

# A CASE OF PALMAR TYPE OF BILATERAL PERSISTENT MEDIAN ARTERY ARISING FROM THE ULNAR ARTERY

ULNAR ARTERDEN ÇIKAN PALMAR TİP BİLATERAL KALICI MEDYAN ARTER OLGUSU

İD RASİM HAMUTOĞLU<sup>1</sup> İD MEHMET YILDIRIM<sup>2</sup> İD ŞÜKRÜ TURAN PEŞTEMALCI<sup>2</sup> İD AHMET ERTAŞ<sup>2</sup> İD ÖZGE IRMAK DOĞANCI<sup>2</sup>

<sup>1</sup>Department of Histology and Embryology, Faculty of Medicine, Sivas Cumhuriyet University, Sivas, Turkey

<sup>2</sup>Anatomy Department, Istanbul University-Cerrahpasa, Cerrahpasa Medical Faculty, Istanbul, Turkey

## ABSTRACT

Accurate information about the arterial anatomy of the upper extremities and their common variations is essential for limb surgeons.

The persistent median artery was observed during the dissection from the forearm of the radial and ulnar arteries, which participate in the formation of the deep palmar arch. We encountered one case of bilateral the absence of superficial palmar arch, a bifid median nerve and the presence of the persistent median artery originating from the ulnar artery during dissection. The incidence of the persistent median artery in this study was 17%. It was determined that persistent median artery and ulnar artery supplied the palm on both extremities of the cadaver without forming an arch. This specimen showed a radio-mediano-ulnar type of incomplete superficial palmar arch. The ulnar artery was the dominant vessel of the palm in almost all cadavers compared to the other vessels.

Awareness of variations in the vascular pattern of the palm will be of considerable help for clinical, plastic surgeons in their reconstructive surgery because such an artery may result in complications such as carpal tunnel syndrome.

**Keywords:** Anatomy, Hand, Palmar type, Persistent median artery, Superficial palmar arch

## ÖZET

Üst ekstremitelerin arteriyel anatomisi ve yaygın varyasyonları hakkında doğru bilgi, ekstremitte cerrahları için çok önemlidir.

Kalıcı medyan arter, derin palmar arkın oluşumuna katılan radyal ve ulnar arterlerin ön koldan itibaren disseksiyonu sırasında gözlemlendi. Disseksiyon sırasında yüzeysel palmar kemerin oluşmadığı, bifid median sinirin ve ulnar arterden köken alan kalıcı medyan arterin olduğu bilateral bir olgu ile karşılaştık. Bu çalışmada, kalıcı medyan arterin insidansı %17 idi. Kalıcı medyan arter ve ulnar arterlerin, kadavranın her iki ekstremitesinde de bir kemer oluşturmadan avuç içini beslediği belirlendi. Bu örnek bir radyo-mediano-ulnar tip-tamamlanmamış yüzeysel palmar kemer oluşumunu gösterdi. Ulnar arter, diğer damarlara göre hemen hemen tüm kadavralarda avuç içi baskın damardı.

Avuç içi vasküler paternindeki varyasyonların bilinmesi, rekonstrüktif cerrahide klinik ve plastik cerrahlara önemli ölçüde yardımcı olacaktır, çünkü böyle bir arter karpal tünel sendromu gibi istenmeyen etkiler ortaya çıkabilir.

**Anahtar Kelimeler:** Anatomi, El, Palmar tip, Kalıcı medyan arter, Yüzeysel palmar kemer

## INTRODUCTION

The persistent median artery (PMA) is known as a relatively common anatomical variant and its presence should be considered for a few causes: it may give rise to some symptoms, it can supply blood to the palm in injuries of the arteries that provide blood the forearm and hand, or it can function as a graft artery (1,2).

However, superficial (SPA) and deep palmar arches (DPA) show an extra diffusiveness of vascular variation resulting from embryological development (3). The PMA plays a dominant role as the axis artery of the arm throughout the embryonal period. The PMA normally begins to lose function when ulnar (UA) and radial (RA) arteries supply blood to the hand area, but occasionally the median artery (MA) may persist permanently and consequently may supply blood to the palm (4).

Coleman and Anson (5) sorted out the SPA into two groups. Group I was divided into five subgroups. In Type A, SPA is formed by anastomosis between the superficial palmar branch of the radial artery (SPBRA) and ulnar artery

(SPBUA); in Type B, SPA is completely formed by the UA alone; in Type C, SPA consists of the MA and UA where the arch is formed by them; in Type D, SPA is formed by radio-mediano-ulnar arch, and in Type E, SPA is formed by UA and a vessel from DPA. Group II was divided into four subgroups. In Type A, there is no anastomosis between the SPBRA and SPBUA; in Type B, SPA is formed by UA; in Type C, SPA is formed by UA and MA without anastomosis; and in Type D, SPA is formed by UA, MA and RA without anastomosis.

Two patterns of MA termination were indicated by their vascular region (6). The palmar type observed in the present study attains the palm, while the antebrachial type mostly does not reach the wrist (7). The incidence of those that can reach the palm is approximately 50%, and the most common artery of origin is the common interosseous trunk (59%). The incidence of those that does not reach the palm is 70-100%, and the most frequently artery of origin is the anterior interosseous artery (55%) (6,8). Data regarding sexual dimorphism of PMA are ambiguous, however,

**Corresponding author:** Rasim Hamutoğlu, MSc, Sivas-Cumhuriyet University, Department of Histology and Embryology, Faculty of Medicine, Sivas, Turkey.

**E-mail:** rasim.hamutoglu@gmail.com

**ORCID:** <https://orcid.org/0000-0002-2474-5336>

**Received date:** 07.04.2023 **Accepted date:** 02.06.2023

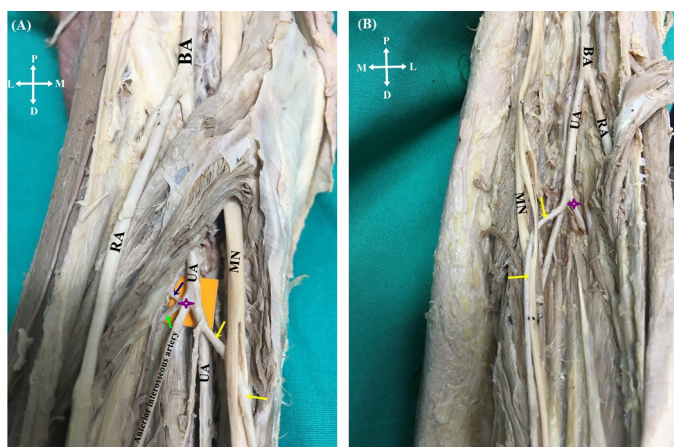
**Cite as:** Hamutoğlu R, Yıldırım M, Peştemalci ŞT, Ertaş A, Doğançlı Ö. A Case of Palmar Type of Bilateral Persistent Median Artery Arising from the Ulnar Artery. Eskisehir Med J. 2023; 4(2): 154-158. doi: 10.48176/esmj.2023.125.

Rodriguez-Niedenführ et al. (6) found to be more frequent in females.

It is vital for all medical fields to be aware of the clinical practices to be made on the forearm regarding possible changes in the anatomical structures in the palmar region (9). Lack of the awareness of the various variations in this region may highlight the difficulty of intervention in hand surgery (9). This study aims to appraise the current knowledge on the anatomy of the PMA, based on cadaveric studies. Knowing the cases proving the PMA and incomplete of radio-mediano-ulnar type of SPA (Group II, Type-D) is crucial for surgical interventions.

## CASE REPORT

The presence of PMA originating from the UA was observed bilaterally in the forearm during the dissection of the RA and UA, which contributed to the formation of the deep palmar arch. Patient consent was not obtained since the cadavers were used in this study. However, we have ethics committee approval (Cerrahpaşa Faculty of Medicine Clinical Research Ethics Committee, Date: 04.09.2015, Approval No: 02-280097). In both cases, the brachial artery (BA) terminated into the RA and UA at the cubital fossa, and the RA descended superficially in the forearm and on reaching the wrist curved dorsally and crossed the anatomical snuffbox (Figure 1). The UA, which had a thick diameter, passed under the pronator teres muscle and continued its course after giving the branch of the common interosseous artery (CIA). Then, the PMA emerged as a single branch of the UA in the proximal part of the forearm, and it was observed that the UA passed into the deep compartment of the forearm. The PMA pierced the median nerve (MN) from the posterior to anterior aspect shortly after the origin, and it proceeded to the hand area with the nerve in the forearm along with the 'vascular-nerve package' (Figure 1). After reaching the



**Figure 1.** Persistent median artery originating from the ulnar artery on the right (A) and left (B) forearms. Blue arrow muscular branches, Green arrow posterior interosseous artery, Purple asterisk common interosseous artery, Yellow arrow persistent median artery, MN median nerve, UA ulnar artery, RA radial artery, BA brachial artery.

palm, the PMA terminated by not joining the ulnar artery to form the SPA. In these cases showed an incomplete form of SPA (Group II, Type D). Two common digital arteries were given off the PMA that supply second and third digits and these branches were divided into two proper digital arteries at second and third web spaces. The UA entered the palm superficially to the flexor retinaculum together with the ulnar nerve (UN), and it gave off the deep palmar branch to contribute to the DPA after passed through the Guyon's canal. The RA gave the superficial palmar branch; however, it did not contribute to the formation of the SPA (Figure 2). The diameter of the PMA was between 1.9-2.0 mm at its termination site. The thicknesses of UA, RA and PMA were measured at the wrist, using a digital caliper (0.01 mm), while the BA, CIA, anterior interosseous artery (AIA), and posterior interosseous artery (PIA) were measured at their origin. The measurements were repeated three times to minimize the measurement error. Measurements were compared on between both sides and arteries. The UA was the dominant artery in almost all cases (Table 1).

## DISCUSSION

While the MA is normally absent during early embryological development, it was reported in the literature as a PMA (4,5). In our study, the presence of a palmar type of the PMA was present in only one case on both sides. It was determined that the PMA arose directly from the UA and continued its course with the MN in the forearm and reached to the palm. However, the PMA did not participate to the SPA. It contributed to the supplying blood of the second and third fingers after proceeding through the carpal tunnel with the MN. Coleman and Anson (5) detected mediano-ulnar and radio-mediano-ulnar types of SPA in 3.8% and 1.2% of cases, respectively. Rapotra et al. (4) also found that 7.5% of specimens exhibited a



**Figure 2.** Incomplete of superficial palmar arch formed by anastomosis between the ulnar artery (UA), superficial branch of radial artery (green arrow) and persistent median artery (PMA) on the right (A) and left (B) hands. UN ulnar nerve, MN median nerve, RA radial artery, yellow arrow deep branch of the ulnar artery.

**Table 1.** The mean diameters of ulnar, radial and, median arteries were taken at wrist level on the presence of an incomplete superficial palmar arch.

	BA (mm)	RA (mm)	UA (mm)	PMA (mm)	CIA (mm)	AIA (mm)	PIA (mm)
Right hand	3.23	2.59	2.55	1.90	2.96	1.90	1.87
Left hand	3.34	2.65	2.69	1.94	2.99	1.93	1.84

BA-Brachial artery, RA-Radial artery, UA-Ulnar artery, PMA-Persistent median artery, CIA-Common interosseous artery, AIA-Anterior interosseous artery, PIA-Posterior interosseous artery.

mediano-ulnar type of incomplete SPA formation.

The presence of a PMA is variable in the literature. The origin of the PMA was previously described as originating from UA, interosseous, RA or BA (1,7). The incidence of the palmar type of PMA has been reported to range from 1.5% to 27.2% (10). Agarwal et al. (11) noted the presence of a PMA along with the MN in 11.53% hands. Coleman and Anson (5) showed that the PMA was not terminated as the princeps pollicis (PPA) and radialis indicis arteries (RIA), although the PMA was involved in a complete palmar arch formation in 5% of the cases and contributed to an incomplete superficial arc formation in 5% of the cases. Kopuz et al. (2) determined the probability of PMA to be 20% (7 in males and 5 in females), however they pointed out that there was no substantial difference between genders ( $p > 0.05$ ). They figured out the presence of the PMA was in 4 cases bilaterally (13.3%), in 4 cases unilaterally (13.3%), and was absent in 22 cases bilaterally (73.4%) out of 30 neonatal cadavers. It was stated that eight of the MAs were arised from the UAs and four of them were originated from the CIA. They expressed that PMAs descended from the lateral side of the MN in the palmar direction of the forearm and joined the SPA to supply the digits of the hand. Kavitha et al. (8) reported the absence of SPA and the presence of the PMA. They indicated that the PMA and UA supplied the hand joining on the left upper extremity.

The PMA was observed almost symmetrically in both limbs in the present study. A unilateral variation of the PMA was found more often than a bilateral variation (6,12), however it has been reported that bilateral MAs are also present in some cases (2,13,14). Buch et al. (15) reported a unilateral presentation of an incomplete SPA. They indicated that apart from the incomplete of SPA, a PMA that originated from the UA was also observed in cadavers bilaterally, but it did not give rise to any common digital arteries even though it coursed along with the MN and entered the carpal tunnel. A study by Claassen et al. (16) observed a PMA with a greater thickness than the others in 7.4% of the cases. The PMAs emerged from the UA or the CIA. The PMA pierced the MN in one case. Henneberg and George (1) noticed that the PMA occurred mostly bilaterally. For this reason, the bilateral occurrence of the PMA in hands is common, whether the variation is

symmetrical or not (12).

The presence of the PMA may cause clinical complications leading to compression of the MN and various syndromes (17). Saenz et al. (18) showed that 60% of PMA penetrated MN in their study on 60 cadavers. They also stated that all PMAs originating from the UA pierced the MN in all cases, and it was more likely to separate the MN. Rodriguez-Niedenführ et al. (6) stated in their study that all PMAs that pierced the MN were of the palmar type, however Saenz et al. (18) noted that both palmar and antebrachial type PMAs pierced the MN in the forearm in cadaver populations. It is believed that penetration of the MN by the PMA causes compression of the MN and affects nerve transmission speed. Clinicians should become aware of these unusual conditions during surgery and should check patients for the presence of such an anatomical variations prior to surgery.

The outer diameter of the PMAs is important, especially in the carpal tunnel. The external diameter of the PMA was determined between 1.5 and 2.0 mm. When the PMA becomes too large, it might affect the conduction velocity in the MN and cause various discomforts. (10,14,19). Gassner et al. (20) observed a 3.0 mm thick PMA. Nayak et al. (7) observed the occurrence of the PMA. They found that the PMA was found in 15.4%, and of this 3.5 %, the PMA did not make up part of the SPA. They also observed that the thickness of the PMAs determined between 0.8 and 2.6 mm. In our study, the PMA varied between 1.9 and 2.0 mm.

## CONCLUSION

Our study represents an infrequent variation of the PMA that originated directly from the UA and reached the hand with the MN. It pierced the MN from the posterior to anterior aspect shortly after the origin and it did not participate to the SPA. The RA gave off the superficial palmar branch, however, it also did not contribute to the SPA. Therefore, the incomplete SPA was made of the PMA, UA, and RA.

Understanding the variations of the arterial network and hand is useful for surgical reconstruction procedures. Knowledge of palm vascular patterns is very important in microsurgical hand procedures and in preventing possible undesirable situations during amputations. Determining the occurrence of the PMA and its involvement in arch



completion is crucial for RA or UA ligation in case of vascular trauma. Moreover, it is of great importance in terms of various surgical interventions at hand that Doppler ultrasonography, photoplethysmography, and oximetric techniques are used to determine any changes in the arterial structure of the hand from the early fetal stage, as well as the complete or incomplete arch formation. It is also very important to avoid any possible complications during both open and endoscopic carpal tunnel surgery and to be aware of the variations of PMA present to prevent injury. A thorough physical examination, especially palpation of the RA and UA, is mandatory. Scientific development encourages researchers to increase knowledge in any medical field. One of these is hand surgery, and it requires more detailed information on the complex anatomical structures of the hand and upper extremity every day to fulfill the need to verify the validity of various surgical procedures in practice and to make new definitions. Anatomical studies of the palmar region are needed in more detail to eliminate the lack of information in the literature.

**Acknowledgments:** We would like to express our intimate gratitude to those who donated their bodies to science for the furthering of understanding and treatment of the living.

**Ethics Committee Approval:** The present study was approved by the Cerrahpaşa Faculty of Medicine Clinical Research Ethics Committee (Date: 04.09.2015, Approval No: 02-280097) and conducted in accordance with the ethical standards of the Helsinki Declaration of 1964.

**Informed Consent:** Patient consent was not obtained since the cadavers were used in this study.

**Authorship Contributions:** Idea/Concept: MY, ŞTP, Design: MY, ŞTP, Supervision: MY, ŞTP, Data Collection or Processing: MY, ŞTP, RH, AE, ÖID, Analysis or Interpretation: MY, ŞTP, RH, Literature Search: RH, AE, ÖID, Writing: MY, ŞTP, RH, Critical Review: MY, ŞTP, RH, AE, ÖID, References And Fundings: -, Materials: -.

**Conflict of Interest:** No conflict of interest was declared by the authors.

**Financial Disclosure:** The authors declare that they have no relevant financial.

## REFERENCES

- 1.Henneberg M, George BJ. A further study of the high incidence of the median artery of the forearm in Southern Africa. *J Anat.* 1992;181:151–4.
- 2.Kopuz C, Baris S, Gulman B. A further morphological study of the persistent median artery in neonatal cadavers.

- Surg Radiol Anat.* 1997;19:403–6.
- 3.Singh S, Lazarus L, De-Gama BZ, Satyapal KS. An anatomical investigation of the superficial and deep palmar arches. *Folia Morphol. (Warsz)* 2017;76:219–25.
- 4.Rapotra M, Sharma A, Sharma M, Singh R. Absence of Superficial Palmar Arch with Persistent Median Artery - A Study. *Int J Sci Study.* 2017;5:130–3.
- 5.Coleman S, Anson J. Arterial pattern in handbased upon a study of 650 specimens. *Surg Gynecol Obstet.* 1961;113:409–24.
- 6.Rodríguez-Niedenführ M, Sañudo JR, Vázquez T, Nearn L, Logan B, Parkin I. Median artery revisited. *J Anat.* 1999;195:57–63.
- 7.Nayak SR, Krishnamurthy A, Kumar SM, et al. Palmar type of median artery as a source of superficial palmar arch: A cadaveric study with its clinical significance. *Hand (N Y)* 2010;5:31–6.
- 8.Kavitha K, Sushma, D'Souza P, Kumar V. Absence of superficial palmar arch with persistent median artery - a case report. *NUJHS.* 2014;4:109–11.
- 9.Olave E, Prates JC. Deep palmar arch pattern in Brazilian individuals. *Surg Radiol Anat.* 1999;21:267–71.
- 10.Haladaj R, Wysiadecki G, Dudkiewicz Z, Polguy M, Topol M. Persistent Median Artery as an Unusual Finding in the Carpal Tunnel: Its Contribution to the Blood Supply of the Hand and Clinical Significance. *Med Sci Monit.* 2019;25:32–9.
- 11.Agarwal P, Gupta S, Yadav P, Sharma D. Cadaveric study of anatomical variations of the median nerve and persistent median artery at wrist. *Indian J Plast Surg.* 2014;7:95–101.
- 12.Tsuruo Y, Ueyama T, Ito T, et al. Persistent median artery in the hand: A report with a brief review of the literature. *Anat Sci Int.* 2006;81:242–52.
- 13.Kumar MR. Multiple Arterial Variations in the Upper Limb of a South Indian Female Cadaver. *Clin Anat.* 2004;17:233–5.
- 14.Feintisch AM, Ayyala HS, Datiashvili R. An Anatomic Variant of Persistent Median Artery in Association with Carpal Tunnel Syndrome: Case Report and Review of the Literature. *J Hand Surg.* 2017;22:523–5.
- 15.Buch C, Devora CM, Johnson LY, Rahimi OB, Kar R. Incomplete superficial palmar arch and bilateral persistent median artery. *Int J Surg Case Reports* 2019;58:205–7.
- 16.Claassen H, Schmitt O, Wree A. Large patent median arteries and their relation to the superficial palmar arch with respect to history, size consideration and clinic consequences. *Surg Radiol Anat.* 2008;30:57–63.
- 17.Jones NF, Ming NL. Persistent median artery as a cause of pronator syndrome. *J Hand Surg.* 1988;13:728–32.
- 18.Saenz C, Rahimi OB, Kar R. Cadaveric study of division of the median nerve by the persistent median artery. *Surg Radiol Anat.* 2022;44:1455–60.

- 19.Raviprasanna KH, Dakshayani KR. Persistent median artery in the carpal tunnel. Int J Anat Res. 2014;2:589–93.
- 20.Gassner EM, Schocke M, Peer S, Schwabegger A, Jaschke W, Bodner G. Persistent median artery in the carpal tunnel: color Doppler ultrasonographic findings. J Ultrasound Med. 2002;21:455–61.



This work is licensed under a [Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License](https://creativecommons.org/licenses/by-nc-nd/4.0/).