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Trapeziectomy and Acute Carpal Tunnel Syndrome. MRI Anatomical Study of the Relationship between Trapezium and Median Nerve

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Abstract

Background: Thumb Carpometacarpal joint (CMCJ) osteoarthritis is a common problem. It has an increased incidence in females over fifty years old. The usual clinical presentation includes activity-related discomfort at the base of the thumb. The standard first line treatment would include modification of activities, analgesia, splintage, and corticosteroid injection. Trapeziectomy or excision arthroplasty is an appropriate option when all non-operative measurements have failed. Several modified techniques of base of thumb arthritis surgery have been described with variable but satisfactory long-term results. There are limited data in the literature concerning acute complications of Trapeziectomy. We are not aware of any reported intra-operative or immediate post- operative complications such as acute carpal Tunnel Syndrome after this operation.

Objectives: To measure the distance of median nerve from Trapezium using MRI scan. To understand the anatomy of the carpal tunnel and its relation to the Trapezium.

Design & methods: Retrospective examination of wrist MRI scans of adult patients who have been referred to our institution with wrist pain and subsequently had MRI scan to investigate their symptoms. Only cases with normal MRI findings were included to ensure normal identification of anatomical structures. Images then reviewed to calculate the distance between the median nerve and the trapezium.

Results: During the study period 20 patients met the inclusion criteria. 14 females and 6 males with a mean age of 48 years (20-73). There were 10 right and 10 left wrists. The shortest distance between median nerve and trapezium was 3.8 mm and the longest distance was 12 mm. On average, the median nerve was found to be at 7.3 mm from trapezium in any plane. In 15 out of 20 patients (75%) the measured distance was between 5 to 10 mm. The distance was less than 5 mm in 3 cases (15%) and more than 10 mm in 2 patients (10%).

Conclusion: Surgeons should bear in mind anatomical variations around the wrist when planning Trapeziectomy. The relation between Trapezium and median nerve is usually affected by the existing arthritic process. Further research on the dynamic relation between the carpal tunnel and trapezium in patients with thumb CMCJ arthritis is warranted.

Keywords: Trapeziectomy; Carpal Tunnel; MRI Anatomy.

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Introduction

Primary osteoarthritis of the CMCJ of the thumb is a common problem, especially in women beyond the fifth decade. Patients classically present with pain at the base of the thumb exacerbated by daily activity [1-4]. The usual first line treatment may include modification of activities, pain relieving medications, splinting, and possibly local anaesthetic with steroid injections. When these nonoperative measures have failed to preserve or restore the patient's quality of life, surgical intervention may be appropriate [5].

Excision Arthroplasty or Trapeziectomy is widely recognised surgical treatment of thumb CMCJ arthritis [6]. Simple Trapeziectomy was first described by Gervis in the late Forties of the Twentieth century [7]. This was an effective intervention for pain relief but later reports showed significant weakness in the thumb post operatively [8]. It was suggested that the weakness caused by instability at the base of the first metacarpal. To improve stability of the thumb and thereby increase strength in the hand; volar oblique ligament reconstruction and tendon interposition techniques introduced [5,6]. Over the years, multiple techniques and modifications have been developed for treating the arthritic thumb carpometacarpal joint. Technique such as using prosthetic or synthetic implants or soft tissue spacer to fill the cavity after excising the Trapezium have all be described [9].

The results of these modifications were largely excellent in studies with reasonable sample size and intermediate to long-term follow up [10-13]. Subsequent reports however showed that Trapeziectomy alone, tendon interposition with or without ligament reconstruction, and using implants or spacers have each been reported to result in satisfactory outcome [14]. Over all, there is no consensus regarding a consistent advantage of one technique over others. It is known that individual anatomy may hinder certain technique for example in revision surgery or iatrogenic tendon injury. Therefore, surgeons should be familiar with the different surgical options for carpometacarpal arthritis of thumb.

Anatomy

Acute carpal tunnel syndrome (ACTS) is much less common than Carpal Tunnel Syndrome (CTS). It is generally related to trauma and necessitates emergent surgical decompression to avoid serious long-term complications [16]. ACTS is characterized by severe pain and altered sensation in the median nerve distribution caused by a rapid increase in pressure within the carpal tunnel. The severity and progression of symptoms develop quickly over hours. This can differentiate ACTS from CTS which usually develop over weeks or months [16].

The carpal Tunnel is a small anatomical space with a relatively fixed-volume. It contains the four flexor digitorum superficialis tendons, the four flexor digitorum profundus tendons, the flexor pollicis longus tendon, and the median nerve (Figure 1). Although carpal tunnel is open at both proximal and distal ends it is considered to be a closed space with volume capacity of 5 mls and cross-sectional area of about 185 mm^2 [17]. The boundaries of the carpal tunnel consist of the scaphoid, the trapezium, and the fascia overlying the flexor carpi radialis on the radial side. On the ulnar aspect, carpal tunnel is bounded by the hook of hamate, the triquetrum, and the pisiform. On its floor lie the carpal bones and its roof is made by the Transverse Carpal Ligament. The margins of the carpal tunnel are not flexible making it intolerant to increase internal pressure or volume. The inability of the carpal tunnel to expand to space occupying lesions or structures leads to rise of the pressure within the tunnel causing compartment syndrome like symptoms [18].

The Trapezium gives attachment to the Transverse Carpal Ligament and it is in close proximity to the Carpal tunnel. Thus, inflammation associated with base of thumb arthritis can spread to adjacent site. The association between thumb CMCJ arthritis and carpal tunnel syndrome is acknowledged but not fully understood [19,20]. MRI scan is the image modality of choice to identify anatomical structures in human body. It can accurately and reliably demonstrate the normal anatomy of the structures around and within the carpal tunnel. It also helps visualising anatomical variants as well as recognising pathological signal patterns [21].

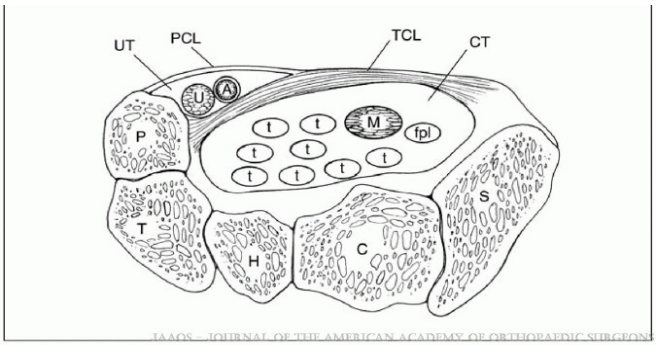

Figure 1: Transverse section through the carpal tunnel. The median nerve is the most superficial structure. A: Ulnar Artery; C: Capitate; CT: Carpal Tunnel; Fpl: Flexor Pollicis Longus Tendon; H: Hamate; M: Median Nerve; P: Pisiform; PCL: Palmar Carpal Ligament; S: Scaphoid; T: Profundus And Sublimis Tendons; T: Triquetrum; TCL: Transverse Carpal Ligament; U: Ulnar Nerve; UT: Ulnar Tunnel. (Adapted from Szabo RM, Steinberg DR: Nerve entrapment syndrome in the wrist. J Am Acad Orthop Surg 1994; 2: 115-123).

Subjects and methods

Adult patients referred to our hospital with wrist pain who then underwent MRI scanning of the wrist as part of clinical workup. Between June 2018 and February 2019, fifty patients underwent MRI scan of their wrist. Only cases with normal MRI findings were included to ensure normal identification of anatomical structures. Patients with history or MRI evidence of trauma or arthritis were excluded. Children and skeletally immature patients were also excluded. Images then examined to calculate the distance between the median nerve and the trapezium.

Imaging technique

All patients were scanned in Phillips Ingenia Omega scanner operating at 1.5 tesla.

The patients were scanned in supine position with the hands lying supine by the side of the torso. Dedicated 16 channel small extremity surface coil was used. The following sequences were employed in line with the hospital's protocol:

- Axial and coronal Proton Density (PD) fatsat (FS) (3 mm thick with 0.3 mm interslice gap)

- Coronal T1 fast spin echo (3 mm thick with 0.3 mm interslice gap)
- Sagittal T2* Gradient echo (3.5 mm thick with 0.3 mm interslice gap)

All images were retrospectively reviewed by a consultant radiologist with MSK interest having over 20 years of experience on Carestream Vue PACS workstation. Measurements were made using electronic calliper from the medial cortex of trapezium to lateral margin of median nerve on PD FS axial images.

Results

Twenty scans analysed for the distance between the median nerve and the trapezium. 14 females and 6 males with a mean age of 48 years (20-73). These were 10 right and 10 left wrists (Table 1). The shortest distance between median nerve and trapezium was 3.8 mm and the longest distance was 12 mm. On average, the median nerve was found to be at 7.3 mm from trapezium at any plane. In 15 out of 20 patients (75%) the measured distance was between 5 to 10 mm. The distance was less than 5 mm in 3 cases (15%) and more than 10 mm in 2 patients (10%) (Table 2).

Table 1: Basic Demographic data of the study sample.

n	20
Male/Female	6/14
Right/Left	10/10
Mean age years	48 (20-73)

Table 2: Measured distance of median nerve from Trapezium in the study sample.

n	20
0-4.9 mm	3 (15%)
5-9.9 mm	15 (75%)
>10 mm	2 (10%)

Discussion

The skeletal changes that occur at the thumb CMCJ arthritis can affect the size of the carpal tunnel. Moreover, the dimensions of the carpal tunnel and the location of the median nerve in relation to trapezium could be dynamic and changes with wrist movements and position during surgery.

Goetz et al [22] showed that the location of the median nerve within the carpal tunnel is variable and changes with different wrist positions. This was a small size MRI study on 6 healthy volunteers. Kwon et al [23] studied the anatomical landmark at different wrist positions in 28 Korean patients with Carpal tunnel syndrome. The focus of the study was mainly on the ulnar side anatomy of the carpal tunnel and how to minimise complication rate during endoscopic carpal tunnel surgery. There were no details about the relation between the median nerve in the carpal tunnel and the trapezium.

Understanding the anatomy in UK population is not fully examined hence this paper. Our work goes in line with previous published literature confirming the correlation between median nerve in carpal tunnel and trapezium. Moreover, wrist anatomy would change in patients with existing arthritis at the thumb CMCJ and further work to examine this area is required.

Limitations

This is a retrospective study with a relatively small number of subjects. Hand position in the MRI coil would influence the location of the median nerve within the carpal tunnel which would affect the measurements. This could not be strictly controlled due to the retrospective design. Intravenous gadolinium and intra articular contrast were not used. Moreover, this study was conducted on normal subjects with no underlying anatomical changes on MRI scan. However, the study is likely to be a reflection of the day-to-day practice in most District General Hospitals settings in the UK.

Conclusion

Trapezium and median nerve within the carpal tunnel are in close proximity. Hand surgeons should be aware of the anatomical variations in the relation between trapezium and carpal tunnel when performing Trapeziectomy. More research on the dynamic relation between the carpal tunnel and trapezium in patients with thumb CMCJ arthritis is necessary.

Conflict of interest: None.

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