Case Report

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Malignant Tenosynovial Giant Cell Tumor Presenting as an Extra-Articular Superficial Soft-Tissue Mass in a Knee

무릎에서 관절 외 표재성 연부 종양으로 나타난 악성 건초 거대세포종

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Malignant tenosynovial giant cell tumor (TsGCT) is a rare disease that can arise as a recurrent lesion or co-exist with a benign TsGCT lesion. Here we report a rare case of malignant TsGCT in a 73-year-old male with a history of lymphoma. The tumor appeared as a superficial soft-tissue mass in the subcutaneous fat tissue of the left knee.

Index terms Giant Cell; Tumor; Knee

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INTRODUCTION

Malignant tenosynovial giant cell tumor (TsGCT) is extremely rare and characterized by high metastatic propensity and considerable tumor-related mortality (1). Fewer than 50 cases of malignant TsGCTs have been reported in the English literature (2) and most of these reports described the clinical and pathologic characteristics of these rare tumor, not the imaging findings.

We report a rare case of malignant TsGCT occurring in the subcutaneous fat tissue of the knee manifesting as a superficial soft-tissue mass in a patient with a history of lymphoma. And we present MRI findings, including diffusion-weighted image (DWI) and T1-weighted dynamic contrast enhanced (DCE) MRI image findings and follow up images.

CASE REPORTS

A 73-year-old male presented with a painful mass at the left knee. The mass was located on the medial side of the left knee and appeared non-tender and non-pulsatile on physical examination. The skin surface over the mass was smooth with no sign of inflammation. The patient felt numbness in the left lower leg but reported no prior history of trauma. He had been treated for diffuse large B cell lymphoma of the left palatine tonsil one year previously and had received chemotherapy for 4 months (six cycles). The lymphoma had completely remitted before knee symptom.

Radiological examinations were performed to characterize and diagnose the soft tissue mass. Radiography of both knees (Fig. 1A) revealed a soft tissue mass with increased opacity and a bulging contour at the medial aspect of the medial condyle of the left femur without mineralization. It has no cortical erosion or periosteal reaction. MRI of the left knee was performed to characterize the mass. The mass measured 4.0 × 3.3 × 2.3 cm and was located in the subcutaneous fat layer of the medial side of the left knee and abutted the superficial layer of deep fascia (investing fascia). However, it was definitively separated from the medial collateral ligament, and no connection existed between the tumor and bursa or the joint capsule. Coronal T1-weighted image (Fig. 1A) showed a mass of low signal intensity with a partially ill-defined margin. Axial fat-suppressed T2-weighted image also revealed accompanying adjacent fascial infiltration (Fig. 1A). Axial fat-suppressed contrast-enhanced T1-weighted image showing the enhanced, irregular peripheral margin of the mass (Fig. 1A). DWI and an apparent diffusion coefficient (ADC) map (Fig. 1B) showed the mass exhibited diffusion restriction and had an ADC value of 0.427×10^{-3} mm^2/s. The peripheral margin of the mass was strongly enhanced and had an irregular shape on dynamic contrast enhanced images (Fig. 1B), and the mass had a graph of the rapid early enhancement followed by plateau type and K_{trans} and K_{ep} values are 0.128 and 0.464. The preoperative differential diagnoses based on imaging findings and clinical history included nodular fasciitisand extranodal involvement of lymphoma.

Wide surgical excision was performed, and grossly, the mass was round and solid with a yellowish-brown color and contained hematoma but no necrotic region. Macroscopic tumor extent was superficial and involved dermal, subcutaneous, and suprafascial layers. Lympho-vascular invasion was not identified. A microscopic examination demonstrated a heterogeneous cell population consisting of sheets of enlarged epithelioid cells with round nuclei and discrete cell borders in a background of histiocytes, lymphocytes, and scattered hemosiderin, which is characteristic of conventional TsGCT containing a cytologically malignant component (Fig. 1C). In addition, to overt malignant cytology, numerous mitoses were observed (Fig. 1C).

PET-CT was done for evaluation of metastasis after mass excision, and no metastatic lesions were evident in other parts of the body. After surgery, the patient did not complain of soft tissue swelling or tenderness at the operative site. Multidisciplinary team decided to consider radiotherapy and chemotherapy after Post op MRI follow up.

During careful follow-up, a recurrent mass lesion was identified at 8 months postoperatively. Follow-up MRI revealed three separate nodular lesions at the previous surgical site (Fig. 1D). All three nodules showed diffusion restriction on DWI and an ADC map and had an ADC value of 0.568×10^{-3} mm^2/s. DCE images showed a graph of rapid initial enhancement

followed by a washout phase that suggests malignancy., with the high value of DCE parameters, including K_{trans} (0.359) and K_{ep} (0.832) (Fig. 1E).

This study was approved by our Institutional Review Board and the informed consent was waived (IRB No. 2203-022-113).

Fig. 1. Extraarticular malignant TsGCT in a 73-year-old male who presented with painful mass in the left knee.
A. Anteroposterior radiography of both knees shows a soft-tissue mass (white arrows) with increased opacity at the medial aspect of the medial femoral condyle of the left knee without cortical erosion or a periosteal reaction. Coronal T1-weighted MR image of the left knee shows a solid mass (white arrows) with low signal intensity abutting the peripheral layer of the deep fascia at the subcutaneous fat layer of the medial aspect of the knee. Axial fat-suppressed T2-weighted image shows diffuse infiltration of the superficial fascia around the mass (white arrows). Axial fat-suppressed contrast-enhanced T1-weighted image shows the enhanced irregular peripheral margin of the mass (white arrow).
TsGCT = tenosynovial giant cell tumor

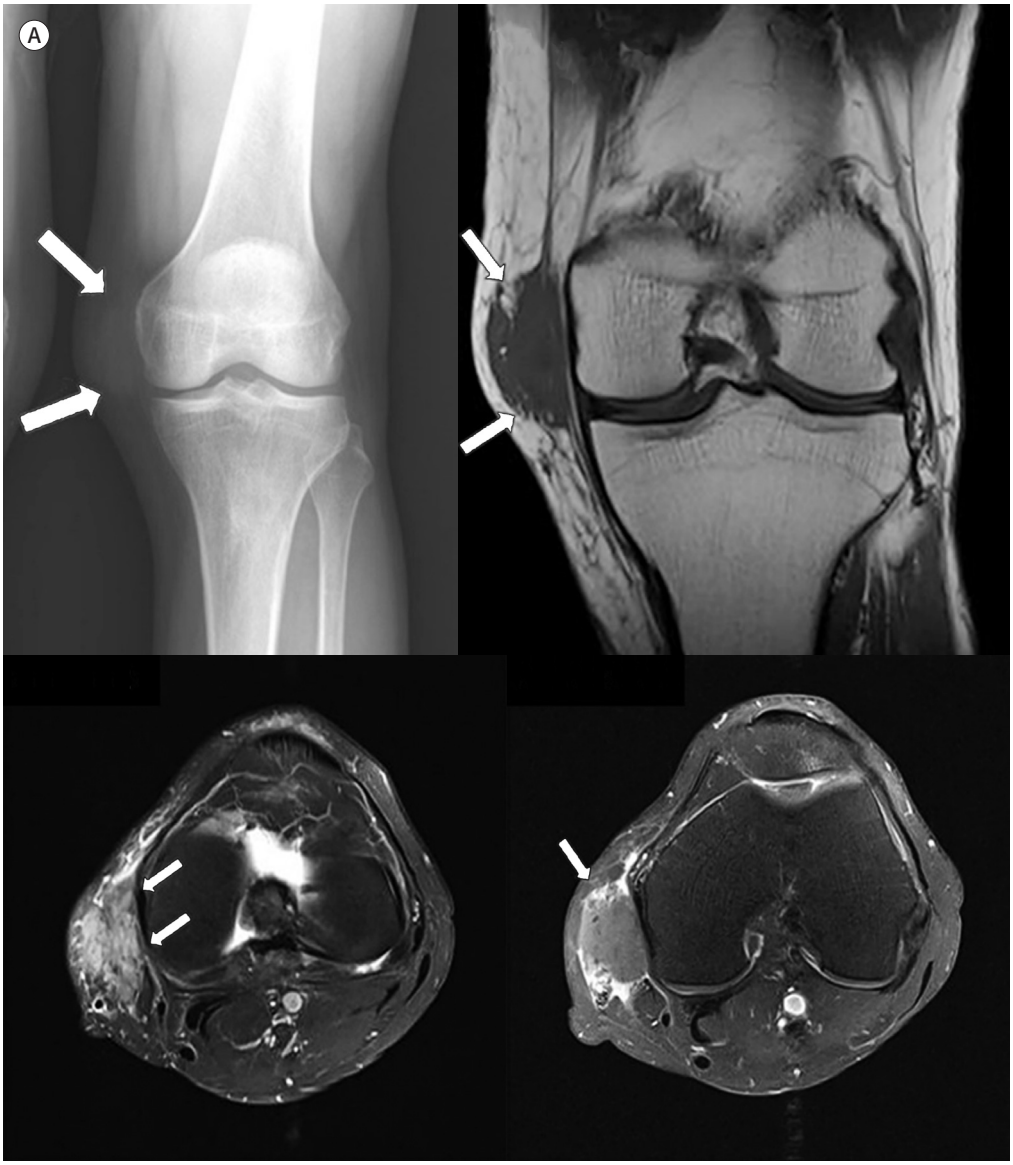
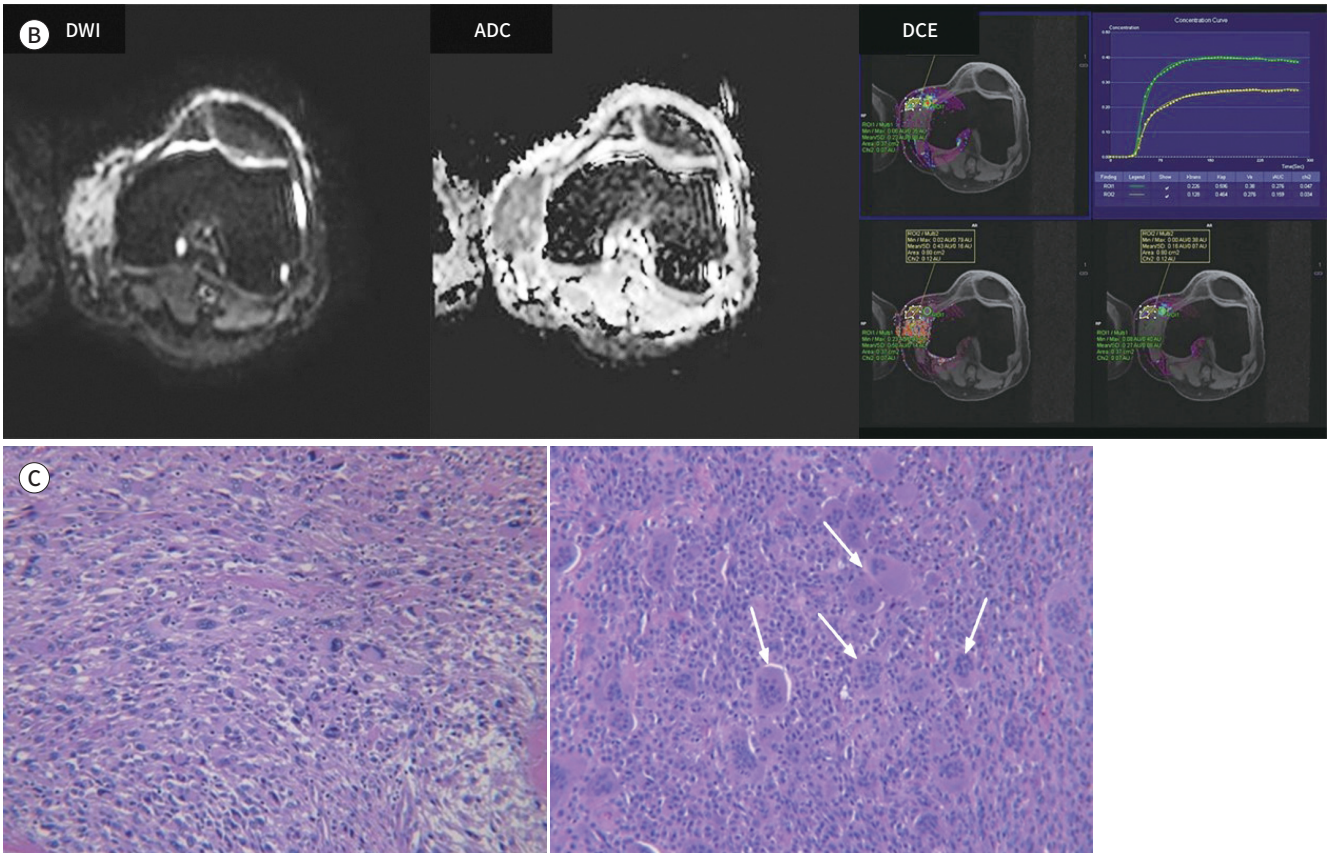


Fig. 1. Extraarticular malignant TsGCT in a 73-year-old male who presented with painful mass in the left knee.
B. DWI and ADC map shows diffusion restriction. The ADC value was 0.427 × 10^{-3} mm^2/s. The DCE image shows a graph of the plateau type and high Ktrans (0.128) and Kep values (0.464), which represents the hyperperfusion pattern of intermediate to malignant grade.
C. Malignant TsGCT is identified when a tumor contains conventional diffuse-type TsGCT (right, H&E stain, × 100) (arrows) and cytologically malignant components. H&E-stained tissue section at 100 × magnification shows a TsGCT with an overt malignant cytology and numerous mitoses (left, H&E stain, × 100).
ADC = apparent diffusion coefficient, DCE = dynamic contrast enhanced, DWI = diffusion-weighted image, H&E = hematoxylin and eosin, TsGCT = tenosynovial giant cell tumor



DISCUSSION

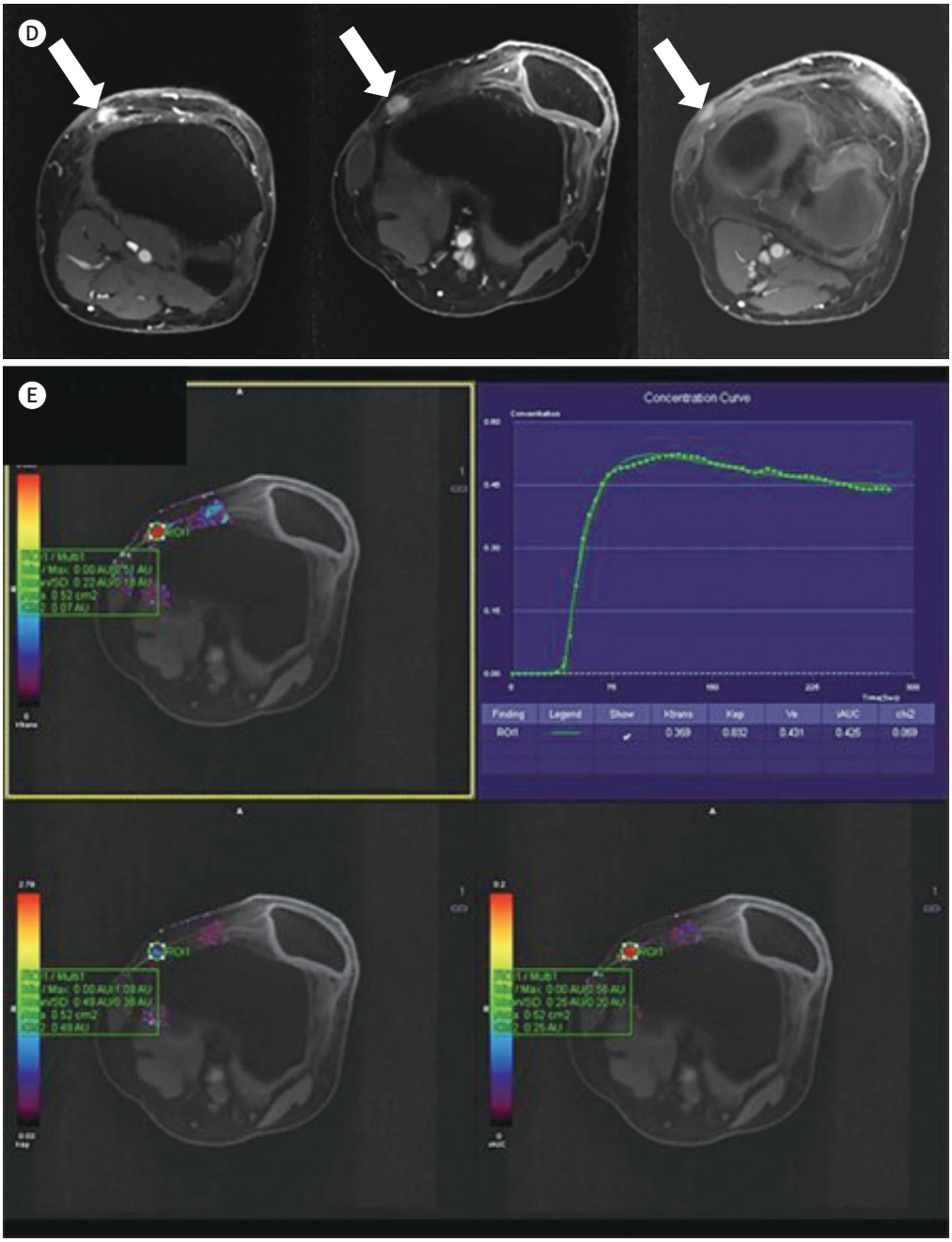
TsGCT was first described in 1852 by Chassaignac as a synovial membrane proliferation involving the flexor tendons of fingers but was later redefined by Jaffe et al. (3) in 1941 as lesions involving not only synovium but also tendon sheath, bursa, and joints. According to the 2020 World Health Organization (WHO) Guidelines, TsGCT is included in so-called fibrohistiocytic tumors and it is classified as a benign entity (4). Giant cell tumor of soft part is classified as intermediate group and malignant TsGCT is classified as malignant group (4).

The first case of malignant TsGCT was described by Castens and Howell (5) in their 1979 report of a 48-year-old female with a sarcoma arising from a pre-existing TsGCT of the foot. Malignant TsGCT was defined by Enzinger and Weiss as a lesion consisting of benign TsGCT coexisting with sarcoma (primary type) or a lesion representing sarcomatous recurrence of previously diagnosed benign TsGCT (secondary type) (6). Sarcomatous change is exceedingly rare for both intra- and extra-articular forms of benign TsGCTs (5). Our case was an extra-ar-

ticular and primary type of malignant TsGCT.

Malignant TsGCTs are generally similar to their benign counterparts in terms of tumor location, that is, they usually affect tenosynovial structures and originate from or near the

Fig. 1. Extraarticular malignant TsGCT in a 73-year-old male who presented with painful mass in the left knee.
D. Follow-up magnetic resonance image obtained about 8 months after surgery. Consecutive axial delayed contrast-enhanced T1-weighted images show three well-enhanced nodular lesions (arrows) that separated from each other during the previous operation.
E. DCE image demonstrates a graph with a decreasing pattern and high Ktrans (0.359) and Kep (0.832) values representing a malignant hyperperfusion pattern.
DCE = dynamic contrast enhanced, TsGCT = tenosynovial giant cell tumor



large joint spaces of limbs, but show marked preference for lower extremities (knees and ankles) as compared with benign TsGCTs (7). In our case, the mass was located in the subcutaneous fat layer near the left knee joint without intra-articular involvement.

According to several previous studies, benign and malignant TsGCT cannot be differentiated by age or size (2). The majority of previously reported cases have involved middle-aged or older adults (age range 12 to 78 years, average 52 years) (2, 7). Our patient was 73 years old.

Malignant TsGCT represents a distinct sarcoma entity with a considerable risk of mortality and metastatic potential (2, 7). Metastasizing benign TsGCT seems to have a much more favorable prognosis than malignant TsGCT, which has a poor prognosis, as exemplified by a mortality rate of 33%-50% and a median survival of only 21.5 months after diagnosis (8). In our case, no metastatic lesions were evident at initial diagnosis, and during the follow-up after surgery, there were neither clinical signs nor imaging findings suggestive of metastasis even after local recurrence, although the follow-up period was only 12 months.

The imaging findings of malignant TsGCT have rarely been reported. The MRI characteristics of malignant TsGCT are of infiltrative lesions with poorly defined margins closely associated with tenosynovial structures and/or joint spaces (2). Some authors have reported malignant TsGCT appears as a large, lobulated soft lesion with numerous dark signal areas and variable cystic changes on T1 and T2-weighted sequence MRI (7). On T1CE, regions of enhancement can be seen in regions of synovial proliferation of TsGCT, but do not predict aggressiveness (9). The progression of tumor enhancement was objectively evaluated, and it has type III graph, which is rapid earyly enhancement followed by washout. Murphey et al. (9) concluded that the findings most consistent with malignancy. However, our patient showed neither evidence of bone invasion nor metastatic lesions.Like in our case, most reported cases of malignant TsGCT has been diagnosed not by imging findings but by histopathologic examination of biopsied lesions, presumably because of the low incidence of TsGCT and lack of imaging information about malignant TsGCT in the literature (10). Genetic findings support a synoviocytic origin for the malignant cells in malignant TsGCT, but genetic studies were not performed in our case. In a previous study, an older age, a large tumor size, tumor necrosis, atypical mitoses, and Ki-67 overexpression appeared significant in malignant lesions (2), but it is questionable whether a diagnosis of malignant TsGCT can be made when these factors are present individually. In our case, the mass was superficial and non-specific, and lesion benignity and malignancy were difficult to differentiate using conventional MR images. On the other hand, functional MR images, including DWI and DCE images, suggested possible malignancy, however, malignant TsGCT was not included in differential diagnosis because of low incidence.

The extra-articular location of the tumor not an intra-articular, add to the rarity of the described case. This meant that its differential diagnosis was unrelated to the knee joint and included fibrous tumors such as desmoplastic fibroblastoma, nodular fasciitis, subcutaneous lymphoma, and myxofibrosarcoma (MFS). Desmoplastic fibroblastoma is visualized as a well-circumscribed, subcutaneous mass that infiltrates surrounding fat, superficial fascia and muscle. MRI reveals prominent low signal intensity on all pulse sequences due to hypocellular collagen. Only mild contrast enhancement is observed, which distinguishes desmoplastic fibroblastoma from the majority of fibromatoses. In our case, the mass showed con-

trast enhancement except in the cystic portion, and heterogenous signal intensity on T2WI, which distinguished it from desmoplastic fibroblastoma. Nodular fasciitis is a well-recognized transient benign neoplasm of soft tissues. Its MRI findings are largely non-specific, although certain features such as a history of trauma, relationship to fascia, and the inverted target sign suggest diagnosis. Based on considerations of fascial infiltration, mass location, and heterogeneous signal intensity, our putative diagnosis was nodular fasciitis. However, the differential diagnosis was more difficult because functional MR images suggested malignancy. MFS can produce very high signal intensities, similar to that of fluid on fluid-sensitive MR sequences, because of its myxoid content. The presence of an enhancing tail extending from a myxoid-containing tumor, especially in an extremity or limb girdle of an elderly patient, is a rather specific and a moderately sensitive MRI feature of MFS. The mass tail sign was also observed on contrast-enhanced images of our patient, but most of the mass did not exhibit a signal intensity suggestive of myxoid content.

Summarizing, malignant TsGCT is extremely rare and there is a lack of specific MR findings that distinguish it from benign TsGCT. Moreover, unlike previously published TsGCT cases, in our patient, the mass was located in the subcutaneous fat layer which is an extra-articular location, though near the left knee joint. A history of lymphoma confused the differential diagnosis and conventional MR images failed to differentiate benignity and malignancy. However, DWI and DCE images indicated a high likelihood of malignancy. It is important to understand that malignant TsGCT can occur in the subcutaneous fat layer near a joint and not be intra-articular. The clinical course of malignant TsGCT is poor with the high risk of rapid, and thus, short-term follow-up imaging and detailed physical examinations are essential.

Author Contributions

Conceptualization, L.I.S.; data curation, L.J., K.J.I., C.K.U.; formal analysis, L.J., S.Y.S.; funding acquistion, L.I.S.; investigation, L.J., S.Y.S; methodology, L.I.S., S.Y.S.; project administration, L.I.S., S.Y.S.; resources, L.J., K.J.I., C.K.U.; software, L.J., S.Y.S.; supervision, L.I.S; validation, L.J., S.Y.S.; visualization, L.J., K.J.I., C.K.U.; writing—original draft, L.J.; and writing—review & editing, L.I.S., S.Y.S.

Conflicts of Interest

The authors have no potential conflicts of interest to disclose.

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무릎에서 관절 외 표재성 연부 종양으로 나타난 악성 건초 거대세포종

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악성 건초 거대세포종은 매우 드물며 양성 거대 세포 종양 이후 발생하거나 함께 발생할 수 있다. 저자들은 임파종을 가진 73세 남자 환자에서 왼쪽 무릎의 표재성 연부 종양으로 나타난 드문 악성 거대 세포 종양에 대해 보고한다.

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