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PALMER ARTERIAL ARCHES - A MORPHOLOGICAL STUDY

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ABSTRACT: INTRODUCTION: Arterial supply to the humans hand is the most important earning tools, is derived from two arterial anastomotic arches, superficial and deep formed by the anastomosis between two main arteries of forearm. Usually the palmar arterial arches are typical but several variations can occur. For example, the superficial palmar arch may be formed by the ulnar artery alone. So, this study is designed to find out the pattern of palmar arterial arches in the hand. **AIMS AND OBJECTIVES:** The objective of this study is to evaluate the morphology of the palmar arterial arches and its variation if present so that it may help Anatomists, Micro vascular surgeons &orthopedic surgeons. **MATERIALS AND METHODS:** 40 upper limbs of 20 cadavers were studied in the Department of Anatomy Nalanda Medical College, Patna. These human cadavers fixed in 10% formaldehyde solution. The male cadavers were 14 and female were 06 in number. Normal pattern of palmar arterial arches and its variation were observed. **RESULTS: Superficial Palmar Arch:** 40 limbs studied, in which single superficial palmar arch found in 38 limbs, 02 cases deviate from normal which shows double superficial palmar arches. Out of 38 limbs with single SPA, 32 limbs with a complete arch and 06 limbs with an incomplete arch, in the complete arch classical radio-ulnar type found in 31 cases where as in one case it was ulnar type of arch. In complete arch group, 04 limbs (10%) had a blood supply from both ulnar artery & superficial palmar branch of radial artery but without an anastomosis with each other, while in 02 limbs, instead of superficial palmar branch of radial, it was median artery was a source of blood supply along with ulnar artery again without anastomosis with each other. **Deep Palmar Arch:** In all the 40 limbs, it was a complete arch. The ulnar artery gave 02 deep palmar branches in all cases. In 22 limbs, it was only inferior deep palmar branch of ulnar artery which formed deep palmar arch, the superior branch which contributed to formation of deep palmar arch. It was only 04 cases, both the branches contributed to the formation of deep palmar arch. In one limb the radial artery dipped in 2nd intermetacarpal space and took part in formation of deep palmar arch with superior deep palmar branch of ulnar artery.
KEY WORDS: Superficial Palmar Arch, Deep Palmar Arch, Palmer Arch.

INTRODUCTION: Arterial supply to the humans hand is the most important earning tools, is derived from two arterial anastomotic arches, superficial and deep formed by the anastomosis between two main arteries of forearm i.e., Radial, Ulnar and their branches in the palm.

Superficial Palmar Arch: This arterial arch is variable. Normally it begins as a terminal branch of the ulnar artery on the flexor retinaculum distal to the pisiform bone. It then crosses the hook of the hamate bone and turns laterally deep to the palmer aponeurosis to join one or other of the branches of the radial artery which may form a significant protein of an incomplete arch. This arch is convex toward the digits and middle of its convexity lies deep to the centre of the proximal transverse crease of the palm.

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Deep Palmar Arch: This arterial arch provides a second channel connecting the radial and ulnar arteries in the palm, the first one being the superficial palmar arch. It is formed mainly by terminal part of the radial artery, and is completed medially at the base of the fifth metacarpal bone by the deep palmar branch of the ulnar artery. This arch lies a finger's breadth proximal to the superficial palmar arch. The deep palmar arch is found to be comparatively less variable than superficial palmar arch. Usually the palmar arterial arches are typical but several variations can occur. For example, the superficial palmar arch may be formed by the ulnar artery alone. So, this study is designed to find out the pattern of palmar arterial arches in the hand. Superficial & deep palmar arch connecting to each other by communicating arteries through the Interdigital cleft, to maintain the proper arterial flow of the both arches.

AIMS AND OBJECTIVES: There is importance of understanding the morphology of the superficial palmar arch for the purpose for micro vascular repair and re-implantation. The superficial palmar arch is a dominant vascular structure of the palm of the hand and together with the deep palmar arch, provides the blood supply to all the fingers. Recently progress in hand surgery needs a precise knowledge of these arterial arches.

The objective of this study is to evaluate the morphology of the palmar arterial arches and its variation if present so that it may help Anatomists, Micro vascular surgeons &orthopedic surgeons.

MATERIALS AND METHODS: 40 UPPER LIMBS OF 20 CADAVERS WERE STUDIED IN THE Department of Anatomy of Nalanda Medical College, Patna. These human cadavers fixed in 10% formaldehyde solution. The male cadavers were 14 and female were 06 in number.

By the help of Cunningham's Manual of Practical Anatomy, the different palmar arches were exposed. Palmar aponeurosis was exposed and separated from flexor retinaculum. It was divided proximally and reflected distally cutting the septae which pass backwards from its edges. This exposed the superficial palmar arch which was cleared to study the pattern. All other branches of radial and ulnar arteries in the palm were also studied. At the level of heads of metacarpals, the tendons of flexor digitorum superficialis were divided and reflected proximally up to wrist. Thus, deep palmar arch was exposed. Normal pattern of palmar arterial arches and its variation were observed.

OBSERVATIONS:

Superficial Palmar Arch: 40 limbs studied, in which single superficial palmar arch are found in 38 limbs, 02 cases deviate from normal which are double superficial palmar arches.

Total no. of limbs	No. of limbs with single SP arch	Percentage	No. of limbs with double SPA	Percentage
40	38	95	02	05
Table - 1				

Out of 38 limbs with single SPA, 32 limbs with a complete arch and 06 limbs with an incomplete arch.

Total no. of limbs	Limbs with single SPA	Complete arch	Percentage	Incomplete arch	Percentage
40	38	32	80	06	15

Table - 2

In the complete arch classical radio-ulnar type found in 31 cases where is in one case it was ulnar type of arch.

TABLE-3

Total no. of limbs	Limbs with single complete arch	percentage	Limbs with classical radioulnar type of arch	percentage	Limbs with ulnar type of arch	percentage
40	32	80	31	96.8	01	2.50

Table - 3

In complete arch group, 04 limbs (10%) had a blood supply from both ulnar artery & superficial palmar branch of radial artery but without an anastomosis with each other, while in 02 limbs, instead of superficial palmar branch of radial, it was median artery was a source of blood supply along with ulnar artery again without anastomosis with each other.

All the 02 double superficial palmar arches had 02 constituent components a proximal &a distal. The proximal arch was invariably complete and situationally where superficial palmar arch is expected. The distal component was incomplete in both 02 cases, but was responsible for palmar interdigital arteries to emanate from and so considered s an incomplete superficial palmar arch. The two component arches together constituted double superficial palmar arch.

Deep Palmar Arch: In all the 40 limbs, it was a complete arch. The ulnar artery gave 02 deep palmar branches in all cases. In 22 limbs, it was only inferior deep palmar branch of ulnar artery which formed deep palmar arch, in 13 cases the superior branch which contributed to formation of deep palmar arch. It was only 04 cases, both the branches contributed to the formation of deep palmar arch.

Total no. of limbs	No. of limbs in which inferior deep branch of ulnar artery took part	Percentage	No. of limbs in which superior ramus of ulnar artery took part	Percentage	No. of limb in which both branch of ulnar artery took part	Percentage
40	22	55	13	32	04	10

Table - 4

In one limb the radial artery dipped in 2nd intermetacarpal space and took part in formation of deep palmar arch with superior deep palmar branch of ulnar artery.

DISCUSSION: The vascular patterns of the palmar arches and their interconnecting branches present a complex and challenging area of study. Many attempts have been made of classify these variations.

Group I: COMPLETE ARCH: - IN 78% cases
In the present study it was found in 80% of cases. Author further divided Complete arch into 05 types: -
Type A: The classical radio ulnar arch is formed by superficial palmar branch of radial artery and the larger ulnar artery. Author found it in 34.50% dissections (36% by Weathersby, 1954; and 30% by Anson1966).In present study it was found in 77.50% cases.
Type B: This arch is formed entirely by ulnar artery. It was found in 37% cases. In present study it is found in 2.5% cases. In this context, comments of Adachi[1] (1928) are worth a mention who commented that differentiation between those two types is very difficult as to what constitutes a minimal contribution by radial artery. It may probably explain part of discrepancy in this observation.
Type C: Mediano-ulnar arch is formed of ulnar artery and an enlarged median artery. It was found in 3.8% specimens. (8% by Anson[5], 1966).
Type D: Radio-Mediano-ulnar arch in which 03 vessels take part in the formation of arch. It was found in 12% dissections.
Type E: It consists of a well formed arch initiated by ulnar artery and completed by a large sized vessel derived from deep arch (2%). In present study no any case was found to be placed in C, D & E types.

Group II: Incomplete Arch: When the contributing arteries to the superficial arch do not anastomose or when the ulnar artery fails to reach the thumb and index finger, the arch is incomplete. Such type of arch was found in 21.5% cases. In present study it was seen in 15% of cases.
Incomplete arch further divided into 4 types:
Type A: Both superficial palmar branch of radial artery and ulnar artery take part in supplying palm and fingers but in doing so, fails to anastomose. It was found in 10% cases (4 limbs).
Type B: Only the ulnar artery forms superficial palmar arch. The arch is incomplete in the sense that the ulnar artery does not take part in the supply of thumb and index finger. It was found in 13.4% dissections.
Type C: superficial vessels receive contributions from both median and ulnar arteries but without anastomosis. Author found it is in 3.8% specimens, where as in present study it was found in 5% (2 limbs) cases.
Type D: Radial, median and ulnar artery, all give origin to superficial vessels but do not anastomose. It was found in 1.1% cases. In present study not a single case was found of this type.

TABLE-5

Sl. No.		Coleman & Anson[4] (1961)	Weatherby (1954)	Anson[5] (1966)	Present study
1.	Group-I	78.5%	--	--	80.0%
	Type A	34.5%	36%	30%	77.5%
	Type B	37.0%	--	--	02.5%
	Type C	03.8%	--	8.6%	--
	Type D	01.2%	--	--	--
	Type E	02.0%	--	--	--
2.	Group-II	21.5%	--	--	15.0%
	Type A	03.2%	--	--	10.0%
	Type B	13.4%	--	--	--
	Type C	03.8%	--	--	04.0%
	Type D	01.0%	--	--	-
3.	Total	100.0%	--	--	95.0%
Table-5					

In 02 of the limbs (5%) double SPA was encountered (radioulnar in one & Mediano ulnar in one limb).Out of these one has been already reported by Patraik et al. (2000a).

Ontogenesis of double SPA: The superficial palmar branch of radial artery failed to develop fully consequent upon median artery persistence. So only a very small superficial palmer arch develops between persistent median artery and ulnar artery or the radial and ulnar arteries and this superficial palmar arch was insufficient to supply palmar interdigital branches. In both 02 cases, the proximal component of double superficial palmar arch remained rudimentary. So the first interdigital was still being supplied by median or radial artery while the ulnar artery continued to supply 4th, 3rd and 2ndinterdigital spaces as a major chunk living the appearance of 2nd superficial palmar arch which is incomplete and falls in type B or C of group II of Coleman & Anson (1961). This is in consonance with Arey's (1957) views that anomalous blood vessels may be due to: -

1. Persistence of vessels normally obliterated (median artery which should have obliterated; as in majority of cases).
2. Hydrodynamically incompetent development of proximal superficial palmar arch which was so unable to give rise to interdigital branches, the later being given off from incomplete distal superficial palmar arch.

Group-I:
Complete Arch: It was found in 97% cases. In present study it was found in 100% cases. Complete arch further divided into 4 types:
Type A: The deep palmar arch is formed by deep palmar branch of ulnar artery. It was found in 34.5% dissections. In present study it was found in 32.5%.
Type B: The deep palmar branch of radial artery anastomoses with the inferior deep palmar branch of ulnar artery encountered in 49% of dissections. In present study it was 55%.

Type C: Here both deep palmar branches of ulnar artery join the deep palmar branch of radial artery of complete the arch. It was found in 13% of specimens. In present study it is 10%.

Type D: It is formed by superior deep palmar branch of the ulnar artery which anastomoses with an enlarged superior perforating artery of the 2nd interspace. There is also a contribution from the 1st interspace which despite its small size helps to complete the arch. It was found only in 0.5% cases.

Group-II:

Incomplete arch: It was found in 3% cases only and can be further divided into: -

Type A: The inferior deep branch of ulnar artery anastomoses with the perforating artery of the 2nd interspace. The deep supply to the thumb and radial border of index finger is derived from deep palmar branch of radial artery. It was found in 1.5% dissections.

Type B: The deep arterial supply to thumb and the index finger are derivative of deep palmar branch of radial artery which in turn anastomoses with a perforating artery of 2nd space. The arch is incomplete because the deep branch of ulnar artery ends in an anastomoses with perforating artery of 3rd interface. It was found in 1.5% of cases.

Percentage Frequency of Various types of deep Palmar Arch

Sl. No.	Type of deep Palmar arch (Coleman & Anson, 1961)	Percentage Frequency	
		Coleman & Anson (1961)[4]	Present study
1.	Type A	34.0%	32.5%
2.	Type B	49.0%	55%
3.	Type C	13.0%	10%
4.	Type D	0.5%	0.0%
5.	Deviant from Coleman & Anson (1961) classification	0.0%	2.1%
	Total	97.0%	100%
Table- 6			

In the rest of their 3% dissection, it was of incomplete type.

SUMMARY AND CONCLUSION: The salient points are in brief:

1. Hand is supplied by SPA & DPA.
2. SPA is found as a single entity in 95% of limbs.
3. In other 5% limbs a definable double superficial palmar arch is observed.
4. It is seen that all the variations observed have some ontogenic basis and are clinically important.
5. DPA was found to be more or less constant with little variation, except for one limb in which it was strikingly different from the rest being limited laterally upto 2nd intermetacarpal space only with no communication or contribution whatever further laterally.

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