



A Cadaveric Study on the Anatomic variation in the formation and variations in the branching pattern of superficial palmar arch and its clinical relevance

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Abstract

Superficial palmar arch (SPA) is an important arterial anastomotic arcade which is the dominant vascular supply to the majority of the palmar muscles²¹. 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 develop²⁹. Present variations of superficial palmar arch and their digital branches was observed during routine dissection on cadavers in the department of anatomy, Rajah muthiah medical college, Chidambaram. Dissection of arch was carried out and variations of superficial palmar arch with regards to formative arteries and branching pattern are studied in detail. In the present study, out of 50 limbs, 28(56%) limbs showed complete palmar arch with ulnar and radial artery, 14(28%) with ulnar artery alone, 2(4%) showed incomplete arch with median, ulnar and radial artery and 6(12%) limbs showed incomplete arch with ulnar artery and radial artery.

Introduction

A hand or manus is a prehensile, multi fingered body part located at the end of upper limb¹. The human hand requires major blood supply because of the multiple positions and tasks in which it would be involved and these multiple positions will result in distribution of pressure in various direction. This prime purpose is mainly solved by the presence of highly branched and dense network of arteries in the palm mainly contributed by two palmar arches namely superficial and deep palmar arch²³. Superficial Palmar Arch is an arterial arcade and a dominant vascular structure amongst the superficial and deep palmar arches of

the hand. It is defined as the anastomosis between the superficial branch of the ulnar artery and superficial palmar branch of the radial 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 hamates, and then curves laterally to form an arch, convex distally and level with a transverse line through the distal border of the fully extended pollical base. About a third of the superficial palmar arches are formed by the ulnar alone; a further third is 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. The superficial palmar arch is covered by palmaris brevis and the palmar aponeurosis and it is superficial to flexor digiti minimi, branches of the median nerve and to the long flexor tendons and lumbricals. The SPA has been described to be broadly divided into two categories: complete and incomplete. The difference resides in the presence or absence of an arch formed either by a single artery or between the constituting vessels. Information on the morphological variations of superficial palmar arch is highly useful in case of microsurgical reconstructive surgeries of hand⁸. Thus, knowledge of superficial palmar arch is important for anatomist for academical purpose as well as for surgeons, radiologists and orthopaedicians in their clinical practice. Considering the role of superficial palmar arch and its variations in the successful outcome of any hand surgeries the presents study is an attempt to learn the course, relation, variations of superficial palmar arches in human cadavers²⁸.

Materials and methods

A variation in the superficial palmar arch was observed during routine dissection of 50 upper limbs of 25 embalmed cadaver in department of Anatomy, Rajah muthiah Medical College and

hospital, Annamalai University, Chidambaram during the study period of 3 years.

A transverse incision was given at wrist. From the midpoint of this incision another incision was taken to the tip of middle finger in the median plane. Transverse incision was given at the roots of fingers. The flaps were reflected taking care not to injure the cutaneous vessels and nerves. Palmar aponeurosis was exposed and divided proximally and reflected distally cutting the septae which pass backwards from its edges. This exposed the superficial palmar arch which was later cleaned to study the formation of arches, branching pattern and variations

Observation

The SPA according to Coleman and Anson was classified into complete or incomplete types. The SPA was defined as complete when the ulnar artery anastomosed with either or both the superficial palmar branch of the radial and the ulnar artery. Where no such anastomosis occurs, the SPA was defined as incomplete²⁰. Out of our 50 limbs, almost all the specimen had either complete or incomplete superficial palmar arch. A complete palmar arch formed by ulnar and radial artery (figure-1) was observed in 28 limbs (56%).

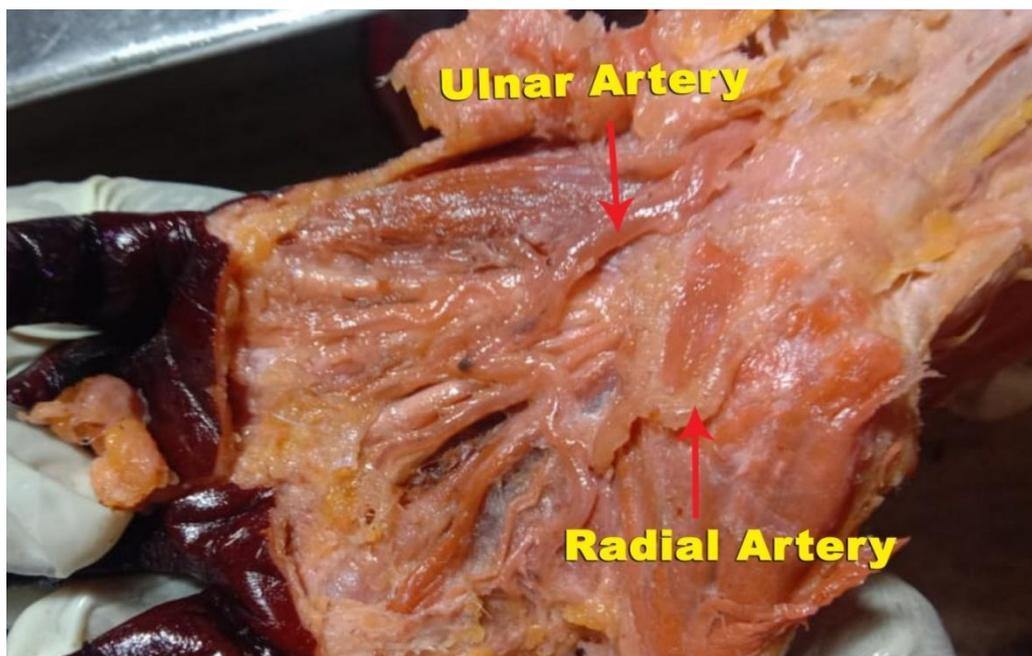


Figure-1: complete palmar arch from ulnar and radial artery

The second highest percentage of 28% was observed in 14 limbs (figure-2) which had superficial palmar arch from ulnar artery alone.

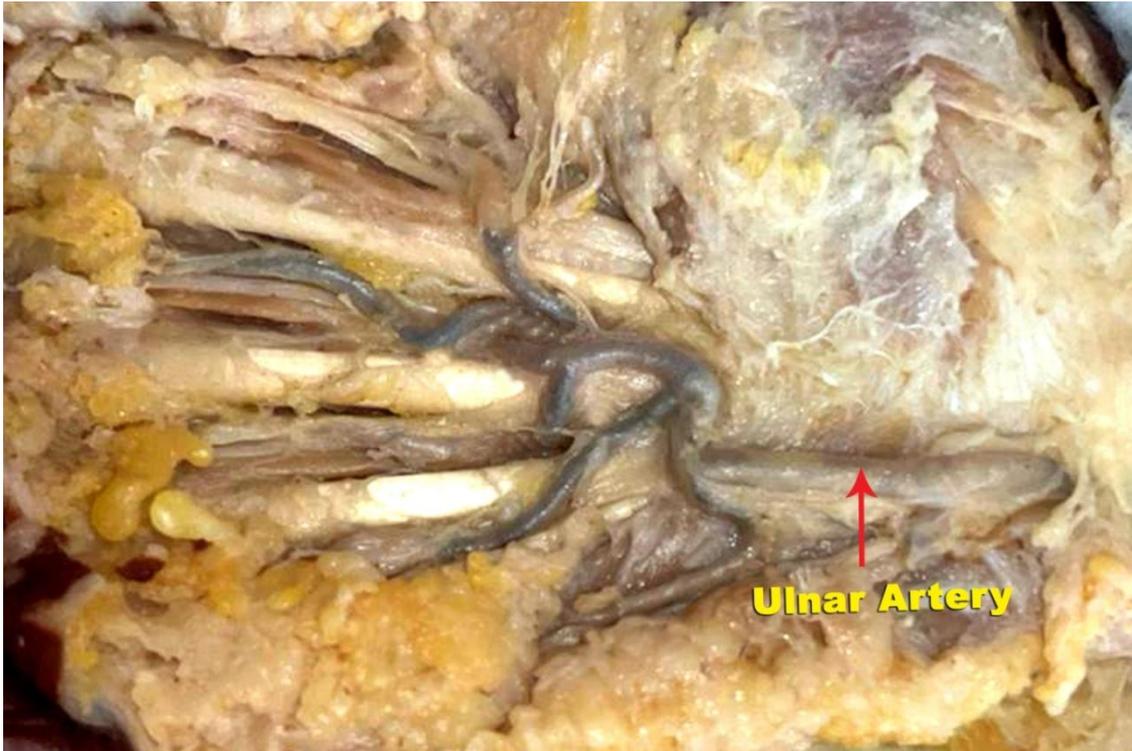


Figure 2: superficial palmar arch from ulnar artery alone

In 6(12%) of the specimens (figure-3), the superficial palmar arches are incomplete arch formed by the superficial palmar branch of the radial artery and the ulnar artery

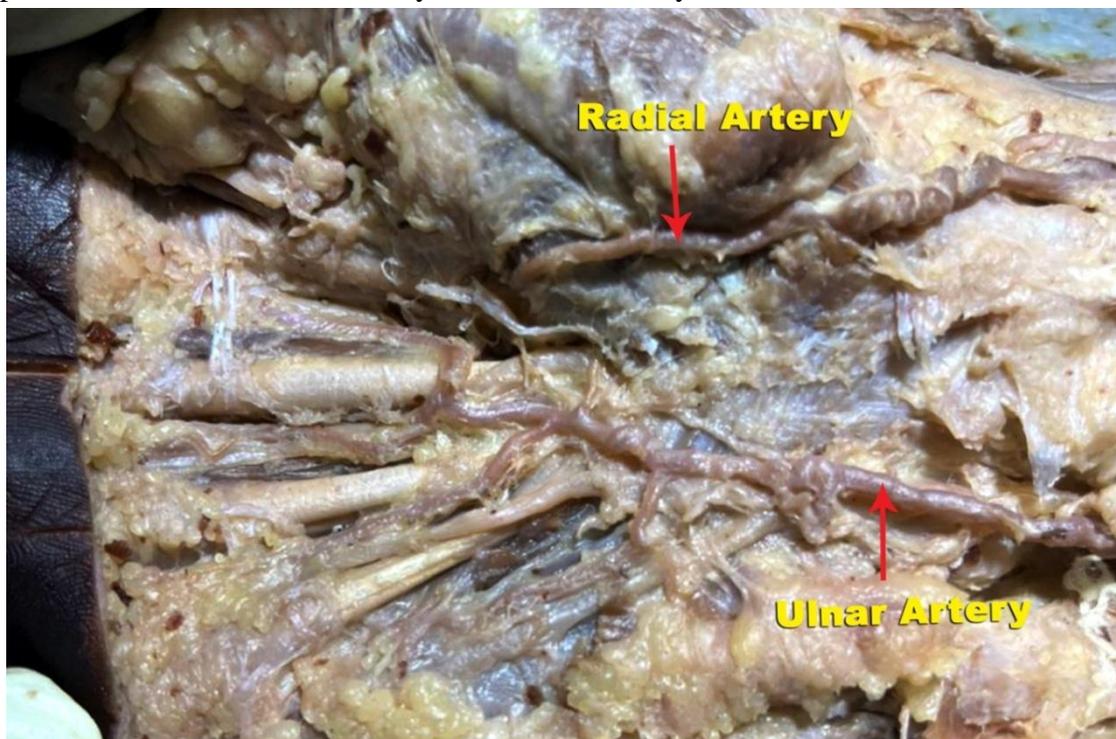


Figure 3: incomplete arch with ulnar and radial artery

A very least percentage of 4% is seen on 2 upper limbs (figure-4) which showed incomplete arch with median, ulnar and radial artery, in this case the median artery arises from the radial artery, this type is not reported in other articles

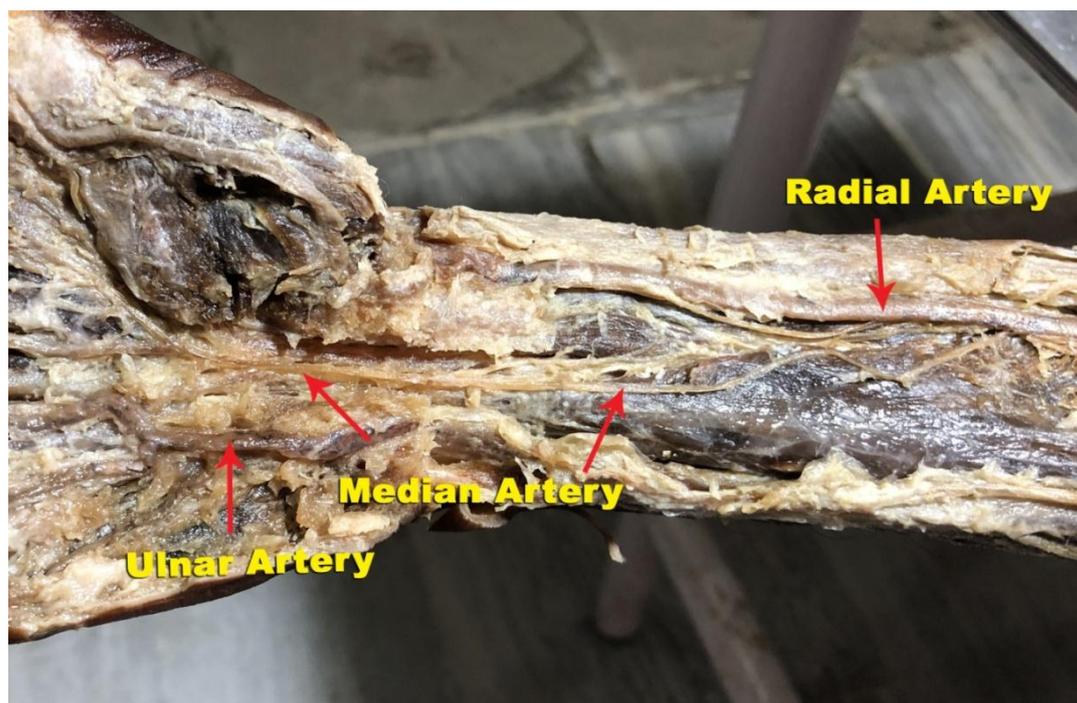


Figure 4: incomplete arch with median, ulnar and radial artery

Discussion

Formation and branching pattern superficial palmar arch are one of the interesting areas in a human body showing high level of variation³. These variations were the centre of attraction for many anatomists and many studies have been conducted on them from centuries. Many attempts have been made to classify these variations¹¹. The systematic arterial patterns of the hand were first described by Jaschtschinski, 1897. 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 authors⁶.

Jaschtschinski divided the superficial palmar arches into complete and incomplete types. This was later modified by Adachi by classifying the arches into 3 types. Type 1: ulnar type with minimal or absence of contribution by radial artery seen in 59% of hands. Type 2: Classical radioulnar type seen in 32% of hands. Type 3: Mediano-ulnar type seen in 9% of hands²⁸.

In our present study all the specimens had superficial palmar artery which is in contrast with the study of Brent et al⁴ who reported a case of unilateral absence of the SPA in one hand. Although lesser incidence of complete arches was reported by Coleman and Anson⁵, 1961 (78.5%), Suleyman et al²⁴, 2007 (75%), Silvia et al²², 2003 (60%), Nicolas et al¹⁷, 2010 (58%); Valeria et al²⁷, 2004 (47.5%) and Elizabeth O' Sullivan et al⁶, 2002 (46.8%), our study almost showed (85%) similar result of Marios Loukas et al¹⁶ (2005) who observed the presence of 90% complete arches in his study.

Comparison with work of researchers like Ikeda et al⁹, Patnaik et al¹⁸., M. Chimmalgi et al¹⁴., Bilge O²., Umopathy Sembian et al²⁶., which followed Coleman and Anson's classification of palmar arterial arches indicates that the classical palmar arch, that is Group I (Type A) of Superficial Palmar Arch is having a higher incidence. This was similar with our present study where in the 28 limbs (56%) had complete palmar arch formed by ulnar and radial artery (figure-1).

The ulnar type of arch formed by the ulnar artery alone (Figure-2) was seen in 14 limbs (28%) in the present study which is similar to studies of Coleman and Anson⁵, 1961, 37%; Suleyman et al²⁴, 2007, 35%; Marios Loukas et al¹⁶, 2005, 35% and Silvia et al²², 2003, 23%.

In the present study, 4% showed mediano ulnar type of incomplete arch (Figure-3). Jaschtschinsky called this an atavistic characteristic because the median artery is normally round in the palmar arch of certain lower animals. Singer describes the persistence of median artery to be due to cessation of development at fourth stage as described by him¹⁰.

In our current study incomplete arch with ulnar artery and radial artery was seen in 6 limbs (12%), in par with Marios Loukas et al¹⁶, 2005, who reported it in 10% of his study and unlike other authors., Elizabeth O' Sullivan et al⁶, 2002, 53.2%; Valeria et al²⁷, 2004, 52.5%; Nicolas et al¹⁷, 2010, 42%; Silvia et al²², 2003, 40%; Suleyman et al²⁴, 2007, 25% and Coleman and Anson⁵, 1961, 21.5%, who have reported increased occurrence of the same.

Conclusion

Vascular supply to human hand is one of the challenging areas showing many morphological variations²⁸. It is a matter of fact that the presence of extensive arterial anastomosis in the hand leads to profuse bleeding from its wounds; but for the same reasons, healing is also very rapid. That's why particular attention has been paid since long time to the superficially placed arch while making incisions. Nowadays, though advanced imaging techniques are used for morphological evaluation, accuracy and reliability of radiological interpretation still often depends on anatomical references¹⁹. Variations found in this study will help not only the anatomists, but also orthopaedicians and microvascular surgeons during reconstructive hand surgeries, preoperative screening of radial artery harvesting for myocardial revascularization and also in arterial interventions that include radial artery cannulation

and radial artery forearm flap. Even while making incisions to evacuate pus from the hand, special attention should be paid to the superficial position of termination of ulnar artery and SPA¹³.

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