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## Case Report

# Bilateral palmar type of persistent median artery: A case report

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### ABSTRACT

The persistent median artery (PMA) is an example of a supernumerary artery in the forearm. During embryonic development, the median artery regresses as the ulnar and radial arteries take over the blood supply of the forearm. Non-regression of the median artery will lead to its persistence into adulthood. We are reporting a bilateral presence of a palmar type of PMA, which was a branch of the ulnar artery, and the PMA passed through the carpal tunnel to supply the hand. On the right side, PMA pierced the median nerve in the upper forearm. In the palm, PMA did not form the superficial palmar arch. However, a communicating twig between the PMA and ulnar artery was observed on the left side. The presence of PMA could cause compression of the median nerve, leading to carpal tunnel syndrome. PMA of larger calibre could be used as a graft and in harvesting reconstructive free flap. Knowledge about these vascular variations is important in diagnosing nerve compression syndromes and avoiding unanticipated surgical complications.

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## 1. Introduction

Variations in arterial patterns of the upper limb could be in the form of atypical origin, course, branching patterns, or supernumerary arteries. The persistent median artery (PMA) is an example of a supernumerary artery in the forearm. The median artery is a part of the axial artery of the upper limb, which regresses during the second month of embryonic life when definitive radial and ulnar arteries are formed. Non-regression of the median artery during the embryonic period will lead to its persistence into adulthood. PMA can be of two types: a) Antebrachial type, which terminates in the forearm, and b) Palmar type, which extends into the hand and supplies it.<sup>1,2</sup>

The antebrachial type, with an incidence of 76%, typically originates from the anterior interosseous artery and terminates within the forearm into the median nerve

sheath. This type is considered a normal pattern. However, if the median artery persists and extends into the palm, it is identified as the palmar type. Therefore, "persistent median artery" usually refers to the palmar type.<sup>1,2</sup> The prevalence of the palmar type may vary from 1.5% to 60%, differing among different geographical populations.<sup>1,3</sup> The common site of origin of the palmar-type PMA is from the angle between the common interosseous and ulnar artery, followed by the ulnar artery, and rarely from the common interosseous artery. The median nerve pierced by the palmar-type PMA has also been reported.<sup>2</sup>

Based on the calibre and the dominance of the arterial supply of the hand, the PMA could be used as a reconstructive flap.<sup>4</sup> The presence of PMA may cause compression of the median, which can lead to carpal tunnel syndrome. PMA has also been linked to the anterior interosseous nerve and pronator syndromes. Due to the lack of space in the carpal tunnel, PMA could be affected by thrombosis, calcification, or atherosclerosis.<sup>5</sup> A case of

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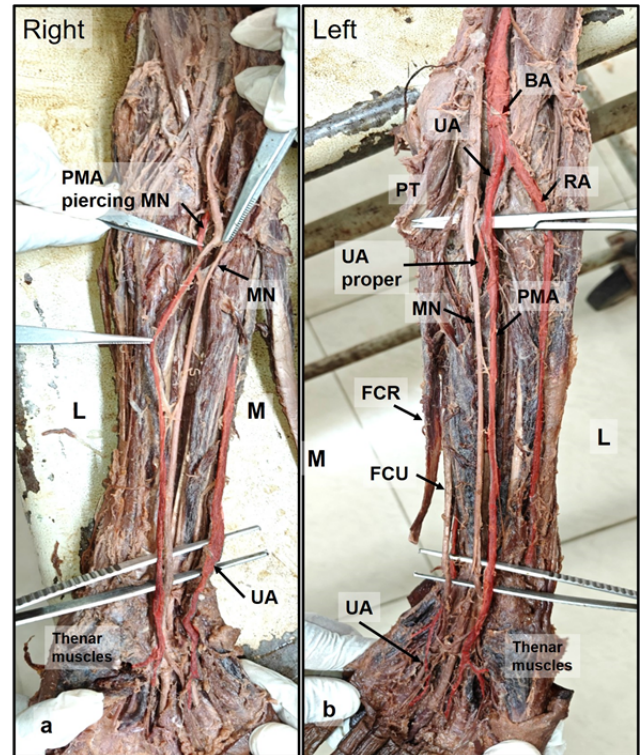
arteriovenous fistula, which had PMA as the primary source of blood supply, has also been reported.<sup>6</sup> We are reporting a case of the bilateral palmar type of PMA, a branch of the ulnar artery, passing through the carpal tunnel to supply the hand. On the right side, PMA was observed to pierce the median nerve after its origin from the ulnar artery.

## 2. Case Report

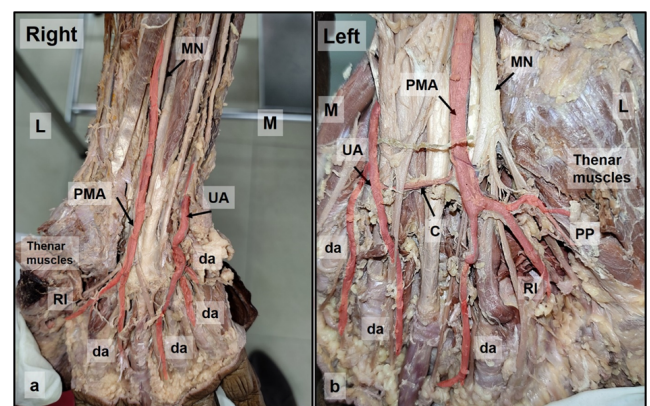
During the dissection of a formalin-embalmed 62-year-old female cadaver, PMA was observed bilaterally in the forearm, following which deep dissection of the forearm was done to identify the origin, course, termination, and branches of the PMA were identified.

On the right side, PMA originated as a branch directly from the ulnar artery. The PMA passes between the heads of the pronator teres muscle with the median nerve. The median nerve was split and the PMA passed through the nerve at the inferior border of the pronator teres, from the deep to the superficial aspect (Figure 1 a). The two divisions of the median nerve soon joined to form a single trunk. In the mid-forearm, the PMA coursed lateral to the median nerve. In the lower part of the forearm, the PMA crossed the median nerve to lie on its anteromedial aspect and coursed underneath the flexor retinaculum to enter the palm. In the palm, the PMA gave origin to the radialis indicis artery, princeps pollicis artery, and a common digital artery to the second interdigital cleft (Figure 2a). The remaining digital arteries were branches of the ulnar artery. The PMA began with an external diameter of 2.77 mm, decreasing to 2.06 mm after piercing the median nerve. Above the wrist, it measured 2 mm, and within the carpal tunnel, it was 2.3 mm. At their origin, the ulnar and radial arteries had diameters of 3.79 mm and 3.26 mm, respectively. At the wrist, the ulnar artery measured 3.22 mm, while the radial artery measured 3.71 mm.

In the left forearm, the ulnar artery was trifurcated, giving rise to three branches: PMA, common interosseous artery, and ulnar artery proper (Figure 1 b). The PMA and the median nerve passed between the heads of pronator teres. In the middle of the forearm, the PMA traversed along the lateral side of the median nerve. However, in the lower third of the forearm, PMA crossed the median nerve anteromedially and entered the palm through the carpal tunnel. A small, slender, communicating twig was observed between the PMA and ulnar artery in the palm. The arterial pattern in the palm was similar to that of the right hand (Figure 2 b). The PMA exhibited an external diameter of 3.08 mm above the wrist, 3.7 mm at the wrist level and 3.5 mm within the carpal tunnel. The ulnar artery had a diameter of 4.53 mm at its origin, while the radial artery measured 3.43 mm, and at the level of the wrist, it was 3.5 mm and 3.17 mm, respectively. On both sides, the radial artery did not participate in the formation of the superficial palmar arch; instead, formed the deep palmar arch.



**Figure 1:** Flexor carpi radialis (FCR) and pronator teres (PT) are cut and reflected to show the course of the persistent median artery (PMA). **a):** Right forearm shows the PMA piercing the median nerve (MN); **b):** Left forearm shows the PMA and MN. UA: Ulnar artery; BA: Brachial artery; RA: Radial artery; FCU: Flexor carpi ulnaris; L: Lateral; M: Medial



**Figure 2:** Dissection of right palm (a) and left palm (b) shows the persistent median artery (PMA) and ulnar artery (UA). Communicating twig (C) between the UA and PMA shown in Fig 2b. Superficial palmar arch was not formed and digital arteries (da) were arising from the ulnar artery and PMA on both sides. Princeps pollicis artery (PP) and Radialis indicis (RI) artery originated from the PMA. MN: Median nerve; L: Lateral; M: Medial

**Table 1:** Prevalence of persistent median artery in various studies

Study	Country	Type of study & Sample size	Prevalence (%)	Laterality (number of cases)		
				Unilateral Right	Left	Bilateral
Srivastava & Pande <sup>7</sup> 1990	India	Cadaver 134 limbs	1.5	1	1	0
Rodriguez NM et al. <sup>2</sup> 1999	United Kingdom	Cadaver 120 cadavers	20	10	9	5
Lucas et al. <sup>3</sup> 2000	Australians of European descent	Cadaver 78 limbs	33.3	11	15	5
Natsis et al. <sup>1</sup> 2009	Greece	Cadaver 72 limbs	2.78	2	0	0
Singla et al. <sup>8</sup> 2012	India	Cadaver 60 limbs	6.6	1	1	1
Cheruiyot et al. <sup>9</sup> 2017	Kenya	Cadaver 62 limbs	59.7	20	17	14
Osiak et al. <sup>10</sup> 2021	Poland	Surgical cases 1285 limbs	2.8	15	21	-

### 3. Discussion

The development of arteries in the upper limb begins with the growth of vascular plexuses through angiogenesis in the limb bud. The capillary network in the forearm undergoes remodelling to form the axial artery from which the arteries of the forearm develop. The median artery is the first to form, followed by the ulnar and interosseous arteries. By the 8th week of gestation, the ulnar and radial arteries take over as the primary vascular supply of the hand and the median artery regresses. However, it remains as a small vessel accompanying the median nerve. If the median artery persists, it forms the PMA of the forearm.<sup>5,11</sup> PMA may vary in origin, course, and termination. The PMA most commonly arises from the interosseous arteries but can also arise from the ulnar artery. Rarely, it could originate from the brachial artery, termed the brachiomedian artery.<sup>11,12</sup> The palmar type of median artery seems to have its origin most commonly from the angle between the ulnar and common interosseous arteries followed by the ulnar artery.<sup>2</sup>

Antebrachial type terminates within the forearm and is usually a branch of the anterior interosseous artery. Palmar-type PMA could pierce the median nerve in the upper part of the forearm, and the prevalence could vary from 1.5% to 41%.<sup>2,7</sup> In the palm, the PMA may or may not contribute to the superficial palmar arch. In a study by Rodriguez et al., 65% of the PMA terminated as digital arteries, and 35% of PMA formed a complete superficial palmar arch.<sup>2</sup> Many reports have shown that the *Princeps pollicis* and *radialis indicis* arteries originate as a branch of the superficial palmar arch.<sup>13</sup> In this report, the arteries mentioned above originated as branches of the PMA on both sides.

A recent study indicates that the prevalence of PMA is increasing among humans.<sup>3</sup> The prevalence of PMA could be between 1.5% and 60% and may differ in different geographical populations (Table 1). Srivastava and Pande reported the prevalence of PMA as 1.5%, whereas in 98.5%,

a small median artery arising from the anterior interosseous artery was observed to terminate in the sheath of the median nerve. The incidence of PMA in fetuses is higher compared to neonates as it is a transitory artery that regresses during development.<sup>14,15</sup> This explains the higher prevalence of the antebrachial type of PMA than the palmar type because of its termination in the median nerve sheath within the forearm.<sup>2</sup> PMA could present unilaterally or bilaterally, though unilateral presentation is more frequent. A study by Rodriguez et al. found that both types of PMA were more common in females than males.<sup>12</sup> However, Lucas et al. did not observe statistically significant differences between the sexes or the sides.<sup>3</sup>

The literature reports that the PMA piercing the median nerve, often associated with the palmar type, can lead to conditions like pronator syndrome or anterior interosseous syndrome.<sup>16–18</sup> Another common clinical condition associated with PMA is carpal tunnel syndrome. The carpal tunnel is an osseo-fibrous tunnel between the carpal bones and flexor retinaculum traversed by flexor tendons, the median nerve, and the PMA if present. Compression of the median nerve may occur in case of a large PMA due to space limitations in the tunnel.<sup>19</sup> In a study by Haladaj et al., the diameter of PMA ranged from 1.04 mm to 2.21 mm at the level of the wrist.<sup>19</sup> Gassner et al. reported that PMA of more than 3 mm diameter could lead to carpal tunnel syndrome. In their study, the diameter of PMA ranged from 0.5 mm to 1.7 mm.<sup>20</sup> In the present report, the diameters were higher compared to other studies, measuring 2.3 mm and 3.77 mm in the carpal tunnel on the right and left side, respectively.

Menichini et al. utilised the PMA-associated forearm free flap with a calibre of 2.1 mm for the intraoral reconstructive procedure. In their report, the PMA was a branch of the radial artery. The blood flow of the ulnar and radial arteries was assessed for any vascular insufficiencies before performing the surgery.<sup>4</sup> Thus, it is essential to identify the dominant vessels of the hand and their area of

distribution before proceeding with any graft or free flap surgeries.

In cases of nerve compression, electrodiagnostic studies are needed, followed by surgical decompression.<sup>10</sup> During carpal tunnel release, it is crucial to consider that the main source of blood supply to the median nerve is the PMA. Furthermore, PMA could be affected by thrombosis and aneurysms in the carpal tunnel.<sup>1</sup> In such cases, patients may present with ischemia of the digits, and revascularisation by surgical release is required. Thrombectomy, catheter-directed thrombolysis, and bypass with venous graft are other choices of treatment.<sup>21</sup> We report this case for its unique presentation. Further studies are needed to determine the precise prevalence of PMA and its types among Indians.

#### 4. Conclusion

In this report, PMA was observed bilaterally originating from the ulnar artery. On the right side, PMA pierced the median nerve. This anatomical variation has implications in nerve compressions, such as carpal tunnel or anterior interosseous syndromes. In addition, the presence of a large PMA might lead to a narrow carpal tunnel, which could further result in thrombosis, aneurysm, calcification, and atherosclerosis of the PMA. Understanding these vascular variations is crucial for diagnosing nerve compression syndromes and avoiding unanticipated surgical complications.

#### 5. Source of Funding

None.

#### 6. Conflict of Interest


None.

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