

***Dorsalis pedis* Perforator Flap: Cadaveric Anatomical Study**

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Background: The *Dorsalis pedis* perforator flap is a thin and pliable fasciocutaneous tissue. No previous study has demonstrated the surgical anatomy among Asians.

Material and Method: Demonstrate the surgical anatomy of *Dorsalis pedis* perforator flap in 12 limbs from Thai cadavers.

Results: We found the *Dorsalis pedis* perforators in all limbs and average the distance of distal perforators was 3.25 ± 0.5 cm proximal to the metatarso-phalangeal joint. The first dorsal metatarsal artery was mainly type 1 (83.3%) while another 16.7% were type 2.

Conclusion: *Dorsalis pedis* perforator flaps were versatile with a constant surgical anatomy and acceptable donor site morbidity.

Keywords: *Dorsalis pedis* perforator flap, Anatomy, Cadaveric study

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The *Dorsalis pedis* perforator flap was proposed by McCraw et al⁽¹⁾ in 1975. It can be harvested in either a loco-regional or free flap manner. The flap is thin, pliable skin based on the perforator from the first dorsal metatarsal arterial perforator. The flap can be used to cover defects of the toes, feet, ankles⁽²⁻⁴⁾, or heel⁽⁵⁾ in loco-regional fashion and be used in many areas as using microvascular transfer (i.e., hand defects⁽⁶⁾ and intraoral defects⁽⁷⁾).

As the *Dorsalis pedis* artery reaches the first inter-metatarsal space, it dips plantarward through the interosseous muscles to join the plantar arch and gives off its terminal branch, the first dorsal metatarsal artery, to the first web space. The origin of the first dorsal metatarsal artery is the most important variable in the arterial anatomy of the flap.

In about 80% of feet, the first dorsal metatarsal artery arises superficially or just within the interosseous muscle, but in the other 20% it is given off more deeply in the inter-metatarsal space and must rise back through

the interosseous musculature to supply the web space⁽⁸⁾.

Russo et al⁽⁹⁾ studied the anatomical position of the *Dorsalis pedis* perforator in Caucasians; the average distance was 4.0 cm proximal to the metatarso-phalangeal joint. Notwithstanding, there has not been any reported study among Thais or Asians. Owing to differences in body size and feet between Caucasians and Asians, the authors set about doing an anatomical study of *Dorsalis pedis* perforator in Thai cadavers. The study was reviewed and approved by the Ethics Committee for Human Research Khon Kaen University (HE591207).

Material and Method

This study was performed at the Anatomy Laboratory at the Faculty of Medicine, Khon Kaen University, Thailand. Twelve fresh cadaveric lower limbs were included in this anatomical study (four males; two females). Systematic dissection was performed under loupe magnification (2.5x) in order to study the location of the perforator of the *Dorsalis pedis* artery. The recorded parameters included (a) the presence/absence of the perforator artery, (b) the distance from the first metatarso-phalangeal joint, and (c) type of first dorsal metatarsal artery.

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Surgical technique

Anatomical landmarks were set, and then used to facilitate flap harvest. The medial incision was made, and skin flaps elevated to expose the subcutaneous tissue. The flap was then raised over the paratenon plane to preserve tendon vascularization. The perforators from the first dorsal metatarsal artery to supply the skin flap were identified and the distance from the metatarso-phalangeal joint recorded. The flaps were elevated with the dorsal metatarsal artery. The venae comitantes and dorsal venous system were also included into the flap. The vascular pedicles were skeletonized to the extensor retinaculum for increased arch of rotation of the flaps.

Results

The origin of the perforator branch of the *Dorsalis pedis* artery was found in all limbs at an average distance of 3.25 ± 0.5 cm (range, 2.5–4.0 cm) proximal to

the metatarso-phalangeal joint (Table 1) (Fig. 2). The origin of the first dorsal metatarsal artery is variable in the arterial anatomy of the flap. In this series, we found that in about 83.3% of feet, the first dorsal metatarsal artery arose superficially or just within the interosseous muscle (type 1), but in the remaining 16.7%, it is given off more deeply in the inter-metatarsal space and must rise back through the interosseous musculature to supply the web space (type 2) (Fig. 1).

Discussion

Reconstructions of the foot, hands, and intra-oral regions can be surgically challenging because the defects need thin and pliable skin. The distal half of the foot in particular represents a difficult task because skin grafting cannot be used when deep structures are exposed or damaged and pedicle local flap are often not available. The *Dorsalis pedis* perforator flap can be used to cover defects in a loco-regional or free flap

Table 1. Anatomical results of first dorsal metatarsal artery and location of perforators

Side	Seen perforator? (yes/no)	Perforator distance form metatarso-phalangeal joint (cm)	Type of first dorsal metatarsal artery
Left	Yes	2.50	Type 2
Right	Yes	3.10	Type 1
Left	Yes	2.80	Type 1
Right	Yes	3.50	Type 2
Left	Yes	3.00	Type 1
Right	Yes	3.20	Type 1
Left	Yes	4.00	Type 1
Right	Yes	4.00	Type 1
Left	Yes	3.20	Type 1
Right	Yes	2.80	Type 1
Left	Yes	3.20	Type 1
Right	Yes	3.80	Type 1

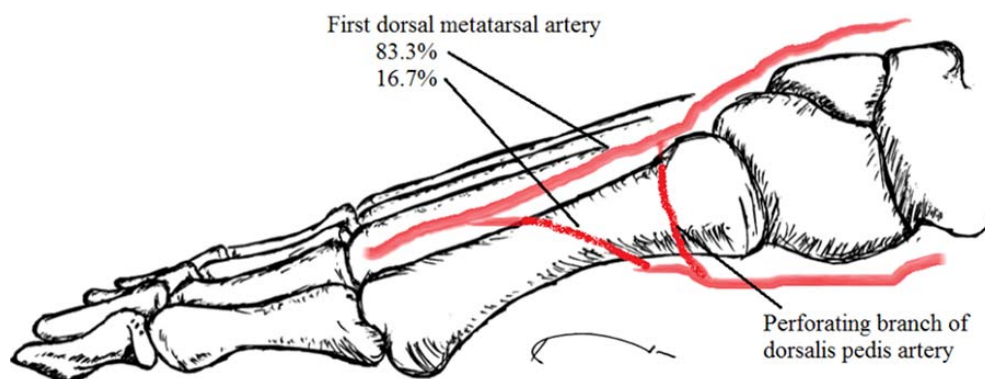


Fig. 1 Variations in the origin and course of the first dorsal metatarsal artery.

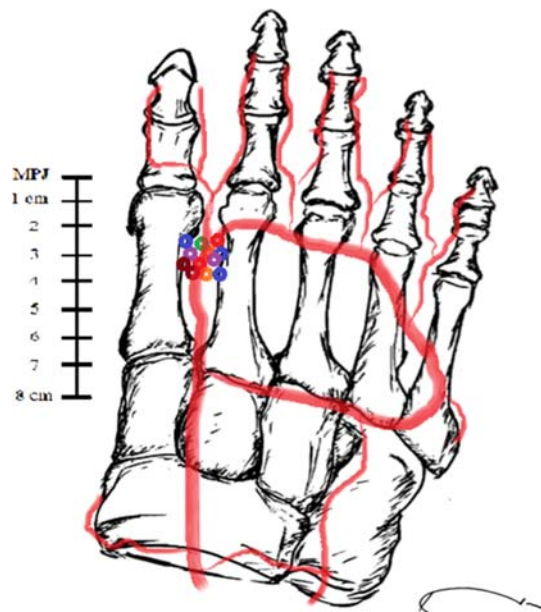


Fig. 2 Anatomical diagram: localization of perforators in anatomical study (MPJ = metatarso-phalangeal joint).

fashions, assuming acceptable donor site morbidity. It can also be designed in an antegrade or retrograde fashion⁽⁴⁾.

A careful pre-operative Doppler evaluation of the vascular axis is mandatory. The first dorsal metatarsal artery arises from the *Dorsalis pedis* artery, the terminal branch of the anterior tibial artery, and then runs to the first inter-metatarsal space or into the first interosseous muscle. McCraw⁽¹⁾ reported that in 13% of cases, the first dorsal metatarsal artery is absent from the communicating branch to plantar arterial network through the distal communicating artery.

Our study demonstrated the first dorsal metatarsal artery arises superficially or just within the interosseous muscle in 83.3% of cases (type 1), while in another 16.7%, it gives off more deeply in the inter-metatarsal space then returns through the interosseous musculature (type 2). Comparable results were reported by Strauch et al⁽⁶⁾, especially the first dorsal metatarsal artery were type 1 in 80% and type 2 in 20%.

Russo et al⁽⁹⁾ showed that among the first distal perforators of the *Dorsalis pedis* flap, the average distant was 4.0 cm proximal to the metatarso-phalangeal joint. Our anatomical studies confirmed the constant presence of a perforator distal branch of the *Dorsalis pedis* artery in 100% of the cadavers dissected. It was on average 3.25 cm proximal to the metatarso-phalangeal joint. This supports the potential use of the

distal perforator branch to supply skin flap for reconstructions of loco-regional defects or distant flap fashion. The secondary donor site defects can be covered by split thickness skin graft after preserving paratenon and periosteum during flap harvesting.

Our study demonstrates constant anatomical study of *Dorsalis pedis* perforators flap in Thai cadavers, and the anatomical landmarks can be used in Thai patients.

Conclusion

Dorsalis pedis perforator flap is versatile with constant surgical anatomy, and can be used to cover defects that need thin, pliable, composite tissue with acceptable donor site morbidity.

What is already known on this topic?

Our study demonstrates surgical anatomy of *Dorsalis pedis* perforator flap in Thai cadavers. The location of the perforator is consistent, so can be used for Thai or Asian patients.

What this study adds?

The surgical anatomy of the *Dorsalis pedis* perforator flap is relatively constant and reliable for use as coverage foot, hand, or intra-oral defects.

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Potential conflicts of interest

None.

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การศึกษากายวิภาคของคอซอลิสพีดีสแฟลปจากร่างอาจารย์ใหญ่

เก่งกาจ วินัยโกศล, ปัทมา ปัญญาวงศ, กมลวรรณ เจนวิสิฐ, พลากร สุรกุลประภา, บวรศิลป์ เชาวนจีน

ภูมิหลัง: คอซอลิสพีดีสแฟลปเป็นการนำเนื้อเยื่อที่หลังเท้ามาใช้ในการปิดบาดแผลต่าง มีข้อดีคือเนื้อเยื่อบาง สามารถนำมาใช้ปิดแผลได้ทั้งที่เท้า ข้อมือ ส้นเท้า มือ รวมไปถึงภายในช่องปาก แต่ยังไม่เคยมีการศึกษากายวิภาคในคนไทยหรือคนเอเชียมาก่อน

วัตถุประสงค์: เพื่อศึกษากายวิภาคของคอซอลิสพีดีสแฟลปในคนไทย

วัสดุและวิธีการ: ทำการศึกษากายวิภาคของคอซอลิสพีดีสแฟลปในร่างอาจารย์ใหญ่อายุ 12 ข้าง โดยบันทึกชนิดและตำแหน่งของหลอดเลือดที่มาเลี้ยงเนื้อเยื่อที่หลังเท้า

ผลการศึกษา: จากการศึกษาพบว่าทุกร่างสามารถพบหลอดเลือดที่มาเลี้ยงเนื้อเยื่อที่หลังเท้า โดยชนิดของหลอดเลือดหลังเท้าเส้นที่หนึ่ง ร้อยละ 83.3 และร้อยละ 16.7 เป็นชนิดที่ 1 และ 2 ตามลำดับ และระยะที่หลอดเลือดให้แขนงออกมาเลี้ยงเนื้อเยื่อที่หลังเท้าเฉลี่ย 3.25 ± 0.5 เซนติเมตร ส่วนต้นต่อข้อเชื่อมระหว่างกระดูกฝ่าเท้าต่อกระดูกนิ้วเท้า

สรุป: คอซอลิสพีดีสแฟลปเป็นเนื้อเยื่อเอนกประสงค์ที่สามารถใช้ปิดบาดแผลได้หลายตำแหน่งและมีกายวิภาคที่คงที่และน่าเชื่อถือ และเกิดบาดแผลทุติยภูมิที่สามารถปิดได้โดยการปะหน้า
