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Analysis of the vascular pattern in the superficial palmar arch formation

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***Abstract*---**Background and Aim: Palmar arterial supply is mainly provided by the superficial palmar arch (SPA). Ulnar artery primarily completes the arterial arcade of the superficial palmar arch. Radial artery grafts and reconstructive hand surgery benefit from understanding the variations in SPA formation. The present study is aimed to analyze the vascular pattern of the superficial palmar arch. Materials and Methods: This cross-sectional study was conducted in the Department of Anatomy, Bacha Khan Medical Complex Mardan and Multan Medical & Dental College, Multan from October 2019 to September 2022 on 60 specimens, 46 male and 14 females. Due to inconvenient sampling, all cadaveric hands studied during the three years in the dissection room of the anatomy department were not calculated. An incision was made along the root of the fingers and another at the wrist joint. The 3rd metacarpo-phalangeal joint was incised vertically from the middle of the wrist. Reflection of the skin and aponeurosis of the palm was done. An area of adipose tissue

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around the superficial palmar arch was removed to observe the arches and their branches. Variations were noted in the superficial palmar arches. Data analysis was done using the SPSS version. Results: Out of 60 specimens, 61.7% (n=37)were found to have a normal pattern of superficial palmar arch and in 38.3% (n=23) cases, ulnar artery alone formed the arch having no contribution by radial artery. The pattern of normal SPA in male and females were 60.7% (n=28) and 71.4% (n=10) respectively. The pattern of SPA-ulnar artery in male and female were 39.3% (n=18) and 28.6% (n=4) respectively. There were higher percentages of SPA-ulnar artery in male than females but statistically insignificant ($p<0.05$). Conclusion: The current study found that 61.7% hands formed a normal pattern of SPA and 38.3% formed the arch by ulnar artery alone. There was an insignificant association between the SPA patterns among male and females.

***Keywords*---**Vascular pattern, superficial palmar arch formation, ulnar artery, superficial palmar arch

Introduction

The human hand has a great level of intricacy and variety. Without doubt, vascular structure of the human hand is important in medical, radiological, and surgical sciences in the modern medical era[1]. Understanding the differences in the arterial supply of the hand is critical as microvascular surgery for revascularization, replantation, and composite tissue transplants becomes more common. The vascular supply to the hand comes from the superficial and deep palmar arches, which are created between the two major arteries of the forearm, the ulnar and radial, and their palm branches [2]. Knowledge of differences in vascular patterns in various areas of the body is critical in the field of microvascular surgery for revascularization and tissue transplantation. The hand vascular supply is one such variation with clinical and surgical implications [3]. If the ulnar or persistent median arteries provide enough arterial flow, the radial artery is non-essential and can be used in grafting [4]. Nevertheless, if these two arteries are not substituting for the supply of the radial artery, their harvesting may pose a danger due to ischemia of the soft tissues in the hand [5].

The artery separates into superficial and deep branches underneath the Palmaris brevis [6]. The direct continuation of the ulnar artery is the superficial branch and a prime contributor to SPA [7]. The superficial palmar arch is an arterial pathway that extends behind the palmar aponeurosis and in front of the long flexor tendons, lumbrical muscles, and palmar digital branches of the median nerve. The superficial branch of the ulnar artery forms the main part of the arch, which is accomplished on the lateral side by a branch from the radial artery.[8-12]. The SPA is the main focus for the majority of operations and traumatic occurrences in the hand. The hand surgeon must take into account the presence and healthy feature of the arch prior to actually conducting surgical techniques such as vascular graft applications, arterial repairs, and free and/or pedicled flaps depending on the radial or ulnar artery in order to maintain or avoid harming the perfusion of the hand and digits. The current study aims to discover and

characterize differences in the development of the superficial palmar arch (SPA) based on formative tributaries.

Methodology

This cross-sectional study was conducted on 60 hands of 46 male and 14 females in the Department of Anatomy, Bacha Khan Medical Complex Mardan and Multan Medical & Dental College, Multan from October 2019 to September 2022. Due to inconvenience in sampling, all cadaveric hands studied during the three years in the dissection room of the anatomy department were not calculated. An incision was made along the root of the fingers and another at the wrist joint. The 3rd metacarpo-phalangeal joint was incised vertically from the middle of the wrist. Reflection of the skin and aponeurosis of the palm was done. An area of adipose tissue around the superficial palmar arch was removed to observe the arches and their branches. Variations were noted in the superficial palmar arches. The collected data was initially put into an Excel spreadsheet. The proportion of frequency was computed. To examine the significant difference between male and female, chi-square test was applied. For the test, SPSS version 27 was utilized.

Results

Of the total 60 specimens, 61.7% (n=37) formed a normal pattern of superficial palmar arch and in 38.3% (n=23) cases, ulnar artery alone formed the arch. The pattern of normal SPA in male and females was 60.7% (n=28) and 71.4% (n=10) respectively. The pattern of SPA-ulnar artery in male and female was 39.3% (n=18) and 28.6% (n=4) respectively. Patterns of variation in the establishment of the cadaveric hand's superficial palmar arch in general are shown in Figure-1.

Patterns of variation in the establishment of the superficial palmar arch in male cadaveric hands are shown in Figure-2. Patterns of variation in the establishment of the superficial palmar arch in female cadaveric hands are depicted in Figure-3.

Patterns of variance in the establishment of the superficial palmar arch in both gender's cadaveric hands are illustrated in Figure-4.

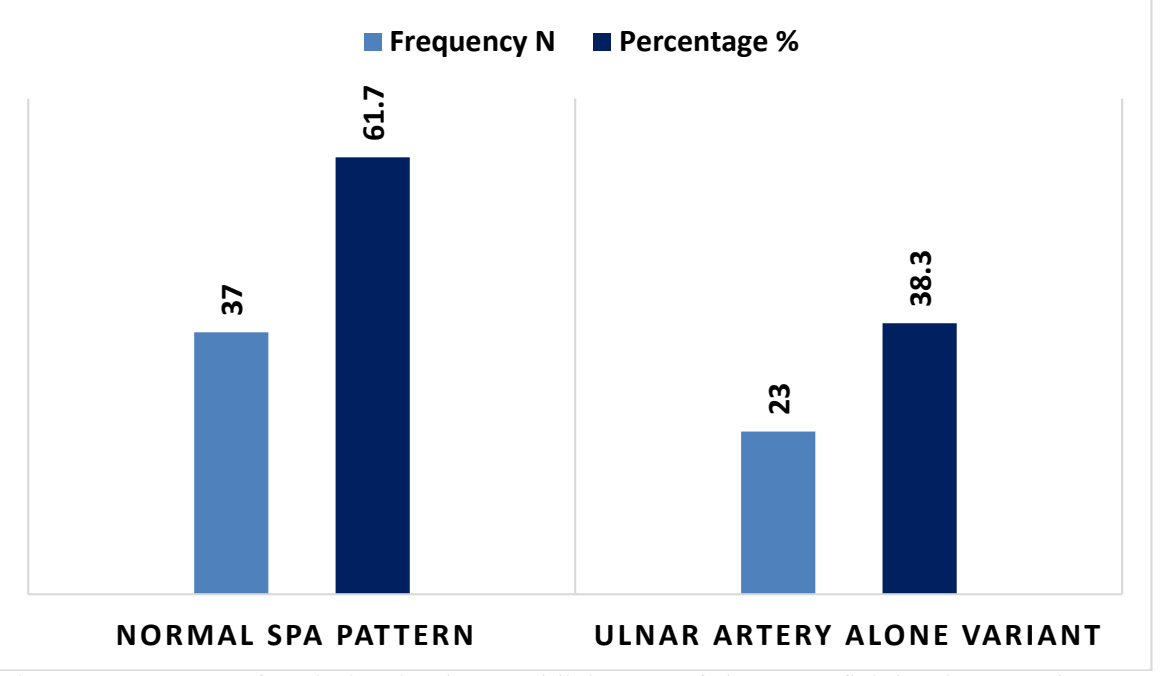

Figure-1 Patterns of variation in the establishment of the superficial palmar arch in cadaveric hands in general (n=60).

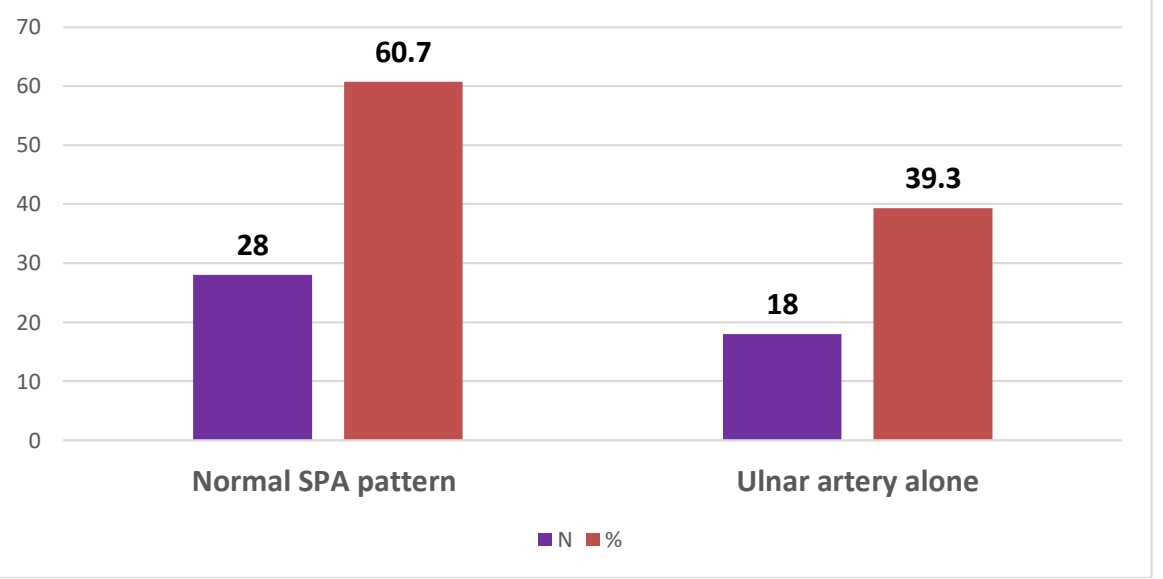

Figure-2 Patterns of variation in the establishment of the male cadaveric hand's superficial palmar arch (n=46).

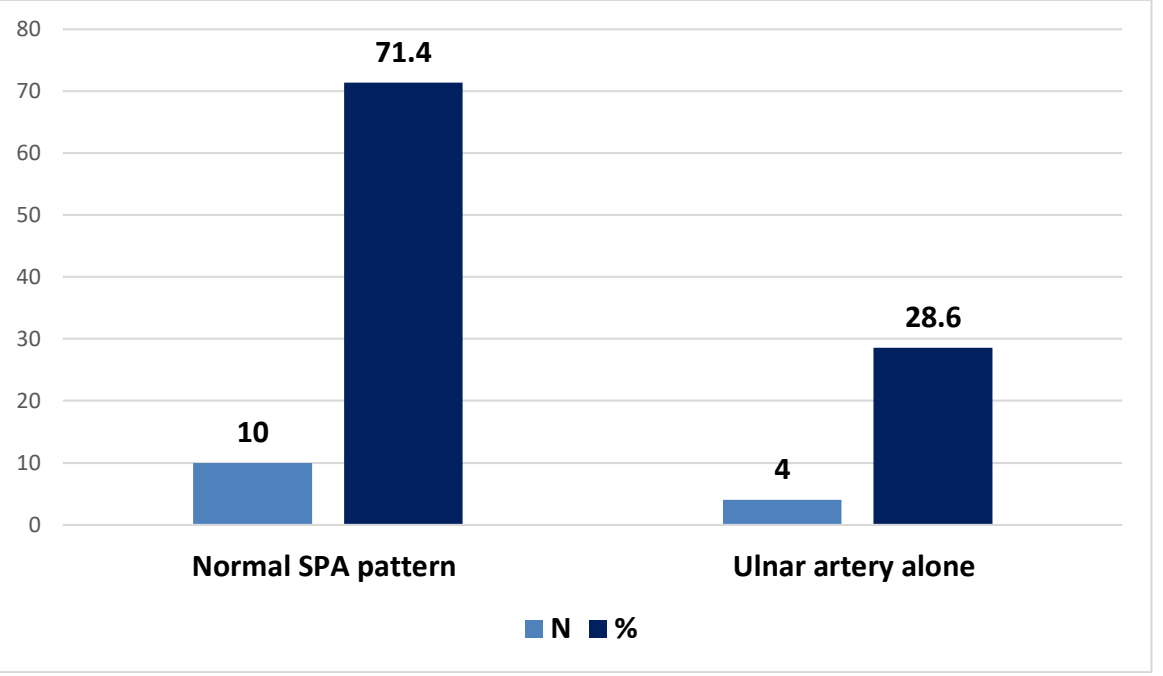

Figure-3 Patterns of variation in the establishment of the female cadaveric hand's superficial palmar arch (n=14).

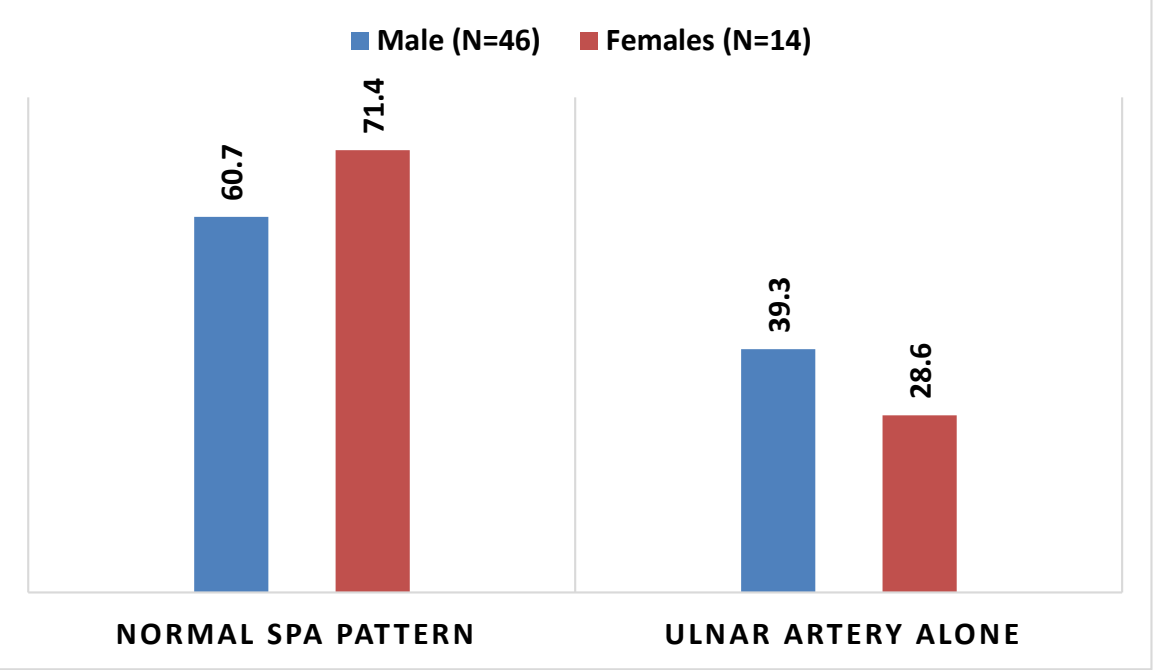

Figure-4 Patterns of variance in the establishment of the superficial palmar arch in both gender's cadaveric hands.

Discussion

The present analysis mainly focused on the superficial palmar arch formation vascular pattern and found that 61.7% hand formed normal pattern of SPA and 38.3% formed arch by ulnar artery alone. There was an insignificant association between SPA patterns among male and females. The SPA is an artery arcade situated in the palm, deep to the palmar aponeurosis and superficial to the flexor tendons, that connects the radial and ulnar arteries. Its major part is created by the ulnar artery. The arch is generally completed laterally by anastomosing with the superficial branch of the radial artery. In some cases, the ulnar artery connects to the arteria radialis indicis or the princeps pollicis artery. The ulnar artery occasionally anastomoses with the arteria nervi mediana. The ulnar artery alone forms the arch in around one-third of the individuals [13-15]. This shows many possibilities for SPA creation[16].

Several investigations have been carried out in order to categorize the differences in SPA[17-19]. There are many categories proposed in the literature depending on the formative vessels and their size. A morphological investigation of differences in superficial palmar arches of the hand conducted by Jena et al[20] discovered that the prevalence of complete and partial specimens was 77.4% and 22.6% respectively which is comparable to the current study. Likewise, Kaplanoglu et al[21] discovered that the prevalence of complete and partial SPA was 82% and 18% respectively. Another study by Kastamoni et al[22] reported that complete and incomplete SPA was 96% and 4% respectively.

Lucas et al.[23] found that the single SPA was 94% out of which complete and incomplete SPA were 78% and 16% respectively. About 6% limbs had two-fold SPA out of which distal incomplete and proximal complete was 2% and 4% respectively. Another study by Saha et al.[24] reported that the incidence of ulnar artery and both (ulnar and radial) was 12% and 80% respectively.

According to Sajey et al.[25], on the right side, there was an unfinished superficial palmar arch that hadn't been completed by any of the radial or median artery branches. The superficial palmar arch was built on the same individual's left side, and it was completed by a superficial branch of the radial artery.

Singh et al.[26] assessed the SPA as either complete or incomplete. If an anastomosis exists between the arch's formative tributaries, it is deemed complete; otherwise, such an anastomosis is lacking. In the current study, 96% of the arches were complete, whereas 4% were incomplete. Our findings were consistent with those of Slobodian et al.[27]

Conclusion

The present study found that 61.7% of the hands formed a normal pattern of SPA and 38.3% formed the arch by the ulnar artery alone. There was an insignificant association between SPA patterns among male and females.

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