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# Anatomical analysis of radial nerve and arcade of Frohse in cubital fossa using human cadavers

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***Background:*** *The radial nerve (RN) is a peripheral nerve that originates from the posterior bundle of the brachial plexus and carries C5-Th1 fibres. In the cubital fossa, the radial nerve divides into a superficial branch of the radial nerve (SBRN) and a deep branch of the radial nerve (DBRN). Next, the DBRN enters under the arcade of Frohse (AF) and changes its name to posterior interosseous nerve of antebrachii (PIN). The AF, first described in 1908 by Frohs and Frankel, is the superior proximal part of the supinator muscle, which can be tendinous or membranous.*

***Materials and methods:*** *Eight dissected upper limbs were examined to measure the distances and characteristics of the RN, DBRN, SBRN and AF, using a precise electronic caliper.*

***Results:*** *The average distance from the point of branching of the RN into its terminal branches to the AF was 54.64 mm. In half of the cases, the DBRN divided before entering the AF. The average distance from the point of branching of the DBRN to the AF in these cases was 13.88 mm. The average width of the AF was 8.60 mm. Five tendinous AF and three membranous AF were identified.*

***Conclusions:*** *A thorough understanding of the anatomy of the radial nerve and its branches in the cubital fossa, as well as the AF, is important for the proper understanding of anatomy, and may also contribute to the reduction of surgical complications during procedures in this area.* (Folia Morphol 2025; 84, 1: 71–75)

**Keywords: radial nerve, arcade of Frohse, DBRN, cubital fossa, cadaver**

## INTRODUCTION

The radial nerve (RN) is a peripheral nerve that originates from the posterior fascicle of the brachial plexus [2, 4, 9] and carries C5-Th1 fibres [9]. It runs between the long head and the medial head of the triceps and further into the radial nerve groove of the humerus. The RN then perforates the lateral intermuscular septum and enters the anterior compartment of the arm. Before it reaches the forearm, it runs between the brachialis and brachioradialis muscles [2, 14, 26]. Here is the origin of the radial canal, which is located between the brachialis muscle and the brachioradialis muscle at the level of the humeroradial joint. The base of the canal is formed by the ulnar joint capsule and a fragment of the deep head of the supinator muscle, while from above it is formed by the brachialis, brachioradialis and extensor carpi radialis brevis muscle [19]. In turn, the radial canal ends with the distal edge of the supinator muscle [24]. At the level of the lateral epicondyle of the humerus, the RN divides into a superficial branch of the radial nerve (SBRN) and a deep branch of the radial nerve (DBRN) [2, 26]. The DBRN runs between the two heads of the supinator muscle and enters under the arcade of

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Frohse (AF). The DBRN when it enters under the AF is known by a different name i.e. posterior interosseous nerve of antebrachii (PIN) [16]. The RN contains motor, sensory [9] and proprioceptive fibres (PIN fibres for the posterior capsule of the wrist joint) [23].

The AF was first described in 1908 by Frohs and Frankel [8]. It is the superior proximal part of the supinator muscle, which can be tendinous or membranous [20]. Understanding the anatomical relationships around the supinator muscle is crucial in reducing surgical complications [29].

## MATERIALS AND METHODS

Eight upper limbs (four right and four left) were dissected, visualising the RN, DBRN, SBRN and AF. Using an electronic caliper with ± 0.02 mm accuracy, the distance of the RN to the AF division, the distance of the DBRN division to the AF, the diameter of the RN at a distance of 1 cm from the end division, and the width of the AF were measured. In addition, the structure of the AF (i.e. tendinous or membranous) was visually assessed. The cadavers used in this study came from the Informed Cadaver Donation Programme run since 2003 by the Medical University of Silesia in Katowice, Poland.

## RESULTS

The average distance from the point of branching of the RN into its terminal branches to the AF was 54.64 mm. In half of the cases, the DBRN divided before entering the AF. The average distance from the point of branching of the DBRN to the AF in these cases was 13.88 mm. Detailed results are set out in Table 1. The division of the RN into the DBRN and SBRN, as well as the AF, is illustrated in Figure 1.

The diameter of the RN measured 10 mm proximally from the division site into terminal branches was 4.79 mm. The diameter of the DBRN measured 10 mm distally from the origin site averaged 4.09 mm, while the diameter of the SBRN measured 10 mm distally from the division site averaged 2.50 mm. Detailed results of the diameter measurements of the RN, DBRN, and SBRN are set out in Table 2.

The width of the AF averaged 8.60 mm. Additionally, five tendinous AF (two left and three right) and three membranous AF (two left and one right) were identified. Detailed results of the width measurement and assessment of AF structure are set out in Table 3.

**Table 1.** Division of RN into terminal branches and division distance of DBRN to AF.

| Side | Division of RN to AF [mm] | Division distance of DBRN to AF [mm] |
|---|---|---|
| Left | 88.50 | – |
| Left | 24.03 | – |
| Left | 47.58 | 16.21 |
| Left | 51.43 | 15.84 |
| Right | 95.05 | 12.31 |
| Right | 20.08 | 11.17 |
| Right | 49.40 | – |
| Right | 61.05 | – |

AF — arcade of Frohse; DBRN — deep branch of radial nerve; RN — radial nerve.

## DISCUSSION

This study showed that RN makes its division at a distance 54.64 mm from the AF. Other studies have reported values of 46 mm [19], 36 mm [29], and 51 mm [18]. Nair et al. [18] described the RN division on the level of the lateral and medial epicondyle of the humerus (transepicondylar distance), stating that the RN divides above the described location in most cases.

The DBRN usually enters under the AF as a single branch [12, 28]. However, there are cases described in the literature where the DBRN divides into two branches before entering under the AF [30]. Such observations were also made in This study.

Measurements of RN, DBRN, and SBRN diameters conducted on human cadavers have been rarely described in the literature. Nair et al. [18] measured the diameter of RN and SBRN at sites of their potential compression, obtaining results of 3.2 mm for RN and 2 mm for SBRN. Welle et al. [31] assessed the RN diameter to be 47 mm, but this measurement was taken at the level of the humeral shaft. Meng et al. [17] measured the diameter of DBRN proximal to AF, yielding results ranging from 1.0 to 1.5 mm.

In this study, the tendinous AF was observed more frequently. The results of other authors' studies are set out in Table 4. Metaanalysis showed that tendinous AF occurs in 66% of cases [1]. Table 4 does not include the results of the study by Tatar et al. [28] because it was not conducted on adult cadavers, but on human foetuses. Nevertheless, the results of that study are ineresting because membranous AF was found in all the cases described. This may imply that a change in AF structure from membranous to tendinous occurs with age. Similar results were presented by Spinner [27] and Caetano et al. [3].

In the literature, the most common classification of AF structure is into tendinous or membranous. However, Debouck et al. [6] created a more complex classification of AF structure, distinguishing type A (tendinous Arcade), type B (musculo-tendinous Arcade), type C (muscular Arcade), and type D (membranous Arcade). Geographical analysis by Benes et al. [1] showed the highest prevalence of tendinous AF to be in Asia (74%), followed by South America (73%), Europe (67%), and North America (42%).

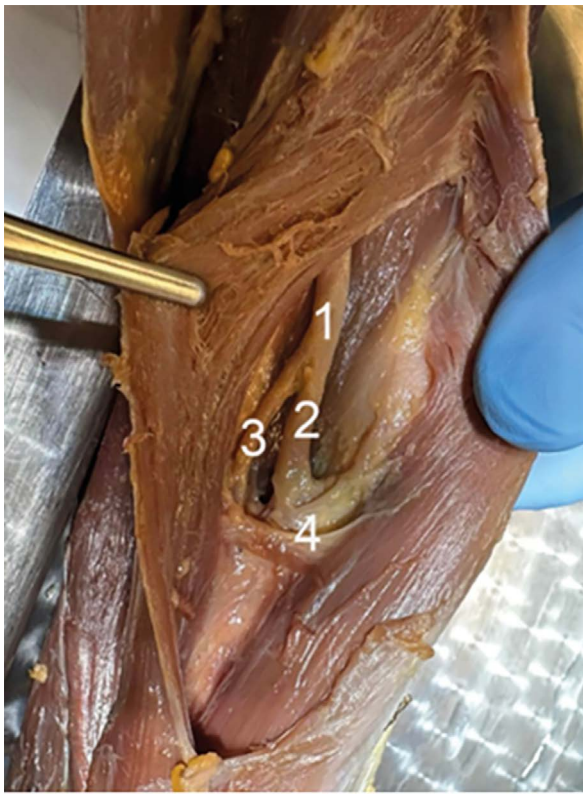


**Figure 1.** Division of RN into DBRN and SBRN, as well as AF. 1 — RN; 2 — DBRN; 3 — SBRN; 4 — AF. AF — arcade of Frohse; DBRN — deep branch of radial nerve; RN — radial nerve; SBRN — superficial branch of radial nerve.

In this study, the average width of AF was 8.60 mm. Data in the literature varies. Ozturk et al. [20] reported an AF width of 10.13 mm. Ebraheim et al. [7] described this dimension as having a gender differentiation i.e. in men the width was 2.8 mm, while in women it was 2.5 mm.

A comprehensive knowledge of the anatomy of the RN, its terminal branches and the AF has a significant role to play in surgery and orthopaedics. Approximately 1% of non-traumatic upper extremity disorders are compression of the RN or its branches [11, 28]. The possibility of compression of the RN–PIN branches was pointed out as long ago as 1905 by Guillain et al. [10] in describing the case of a conductor of an orchestra. Compression can occur at four locations: under the AF (the most common cause) [20], in the tendinous band forward of the radial bone, at the tendinous margin of the extensor carpi radialis brevis muscle, and through the radial recurrent artery (Henry's leash) [13]. The peak incidence of radial tunnel syndrome (RTS) is between the ages of 40 and 60 [15, 25], and RTS almost always affects the dominant limb [25].

**Table 3.** Results of arcade of Frohse (AF) width measurements and assessment of its structure.

| Side | AF width [mm] | AF structure |
|---|---|---|
| Left | 11.19 | Tendinous |
| Left | 8.11 | Tendinous |
| Left | 7.98 | Membranous |
| Left | 9.41 | Membranous |
| Right | 10.02 | Membranous |
| Right | 10.14 | Tendinous |
| Right | 7.36 | Tendinous |
| Right | 4.56 | Tendinous |

**Table 2.** Measurements of diameters of RN, DBRN, SBRN.

| Side | Diameter of RN [mm] | Diameter of DBRN [mm] | Diameter of SBRN [mm] |
|---|---|---|---|
| Left | 4.35 | 2.68 | 2.46 |
| Left | 4.75 | 4.18 | 1.48 |
| Left | 4.45 | 4.56 | 2.48 |
| Left | 4.92 | 4.27 | 2.77 |
| Right | 6.85 | 6.29 | 4.83 |
| Right | 3.65 | 3.82 | 1.48 |
| Right | 4.35 | 3.04 | 1.75 |
| Right | 5.00 | 3.87 | 2.73 |

DBRN — deep branch of radial nerve; RN — radial nerve; SBRN — superficial branch of radial nerve.

**Table 4.** Ratio of arcade of Frohse (AF) tendinous or AF membranous in other authors' studies results — own development.

| Number of upper extremities | AF tendinous | AF membranous | Reference |
|---|---|---|---|
| 55 | 48 (87%) | 7 (13%) | Ozturk et al. (2005) [20] |
| 100 | 46 (46%) | 54 (54%) | Hohenberger et al. (2020) [12] |
| 60 | 48 (80%) | 12 (20%) | Ozkan et al. [19] |
| 20 | 14 (70%) | 6 (30%) | Ebraheim et al. (2000) [7] |
| 18 | 14 (78%) | 4 (22%) | Hazani et al. (2008) [11] |
| 31 | 21 (68%) | 10 (32%) | Thomas et al. (2000) [29] |
| 120 | 61 (51%) | 59 (49%) | Papadopoulos et al. (1989) [21] |
| 60 | 34 (57%) | 26 (43%) | Prasartritha et al. (1993) [24] |
| 30 | 26 (87%) | 4 (13%) | Clavert et al. (2009) [5] |
| 21 | 15 (71%) | 6 (29%) | Meng et al. (2015) [17] |
| 60 | 48 (80%) | 12 (20%) | Paul et al. (2020) [22] |
| 8 | 5 (62.5%) | 3 (37.5%) | Results of this study |

The number of extremities used in this study was relatively small, but we consider this study to be of high value in the development of anatomy, especially in view of the scarcity of human bodies donated to science and the crisis in the teaching of anatomy at universities, both of which do not provide medical students with adequate access to bodies during anatomy classes.

## CONCLUSIONS

The availability of human cadavers to be used for scientific research and medical education is limited. Many medical schools face a shortage of cadavers in the dissection room. This makes any scientific research conducted on cadavers valuable. A thorough understanding of the anatomy of the radial nerve and its branches in the cubital fossa, as well as the arcade of Frohse, is important for a proper understanding of anatomy.

## ARTICLE INFORMATION AND DECLARATIONS

### Data availability statement

Original contributions presented in the study are included in the article. Further inquiries may be directed to the corresponding author.

### Ethics statement

The study was reviewed and approved by an Ethics Committee. Number assigned by the Bioethics Committee: KAP/0724/7/2024.

### Author contributions

TL: concept, design, execution and interpretation of data; RK: design, execution and interpretation of data, writing of paper, KK: design, execution and interpretation of data, writing of paper, KB: execution and interpretation of data, writing of paper; GB: concept, scientific supervision.

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### Conflict of interest

The authors declare that there is no conflict of interest.

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