: In the present study, 3.33% cases had arcuate artery arising higher at Cuneonavicular joint rather than its normal position at tarsometatarsal joint (Figure 6).

Type F: In the present study, in 1 case (1.66%) DPA took a lateral course and terminated into the 2nd and 3rd DMAs. FDMA and 4th DMA arose from plantar arch. AA was absent (Figure 7).

Type G: In the present study, in 1case (1.66%) AA was absent and 2nd, 3rd and 4th DMA were given by plantar arch (Figure 8).

Type H: In the present study, in 1 case (1.66%) LTA and AA were absent; 2nd, 3rd and 4th DMA were given by plantar arch (Figure 9).

Type I: In the present study, in 1 case (1.66%) FDMA and AA were absent; 2nd, 3rd and 4th DMA were given by plantar arch (Figure 10).

Type J: In the present study, in 1 case (1.66%) DPA was hypoplastic, it terminated just below ankle into two terminal branches; MTA and LTA. AA was absent and all DMA's were given by plantar arch (Figure 11).

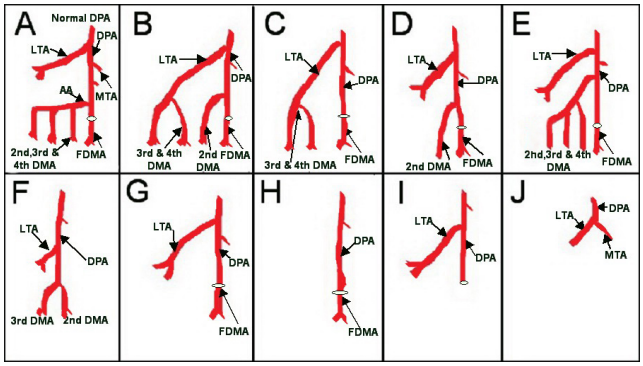


**Figure 1:** Schematic diagrams of branching patterns observed in present study.

| Branching pattern type | Cases | Percentage (%) |
|---|---|---|
| A | 44 | 73.33 |
| B | 4 | 6.66 |
| C | 3 | 5 |
| D | 2 | 3.33 |
| E | 2 | 3.33 |
| F | 1 | 1.66 |
| G | 1 | 1.66 |
| H | 1 | 1.66 |
| I | 1 | 1.66 |
| J | 1 | 1.66 |

**Table 1:** Incidence of the different branching patterns in present study.

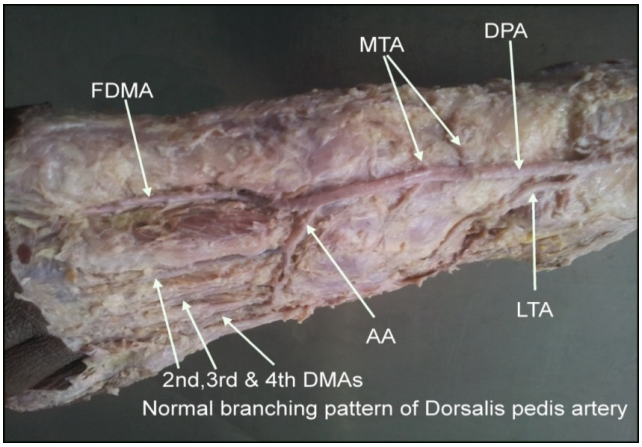


**Figure 2:** Branching Pattern: Type "A".

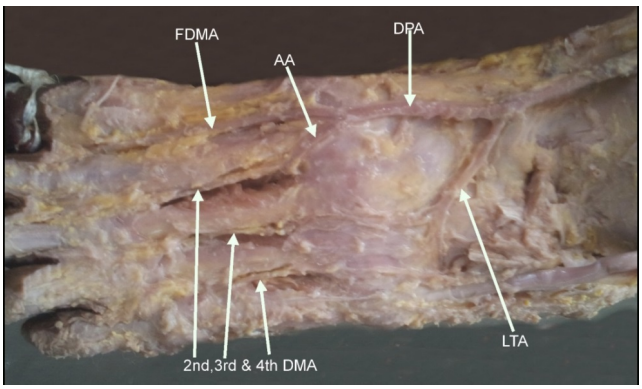


**Figure 3:** Branching Pattern: Type "B".

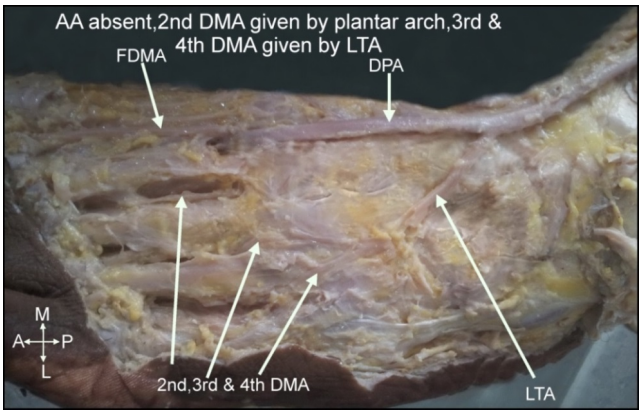


**Figure 4:** Branching Pattern: Type "C".

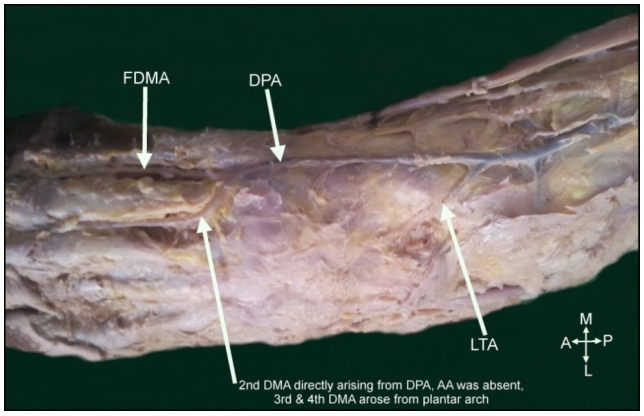


**Figure 5:** Branching pattern: Type "D".

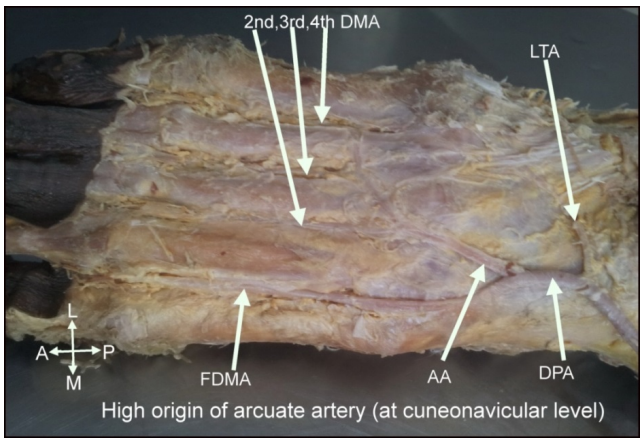


**Figure 6:** Branching pattern: Type "E".

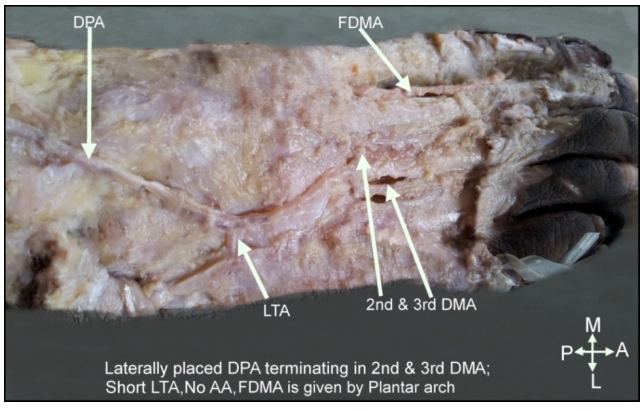


**Figure 7:** Branching pattern: Type "F".

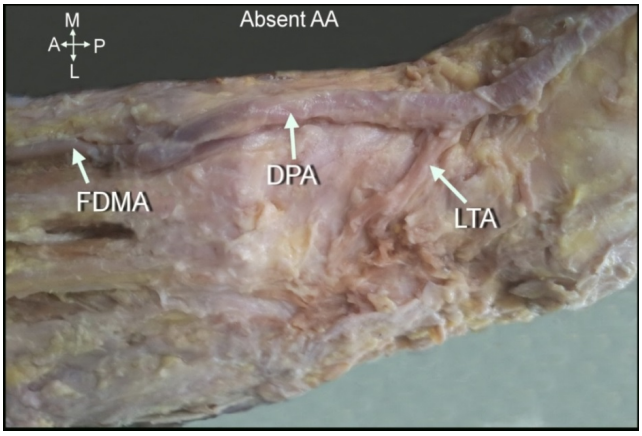


**Figure 8:** Branching pattern: Type "G".

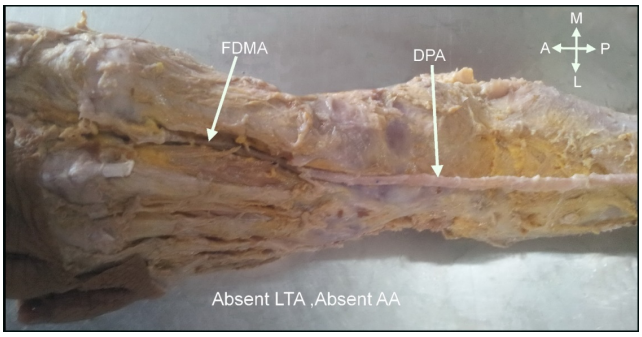


**Figure 9:** Branching pattern: Type "H".

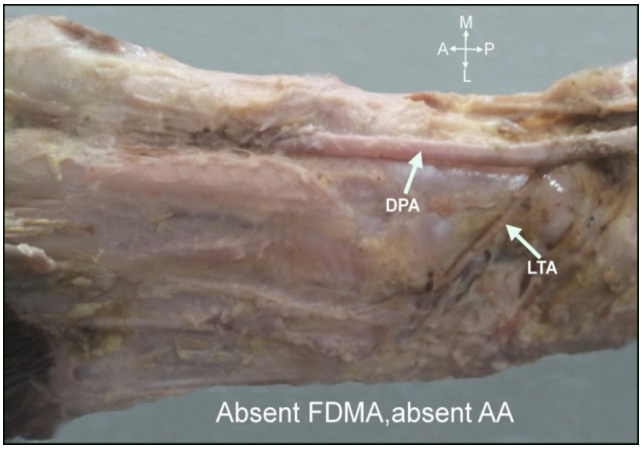


**Figure 10:** Branching pattern: Type "I".

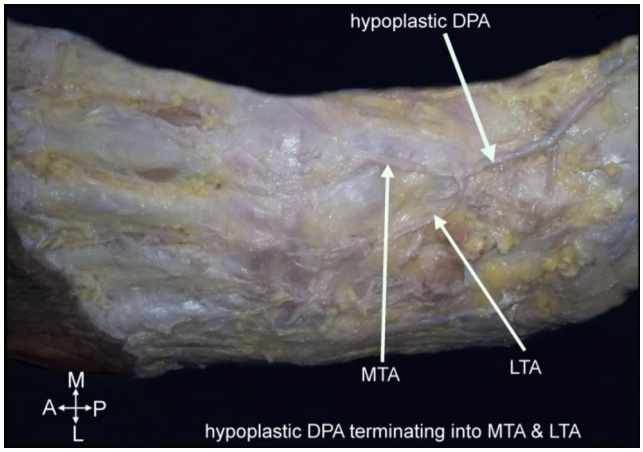


**Figure 11:** Branching Pattern: Type "J".

| Author | Normal branching pattern (%) |
|---|---|
| Vijayalakshmi et al. | 56 |
| Kaur et al. | 90 |
| Rajeshwari et al. | 54.76 |
| Present study | 73.33 |
| Ntuli et al. | 36.36 |
| Luckrajh et al. | 42.5 |

**Table 2:** Incidence of the normal branching pattern of the DPA.

| Author | Laterally deviated DPA (%) |
|---|---|
| Hamada et al. | 5 |
| EI-Saeed et al. | 5 |
| Vijayalakshmi et al. | 4 |
| Kulkarni and Ramesh | 6.06 |
| Present study | 1.66 |
| Luckrajh et al. | 25 |

**Table 3:** Incidence of the laterally deviated DPA in past studies.

## Discussion

Dorsalis pedis artery has been attracting many anatomist, foot surgeons, plastic surgeons for its important location in the foot and its blood supply to dorsum of foot.

Literature describes branching patterns of DPA which have varied explanations. No textbook mentions standard categories of different patterns except normal branching pattern. We have labeled normal pattern as type 'A', where all foresaid Branches of DPA i.e. LTA, MTA, AA & FDMA are as per standard description.

Vijayalakshmi et al. reported normal branching pattern in 56% [2], Kaur et al. in 90% [8], Rajeshwari et al. in 54.76% cases [9], Ntuli et al. in 36.36% cases [10], and Luckrajh et al. in 42.5% cases [11] (Table 2).

In the present study, percentage of normal dorsalis pedis artery was 73.33% which is not closely related to the result of any previous studies. This suggests the variability in the branching pattern of dorsalis pedis artery. However, the Percentage of the normal branching pattern was higher than percentage of the abnormal branching pattern in all the studies including the present study.

Second dorsal metatarsal artery originating from the dorsalis pedis artery was reported by Mitra et al. in one case [12], Rajeshwari et al. in 14.29% cases [9], and Awari and Vatsalaswamy 10% cases [13]. These patterns resemble Type B branching pattern. EI-Saeed et al. also reported 2nd DMA arising from DPA but they have not mentioned the prevalence of the cases [14].

High origin of Arcuate artery was reported by EI-Saeed et al. in 30% cases [14], and Kaur et al. in 1.66% cases [8]. We observed high origin of AA in 3.33% cases.

Lateral deviation of DPA was reported by Hamada et al. in 5% cases [15], Kulkarni and Ramesh in 6.06% cases [16], and Luckrajh et al. reported 25% laterally deviated dorsalis pedis arteries [11] (Table 3).

Awari and Vatsalaswamy reported 8% cases in which FDMA was absent [13], We observed 3.33% cases where FDMA was absent.

Vijayalakshmi et al. reported 8 (16%) cases where DPA run a short straight course before terminating into Lateral and Medial main trunks; medial trunk continuing as DPA and FDMA [2]. In the present study, 1 case (1.66%) had this type of pattern (type J).

Commonest abnormal branching pattern (type B and type D) had 2nd DMA emerging from DPA in 10% cases. Type "C", "D", "H" & "I" were not reported in literature.

In cases of absence of arcuate artery dorsal metatarsal arteries were supplied by lateral tarsal arteries in 7 cases (11.66%) (Type B, C) whereas in 4 cases (6.66%) (Types G, H, I, J) apart from FDMA all DMAs were given by plantar arch and in 3 cases (5%) DMAs (Type D, F) were arising from mixed sources of DPA and plantar arch. Awari PS & Vatsalaswamy P reported 10% cases where DMAs arose from mixed sources of DPA & deep plantar arch [13].

Various kinds of flaps important for distal foot reconstruction based on DMAs are still under invention. Knowledge about the anatomical variations in DMAs can also help select the artery for pedicle-based flap to repair soft tissue defects in distal third of lower extremity [17].

Knowledge of these branching patterns is essential to surgeons to minimize the risks during surgery. Presence of any of the above variations can increase the risk of injury to dorsalis pedis artery during surgery. Awareness of these variations and a careful examination before performing any procedure is advisable to prevent arterial injury [18].

Since the dorsalis pedis artery serves as an important pedicle for most of the reconstructive surgeries of the foot, the knowledge about the variation from the usual anatomic pattern of origin, branching and anastomosing patterns of the artery are of prime importance to the general surgeons, orthopaedic surgeons, plastic and reconstructive surgeons who deal with this area.

## Conclusion

The present study has shown that DPA has different branching patterns. Study reveals 4 new branching patterns not reported in history. Knowledge of branching patterns observed in this study will be of great significance for Vascular surgeons as dorsalis pedis artery is essential for flap transfers and will also help in micro vascular surgeries such as reimplantations and repairs. This study will be helpful in improving potential of limb salvage.

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## Conflict of Interest

None

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