

**PERFORATORS OF THE FIRST DORSAL METATARSAL ARTERY
OF THE FOOT ON THE VIETNAMESE ADULT CADAVER**

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Summary

Objectives: To describe the anatomical features of the perforators of the first dorsal metatarsal artery of the foot on the normal Vietnamese adult cadaver. **Subjects and methods:** A prospective, descriptive, and cross-sectional study on 50 feet of 25 adult Vietnamese corpses preserved at the Department of Anatomy, Pham Ngoc Thach University of Medicine, from June 2018 to June 2021. **Results and conclusion:** Research of 140 transdermal branches on 50 feet. Most of them were transdermal branches 106/140 (75.71%), the rest 34/140 (24.29%) were transmuscular - skin branches. A number of perforators ~ 2.8 vessels per foot. The average perforators length was 4.92 ± 3.59 mm; the original and terminal diameters of the perforators were mainly concentrated in subgroup 2 (0.3 - 0.8 mm), accounting for 96 (68.6%) and 93 (65.7%). The distance between the penetration circuit was 12.97 ± 9.05 mm, the longest 48.12 mm, the shortest 0.62 mm; the distance between the origin of the penetrating vessel to the first metatarsal joint was 22.30 ± 14.54 mm, the longest was 59.30 mm, the shortest was 1.31 mm.

* **Keywords:** Perforators; First dorsal metatarsal artery.

INTRODUCTION

Treatment of soft tissue defects at the distal first toe of the foot is currently still difficult due to poor anatomical features and surrounding soft tissue. Previously random flaps were often limited in size and flexibility. The microsurgery free flap has a higher

complication rate, which is a difficult surgery with a long surgery time, and requires a complex surgeon and microsurgical equipment. The pedicle flap consists of the skin and subcutaneous tissue, which is nourished by perforating artery originating from the deep blood artery,

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from there passing through the muscle and muscle walls to reach the superficial area. The advantages of the pedicle flap are safety and few complications. The propeller-shaped design and the ability to rotate up to 180^o to adequately cover the lesions have provided a high degree of flexibility for the flap [0]. In order to use the first metatarsal artery perforating branch flap, the surgeons must know the path and location of the skin distribution of the first metatarsal artery perforators. However, in Vietnam, the number of patients is limited. Research is limited, especially in transverse vascular anatomy in the instep region. Therefore we performed: *Anatomical study of the perforators of the first dorsal metatarsal region of the foot.*

SUBJECTS AND METHODS

1. Subjects

50 feet of 25 adult Vietnamese corpses were preserved at the Department of Anatomy, Pham Ngoc Thach University of Medicine, from June 2018 to June 2021.

2. Methods

* *Research design:* A prospective, descriptive and cross-sectional study.

* *Method of implementation:*

Direct dissection of foot specimens has been embalmed in formalin at the

practice room of the Department of Anatomy, Pham Ngoc Thach University of Medicine. The dissection method follows the classic method, exposing the vascular pedicle to the smallest dissectable branches. The results are recorded by measuring, drawing, and taking pictures.

Dimensional kits: Ruler, palmer caliper with 0.1 mm, camera, calculator.

Statistical analyses were performed using SPSS 22.0 for Windows. Anatomical identification and marking of anatomical landmarks in the foot area.

Template pose: Legs straight, feet perpendicular to ankles.

Determine the standard curve: The line connecting the midpoint of the line connecting the medial and lateral ankles with the midpoint of the dorsal face of the third finger.

Identify the first toe joint: Press the hollow area when the first toe is flexed to determine the first toe joint and use the needle to find a joint slot.

Dissection reveals the vascular structures feeding the toes 1, 2 and measures the dimensions.

Step 1: The skin incision at the position corresponding to the target standard is the line connecting the midpoint of the line connecting the

medial and lateral ankles with the midpoint of the base of the dorsal 3rd toe. Dissect the entire layer of skin and subcutaneous fat close to the fascia of the superficial muscles of the dorsal region, carefully following the standard path from the ankle down to the middle of the 3rd toe.

During the dissection, if percutaneous artery branches are detected, stop and make a hole in the skin at the position corresponding to the exit point of that artery branch. Continue dissection until the end of the cut-off area. Use a pin to mark and fix the exact position of the percutaneous artery branches.



Figure 1: Tracking needle for perforating branch through the skin when dissecting.

Step 2: Find the dorsal artery to locate the dorsal artery, dissect it further down to evaluate the anastomosis branches, and measure the original size of the dorsal artery.

Step 3: Dissect deep down and inward, opening the window of the short extensor muscle of the thumb. Find the first dorsal metatarsal artery and the deep plantar artery. Find the presence of the first dorsal metatarsal artery, and evaluate its diameter, length, and anastomosis. Dissect to assess the number - size - length - branch angle

of the first dorsal metatarsal artery of the foot.

Measure the diameter of the first dorsal metatarsal artery at its origin as soon as it separates from the dorsal pedis artery or arcuate artery.

Measure the diameter of the dorsal artery at its origin as soon as it separates from the first dorsal metatarsal artery.

Measure the distance from the origin of the first dorsal metatarsal artery and the dorsal toe artery to the first dorsal metatarsal joint.

RESULTS AND DISCUSSION

1. Classification characteristics of the perforator

Table 1: Ratio of types of cross-circuits.

Piercing circuit type	Transdermal vessels	Transmuscular - skin vessels	Total
n	106	34	140
%	75.71%	24.29%	100%

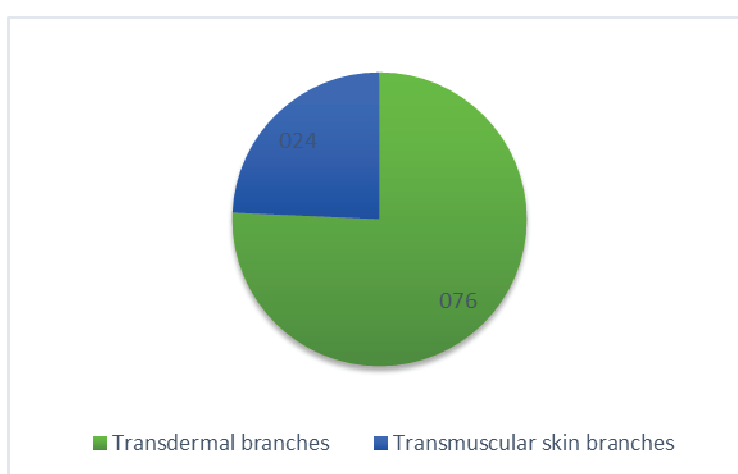


Chart 1: Percentage of types of perforating vessels from the perforating branch of the 1st metatarsal artery.

Out of the total of 140 transdermal branches, there are 106 transdermal branches, accounting for 75.71%. The rest is the transmuscular - skin type, accounting for 24.29% (34/140 branches). No transmuscular branch type (0/140 branches).

Our ratio of type and direction of transmuscular vessels will be clinically useful for the surgeon to operate flap dissection as some authors commented as follows: Lara J.A.H. as the internal

part of the muscle, the deviated vessels require more muscle dissection, the vessels passing through the fascia are more often chosen [0]. Following Alonso Burgos A., a perforating vessel perpendicular to the fascia and minimizing the muscle is considered the easiest to perform for microsurgery [0]. Following Cina A., understanding the intramuscular path of the perforating artery before surgery will help select the shortest path through the perforating artery, thereby saving surgery time [0].

2. Characteristics of the length perforators of the first dorsal metatarsal artery on the foot

Table 2: Relation of length perforators to gender.

Gender	Perforators length (mm)				p
	Value	Right	Left	Overall	
Female	$\bar{X} \pm SD$	5.45 ± 2.71	4.67 ± 5.85	5.04 ± 4.61	0.480
	Min	0.47	0.35	0.35	
	Max	12.40	36	36	
	n	33	36	69	
Male	$\bar{X} \pm SD$	4.88 ± 2.17	4.73 ± 2.28	4.80 ± 2.22	0.775
	Min	0.98	1.37	0.98	
	Max	9.98	13.30	13.30	
	n	34	37	71	
Overall	$\bar{X} \pm SD$	5.16 ± 2.45	4.69 ± 4.39	4.92 ± 3.59	
	Min	0.47	0.35	0.35	
	Max	12.4	36	36	
	n	67	71	140	
p		0.341	0.950		

The average length of the perforators is 4.92 ± 3.59 mm, the shortest is 0.35 mm and the longest is 36 mm. There was no difference in the length of the perforating branch between the sexes and between the legs.

The length of perforating branches of the first dorsal metatarsal artery on the foot represents the rotation and displacement

of the first dorsal metatarsal artery flap. Perforating branch of upper and lower extremities, according to the author Chen S. H. the upper limb branches have an average length of 31mm [0], according to the author Hwang K. the upper transliminal branches have an average length of 22 - 32 mm [0], according to Morris S., et al, the upper limb branches

have an average length of 33 mm and the lower transverse branches have an average length of 33 mm [0].

There has not been a study giving the length of the pedicle perforating the first dorsal artery to compare with ours, but according to other transverse vascular studies in the body, the 30 mm perforating pedicle ensures the maximum blood supply to the flap when rotating the propeller 180 degrees.

3. Diameter distribution of the perforating branch of the first metatarsal artery of the foot

Our study classifies the diameter of the penetrating vessel into 3 subclasses: < 0.3 mm; 0.3 - 0.8 mm; > 0.8 mm based on the microsurgery concept of Koshima 2010 [0] and reported on previously studied penetrating vessel diameters from Koshima 2019 and Alphen 2019, Yeo 2014 [0; 11].

Table 3: Classifying the diameter of the penetrating branch at the origin and at the end.

Diameter \ Subgroup	Group 1 < 0.3 mm n (%)	Group 2 0.3 - 0.8 mm n (%)	Group 3 > 0.8 mm n (%)	Total n (%)
Original diameter	28 (20)	96 (68.6%)	16 (11.4)	140 (100)
End diameter	34 (24.3)	93 (65.7)	13 (10)	140 (100)

The classification of the original and terminal diameters of the penetrating branch is mainly concentrated in subgroup 2 (0.3 - 0.8 mm), accounting for 96 (68.6%) and 93 (65.7%).

The classification of the diameter is different from that of many authors reporting on perforating branches in other regions, such as transverse vessels in the dorsal and abdominal regions. But we found that the instep has a smaller number of perforating branches and smaller vessel diameter,

and microvascular interventions in this area require microsurgery, so the above diameter classification is more appropriate, so that surgeons have more useful information to prepare for surgery. In the study of some authors, the average diameter of the upper and lower transverse branches is as follows: Chen S. H. the upper limb perforator artery has an average diameter of 0.75 mm [0], according to the author Hwang K. the upper perforator artery has an average diameter of 0.84 - 1.40 mm

[0], according to Morris S., et al the upper limb perforator artery had a mean diameter of 0.7 mm, and the lower perforator artery had a mean diameter of 0.7 mm [0].

The diameter of the upper perforator artery in this patient will actually be larger because the tissue size on the formol mummy is partially atrophied. However, it is still valuable for research reference.

4. Location of the cutaneous distribution of the perforating branch of the first metatarsal artery on the foot

Our study has determined the location of the distribution in the skin of the

perforators of the first dorsal metatarsal artery in relation to the first metatarsal joint in the cadavers.

Within a radius of 50 mm, the midpoint of the first metatarsal joint, there are 135 perforators out of a total of 140 perforators of the first dorsal metatarsal artery, accounting for 96%, of which 95 arteries have a diameter of 0.3 - 0.8 mm, accounting for 67.86%.

Thus, within a radius of 50 mm, midpoint on the first metatarsal joint, we always find at least 1 perforating branch of the first metatarsal artery, and the rate of 67.86% encountering a perforating branch with a diameter of 0.3 - 0.8 mm.

Table 4: The distance between the origin of the branch through to the first metatarsal joint and the distance between the perforating branches.

Value	Distance between the perforators (n = 90)	Distance from the origin to the first metatarsal joint (n = 140)
$\bar{X} \pm SD$ (mm)	12.97 ± 9.05	22.30 ± 14.54
Min (mm)	0.62	1.31
Max (mm)	48.12	59.30

The distance between the perforators is 12.97 ± 9.05 mm, the longest 48.12 mm, the shortest 0.62 mm; the distance from the origin of the perforators to the first metatarsal joint

is 22.30 ± 14.54 mm, the longest is 59.30 mm, the shortest is 1.31 mm.

With such information, the surgeon can easily identify the perforating branches within a radius of 20 mm

from the first metatarsal joint and trace the path of the first dorsal metatarsal artery at a distance of about 12.97 mm next pass. In addition, the distance between the perforators helps the surgeon consider the number of perforating branches as pedicles when rotating the flap.

CONCLUSION

Research of 140 transdermal branches on 50 feet, most of them are transdermal branches 106/140 (75.71%), the rest 46/140 (24.29%) are transmuscular - skin branches. A number of perforators ~ 2.8 vessels per foot. The average perforators length is 4.92 ± 3.59 mm; The original and terminal diameters of the perforators are mainly concentrated in subgroup 2 (0.3 - 0.8 mm), accounting for 96 (68.6%) and 93 (65.7%). The distance between the penetration circuit is 12.97 ± 9.05 mm; the longest 48.12 mm, the shortest 0.62 mm; the distance between the origin of the penetrating vessel to the first metatarsal joint is 22.30 ± 14.54 mm, the longest is 59.30 mm, the shortest is 1.31 mm.

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