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## Case Report

# Role of MRI and surgical excision in long-standing diffuse-type GCTTS of the flexor tendon sheath<sup>☆</sup>

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## ABSTRACT

Diffuse-type giant cell tumor of the tendon sheath (GCTTS) is a rare, benign, yet locally aggressive soft tissue tumor commonly affecting the hand. This case report presents a 55-year-old male with a 5-year history of GCTTS in the flexor tendon sheath of the long finger. MRI played a critical role in both diagnosis and surgical planning, revealing key features such as the tumor's 10 cm length, hemosiderin deposition, and blooming artifacts. The patient underwent successful surgical excision with no recurrence at the 1-year follow-up. This case underscores the significance of MRI in preventing functional impairment and reducing recurrence risk in diffuse-type GCTTS.

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## Introduction

Diffuse-type giant cell tumor of the tendon sheath (GCTTS), also known as pigmented villonodular synovitis (PVNS) when involving joints, is a rare benign soft tissue tumor. The diffuse

form of GCTTS is locally aggressive, with a high risk of recurrence, while the localized form is typically contained and has a lower recurrence rate. GCTTS originates from the synovium of tendon sheaths, joints, or bursae. The diffuse form, in particular, displays aggressive infiltrative behavior and has a higher recurrence rate [1]. GCTTS is most frequently seen in the small

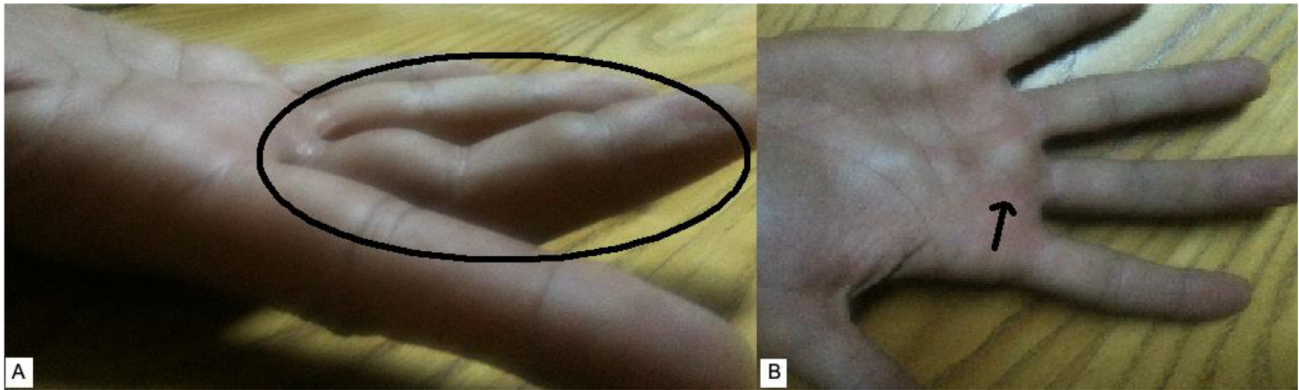
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**Fig. 1 – (A) Preoperative image of the hand of the patient showing a lobulated mass on the palmar surface of his mid-finger at the proximal and middle phalangeal region along the flexor tendon (black circle). (B) Palpable mass at the palmar surface at the metacarpophalangeal joint of the middle finger (small black arrow) extended to the midpalmar area (big black arrow).**

joints of the fingers, where it presents as a slowly enlarging mass that can lead to functional impairment, pain, or joint stiffness.

The diffuse form is differentiated by its extensive involvement of surrounding soft tissues and high recurrence rate following incomplete excision [2]. Although uncommon, GCTTS can be challenging to distinguish from other soft tissue masses clinically. It often mimics other soft tissue masses, such as fibroma of the tendon sheath, hemangioma, or lipoma, making imaging, particularly MRI, essential for accurate diagnosis [3]. MRI offers detailed visualization of the lesion's size, location, and extent while also revealing characteristic features like hemosiderin deposition, aiding in distinguishing GCTTS from other benign tumors [4].

MRI also provides crucial insights for surgical planning in diffuse GCTTS, allowing evaluation of the tumor's proximity to vital structures like tendons and neurovascular bundles. Recurrence rates for diffuse-type GCTTS range from 10% to 45%, depending on the tumor's extent and excision completeness [5]. This case illustrates MRI's key role in diagnosing and planning excision of diffuse-type GCTTS and the importance of postoperative MRI to monitor for recurrence.

## Case report

### Clinical presentation

A 35-year-old male presented with a painless, progressively enlarging mass on the palmar surface of his long finger extending to the metacarpal and proximal phalangeal region, present for approximately 5 years. Initially, the patient reported minimal discomfort but gradually experienced decreased finger flexion and grip strength. Physical examination revealed a firm, nonmobile mass measuring approximately 10 cm along the flexor tendon course (Fig. 1). The overlying skin was intact, with no erythema or tenderness observed. Neurovascular examination was normal, and there were no signs of distal ischemia.

### Imaging findings

MRI was essential in differentiating GCTTS from other soft tissue masses through specific characteristics. T1-weighted images demonstrated intermediate signal intensity, while T2-weighted images displayed heterogeneous signal intensities, with areas of low signal intensity corresponding to hemosiderin deposition, a hallmark feature of GCTTS. Hemosiderin, a byproduct of hemorrhage, creates characteristic low signal regions on T2-weighted images, aiding in diagnosis. Postcontrast T1-weighted fat-saturated images with gadolinium enhancement revealed heterogeneous enhancement, indicating tumor vascularity (Fig. 2).

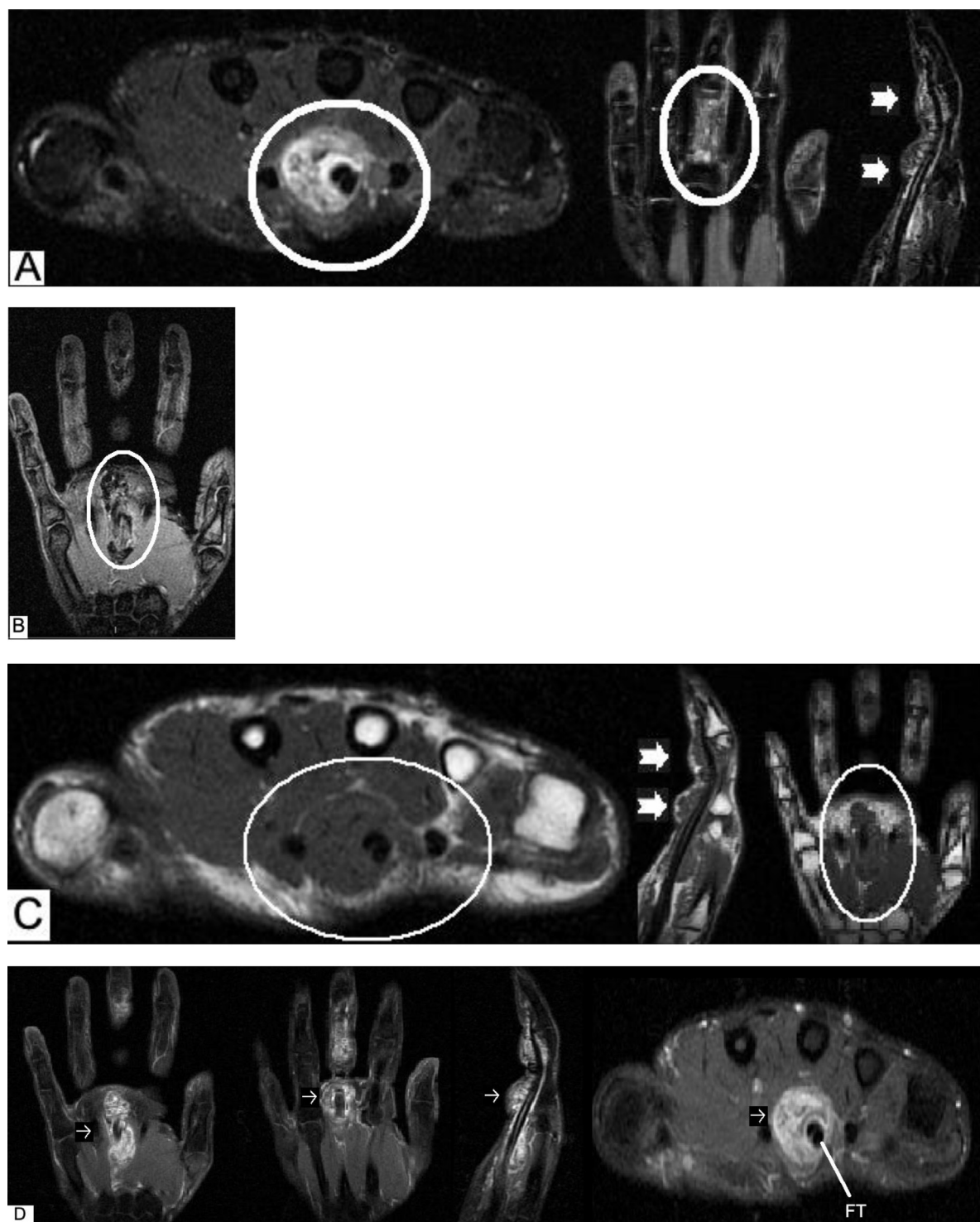
The blooming artifacts observed on gradient-echo (GRE) sequences further suggested hemosiderin, characteristic of GCTTS. Diffusion-weighted imaging (DWI) and dynamic contrast-enhanced (DCE) imaging could offer additional insights, though not used in this case. Based on MRI characteristics, a preoperative diagnosis of diffuse-type GCTTS was established.

### Differential diagnosis

The differential diagnosis for a soft tissue mass of the flexor tendon sheath includes:

- Fibroma of the tendon sheath: Typically presents with low signal intensity on all MRI sequences, without the hemosiderin deposition seen in GCTTS.
- Lipoma: Characterized by high signal intensity on T1-weighted images and fat suppression sequences.
- Hemangioma: Often presents with high T2 signal intensity due to its vascularity and may show characteristic flow voids on MRI.

Given the MRI characteristics, particularly hemosiderin deposition and postcontrast enhancement, diffuse-type GCTTS was favored over these other possibilities.



**Fig. 2 – (A)** Preprocedural MRI STIR images in all 3 planes (axial, coronal, and sagittal) demonstrate a lobulated, heterogeneous mass extending from the mid metacarpal diaphysis along the flexor tendon to the proximal phalangeal region of the long finger. The mass, measuring approximately 1.5 cm in width and 10 cm in length, exhibits heterogeneously high signal intensity with low signal foci likely corresponding to hemosiderin deposits, suggestive of diffuse-type GCTTS. **(B)** Preoperative T2-weighted coronal images show a pronounced blooming artifact, indicating hemosiderin deposition within the mass. This blooming artifact reflects iron accumulation from hemorrhage, which is characteristic of diffuse-type GCTTS and aids in diagnostic differentiation. **(C)** Preoperative T1-weighted fat-saturated (FS) images in all 3 planes highlight the mass with intermediate signal intensity, similar to surrounding muscle. The lesion appears well-delineated yet infiltrative, extending along the tendon sheath, which is typical of diffuse-type GCTTS. **(D)** Postcontrast T1-weighted fat-saturated (FS + contrast) images in all 3 planes reveal heterogeneous contrast enhancement of the lesion (indicated by the white arrow) around the flexor tendon (marked by the white line). The enhancement pattern underscores the vascular nature of the tumor, with nonenhanced areas corresponding to hemosiderin deposits or necrotic tissue (FT: flexor tendon).

### Surgical treatment

The patient underwent surgical excision of the mass under regional anesthesia and an above-elbow pneumatic tourniquet. The procedure was performed using  $3.5\times$  magnification to enhance precision and avoid damage to neurovascular structures. The tumor was well-encapsulated but densely adherent to the flexor tendon sheath, extending from the mid metacarpal diaphysis to the distal interphalangeal joint (DIP) of the long finger. The mass extended along the synovial lining, infiltrating surrounding soft tissues. Meticulous dissection under magnification helped preserve both ulnar and radial neurovascular bundles. The skin was closed with interrupted 4-0 sutures after complete excision, and histopathological analysis confirmed diffuse-type GCTTS.

The patient had an uneventful recovery, with early mobilization exercises and active tendon gliding initiated as pain subsided, restoring full finger motion within 4 weeks. Follow-up MRIs over the next year showed no recurrence (Fig. 3).

### Discussion

Diffuse-type GCTTS is a rare but locally aggressive benign tumor with a high propensity for recurrence if not completely excised. This case highlights MRI's crucial role in both diagnosis and preoperative planning, providing essential information on tumor size, extent, and anatomical relationships

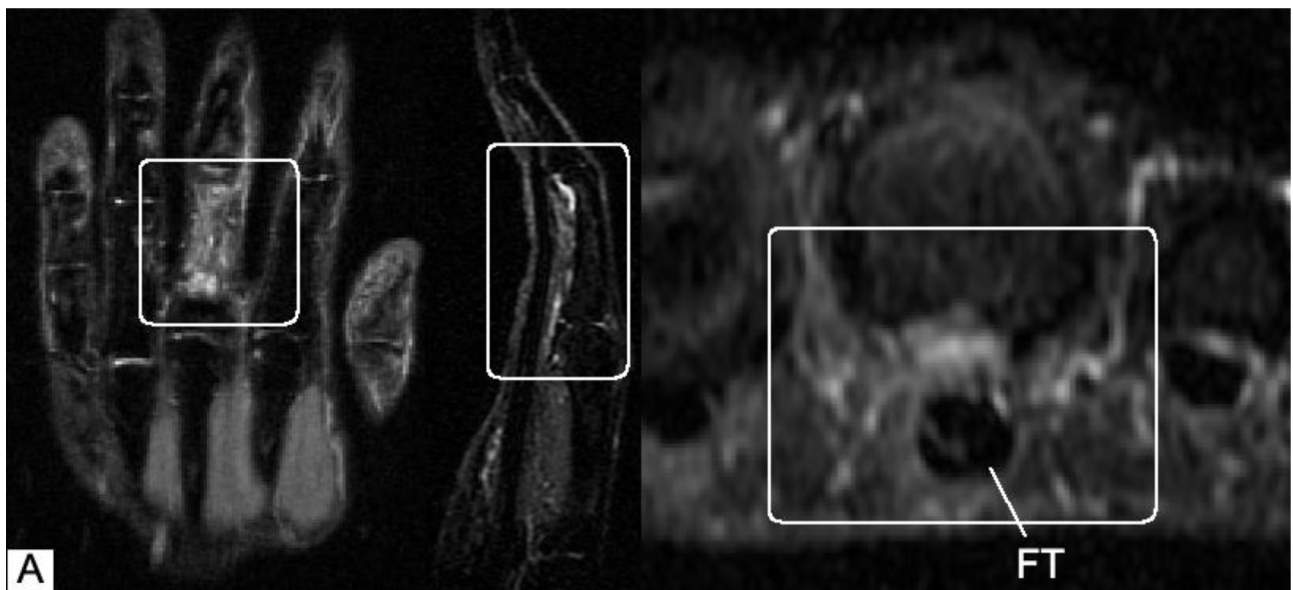
to surrounding structures, significantly aiding in the surgical approach [6]. Balancing complete excision with functional preservation is key in diffuse-type GCTTS given its infiltrative behavior and high recurrence potential.

Unlike the localized type, diffuse-type GCTTS often infiltrates nearby soft tissues and joints, complicating surgical removal. MRI's ability to detect hemosiderin and blooming artifacts on GRE sequences is invaluable in distinguishing GCTTS from other benign masses. Hemosiderin, characteristic of GCTTS, provides a definitive diagnostic marker on MRI. This case exemplifies the importance of early diagnosis and intervention to prevent functional impairment.

The high recurrence rate of diffuse-type GCTTS, reported between 10-45%, necessitates regular MRI follow-up to monitor for recurrence. MRI's sensitivity allows early detection of recurrent tumors, supporting timely intervention to prevent functional decline and reduce the need for complex surgeries [7,8].

DCE imaging and DWI offer further diagnostic potential by evaluating tumor perfusion, vascularity, and diffusion properties. DWI aids in differentiating GCTTS from other neoplasms, and DCE provides insights into vascular characteristics, aiding surgical planning [9].

Long-term considerations include secondary joint damage and osteoarthritis, especially if GCTTS has caused joint involvement. Timely surgical intervention and postoperative monitoring mitigate these risks. In this case, precise surgical technique preserved function, avoiding joint stiffness or loss of mobility [10].



**Fig. 3 – (A)** Postoperative MRI STIR images in all 3 planes (axial, coronal, and sagittal) taken 1 year after surgical excision show the complete removal of the previously visualized mass. Postoperative changes along the flexor tendon sheath are visible, with mild edema and scarring in the soft tissues. The flexor tendon remains intact, and no recurrent mass is detected. **(B)** Postoperative T1-weighted fat-saturated (FS) images in all 3 planes display normal signal intensity in the flexor tendon (FT) and surrounding structures. Postoperative fibrosis is noted along the tendon sheath (indicated by the white arrow), with no evidence of mass recurrence or abnormal signal intensity. Axial images provide detail of the proximal phalange (PP) and metacarpal (M) regions. **(C)** Postcontrast T1-weighted fat-saturated (FS + contrast) images in all 3 planes show no enhancement indicative of residual or recurrent tumor. The observed enhancement pattern aligns with postoperative scarring and soft tissue healing, with no signs of abnormal vascularity or mass recurrence.

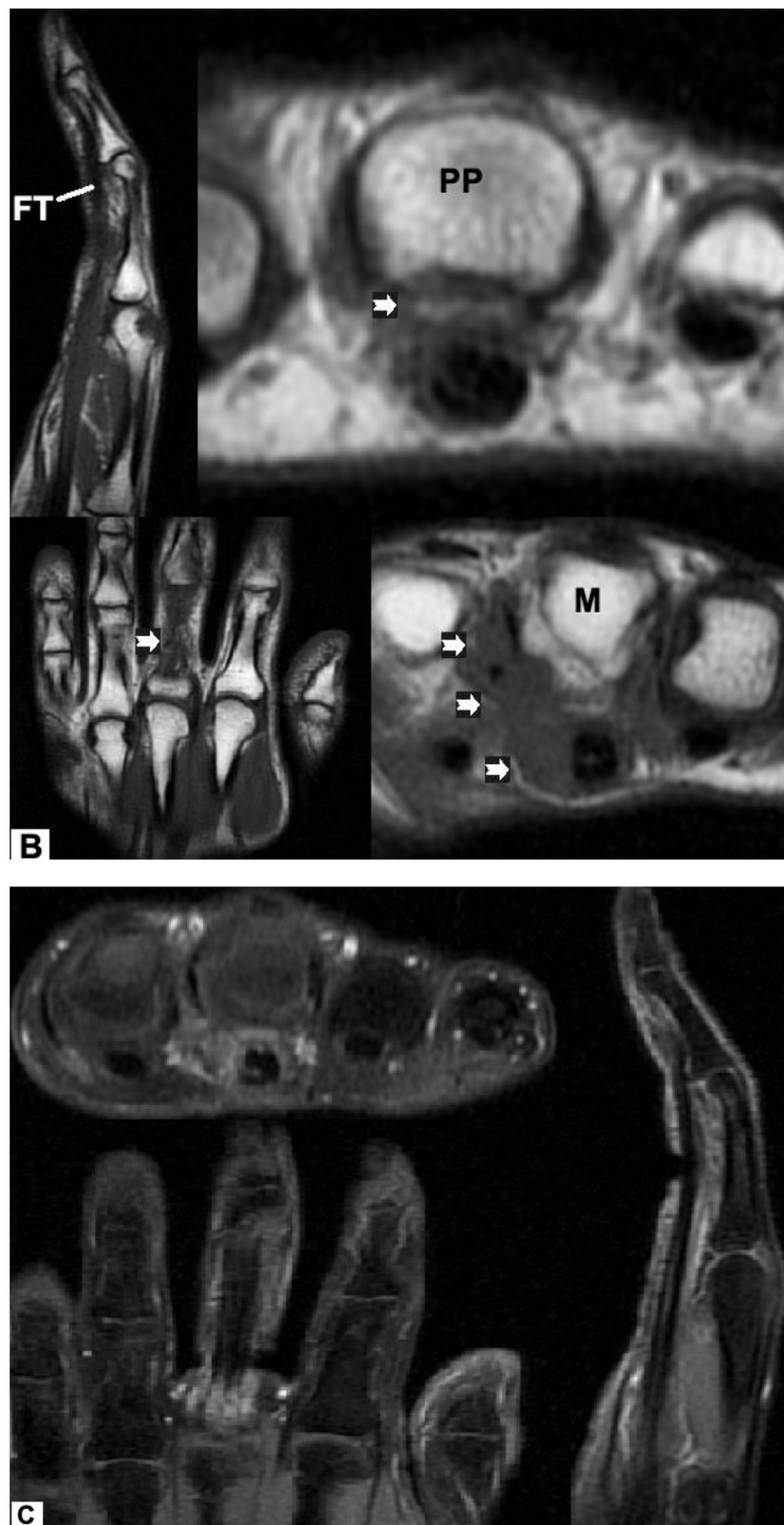


Fig. 3 – Continued



Complete surgical excision remains the preferred treatment for diffuse-type GCTTS. In cases of recurrence, adjuvant therapies like radiotherapy may be beneficial when full resection is not possible. Routine MRI monitoring [11] is crucial for recurrence detection, preventing further functional loss, and enhancing patient outcomes.

## Conclusion

MRI is indispensable in managing diffuse-type GCTTS, from initial diagnosis and surgical planning to monitoring for recurrence. This case demonstrates MRI's role in assessing tumor boundaries, facilitating successful excision, and ensuring effective follow-up for this aggressive tumor subtype. Long-term MRI surveillance is essential to prevent functional impairment and ensure favorable outcomes in diffuse-type GCTTS.

## Patient consent

Informed consent for publication of their case was obtained from the patients.

Approval to publish by the patients has been given by my institution, its legal representative and an ethics committee, and in accordance with local legislation.

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