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Case Study

CADAVERIC STUDY OF UNILATERAL PRESENCE OF NON-ARCH CODOMINANT SUBTYPE ULNAR/RADIOPALMAR PATTERN OF SUPERFICIAL PALMAR ARCH

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ABSTRACT

The traditional description of the hand's superficial palmar arch highlights its formation through an anastomosis between the ulnar artery and the superficial palmar branch of the radial artery. However, the actual structure of the arch show significant variation, both in the size of the contributing arteries and due to the presence of additional branches from other arteries that may also contribute to its formation. **Material and Results:** A case of unilateral presence of incomplete superficial palmar arch has been found with respect to its course and branching. This variation was found on the left-hand palmar aspect of a 72-year-old male cadaver during regular anatomical dissection. Non arch codominant subtype ulnar/radiopalmar pattern of superficial palmar arch was found with varied branching pattern. **Conclusions:** The anatomical knowledge of the variability in the arch formation becomes important in the application of surgical techniques that can help treating pathologies of the hand.

INTRODUCTION

The anastomosis between the ulnar and radial arteries indicates the Superficial Palmar Arch (SPA). The arch is convex towards the fingers. Usually, The SPA is formed as the direct continuation of the ulnar artery beyond the flexor retinaculum, i.e., by the superficial palmar branch. At lateral side, the completion of the arch is done by superficial palmar branch of radial artery. Three common digital and one proper digital branch from SPA. The one proper digital branch supplies the medial 3½ digits. Three lateral common digital branches connected by the corresponding arteries from the deep palmar arch.[1]

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According to study conducted by Nicolás Ernesto Ottone, over a total amount of 86 dissected hands, they observed a first major division into two types: Arch Type and Non-Arch Type. The Arch Type corresponds to an arterial system which is formed by the anastomosis of two arteries. This arrangement was found in 50 cases (58.0%). In the Non-Arch Type there is no complete "arch" formation. The area vascularized by the arch is replaced by one artery (alone) or two (mutually independently) arteries [3,4].

Regarding the Non-Arch Type, there are two subtypes: Dominant Ulnar Subtype (36 cases; 42.0%): in this arrangement, the ulnar artery is the only artery responsible for the formation of the SPA. This subtype has two forms: - Ulnar Pattern (20 cases; 23.2%): the ulnar artery is completely in charge of the superficial palmar vascularization in the absence of a radiopalmar artery. Ulnar/Radiopalmar Pattern (5 cases; 5.8%): as in the ulnar pattern, the ulnar artery supplies the whole of the superficial palmar area, but in case presence of a small radiopalmar artery it ends at the

level of the thenar muscles. Codominant Subtype (11 cases; 13.0%): here subtype indicate to the presence of two arteries, which supply two totally independent regions. Ulnar/Radiopalmar Pattern (7 cases; 8.3%) and Ulnar/Median Artery Pattern (4 cases; 4.7%) are the two patterns (Fig 1) [5].

The anatomical information of the variability in the arching pattern plays very important role in the application of surgical techniques.

MATERIALS AND METHODS

A case of unilateral presence of incomplete superficial palmar arch was identified during our routine dissection. This dissection was performed on the male cadaver of 72 years old in the Department of Rachana Sharir, National Institute of Ayurveda (Deemed university) Jaipur, Rajasthan, India. The cadavers were sourced from donated bodies for medical education and research purposes and were preserved as per standard technique.

Case report

During the routine dissection, we have identified unilateral presence of incomplete superficial palmar arch at left side of hand [Fig 2] on male cadaver aged 72 years through the approach of grants dissector. On the left-hand palmar region non arch with codominant subtype ulnar/ radiopalmar pattern was identified.

There was absence of anastomosis between radiopalmar and ulnar arteries forming incomplete superficial palmar arch.

Three common palmar digital arterial branches and the appropriate palmar digital artery were emerging from the ulnar palmar artery. These were originated from the 2 main branches from ulnar artery. The branch which is most medial [U1] is giving one proper palmar digital artery to little finger and one common palmar digital arterial branch to ring and little finger. The medial one [U2] was giving two common palmar digital arterial branches to ring, middle, and index finger.

The superficial palmar branch from the radial artery was giving one proper palmar artery to thumb and index finger. [Fig 3-4]

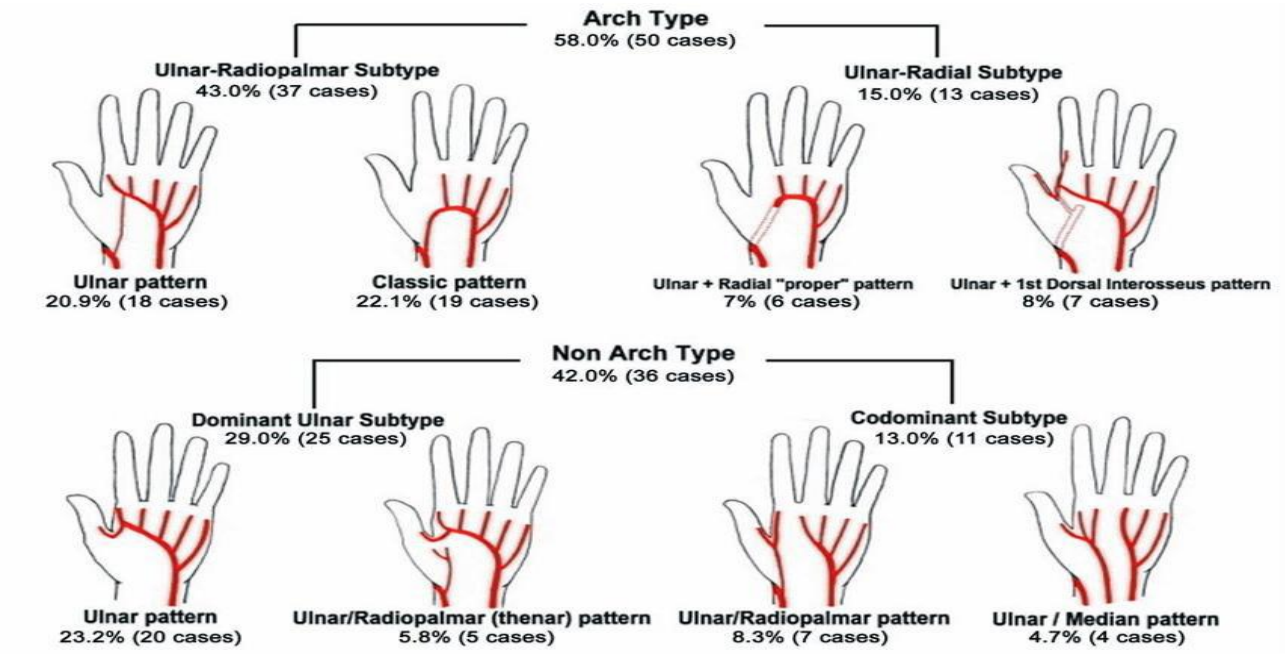

Figure 1 - Classification of the superficial palmar arch [6]

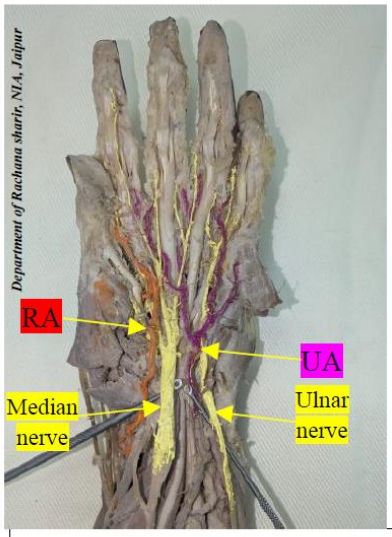

Figure -2 Incomplete /Non-arch codominant subtype ulnar/ radiopalmar pattern of SPA

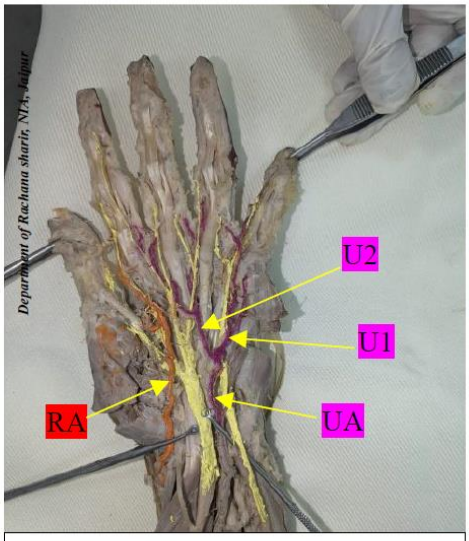

Figure- 3 Branching pattern of ulnar & radial artery (UA &RA) in palm. U1 &U2 two main branches from ulnar arterv

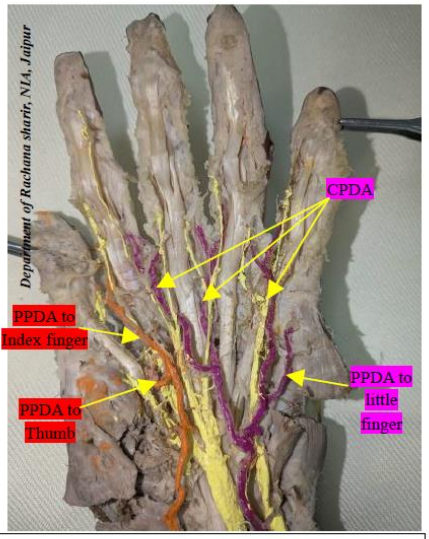

Figure- 4 Branching UA & RA in palm. PPDA -Proper palmar digital artery &CPDA-common palmar digital artery

Result

Incomplete superficial palmar arch was found unilaterally on left side. The anastomosis between radial and ulnar artery was absent. This was non arch codominant subtype Ulnar/Radiopalmar Pattern of superficial palmar arch with varied branching pattern.

DISCUSSION

The anastomosis between radial and ulnar artery was absent. This was non arch codominant subtype Ulnar/Radiopalmar Pattern of superficial palmar arch with varied branching pattern according to study conducted by Nicolás Ernesto Ottone.

Coleman & Anson established that the arteries of the hand form several varieties of patterns which made the classification into well-defined categories. The superficial palmar arch is divided into two groups: complete (78.46%) and incomplete (21.47%). They established several types of complete superficial palmar arches, subdivided according to the way in which the contributing arteries join; similarly, there are types of incomplete superficial palmar arches, and are divided at the same way. They considered that there is a compensatory size relationship between the common digital arteries and the volar metacarpal arteries which originate from the deep palmar arch. [6]

Adachi established a new categorization system that separates superficial palmar arches into three categories based on tributary vessels. The resulted groups were three they are: Ulnar, Radial-Ulnar and Median-Ulnar type.[7]

The Arch formation is formed by the anastomosis of the ulnar and median arteries. This pattern has an important embryological correlation. As stated by Rodríguez-Niedenführ et al. (1999), the median artery exhibits two distinct patterns: the antebrachial pattern, which terminates at the forearm level (76%), and the palmar pattern, characterized by an artery that accompanies the median nerve in the forearm and extends into the palm, supplying digital branches to the fingers (20%)[8]. Additionally, other researchers, including McCormack et al. (1953) and Fazan et al. (2004), reported observing this configuration in 10% of the cases. Patnaik et al. (2000) documented a case involving a persistent median artery accompanied by a double superficial palmar arch. As stated by Rodríguez-Niedenführ et al. (2001a), by the time the embryo reaches stage 21, the radial artery attains its fully differentiated form. The variations in the arteries that influence the distal pathway of this artery need to be identified prior to stage 21, as it has already developed in its final adult form (Rodríguez-Niedenführ et al., 2001b)[9,10,11,12,13]. Certain authors characterize the development of the superficial palmar arch as resulting from the

convergence of three arterial vessels: the ulnar artery, the radiopalmar artery, and the median nerve artery (McCormack et al. 2.4%, Coleman & Anson 1.2%, Olave et al. (1993) 3.3%)[14]. O'Sullivan and Mitchell (2002) described a variation of the superficial palmar arch associated with the absence of the long palmar muscle tendon (palmaris longus). In contrast, similar to the findings of Fazan et al., they identified the long palmar muscle tendon present in all cases.[15]

An injury to the ulnar artery or the superficial palmar arch can jeopardize the blood supply to the fingers, especially in cases where there is inadequate anastomosis between the superficial and deep palmar arches (Calenoff, 1972) [16].

According to findings, the ulnar artery consistently contributes to the vascularization of the hand, regardless of whether it creates an arch. The variations of the arch are entirely contingent upon the differences in the radial contribution. However, there exists a case report detailing a congenital absence of the left ulnar artery, which was functionally compensated for by an unusually large interosseous artery (Nunoo-Mensah, 1998). [17]

To establish surgical techniques for the hand, it is crucial to conduct both angiographic examinations (colour doppler) and the Allen test. Even if the arteries involved in the superficial palmar arch are not precisely recognized, the application of an invasive technique in the region can assess whether their functionality has been maintained or not (Kamienski & Barnes, 1976). In the absence of collateral circulation through the ulnar artery, it is contraindicated to clamp the radial artery, as this may lead to gangrene of the fingers in a non-arch type.[18]

CONCLUSION

The superficial palmar arch serves as the primary vascular structure within the palm (Gajisin & Zbrodowski, 1993) [19]. Ulnar artery prevails as far as irrigation of the hand, either forming an arch or not. According to Jelicic et al., 1988 the variations occur mainly in the radial part of the arch. Understanding the anatomical variability in arch formation is crucial for the implementation of surgical techniques aimed at addressing hand pathologies. [20]

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