

**MR Imaging of post-traumatic tendon and ligament injuries of the thumb****Neveen Seif Al-Islam Shaker<sup>a\*</sup>, Yousra Foud Rashad<sup>a</sup> , Rehab Elnagar<sup>a</sup>**<sup>a</sup>Diagnostic Radiology Department, Faculty of Medicine, Tanta University, Tanta, Egypt**Abstract****Background:** Magnetic resonance imaging is an optimal method for evaluating soft-tissue trauma in the thumbs, clarifying its fine anatomy which is crucial for identifying pathologic entities, presence of a tear, and the extent of tendon retraction.**Objectives:** This study was done to emphasize the MRI role in assessment of trauma-related injuries of the thumb and subsequently positively affect the surgical decisions.**Patients and methods:** This retrospective study included (50) cases referred by orthopedic surgeons for MR imaging of the thumb following injury. Radiographs were performed to assess tendon & ligaments injuries.**Results:** Regarding tendon affection ,it was found in 43 cases with flexor tendon affection in 36 patients out of 43 and extensor tendon affection in 7 patients ,Regarding the level of tendon tears (20 cases) ,in 55% of cases, it was at the level of MCP .Ulnar collateral ligament injury was found in 8 cases while radial collateral ligament injury was found in 5 cases associated with subluxation of the MCP . Muscle injury was found in 23 cases while tears was found in 7 cases. Volar plate injury was reported in only one case. Bone marrow edema was detected in 9 cases.**Conclusion:** MRI is an essential technique to obtain a correct pre-surgical diagnosis. It provides a great assessment of the tendons and ligaments tear by whether partial or complete, or bony fragment avulsion and the extent of retraction in cases of complete tear.**Keywords:** Hand, thumb tendon, Ligament, Injury, Tear, Magnetic resonance**DOI:** 10.21608/SVUIJM.2024.268546.1816**\*Correspondence:** [dr.neveenseif@hotmail.com](mailto:dr.neveenseif@hotmail.com)**Received:** 14 March,2024.**Revised:** 24 March,2024..**Accepted:** 26 March,2024..**Published:** 5 June, 2024**Cite this article as:** Neveen Seif Al-Islam Shaker, Yousra Foud Rashad , Rehab Elnagar (2024). MR Imaging of post-traumatic tendon and ligament injuries of the thumb. *SVU-International Journal of Medical Sciences*. Vol.7, Issue 2, pp: 42-51.

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## Introduction

Fingers and thumb injuries are common traumatic injuries in both sports and work activities (Clavero et al., 2002). The most frequent soft-tissue injuries, divided into articular and tendon injuries. -Articular injuries include: volar plate and collateral ligament lesions of the proximal interphalangeal (PIP) and metacarpophalangeal (MCP) joints. Trauma to the extensor and flexor tendons can result in open or closed injuries. The most frequent of the latter are mallet finger deformity, boutonnière deformity, dislocation of the extensor tendon at the MCP joint, and avulsion of the flexor digitorum profundus tendon from the distal phalanx. Injuries of the pulley system. (Clavero et al., 2002)

Injuries to the tendons occur commonly as inflammation of the tendon (tendinitis), tendon sheath (tenosynovitis), or perivascular bundle (peritendinitis), tendon ruptures which may be partial or complete, tendon subluxations and dislocations (Meraj et al., 2017)

Collateral ligaments injuries could be acute or chronic, acute stage includes discontinuity, detachment, and thickening of the ligament. Chronic injuries often demonstrate thickening of the ligament, likely due to scar formation, thinning, elongation, or a wavy contour of the ligament may also be detected (Kadow and Fowler, 2017; Abdellatif et al., 2021).

Pulley system injuries can be diagnosed indirectly by detection of a gap between the flexor tendon and the bone on sagittal images obtained during forced flexion, a finding referred to as the “bowstringing sign” (King and Lien, 2017)

A trigger finger is a common condition and means either blockage or triggering of the finger from flexion to

extension and in most cases involves the MCP joint. (Makkouk et al., 2008). Magnetic resonance imaging demonstrates findings of thickening and inflammation of the annular pulley 1 (A1 pulley), (Abdellatif et al., 2021).

Magnetic resonance (MR) imaging has fine soft-tissue contrast resolution and multiplanar capability allowing optimal assessment of fine lesion (Abdellatif et al., 2021). Thus making it possible to recognize the presence of a tear, number of affected tendons, tendon retraction extent & associated lesions. (Pilania and Jankharia, 2018; Clavero et al., 2002)

This information is used to determine the correct surgical plan and surgical approach and is especially useful for closed fractures. MR imaging is also especially in ambiguous or clinically equivocal cases or cases with negative results at plain radiography (Clavero et al., 2002) and play an important role in the functional recovery of the involved ligaments and tendons, preventing the occurrence of the injury-related deformities. (Bail et al., 2018)

This study was done to emphasize the MRI role in assessment of trauma-related injuries of the thumb and subsequently positively affect the surgical decisions.

## Patients and methods

### Patients

After institutional ethics committee approval (50) was obtained, this retrospective study was done in Tanta University Hospital in the period between from January 2022 to January 2023, 150 patients were referred by orthopedic surgeons for MR imaging of the base of the thumb following injury. Radiographs were performed to assess tendon & ligaments injuries with age range from 20 to 60 years.

**Inclusion criteria**

Patients presented with swelling, limitation of function or pain following history of trauma.

**Exclusion criteria**

Patients with rheumatoid arthritis.

Patients with history of related operations or internal fixations were excluded.

Patients with cardiac pacemaker or critically located foreign body were not subjected to MRI examination.

**Ethics approval:** The local ethics committee gave its approval to this study.

**Informed consent:** All participants in this study provided their informed consent.

**Subject confidentiality:** To ensure subject confidentiality, none of the assessment forms, reports, or other documents include unique personal information.

**Methods****Image acquisition & reconstruction:**

The spectrum of injury was felt to range from ligamentous sprain to frank dislocation. Patients were examined with a 1.5 T (Signal6 channel, Excite, GE Healthcare, Milwaukee, WI, USA machine) with wrist coil.

Each was placed in a supine position with the hand by the side and the thumb in a phase array wrist coil with the thumb carpometacarpal joint placed in the center of the coil. An axial localizing image was performed after which the following sequences were taken:

- a) T1-weighted fast spin-echo in axial, coronal, and sagittal planes (TR/TE: 521–780 ms/20–40 ms); section thickness: 2 mm; inter-slice space: 0.2 mm; number of excitations: 2–4; FOV: 100–140 mm × 70–100 mm × 26–40 mm; and voxel: 0.15–0.25 mm × 0.15–0.25 mm × 1.50 mm.
- b) proton density-weighted imaging with fat suppression (PD FS) in

axial, coronal and sagittal planes (repetition time/echo time [TR/TE]: 2347–3657 ms/40–45 ms),

- c) T2 weighted imaging in axial , coronal and sagittal planes (repetition time/echo time [TR/TE]: 2347–3657 ms/40–45 ms),

- d) Coronal STIR (TR/TE/TI 3500/45/120) 256\_224 matrix, four signals acquired, 10 cm field of view, 3.0mm section thickness with no gap (**Abdellatif et al., 2021**).

**Image analysis:** Three radiologists interpreted the images in conjunction One reader (S.N) had 13 years of experience interpreting, the second reader (Y.F) had 12 years of experience & the third one (A.R) had 12 years of experience

**Systematic approach to MRI interpretation**

- The bones are evaluated for the presence of fracture, osteomyelitis, osteonecrosis, or neoplasm.
- The joints are evaluated for the presence of effusion, synovial proliferation, erosions, osteophytes, and articular cartilage abnormalities.
- Next, the tendons and ligaments are analyzed with special emphasis on the flexor mechanism, extensor mechanism, collateral ligaments, volar plates, and sagittal bands.
- Finally, the surrounding soft tissues are evaluated for the presence of neoplasms, fluid collections, and neurovascular abnormalities.

Disruption of the normal low signal band with or without hyperintensity of a ligament was felt to represent a complete tear. Incomplete disruption with some continuity of the fibers at the site of the injury was interpreted as a partial tear. Partial injuries were considered high grade if more than 70% of fibers were torn, moderate if 30–70% of the fibers were torn and low

grade if less than 30% of the fibers were torn. The trapezium and thumb metacarpal were assessed for periosteal stripping and the ligament edge morphology was assessed for the presence of local hematoma, edema or ganglion cyst formation. An assessment was made of joint congruity and the surfaces of the joint were assessed for cartilage injury. Any bone contusion or fracture was noted.

(Connel et al,2004)

#### Statistical analysis

The statistical analysis was performed using SPSS, version 23.0. Age, gender, co-morbidities, and imaging characteristics are examples of qualitative variables that were represented using frequency and

percentages. The Pearson correlation test was used to determine the degree of association between the CTSI.

#### Results

This study is a retrospective study that was conducted on 50 patients that suffered from traumatic injury to the thumb, their age ranged from 20 to 60 years with slight male predominance (58%) compared to female affection (42%). Right sided hand affection was found in 44 cases compared to 6 cases showed left sided affection. Regarding tendon affection, it was found in 43 cases with flexor tendon affection in 36 patients out of 43 (83.7 %) and extensor tendon affection in seven patients (16.3%) as shown in (Table.1).

**Table 1. Types of the injury**

Type of injury	No .	Percentage %
Tenosynovitis	23	53.5
Partial thickness tear	11	25.6
Full thickness tear	9	20.9
Total	43	100%

Tenosynovitis appeared as tendon sheath thickening with low T1, High T2 SI surrounding the tendon, partial thickness tear is a focal interruption of tendon fibers displaying fluid signal (high fat-saturated PD or T2 weighted images with intact residual fibers while full thickness tear

appeared as total interruption of tendon fibers with gapping and tendon retraction with fluid signal within the gap. Regarding the level of tendon tears -whether partial or full thickness tear- (20 cases), in 55% of cases, it was at the level of MCP as shown in (Table.2).

**Table 2. Level of the injury**

Level of injury	No.	Percentage %
MCP	11	22
Proximal phalanx	8	16
DIP	1	2
Total	20	40

Ulnar collateral ligament injury was found in 8 cases (16%) while radial collateral ligament injury was found in 5 cases (10%) associated with subluxation of the MCP. Muscle injury was found in 23 cases as hyperintense T2 signal without muscle fibers interruption (muscle edema) in 16 cases while tears was found in 7 cases . Volar plate injury was reported in only

one case (2%) as abnormal high T2 SI along volar plate with discontinuity of the pulley around it. Bone marrow edema was detected in 9 cases.

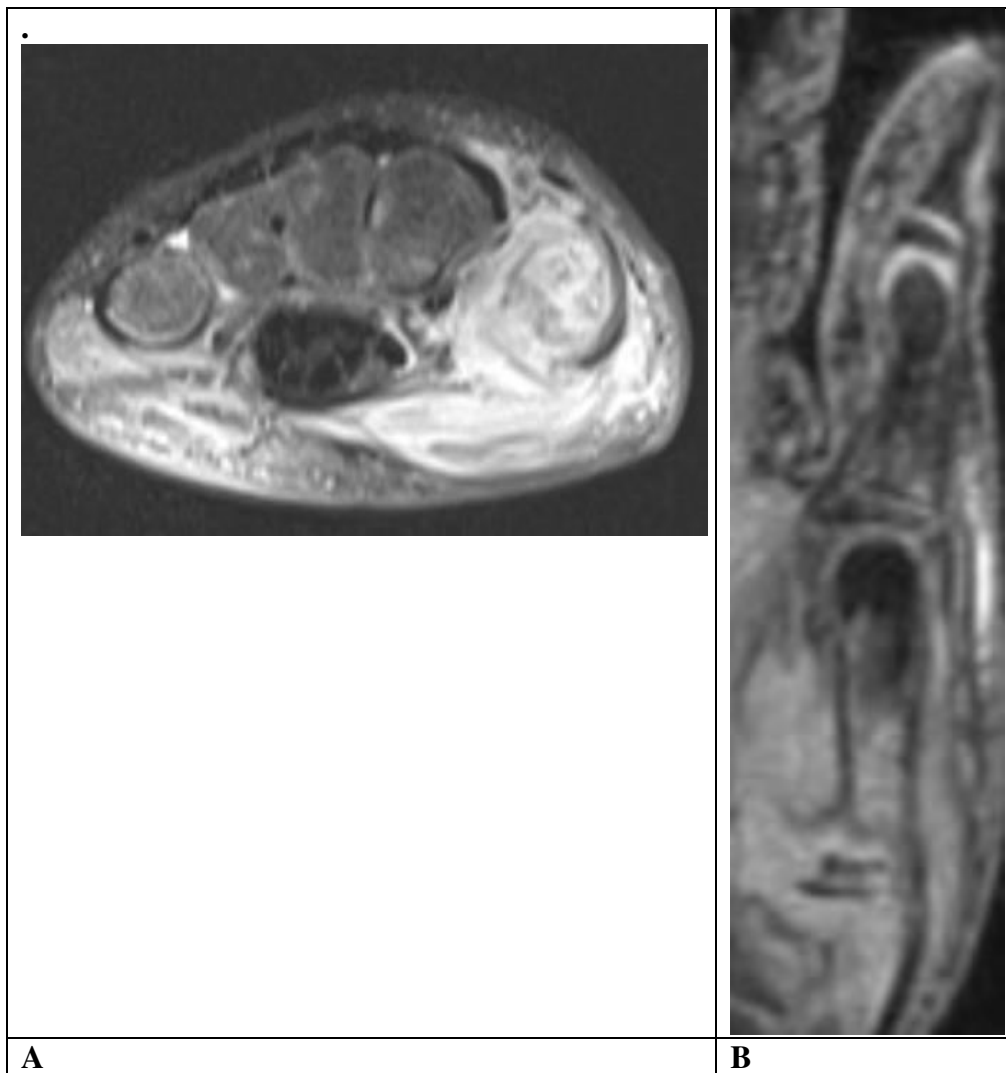
Correlation between MRI and surgery was performed in 20 patients, 15 patients with full thickness tear either of flexor or extensor tendons and 5 cases with radial collateral ligament injury as demonstrated in (Table.3).

**Table 3. Types of the injury & surgical correlation**

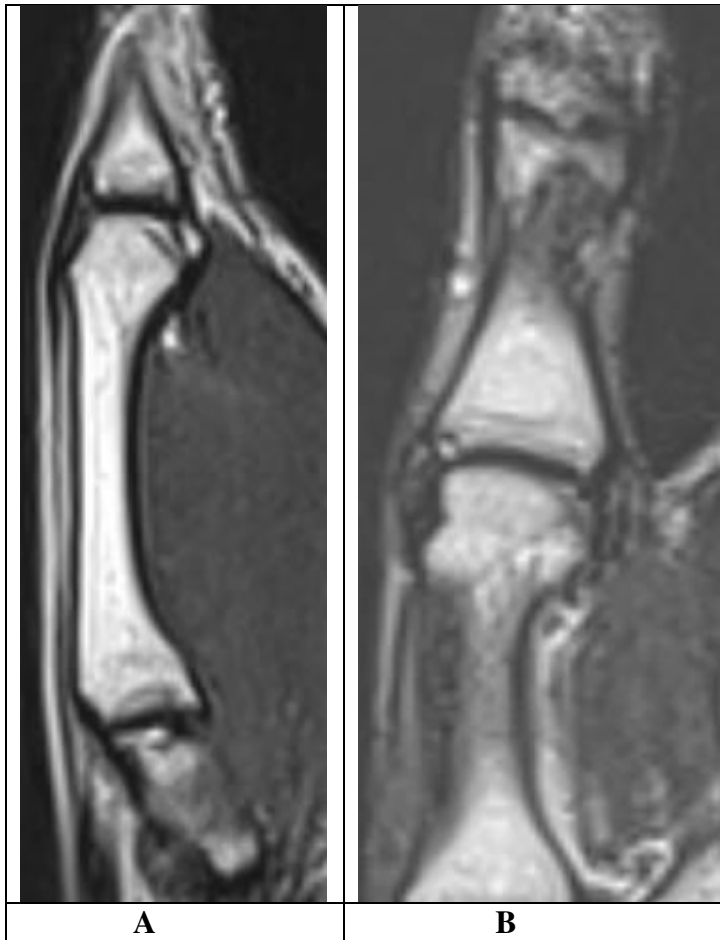
Type of injury	MRI findings (no. of patients)	Surgical findings(no. of patients)	Sensitivity
<b>Full thickness tear of the tendon</b>	15	15	100%
<b>Isolated Radial collateral ligament injury</b>	5	3	60%

These two cases show combined radial and ulnar collateral ligaments injury on surgical

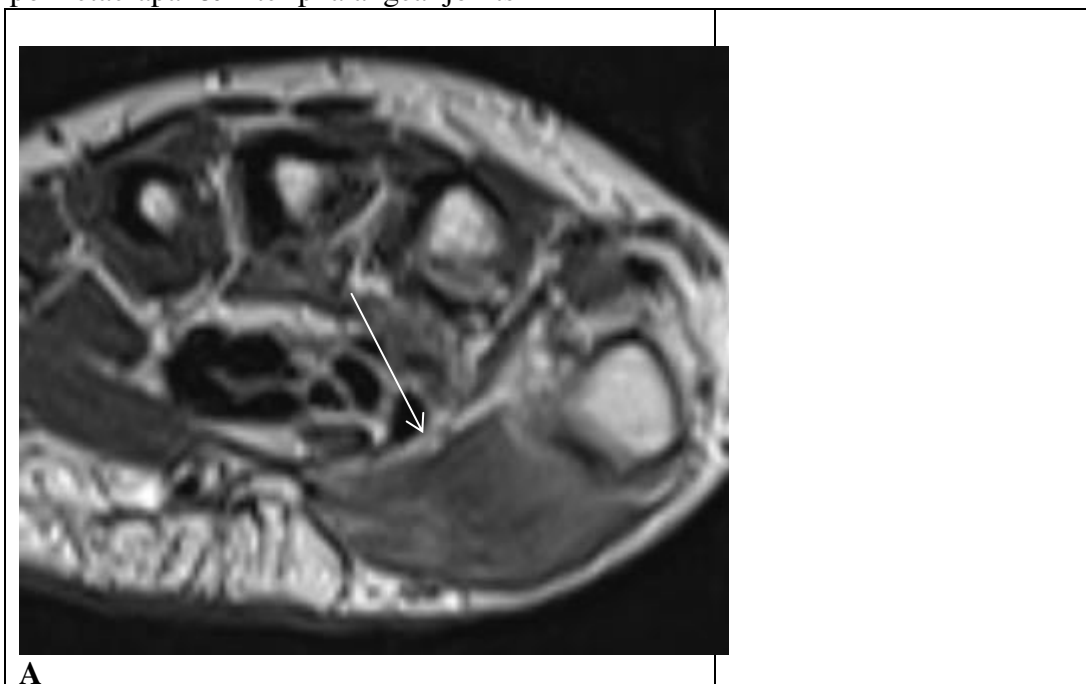
intervention rather than an isolated radial collateral ligament injury as MRI revealed.

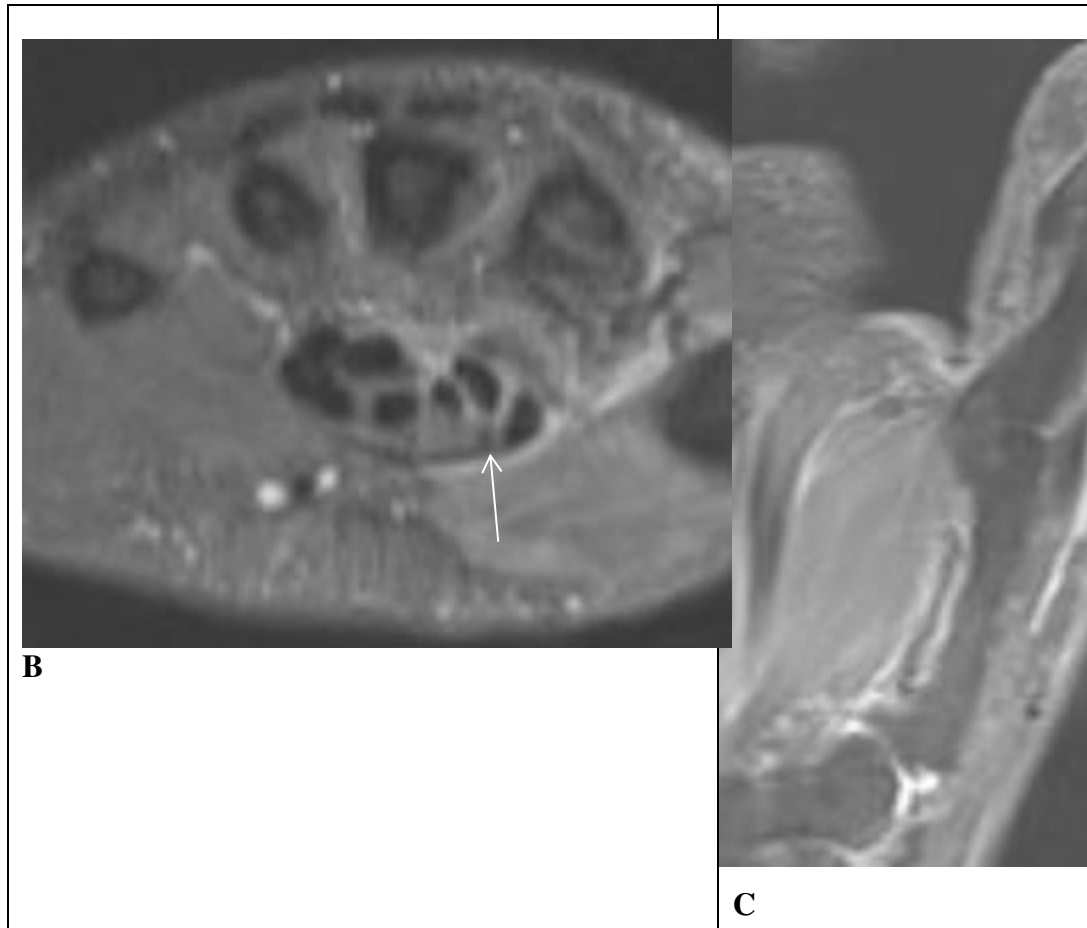


**Fig.1.**A) axial T2 fat sat shows edema signal and discontinuity of the thenar muscles with overlying skin and subcutaneous edema along the dorsal and the volar aspect of the thumb. B) Disruption of the thumb anterior oblique ligament



**Fig.2** A) coronal T2 shows Detached bony fragment at the radial aspect of the base of the proximal phalanx of the thumb at site of abductor pollicis brevis tendon attachment with underlying bone marrow edema .B) Partial interruption of the radial collateral ligament mainly at its volar aspect with relative high T2 SI. Subluxation of metacarpophalangeal joint with preserved articulation of 1st carpo metacarpal & inter phalangeal joints





**Fig 3.**A)axial T2 shows Abnormal intra substance noted within thenar muscles together with partial fibers discontinuity. B)High signal noted within recurrent branch of median nerve passing through thenar muscles. C)Disruption of flexor pollicis longus tendon from its insertion at the base of the distal phalanx of thumb

### Discussion

Magnetic resonance (MR) imaging has fine soft-tissue contrast resolution and multiplanar capability this together with recent advances in MRI hardware and coil design allow the acquisition of small extremities like thumb that require very small field of view at high resolution. This has a great impact in choosing the correct surgical plan and surgical approach. (Abdellatif et al., 2021)

According to our finding, among the 50 patients that suffered from traumatic injury to the thumb, their age ranged from 23 to 67 years with slight male predominance (58%) compared to female affection (42%).The right sided hand affection was found in 44 cases

compared to 6 cases with left sided affection. Regarding tendon affection, it was found in 43 cases with flexor tendon affection in 36 patients out of 43 (83.7 %) and extensor tendon affection in 7 patients (16.3%).

In line with our results, **Shin et al. (2020)** showed that among total of 56 patients (56 thumbs), there were 47 males and 9 females, with a mean age of 38.3 years in cases diagnosed with unstable ligament injuries around the thumb metacarpophalangeal joint .

In agreement with our results, **Abdellatif et al. (2021)** studied 42 patients with fingers diagnosed with post-traumatic tendon and ligament injuries and showed that there were 33 males, 9 females, with a mean age

35 years. All of them had history of trauma. Striking male affection was noted reaching 78.5% of the reported cases with history of trauma and subsequent tendon or ligament injury proven by MRI. On the other side, only 21.5% of the cases were female. The frequency and percentage according to the side of the injured finger in the study population showed right sided-hand affection representing 92.9% and, on the other side, left-sided-hand affection representing 7.1%.

This agreed with the study of **De Jong et al. (2014)**, which showed that mean age at the time of injury was 35.9 years (range 1–91 years). This corresponds to the age of the workforce most likely to have more physical labor-intensive occupations, which may place them at increased risk for injury. Right-hand finger affection is about 91.4%, while the left-hand fingers were affected in only about 7.6% of cases.

This agreed with the study of **Kringstad et al. (2019)**, which announced that males sustained more wounds from using hazardous equipment and thus have more severe injuries. Males have a significantly higher incidence of traumatic tendon injuries to the hand or wrist compared to females.

Our study stated that the incidence of partial thickness tear (55%) was slightly higher than that of the full thickness tear (45%). Regarding the level of tendon tears -whether partial or full thickness tear- (20 cases), it was at the level of metacarpophalangeal (MCP) in 55% of cases. Supporting our results, **Abdellatif et al. (2021)** demonstrated that the frequency and percentage of partial thickness tear in the study population represented by 66.7% is nearly twice that of the complete thickness tear (33.3%). Moreover, they showed that the most common affected finger levels were

extending from the MCP till the proximal interphalangeal (PIP).

Our findings showed that ulnar collateral ligament injury was found in 8 cases (16%) while radial collateral ligament injury was found in 5 cases (10%) with ratio between both injuries about 1.6. This is in consonance with **Shin et al. (2020)** line who reported higher incidence of UCL injury (33.9%) when compared to RCL injury (17.9%) with the ratio inbetween was about 1.9.

Muscle edema was found in 16 cases while tears were found in 7 cases. Volar plate injury was reported in only one case (2%) as abnormal high T2 SI along volar plate with discontinuity of the pulley around it. Bone marrow edema was detected in 9 cases (18%). This agreed with the study of **Abdellatif et al. (2021)**, who reported bone marrow edema in about 26.6% of the traumatic patients. Detection of bone marrow edema signal is a unique advantage of MRI when compared to X-ray or CT technology. This agreed with the study of **Almusa et al. (2013)**, which announced that advanced imaging with MRI is helpful to both confirm the diagnosis and accurately define the exact location of tendon injury for surgical planning.

Our study revealed that there was a good correlation between MRI and surgery in patients with full thickness tear either of flexor or extensor tendons, yet in two MRI diagnosed cases with radial collateral ligament injury, there was a combined radial and ulnar collateral ligaments injury on surgical intervention not isolated radial collateral ligament injury as MRI revealed.

Moreover, **Shin et al. (2020)** reported a complete correspondence between the MRI findings and surgical arthroscopy in (67.9%) of cases.



Since a clear demarcation between the proper and accessory collateral ligaments is not present on MRI, those ligaments run along the dorsal-to-volar course, which require additional sequential coronal images, and the signal intensity variation commonly presented in the collateral ligament may interrupt accurate assessment of ligament injuries around the thumb MCPJ. (Madan et al., 2014)

Furthermore, to acquire MR imaging of the thumb with a dedicated hand coil that is necessarily required in a high-resolution MRI, the patient could be positioned prone, with the arm positioned over the head in the so-called Superman position, which is not comfortable for all patients. This eventually can cause assessments with inaccurate images. Furthermore, the length of time from injury to presentation appears to have a negative effect on the accuracy of MRI, which was demonstrated in our study. Nonetheless, previous investigators reported a high accuracy of high-resolution MRI in diagnosing small joint lesions (Hafezi-Nejad et al., 2016).

Limitations of our study were the relatively small sample size, not covering all diagnosis of traumatic injury to the thumb, recruiting the sample from only one centre all over Egypt, so we could not generalize our data.

### Conclusion

Magnetic resonance imaging is an essential technique to obtain a correct pre-surgical diagnosis. It is of utmost importance to possess an in-depth knowledge of finger radiological anatomy in detail, as well as the appearance of the different pathologic entities on MRI. It provides a great assessment of the tendons and ligaments tear by whether partial or complete, or bony fragment avulsion

and the extent of retraction in cases of complete tear.

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