International Journal of Advanced Research in Medicine

E-ISSN: 2706-9575
P-ISSN: 2706-9567
IJARM 2021; 3(1): 575-578
Received: 18-01-2021
Accepted: 21-02-2021

Dr. Sujana Arani
Associate Professor, Department of Anatomy, Kamineni Institute of Medical Sciences, Narketpally, Telangana, India

Dr. Ananda Sagari A
Assistant Professor, Department of Anatomy, Mallareddy Institute of Medical Sciences, Hyderabad, Telangana, India

Corresponding Author:
Dr. Ananda Sagari A
Assistant Professor, Department of Anatomy, Mallareddy Institute of Medical Sciences, Hyderabad, Telangana, India

Clinical implications of studying the radial artery, its branches, and variations

Dr. Sujana Arani and Dr. Ananda Sagari A

DOI: https://doi.org/10.22271/27069567.2021.v3.i1i.439

Abstract
Background: The cubital fossa lies near the radial artery, a brachial artery terminal branch. Anatomists and physicians' study radial artery branching patterns, origin, and trajectory. Coronary angiography and bypass operations increasingly employ the radial artery. Vascular and plastic surgeons use the superficial and deep palmar arches, Radial artery origin, course, and branches as markers.
Methods: The standard dissection technique was used for this. 40 human upper limbs were used for this analysis. The adult upper limb specimens used in this study were taken from embalmed cadavers donated to the Department of Anatomy, Mallareddy Institute of Medical Sciences, Hyderabad, Telangana, India, between the October 2020 to July 2021, for use in the first year MBBS and BDS dissection courses.
Results: This study was conducted to document and provide insight into radial artery anatomy both in its normal and variant forms. Subjects were selected from the Medical College and the Institute of Anatomy for the study. There was a fullness to the superficial palmar arch in 80% of people and a lack of perfection in the other 20%. Forty percent of the whole arch was made up of type I arches, 8% of the arches were of type II, and 2% of the arches were of type V. The proportion of type I incomplete arches was 4%, whereas the proportion of type II arches was 16%.
Conclusion: Only 6% of people in this research had a radial artery that originated high in the arm from the brachial artery. Overall, radial arteries averaged 21.25 centimetres in length. In 96% and 4% of cases, respectively, the recurrent radial artery originated from the radial artery and the brachial artery. Only around 4% of samples had a recurrent radial artery that was considered an accessory.

Keywords: Brachial artery, superficial and deep palmar arches, and the radial artery

Introduction
The radial artery develops from a terminal branch of the brachial artery in the cubital fossa, 1 centimetre distal to the elbow's flexor crease. The radial artery's path seems to be a straight offshoot of the main stem [1]. The deep palmar arch is formed when this artery anastomoses with the ulnar artery, which it reaches from the cubital fossa. There are three branches from the main stem of the radial artery. The first segment extends from the wrist's origin to the styloid process's apex, the second segment curved around the lateral aspect of the wrist to the proximal portion of the first interosseous space, and the third segment travels through the interosseous space into the palm [2, 3].
The radial artery and its two comitant veins run along the forearm's preaxial border. On the majority of the forearm, it is covered by skin, superficial and deep fasciae, but is occluded by the belly of brachioradialis towards the proximal end. From above downward, the radial artery rests on the tendons of the biceps, supinator, insertion of the pronator teres, lateral half of the flexor digitorum superficialis [4], flexor pollicis longus, and the pronator quadratus. There's a connection between the radial nerve's superficial branch and the artery's middle third. Anterolateral to the brachioradialis and medial to the pronator teres, it then travels infralaterally between the brachioradialis and flexor carpi radialis to reach the anterior side of the distal end of the radius between the tendons of both muscles. The radial pulse may be felt just here, against the bone. The artery then makes a gentle curve along the radial aspect of the wrist joint, beginning just beyond the styloid process and ending at the first interosseous gap. It travels between the thumb's long abductor and short extensor muscles and the lateral carpal ligament. Here it is superficially crossed by the origin of the cephalic vein and the digital branches of the radial nerve, and it is dorsally connected to the scaphoid and trapezium. As a result, it just appears on the surface [5, 6].

After entering the forearm, the radial artery enters the palm of the hand between the two heads of the first dorsal interosseous muscle. After joining the deep branch of the ulnar artery, the ulnar artery makes a medial bend and travels between the transverse and oblique head of adductor pollicis before continuing its path over the base of the metacarpal bones with a small forward convexity to create the deep palmar arch. It's located next to the lumbricals and the long flexor tendons [7].

Numerous diagnostic procedures and therapeutic treatments depend on access to the radial artery. The next section will go through a few of the most salient ones. Through its entire forearm course, the radial artery remains superficial and is hence simple to catheterize. Therefore, it may serve as a tool in coronary angiography as well as in invasive coronary angioplasty and stenting procedures [8, 9].

Materials and Method

The standard dissection technique was used for this. 40 human upper limbs were used for this analysis. The adult upper limb specimens used in this study were taken from embalmed cadavers donated to the Department of Anatomy, Mallareddy Institute of Medical Sciences, Hyderabad, Telangana, India, between the October 2020 to July 2021, for use in the first year MBBS and BDS dissection courses.

The top two-thirds and the middle third of the arm were cut horizontally. From the median cubital fossa down to the wrist, a vertical incision was created that crossed the palm and ended at the middle finger. In this case, the incision was taken all the way up till it met the initial incision that had been made horizontally. The skin flap was elevated medially and laterally by a second horizontal incision made at the wrist. From the vertical incision down to the thumb, an oblique incision was created in the palm. The skin flaps were elevated after a second horizontal incision was made in the palm at the level of the base of the metacarpals. Without harming the tissues underneath the fascia, a fascial flap was reflected and the deep fascia of the forearm was separated from the cubital fossa to the proximal edge of the flexor retinaculum. The flexor muscles are located medially while the extensor muscles are located laterally beneath the fascia. The brachio radialis is the front of the arm's most superficial muscle. The extensor carpi radialis longus was exposed by a lateral pull, and the extensor and flexor groups of muscles were disentangled. Within this notch are the radial artery and the superficial radial nerve.

Results

In 36 of the 40 upper limb specimens examined, the radial artery originated in the brachial artery in the cubital fossa. The RA was derived from the BA in 10 of the arms studied (Table1).

Table 1: Location of Radial Artery Root

Sr. No.	Origin of RA	Frequency (n=40)	Percentage
1.	From BA in CF	36	90
2.	From BA in arm	4	10

The dissections showed that the RA followed a typical path in every case. The length was calculated by removing the high origin and measuring from the RA origin in CF to the styloid process. The shortest RA was 18 centimetres, the longest 23.7 centimetres, and the average was 21.25 centimetres (Table 2).

Table 2: Radial Artery Length

Sr. No.	Artery	Length (cms)
1.	Min. length	19.00
2.	Max. length	22.6
3.	Mean length	20.28

In 37 of 40 dissected upper extremities, RRA originated in the region of the RA closest to its origin. The first cases of RRA in the upper extremities were documented in the UA in 2003. (Table 3).

Table 3: The Root of the Recurrent Radial Artery

Sr. No.	Origin of RRA	Frequency (n=40)
1.	From RA	37
2.	From UA	03

After separating into the Arteria princeps Pollicis and the Arteria Radialis, the Superficial Palmar Arch (SPB) of each of the 40 dissected lower extremities comes to a close. Indicis, and in 7 of them it supplies the thenar muscles. In three cases, it bifurcates into the five general digital arteries (Table 4).

Table 4: Inferior Palmar Fraction of Rheumatoid Arthritis

Sr. No.	SPB of RA	Frequency (n=50)
1.	Completing the SPA	25
2.	Divides into APP and ARI	5
3.	Ends by supplying the thenar muscles	7
4.	Divides into common digital arteries to the 1st and 2nd web space	3

In 28 of 40 dissected specimens, the superficial phalangeal branch (SPB) of RA travels through the thenar muscle material, whereas in 9 specimens, the RA travels superficially to the thenar muscles and finally terminates by feeding the thenar muscles (Table 5).

Table 5: Inferior Palmar Fraction of Rheumatoid Arthritis

Sr. No.	SPB of RA	Frequency (n=40)
1.	Passes through the thenar muscles	28
2.	Passes superficial to thenar muscles	09
3.	Ends by supplying thenar muscles	03

In 26 of the 40 dissected specimens, the APP and ARI originated as a single trunk from the Superficial Palmar Arch; in 5 specimens, the SPA was created only by the UA; in 4 specimens, the CDA reached the first web gap; and in 5 specimens, the SPB terminated in the CDA (Table 6).

Table 6: The Beginnings of APP and ARI

Sr. No.	Origin of APP and ARI	No. of samples (n=40)
1.	From SPA (formed by the of UA and RA)	26
2.	From SPA formed by the UA alone	05
3.	From common digital artery to the first web space(from SPB)	04
4.	As the terminal branches of SPB	05

Discussion

According to G J Romanes's account in Cunningham's Anatomy, the RA may be nonexistent and its forearm region supplied by other arteries. According to the work of

Suganthy J. *et al*., a patient was found to have no evidence of RA in their right upper extremity. Omer Faruk Dogan *et al*. found that the lack of RA was linked to the persistence of the median artery in 8.33% of patients who had CABG. According to Susan Standring, author of "Gray's Anatomy," the Radial artery (RA) originates from the Brachial artery (BA) in the cubital fossa (CF), located about a centimetre below the elbow crease. Researchers Chandini gupta *et al*. claimed that 94.8 percent of CF RA was caused by the BA. Nasr AY found that BA in the CF was the starting point for RA 84 percent of the time. For 86% of samples examined by Sharadhakumar, the RA was shown to originate from the BA at the level of the neck of radius. According to Prakash *et al*., the BA in CF is where RA first appeared. Eighty-six percent of RA, according to Nitin R. Mudiraj *et al*. [8-10].

Similar to the aforementioned research, we found that 96% of RA in CF was caused by the BA. This research contradicts the findings of suganthy J *et al*. and Omer Faruk Dogan *et al*., who report no evidence of RA. Omer Faruk Dogan *et al*. also discovered that the median artery did not remain persistent in their investigation. W According to the research of Henry Hollinshead, HORA occurred in 14.27% of cases, with 2.13 percent of RA coming from the AA and 12.14 percent from the BA in the arm. According to Ernest W April's book, RA may originate from the BA anywhere in the arm in 14% of cases. 4.9% of the cases studied by Baral P *et al*. had RA that had originated in the arm BA. There was an instance of RA traced back to the first AA segment, as described by Priya S patil *et al*. According to Ileana Dinea *et al*., HORA was detected in 7.14 percent of samples. According to the research conducted by Chandini gupta *et al*., researchers found that AA accounted for 2.66 percent of RA and BA accounted for 2.66 percent of RA in the arm. According to Nasr A Y, 16% of tissues tested positive for HORA. Proximal to the junction of the medial and lateral roots of the median nerve is the location where Shiny *et al*. described a case of HORA in AA [10-13].

13% of specimens in the research by Sharadhakumar had HORA from the BA in the arm. The origin of RA in the arm is from the BA in 10.1% of cases, according to the research of Shubha *et al*. 1.7% of patients who had a transradial coronary angiography had HORA, according to a study by Li L *et al*. Based on research by Padma Varlekar *et al*., 3.12% of RA cases originate in the BA of the arm [14, 15].

Three specimens in the current investigation showed HORA from BA in the arm. Since the radial artery's diameter is so close to that of the coronary artery, it was the third most frequent artery utilised as a transplant in CABG. Higher-level RA may have a smaller diameter, making grafting impossible, and also making catheterization unsuccessful. When compared to internal mammary artery grafting, the rate of hypoperfusion syndrome after RA autografting is lower [16, 17]. When RA begins farther up in the arm, the risk of injury and severe bleeding increases62. Accidental ligation during humerus surgery, mistaking it for a vein, might cause hand gangrene. It is common practise to auscultate the BA in the CF to get a reading of the blood pressure. Low blood pressure monitoring may be connected with HORA. Consequently, orthopaedic and vascular operations need an understanding of the cause of RA.

According to Thomas Walmsley's book, the brachioradialis muscle covers the RA's proximal portion while the skin, superficial fascia, and deep fascia cover the distal portion. In certain cases, he said, RA occurs on the surface rather than in the deep fascia. As reported by Sachs M. *et al*. in the anatomical snuff box, RA takes a superficial path in 0.87 percent of specimens. According to a case study by Aparna G. *et al*., the radial artery might sometimes run superficial to the tendons of the anatomical snuff box [16-18].

All of the samples in this investigation had a typical RA course. No evidence of a superficial course of RA was identified. In the lateral side of the forearm, the RA divides into branches that supply the skin and the muscles. Since most of its path in the forearm is superficial (RA is often located in the deep to deep fascia), it may be readily accessed for interventional and diagnostic procedures. There is no evidence that the progression of RA is connected to the forearm's neurovascular systems [19-22]. Because of the hand's UA's collateral blood supply, it may be used for invasive treatments like catheterization and grafting. When puncturing the median cubital vein, the superficial course of RA in the CF increases the risk of mistaking the tissue for a vein. If you inject anything intra-arterially by accident, you might end up with arterial spasms or even gangrene in your hand. Forearm RA tends to progress superficially, making it more vulnerable to injury. It is possible to reconstruct the mandible and thumb from the radius. The RA muscle fibres provide vasculature in the bony flap. Harvesting of the radius occurs between the proximal insertion of the pronator teres and the distal insertion of the brachioradialis. Therefore, it is crucial to understand how RA develops [23-25].

In this analysis, 96% of RRA was attributed to the RA, 4% to the UA, and 0% to the BA. Only around 4% of samples were found to have accessory RRA. The current study's findings are consistent with those of the preceding studies by Atsumori Hamahata A *et al*., Prakash *et al*., and Vazquez T *et al*. Since the anastomosis is already well established in the area surrounding the elbow, microsurgery and reconstruction may be performed using an RRA based flap. The rate of survival with an RRA flap is rather high. When the flap is being harvested, having the Accessory RRA present is helpful in a number of different ways [26-28]. All tissues tested positive for DPA, and the RA had a role in arch development in this analysis. As the artery arches provide abundant blood flow to the hand, any lesion there will bleed heavily and heal rapidly. An understanding of the hand's vascular system is crucial for the success of microsurgical reconstruction techniques on the hand.

Conclusion

Since the Radial artery's branching pattern has such far-reaching clinical and radiological ramifications, it has long been of interest to anatomists and surgeons. The aim of the present research was to dissect human adult cadavers and record the normal and variant anatomy of the radial artery. From this, we inferred the following. In 94% of samples, the Radial artery originated at the brachial artery in the cubital fossa, whereas in 6% of samples, it originated at the brachial artery in the arm. Most forearm and hand operations focus on the superficial palmar arch because its proper function is essential to the continued circulation of the hand and fingers. Doppler ultrasonography and arterial angiography are two methods that may be used to determine the hand's vascular pattern before invasive and interventional operations are performed.

Conflict of interest
None

Funding support
Nil

References

1. Adib A Aughsteen, Hasan M Hawamdeh, Muzahim AI Khayat. Bilateral variations in the branching pattern of Brachial artery, International Journal of Anatomical variations, 2011, 167-170.
2. Atsumori Hamatha, Hiroaki Nakazawa, Maski Takeuchi, Hiroyuki Sakurai. Usefulness of Radial recurrent artery in Transplant of Radial Forearm Flap:An Anatomical and Clinical Study, J Reconstr Microsurg. 2012;28:195-198.
3. Baral P, Koirala S, Baral R, Bhattacharya S, Jha CB, vijayabhaskar P. A series of study of Anatomical Variation on Arterial system of Upperlimb in Nepalese Cadavers, 2008, 1-9.
4. Barry J Anson. An Atlas of Human Anatomy 5th edition. 1950, 1016-1033.
5. Bilodi AK, Sanikop MB, variations in the termination of brachial artery: A case report, Kathmandu univ Med J. 2004;2(1):49-51.
6. Pelin C, Zgayapan R, Mas N, karabay G. Au unusual course of the Radial Artery, Folia Morphol. 2006 Sep;65(4):410-413.
7. Chandini Gupta, Vikram Palimar, Murlimanju BV, Vaishali R shatti. A Morphological syudy of variations in the Origin and Course of Radial Artery, Research Journal of Pharmaceutical, Biological and chemical Sciences. 2002 April –June;l 3(2):333.
8. Coleman SS, Anson BJ. Arterial pattern in hand, Surg. Gynec and Obst. 1961;113:409-424.
9. Nezic D, Milojevic P, Cirkovic M, Knezevic A, Navokanovic A, Gojkovic-Bukarica LJ. The radial artery for coronary aertery bypass Grafting, ACI, LII:11-19.
10. Srivani D, Sofia P, Lakshmi Devi CK, Jayachandra Pillai T. Variation in superficial palmar arch arch: A case report, Sch Jn Med Case Rep. 2015;3(5):435-437.
11. Dr. Chandrika Teli, Dr. Nilesh N Kate, Dr. Paarthipan. Hing division and variation in brachial artery branching pattern, Journal on Dental and Medical Sciences, 2013;3(6);68-70.
12. Ernest Gardner, Donald J Gray, Rahilly RO. A Regional study of Human structures, 2nd edition. 1967:179:193-194.
13. Mookambica RV, Velayutham Nair, Rema Nair, Somayaji SN, Narendra Pamidi, Venkata R Vollala. Incomplete superficial palmar arch, International Journal of Anatomical Variations. 2010;3:65-66.
14. Naoyuki Yokoyama, Satoshi Takeshita, Masahiko Ochial, Yutaka Koyama, Satoshi Hoshino, Takaaki Isshiki. Anatomic Variation of the Radial Artery in Patients Undergoing Transradial coronary Intervention, Catheterization and cardiovascular interventions. 2002;49:357-362.
15. Nasr AY. The Radial Artery And its Variations: Anatomical study and clinical importance, Folia Morphol. 2012 Nov;71(4):252- 262.
16. Nitin R Mudiraj, Manisha R Dhobale. Morphometric study of radial artery, International Journal of Recent Trends. 2015:15(1):6-10.
17. Omer Faruk Dogan, Musturay Karcaaltincaba, Umit Duman, deniz Akata, Aytekin Besim, Erkmen Boke. Assessment of radial artery and Hand circulation by computed Tomography Angiography:A pilot study, The heart surgery forum. 2004;8(1):28-32.
18. Padma Varlekar, Hiren Chavda, Dharati Kubavat, Shalieshkumar Nagar, SS Saiyad, Chintan Lakani. Higher bifurcation of Brachial artery with Superficial course of radial artery in forearm: A case Report,
19. Prakash KG, Saniya K. A study of Radial artery in cadavers and its clinical importance, International Journal of Medical Research and health Sciences. 2014 Jan;3(2):254-262.
20. Shubha R, Sudharshan Babu KG, Mekala D, Lalitha C. An Anatomical study of variations in the termination of brachial artery:embryological basis and clinical importance, ISRO Journal of Dental and Medical Sciences. 2013;9(1):68-75.
21. Soubhagya R, Nayak, Ashwin Krishnamurthy, Lakshmi Ramanathan, Latha V Prabhu. The median radial type of Superficial palmar arch: A case report and review of literature, Clinics. 2008;63:409-410.
22. Swaroop N, Dakshayani KR. The High Origin of Radial Artery and its Clinical Significance,Anatomica Karnataka. 2011;5(2):32-35.
23. Umapathy Sembian, Kamala E, Muhil M, Nalina Kumari. A study of variations in the formation of superficial palmar arch in the rural population of southern Tamilnadu, International Journal of Anatomy radiology and surgery. 2012;1(1):7-11.
24. Vaishali Bondage, Anuj Balaji More, Gangane SD. A case report on high origin of radial artery, International Journal of Anatomy and Research. 2014;2(3):503-506.
25. Vazquez T, sanudo JR, Carretero J, Parkin I, Rodriqueez- NiedenfuhrM. Variations of thr Radial recurrent artery of its clinical interest, Surg Radiol Anat. 2013 Oct; 36(8):689-694.
26. Venkata Ramana Vollala, Somayaji Nagabhooshana, Bhat SM, Rodrigues V. M Rare Anatomical variant: Arterial circle in palm and at the base of the thumb, Romanian Journal of Morphology and Embryology. 2008;49(4):585-587.
27. Vidhya Ramakrishnan, Anil Kumar Reddy Y, Aruna S, Balaji Thotakura, Suba Ananthi. A cadaveric study on anatomical variations of the superficial palmar arch, International journal of health Science and Research. 2014;3(1):144-148.
28. Waseem Al Talawah, Dereje Getachew, Roger Soames. The Clinical significance of Radial artery morphology in artificial arterio- venous fistula for haemodialysis, Indian j Sci. Res. 2015;11(1):24-29.

How to Cite This Article
Arani S, Sagari AA. Clinical implications of studying the radial artery, its branches, and variations. International Journal of Advanced Research in Medicine. 2021;3(1):575-578.