

Determination of Safe Zone of Median Nerve in the Carpal Tunnel, using Radial Styloid Process and the Medial-Most Point at the Lower End of Ulna

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Abstract

Context: Introduction: In the current study, an attempt was made to determine the safe zone for the limited carpal tunnel incision in case of carpal tunnel syndrome, in order to avoid injuries to the median nerve, by measuring the distance of median nerve from radial styloid process. **Aims:** To determine the safe zone of the median nerve (during surgical procedures for treating carpal tunnel syndrome) using various measurements. **Settings and Design:** Descriptive study. **Methods and Material:** 23 upper limbs, both right (11) and left (12), obtained from embalmed cadavers formed the material for the current study. Measurements of Median Nerve (MN) diameter, its distance from Radial Styloid Process (RSP) and Medial Most Point of Ulna (MMPU) were taken. **Statistical Analysis used:** Mean and range. **Results:** A distance greater than 64.57% from RSP, of the distance between RSP and MMPU, according to our study, will be useful for surgeons in order to avoid damage to median nerve. **Conclusions:** The safe zone for surgical procedures in treating carpal tunnel syndrome, in order to avoid damage to the median nerve is a distance greater than 64.57% of the distance between RSP and MMPU.

Keywords: Median Nerve; Carpal Tunnel Syndrome; Flexor Retinaculum.

Introduction

Flexor retinaculum [3] is a fibrous band which bridges anterior concavity of carpus. Carpal tunnel [6], is a passage on the palmar side of the wrist. The narrowing of the canal results in the median nerve becoming entrapped- carpal tunnel syndrome.

Various imaging techniques are available for determining the location of the median nerve. But advanced technology is not available to a surgeon in the peripheral villages. This study for mitigating the difficulty in locating the median nerve.

In the current study, an attempt was made to determine the safe zone by measuring the distance of median nerve from radial styloid process.

Objectives

1. To measure the distance between the radial styloid process and the medial most point on the lower end of ulna.
2. To measure the distance between median nerve and radial styloid process.
3. To measure the distance between median nerve and medial most point on the lower end of ulna.
4. To measure the diameter of median nerve.
5. To determine the safe zone of the median nerve (during surgical procedures for treating carpal tunnel syndrome) using all these measurements.

Materials and Methods

23 upper limbs, both right (11) and left (12), obtained from embalmed cadavers in the department of Anatomy, Geetanjali Medical College and Hospital and in the department of Anatomy, Rabindranath Tagore Medical College, Udaipur formed the material for the current study. Permission and ethical clearance were obtained from the human ethics committee for

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conducting the study. The study is of descriptive type. Only normal upper limbs, both right and left, were included in the current study. Upper limbs with deformity or congenital malformation were excluded from the study. Each un-dissected specimen was carefully dissected using standard dissection instruments like scalpels, toothed forceps, blunt forceps and scissors. In some cases, already dissected specimens were also used. Median nerve was identified within the carpal tunnel after sectioning the flexor retinaculum. The distance between the radial styloid process and the median nerve was measured using digital vernier calipers. Similarly, distance between radial styloid process and the medial most point of ulna and the diameter of median nerve were measured. From the above mentioned measurements, the safe zone for median nerve in surgical procedures for treating carpal tunnel syndrome was estimated.

Results

The time period in which the research was conducted is August and September. The following parameters were observed and measured:

- The distance of the median nerve to the radial styloid process (RSP-MN)
- The distance of radial styloid process to the medial most point on the lower end of ulna. (RSP-MMPU)
- The diameter (width) of the median nerve (MN).
- The distance of median nerve to the medial most point on the lower end of ulna (MN-MMPU).
- The mean values of all the above mentioned parameters.

The following points were kept under consideration:

- The skin and the fascia had been removed before taking the measurements.
- The measurements were taken at the level of the flexor retinaculum (wrist).
- Ulnar styloid process was not considered as a landmark for measurement as it is posteriorly placed. Instead the medial most point measurement, the radial styloid process, was considered as a landmark for measurement as it is lateral in position.

The maximum distance between the RSP and MMPU was found to be 57.00 mm. The minimum distance between the RSP and MMPU was found to

be 42.73 mm. The mean value of the distance between radial styloid process (RSP) and medial most point of lower end of ulna (MMPU) is calculated to be 48.598 mm.

The maximum distance between the MN and RSP was found to be 31.38 mm. The minimum distance between the MN and RSP was found to be 14.45 mm. The mean value of the distance between median nerve (MN) and radial styloid process (RSP) is calculated to be 22.39 mm.

The maximum diameter of median nerve was found to be 7.24 mm. The minimum diameter of median nerve was found to be 3.15 mm. The mean value of the diameter of the median nerve is calculated to be 5.42 mm.

The maximum distance between the MN and MMPU was found to be 32.60 mm.

The minimum distance between the MN and MMPU was found to be 15.30 mm.

The mean value of the distance between median nerve (MN) and medial most point on the lower end of ulna (MMPU) is calculated to be 23.39 mm.

- The mean distance between RSP and MMPU was 48.598 mm (42.73-57.00 mm).
- The mean distance of the MN from RSP is calculated to be 22.39 mm (14.45-31.38 mm).
- The mean distance of the MN from MMPU is calculated to be 22.39 mm (15.30-32.60 mm).
- The mean distance of the MN from RSP (22.39) in the total sample of 23 upper limbs was found to be less than 50% of the RSP-MMPU distance.
- In all the cases, the distance of the median nerve from RSP was measured to be less than 64.57% the distance between RSP and MMPU.
- In 65.2% of cases the median nerve was found to be at less than 50% of the distance between RSP and medial most point on the lower end of ulna (MMPU).
- In 16 out of 23 specimens (70%), the location of MN to the RSP was less than 50% of the RSP-MMPU distance.
- In 5 out of 23 specimens (21.7%), the location of MN to the RSP was between 51-55% of the RSP-MMPU distance.
- In 1 out of 23 specimens (4.4%), the location of MN to the RSP was between 56-60% of the RSP-MMPU distance.
- In 1 out of 23 specimens (4.4%), the location of MN to the RSP was less than 50% of the RSP-MMPU distance.



Fig. 1: Measuring the distance between the median nerve and radial styloid process



Fig. 3: Measuring the diameter of the median nerve.



Fig. 2: Measuring the distance between the radial styloid process and medial most point at the end of ulna.

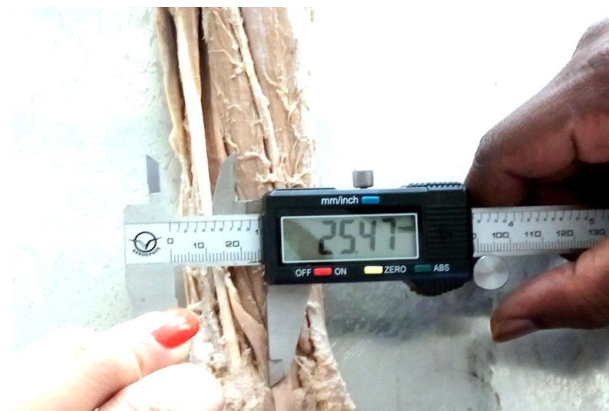


Fig. 4: Measuring the distance between the median nerve and the medial most point at the lower end of ulna

Table 1: [Distance between Radial Styloid process (RSP) and Medial most point of lower end of ulna (MMPU) (mm)]

Specimen No.	RSP-MMPU (mm)
1	44.87
2	43.06
3	52.06
4	48.24
5	53.76
6	48.75
7	46.26
8	44.65
9	50.89
10	57.00
11	52.10
12	47.96
13	52.10
14	51.46
15	45.74
16	50.06
17	45.24
18	53.53
19	49.99
20	50.28
21	46.57
22	40.47
23	42.73

Abbreviations: [Radial Styloid process (RSP) and Medial most point of lower end of ulna (MMPU).]

Table 2: [Distance between Median nerve and radial styloid process (mm)]

Specimen No.	MN-RSP (mm)
1	26.32
2	14.45
3	20.96
4	19.14
5	24.66
6	22.30
7	20.51
8	19.69
9	18.74
10	31.38
11	22.16
12	17.50
13	27.91
14	26.22
15	24.96
16	24.23
17	25.17
18	24.40
19	20.87
20	26.79
21	16.43
22	16.84
23	23.47

Table 3: [Diameter of the Median Nerve (mm)]

Specimen No.	Diameter of the Median Nerve (mm)
1	4.88
2	4.39
3	5.10
4	7.16
5	5.51
6	6.29
7	5.91
8	4.22
9	5.63
10	6.20
11	5.52
12	3.54
13	5.33
14	5.68
15	4.44
16	5.73
17	5.72
18	6.38
19	6.03
20	6.38
21	3.15
22	7.24
23	4.27

Table 4: [Distance between Median Nerve (MN) and medial most point on lower end of ulna (MMPU) (mm)]

Specimen No.	MN-MMPU (mm)
1	19.83
2	26.20
3	26.20
4	23.16
5	22.53
6	20.70
7	24.98
8	23.45

9	22.65
10	20.23
11	32.60
12	24.04
13	32.22
14	28.30
15	18.44
16	15.30
17	16.50
18	25.48
19	21.00
20	22.80
21	30.05
22	17.63
23	19.90

Abbreviations: [Distance between Median Nerve- MN, medial most point on lower end of ulna- MMPU.]

Discussion

In surgical procedures like, limited open carpal tunnel release/endoscopic technique, involving carpal tunnel syndrome, it is important to avoid damage to median nerve when incising the flexor retinaculum in order to relieve the compression of the median nerve. So determining the safe zone for such procedures is of utmost importance. Earlier studies [1,2,4,5] have shown certain safe zones to avoid injury to median nerve during surgical procedures. One of the studies done by N.O. Ajayi et al [1] have shown that the safe zone for surgical procedures is to operate at a distance which is more than 60% the distance between RSP and USP.P.

In our study, we found that the safe zone for surgical procedures was greater than 64.57% the distance between RSP and MMPU since the median nerve in all the cases was found to be well within this distance. Though in our study, the landmarks used were radial styloid process and the medial most point of the lower end of ulna. Ulnar styloid process was not considered as a landmark since it is posterior in position.

According to the study done by Ajayi et al [1], the mean distance between the RSP and USP was 49.34 mm, whereas in our study, the distance between RSP and MMPU is 48.598 mm.

The mean distance of MN from RSP and USP according to the research [1] was 22.44 mm and 26.66 mm respectively while in our study, the distance of MN from RSP and MMPU was found to be 22.39 mm and 23.39 mm respectively.

According to the previous research [1], in 76.6% (46/60) of specimens, the location of the MN to the RSP was less than 50% of the RSP-USP distance. The location of the MN to the RSP was between the ranges

of 50-59%, 60-69% of the RSP-USP distance in 18.35 (11/60) and 3.3% (2/60) of specimens, respectively.

According to our research, in 16 out of 23 specimens (70%), the location of MN to the RSP was less than 50% of the RSP-MMPU distance. The location of MN to the RSP was between the ranges 51-55%, 56-60%, 61-65% of the RSP-MMPU distance in 21/7% (5/23), 4.4% (1/23) and 4.4% (1/23) of the specimens respectively.

In some earlier studies [1,2,4,5], the distance between RSP and Palmaris longus tendon and the distance between USP and Palmaris longus tendon were measured since median nerve is closely related to Palmaris longus tendon. Though in our study, we could not measure that, as in many specimens the Palmaris longus tendon had already been cut.

The safe zone, as stated by us, i.e., a distance greater than 64.57% of the distance between RSP and MMPU, according to our study will be useful for orthopedic surgeons in order to avoid damage to median nerve. Also, the location of median nerve helps the anaesthetists to give local anaesthetic without damaging nearby structures.

Conclusion

The safe zone for surgical procedures in treating carpal tunnel syndrome, in order to avoid damage to the median nerve is "a distance greater than 64.57% of the distance between RSP and MMPU", according to our study will be useful.

Conflict of Interest

None to declare

References

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