

Pattern of variations in superficial palmar arch and its clinical importance

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Received: 22-02-2017

Revised: 09-03-2017

Accepted: 12-04-2017

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ABSTRACT

Background: Superficial palmar arch (SPA) is an important arterial anastomotic arcade which is the dominant vascular supply to the majority of the palmar muscles.

Objectives: Keeping the importance of these variations in mind this study was designed to find out the pattern of superficial palmar arterial arches.

Materials and Methods: A total of 40 adults upper limbs of unknown sex were observed for the variations in the pattern of superficial palmar arches on right and left side and were compared with the previous data.

Results: A complete superficial palmar arch was encountered in 72.5% (n=29/40) of specimens and an incomplete SPA was observed in 27.5% (n=11/40) of specimens.

Conclusion: Knowledge of the variations in the arterial supply of hand is essential in advent of microvascular surgery for revascularisation, replantation and composite tissue transfers.

Key Words: Superficial palmar arch, ulnar artery, median artery, radial artery

Introduction

Superficial Palmar Arch is an arterial arcade and a dominant vascular structure amongst the superficial and deep palmar arches of the hand. It is defined as the anastomosis between the superficial branch of the ulnar artery and superficial palmar branch of the radial artery. [1] The superficial palmar arch is a direct continuation of the ulnar artery. On entering the palm, it curves laterally deep to the palmar aponeurosis and superficial to the long flexor tendons. The arch is contributed on the lateral side by one of the branches of the radial artery. [2] It gives four palmar digital arteries, the medial most supplies the medial side of 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. [3] The classic morphology of SPA is defined as direct continuity between the ulnar artery and superficial palmar branch of the radial artery. [4] The Vascular patterns of the palmar arches and their interconnecting branches present a complex and challenging study. [5] In cases without an efficient collateral circulation, ulnar has clinical significance. Knowledge of the variations in the arterial supply of hand is

essential in advent of microvascular surgery for revascularisation, replantation and composite tissue transfers. [5] Recent improvements in microsurgical techniques have increased the necessity of better understanding of the vascular pattern of the hand. [6] Keeping the importance of variations in mind this study was designed to find out the pattern of superficial palmar arterial arches.

Material 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 Collage 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 ulnar and radial arteries identified proximal to the wrist were preserved. The palmar aponeurosis was removed together with the palmaris longus where present, to show the SPA. The SPA was

more fully demonstrated by carefully removing the adipose tissue surrounding it. Branches of median and ulnar nerves 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.

Results

There were no specimens that had complete absence of the SPA. The SPA according to Coleman and Anson was classified into complete or incomplete types. The SPA was defined as complete when the ulnar artery anastomosed with either or both the superficial palmar branch of the radial and the ulnar artery. Where no such anastomosis occurs, the SPA was defined as incomplete. A complete SPA was encountered in 72.5% (n=29/40) of specimens. The arches were divided into following types depending on the formation of the SPA:

- 1) The superficial arches completed by the anastomosis of the superficial palmar branch of the radial artery with the ulnar artery. This type was observed in 20/29(69%) of specimens. (Fig.1)
- 2) The complete superficial arches formed by the ulnar artery only. This type was observed in 9/29 (31.03%) of specimens. In these specimens, the ulnar artery provided the branches supplying the thumb and index finger called the arteria princeps pollicis and arteria radialis indicis, respectively. (Fig.2)

Out of 9 cases of ulnar superficial palmar arches, single case of double superficial palmar arch was found on the left side. We named them as proximal and distal arches. Proximal ulnar arch arose from the lateral side of the ulnar artery and terminate by giving arteria princeps pollicis and arteria radialis indicis. The distal arch arose a little higher to the previous arch and three common palmar digital arteries and one proper palmar digital artery arose from the convexity of the arch. (Fig.3) An incomplete SPA was observed in 27.5% (n=11/40) of specimens. Two types of incomplete superficial arches were observed. Ulnar type SPA was coated in 83.33% (n=5) on the right side and 60% (n=3) on the left side. The

ulnar artery gave rise to the proper palmar digital artery to the little finger, second common palmar digital (between the little and the ring finger) and third common palmar digital arteries (between middle and ring fingers and) and get terminate by supplying medial side of the index finger. It does not contribute to the blood supply to the thumb and index finger. (Fig. 4)

Median-ulnar type SPA was observed in single case i.e in 16.67% on the right side and 40% (n=2) on the left side of specimens. In this Median and ulnar arteries are independent arteries supplying the hand without anastomosis. The Medial artery provides the branches to supply the thumb, index finger and lateral side of the middle finger. Ulnar artery gives branches to the little finger, ring finger and to the medial side of the middle finger. (Fig. 5,6)

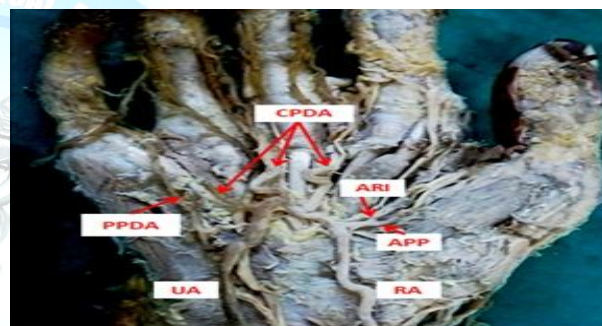


Fig. 1 Complete superficial palmar arch with contribution from both ulnar and radial arteries

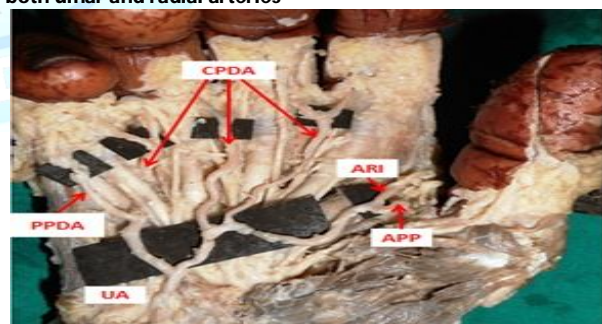


Fig. 2 Complete superficial arch formed solely by ulnar artery

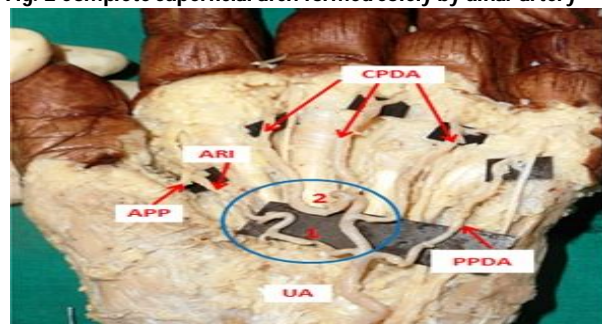


Fig. 3 Double superficial ulnar arch 1-Proximal arch, 2-Distal arch

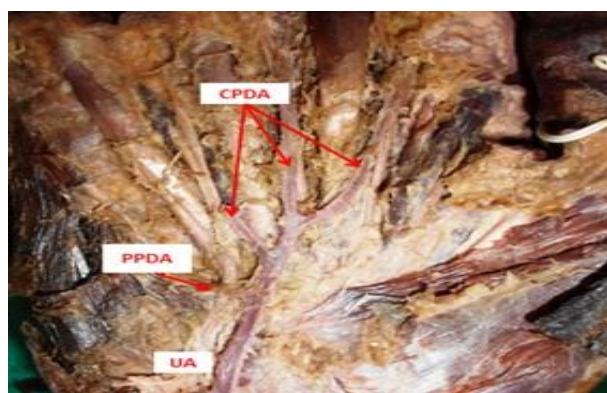


Fig. 4 Incomplete superficial arch formed solely by ulnar artery

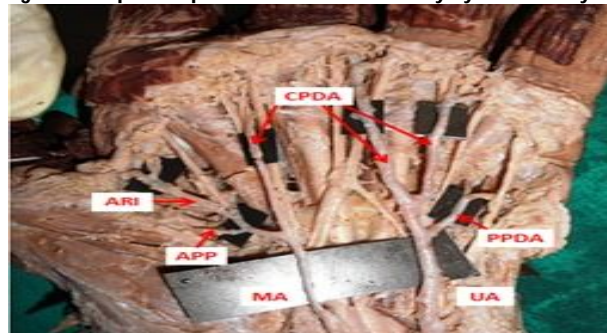


Fig. 5 Incomplete superficial arch in which the ulnar and median arteries are equally dominant but with no communication.

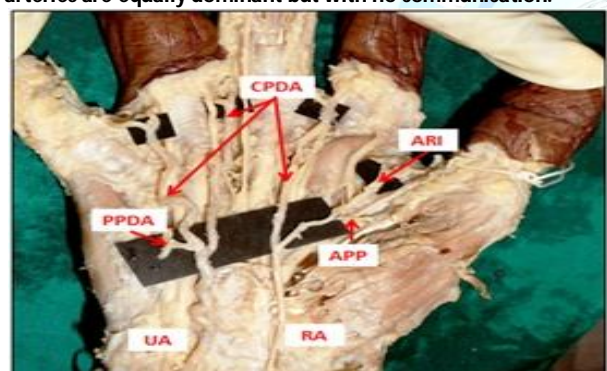


Fig. 6 Incomplete superficial arch in which the ulnar and median arteries are equally dominant but with no communication

UA-Ulnar artery, RA-Radial artery, APP-Arteria princeps pollicis, ARI-Arteria radialis indicis, CPDA-Common palmar digital arteries, PPDA-Proper palmar digital artery to the little finger

Discussion

The vascular plexuses of the limb-buds are initially supplied by four or five consecutive intersegmental 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 the axial arteries of the upper and lower limb respectively. In the upper limbs axial artery terminate in a capillary plexus from which later,

digital branches arise. The proximal part of the artery can be recognised as the brachial artery, its distal portion is the interosseous artery. By 6th week, ulnar artery is apparent and branches from brachial artery progressing down the hand plate to form the deep palmar arch. The radial artery develops later and is more variable progressing down the preaxial side of the limb. Eventually, median and interosseous arteries decrease in size, and median artery 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.^[7]

Many attempts have been made to classify these variations. One of the first reports that presented a classification of palmar arches was the classic work of Coleman and Anson. They studied these diversities in 1961 and classified complete SPAs into 5 groups. These authors again typified the incomplete SPAs into 4 categories, namely, Type A, Type B, Type C and Type D. Type A had no anastomosis between superficial branches of RA and UA. In Type B, the SPAs were solely formed by UA. Type C SPAs were formed by ulnar and median arteries without anastomosis. Type D varieties were contributed by ulnar, median and radial arteries, without any anastomosis between them. In our study we observed an incomplete arch belonging to the 'Type B and C variety of Incomplete Palmar Arches' of Coleman and Anson's classification.^[5] In a study by Janevsky et al, the complete arches were seen in 75% and incomplete arches in 25% of cases.^[8] SPA alone formed by UA was reported by Coleman and Anson as 37% , by Jelcic et al as 10% and by Ikeda et al as 25.5%.^[5,9-10] The incidence of incomplete SPAs reported are 10%, 16%, 16% and 21.47% of cases in studies of Loukas et al, Patnaik et al, Al turk and Metcalf and Coleman and Anson respectively.^[11-13,5] Tagil et al noticed that the most consistent incomplete form was the UA alone forming SPA which was seen in about 20% of subjects.^[14] Ikeda et al

demonstrated 96.4% complete and 3.6% incomplete forms of SPA. [10] In present study, there was higher frequency of the classical type arches compared to other previous studies done by other authors. The complete form is seen in 72.5% and incomplete SPA was found only in 27.5 % case.

Loukas et al, observed that 40% were formed by anastomosis of superficial palmar branch of radial artery with the ulnar artery, 35% were formed entirely by the ulnar artery 15% of them had anastomosis between ulnar and median arteries and 6% showed anastomosis between ulnar, radial median arteries. [11] In contrast, Al-turk et al, observed that 78% of the complete arches were having the classical radioulnar type, 4% had medioulnar type and 2% were of radiomedianoulnar type. [13] Present study observed classical radioulnar type in 29 cases, 8 cases were of ulnar type and 3 cases had medioulnar type . Persisting median artery is known to take part in the supply of the hand participating in the formation of superficial palmar arch. In the present study 7.5% (3cases) showed medianoulnar type of incomplete arch. Jaschtschinsky called this an atavistic characteristic because the median artery is normally found in the palmar arch of certain lower animals. [15] Singer describes the persistence of median artery to be due to cessation of development at fourth stage as described by him. [16]

Gindha Gurbachan Singh observed 5 cases (16.6%) of double superficial palmar arch in 30 hands. Out of this one case (20%) was of mediano-ulnar type and rest from (80%) were of radio-ulnar type. [17] Patnaik et al also found in 6% of limbs, a double superficial palmar arch. [12] Present study also reported a single case of double superficial palmar arch of ulnar type. Double superficial palmar arch is very important clinically in cases of bleeding from any of inter-digital branches of ulnar artery.

The surgeons may ligate the ulnar artery at a point proximal to usual level of superficial palmar arch expecting the blood supply through 4th, 3rd, 2nd inter-digital artery to be cut off as an incomplete digital superficial palmar arch was

encountered. [17] Due to its superficial nature, the arterial arch is constantly exposed to mechanical injuries. [18] In ulnar dominant complete superficial palmar arch, the arch is entirely formed by ulnar artery and supplies thumb and index finger without communicating with radial artery. In these cases, potential hazard to the ulnar artery could exist to the digits in the event of traumatic injury, occlusion of the artery may also cause claudication and gangrene in the digit. [11]

In 72.5 % of specimens superficial palmar arch was complete and in 27.5% of specimens it was incomplete. We also came across the three cases of ulnar –median type of palmar arch and single case with double superficial palmar arch. So, all these variations found in this study will help not only the anatomists, but also orthopedics and microvascular surgeons during reconstructive hand surgeries, preoperative screening of radial artery harvesting for myocardial revascularization and also in arterial interventions that include radial artery cannulation and radial artery forearm flap. [19] Even while making incisions to evacuate pus from the hand, special attention should be paid to the superficial position of termination of ulnar artery and SPA. [20]

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Cite this article as: Rapotra M, Sharma A, Sharma M. Pattern of variations in superficial palmar arch and its clinical importance. Int J Med and Dent Sci 2017;6(2):1483-1487.

Source of Support: Nil
Conflict of Interest: No