

# Absence of Superficial Palmar Arch with Persistent Median Artery - A Study

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## Abstract

**Background:** Knowledge of the variations in the arterial supply of hand has reached a point of practical importance with the advent of microvascular surgery for revascularization, replantation, and composite tissue transfers. Superficial palmar arch (SPA) has many interesting variations, of them, the median artery (MA) contribution is been evaluated in this study.

**Materials and Methods:** Present study was conducted on 40 adults upper limbs of unknown sex. All the specimens were obtained from the Anatomy Departments of Government Medical College and Hospital, Chandigarh, India.

**Results:** In this study, 7.5% of specimens showed median-ulnar type of incomplete SPA.

**Conclusion:** The clinical importance of the persistence of this artery at wrist level is well documented as a cause of the carpal tunnel syndrome but it has also been associated with the "pronator teres syndrome" in cases where the persistent MA pierces the median nerve in the proximal third of the forearm.

**Key words:** Median artery, Median nerve, Superficial palmar arch, Ulnar artery

## INTRODUCTION

Superficial palmar arch (SPA) is an important arterial anastomotic arcade which is the dominant vascular supply to the majority of the palmar muscles. The high prevalence of variations of SPA makes it an interesting as well as challenging area of study.<sup>1</sup> It is principally formed by the ulnar artery (UA), completed on the lateral side by the superficial branch of radial artery (RA) or arteria princeps pollicis (APP) or arteria radialis indicis (ARI) from RA or median artery (MA) accompanying the median nerve.<sup>2</sup>

The MA is normally a transitory vessel, which develops from the axial artery of the upper extremity during early embryonic life. It maintains the superficial palmar arch (SPA) while the ulnar and radial arteries are developing.<sup>3</sup>

When the ulnar and radial arteries develop, the MA usually involutes and does not persist in the post-fetal life.<sup>4</sup> The MA may persist in adult life in two different patterns, palmar and antebrachial, based on their extent of supply. The SPA formed by the contribution of the MA is of two types, complete and incomplete arch. In the complete type, arch is formed by the contribution of ulnar and MA. In incomplete type, no arch is formed but ulnar and median arteries individually supply the respected areas of the hand.<sup>5</sup>

The origin of the MA in adults has been previously described as arising from the ulnar, interosseous, radial or brachial arteries.<sup>6,7</sup> According to Huelin, Barreiro and Barcia, two patterns of MA termination have been described based on their vascular territory.

1. The palmar type or embryonal type also shows two variants:
  - a. Long type, which ends in the SPA through small arterioles or supplying small vessels to the subcutaneous cellular tissue; before reaches the end; the MA sends branches which anastomose with the ulnar and radial arteries at the carpus level.
  - b. The second variant is digital type. In this type, MA does not contribute in the formation of SPA but

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supply the hand by giving common and proper palmar digital branches.

2. The antebrachial type, which represents a partial regression of the embryonic artery is slender, short and terminates before reaching the wrist. Antebrachial type also shows two variants:
  - a. Atrophic type-(termination of MA in the upper third of forearm in 74%).
  - b. Carpal type-(termination of the MA in distal third of the forearm in 26%).<sup>8</sup>

In this study, the palmar type of MA is highlighted for its significance in contributing the arterial supply to the hand. Knowledge of the variations in the arterial supply of hand is essential in advent of microvascular surgery for revascularization, replantation, and composite tissue transfers. Recent improvements in microsurgical techniques have increased the necessity of better understanding of the vascular pattern of the hand.<sup>9</sup>

Many variations have been reported, but the focus of this study is to record involvement of MA in the formation of SPA. The objective of this study was to evaluate the arterial variations, with special attention to the MA forming the SPA and its major branches.

### Aim

The objective of this study was to evaluate the arterial variations, with special attention to the contribution of SPA by MA.

## MATERIALS AND METHODS

A total of 40 adults upper limbs embalmed with formaldehyde comprising 20 right, 20 left. Detached limbs were used for the study, and their sex identity could not be determined. Sex variation was therefore not considered. All the specimens were obtained from the Anatomy Departments of Government Medical College and Hospital, Chandigarh, India.

The hands were dissected by first removing the skin covering the flexor surface of the hand with a slight extension proximal to the wrist joint and then distally in the palm to the bases of the digits. The forearms were carefully dissected and observed for the presence of the MA. When there was an MA observed, it was carefully dissected from its origin to its termination. The origin of MA and its relation with the MN was studied in detail. The external diameters of the MA were measured at the distal rim of the flexor retinaculum by a caliper, to a precision of 0.02 mm. The palmar aponeurosis was removed together with the palmaris longus where present, to show the SPA. Branches of median and ulnar arteries were equally exposed. The different superficial arterial arch patterns observed were

illustrated as well as digitally photographed. The frequency of each pattern was expressed as percentage.

## RESULT

Careful dissection of the upper extremities revealed the presence of persistent MA in 3 out of 40 upper limbs (7.5%) and its relation to MN are also noted. We found it two times on the right and one time on the left, respectively. A detailed description of each case is as follows:

### Case 1

In one case on the left hand, the MA did not makeup part of the SPA, it supplies separately the middle, index and thumb through a common palmar digital artery, ARI and APP. UA also supplies the medial half of the hand by common palmar digital and proper palmar digital arteries. The diameter of the MA is less, i.e., 1.51 mm as compared to the UA (2.95 mm). The superficial branch of RA was absent in this case (Figure 1).

### Case 2

In another case, on the right hand, MA entering into the palm by running parallel to the UA. The MA terminates by giving a common palmar digital artery, ARI, and APP. On the other side, UA gives two common palmar digital and one proper palmar digital artery (Figure 2). The caliber of the MA measured to be 1.56 mm which is less than the UA, i.e., 2.37 mm.

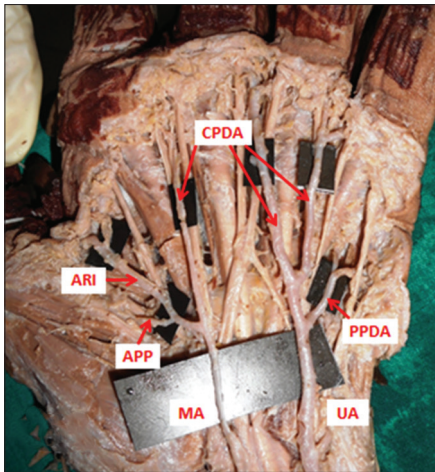
### Case 3

In this case on the right hand, MA supplies the lateral 2<sup>1/2</sup> of the digits. MA gives common palmar digital branch, ARI, and APP. UA also supplies medial 2<sup>1/2</sup> of the digits by giving two common palmar digital branches (Figure 3). UA is tortuous in nature. MA was measured to be of 1.55 mm diameter which is less than the diameter of the UA (2.10 mm).

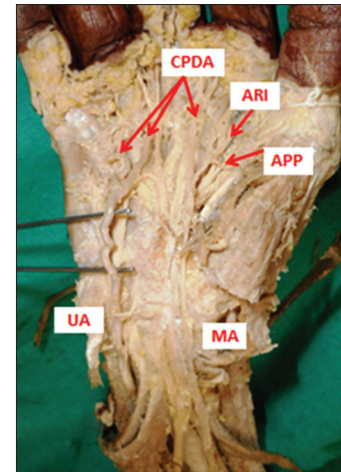
In all the three cases, we observed a different arterial pattern in the forearm. Brachial artery was dividing into three branches in the cubital fossa, namely, radial, ulnar, and median arteries (Figure 4). The MA coursed distally to lie alongside the median nerve in the upper third of the forearm and then continued its distal course between the anterior surface of the median nerve and the deep surface of flexor digitorum superficialis.

### Embryology

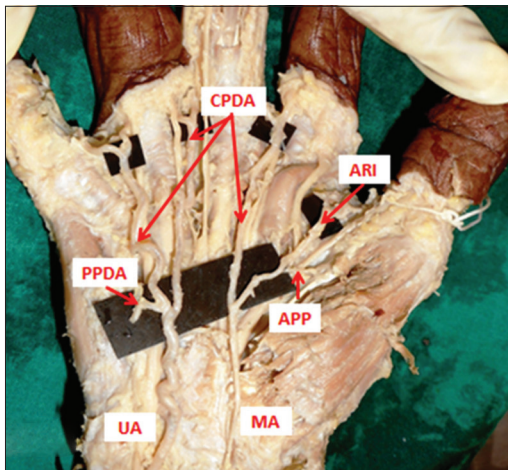
The vascular plexuses of the limb buds are initially supplied by four or five consecutive intersegment branches of the dorsal aortae at the levels at which the limb-buds are situated. Very early, however, the lateral branch of the seventh cervical and branches of the fifth lumbar intersegmental arteries become much enlarged to form



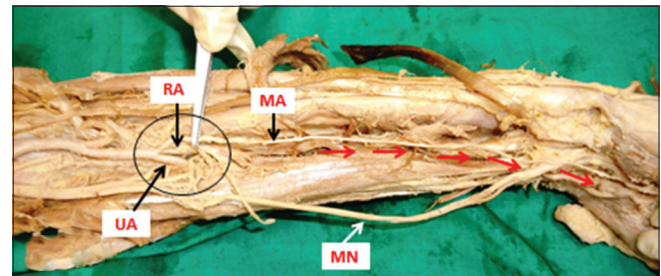
**Figure 1:** Incomplete superficial arch in which the ulnar and median arteries are equally dominant but with no communication. UA: Ulnar artery, RA: Radial artery, APP: Arteria princeps pollicis, ARI: Arteria radialis indicis, CPDA: Common palmar digital arteries, PPDA: Proper palmar digital artery



**Figure 3:** Right hand supplied by ulnar and median artery without forming an palmar arch. UA: Ulnar artery, RA: Radial artery, APP: Arteria princeps pollicis, ARI: Arteria radialis indicis, CPDA: Common palmar digital arteries, PPDA: Proper palmar digital artery



**Figure 2:** Incomplete superficial palmar arch formed by median and ulnar artery on the right hand side. UA: Ulnar artery, RA: Radial artery, APP: Arteria princeps pollicis, ARI: Arteria radialis indicis, CPDA: Common palmar digital arteries, PPDA: Proper palmar digital artery



**Figure 4:** The origin and course of the median artery in the forearm. Also showing the relation with the median nerve. UA: Ulnar artery, RA: Radial artery, APP: Arteria princeps pollicis, ARI: Arteria radialis indicis, CPDA: Common palmar digital arteries, PPDA: Proper palmar digital artery

the axial arteries of the upper and lower limb, respectively. In the upper limbs, this axial artery terminates in a capillary plexus from which later, digital branches arise. The proximal part of the artery can be recognized as the brachial artery; its distal portion is the interosseous artery. By 6<sup>th</sup> week, UA is apparent and branches from brachial artery progressing down the hand plate to form the deep palmar arch. The RA develops later and is more variable progressing down the preaxial side of the limb. Eventually, median and interosseous arteries decrease in size, and MA degenerates, providing only some blood supply to median nerve the small vestige of interosseous artery terminates in many small branches (rete system). The anomalies of blood vessels may be due to the choice of unusual paths in the primitive vascular plexuses, the persistence of vessels

normally retained, incomplete development or fusion and absorption of parts usually distinct.<sup>10</sup>

## DISCUSSION

The vascular anatomy of the upper limb is a complex and challenging area and has been the subject of many studies. Jaschtschinski studied the SPA in 200 subjects and concluded the median-ulnar in 3%.<sup>11</sup> Coleman and Anson observed median-ulnar and radial-median-ulnar types of SPA in 3.8% and 1.2% of subjects, respectively.<sup>12</sup> Al-Turk and Metcalf found the same type of SPA in 4% and 2% of hands, respectively, by using the Doppler ultrasonic flow meter.<sup>13</sup> Ikeda *et al.* observed median-ulnar type only in 0.9% of subjects.<sup>14</sup> Loukas *et al.* dissected 200 hands; they found the median-ulnar type in 15%, Adachi (1928; quoted by Keen) reported in 9%, Moraes *et al.* reported occurrence in 13.3%, Olave *et al.* observed the MA of the forearm without anastomosis in 6.7% subjects, and Moraes *et al.* coated in 3.3% subjects.<sup>15-18</sup> In this study, we observed



the above rare variant of SPA of ulnar–median type in 7.5% subjects ( $n = 3/40$ ).

The origin of MA has previously been described as arising from the common interosseous artery, anterior interosseous artery, and ulnar arteries frequently but it can also arise from the brachial artery, superficial brachial artery, and deep brachial artery.<sup>19</sup> According to Varley *et al.* when the MA arise from the RA, it may increase the risk of hand ischemia if the RA is sacrificed during harvesting.<sup>20</sup> In this study, we encounter the MA taking origin from the brachial artery in all the cases.

The external diameter of a persistent MA is important, especially in the carpal tunnel. According to Barfred *et al.*, the MA with an external diameter of more than 2.0 mm can cause MN compression. They operated 239 patients with carpal tunnel syndrome (CTS) and found the MA of considerable caliber in 4% cases.<sup>21</sup> Gassner *et al.* found two MA with a diameter of 3.00 mm, Libersa *et al.* reported diameter ranging from 0.5 to 2.7 mm, Nayak *et al.* observed diameter of the MA between 0.8 and 2.6 mm.<sup>19,22,23</sup> In this study, we obtained the diameter ranging from 1.51 to 1.56 mm. The MA can increase in the caliber due to thrombosis, aneurysm, calcification, or congenital regions, which may lead to CTS.<sup>21</sup>

Nayak *et al.* analyzed the course of the MA in relation with the MN, they observed three distinct pattern: (a) The MA was lateral to the MN in the forearm, (b) the MA crossed the MN when the artery splitted the nerve in the forearm, and (c) the MA was anterior to the MN in the carpal tunnel.<sup>19</sup> In the current study, we noticed the MA running lateral to the median nerve in the forearm and while entering into the palm it crosses the median nerve anteriorly. The above details should be taken into consideration while approaching the forearm and hand for various surgical procedures as both the MA and the MN are in close proximity with each other throughout the forearm and hand.

## CONCLUSION

This study highlights a palmar type of digital variety of MA in the 3 cases, so this study has provided details about one of the variants of SPA in humans. In this three cases, no superficial palmar arch is formed but ulnar and median arteries individually supply the respected areas of the hand. The knowledge of median–ulnar pattern of superficial palmar arch helps in accurate planning and better performance of surgical procedures in the forearm. Association of a persistent MA with the median nerve

should be considered in the evaluation of all patients with carpal tunnel syndrome, pronator teres syndrome, and anterior interosseous syndrome.<sup>24</sup>

## REFERENCES

- Gajisin S, Zbrodowski A. Local vascular contribution of the superficial palmar arch. *Acta Anat (Basel)* 1993;147:248-51.
- 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.
- Williams PL. *Gray's Anatomy*. Vol. 38. New York: Churchill Livingstone; 1995. p. 319, 1542.
- Jones NF, Ming NL. Persistent median artery as a cause of pronator syndrome. *J Hand Surg Am* 1988;13:728-32.
- Standring S, Ellis H, Healy JC, Johnson D, Williams A. *Gray's Anatomy*. 39<sup>th</sup> ed. Edinburgh: Churchill Livingstone; 2005. p. 929.
- Quain R. *The Anatomy of Arteries of Human Body*. London: Longmans, Green and Co.; 1884. p. 235-71.
- Henneberg M, George BJ. High incidence of the median artery of the forearm in a sample of recent southern African cadavers. *J Anat* 1992;180:185-8.
- Rodríguez-Baeza A, Nebot J, Ferreira B, Reina F, Pérez J, Sañudo JR, *et al.* An anatomical study and ontogenetic explanation of 23 cases with variations in the main pattern of the human brachio-antebrachial arteries. *J Anat* 1995;187:473-9.
- Johnson WH, Cromartie RS, Arrants JE, Wuamett JD, Holt JB. Simplified method for candidate selection for radial artery harvesting. *Ann Thorac Surg* 1998;65:1167.
- Arey LB. *Developmental Anatomy*. 6<sup>th</sup> ed. Philadelphia, PA: W.B. Saunders's Co.; 1957. p. 375-7.
- Jaschtschinski SN. Morphology and topography of human Arcus volaris sublimis and profundus of man. *Anat Hefte* 1897;7:161-88.
- Coleman SS, Anson BJ. Arterial patterns in the hand based upon a study of 650 specimens. *Surg Gynecol Obstet* 1961;113:409-24.
- Al-Turk M, Metcalf WK. A study of the superficial palmar arteries using the doppler ultrasonic flowmeter. *J Anat* 1984;138:27-32.
- Ikeda A, Ugawa A, Kazihara Y, Hamada N. Arterial patterns in the hand based on three-dimensional analysis of 220 cadaver hands. *J Hand Surg Am* 1988;13:501-9.
- Loukas M, Holdman D, Holdman S. Anatomical variations of the superficial and deep palmar arches. *Folia Morphol (Warsz)* 2005;64:78-83.
- Keen JA. A study of the arterial variations in the limbs, with special reference to symmetry of vascular patterns. *Am J Anat* 1961;108:245-61.
- Moraes SR, Araújo TN, Silva AR, Paula AR, Salgado JL. Morphologic variations of the superficial palmar arc. *Acta Cir Bras* 2003;18:183-8.
- Olave E, Prates JC, Mandiola E, Del Sol Calderón M, Gabrielli C, *et al.* Formaciones arteriales superficiales de la palma de la mano. *Rev Chil Anat* 1993;11:35-40.
- Nayak SR, Krishnamurthy A, Kumar SM, Prabhu LV, Potu BK, D'Costa S, *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.
- Varley I, Wales CJ, Carter LM. The median artery: Its potential implications for the radial forearm flap. *J Plast Reconstr Aesthet Surg* 2008;61:693-5.
- Barfred T, Højlund AP, Bertheussen K. Median artery in carpal tunnel syndrome. *J Hand Surg Am* 1985;10:864-7.
- 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.
- Libersa C, Francke JP, Mauppin JM, Bailleul JP, Gamblin P. The arterial supply to the palm of the hand (arteriae palmar manus). *Anat Clin* 1982;4:33-45.
- Kavitha K, Sushma, D'Souza P, Kumar V. Absence of superficial palmar arch with persistent median artery - A case report. *Nitte Univ J Health Sci* 2014;4:109-11.

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