

Original Research Article

A study on morphological variants of human superficial palmar arch and their clinical importance

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Abstract: Superficial palmar arch is a linkage between superficial branch of the radial artery and ulnar artery. According to traditional concept the arch is mainly fed by the ulnar artery. But there occur a lot of variations in the formation of superficial palmar arch. This study was done in 92 hands from the adult human cadavers. The cadavers were well fixed with 10% formalin solution in the department of anatomy of Hi-Tech Medical College, Bhubaneswar and MKCG Medical College, Berhampur. The different pattern of formation of superficial palmar arch was then observed. Among the specimens 76 hands had the classical morphology i.e. formed between superficial branch of radial artery and ulnar artery. In 1st variant i.e. in two hands the arch was incomplete and formed by the superficial branch of the ulnar artery alone. In the 2nd variant i.e. in two cases the arch was there like the normal pattern but there was another bridging vessel in between the two main vessels. In the 3rd variant i.e. in 10 cases the arch was in between superficial branch of ulnar artery and Arteria radialis indicis. In the 4th variant i.e. in two cases the arch was formed by only ulnar artery and the Arteria radialis indicis had risen from the arch.

Keywords: Superficial palmar arch, variation

INTRODUCTION

The adult human hand receives most of its blood supply from the ulnar and radial artery [1]. The ulnar artery enters the palm with the ulnar nerve anterior to flexor retinaculum and lateral to pisiform. Then it passes radial to the hook of hamate, curves laterally to form an arch that is completed on lateral side by a branch from radial artery [3]. The arch is deep to the palmar aponeurosis and superficial to the long flexor tendons. The arch is convex distally in level with a transverse line through the distal border of the fully extended pollicial base. It gives four palmar digital arteries, the medial most supplies the medial side of the little finger and is termed as the proper palmar digital artery. The other three are common palmar digital arteries which pass to the medial three interdigital clefts [2]. The classic morphology of the superficial palmar arch is the direct continuity between the ulnar artery and superficial branch of the radial artery [1]. According to

Gray's 40th Ed. and Keen in 1961 [4], there are three types of superficial palmar arches. About a third of them are formed by the ulnar artery alone, a further third are between ulnar artery and superficial branch of the radial artery and the rest third are between ulnar artery and Arteria radialis indicis or Arteria princeps pollicis or median artery.

Since superficial palmar arch is the main source of arterial supply to the palm, the details about its possible variations is important for the reconstructive hand surgeons. This knowledge is required particularly while performing superficial dissections and to the radiologists while performing angiographic procedure [5]. Few studies regarding the variation of superficial palmar arches are reported in literature. The present study is focussed on different morphological pattern of superficial palmar arches in adult humans. The clinical

correlations of these variants are emphasized with relevant review of literature.

MATERIALS AND METHODS

The present study was carried out in 92 human adult cadaveric hands, 46 right and 46 left hands. They were all fixed with 10% formalin solution. The hands were devoid of any major trauma or pathology. The dissections of the hand were performed as per the Cunningham’s manual of practical anatomy. The course and branches of the radial and ulnar arteries in hand were meticulously dissected. The formations of

superficial palmer arches were observed and any variations were noted.

OBSERVATION

A total of 92 human cadaveric hands were included in the study, out of which 46 were right and 46 were left hand. Among them 34 were male and 12 were female adult cadavers. Among our series, 76 specimens (82.6%) shows that the superficial palmer arches were of classic type, i.e. Between the ulnar artery and the superficial branch of the radial artery. 16 cases were of different morphology. No double superficial palmar arch was found in any specimen.

Observation of the Different Variation of Superficial Palmar Arch

PATTERN	NO OF HANDS(92)	%	ARCH FORMATION
CLASSIC	76	82.6%	Ulnar artery and superficial branch of the radial artery
VARIANT -1	2	2.1%	arch was incomplete and formed by the superficial branch of the ulnar artery alone
VARIANT-2	2	2.1%	arch was like the normal pattern with another bridging vessel in between the two main vessels
VARIANT-3	10	10.5%	arch formed by superficial branch of ulnar artery and arteria radialis indicis
VARIANT-4	2	2.1%	arch formed by only ulnar artery and the arteria radialis indicis arised from the arch



PICTURE-1 (variation-1)

In the first variant (2.1%), arch was exclusively formed by the ulnar artery without having any contribution from the radial artery and the arch was also incomplete. The arch was having one proper digital

branch and was going towards the medial side of the little finger and the artery itself was going towards 3rd web space. (Pic-1)



PICTURE-2 (variation-2)

In second variant (2.1%), the superficial palmar arch was formed but it was having one proper digital branch which was going towards the medial side of the little

finger. From the remaining four common digital arteries the most lateral one was dividing into arteria radialis indicis and arteria princeps pollicis. (Pic-2)



PICTURE-3 (variation-3)

In the third variant (10.5%), the superficial palmar arch was complete like the classic variant, but there was

another bridging vessel in between the ulnar artery and radial artery proximal to the arch. (Pic-3)



PICTURE-4 (variation-4)



PICTURE-5 (variation-4)

In the fourth variant the superficial palmar arch was in between the superficial branch of the ulnar artery and the radialis indicis artery. The arch was having one proper palmar digital branch and three common palmar digital branches. (Pic-4 & Pic-5)

DISCUSSION

Superficial palmar arch formed between the ulnar artery and superficial branch of radial artery is not always the most common observed morphology. In the present study there was a higher incidence of classical

morphology 82.6% which is inconsistent with the findings of Al-turk and Metcalf [6].

The incomplete superficial palmar arch was observed in 10% cases by Loukas, Holdman and Holdman and 16% cases by Patnaik, Kalcey and Singla [8] and Al-turk and Metcalf and 21.47% cases by Coleman and Anson [9]. Loukas, Holdman and Holdman [7] observed that 40% of the superficial palmar artery were formed by anastomosis of superficial palmar branch of radial artery with the ulnar artery, 35% were formed entirely by the ulnar artery, 15% Superficial palmar artery between ulnar and median arteries, 6% of superficial palmar artery in between ulnar, radial and median arteries and 4% of cases the arch was completed by a branch of the deep palmar arch. Al-Turk and Metcalf observed that 78% of superficial palmar artery was of classical type i.e. between ulnar artery and superficial branch of radial artery.

Ottone, Prum, Dominguez *et al.*; [10] opined that the ulnar artery always takes part in the vascularisation of the hand, whether it forms the arch or not. They proposed that any variations of the superficial palmar artery depend completely on the radial artery. In our series observed a superficial palmar artery which was only formed by ulnar artery (figure –I) and the arch was incomplete.

In the second specimen we found that the arch was giving an additional palmar digital branch to the first web space which was dividing into the arteria radialis indicis and arteria prince's policis. Similar observation was found by Ikeda, Ugawa, Kazihara *et al.*; [11] Vollala, Nagabhooshana, Bhat *et al.*; [12] observed that the superficial arch gave origin to four common palmar digital arteries instead of three and the first common palmar digital artery was divided into radialis indicis and princeps pollicis artery. The arteries arising from the superficial palmar artery which supplies the first web space acquire great importance in case of absence of arterial supply from the deep arch to that region Vollala, Nagabhooshana, Bhat *et al.*; in 2008 [12]. Ruengsakulrach, Eizenberg, Fahrer *et al.*; [1] reported that in 66% of the hands, all the fingers supplied by the superficial palmar artery. In these cases superficial palmar artery was dominant over deep palmar arch in supplying the thumb and index finger. In the third finger there was a small bridging vessel in between the ulnar artery and radial artery just proximal to the arch which is consistent with the finding of Madhyastha, S Murali Manju *et al.*; [13].

In the fourth variant the superficial palmar artery was formed in between the superficial branch of ulnar artery and arteria radialis indicis which is consistent with the finding of Loukas, Holdman *et al.*; in 2005 [14]. It was reported that the patient should be screened enough before harvesting the radial artery to confirm the presence of a viable collateral circulation in the hand Ruengsakulrach, Eizenberg, Fahrer *et al.*; in 2001 [1]. Now a day's colour Doppler technique may be used to know the different arterial variation. According to Cable, Mullary and Schaff 1999, the Allen test could be used as a bedside evaluation to assess the collateral circulation in between the radial artery and ulnar artery.

A sound knowledge regarding the morphology of arterial arches of the hand is necessary for the micro vascular surgeons as well as orthopaedicians [8]. The clamping of radial artery is contraindicated in case of deficient collateral flow through the ulnar artery, as it can lead to ischemia and gangrene of the fingers Ottone, Prum, Dominguez *et al.*; in 2010 [10].

Injury to the superficial palmar artery or ulnar artery can compromise the arterial supply of the fingers, especially if there is an insufficient anastomosis between the superficial and deep palmar arches Calenoff *et al.*; [15]. Hence it is necessity to conduct the investigations like Allen test, angiography and colour Doppler studies of the hand before starting any invasive procedure including the vascular surgeries. The present study has provided few of the morphological variants of the superficial palmar arch which will enlighten the clinicians who are involved in the surgical procedure of the hand.

REFERENCES

1. Ruengsakulrach P, Eizenberg N, Fahrer C, Fahrer M, Buxton BF. Surgical implications of variations in hand collateral circulation: anatomy revisited. *The Journal of thoracic and cardiovascular surgery*. 2001 Oct 31; 122(4):682-6.
2. Romanes, GJ. *Cunningham's manual of practical anatomy*. 15th ed. Oxford: Oxford University press, 2005; 1: 74-104
3. *Grey's Anatomy*, 40th edition, P-894
4. Keen JA. A study of the arterial variations in the limbs, with special reference to symmetry of vascular patterns. *Developmental Dynamics*. 1961 May 1; 108(3):245-61.
5. Latiff AA, Othman F, Suhaimi FH, Das S. Anomalous superficial palmar arch: a cadaveric study with clinical implications. *Archives of Medical Science*. 2008 Jun 1; 4(2):197-9.

6. Al-Turk M, Metcalf WK. A study of the superficial palmar arteries using the Doppler Ultrasonic Flowmeter. *Journal of anatomy*. 1984 Jan; 138(Pt 1):27.
7. Loukas M, Holdman D, Holdman S. Anatomical variations of the superficial and deep palmar arches. *Folia Morphol (Warsz)*. 2005 May; 64(2):78-83.
8. Patnaik VV, Kalsey G, Singla RK. Palmar arterial arches-A morphological study. *J Anat Soc India*. 2002; 51(2):187-93.
9. COLEMAN SS, Anson BJ. Arterial patterns in the hand based upon a study of 650 specimens. *Surgery, gynecology & obstetrics*. 1961 Oct 1; 113:409-24.
10. Ottone NE, Prum N, Dominguez M, Blasi E, Medan C, Shinzato S, Finkelstein D, Bertone VH. Análisis e Importancia Clínica de la Irrigación Arterial Palmar Superficial y sus Variations sobre 86 Cases. *International Journal of Morphology*. 2010 Mar; 28(1):157-64.
11. Ikeda A, Ugawa A, Kazihara Y, Hamada N. Arterial patterns in the hand based on a three-dimensional analysis of 220 cadaver hands. *The Journal of hand surgery*. 1988 Jul 1; 13(4):501-9.
12. Vollala VR, Nagabhooshana S, Bhat SM, Rodrigues V, Rao M, Pamidi N, Surendran S. Rare anatomical variant: arterial circle in palm and at the base of the thumb. *Romanian Journal of Morphology and Embryology*. 2008 Jan 1; 49(4):585-7.
13. D'Costa SU, Ramanathan LA, Madhyastha S, Nayak SR, Prabhu LV, Rai R, Saralaya VV. An accessory iliocostalis muscle: a case report. *Rom J Morphol Embryol*. 2008 May;49(3):407-9.
14. Loukas M, Holdman D, Holdman S. Anatomical variations of the superficial and deep palmar arches. *Folia Morphol (Warsz)*. 2005 May;64(2):78-83.
15. Madhyastha S, Murlimanju BV, Jiji PJ, Saralaya VV, Rai A, Vadgaonkar R. Morphological variants of the human superficial palmar arch and their clinical implications. *Journal of Morphological Science*. 2011; 28(4):261-4.
16. Calenoff L. *Angiography of the Hand: Guidelines for Interpretation 1*. Radiology. 1972 Feb; 102(2):331-6.