IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 15, Issue 5 Ver. VIII (May. 2016), PP 129-133
www.iosrjournals.org

Diameter of the Dorsalis Pedis Artery and its Clinical Relevance

Zareen Ashfaque Khan, Mohammad Afzal Khan,
Faris MohammednourAltaf, Abdullah G. Alkhushi
and Wardah A. Alasmari
Department of Human AnatomyFaculty of Medicine, Umm Al Qura University, Makkah, Saudi Arabia

Abstract
Background and purpose: *Dorsalis pedis artery being the principal source of blood supply to the dorsum of the foot, its diameter is clinically important for normal growth of the foot and surgery in the area. The study was planned to observe the diameters of the artery at its origin and termination.*
Material and methods: *Dorsalis pedis artery was dissected on both sides in thirty-eight apparently normal adult male and female formalin-fixed cadavers. Diameters were recorded at the beginning and termination of the artery using digital calipers.*
Results: *Mean proximal diameter on the right and left side in the male were found to be 3.32 ± 0.91mm and 3.64 ± 0.76 mm respectively; while in the female the same were 3.10 ± 1.21 mm and 2.98 ± 0.94 mm. Values for the distal diameter in the male were 2.74 ± 0.82 mm and 2.31 ± 0.71 mm on the right and left sides; in the female, the same were 2.21 ± 0.68 mm and 2.41 ± 0.77 mm.*
Conclusion: *The study has provided useful anatomical data on the diameters of the dorsalis pedis artery that may be useful for future research and reference and bear considerable clinical significance.*
Keywords: *Dorsalis pedis artery, arteria dorsalis pedis, diameter, origin, termination, clinical relevance*

I. Introduction

Dorsalis pedis artery (DPA) is the prime source of vascular irrigation to dorsum of the foot [1]. It is the artery of peripheral vascular disease [2]. It is an easily accessible artery for assessing pedal pulsations which is a useful clinical tool when evaluating peripheral circulation [3,4]. Absence of the DPA pulsation in a child has been observed to lead to contracture and retarded growth of the foot [5]. The anatomical basis for the absence of its pulsations has been attributed to the change in the arterial branching pattern, deviant course and its small caliber [6,7].

A dorsalis pedis artery bypass is frequently used for the treatment of an ischemic foot; viability of the artery in such cases is of prime value [8]. Information on the diameter of the DPA is also germane to vascular surgeons for understanding the degree of stenosis of the artery in peripheral vascular disease while performing endovascular catheterization [9]. Awareness of the anatomical variability is also imperative for radiologists and plastic surgeons. Knowledge of the size and branching pattern of the dorsalis pedis artery is likewise important for surgeons operating on diabetic-foot ulcers using musculo-cutaneous flaps to improve blood supply and soft tissue coverage. A lack of such knowledge might complicate surgical repair and outcome [2,8.10].

The present study aimed at determining the diameters at the origin and termination of the Dorsalis pedis artery in the adult male and female cadavers.

II. Materials and Methods

The study was carried out in accordance with the institutional standards and protocols for biomedical research. Departmental permission was obtained for this purpose. It was checked from the record that the subjects had had no history of surgery or extensive disease involving the arteries or the area under study. Only apparently normal cadavers were included in the study.

Diameter of the dorsalis pedis artery was recorded externally on both right and left side, at its origin and termination in the first inter-metatarsal space on formalin-fixed adult male (n = 22) and female(n = 16) cadavers during regular course of medical students' dissection at the Department of Human Anatomy, Faculty of Medicine, Umm al Qura University, Makkah and took three years (2014-2016) to complete. Diameters of the artery were taken at the following points (Fig. 1):

- Proximal point: At the origin of the artery i.e., mid-malleolar, deep to the inferior extensor retinaculum

- Distal point: At the termination of the artery in the first (or other) intermetatarsal space where it penetrated the dorsal interosseous muscle

Figure 1: Showing the proximal point of origin (continuation of the anterior tibial artery at the inter-malleolar point) and the distal point of termination of the Dorsalis pedis artery (by piercing the interosseous muscles in the first inter-metatarsal space) where the diameters were recorded.

Diameters were recorded using a digital vernier calipers (Mitutoyo absolute 500-196-20 Digital Caliper, with ±0.001" accuracy, Mitutoyo, Japan) to the closest 0.001 mm. All measurements were taken by the same person (MAK) to avoid any bias in observations.

The course and tortuosity or any unusual pattern of branching of the artery was looked for and recorded. The data were organized and statistically analyzed. Student's t-test was used for statistical comparison at 95% confidence limit.

III. Results

The artery (DPA) was present in all cases. The mean proximal diameter on the right and left side in the male were found to be 3.32 ±0.91mm and 3.64 ± 0.76 mm, respectively; while in the female the same were 3.10 ± 1.21 mm and 2.98 ± 0.94 mm. The widest proximal diameter was 4.51 mm in a male cadaver on the left side and the smallest was 1.98 mm in a female cadaver on the left side. Values for the distal diameter in the male were 2.74 ± 0.82 mm and 2.31 ± 0.71 mm on the right and left sides; in the female, the same were 2.21 ± 0.68 mm and 2.41 ± 0.77 mm *(Table 1).*

Table 1: Showing the mean values (Mean ± SEM) of the proximal (at the origin) and distal (at or near the termination) diameters in millimeter of the Dorsalis pedis artery in male (n = 44) and female (n = 32) specimens and the significance of comparisons

	MALE (n = 44)				**FEMALE (n = 32)**			
	Proximal Diameter (Mean ± SEM) (n = 22)		**Distal Diameter (Mean ± SEM) (n = 22)**		**Proximal Diameter (Mean ± SEM) (n = 16)**		**Distal Diameter (Mean ± SEM) (n = 16)**	
Values	**Right (n = 22)**	**Left (n = 22)**	**Right (n = 22)**	**Left (n = 22)**	**Right (n = 16)**	**Left (n = 16)**	**Right (n = 16)**	**Left (n = 16)**
	3,32 ± 0.91 Maximum: 4.43 mm Minimum: 2.28 mm	3.64 ± 0.76 Maximum: 4.51 mm Minimum 2.85 mm	2.74 ± 0.82 Maximum: 3.43 mm Minimum 1.32 mm	2.31 ± 0.71 Maximum: 2,97 mm Minimum 1.19 mm	3.10 ± 1.21 Maximum: 4.36mm Minimum 2.37 mm	2.98 ± 0.94 Maximum: 4.43 mm Minimum 1.98 mm	2.21 ± 0.68 Maximum: 3.43 mm Minimum. 1.44 mm	2.41 ± 0.77 Maximum: 3.43 mm Minimum 1.75 mm
Statistical difference	a: The difference is statistically not significant, P value: 0.7886		a: The difference is statistically not significant, P value: 0.6938		a: The difference is statistically not significant, P value: 0.9381		a: The difference is statistically not significant, P value: 0.8469	

and significance	b: The difference is statistically not significant, P value: 0.8829	b: The difference is statistically not significant, P value: 0.5852	b: The difference is statistically not significant, P value: 0.6402	b: The difference is statistically not significant, P value: 0.9254	b: The difference is statistically not significant, P value: 0.8829	b: The difference is statistically not significant, P value: 0.5852	b: The difference is statistically not significant, P value: 0.6402	b: The difference is statistically not significant, P value: 0.9254

a: significance when values were compared between the right and left side within the same group at 95% confidence limit
b: significance when values were compared between the similar groups of males and females at 95% confidence limit

The proximal as well as the distal diameters, although generally larger in the male than in the female, did not show a significant difference when a student's t-test was applied at 95% confidence limit. Similarly, there was no significant difference when the right and left sides were compared in the male and female groups (Fig. 2).

We did not find any aberration of origin of DPA from the anterior tibial artery or any deviation in its usual course. Similarly, we did not observe any tortuosity of the vessel. At the termination, however, we found that the artery pierced the second interosseous muscle in two males, one on the right and one on left side (4.54 %) and in one female on the left side (3.125 %).

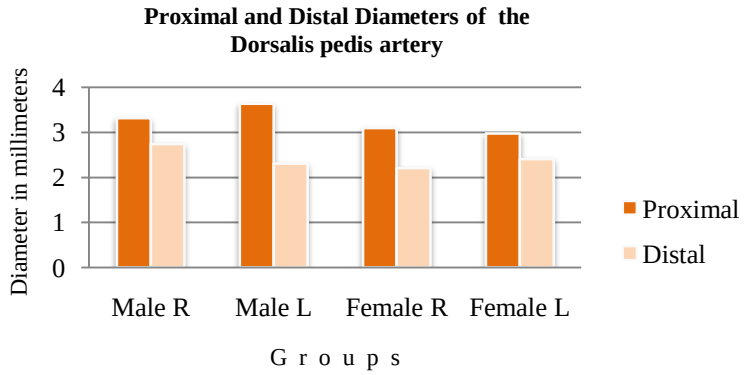

Figure 2: Showing the diameters of the Dorsalis pedis artery at the proximal and distal points in both sexes and the two sides (R= right, L=left).

IV. Discussion

In the present study, the dorsalis pedis artery was present in all cases. This is in contrast to the observations recorded by Yamada et al [11] who reported absence of DPA in 6.7%. This difference of observation may be attributed to the genetic and racial characteristics of the population.

Due to its unique arterial supply and innervation, the first inter-metatarsal space of the foot has been used to harvest various sizes and shapes of flaps in reconstructive surgery. Eo and associates [12] have described a first inter-metatarsal space free flap for reconstruction of upper and lower eyelid defect in a patient in which the first dorsal metatarsal artery was anastomosed to the frontal branch of the superficial temporal artery.

Since DPA serves as the main vascular source for the pedicles for most reconstructive surgeries in the foot or elsewhere detailed information of the origin, branching and anastomosing pattern of the vessel are of immense importance to the orthopedic, plastic and reconstructive surgeons working in this area. That precise knowledge of the donor site ensures an accurate microsurgical attachment has been emphasized by Eo and co-workers [12]. Since dorsalis pedis is the artery of irrigation to the dorsum of the foot, its diameter which reflects the possible amount of blood flow is of paramount importance in this perspective. Data on the diameter of the DPA is scantily available in the literature.

In our study the mean proximal diameter on the right and left side in the male were found to be 3.32 $\pm$ 0.91mm and 3.64 $\pm$ 0.76 mm respectively. In the female the same values were 3.10 $\pm$ 1.21 mm and 2.98 $\pm$ 0.94 mm. Values for the distal diameter in the male were 2.74 $\pm$ 0.82 mm and 2.31 $\pm$ 0.71 mm on the right and left sides; in the female, the same were 2.21 $\pm$ 0.68 mm and 2.41 $\pm$ 0.77 mm. Proximal and distal

diameters of the DPA when statistically compared for the two sides within the same gender or similar sides across the genders were not significant at 95% confidence limit.

In their cadaveric study Prigge and Briers [13] have recorded the diameter of the dorsalis pedis artery at its origin; the recorded figures are 3.29 mm ± 0.2 (mean ± SD) on the left side and 3.23mm ± 0.2 on the right side. However, it is not clear whether these figures are from male or female and of which age group; more probably these might be from a mixed group. Our values for proximal diameter in the male i.e., 3.32 $\pm$ 0.91mm on right and 3.64 $\pm$ 0.76 mm on left side are very close to the observation of Prigge and Briers [13]. Our data nonetheless is more precise in being gender and age specific.

Diameters of the DPA are relevant to the recent developments in balloon catheter technology for treating an ischemic diabetic foot allowing percutaneous trans-luminal angioplasty [2, 14]. Similarly, such precise knowledge is indispensable for surgeons working around this area such as for arthroscopy of the ankle joint or release of clubfoot [15, 16].

Blood supply to the talus bone is derived either by direct branches from the DPA close to its origin or from its lateral tarsal branch which also gives out branches to the head of the talus and anterior and lateral part of its body. Knowledge pertaining to the diameter of the vessel at its origin is therefore relevant to understanding the avascular necrosis and triple arthrodesis of the talus bone [17. 18, 19].

Limitations

- The study was carried out on formalin-fixed cadavers where the tissue may have been affected and therefore the recorded diameters may not reflect the actual values in a living population.
- External diameters of the vessel may not reflect the true consideration of the amount of blood flow to the tissue; internal diameters of the artery would be more significant.

V. Conclusion

Notwithstanding the limitations, the study has provided useful gender specific anatomical data on the diameters of the dorsalis pedis artery which may be useful for future research and reference and bears vast clinical relevance for surgical procedures.

Acknowledgements

The authors appreciate and gratefully acknowledge the useful contribution made by students of 2nd year medicine at this faculty in doing a meticulous dissection of the foot in the specimens allocated to them.

References

[1]. Sinnatamby CS. Last's Anatomy.Regional and applied.12th edition. Churchill Livingstone, Elsevier. Chapter 3, Lower limb.2011; pp 145 – 146.
[2]. Hamada N,IkutaY,Ikeda A. Arteriographic study of the arterial supply of the foot. Surgical and Radiological Anatomy.1993;15:187-92.
[3]. Mowlavi, A; Whiteman, J; Wilhelmi, BJ; Neumeister, MW; McLafferty, R. "Dorsalis pedis arterial pulse: palpation using a bony landmark". Postgraduate Medical Journal. 2002; 78 (926): 746–7.
[4]. Robertson GS; Ristic CD; Bullen BR. "The incidence of congenitally absent foot pulses". Annals of the Royal College of Surgeons of England 1990, 72 (2): 99–100.
[5]. Muir L, Labiotis N, Kutty S, Kenerman L. Absence of dorsalis pedis pulse in the parents of children with club foot. Journal of Bone joint surgery.1995; 77: 114-116.
[6]. Aithal PA, Patil J, D'Souza MR, Kumar N, Nayak BS, Guru A. Anomalous origin of dorsalis pedis artery and its clinical significance. Chrismed J Health Res 2015; 2:302-4.
[7]. Vijayalakshmi S, Raghunath G, Sheno YV. Anatomical study of Dorsalis pedis artery and its clinical correlations.J ClinDiagn Res 2011; 5:287- 90.
[8]. Pomposelli F, Maecaccio E, Gibbons G. Dorsalis pedis arterial bypass: Durable limb salvage for foot ischemia in patients with diabetes mellitus.J Vasc Surg. 1995; 21; 375.
[9]. Martin C, Saux P, Papazian L. Long-term arterial cannulation in ICU patients using the radial artery or dorsalis pedis artery. Chest 2001; 119: 901-906.
[10]. Tang YB, Chen HC. 1990. Dorsalis pedis flap with vascularized nerve graft for simultaneous reconstruction of palm and digital nerves. Br J Plast Surg. 1990; 43:494.
[11]. Yamada T, Gloviczk P, Bower TC, Naesseus JM, Carmichand SW. Variations of the arterial anatomy of foot.Am.J.Surg. 1993; 166(2):130-5.
[12]. Eo S, Kim Y, Kim JY. The versatility of the dorsalis pedis compound free flap in hand reconstruction. Ann Plast Surg. 2008; 61: 157–163.
[13]. Prigge L and Briers N.A description of the size and distal branching pattern of the dorsalis pedis artery: a cadaveric study.Anatomy Journal of Africa. 2016; Vol 5 (1): 644-64

[14]. Durham JR, Horowitz JD, Wright JG, Smead WL.Percutaneous transluminal angioplasty of tibial arteries for limb salvage in the high-risk diabetic patient.Ann Vasc Surg. 1994; 8: 48–53.
[15]. Vazquez T, Rodriguez-Niedenfuhr M, Parkin I, Viejo F, Sanudo J. Anatomic study of blood supply of the dorsum of the foot and ankle. Arthroscopy. 2006; 22: 287–290.
[16]. Jiji PJ, D'Costa S, Nayak SR, Prabhu LV, Pai MM, Vadgaonkar R, Rai R, Sugavasi R. Hypoplastic posterior tibial artery and the enlarged peroneal artery supplying the posterior crural region: A rare variation. J Vasc Bras.2008; 7: 272–274.
[17]. Mulfinger GL, Pasadena A and Trueta J.The blood supply of the talus.The Journal of Bone and Joint surgery. 1970; 52 B (1): 160-167.
[18]. Pomposelli FB, Kansal N and Hamdan AL. 2003.A decade of experience with dorsalis pedis artery bypass: Analysis of outcome in more than 1000 cases.J Vasc Surg. 2003; 37: 307-315.
[19]. De Groot IB, Reijman M, Luning, HAF and Verhaar JAN.Long-term results after a triple arthrodesis of the hindfoot: function and satisfaction in 36 patients.IntOrthop.2008 Apr; 32(2): 237–241.