

## CASE REPORT

# Rare anatomical variant: arterial circle in palm and at the base of the thumb

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### Abstract

In this article, we describe anomalous formation, distribution of superficial palmar arch and an arterial circle at the base of the thumb found during routine dissection classes in the right hand of a 45-year-old male cadaver. These variations are unique and provide significant information to surgeons dissecting the hand region.

**Keywords:** superficial palmar arch, thumb, cadaver.

### ■ Introduction

The superficial palmar arch (SPA) is an arterial arcade that lies beneath the palmar aponeurosis and in front of long flexor tendons, lumbrical muscles and palmar digital branches of median nerve. The SPA is the major source of blood supply to the hand and fingers and is normally formed by the superficial branch of ulnar artery and completed on the lateral side by one of the following arteries: (a) the superficial palmar branch of radial artery; (b) princeps pollicis artery; (c) radialis indicis artery; or median artery. Various anomalous patterns in the SPA of the hand have been reported. Among these variations are the superficial palmar branch of the radial artery passing deep to the flexor retinaculum to form the SPA [1], absence of the SPA [2], incomplete development of the SPA [3], doubled SPA [4] and princeps pollicis and radialis indicis arteries arising from SPA [5].

### ■ Material and Methods

The study involved the upper limb dissections of a 45-year-old male cadaver of South Indian origin in the Department of Anatomy, Melaka Manipal Medical College, Manipal, India. The dissection of upper limbs was carried out according to the instructions by Cunningham's *Manual of Practical Anatomy*. The dissections took place during the year 2006–2007. The body was preserved by the injection of a formalin-based preservative (10% formalin) and stored at -4°C.

### ■ Results

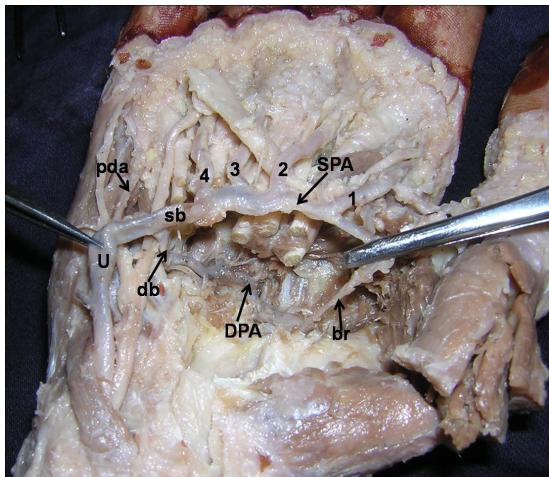
The present report is about a variant SPA observed in right hand. The SPA was formed by superficial branch of ulnar artery and a communicating branch

from the deep palmar arch (DPA) which passed between the oblique and transverse heads of adductor pollicis muscle before completing the arch. This anastomosis formed an arterial circle in the palm. The SPA gave origin to four common palmar digital arteries and a proper palmar digital artery. The first common palmar digital artery is a rare occurrence and in the present case, it divided into radialis indicis and princeps pollicis arteries (Figures 1 and 2). There were no branches from the DPA to supply the index finger and thumb. The second, third and fourth common palmar digital arteries divided into digital branches to supply the second, third and fourth web spaces and the proper palmar digital artery was supplying the ulnar side of the little finger. In the present case the superficial palmar branch of radial artery anastomosed with a branch of DPA. Thus radial artery, its superficial palmar branch and branch from DPA formed an arterial circle "circulus arteriosus pollicis" at the base of thumb (Figure 2).

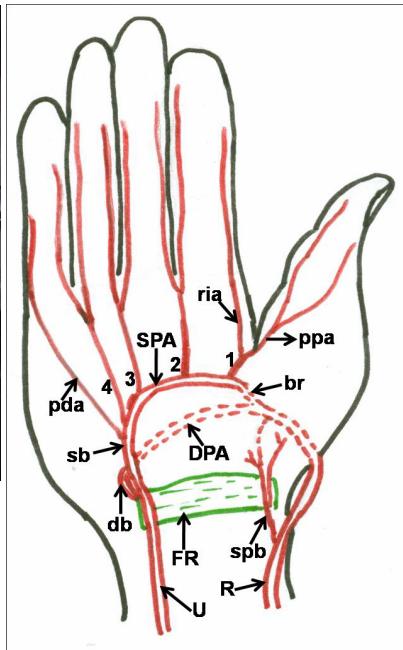
### ■ Discussion

The developmental reason for the anomalous superficial palmar arch in the present case can be explained as the persistence of anastomotic channel, which is seen in the embryonic life between superficial and deep palmar arches.

A study of 200 hands by Loukas M *et al.* (2005) showed complete superficial palmar arch in 90% of cases and divided into five types, while the remaining 10% possessed an incomplete palmar arch. In type I (40%), the SPA is formed by anastomosis of the superficial palmar branch of the radial artery to the ulnar artery. Type II (35%) is formed entirely of the ulnar artery. Type III (15%) is formed by anastomosis of the ulnar and median arteries.



**Figure 1 – Anomalous superficial palmar arch:**  
SPA – superficial palmar arch; DPA – deep palmar arch; br – branch from deep palmar arch; U – ulnar artery; sb – superficial branch; db – deep branch; 1–4, common palmar digital arteries; pda – proper palmar digital artery



**Figure 2 – Schematic drawing showing variant formation and distribution of superficial palmar arch and arterial circle at the base of the thumb:**  
R – radial artery; spb – superficial palmar branch; U – ulnar artery; sb – superficial branch; db – deep branch; DPA – deep palmar arch; SPA – superficial palmar arch; br – communicating branch; 1–4, common palmar digital arteries; pda – proper palmar digital artery; ppa – princeps pollicis artery; ria – radialis indicis artery; FR – flexor retinaculum

Type IV (6%) is formed by anastomosis of the ulnar, radial, and median arteries and Type V (4%) is formed by a branch of the deep palmar arch (DPA) communicating with the SPA [6]. The present case is similar to the type V of the above study in formation of SPA. However, the SPA in the present case showed anomalous branching pattern. There are no other reports in the literature suggesting that a communicating branch from the DPA can form the SPA.

McCormack LJ *et al.* (1953) in their comprehensive study on the arterial pattern of 750 hands did not find the origin of the princeps pollicis and radialis indicis arteries from the SPA [7].

Gajisin and Zbrodowski (1993), in their series of 200 specimens, found three common palmar digital arteries from SPA in addition to numerous small branches [8]. They did not refer to any branches from the superficial arch supplying the first web space.

According to Ikeda A *et al.* (1988) the artery arising from the SPA to supply the first web space can be called as the first common palmar digital artery [9]. There is a contradiction in the origin of the blood supply to the first web space of the hand. Karlsson and Niechajev (1982), in their study of the blood supply of the hand, demonstrated the presence of the princeps pollicis artery in all 139 cases studied and it was the most constant branch of the palmar metacarpal arteries [10].

On the contrary, Al-Turk M and Metcalf WK (1984) in their series of 50 cases found that the princeps pollicis artery arising from the carpal branch of the radial artery (56%) and in these cases the radialis indicis artery arose either from the superficial arch (12%) or from the carpal branch of the radial artery (44%) [11].

Ames EL *et al.* (1993) reported that in only three of their 40 cases was the princeps pollicis artery the only branch supplying the thumb and index finger and suggested that the term princeps pollicis artery be abandoned [12]. They indicated that branches from both the superficial and deep palmar arches usually supply

the thumb and index finger and neither of these two systems was dominant in 54% of their 40 cases. In the remaining specimens, they found the dominant vessel was the superficial palmar branch of the radial artery in 8%, the first metacarpal artery in 18%, and the dorsal metacarpal artery in 8%. In the present report, branches of the superficial arch were the main blood-supply of the thumb as there were no branches from the deep arch.

The superficial palmar branch of the radial artery is reported to course within or deep and occasionally superficial to the thenar muscles [13]. In this case, the superficial palmar branch of the radial artery coursed deep to the thenar muscles and terminated by anastomosing with a branch of the DPA to form an arterial circle at the base of the thumb, which is important information for an orthopedician heading for thumb surgery.

Knowledge of the frequency of anatomical variations of the arterial pattern of the hand is crucial for safe and successful hand surgery [14]. During surgical procedures of thumb in the cases similar to ours, ligation of radial artery may not be sufficient to stop the profuse bleeding since major blood supply was coming from the SPA. Several techniques are used to identify and locate any unusual vessel in the upper limb, including Doppler ultrasound, the modified Allen test, pulse oximetry and arterial angiography [15–17].

In the case presented here, the superficial arch predominated over the deep arch in the region of the thumb and index finger. This is similar to the cases reported by Ugawa A and Ikeda A (1985) where the princeps pollicis artery of monkeys originated from the superficial palmar arch [18].

In the absence of arterial supply from the deep arch, the arteries arising from the SPA to the first web space acquire great importance and should be handled with care in various surgical operations, such as resection of the second metacarpal bone in complex hand injuries to

achieve improved function. These variations must be taken into account during surgical dissections in that area.

## Conclusions

Knowledge of anatomical variations of the arterial pattern of the hand is crucial for safe and successful hand surgery. Although there are number of variations reported in the arterial supply of palm, the case described here is unique and it will be an interesting finding to anatomists and clinicians.

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