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Anatomy

SUPERFICIAL PALMAR ARCH- INCOMPLETE VARIANTS

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ABSTRACT The superficial palmar arch (SPA) and deep palmar arch (DPA) provide the dominant vascular supply to the hand. The SPA is highly variable with multifarious contributions from the ulnar, radial and persistent median arteries. It is classified into Complete and Incomplete SPA based on the anastomosis of Ulnar artery (UA) with or without one of these arteries respectively. The study was conducted to estimate the prevalence of Incomplete type of superficial palmar arch. In this study, dissection was done on 60 upper limbs from 30 cadavers and SPA was classified according to Coleman and Anson's [1] classification of Complete and Incomplete SPA. Complete SPA was seen in 63.3% cases and incomplete in 36.6%. Out of the incomplete SPA, Type F was seen in 35% and Type G in 1.6% cases. This study will help in better understanding of the anatomy of the vascular structure of the palm, which can benefit General and Plastic Reconstructive Surgeons, Interventional Cardiologists, Cardiothoracic Surgeons and Radiologists.

KEYWORDS : Superficial Palmar Arch, Incomplete type, Type F

INTRODUCTION:

Arterial supply to the hand is provided by an intricate network of collateral flow referred to as Superficial Palmar Arch (SPA) and Deep Palmar Arch (DPA). According to Gray's Anatomy[2] SPA is an anastomosis which is mainly fed by the UA. It enters the palm accompanied by the ulnar nerve, lateral to the pisiform and superficial to the flexor retinaculum. It then runs medial to the hook of hamate and forms the arch by passing laterally. The arch is convex distally. It lies along a transverse line passing through the distal border of base of the thumb that is fully extended.

According to A K Dutta[3], the SPA is formed by the superficial terminal branch of UA and completed on the lateral side by either the superficial palmar branch of radial artery (SBRA) or Arteria Princeps Pollicis (APP) or Arteria Radialis Indicis (ARI) or arteria nervi mediana which accompanies the median nerve.

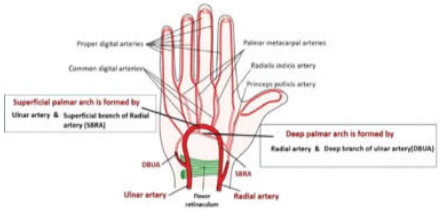

Fig 1 : Formation and Branches of SPA

The variations of the SPA were first classified into 2 groups by Jachtschinski[4] as complete and incomplete. According to Adachi[5], there are 3 types of SPA-Type I, II, III, depending on the major contributory vessel which forms the arch. The superficial palmar arch was classified by Coleman and Anson into two groups, Group I and Group II (Fig2) as follows:

Group I Complete Arch: Vessels contributing to the arch anastomose with each other. They are divided into five types.
Type A: SPA formed by the UA and the SBRA
Type B: SPA is formed by the UA alone
Type C: SPA is formed by the anastomosis of median and ulnar arteries
Type D: SPA is formed by the radial, median and ulnar arteries
Type E: SPA is formed by the UA and a branch from deep palmar arch

Group II Incomplete Arch: There is no anastomosis between the contributing vessels.

They are further divided into four types

Type F: SPA is formed by the UA alone but it does not contribute to the blood supply of the thumb and index finger

Type G: SPA is formed by the ulnar artery and the superficial branch of the radial artery without anastomosing with each other.

Type H: SPA formed by the independent radial, median and ulnar arteries, where the 1st and 2nd digits are supplied by the branches of median artery

Type I: SPA formed by the independent radial, median and ulnar arteries, where the thumb and index finger are supplied by the radial artery.

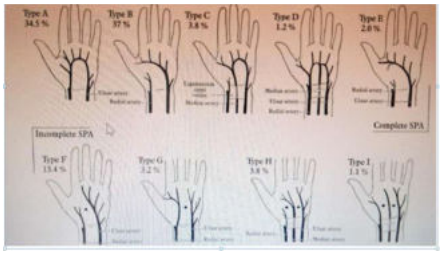

Fig. 2 Complete and incomplete types of SPA and the incidence of each type as described by Coleman and Anson.

OBJECTIVES:

The study aims at describing the anatomical variations in the formation of SPA, emphasizing on the Incomplete forms .

MATERIALS AND METHODS:

A descriptive observational study was done by dissection method on 30 cadavers (60 hands) in the dissection hall of Department of Anatomy, Government Medical College, Kozhikode, Kerala. Dissection was done according to Cunningham's Manual of Practical Anatomy[6]. Adult human cadavers for undergraduate teaching and dissection classes, without any gross anomalies or pathological changes were used for the study.

RESULTS:

SPA, either complete or incomplete was present in all 60 specimens. Complete SPA was seen in 38 palms and Incomplete SPA constituted 22 out of 60 palms. Hence, there was a prevalence of 63.3% complete and 36.6% incomplete arches. Coleman and Anson observed complete SPA in 78.5% hands and incomplete form in 21.5% out of 650 hands

Table 1: Frequency (%) of complete and incomplete arches in present study

Side of Limb	Number	Complete arch	Incomplete arch
Right	30	20	16

Left	30	18	6
Total	60	38	22
Percentage	%	63.3	36.6

Table 2 shows the frequency and percentage of types of SPA observed .

Type	No. of specimens with complete SPA	Percentage
A	12	20
B	24	40
C	2	3.33
D	0	-
E	0	-
	No. of specimens with incomplete SPA	
F	21	35
G	1	1.6
H	0	-
I	0	-

Table 2: Frequency (%) of various types of complete and incomplete SPA in this study according to Coleman and Anson's classification

COMPLETE SPA TYPE A:

Classic Radio Ulnar type (Type A) SPA seen in 12 specimens (20%) in present study. Coleman and Anson's study revealed 34.5% of Type A SPA. (Fig.3)

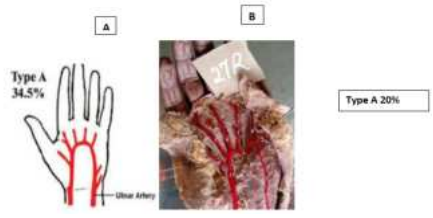

Fig. 3 : Pic A- Coleman and Anson

Pic B- Type A SPA-(Right Hand) formed by Ulnar Artery and Superficial branch of Radial artery (SBRA) 1- Ulnar Artery
2- Superficial branch of Radial artery (SBRA)
3- Superficial Palmar Arch
4- Proper Palmar Digital Artery to medial side of little finger
5,6,7- Three Common Palmar Digital arteries (CPDA)
8- Arteria Radialis Indicis arising from SBRA
9- Arteria Princeps Pollicis arising from SBRA
10- Proper Palmar Digital arteries to the web of fingers

INCOMPLETE SUPERFICIAL PALMAR ARCH

Among this variety, Type F was seen in 21 specimens out of 22 incomplete SPA (35%) and Type G in 1 specimen (1.6%), while there were no specimens with Type H or Type I .Coleman and Anson dissected 13.4% Type F , 3.2% Type G , 3.8% Type H and 1.1% Type I incomplete SPA in their study

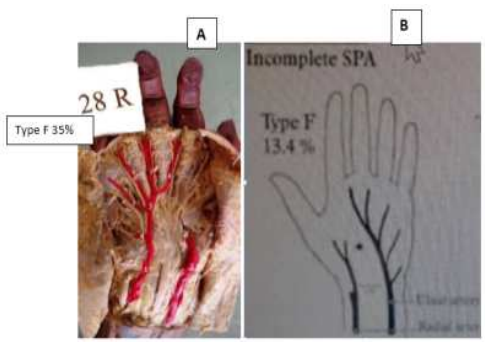

Fig.4: Pic A - Type F SPA (Right Hand) formed by the UA which does not contribute to the blood supply of the thumb and index finger.

Pic B – Coleman and Anson
1- Ulnar Artery
2- Superficial branch of Radial artery (SBRA)
3- Superficial Palmar Arch
4-Branch to Hypothenar muscles
5- Proper Palmar Digital Artery to medial side of little finger
6,7, 8- Three Common Palmar Digital arteries

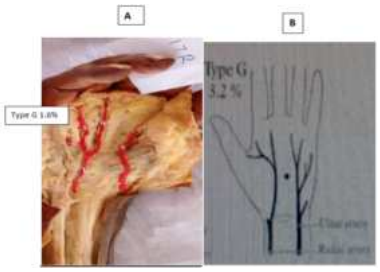

Fig 5: Pic A- Type G SPA (Right Hand) formed by the UA and the SBRA without anastomosis
Pic B- Coleman and Anson

1- Ulnar Artery
2- Proper Palmar Digital Artery to medial side of little finger
3,4- Two Common Palmar Digital arteries
5-Superficial branch of the Radial Artery

DISCUSSION:

In the present study, Superficial Palmar Arch (SPA) was present in all the 60 hands (100%). K Ozkus et al[7] dissected 80 specimens out of which 78 hands (97.5%) had SPA while SPA was absent in 2 of the specimens (2.5%) , which were supplied by the anterior median artery. Coleman and Anson observed complete SPA in 78.5% hands and incomplete form in 21.5% of 650 hands .The comparative statistics of various studies have been given in Table 3:

Table 3: Comparison between various studies, done by dissection method on cadaveric hands

Author(s)	% of Complete Arch	% of Incomplete Arch
S N Jaschtschinski[4]	68.5	16%
Coleman and Anson[1]	78.5	21.5
H Lippert[8]	42	58
Ikeda et al[9]	96.4	3.6
Ruengsakulrach et al[10]	66	34
H Gellman[11]	84.4	15.5
Valéria Paula Sassoli Fazan et al[12]	95	5
Marios Loukas et al[13]	90	10
O Bilge et al[14]	86	14
Süleyman Murat Taðýl et al[15]	75	25
Anand P et al[16]	73.3	26.6
Ron Hazani et al[17]	100	0
Aniruddha Sarkarl et al[18]	45.2	54.7
Godwin Mbaka et al[19]	73.9	26
Sheetal Bhimprasad Joshi et al[20]	82	18
Chandni Gupta et al[21]	77.3	22.6
Rapotra M et al[22]	72.5	27.5
S Singh et al[23]	92	8
Michal P Zarzecki et al[24]	81.3	18.7
Dhivyalekshmi et al[25]	80	20
Present study	63.3	36.6

Type F Incomplete SPA was observed in the studies conducted by Coleman and Anson in 13.4% of 650 hands. In this study of 60 hands there were 21 specimens (35%) belonging to Type F incomplete SPA. The comparative studies on the prevalence of Type F SPA has been given in Table 4

Table 4: Comparison between various studies in the frequency (%) of Type F SPA

Author(s)	Type F Incomplete SPA
Coleman and Anson[1]	13.4%
M Al-Turk and Metcalf[26]	8%
H Lippert[8]	58%
H Gellman[11]	11.1%
Süleyman Murat Taðýl et al[15]	20%

Aniruddha Sarkarl et al[18]	16.66%
Sheetal Bhimprasad et al[20]	10%
Rapotra m et al[22]	71.6%
Michal P Zarzecki[24]	34.8%
Present study	35%

Type G Incomplete SPA was observed in the studies conducted by Coleman and Anson in 3.2% of 650 hands. In this study of 60 hands there was 1 specimen (1.6%) belonging to Type G incomplete SPA . The comparative studies on the prevalence of Type G SPA has been given in Table 5

Table 5: The comparative studies on the prevalence of Type G SPA

Author(s)	Type G Incomplete SPA (%)
Coleman and Anson[1]	3.2
H Gellman et al[11]	4.4
Dhar P et al[27]	4.2
Aniruddha Sarkarl et al[18]	7.14
Godwin Mbaka et al[19]	26.1
Sheetal Bhimprasad et al[20]	4
Present study	1.6

Type H Incomplete SPA was observed in the studies conducted by Coleman and Anson in 3.8% of 650 hands. Süleyman Murat Taðýl et al[15] and Sheetal Bhimprasad et al[20] also reported 5% and 4% specimens with Type H respectively**.** We did not find this pattern in our study.

Type I Incomplete SPA was observed in the studies conducted by Coleman and Anson in 1.1% of 650 hands and by Robert Haladaj et al[28] in 1.6% of 125 hands. In this study of 60 hands there were no specimens belonging to Type I incomplete SPA.

CONCLUSION:

Knowledge of the various anatomical patterns in the formation of SPA is crucial for surgeons performing reconstructive hand procedures. Advancement in innovative microsurgical procedures have necessitated an in- depth understanding of the various vascular formations[27]. Sometimes the entire arterial supply to the thumb would be provided by the superficial palmar arch of the ulnar artery. It may not have collateral supply from the radial artery. In such cases traumatic injury to the ulnar artery[29] could be hazardous to the thumb since its arterial supply was solely provided by the superficial palmar arch. Since SPA is the main vascular component of the palm, being familiar about its variations is important for the surgeons performing surgeries like congenital malformations, general procedures, post traumatic deformities, as well as those procedures for the restoration of the functional anatomy of the hand. The results of this study may be helpful for a better understanding of the anatomy of the vascular structure of the palm, which can benefit General and Plastic Reconstructive Surgeons, Interventional Cardiologists, Cardiothoracic Surgeons and Radiologists.

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