

Original article:

Study of variations in blood supply to thumb: Cadaveric study

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Abstract:

Aims & Objectives: To study variations in patterns of blood supply to thumb

Introduction: The princeps pollicis artery arising from radial artery is the largest source of blood supply to thumb. Variations in blood supply to thumb have been reported in literature by different authors. The knowledge about the blood supply to thumb is important for surgeons involved in hand surgeries. So as there is wide variation in classification of arterial irrigations to thumb described in literature, present study is planned to study the pattern of blood supply to thumb.

Study settings and period: Dissection hall, Dept of Anatomy, PIMS' Rural Medical College, Loni, period of 4 years, 2012-2016.

Material and methods: Study was conducted at dept. of anatomy, Rural Medical College, Loni. Total 177 adult human cadaveric hands available for dissection by MBBS and Dental students were dissected and arteries were traced up to the tip of fingers, specially thumb to observe arterial pattern.

Result: In present study we found blood supply to thumb was contributed by branches from both superficial and deep palmar arches and also supplied by single dominant vessels either from radial artery, ulnar artery and persistent median artery. In majority of the specimens i.e. 77 hands (43.50%) , thumb was supplied by superficial palmar branch of ulnar artery.

Conclusion: The knowledge of blood supply to thumb is important for clinicians and surgeons. Collateral blood supply is necessary if the radial artery is damaged, for maintaining blood supply to thumb.

Key words: princeps pollicis artery (PPA), superficial palmar arch (SPA), deep palmar arch (DPA)

Introduction:

The princeps pollicis artery (PPA) arises from the radial artery and descends on the palmar aspect of the first metacarpal under the oblique head of the adductor pollicis and after which the artery divides into two branches. The PPA is generally considered the largest source for the palmar arteries of the thumb.^{1, 2, 3} Murakami et al reported the arterial patterns of the index finger and those of the palmar metacarpal arteries and the princeps pollicis artery.² According to Hollinshead, the PPA may arise directly from the deep palmar arch, or from a common trunk with the radialis indicis; while both are derived from the radial artery, they commonly have collateral circulation available to them from the ulnar artery by way of the superficial palmar arch or one of its branches.⁴

Erbil et al (1999) observed the superficial palmar arch providing blood supply to thumb and index fingers through the arteria prince pollicis and arteria radialis indicis arteries in five cases in their studies.⁵ Adachi classified variations of Princeps pollicis artery according to its relation to the adductor pollicis muscle.³ Murakami et al found Adachi's classification simple, and thus proposed a classification based on the origin and proximal course of the PPA. Their classification involved three major types and four intermediate, rather anomalous types.²

Loukas M et al (2009) published a case report of a 48-year-old male cadaver in which the right superficial palmar arterial arch had no contribution from the radial artery and terminated by giving rise to a common trunk for the PPA and radialis indicis artery.⁴ Accordingly, the entire arterial supply to the right thumb was provided by the superficial palmar arterial arch, which was composed solely by the ulnar artery, which received no collateral supply from the radial arterial system. This unilateral variation was identified in a 48-year-old male.

The arterial supply of the thumb may arise from a combination of the PPA, the first common palmar digital artery of the superficial palmar arch and the first dorsal metacarpal artery (Ikeda 1988).⁽⁶⁾

Ames EL et al (1993) conducted study on 40 hands with 35 intravascularly injected and five non-injected hands. They identified five patterns of arterial supply to thumb. The most common pattern they reported was, superficial and deep vessel both supplying to the first web space in 54% of specimens. Dominant vessels included the superficial palmar branch of the radial artery in 8%, first palmar metacarpal artery in 18% and dorsal metacarpal artery in 8%. Only three specimens correlated with the textbook description. They concluded that the term "princeps pollicis" is actually a misnomer.⁽⁷⁾

Ramirez AR (2012) in their study with 30 specimens found, princeps pollicis artery present in all of the hands and was arising from radial and ulnar digital arteries in 73.3 percent. The radial and ulnar digital arteries originated from the princeps pollicis artery or branches of the palmar metacarpal artery in 53.3 and 83.3 percent of the dissections, respectively. Dorsally, the dorsal ulnar artery was present in 100 percent of the hands and originated mainly from the princeps pollicis artery (73.3 percent). The dorsal radial artery was present in 66.7 percent of dissections as a direct branch of the radial artery. Several anastomoses were observed between the radial and ulnar digital arteries and between the dorsal and palmar systems.⁽⁸⁾

Various classifications of the arterial irrigations of the thumb have been described in literature, such as the dorsopalmar and radioulnar. So the present study was planned to find out the variations in arterial supply to thumb at department of Anatomy, Rural Medical College, Loni, Maharashtra under PIMS deemed university.

Materials and Method

The Study was conducted at the Department of Anatomy, Rural Medical College, Loni, over a period of three years. Total 177 adult human cadaveric hands available for routine dissection by MBBS and Dental students were dissected

A transverse incision was taken at wrist. From the midpoint of this incision, another incision was extended to the tip of middle finger. Another transverse incision was taken at the roots of fingers. The skin flaps were reflected. Palmar aponeurosis was exposed, divided proximally and reflected distally. This exposed the superficial palmar arch which was cleaned to study branching pattern and variations. The arteries were traced up to the tip of fingers specially thumbs. Photographs of dissected hands were taken.

Observations

We found that blood supply to thumb was contributed by branches from both superficial and deep palmar arches and also supplied by single dominant vessel either from radial artery, ulnar artery and persistent median artery. The variations found were classified as pattern A, B and C and further sub classified as A1, A2.....etc.

In majority of the specimens the thumb was supplied by superficial palmar branch of ulnar artery i.e. in 77 hands (43.50%) followed by Superficial palmar arch by radial and ulnar artery in 27 hands (15.25%) and in 18 hands (10.17%) blood supply was from superficial branch of ulnar artery and first palmar metacarpal artery. We found 11 different patterns of blood supply to thumb.

Pattern A-1: In 18 hands (10.17%) blood supply from superficial branch of ulnar artery and first palmar metacarpal artery (fig 1)

A -2: From first palmar metacarpal artery on radial side of thumb and from superficial arch formed by radial and ulnar artery on ulnar side of thumb in 6 hands (3.39%) (fig.2)

A-3: From both Superficial palmar branch of radial artery and first palmar metacarpal artery in 2 hands (1.13%) (fig.3)

By dominant vessels B -1

B-1 : Superficial palmar branch of ulnar artery in 77 hands (43.50%).(fig.4)

B-2: Superficial palmar arch by radial and ulnar artery in 27 hands (15.25%) (fig.5)

B-3: Both ulnar and radial side from superficial branch of radial artery in 12 hands (6.78%) (fig.6)

B – 4: From persistent median artery in 10 hands (5.65%) (fig.7)

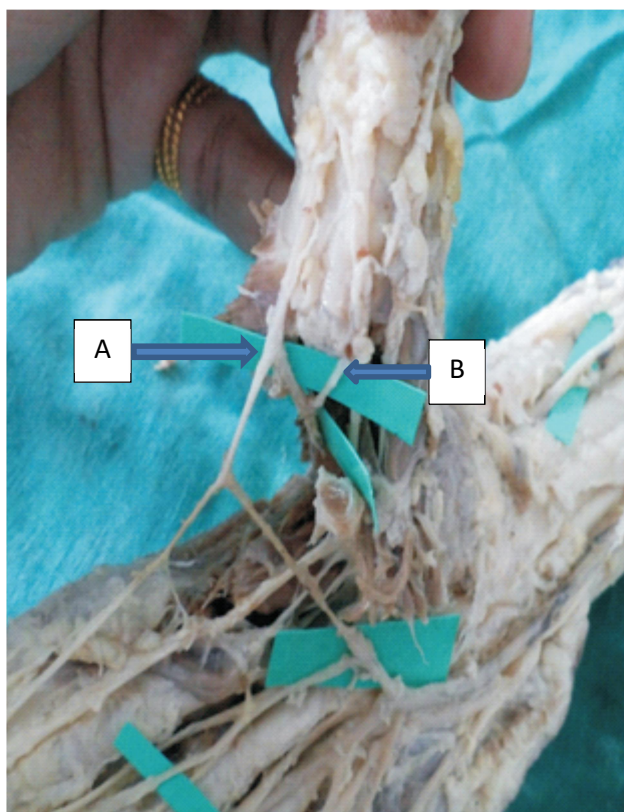
B -5: From Superficial palmar arch formed by ulnar and persistentmedian artery in 9 hands (5.08%) (fig.8)

B -6: From first palmar metacarpal artery in 13 hands (7.34%) (fig.9)

B -7: by 1st dorsal metacarpal artery in one hand (0.56%) (fig.10)

Pattern -C: Radial aspect of thumb by superficial branch of radial artery in 2 hands (1.13%) (fig.11)

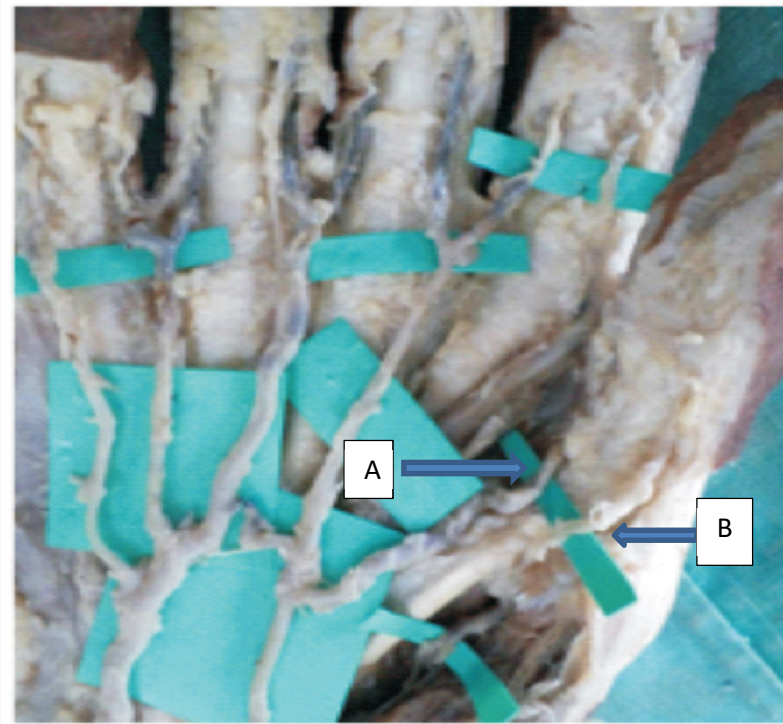
Fig.1:A-1: Blood supply from superficial branch of ulnar artery and first palmar metacarpal artery



A - Palmar digital branch of ulnar artery

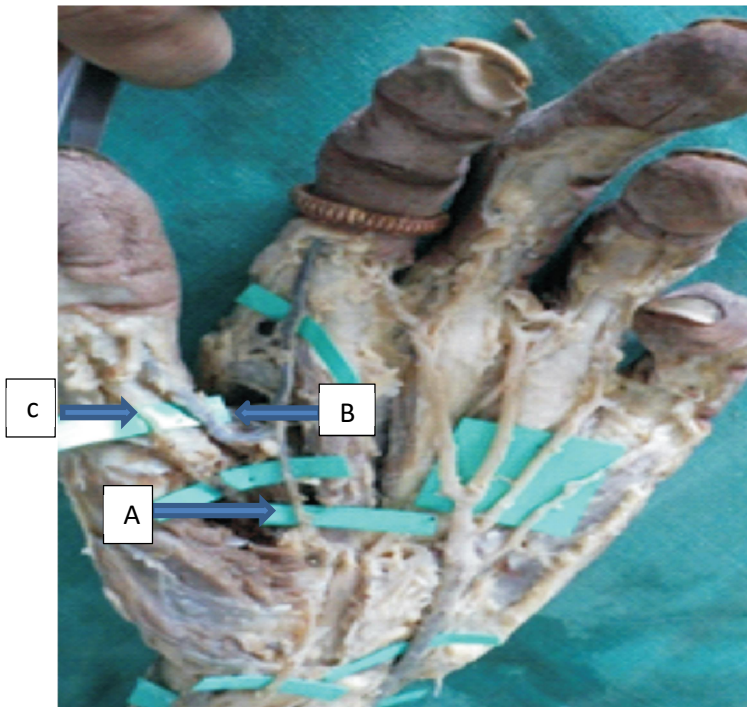
B - First palmar metacarpal artery

Fig 2: Pattern A -2: From first palmar metacarpal artery on radial side of thumb and from superficial arch formed by radial and ulnar artery on ulnar side of thumb



A - First palmar metacarpal artery; B - Branch by superficial palmar arch

Fig 3: A-3: From both Superficial palmar branch of radial artery and first palmar metacarpal artery

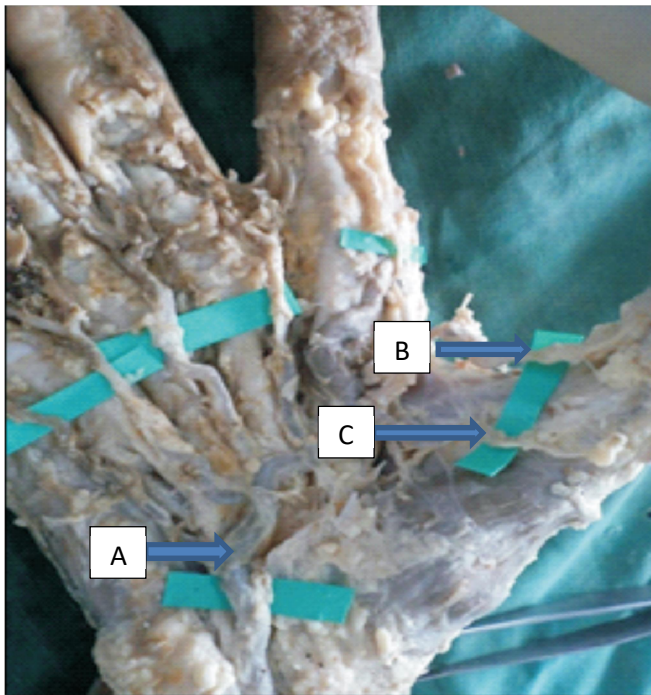


A - Superficial branch of radial artery

B - Branch by Superficial branch of radial artery

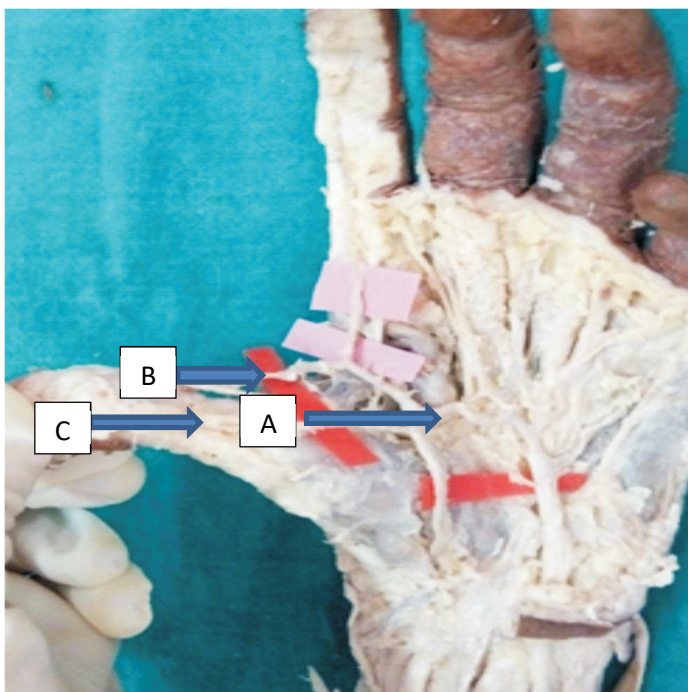
C - First Palmar Metacarpal Artery

Fig 4: By dominant vessels B -1: Superficial palmar branch of ulnar artery



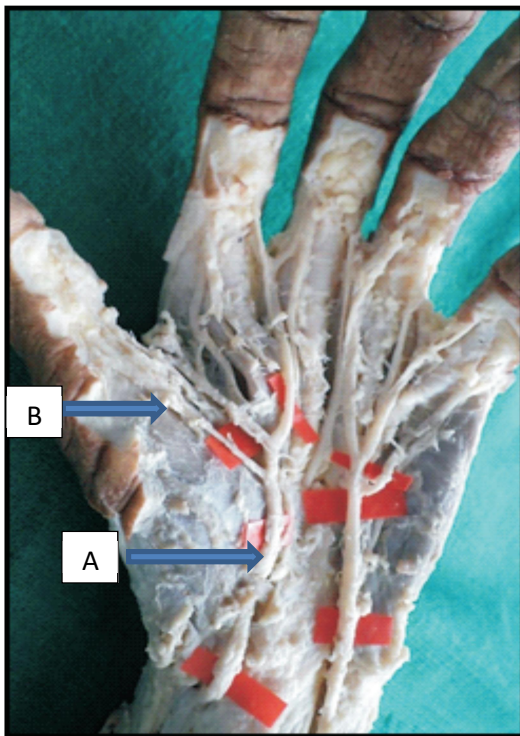
A - Superficial palmar branch of ulnar artery
B&C - Palmar digital branch to thumb

Fig 5: B-2: Superficial palmar arch by radial and ulnar artery



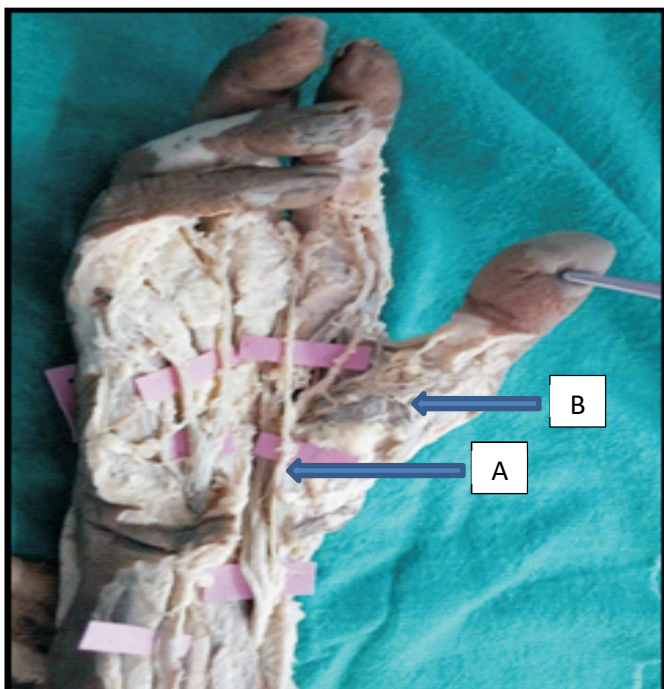
A - Superficial palmar arch
B&C - Palmar digital branch to thumb

Fig 6: B-3: Both ulnar and radial side from superficial branch of radial artery



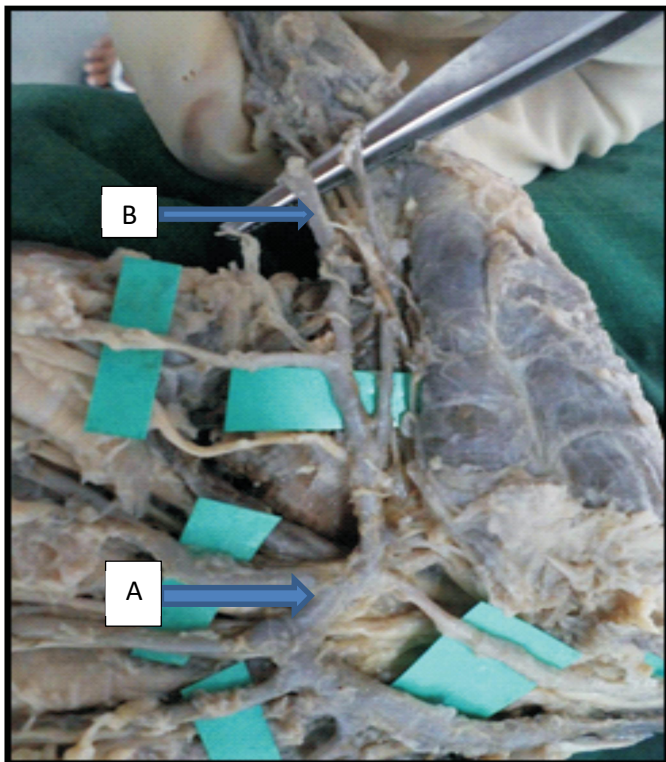
A - Superficial Branch of Radial Artery
B - Palmar Digital Branches to Thumb

Fig 7: B – 4: From persistent median artery



A - Persistent median artery
B - Palmar digital branches to thumb

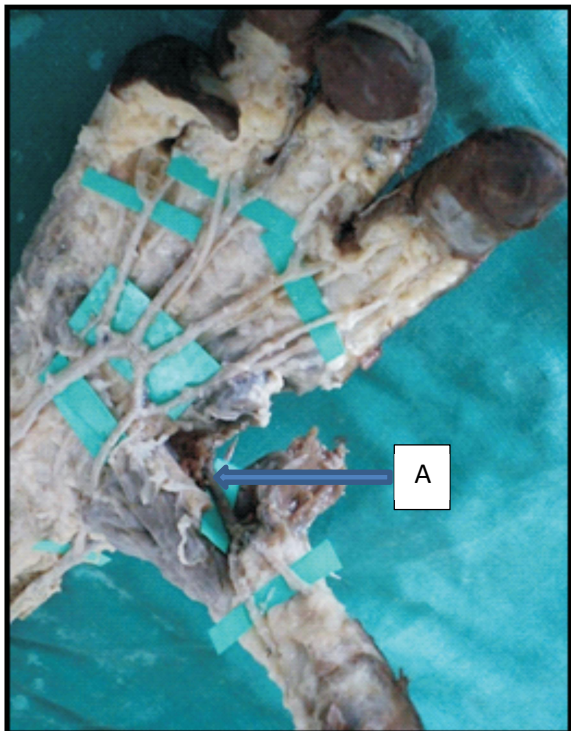
Fig 8: B -5: From Superficial palmar arch formed by ulnar and persistent median artery



A - Arch by ulnar and persistent median artery

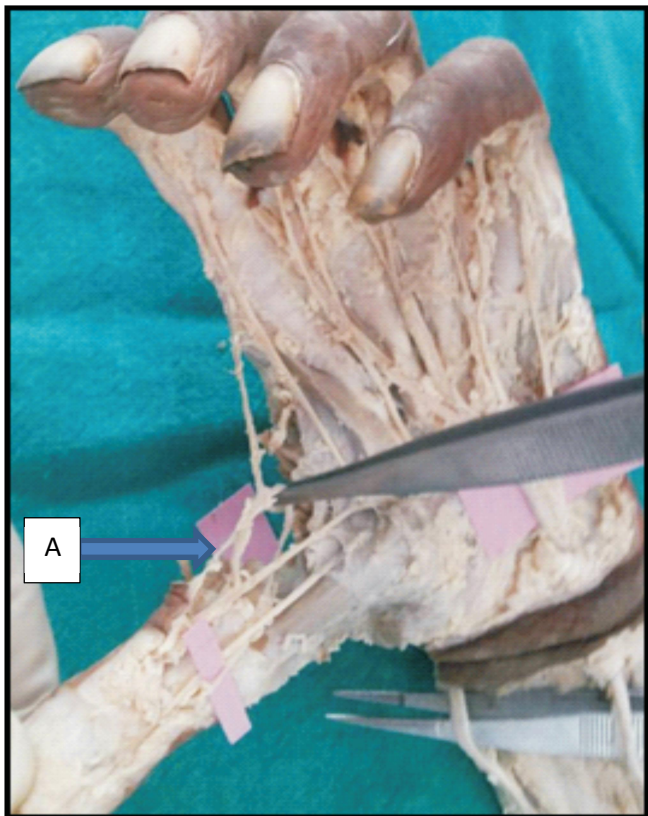
B - Branches to thumb

Fig 9: B -6: From first palmar metacarpal artery



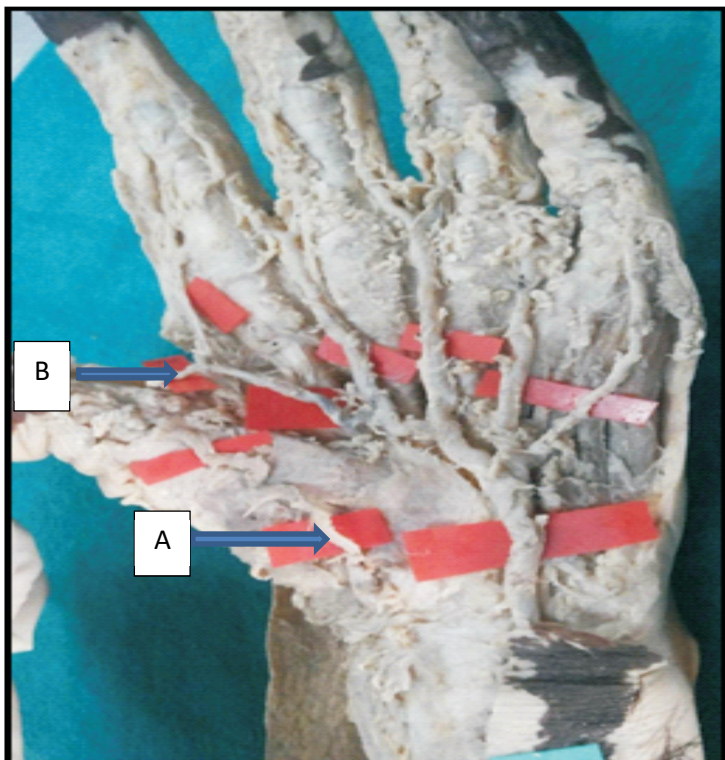
A - First palmar metacarpal artery

Fig 10: B -7: by 1st dorsal metacarpal artery



A - First dorsal metacarpal artery

Fig 11 : Pattern -C: Radial aspect of thumb by superficial branch of radial artery



A - Superficial branch of radial artery

B - Palmar digital branch by superficial branch of ulnar artery

Discussion

In our study we found in majority of specimens thumb was supplied by superficial branch of ulnar artery i.e. 40.68% followed by complete SPA formed by ulnar and radial artery in 18.08 % hands. While Tandler (1897) found superficial palmar branch of the radial artery supplying thumb in majority of specimens.⁹ Parks et al (1978), in a dissection of 50 cadaveric hands found that the principal blood supply to the thumb was coming from the first palmar metacarpal artery¹⁰, in our study it was found in only 5 (2.82%) specimen. The findings in this study and previous research indicate wide variation in the blood supply to thumb.

McCormack LJ et al (1953) in their comprehensive study on the arterial pattern of 750 hands did not find the origin of the princepspollicis and radialisindicis arteries from the SPA,¹¹ Gajisin and Zbrodowski (1993), in their series of 200 specimens, found three common palmar digital arteries from SPA in addition to numerous small branches.¹² They did not refer to any branches from the superficial arch supplying the first web space.

In our study 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.¹³

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.¹⁴

Injury to the SPA or ulnar artery can compromise the arterial supply of the fingers, especially if there is an insufficient anastomosis between the superficial and deep palmar arches.^{15, 16}

The knowledge of arterial blood supply of the thumb is important for clinicians and surgeons. As mentioned in literature the “collateral supply” is necessary if the radial artery, and in turn, the PPA is damaged for maintaining blood supply to thumb. Parks et al mentioned in their case reports, the occlusion of the radial artery or surgical manipulation of the PPA led to pain, paresthesia, or gangrene of the thumb and index finger, although the thumbs survived in these cases⁽⁹⁾.

Conclusion

We found variation in blood supply to thumb. Also there are wide variations reported by various studies in the literature. The complex anastomotic arcades between the arterial systems allow the thumb to survive even after severe lesions, which also provides multiple alternatives in flap design without endangering their survival. So there is need of further research in different ethnic groups and wider geographical regions to have uniform classification of blood supply to thumb which will be helpful in reconstructive surgeries.

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