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Research article

MEDIAN ARTERY IN FORMATION OF SUPERFICIAL PALMAR ARCH: A CADAVERIC 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 has many interesting variations, of them the median artery contribution is been evaluated in the present study. **Method:** 100 cadaveric hands of 50 cadavers were dissected and their formation and pattern was recorded according to Coleman and Anson classification, 1961 and photographed. The present study highlights particularly the median artery contribution in the formation of superficial palmar arch. **Results:** In the present study 4% of specimens showed mediano-ulnar type of incomplete superficial palmar arch. This observation had a unilateral presentation seen in only right hand of four adult male cadavers. The left hand of these specimens showed ulnar type of complete arch. **Conclusion:** The median artery is a transitory vessel that represents the arterial axis of the forearm during early embryonic life. It normally regresses in the second embryonic month Its persistence in the human adult has been recorded in different patterns: as a large, long vessel (palmar type) which reaches the hand is the focus of present study 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 median artery pierces the median nerve in the proximal third of the forearm.

Keywords: Mediano-ulnar arch, Ular arch, Palmar type

INTRODUCTION

A detailed study of the functions of the hand is the basic requirement of all aspiring hand surgeons. This is unfortunately a highly complex matter and though general guidelines can be given, continued clinical experience and observations are necessary if treatment programmes are to be put to the best advantage to the patient.¹

We need to study hand in terms of arterial supply and the more intimate knowledge, the hand surgeon is provided with, he can get better equipped to deal with microvascular and plastic surgeries.

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.²

The superficial palmar arch is an anastomosis fed mainly by the ulnar artery. The later enters the palm with the ulnar nerve, anterior to the flexor retinaculum and lateral to the pisiform. It passes medial to the hook of the hamate, and then curves laterally to form an arch, convex distally and level with a transverse line through the distal border of the fully extended pollicial base. About a third of the superficial palmar arches are formed by the ulnar alone; a further third are completed by the superficial palmar branch of the radial artery and a third by the arteria radialis indicis, a branch of arteria princeps pollicis or the median artery.

Four digital arteries arise from the convexity of the arch and pass to the fingers. The most medial artery supplies the medial side of the little finger and the remaining three subdivide into two and supply the contiguous sides of the little, ring, middle, and index fingers, respectively.³

Variation in superficial palmar arches has always attracted attention of number of researchers. Many variations have been reported but the focus of present study is to record involvement of median artery in the formation of superficial palmar arch. According to Huelin, Barreiro and Barcia, antebrachial and palmar are the two types of termination of median artery. Antebrachial type shows two variants Atrophic type and Carpal type.

Palmar or embryonal type also shows two variants, Long type, which ends in the superficial palmar arc through small arterioles or supplying small vases to the subcutaneous cellular tissue; before reaches the end; the median artery sends branches which anastomose with the ulnar and radial arteries at the carpus level. The second variant is Digital type⁴

In present study the palmar type of median artery is highlighted for its significance in formation o superficial plmar arch

Aims and objectives: The present study was conducted to analyse the contribution of median

artery in the formation of superficial palmar arch in human cadavers.

The aim of present study was to establish the pattern of the palmar type of median artery in a large sample of hands in terms of side, and also to provide a more accurate account of its detailed morphology and relationships along its course.

MATERIALS AND METHODS

The study was carried out in 100 formalin fixed human hands of 50 cadavers (46 male and 4 female) during the period 2009 to 2012 at Dr. D. Y. Patil Medical College, Pune and B. J. Govt. Medical College, Pune. The dissection was carried out according to Cunningham's manual the formation of superficial palmar arch was observed and recorded. The data was classified according to Coleman and Anson, 1961⁵ classifications. (Table 1)

Observations: Among the 100 hands of 50 cadavers, 4 male right hands showed the formation of superficial palmar arch by median and ulnar arteries where in the two arteries did not anastomose. According to Coleman and Anson classification the superficial palmar arch is broadly categorized into complete type-group I (contributing arteries anastomose) and incomplete type-Group II (contributing arteries do not anastomose). Each category is further sub classified into types A to type E depending on the arteries which form the superficial palmar arch. Refer table 1.

In the present study 4% showed type C where in superficial palmar arch is Incomplete arch - group II , mediano- ulnar type according to Coleman and Anson, 1961.⁵ In all 4 male cadaveric specimens this type had a unilateral presentation, observed in the right hand only. The left hand in these specimens showed ulnar type of arch where in the arch was completely formed by superficial palmar branch of ulnar artery. This type of arch is classified according to Coleman and Anson, 1961 as type B superficial palmar arch (Complete arch - group I) Ulnar type.

Table 1: classified according to Coleman and Anson⁵

Group	Types according to Coleman and Anson 1961. ⁵				
	A	B	C	D	E
Complete Arch(I) (contributing vessels anastomose)	Superficial palmar branch of radial artery + larger ulnar artery	Entirely by ulnar artery	Ulnar artery + enlarged median artery.	Radio-mediano-ulnar arch	Ulnar artery + large sized vessel derived from deep arch.
Incomplete Arch(II) (contributing vessels do not anastomose)	Superficial palmar branch of the radial artery + ulnar artery.	Ulnar artery only (does not supply the thumb and the index finger).	Superficial vessels of median +ulnar arteries.	Superficial vessels of Radial + median +ulnar arteries.	-



Fig. 1 Shows incomplete mediao-ulnar superficial palmar arch. Classified as group(II) type C according to Coleman and Anson,1961

M-Median artery, U-Ulnar artery, SU- Superficial palmar branch of ulnar, 1-4- Common plamar digital arteries, 5- Proper palmar digital artery, B- Brachial artery, R-Radial artery, MN-Median nerve, AIA- Anterior interosseous artery, Encircled area shows median artery piercing median nerve

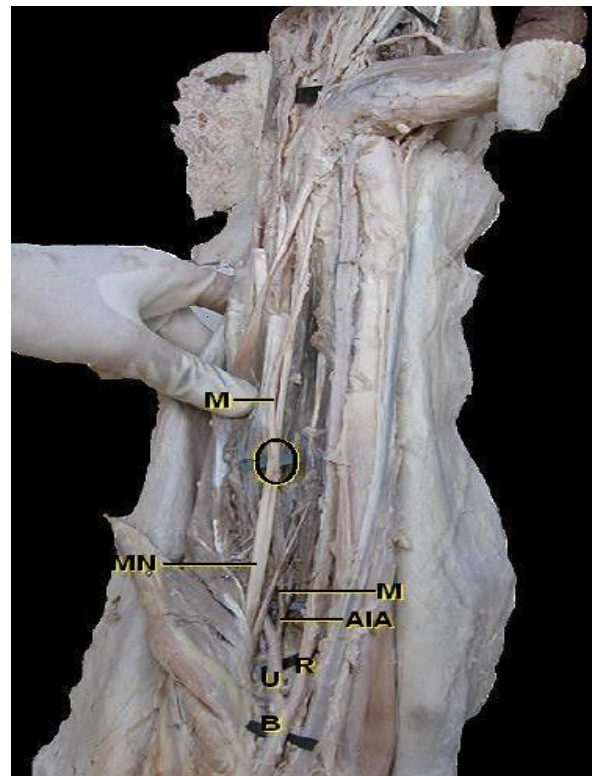


Fig.2: Shows course and relations of median artery in forearm

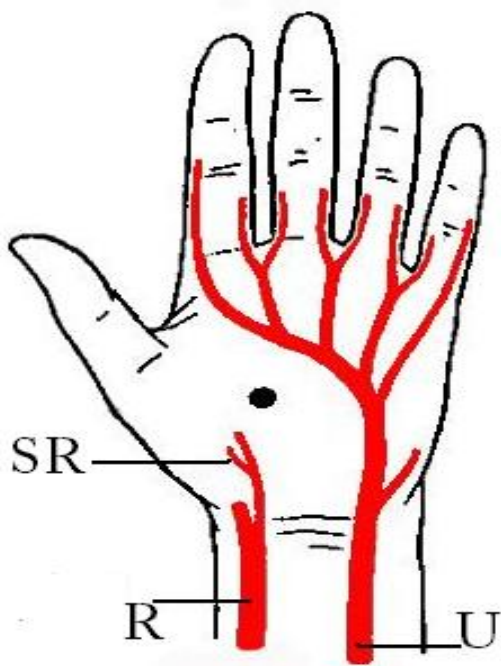


Fig. 3 Shows complete Ulnar type of superficial palmar arch. Classified Group I – type B⁵

R- radial artery, U- ulnar artery, SR- superficial palmar branch of radial

Superficial palmar arch in the right hand of 4 specimens: In four adult male cadavers the right hand showed superficial palmar arch formed by superficial palmar branch of ulnar artery (U) and median artery (M). The contributing arteries did not show anastomosis, so were termed to have incomplete type of arch. (Fig.1)

Branches of superficial palmar arch in the right hand of four specimens: The superficial palmar branch of ulnar was noted to have given a proper palmar digital branch to the ulnar side of little finger (5) and two common palmar digital arteries which divided into proper palmar digital arteries (3&4) to supply the adjacent sides of little, ring, and middle fingers respectively. (Fig. 1)

The median artery in the hand was found to have given two common palmar digital arteries (1 & 2) which divided into proper palmar digital arteries to supply the adjacent sides of thumb, index and middle fingers respectively.

Course of median artery in right forearm of 4 specimens:

normal origin as a terminal branch of brachial artery in the cubital fossa. To visualize the median artery the oblique attachment of flexor digitorum superficialis on the anterior surface of radius was reflected medially. Another important and interesting finding of the median artery which was recorded was that, it pierced the median nerve (MN) in the upper third of the forearm and then traversed distally into the hand deep to flexor retinaculum. (Fig. 2)

Superficial palmar arch in the left hand of 4 specimens: The superficial palmar arch was formed by superficial palmar branch of ulnar artery (U) only. The superficial palmar branch of radial artery (R) was did not contribute to the formation of the arch on the lateral side, instead the artery ended in thenar eminence. See fig. 3

Branches of superficial palmar arch in the left hand of 4 cadavers: The superficial palmar branch of ulnar was noted to have given a proper palmar digital branch to the ulnar side of little finger and four common palmar digital arteries that divided into proper palmar digital arteries to supply adjacent sides of thumb, index, middle, ring and little fingers respectively. Fig 3

Ontogenic basis : According to classic studies of Caplan and Koutroupas, myogenic areas become vascular and chondrogenic areas become clear and avascular. 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) in the carpus.⁶

Arey 1957,⁷ is of the view that the anomalies of blood vessels may be due to;

1. The choice of unusual paths in the primitive vascular plexuses.
2. Persistence of vessels normally obliterated.
3. Disappearance of vessels normally retained.
4. Incomplete development.
5. When the median artery was traced in these specimens

Fusion and absorption of the parts usually distinct.

DISCUSSION

Coleman and Anson 1961,⁵ Classified the superficial palmar arch as: Group (I) Complete Arch (contributing vessels anastomose) Group (II) Incomplete Arch (contributing vessels do not anastomose). According to Coleman and Anson 1961,⁵ in the present study the superficial palmar arches of the right hand in 4 specimens is classified into group II (incomplete) and type C (mediano-ulnar arch), whereas the superficial palmar arch of the left hands is classified as group I (complete) and type B (ulnar arch).

According to Coleman and Anson 1961,⁽¹⁾ the common palmar digital arteries were recorded to have 7 different patterns which applied to the present study and it is noted to be of type 1 in both hands. This type shows that the 1st common palmar digital artery which supplies ulnar side of the thumb and radial side of the index finger. The rest 3 common palmar digital arteries supply 2nd, 3rd, and 4th inter-spaces

Many studies which comprised recordings exclusively of median artery and its contribution to Superficial Palmar Arch have been put forth. Few of these studies with their percentages are as follows Tandler et al, 1887⁵ (16%) Adachi, 1928⁸ (8%), Misra, 1955⁹ (8.4%), Coleman and Anson, 1961⁵ (9.9%), M. Chimalgi, 1995¹⁰ 14% The present study reflects 4%. The past studies had varying sample size so the incidence cannot be justified.

Lo, Leung, Lau and Young 1986¹¹ have observed that 16% of the patients with Down's syndrome demonstrate persisting median artery. 76.9% of the hands with radial or ulnar deficiency syndromes demonstrated persisting median artery as put forth by Inoue and Miura, 1991¹². Such an association could be due to simultaneous teratogenic effects.

The unilateral presence of median artery in the present four cases indicates that, the factors

responsible for these variations could be acting unilaterally.

Rodríguez-Niedenführ et al, 1999¹³ study also confirms that the median artery may persist in adult life in two different patterns palmar and antebrachial based on their vascular territory the palmar type which represents the embryonic pattern is large long and reaches the palm the antebrachial type which represents a partial regression of embryonic artery is slender short and terminates before reaching the wrist.

In the present study only the palmar type of median artery was taken into consideration whereas antebrachial pattern was not recorded. D'Costa et al, 2006¹⁴ conclude that palmar type of median artery have a higher incidence than the antebrachial type and that it may be involved in the pronator teres syndrome, carpal tunnel syndrome and anterior interosseous syndrome. In the present study the right hand of all four specimens showed presence of palmar type of median artery.

CONCLUSION

The knowledge of frequency of anatomical variations of arterial pattern of hand is very important for safe and successful hand surgery. In the present study in 4% cases the right hand showed mediano- ulnar type of superficial palmar arch and left hand only ulnar type from which it can be concluded that, in such cases radial artery harvest for coronary artery bypass may prove to be less fatal. The study highlights a palmar type of median artery in the right hand of 4 specimens which may be involved in the pronator teres syndrome, carpal tunnel syndrome and anterior interosseous syndrome. It is interesting to note that many authors have tried to explore the anatomy of hand but very few report similar results.

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