

Case report:

A Rare Finding In The Hand Irrigation.

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Abstract.

Background: The blood supply of the hand is complex and challenging. Awareness of the anatomical variations is necessary not only for the anatomist but also for surgeons. The ulnar artery provides a major blood supply to the hand with the assistance of the radial artery in the form of the superficial palmar arch. The objective of this study was reported a rare anatomical variation of the superficial palmar arch. **Materials and Methods:** The anatomical variation described was found during routine dissection performed by medical students of second semester in a 75-year-old male embalmed adult cadaver in the laboratory of Morphology of the University of Pamplona. **Results and Discussion:** In the right hand, the superficial palmar arch only gave rise to two common palmar digital arteries. In the left hand, the arch provided common palmar digital arteries which ran into the first, third and the fourth spaces and one proper palmar digital for the little finger. The arch does not supply the second intermetacarpal space. **Conclusions:** Less critical knowledge of vasculature of the hand might lead iatrogenic injury during surgery, microvascular surgery for revascularization, replantation and composite tissue transfers.

Keywords: Anatomical variations; superficial palmar arch; deep palmar arch; ulnar artery; radial artery; common palmar digital arteries.

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Introduction:

The hand is supplied by the terminal branches of the radial and ulnar arteries. The blood supply of the hand is derived from the superficial and the deep palmar arches (respectively SPA and DPA). The superficial palmar arch is an anastomosis fed mainly by the ulnar 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 pollicial base. About a third of the superficial palmar arches are formed by the ulnar alone; a further third are completed by the superficial palmar branch of the radial artery and a third by the artery radialis indicis, a branch of artery princeps pollicis or the median artery. Four digital arteries arise from the convexity of the arch and pass to the fingers. The most medial artery

supplies the medial side of the little finger and the remaining three subdivide into two and supply the contiguous sides of the little, ring, middle, and index fingers, respectively. 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^{1,2}.

The anatomy of the hand is of significant interest to various disciplines of science. The arterial supply of the human hand is of major importance given its clinical relevance. A thorough knowledge of the arterial supply of the hand is imperative when carrying out procedures such as radial artery conduits in coronary artery bypass grafting (CABG), radial arterial cannulation and reconstructive surgery of the hand². The Vascular patterns of the palmar arches and their interconnecting branches present a complex and challenging study. Many attempts have been made to

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classify these variations. One of the first reports that presented a classification of palmar arches was the classic work of Coleman and Anson³.

The vascular anatomy of the hand is challenging due to a high prevalence of previously identified variations. These variations were usually found in the palmar arches of which the superficial palmar arch (SPA), through which the hand receives its major blood supply, has been shown to be more variable. 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. Variations seem to be more prevalent within the complete arch category. The variations that occur in the arch are known to be more frequent on the radial side. This may involve one or more interconnecting branches. In view of its importance, the study of the intricate vascular pattern of SPA has continued to receive much interest following advances in microsurgical procedure for reconstructive hand surgery. Awareness of the frequency of these arterial variations has been observed to be of great assistance in preparation and planning for safe hand surgery. Such procedures are now preceded by arterial cannulation in order to determine the exact vascular pattern and hence minimize any potential tissue damage⁴⁻¹¹. The objective of this paper was described a rare anatomical variation in the pattern of the superficial palmar arch.

Materials and methods:

This work was previously approved by the Ethics Committee in Research and Environmental Impact of the University of Pamplona, conformed by resolution 030 of January 16 of 2014 and Resolution No. 008430 of 1993 of October 4 of the Ministry of Health of Republic of Colombia by which regulates the scientific, technical and administrative norms for health research. The hands were dissected by first removing the skin covering the flexor surface of the hand with a slight extension proximal to the wrist joint and then distally in the palm to the bases of the digits. The anatomical variation described was found during routine dissection performed by medical students of second semester in a 75-year-old male embalmed adult cadaver in the laboratory of Morphology of the University of Pamplona. Topographic details of the variations were examined, recorded and photographed.

Results:

Anatomical variations were found in the right and left side which were incomplete superficial palmar

arch (incomplete SPA) with formations from ulnar artery alone.

In the right hand:

Brachial artery terminates into radial and ulnar artery in the cubital fossa and the radial artery runs superficial in the forearm and on reaching the wrist curves dorsally and crosses the anatomical snuff box and the ulnar artery enters the hand superficial to the flexor retinaculum along with the ulnar nerve. The radial artery does not give off the superficial branch. The ulnar artery lies lateral to the nerve throughout its course and its superficial branch forms the SPA which gives off the two common digital arteries from the arch which again divides into two proper digital arteries. The arch only gave rise to two common palmar digital arteries what supply the medial and the lateral sides of the third and fourth intermetacarpal space and the lateral side of little finger, lateral and medial side of the ring finger and the medial side middle finger. It was not formed the proper digital branch to the ulnar side of little finger. Deep palmar arch directly contributing to the circulation of the thumb, index finger and the lateral sides of the middle finger. Figure 1.

In the left hand:

Brachial artery terminates into radial and ulnar artery in the cubital fossa and the radial artery runs superficial in the forearm and on reaching the wrist curves dorsally and crosses the anatomical snuff box and the ulnar artery enters the hand superficial to the flexor retinaculum along with the ulnar nerve. The radial artery does not give off the superficial branch. The ulnar artery lies lateral to the nerve throughout its course and its superficial branch forms the superficial palmar arch.

The arch was devoid of the superficial branch of the radial artery. It was solely formed by the ulnar artery on the palmar region and it provided three common palmar digital arteries which ran into the first spaces and provide three proper digital branch to the nourishing thumb and index finger (one princepspollicis artery, PPA and two radialisindicis artery, RIA); from to the third and the fourth spaces between the corresponding digits and one proper palmar digital artery which ran along the ulnar side of the little finger.

The arch does not supply the second intermetacarpal space and the medial sides of the index finger and lateral sides of the middle finger which are supply for the deep palmar arch. Figure 2.

Discussion:

First descriptions of frequencies and variations of the

superficial palmar arch (SPA) were collected in the 19th century. Jaschtschinski¹², created a classification concerning the variability of SPAs which was used by other authors: Coleman and Anson³; Gellman et al⁵; Ikeda et al⁷. Jaschtschinski¹², determined complete and incomplete arches with different subtypes. In the category of complete arches he lists the radioulnar arch, medianoulnar arch, radiomedianoulnar and ulnar arch. Latter one is the most important to be an arch formed by the ulnar artery only. What is more, Jaschtschinski subdivides the ulnar arch as well developed to send arteries to the thumb's both sides or a "weak" developed one with the first palmar digital common artery to reach only the thumb's ulnar side. However, he clearly determines the ulnar arch to reach the entire thumb or parts of it. Simultaneously it is one of the key points which can change the results dramatically. Adachi¹³ tried to classify his 200 collected hands according to Jaschtschinski's classification but failed to finish it. As a consequence he describes more less many different types without any classification of complete or incomplete. This should be seen as a very important message that Jaschtschinski's classification should always be regarded critically, cannot be borrowed entirely but has to be adapted. Moreover the paper of Coleman and Anson³, concerning the arterial patterns of the SPA does include some contradictions. In this paper the authors followed the Jaschtschinski's classification but defined an arch as complete in case of anastomosis between vessels. Certainly this cannot be because Jaschtschinski's ulnar arch does not contain any anastomosis. In addition, Coleman and Anson³, state to have found a not yet described type providing an anastomosis between the ulnar artery and the deep arch. Well, this corresponds to one subdivision of Jaschtschinski's radioulnar arches. Regarding other, later published papers such as Gellman et al. (5), they include the same concept as Coleman and Anson³, had happened. However, Lippert and Pabst¹⁴, published a classification to be in contrast to Jaschtschinski's due to its terminology because they determined a complete arch in case of anastomosis between at least two vessels no matter how large the anastomosis might be. As a consequence, Lippert and Pabst¹⁴, list 4 subtypes of complete arches and 5 subtypes of incomplete arches. Most important difference to Jaschtschinski's classification is that Jaschtschinski's ulnar arch is not found in the category of complete but incomplete arches. Additionally it is defined as a variation to reach at least the radial side of the index. Regarding

the ulnar arch more precisely, another important detail must be considered. Jaschtschinski determined this arch to reach at least the thumb on its ulnar side whereas Lippert and Pabst¹⁴, include the radial side of the index. As a consequence, it is crucial that the "ulnar arch" has to be defined precisely which of the fingers has to be reached. In the present case the cadaver showed bilateral presentations of incomplete superficial palmar arch with an exclusive vascular pattern, which did not show absolute similarity with findings of the above mentioned studies. The extent of radial and ulnar contribution to the blood supply of the hand can be determined through a variety of invasive and non-invasive methods, including angiography, ultrasonography and the standard Allen test. In fact a combination of the standard Allen test and ultrasonography has been reported to be very successful¹⁵. Ruengsakulrach et al, have suggested the use of a modified Allen test (Allen-LEC) to determine whether variations exist such as a radial version of the persistent median artery and a type of high-take off the superficial dorsal radial artery exist¹⁶. Either of these exceptional situations might yield misleading information during a standard Allen test (without confirmatory angiography or ultrasonography) that could potentially result in serious ischaemia following radial artery harvest such as that described by Parks et al¹⁷. The findings of Bianchi and Leiro support our assertion that in most cases a complete SPA is usually sufficient to provide adequate blood flow to the thumb in conjunction with a complete DPA^{18,19}.

There has been an increase in the use of radial artery for arterial bypass. The major risk likely to be associated with the harvest is the danger that ischaemia of soft tissues of the hand might occur¹⁹. The underlying factor is the frequency of variations encountered some of which are familiar while some are rare cases that may not have been described. In order to minimize the risk, the knowledge of superficial palmar arterial arrangement is crucial to ascertain which of the patterns would enable safe removal of the radial artery for use in arterial bypass surgery. More often, the lack of informed knowledge of this type of irregular pattern in hand surgery has been implicated as the underlying factor in the aetiology of palmar and digital ischaemia¹⁰. Regarding the anatomical variation described in the present paper, it is assumed that the knowledge of this unusual shape is extremely important, especially because the influence it can exert on the conduct of clinical or surgical procedures.

Conclusion:

The proper knowledge of frequency of anatomical variations of vasculature of the hand is very important for safe and successful procedures in order to avoid or minimize the risk of complications during vascular surgeries or reconstructive surgery in the hand. A review of vascular pattern prior to invasive or intervention surgery is strongly recommended, which would allow to detect anomalies likely to necessitate modification of surgical procedures.

Conflict of interest:

Conflict of interest declared none

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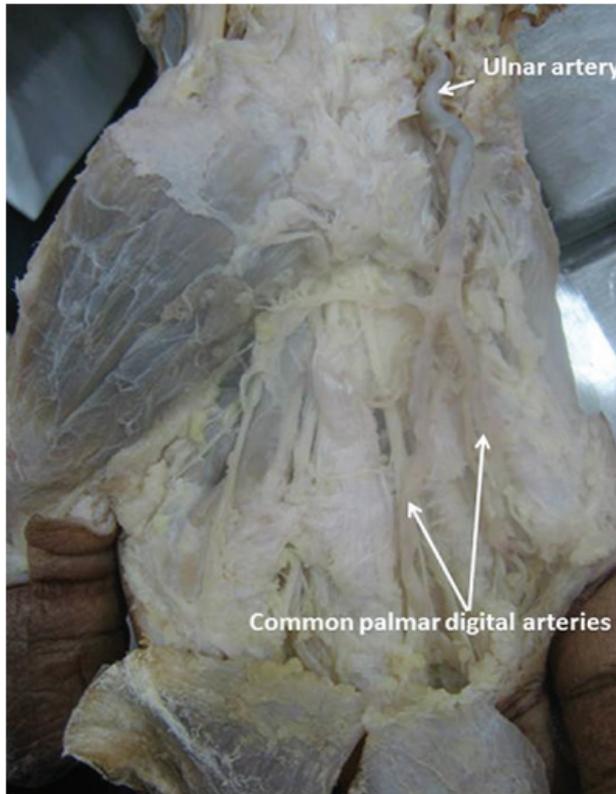


Figure 1. Right hand exhibiting incomplete superficial palmar arch.

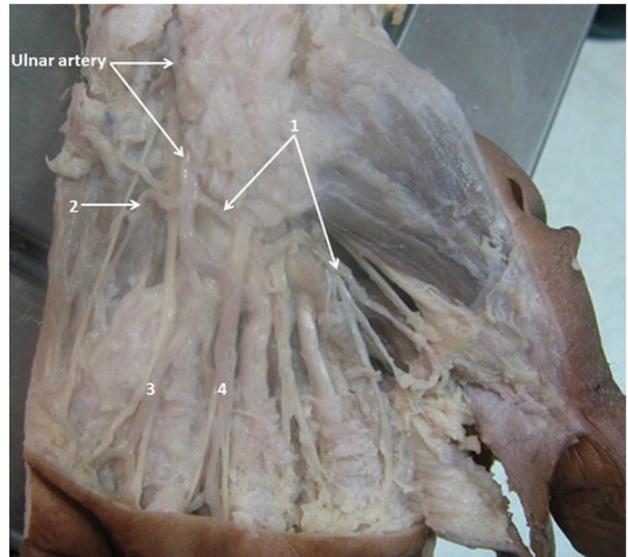


Figure 2. Left hand exhibiting incomplete superficial palmar arch: 1: Common palmar digital artery for the first intermetacarpal space. Note: the trifurcation of the artery in proper digital branch to the nourishing thumb and index finger (one pricepspollicis artery, PPA and two radial-isindicis artery, RIA); 2: proper digital branch to the ulnar side of little finger; 3,4: Common palmar digital arteries and common digital branches to the adjacent sides to little, ring, and middle. Note: Absence of the common palmar digital artery to the second intermetacarpal space, this space was supplied by the first common palmar metacarpal artery from the deep palmar arch.

References:

- 1- Joshi et al. Variation in formation of superficial palmar arches with clinical implications. *JCDR* 2014 apr;**8**(4): 6-9.
- 2- Salgado LSS et al. Variations of the superficial palmar arch in a sri Lankan perspective: A cadaveric study. *JAMR*2014 oct;**1**(2):61-7
- 3- Coleman SS, Anson BJ. Arterial pattern in the hand based upon a study of 650 specimens. *Surgery, Gynaecology, Obstetrics* 1961; **113**:409-24.
- 4- Bianchi H. Anatomy of the radial branches of the palmar arch. Variations and surgical importance. *Hand Clin*2001;**17**: 139-46.
- 5- Gellman H, BotteMJ, Shankwiler J, Gelberman R. Arterial patterns of the deep and superficial palmar arches. *Clin. Orthop. Relat. Res* 2001; **383**: 46-7.
- 6- Valeria PSF, Celso TB, Jefferson HS, Abadio GC, Omar ARF. Superficial palmar arch: an arterial diameter study. *J. Anat* 2004;**204**: 307-11.
- 7- Ikeda A, Ugawa A, Kazihara Y, Hamada N. Arterial patterns in the hand based on a three-dimensional analysis of 220 cadaver hands. *J. Hand Surg*1998; **13**: 501-9.
- 8- Bilge O, Pinar Y, Ozer MA, Govsa F. A morphometric study on the superficial palmar arch of the hand. *Surg. Rad. Anat* 2006; **28**: 343-50.
- 9- Jelcic N, Gajisin S, Zbrodowski A. Arcuspalmaris superficialis. *Acta Anat*1988;**132**: 187-90.
- 10- Mbaka G et al. Pattern of variations in superficial palmar arch in 134 negro cadaveric hands. *IJAE*. 2014; **119**(3): 153-62.
- 11- Ferreira-Arquez H, Arias-Hurtado DK. Variations of the superficial palmar arches: A cadaveric study. *Journal of Chemical and Pharmaceutical Research* 2016;**8**(5):6-14
- 12- JaschtschinskiSN. Morphologie und Topographie des Arcusvolarissublimis und profundus des Menschen. *Anat. Hefte*1897; **7**: 161–88.
- 13- Adachi B. 1928a. Arcusmediana. In: Adachi, B. (Ed.), *Das Arteriensystem der Japaner*, vol. 1. Kenkyusha, Kyoto, pp. 364–68.
- 14- Lippert H, Pabst R. In: Bergmann, J.F. (Ed.), *Arterial variations in man*. Urban &Schwarzenberg, München.1985; pp. 71–7.
- 15- Pola P, Serricchio M, Flore R, Manasse E, Favuzzi A, PossatiGF. Safe removal of the radial artery for myocardial revascularization: a Doppler study to prevent ischemic complications to the hand. *J Thorac Cardiovasc Surg* 1996;**112**: 737–44.
- 16- Ruengsa kulrach P, Eizenberg N, Fahrer C, Fahrer M, Buxton BF. Surgical implications of variations in hand collateral circulation: Anatomy revisited. *J Thor Cardio Surg* 2001;**122**: 682–86.
- 17- Parks BJ, Arbelaez J, Horner RL. Medical and surgical importance of the arterial blood supply of the thumb. *J Hand Surg* 1978;**3**: 383–85.
- 18- Bianchi H, Leiro R. The arterial trunk of the thumbindex digital collaterals. *Surg RadiolAnat* 1987;**9**: 63–7.
- 19- Loukas M, Holdman D, Holdman S. Anatomical variations of the superficial and deep palmar arches. *Folia Morphol*2005 May;**64**(2):78-83.