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Research article

A CADAVERIC STUDY ON ANATOMICAL VARIATIONS OF THE SUPERFICIAL PALMAR ARCH

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ABSTRACT

Background: The Superficial Palmar arch (SPA) is an anastomosis between the ulnar and radial artery in the palm. Maximum contribution in the arch is by an ulnar artery and it is completed by superficial palmar branch of radial artery or arteria princeps pollicis or arteria radialis indicis or median artery. The SPA develops as a terminal plexus of axis artery which is later joined by median, ulnar and radial arteries as these arteries develop. **Materials & Methods:** Present study conducted in the Department of Anatomy, Chettinad Hospital and Research Institute on 50 (28 right and 22 left) formalin fixed hands were used. The variations observed were classified as per *Coleman and Anson*, 1961, classification of the superficial palmar arch. **Results:** As per *Coleman and Anson* classification, complete arch of type A was seen in 43 hands (86%) and of type B in 3 hands (6%). In this study incomplete arch was seen in 4 hands (8%, 1 right and 3 left), persistent median artery type H supplying the radial side of the palm and digits was seen in only one hand (2%). **Conclusion:** The data regarding the study on variations of SPA is helpful in crushing injury of hand, arterial grafting, and vascular trauma of the upper extremity.

Keywords: Superficial Palmar arch, Radial artery, Ulnar artery, Median artery, Coronary artery bypass graft

INTRODUCTION

A hand or manus is a prehensile, multi fingered body part located at the end of upper limb or forelimb of primates and some other vibrates used for both gross and fine motor skills. In order to perform its various functions, it is richly supplied with blood vessels and nerves¹. The radial and ulnar arteries provide most of the blood supply to the hands. Additional circulation may come from the median artery or the interosseous arterial system.

The superficial palmar arch (SPA) is an anastomosis fed mainly by the ulnar artery. About a third of the SPA are formed by the ulnar artery 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 either arteria princeps pollicis or the median artery².

The radial and ulnar arteries form 4 circuits in the hand; anterior and posterior carpal arches at the level of carpal bones, superficial and deep palmar arches at the mid of palmar level³. Among these the superficial and the deep palmar arches are the most important circuits because they provide the principal blood supply to all the structures in the hands. The SPA develops as a terminal plexus of axis artery which is later joined by median, ulnar and radial arteries as these arteries develop⁴.

According to one of the extensive studies conducted on 1200 formalin fixed hands, by Coleman and Anson in 1961, the variations in the SPA were classified as

complete and incomplete arches which were further subdivided into various subtypes as follows³.

GROUP I – Complete Arch : Type A: classical radio ulnar arch , Type B: Ulnar arch, Type C : mediano-ulnar arch ,Type D: radio-mediano-ulnar arch, Type E: ulnar artery & a branch from deep arch

GROUP II – Incomplete Arch : Type F: radial and ulnar arteries without anastomosis, Type G; only ulnar artery without supply to thumb and index finger, Type H : ulnar and median arteries without anastomosis, Type I: Median, radial and ulnar arteries without anastomosis

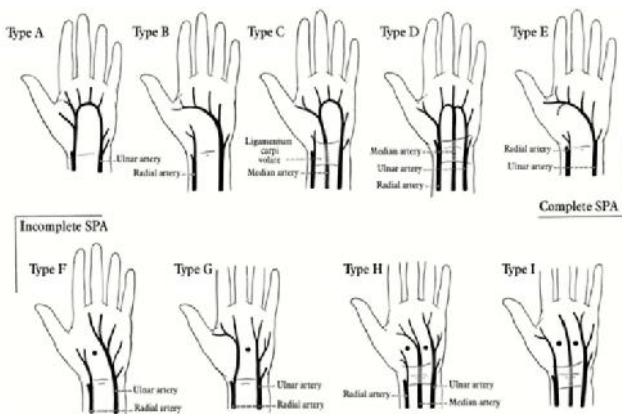


Fig 1: Coleman and Anson classification

Hence the frequent anatomic variations encountered in the formation of the SPA and increasing incidence of taking radial arterial grafts for coronary bypass attracted the interest in checking its incidence.

MATERIALS AND METHODS

For the current study 50 human cadaveric hands (28 right and 22 left) fixed in formalin (10%) solution, hands in the Department of Anatomy, Chettinad Hospital and Research Institute were used. Macroscopic dissection of the palm was done according Cunningham’s manual of practical anatomy and variations in the formation and branching pattern of the SPA were studied, variation were noted and compared with similar studies conducted previously.

OBSERVATION

Out of the 50 hands, complete arch was seen in 46 hands (24 right and 22 left) and incomplete arch in 4 hands. As per **Coleman and Anson** classification, complete arch of type A was seen in 43 hands (86%) and of type B in 3 hands (6%). Between the

incomplete arches, 3 were of type F (6%) and 1 was of type H (2%) (Tab. 1)

Table 1: Incidence percentage of variations in the current study

Arch type	No. of hands	Percentage
Complete arch	46	92
Type A	43	86
Type B	3	6
Incomplete arch	4	8
Type F	3	6
Type H	1	2

Most of the arches seen in the current study were of type A (Fig. 2), formed by the ulnar artery and completed on the radial side either by the superficial branch of the radial artery or princeps pollicis artery or radialis indicis artery, branches of radial artery. Only ulnar artery formed the arch (Fig. 3) in only 3 hands and ulnar & radial without anastomosis (Fig. 4) in 3 hands. Persistent median artery supplying the radial side of the palm and digits (Fig. 5) was seen in only one hand.



Fig. 2: Complete arch, Type A – Classical radio ulnar arch. (RA: Radial artery, UA: Ulnar artery)



Fig. 3: Complete arch, Type B – Ulnar arch . (UA: Ulnar artery)



Fig. 4: Incomplete arch, Type F – Radial and ulnar arteries without anastomosis (UA: Ulnar artery, RA : Radial artery).

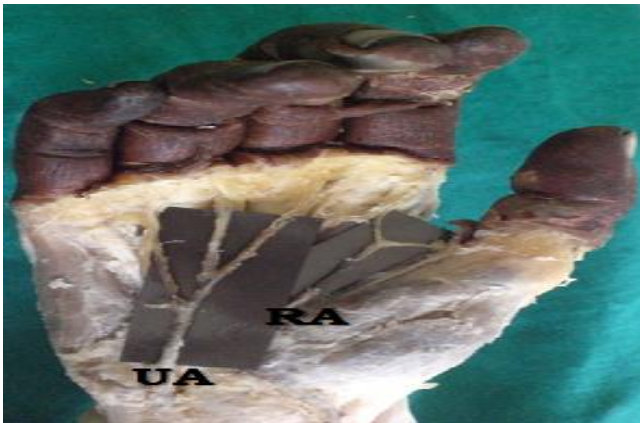


Fig. 5: Incomplete arch, Type H – Mediano-ulnar arch (2%), MA – Median artery, UA – Ulnar artery.

DISCUSSION

Advanced methods in Microsurgical techniques for the reconstructing surgery of the hand and Upper extremity and the choice of using a radial artery graft during Coronary artery bypass grafting (CABG) have necessitated the understanding of vascular architecture in the palm.

Developmental the anomalies of blood vessels may be due to: (i) The choice of unusual paths in the primitive vascular plexuses. (ii) The persistence of vessels normally obliterated. (iii) The disappearance of vessels normally retained. (iv) Incomplete development.

The normal arterial blood supply to the human hand is well documented, although the vascular supply to the hand and digits via the SPA is known to be variable (Al-Turk & Metcalf, 1984; Iossifidis, 1995⁴, Ikeda et al, 1988, Onderoglu et al, 1997⁵). The systematic arterial patterns of the hand were first described by Jaschtschinski, 1897⁶. Various anomalous patterns in the arterial arches have been studied and various

classifications based on the contribution from the formative branches, mainly superficial branches of the radial artery and ulnar artery have been proposed by various authors.

SPA was seen in all the 50 hands (100%) dissected (25 right, 25 left) unlike Brent et al⁷ (2010) who reported a case of unilateral absence of the SPA in one hand he observed. Complete arch was seen in 92% of the hands (46, 22 left and 24 right) in the current study. These results are similar to those reported by MariosLoukas et al (2005)⁸, who observed the presence of 90% complete arches in his study. Although complete arches seem to be more prevalent, as observed in the present study, in most of the studies done by Coleman and Anson, 1961 (78.5%), Suleyman et al, 2007 (75%)⁹, Silvia et al, 2003 (60%)¹⁰, Nicolas et al, 2010 (58%)¹¹; some authors like Valeria et al, 2004 (47.5%)¹² and Elizabeth O' Sullivan et al, 2002 (46.8%)¹³ lesser incidence of complete arches was reported.

The classical radio-ulnar arch formed by ulnar artery and the superficial branch of radial artery or princeps pollicis artery or radialis indicis artery (Coleman and Anson, 1961, Type A) was seen in 43 hands (86%, 21 left and 22 right) in the current study unlike other authors (Silvia et al, 2003, 67%; Suleyman et al, 2007, 40%; MariosLoukas et al, 2005, 40% and Coleman and Anson, 1961, 34%) who have reported a lesser incidence of the same type.

The ulnar type of arch formed by the ulnar artery alone (Coleman and Anson, 1961, Type B) was seen in 3 hands (6%, 2right and 1 left) in the present study. In comparison such an arch was more prevalent in other studies such as Coleman and Anson, 1961, 37%; Suleyman et al, 2007, 35%; MariosLoukas et al, 2005, 35%; Silvia et al, 2003, 23%.

In this study incomplete arch was seen in 4 hands (8%, 1 right and 3 left) in par with Marios Loukas et al, 2005, who reported it in 10% of his study and unlike other authors (Elizabeth O' Sullivan et al, 2002, 53.2%; Valeria et al, 2004, 52.5%; Nicolas et al, 2010, 42%; Silvia et al, 2003, 40%; Suleyman et al, 2007, 25% and Coleman and Anson, 1961, 21.5%, who have reported increased occurrence of the same (Fig. 6).

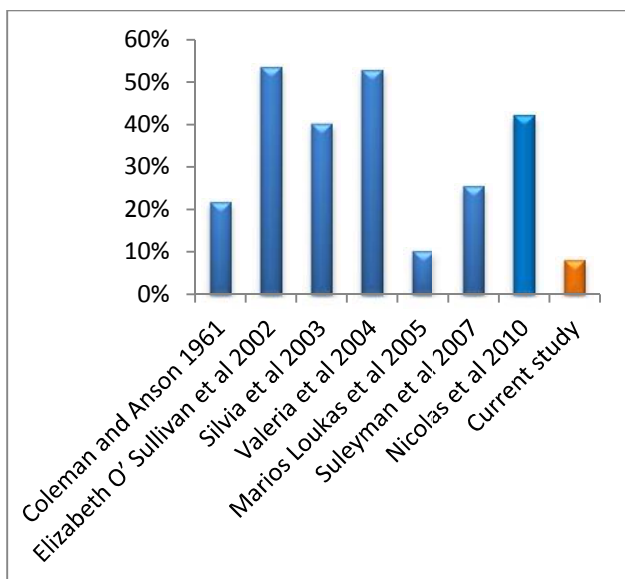


Fig. 6: Incomplete superficial Palmar arch - Current study Vs Various authors

The most consistent incomplete arch was ulnar and radial arteries without anastomosis (Coleman and Anson, 1961, Type F), seen in 3 hands in this study (6%, 2 left and 1 right hands). This type was seen in 3.2% of the hands by Coleman and Anson, 1961; in 20% of the hands by Suleyman et al, 2007 and in 33% of the hands by Silvia et al, 2003 (Fig. 7).

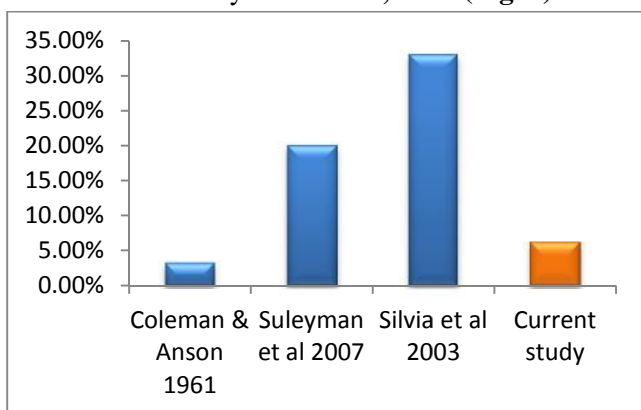


Fig. 7: Type F of incomplete superficial palmar arch - Current study Vs Various authors

Only one of Coleman and Anson, Type H, in which median and ulnar arteries supplied the palm without anastomosis, was observed in the current study (2%, left hand). Whereas Coleman and Anson reported 3.8% of the same type and Silvia et al, 10% (Fig 8). The other types of arches described by Coleman and Anson (Types C, D, E, G and I) were not observed in the current study.

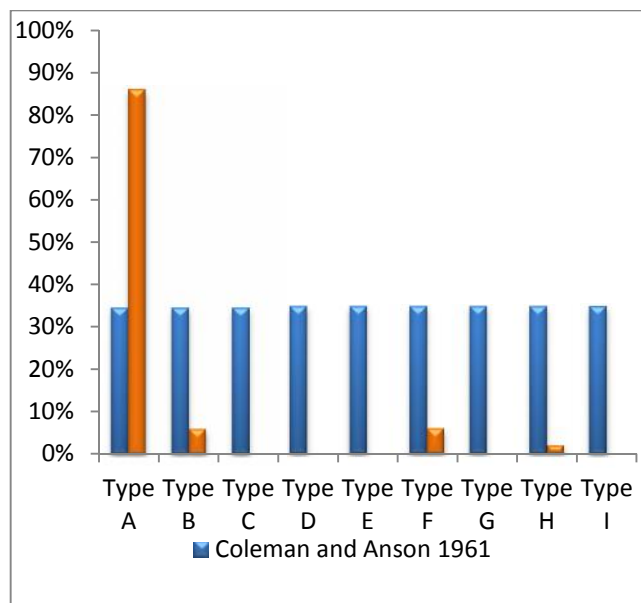


Fig. 8: Various types of arches - Current study Vs Coleman & Anson's

CONCLUSION

The superficial and deep palmar arches account for a rich anastomosis between arteries of the palm. Wounds of the palm bleed profusely but heal rapidly because of this anastomosis. An injury in the ulnar artery or the SPA may compromise the arterial supply of the fingers, particularly if there is an insufficient anastomosis between the superficial and deep palmar arches.

The sound knowledge about the vascular patterns in the palm is crucial in microsurgical procedures of hand and in amputations and in the choice of using the radial artery for coronary bypass graft and in preventing possible complications during hand surgery. Identifying the presence of median artery and its participation in the arch completion is important in ligation of radial or ulnar artery in case of vascular trauma.

In addition, the identification of any variation in the arterial pattern of the hand using Doppler ultrasonography, photoplethysmography and oximetric techniques acquires great importance in various surgical interventions in the hand.¹⁴ The present study gives necessary information to understand the vascular architecture and its common and rare variations in the hand.

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