The Superficial Palmar Arch: Anatomical and Angiographic Study in Human

A Thesis

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ABSTRACT

In this thesis 10 hands of adult cadavers (6 females and 4 males) were used. The specimens were subjected to dissection. Also 10 angiography of hands and 20 duplex ultrasound of hands were used. The arterial supply of the hands was thoroughly studied. Variations in female hands were more obvious than in the male ones and in right hands more than in left ones.

According to formation, the superficial palmar arch was complete in 50%, incomplete in 35% and absent in 15%. The ulnar artery curved laterally and ended opposite the 2nd intermetacarpal space. Number of common palmar digital branches varied from two branches in 35% and three branches in 65%. There was other branches arising from the SPA as the principis pollicis in 15% and radialis indicies in 20 % and a branch to medial side of little finger in 5%.

According to distribution of palmar digital arteries, palmar digital arteries supplying adjacent sides of the medial four finger. This was found in 10 hands out of 20 (50 %). Palmar digital arteries supplying adjacent sides of the medial fingers . This was found in 3 hands out of 20 (15 %) . Palmar digital arteries supplying adjacent sides of middle 3 fingers. This was found in 7 hands out of 20 (35 %).

In the present study, we measured the diameters of ulnar, radial and SPA arteries using duplex ultrasound. It was found that the diameter of superficial palmar arch ranged from 0.99 mm to 2.8 mm with a mean value of 1.665mm. On the other hand the diameter of ulnar artery ranged from 1.6mm to 2.7mm with a mean value of 2.40 mm, while that of radial artery ranged from 1.3 mm to 3 mm with a mean value of 2.065 mm.

It could be concluded from this study, that any surgical interference in the SPA would affect the vascularity of the thumb. Also, for finger transplantation and for hand transfer, full knowledge of the origin of digital branches of the arches should be known.

Key words : Superficial palmer arch - Ulnar artery - Radial artery - Angiographic study - Ultrasound.

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CPDA Common Palmar Digital Artery

PL Palmaris Longus

PP Princips Pollicis Artery

R Radial Artery

RI Radialis Indicis Artery

SPA Superficial Palmar Arch

SPBR Superficial Palmar Branch of Radial artery

U Ulnar Artery

The superficial palmar arch is the major blood supply of the hand **(McMimm 1992; Gajisin and Zhrodowski 1993; Carlson 1994; Olave et al. 1997 and Mathew and Ebby 2012)**. The authors reported that the radial and ulnar arteries form the superficial and deep arterial arches of the hand. They found that the superficial palmar arch is the dominant vascular structure of the palm. It is localized just deep to the palmar aponeurosis and is superficial to digital branches of the median nerve, long flexor tendons of the forearm and lumbrical muscles of the hand.

Williams et al. (1999) mentioned that there are three common palmar digital arteries arising from the convexity of the superficial palmar arch, each divides into two proper palmar digital arteries. These arteries run along the contiguous sides of the four medial fingers except the radial side of the index and ulnar side of the little finger. The palmar digital artery for the medial side of the little finger arises from the arch under the palmaris brevis muscle. The authors observed in some cases a persistent median artery which is the axis artery of the superior

extremity during early embryonic life that maintains the superficial palmar arch (SPA) during development of the radial and ulnar arteries.

Batta (2000) described that the superficial palmar arch is formed by the superficial terminal branch of ulnar artery and is usually completed on the lateral side by one of the following arteries; the superficial palmar branch of radial artery, princeps pollicis or radialis indicis artery or the median artery which accompanies the median nerve.

McWilliams and Sodha (2000) stressed on the fact that knowledge of the frequency of anatomical variations of the arterial pattern of the hand is crucial for safe and successful hand surgeries. Several techniques are used to identify and locate vessels in the hand including doppler ultrasound pulse oximetry and arterial angiography (**Janevski 1982; Uglietta and Kadir, 1989; Fuhrman et al. 1992 ; Erbil et al. 1999; Omokawa et al. 2001 and Ottone et al. 2010).**

The general pattern of arterial supply of the hand consists of two systems for the palmar aspect and a single system for the dorsal aspect of the hand. The palmar supply is arranged into superficial and deep palmar arches. The superficial palmar arch is mainly fed by the ulnar artery, passing superficial to the flexor retinaculum, and then curving laterally to form an arch, lying just deep to the palmar aponeurosis. About one third of the superficial palmar arches are formed by the ulnar artery alone; a further third is completed by the superficial palmar branch of the radial artery; and a third by the radialis indicis, princeps pollicis or by the median artery **(Ruengsakulrach 2001; Valeria et al. 2004; Johnson et al. 2005 and Vollala et al. 2009) .**

Aim of the work

The aim of the present work is to throw light on the anatomy of the superficial palmar arch and its variations augmented with angiographic and ultrasonic findings in an attempt to help in the treatment strategies of the ischemic hand conditions and for a safe and successful hand surgery.

Anatomy of the Superficial Palmar Arch

Gellman et al. (2001) and Marios et al. (2005) classified arterial palmar arches into superficial and deep arches. The superficial arch is more superficial and distal in relation to the deep arch

Venkata et al. (2009) concluded that the superficial palmar arch was the major blood supply of the hand and present just beneath the palmar aponeurosis and superficial to the long flexor tendons, lumbrical muscles and palmar digital branches of the median and ulnar nerves.

The superficial palmar arch is represented by a line that begins at the radial side of the pisiform, bends laterally up to the base of the thumb, with its convexity towards the fingers **(Ikeda et al. 1988; Silvia et al. 2003; Latiff 2008 and Vollala et al 2008).**

Romanes (2005) observed that the superficial palmar arch gives four palmar digital arteries, the medial most supplies

the medial side of little finger and is termed as proper palmar digital artery. The other three are common palmar digital arteries which pass to the medial three interdigital clefts

Anatomical Variations in the Superficial Palmar Arch

Soubhagya 2010; Al-Turk and Metcalf (1984); Standring 2005 and **Suleyman et al. (2007)** indicated that there were no specimens that had absent SPA.

Ronald (1995) reported that in a study of 200 subjects, the superficial palmar arch was present in 68% of individuals. It was formed by the superficial branch of the ulnar artery anastomosing with the superficial palmar branch of the radial artery in 68% where as it was absent in 32%.The superficial palmar branch of radial artery may be larger than usual, and have a greater role than the ulnar in the formation of the arch, When the arch is absent, the digital arteries arise from enlarged metacarpal arteries from the deep palmar arch or from enlarged dorsal metacarpal arteries.