Fibro-Osseous Pseudotumor of the Digit: A Rare Non-Calcified Presentation with Radiographic and MRI Insights

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AUTHORS' CONTRIBUTIONS

A.C.: Concept and design of the case report, literature review, contribution to the discussion section, writing of the manuscript.
M.P., T.S.: Radiological image analysis, interpretation of imaging findings, manuscript supervision, and final approval.
A.R.: Radiological image analysis, interpretation of imaging findings, and contribution to the discussion section.
M.R.A.P.: Clinical data collection, critical revision of the manuscript for important intellectual content, and contribution to data analysis and interpretation.
M.A.P.M: Histopathological evaluation and image analysis, critical revision of the manuscript for important intellectual content, and contribution to data interpretation.
All authors discussed the results and commented on the manuscript.

CONFLICT OF INTEREST/ DISCLOSURE

The author(s) declare no competing interests.

CONSENT FOR PUBLICATION

Written informed consent was obtained from the patient and the patient's identity was kept anonymous.

HUMAN AND ANIMAL RIGHTS

This case report involved no experimental procedures. All procedures performed were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki Declaration and its later amendments.

ABSTRACT

Soft tissue tumors of the digit are frequently benign but often pose diagnostic challenges. We report a rare case of fibro-osseous pseudotumor of the digit in a 42-year-old female presenting with a progressively painful, non-calcified mass. Radiographic imaging initially mimicked other soft tissue tumors, but MRI findings suggested a distinct diagnosis, confirmed by histopathology. Recognizing MRI features of fibro-osseous pseudotumor of the digit can prevent misdiagnosis and unnecessary surgical interventions.

CASE REPORT

BACKGROUND

Fibro-osseous pseudotumor of the digit (FOPD) is a rare, benign soft tissue mass, predominantly affecting the fingers and toes of young adults [1,2]. Although generally benign, its aggressive imaging appearance frequently leads to misdiagnosis as malignant or other benign soft tissue lesions, causing unnecessary extensive interventions. Typical radiologic findings include subcutaneous masses with variable calcifications, closely associated with tendons [1]. However, presentations lacking radiographically visible calcifications are particularly challenging and understudied. Here, we highlight the diagnostic value of MRI in a rare, non-calcified presentation of FOPD, emphasizing distinct imaging characteristics that facilitate accurate diagnosis and management.

CASE REPORT

A 42-year-old female patient presented with a progressively painful, growing mass on the right index finger that had developed over the past nine months. She noticed an increase

in the mass's size, accompanied by pain, starting approximately seven months after its initial appearance. The patient had not sought medical attention earlier because the mass was initially painless and did not interfere with her daily activities. She denied any prior history of trauma, fever, or significant weight loss. The patient reported a maternal family history of breast cancer.

Approximately one month before presentation, the patient began experiencing tingling at the tip of her finger. A mass with the same color as the surrounding skin was visible on the dorsoulnar side of the proximal index finger. On palpation, the mass was immobile with a spongy consistency, measuring approximately 3 × 2 × 1 cm (Figure 1). The results of routine blood tests showed no significant findings.

Two months prior to presentation, the patient had visited two other hospitals, where X-ray and MRI of the hand were performed (Figures 2,3). X-ray imaging revealed soft tissue swelling without calcification in the dorsoulnar proximal region of the right index finger (first digit). MRI revealed a solid lesion with minimal hypointense signal intensities that enhanced homogeneously adjacent to the flexor tendon in the dorsoulnar soft tissue region of the proximal phalanx of the first digit. No erosion of the underlying bone was seen on either the X-ray or MRI findings.

The patient underwent exploratory surgery and excision of the mass. The mass and adjacent tendon sheath were fully excised (Figure 4) and sent for histopathological examination, which identified it as a fibro-osseous pseudotumor (Figure 5). Postoperatively (Figure 6), the patient did not complain of stiffness or show signs of infection at the excision site.

DISCUSSION

FOPD is a rare soft tissue mass characterized by the irregular proliferation of osteoid and fibroblasts [1]. The first documented cases of FOPD were compiled by Dupree and Edzinger in 1986, describing it as a benign fibroblastic proliferation with foci of osseous differentiation and a superficial variant of myositis ossificans [3].

Clinically, patients present with painful, localized erythematous swelling in the soft tissue region of the mass [4]. The pathogenesis of FOPD is still unknown. While repeated trauma has been recognized as a potential risk factor, many cases occur without any history of trauma[4]. A study by Pombo JN et al. reported that only about 40% of cases had a history of trauma [5]. Flucke et al., along with several other studies, have reported similar genetic hallmarks between FOPD and conditions such as aneurysmal bone cysts, nodular fasciitis, myositis ossificans, and giant cell lesions of small bones [6,7]. All of these conditions demonstrate rearrangements in the *Ubiquitin-specific peptidase 6* (*USP6*) gene, which is located on chromosome 17p13. This finding supports a clonal neoplastic etiology for these lesions, rather than the previously believed reactive nature [7].

Radiographic images of FOPD typically reveal soft tissue swelling accompanied by calcification especially in the peripheral rim depending on the duration [6, 7]. However, in our case, no visible calcification was observed in the initial radiographic examination. Although previous cases of FOPD without apparent calcification have been reported, MRI was not performed in those cases[3]. The presence of extraosseous ossification and bone formation in FOPD may mimic malignant extraskeletal osteosarcoma, which often requires amputation. Osteosarcoma is usually diagnosed in individuals over 40 years of age and is more commonly found in large bones of the upper and lower extremities [5]. In cases with minimal or no extraosseous ossification, as in our case, the initial radiographic appearance of FOPD may resemble other soft tissue tumors and necessitate further imaging modalities like ultrasound or MRI.

After reviewing the literature [2,4,7,8] and correlating the imaging findings of FOPD, we identified the following MRI characteristics for FOPD: (I) Intermediate T1-weighted and hyperintense T2-weighted imaging with an ill-defined, irregular foci of hypointense T1/T2-weighted imaging (calcification); (II) Heterogeneous enhancement post-gadolinium contrast, (III) Absence of a string sign (hyperintense T2-weighted region around the lesion, typical of peripheral nerve sheath tumors (PNST) [9] ; (IV) Absence of infiltration to the bone, muscles or tendon.

The intermediate T1-weighted and hyperintense T2-weighted regions of the lesion that enhance represent the proliferative fibroblastic portion, as seen in histopathology (Figure 5A.). The areas that are hypointense on T1- and T2-weighted images and do not enhance correspond to the bone matrix portion (Figure 5B.). The osseous component may contain hyperintense T1- and T2-weighted areas due to the presence of bone marrow [4].

The initial MRI features of FOPD were similar to those of PNST, GCTTS, leiomyoma, and angioleiomyoma [9]. The MRI characteristics of FOPD and PNST both appear hypointense on T1-weighted images and hyperintense on T2-weighted images, with enhancement observed. However, the fusiform, elongated masses along a nerve and string sign/ “entering-exiting nerve sign” (nerve roots entering and exiting the lesion) characteristic of PNST was not clearly seen in our case.

GCTTS was included in our differential diagnosis because the lesion abutted the flexor tendon of the first digit. However, the lesion in our case was hyperintense on T2-weighted imaging, whereas giant cell tumor of the tendon sheath is typically diffusely hypointense on T2-weighted imaging due to the presence of hemosiderin. This is in stark contrast to FOPD, which (when ossification is present) shows foci of low signal on all sequences due to calcified bone but generally lacks diffuse hemosiderin. If the FOPD is truly non-calcified (early phase), it would appear hyperintense on T2 (soft-tissue mass) without the blooming artifact seen in GCTTS. GCTTS lesions are also often well-defined and may cause pressure erosion on adjacent

bone but do not produce new bone formation [10]. GCTTS is a synovial proliferative lesion with histology showing synovial cells, hemosiderin-laden macrophages, and osteoclast-like giant cells, without osteoid production. FOPD, conversely, is a fibroblastic/myofibroblastic proliferation with osteoid and bone formation. This means a biopsy of GCTTS would show no bone formation, whereas FOPD biopsy shows woven bone or osteoid rimmed by benign osteoblasts [11].

The MRI characteristics of leiomyoma include enhancing isohypointense T1-weighted and hyperintense T2-weighted regions near the flexor tendon, and often exhibit inner tubular flow-voids corresponding to vessels inside the lesion. Leiomyoma and angioleiomyoma, although rare in the digit, can mimic FOPD on MRI due to their soft tissue location and enhancement characteristics. However, the presence of vascular flow voids and histologic smooth muscle bundles in angioleiomyoma differentiates it from FOPD. Furthermore, unlike FOPD, these lesions lack bone or osteoid formation [9].

Other soft tissue lesions includes myositis ossificans (MO) of the digits, although rare, may present with similar characteristic with FOPD. FOPD lesions can cause periosteal reaction or slight cortical erosion of the adjacent bone whereas MO usually has a clear separation (radiolucent cleft) from bone. On MRI, early MO can show peripheral rim enhancement and central low T2 signal due to mature ossification, aligning with its zoning pattern [11]. A distinct zonal pattern could also be seen histologically (immature cellular center, mature bone at periphery). FOPD is usually more cellular and may lack the complete multilayered zonation seen in MO [12]. In our case, there is an ill-defined ossific central lesion in the soft tissue mass pointing more towards FOPD.

TEACHING POINT

The absence of calcification on plain radiographs can delay the diagnosis of FOPD, as it may lead clinicians to consider alternative conditions. Nevertheless, FOPD should be included in the differential diagnosis of progressively growing subcutaneous masses, particularly in the proximal regions of the digits of the hand.

QUESTIONS

Question 1: Which of the following MRI features are characteristic of fibro-osseous pseudotumor of the digit (FOPD)?

1. T2-hyperintense soft tissue mass (applies)
2. Peripheral hypointense rim ("string sign")
3. Heterogeneous post-contrast enhancement (applies)
4. Infiltration of adjacent bone and tendon
5. Ill-defined foci of T1 and T2 hypointensity within the lesion (applies)

Explanation: FOPD often presents on MRI as a T2-hyperintense lesion with heterogeneous enhancement and internal areas of hypointense signal on both T1 and T2, representing ossification or calcification ["MRI characteristics for FOPD: (I) Intermediate T1-weighted and hyperintense T2-weighted imaging with an ill-defined, irregular foci of hypointense T1/T2-weighted imaging..."]. The "string sign" is typical of peripheral nerve sheath tumors (PNST), not FOPD ["Absence of a string sign... typical of PNST"]. FOPD generally does not infiltrate bone, tendon, or muscle ["(IV) Absence of infiltration to the bone, muscles or tendon"].

Question 2: Which of the following are included in the differential diagnosis of fibro-osseous pseudotumor of the digit?

1. Giant cell tumor of tendon sheath (GCTTS) (applies)
2. Myositis ossificans (MO) (applies)
3. Schwannoma (applies)
4. Glomus tumor
5. Leiomyoma (applies)

Explanation: The manuscript discusses several conditions that mimic FOPD radiologically and histologically, including GCTTS, MO, peripheral nerve sheath tumors (such as schwannoma), and leiomyoma/angioleiomyoma ["The initial MRI features of FOPD were similar to those of PNST, GCTTS, leiomyoma, and angioleiomyoma"]. Glomus tumors are not discussed as a differential in this case and are typically smaller, subungual, and intensely painful.

Question 3: Which histological findings support the diagnosis of fibro-osseous pseudotumor of the digit?

1. Proliferation of bland fibroblasts (applies)
2. Presence of osteoid and woven bone (applies)
3. Diffuse hemosiderin-laden macrophages
4. Spindle cells in a myxoid stroma (applies)
5. Atypical mitotic figures

Explanation: FOPD is characterized histologically by bland fibroblasts, osteoid and bone formation, and a background of myxoid stroma ["(A) Proliferation of bland fibroblasts embedded in a myxoid stroma... (B) Formation of woven bone matrix..."]. The presence of hemosiderin-laden macrophages is typical of GCTTS, not FOPD ["GCTTS... histology showing synovial cells, hemosiderin-laden macrophages…"]. Atypical mitoses would suggest a malignant process, which is not consistent with FOPD's benign nature.

Question 4: Which of the following statements about imaging and diagnosis of FOPD are correct?

1. Calcifications are always visible on initial radiographs
2. MRI is essential when radiographs are non-diagnostic (applies)
3. The lesion typically involves underlying bone
4. FOPD can mimic malignant tumors such as extraskeletal osteosarcoma (applies)
5. Absence of calcification on radiographs excludes FOPD

Explanation: MRI is crucial in non-calcified cases to avoid misdiagnosis ["highlight the diagnostic value of MRI in a rare,

non-calcified presentation of FOPD"]. FOPD may lack visible calcification, especially in early stages ["no visible calcification was observed in the initial radiographic examination"]. It can mimic osteosarcoma, leading to unnecessary radical treatment if misdiagnosed ["may mimic malignant extraskeletal osteosarcoma, which often requires amputation"]. It typically does not involve bone.

Question 5: Which of the following features help distinguish FOPD from giant cell tumor of tendon sheath (GCTTS) on MRI?

1. Hyperintensity on T2-weighted imaging (applies)
2. Presence of hemosiderin blooming artifact
3. Ill-defined hypointense foci on all sequences (applies)
4. Periosteal reaction and new bone formation (applies)
5. Location adjacent to a tendon sheath

Explanation: FOPD typically shows T2 hyperintensity and ill-defined hypointense foci when ossified ["FOPD... shows foci of low signal on all sequences due to calcified bone"]. Periosteal reaction and new bone formation favor FOPD ["FOPD lesions can cause periosteal reaction... GCTTS... do not produce new bone formation"]. GCTTS, in contrast, often shows hypointensity on T2 due to hemosiderin ["GCTTS... diffusely hypointense on T2-weighted imaging due to the presence of hemosiderin"]. Both lesions may be adjacent to tendon sheaths, but this is not a discriminating feature.

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FIGURES

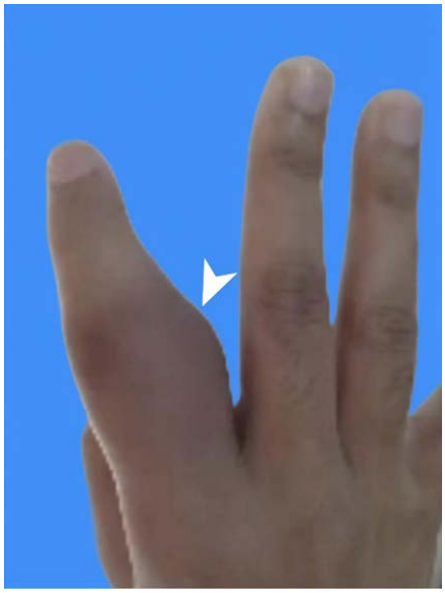

Figure 1: 45-year-old female with fibro-osseous pseudotumor of the index finger. The clinical presentation of a bulging mass (arrowhead) is observed in the proximal ulnar part of the right hand's index finger.

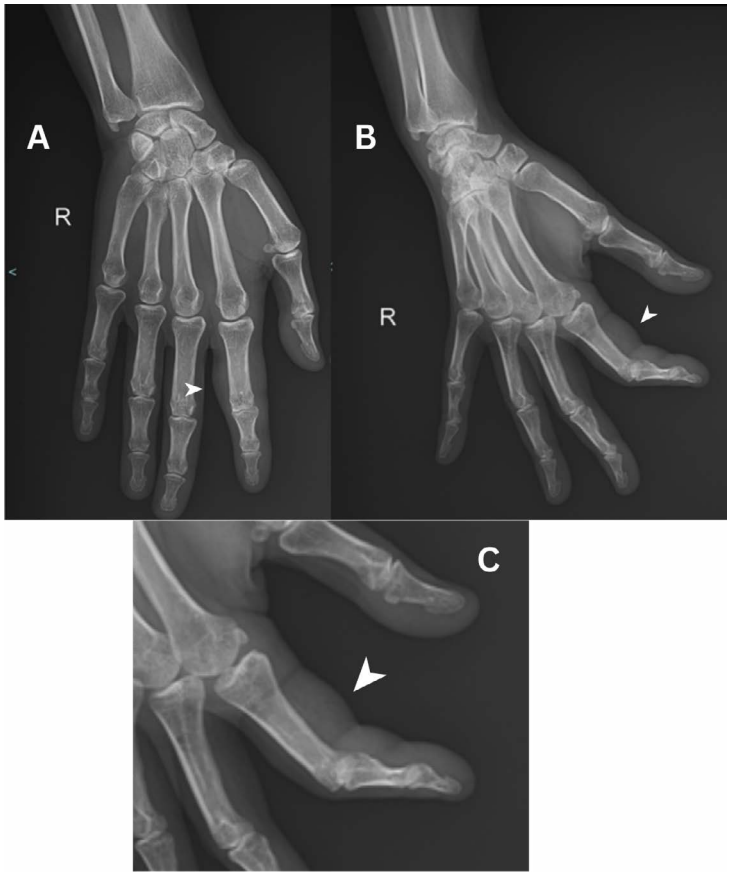

Figure 2: X-ray imaging of the right hand. (A) Anteroposterior, (B) oblique, and (C) close-up oblique views of the first digit demonstrate an ill-defined soft tissue swelling in the dorsoulnar aspect of the proximal phalanx (arrowhead). No radiopaque calcifications or periosteal reaction are visible. The absence of mineralization on plain radiography may obscure the diagnosis of fibro-osseous lesions such as FOPD, highlighting the need for advanced imaging modalities like MRI in non-calcified presentations.

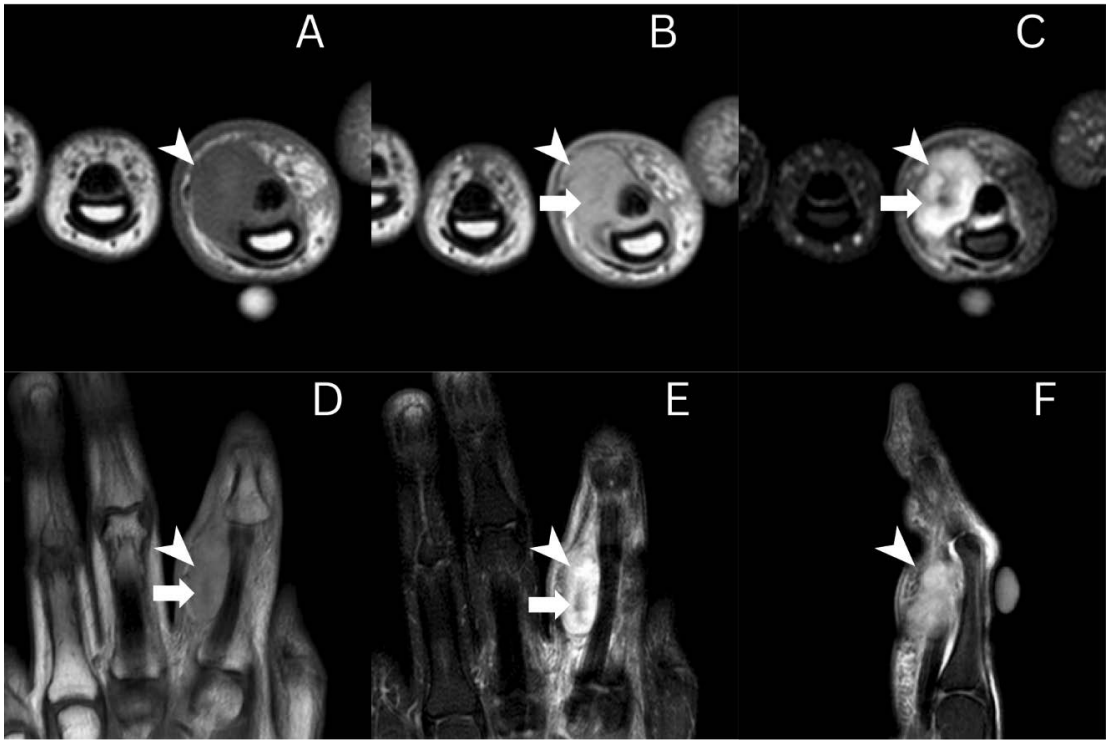

Figure 3: Axial T1-weighted (A), contrast-enhanced T1-weighted (B, D), and T2 fat-saturated (C, E, F) Findings: MRI images demonstrate a solid, T2-hyperintense subcutaneous mass (arrowheads) with homogeneous post-contrast enhancement and focal ill-defined low-signal areas suggestive of calcification (arrows) adjacent to the flexor tendon of the first proximal phalanx. Notably, the lesion lacks the peripheral low-signal fibrous capsule characteristic of GCTTS. Coronal and sagittal views show no evidence of a "string sign" typical of PNST, nor are there any intralesional flow voids suggestive of leiomyoma or angioleiomyoma. *TECHNIQUE*: T1WI ax,sag,cor (TR 583.5, TE 8.0), T2WI ax,sag,cor (TR 4320.8, TE 80.0), T2SPAIR ax,sag,cor (TR 4064.3, TE 60.0), T1WI+ contrast ax,sag,cor (TR 582.1, TE 8.0), T1WI-FS + contrast ax (TR 538.6, TE 8.0), PDW ax (TR 2988.8, TE 30.0). Slice thickness ax 3.0 mm, sag 4.0 mm, cor 4.0 mm.

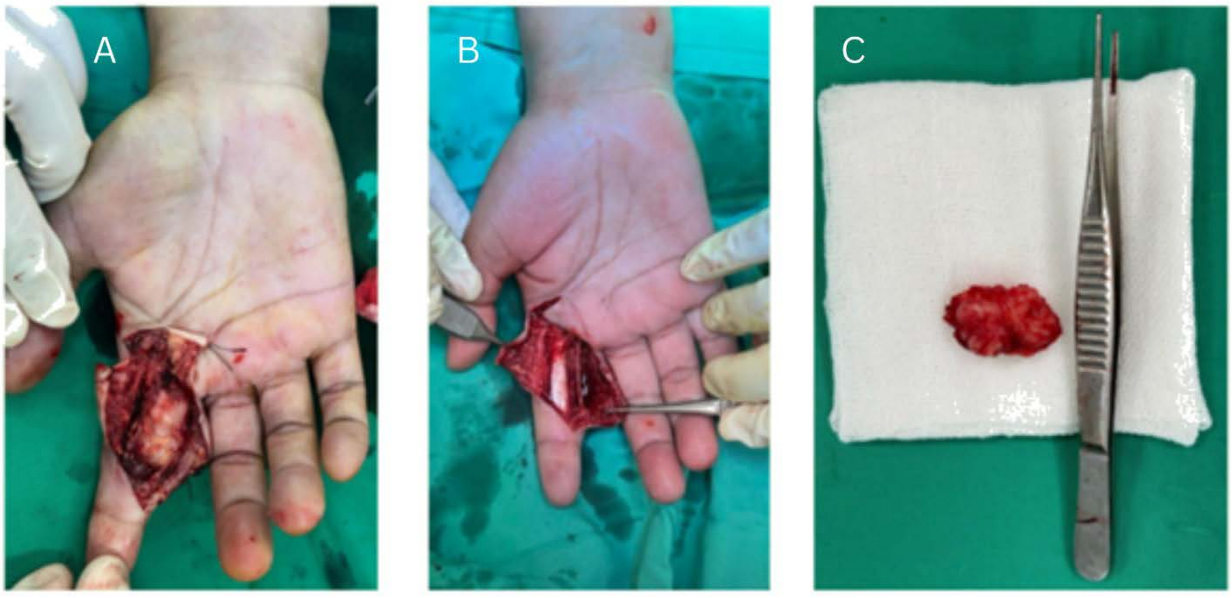

Figure 4: Intra-operative excision of the mass (A) The lesion was identified on the ulnar aspect of the flexor tendon of the right index finger. (B) The mass, along with the adjacent tendon sheath, was completely excised while preserving the underlying pulley system—crucial for maintaining postoperative digit function. (C) Gross pathology revealed a white-brown, solid mass with a spongy to partially firm consistency, measuring 3 × 1.8 × 1 cm. The firm texture and distinct borders were consistent with a well-demarcated neoplasm, favoring a fibro-osseous process rather than an infiltrative malignancy.

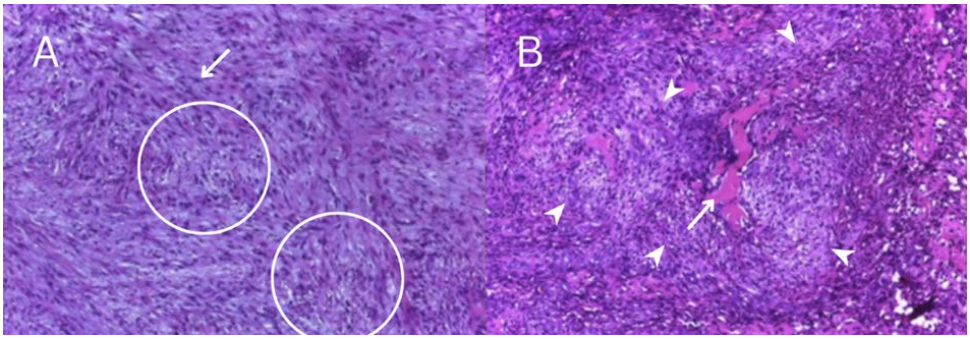

Figure 5: Histopathological features of the excised mass (H&E staining, ×100) (A) Proliferation of bland fibroblasts (white arrow) embedded in a myxoid stroma (white circles), consistent with a benign fibroblastic/myofibroblastic lesion. (B) Formation of woven bone matrix (white arrowheads) accompanied by prominent interstitial vasculature (white arrow). The presence of osteoid and bone formation with benign cytology supports the diagnosis of a fibro-osseous pseudotumor, distinguishing it from giant cell tumor of the tendon sheath, which lacks osteoid production.

KEYWORDS

Fingers; Soft Tissue Neoplasms; Ossification, Heterotopic; Fibro-osseous Pseudotumor; Magnetic resonance imaging (MRI)

ABBREVIATIONS

FOPD = FIBRO-OSSEOUS PSEUDOTUMOR OF THE DIGIT
MRI = MAGNETIC RESONANCE IMAGING
PNST = PERIPHERAL NERVE SHEATH TUMOR
GCTTS = GIANT CELL TUMOR OF THE TENDON SHEATH
MO = MYOSITIS OSSIFICANS
USP6 = UBIQUITIN-SPECIFIC PEPTIDASE 6
H&E = HEMATOXYLIN AND EOSIN
T1WI = T1-WEIGHTED IMAGING (USED IN FIGURES/ DESCRIPTIONS)
T2WI = T2-WEIGHTED IMAGING (USED IN FIGURES/ DESCRIPTIONS)
CM = CENTIMETER (USED FOR LESION SIZE)
AX = AXIAL (PLANES USED IN MRI)
SAG = SAGITTAL (PLANES USED IN MRI)
COR = CORONAL (PLANES USED IN MRI)

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