

ANATOMICAL VARIATIONS OF THE SUPERFICIAL PALMAR ARCH- A CADAVERIC STUDY*Varigeti Mizoram¹, Arindom Banerjee²*¹Assistant Professor, Department of Anatomy, IQ City Medical College, Durgapur, West Bengal.²Professor, Department of Anatomy, IQ City Medical College, Durgapur, West Bengal.**ABSTRACT****BACKGROUND**

There is lot of variability in the formation of the superficial palmar arch and its contributing arteries. The superficial palmar arch is usually formed by the superficial branch of ulnar artery and completed by one of the branch of radial artery, i.e. superficial palmar branch, arteria radialis indices or arteria princeps pollicis. It is rarely completed by the axis artery of the upper limb, i.e. median artery, which accompanies the median nerve type. In some cases, it is of incomplete nature where digital branches are arising separately from the superficial branch of ulnar artery on one side and from one of the branches of radial artery on the other side. A study of the variations of the palmar arch will not only help anatomists, but also vascular surgeons while doing reconstructive surgeries of the hand to avoid possible complications.

MATERIALS AND METHODS

The study was done on 60 formalin fixed upper limbs from the Department of Anatomy during routine first professional MBBS dissection classes over a period of two years. Incision was given according to Cunningham Manual of Anatomy and superficial palmar arch was exposed and its formation from different branches was noted down. The variations were noted down to provide a database of the normal and variant anatomy.

RESULTS

In our present study, the normal complete arch was observed in 50 (83.3%) upper limbs and anomalous branching patterns were seen in 10 (16.7%) cases and were documented.

CONCLUSION

The present study though not of the only member of its kind will definitely add up to the progress in the microsurgical procedures for reconstructive hand operations, which needs the understanding of variant arterial arches. Thus, the comprehensive knowledge of arterial variations is vital for the surgical interventions and their successful outcome.

KEYWORDS

Palmar Arch, Ulnar Artery, Anatomical Variations, Reconstructive Surgeries.

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BACKGROUND

Superficial palmar arch is an arterial arcade and a dominant vascular structure in the palm. Superficial palmar arch is also known as superficial volar arch or superficial ulnar arch or arcus palmaris superficialis or arcus volaris superficialis. It is defined as the anastomoses between the superficial branch of ulnar artery and superficial palmar branch of radial artery. The superficial palmar arch ensures the blood supply of the palm of the hand. It lies beneath the palmar aponeurosis and in front of long flexor tendons, lumbrical muscles and palmar digital branches of median nerve. The convexity of the arch is directed distally on a level with the distal border of outstretched thumb.

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The vascular pattern of the palmar arches and their interconnecting branches present a complex and challenging area of study. Improvements in microsurgical techniques have made a better understanding of vascular pattern study more validated. Variations among frequency of the pattern of the arch have been described by Coleman and Fazan et al¹ as completed, incomplete and unknown. The incidence of complete arch formed entirely by ulnar artery is seen to vary from 20 to 88%. The variations that occur in the arch are known to be more frequent on the radial side. This may involve one or more interconnecting branches.²

The superficial palmar arch had been the centre of attraction for most of the procedures and traumatic events in hand. The study of the intricate vascular pattern of SPA has continued to receive much interest following advances in microsurgical procedure for reconstructive hand surgery.³ Awareness of the frequency of these arterial variations has been observed to be of great assistance in preparation and planning for safe hand surgery. The hand surgeons need to refer the existence of healthy functional arch before surgical procedures such as arterial repairs, vascular graft applications and free pedicle flaps depending on radial or

ulnar artery in order to maintain the perfusion of the hand and digits.

The vasculature develops through haemodynamically-induced modeling and remodeling of numerous primitive vascular precursors. It has being shown that some of these anomalies have a genetic basis and in others an abnormal embryonic or environmental factors contribute to the pathogenesis.

Latest investigations such as ultrasonography, computerised axial tomography, angiography, arteriography and various other specific imaging modalities are in use to detect different types of vascular variations occurring in any part of the human body, which was not possible, previously.

This present study was therefore designed to find out the pattern of superficial palmar arterial arches in this region, which may help not only the anatomists, but also the orthopaedics and microvascular surgeons.

Aims and Objectives

The aim of this study is to document the prevalence of superficial palmar arch variations retrospectively from

cadaveric study at IQ City Medical College, Durgapur, West Bengal.

MATERIALS AND METHODS

The study was done on 60 formalin fixed upper limbs at the Department of Anatomy, IQ City Medical College, Durgapur, during routine first professional MBBS dissection classes over a period of two years. Incision was given according to Cunningham Manual of Anatomy and superficial palmar arch was exposed and its formation from different branches was observed. The variations were noted down to provide a database of the normal and variant anatomy.

As this study is an observational study on cadavers, specific inclusion and exclusion criterias were not required.

RESULTS

In our present study, the normal complete arch was observed in 50 (83.3%) upper limbs and anomalous branching patterns were seen in 10 (16.7%) cases and were documented (Table 1).

Variations	Number	Percentage
Normal superficial palmar arch	50	(83.3%)
Incomplete arch with radial side contributed by median artery (Figure 1)	2	(3.33%)
Incomplete arch being entirely contributed by superficial branch of ulnar artery (Figure 2)	4	(6.66%)
Superficial palmar arch is triradiate in origin (Figure 3)	1	(1.66%)
Incomplete arch with SPBRA supplying the radial side by giving rise to arteria radialis indices and princeps pollicis and remaining digital branches coming from the ulnar artery (Figure 4)	3	(5%)

Table 1. Showing Types of Variations in the Formation of the Superficial Palmar Arch along with their Actual Number and Percentage (SPBRA = Superficial Palmar Branch of Radial Artery)

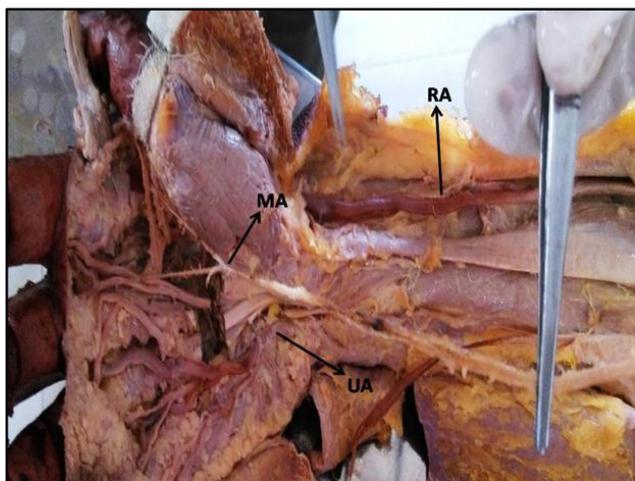


Figure 1. Shows the Incomplete Superficial Palmar Arch with the Radial Side being Contributed by the Median Artery (MA = Median Artery, UA = Ulnar Artery and RA = Radial Artery)

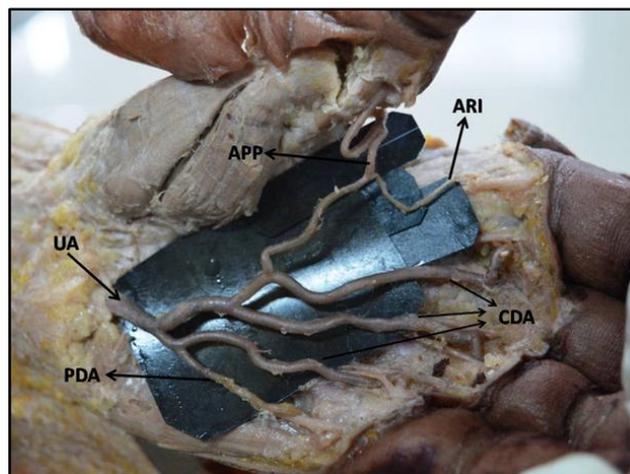


Figure 2. Showing the Incomplete Arch being Contributed Entirely by the Superficial Branch of Ulnar Artery (UA = Ulnar Artery Superficial Branch, PDA = Proper Digital Artery, CDA = Common Digital Artery, ARI = Arteria Radialis Indices and APP = Arteria Princeps Pollicis)

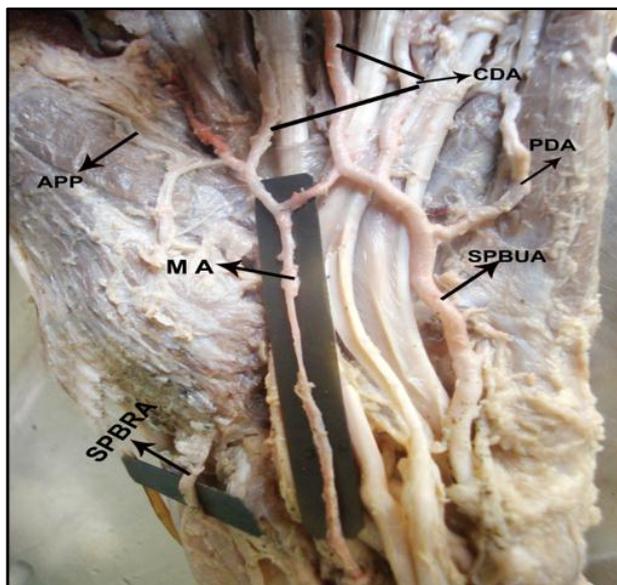


Figure 3. Showing the Superficial Palmar Arch being contributed by Superficial Branch of Radial Artery (SPBRA), Ulnar Artery (SPBUA) and Median Artery (MA). PDA = Proper Digital Artery, CDA= Common Digital Artery and APP = Arteria Princeps Pollicis

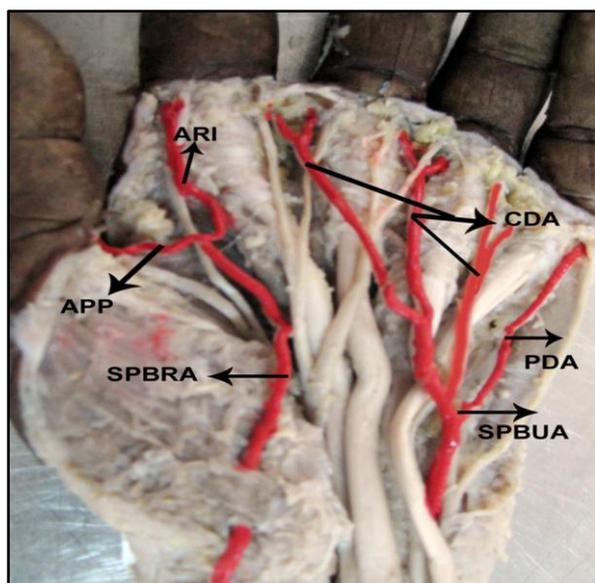


Figure 4. Showing the Incomplete Arch with Superficial Palmar Branch of Radial Artery (SPBRA) Supplying the Radial Side by Giving Rise to Arteria Radialis Indices (ARI) and Princeps Pollicis (APP) and Remaining Digital Branches Coming from the Ulnar Artery (SPBUA)

DISCUSSION

The high rate of variations of the superficial palmar arch makes it an interesting area of study. A key guide to understanding the anatomy of the arterial distribution of the SPA is the classification into complete and incomplete arches. An arch is said to be complete, if an anastomosis is found between the vessels contributing to it. An incomplete arch has an absence of a communication or anastomosis between the vessels constituting the arch. This classification is currently in use and provides the simplest understanding of the anatomic distribution of the arches.⁴

The median artery as a component of the SPA has been described in the literature. Coleman and Anson⁵ observed median-ulnar and radial-median-ulnar type of SPA in 3.8% and 1.2% of subjects, respectively. Ikeda et al⁶ observed that the radial-median-ulnar type of SPA was absent in their study and the median-ulnar type was found in 0.9% of subjects. In the present study, we observed that arch was incomplete with contribution by the median artery on the radial side in 3.33% of cases.

In our present study, an incomplete arch formed entirely by the ulnar artery was found in 6.66% of cases. All the common proper digital branches are arising from the ulnar artery only. Even the arteria radialis indices and princeps pollicis are arising from the ulnar artery.

Gharravi et al⁷ found one case in which superficial palmar arch was absent. They found that there was no anastomosis between radial and ulnar arteries in the palm of the hand. Ulnar artery gave three palmar digital arteries; proper palmar digital artery and two common palmar digital arteries. Radial artery gave proper palmar digital artery and arteria princeps pollicis.

Suman and Jayanthi⁸ found in 50% of cases, an ulnar dominant superficial palmar arch where ulnar artery was forming the superficial palmar arch and it terminates by supplying the thumb and index finger. Their finding is similar to the second type of variation encountered in the present study.

A single case of triradiate superficial palmar arch was also encountered where the radial, ulnar and median artery all contributed to the formation of the arch. Adachi (1928: quoted by Keen 1961) recorded the median-ulnar type of SPA in 9% of subjects.⁹ The origin of median artery has been previously described as arising from common interosseous, anterior interosseous and ulnar arteries frequently. It can also arise from brachial artery or its branches.¹⁰ Very rarely, the median artery arose from the RA as suggested by Acarturk et al.¹¹ In the present study, the median artery arises from the axillary artery.

There were 3 cases where the arch with superficial palmar branch of radial artery supplies the radial side of the hand by giving rise to arteria radialis indices and princeps pollicis artery and the remaining digital branches arise from the ulnar artery. This type A incomplete SPA was reported by Coleman and Anson⁵ in 3.6% cases and Olave et al¹² in 15% of cases. These type for arterial pattern are not suited for radial artery grafting in cases of CABG, because there is no collateral circulation from the ulnar artery, which may lead to necrosis and gangrene of the fingers.

Name of the Author (s)	Complete arch Percentage	Incomplete arch Percentage
Coleman and Anson	80	21.5
Doscher et al ¹³	Not done	11
Ikeda et al	96.4	3.6
Patnaik et al ¹⁴	78	16
Present study	83.3%	16.7%

Table 2. Compares the Findings of Our Present Study with that of Previous Research Workers

CONCLUSION

The present study shows that the complete superficial palmar arch is the commonest type present in the population, a finding, which is similar to those of other research works in this field. However, variations do exist and should be kept in mind while attempting a radial artery graft in CABG case or during microvascular surgeries of the hand.

These days, with the advent of various techniques like Doppler ultrasound, arterial angiography and pulse oximetry, assessing the efficiency of collateral circulation has become essential before surgical interventions.

Therefore, the present study adds to the already preexisting information regarding the vascular anatomy of the superficial palmar arch of the hand, but at the same time, re-enforcing the point that anomalies do exist as being reported by so many studies throughout the world and a working knowledge of those the vascular surgeons and radiologists must have to approach any such cases in the future with confidence rather than with surprise.

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