

Case Report

Lipoma of the Infrapatellar Fat Pad: A Report of Three CasesYasuyuki Kitagawa¹, Kazuma Miura¹, Daisuke Fukuhara¹, Naoto Kotani¹,
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Although lipoma is the most common soft tissue tumor, lipoma in the infrapatellar fat pad (IFP) is rare. Herein, we report three cases of lipoma in the IFP that penetrated the joint capsule and extended subcutaneously. All patients presented with unusual MRI findings. Patients 1, 2, and 3 were 63, 74, and 64 years old, respectively, and all were female. Their chief complaint was a knee mass; however, they did not experience pain or limitations in range of motion. The interval from initial awareness of the mass to first consultation was long (3, 8, and 13 years, respectively). MRI revealed that the mass had extended subcutaneously from the IFP through the lateral, medial, and bilateral joint capsules of the patellar tendon, respectively. On MRI, the masses appeared as lipomatous tumors with scattered low signal areas on T1-weighted imaging. The tumors excised after biopsy had long axes of approximately 6, 7, and 7 cm, respectively. Histological examination revealed lipomas with partial fibrosis in all three tumors and cartilage metaplasia in the tumor from patient 3. Lipomas in IFPs often exhibit secondary changes, such as fibrosis and cartilage metaplasia, resulting in MRI findings that differ from those of typical lipomas. In the present cases, biopsy was necessary to differentiate them from atypical lipomatous tumors or Hoffa disease.

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Introduction

The infrapatellar fat pad (IFP) is a mass of adipose tissue that is posterior to the patellar tendon and within the joint capsule but outside the synovial cavity. The IFP comprises a central body, medial extension, lateral extension, superior tag, and ligamentum mucosum¹. Anatomically, it is connected to multiple structures, including the inferior pole of the patella, the patellar retinacula, the patellar tendon, the anterior tibia, the anterior horns of the menisci, the femoral condyles, and the intercondylar notch, and is covered posteriorly by the synovium¹. Although the function of the IFP is unclear, it has been reported that the IFP fills space, reduces the load on the knee joint, supplements blood flow to the patellar tendon, stabilizes the anterior part of the joint, and acts as a

local modulator of inflammatory response^{2,3}.

Although Hoffa disease of the IFP is frequent, lipoma in the IFP is rare. Lipomas can be diagnosed using MRI; however, signals other than fat components are sometimes present, necessitating differentiation from tumors such as atypical lipomatous tumor (ALT). Herein, we report three cases of lipoma arising from the IFP that showed atypical MRI findings for lipoma.

Case 1

A 63-year-old woman was referred to our hospital for a left knee mass that had developed approximately 3 years previously. She had a medical history of hypertension and maxillary sinus tumor for which she received treatment in her thirties. She had no pain or limitation in the

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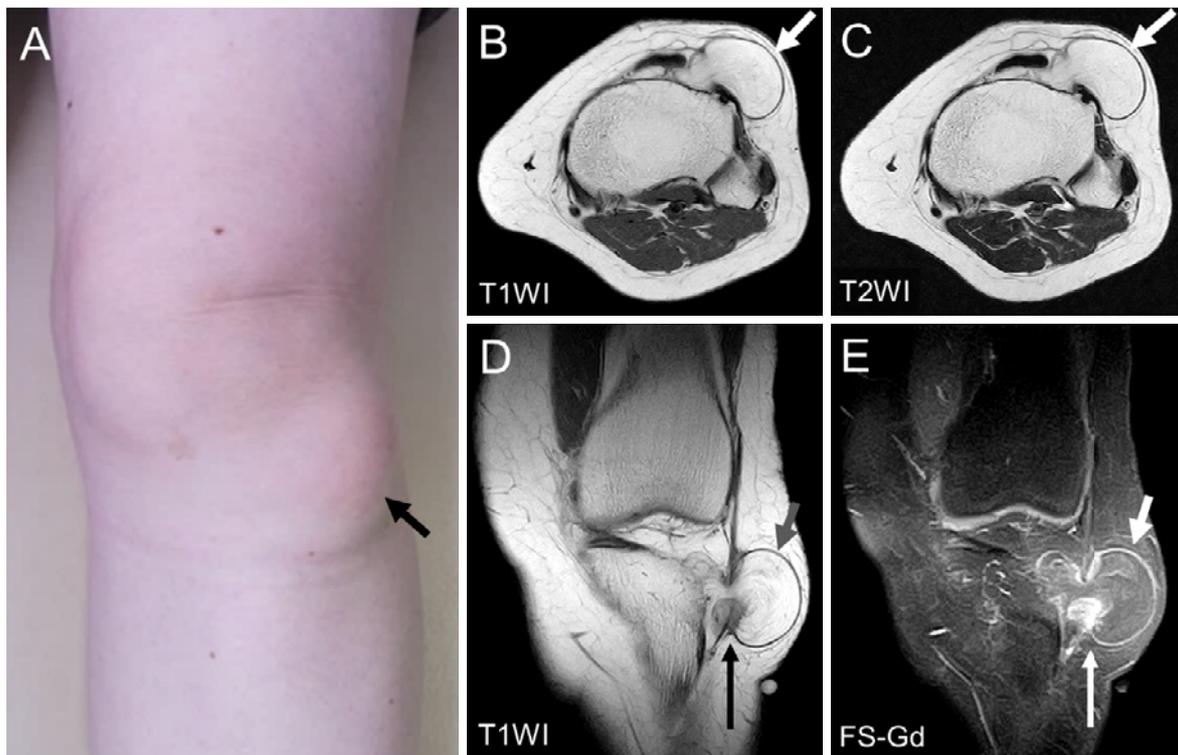


Figure 1 Patient 1

A: Left knee of a 63-year-old woman showing a knee mass (arrow). B and C: MRIs show a lipomatous tumor extending subcutaneously from the infrapatellar fat pad through the joint capsule. Axial T1-weighted (B) and T2-weighted (C) images showing dumbbell-shaped lipomatous tumor in which the intra-articular component had a slightly lower signal than the extra-articular component. D and E: Coronal T1-weighted image (D) showing that the area compressed by the tear in the joint capsule exhibits lower signal intensity than fat. Coronal fat-suppressed image after intravenous injection of contrast medium (E) showing enhancement of the hypointense area.

range of motion in the knee joint (**Figure 1**). MRI revealed a mass extending from the IFP to the subcutaneous tissue through the joint capsule on the lateral side of the patellar tendon; T1- and T2-weighted images showed high signal intensity. MRI suggested lipoma, but the constricted area near the joint capsule exhibited low signal intensity on T1- and T2-weighted images and showed contrast enhancement. Needle biopsy was performed to differentiate it from ALT, but no malignant findings were found. The excised tumor was shaped like a snowman, with a long axis of approximately 6 cm (**Figure 2**). Histologically, it was identified as a lipoma with areas of fibrosis, some of which were partially hyalinized. The patient was walking without pain at an evaluation 1 month postoperatively. She gave her informed consent for publication of this report.

Case 2

A 74-year-old woman was referred to our hospital for a left knee mass that developed approximately 8 years previously. She had a medical history of left varicose veins,

for which she received treatment at age 66 years. She had no pain or limitation in the range of motion in the knee joint (**Figure 3**). MRI revealed a mass occupying the medial half of the IFP and extended subcutaneously from the medial side through the joint capsule. The center of the extra-articular component exhibited high signal intensity on T1- and T2-weighted images, whereas the periphery displayed a band-like area of slightly lower signal intensity. The intra-articular component had a signal intensity similar to that of muscle. A needle biopsy performed to differentiate it from ALT revealed no malignant findings. The excised tumor was shaped like a snowman and had a long axis of approximately 7 cm. Histologically, fibrous septa and surrounding bands of fibrosis were observed in the lipoma (**Figure 4**). The patient was walking without pain at an evaluation 1 month postoperatively. She gave her informed consent for publication of this report.

Case 3

A 64-year-old woman was referred to our hospital for a

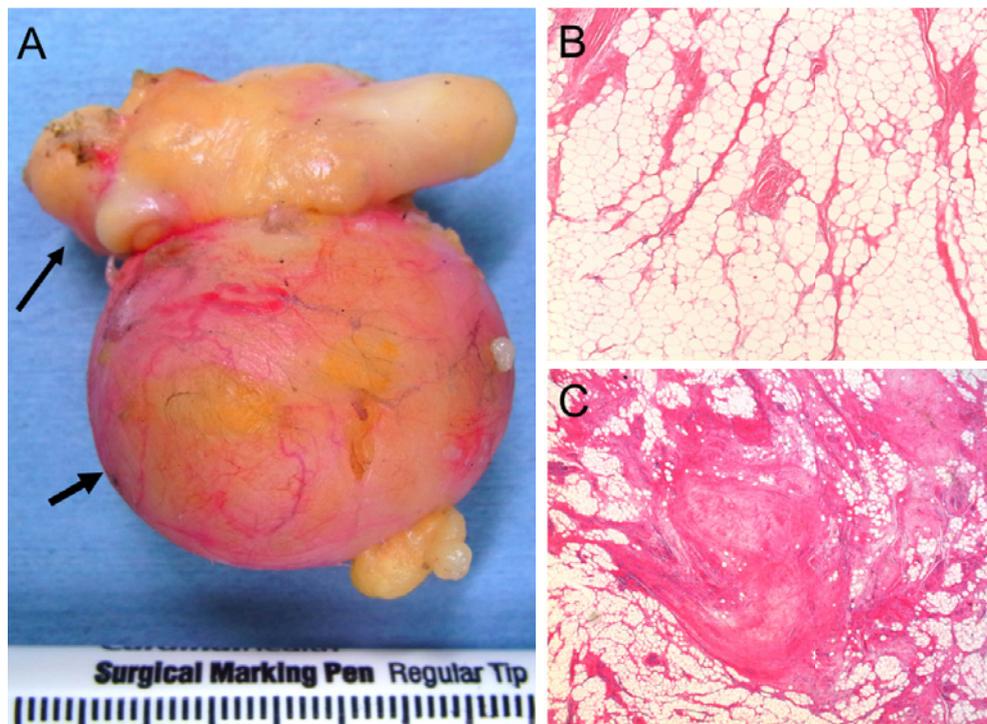


Figure 2 Patient 1

A: Photograph of the tumor showing a yellow, snowman-shaped mass. The extra-articular component (arrow) is round, whereas the intra-articular component (long arrow) is irregular in shape. B and C: Histological appearance of the tumor at low magnification (H&E staining). The tumor comprises mature adipose cells with fibrous septa (B) and a large hyalinized fibrosis (C).

left knee mass that developed approximately 13 years previously. She had a medical history of hypothyroidism, atrial fibrillation, vesical leukoplakia, and nephrolithiasis. She had no pain or limitation in the range of motion in the knee joint (**Figure 5**). MRI revealed a mass occupying almost the entire IFP that had extended subcutaneously through the medial and lateral joint capsules. The center of the mass was hyperintense on T1- and T2-weighted images. The periphery displayed a wide band-like pattern, had a signal intensity similar to that of muscle on T1- and T2-weighted images, and exhibited contrast enhancement. An open biopsy was performed to differentiate this mass from ALT, but no malignant findings were found. The mass was excised. The irregularly shaped tumor was approximately 7 cm in length (**Figure 6**). Histological examination revealed fibrous septa and cartilaginous metaplasia within the lipoma, as well as peripheral bands of fibrosis. The patient was walking without pain at an evaluation 6 months postoperatively. She gave her informed consent for publication of this report.

Discussion

We evaluated and treated three patients with lipomas arising in the IFP. To our knowledge, only eight such

cases have been previously reported in English⁴⁻¹¹. In a summary combining the previous cases and the present three cases, the median patient age was 44 years (range 8-74 years), all but one patient was female, seven patients reported pain and four did not, five had limited range of motion of the knee joint, and the median long axis of the tumor was 4.5 cm (range 1-7 cm) (**Table 1**). With regard to tumor extension, five had intra-articular extension, four had extra-articular extension, and two had no extension. Regarding MRI findings, eight tumors exhibited hypointense or mixed hypointense/hyperintense signals on T1-weighted images. Histological findings included fibrosis, bone metaplasia, cartilage metaplasia, necrosis, and deposition of mucoid materials. All five patients with intra-articular extension reported pain; however, the four patients with extra-articular tumor extension had no pain. Ten of the 11 patients with lipomas in the IFP were women. The reported gender ratio for lipoma varies, but it is generally considered to be slightly more prevalent in men¹². Lipomas in the IFP may be more frequent in women. However, because the number of cases is small, further cases and research on hormone receptors are needed to clarify this.

In all three of the present patients, histological findings

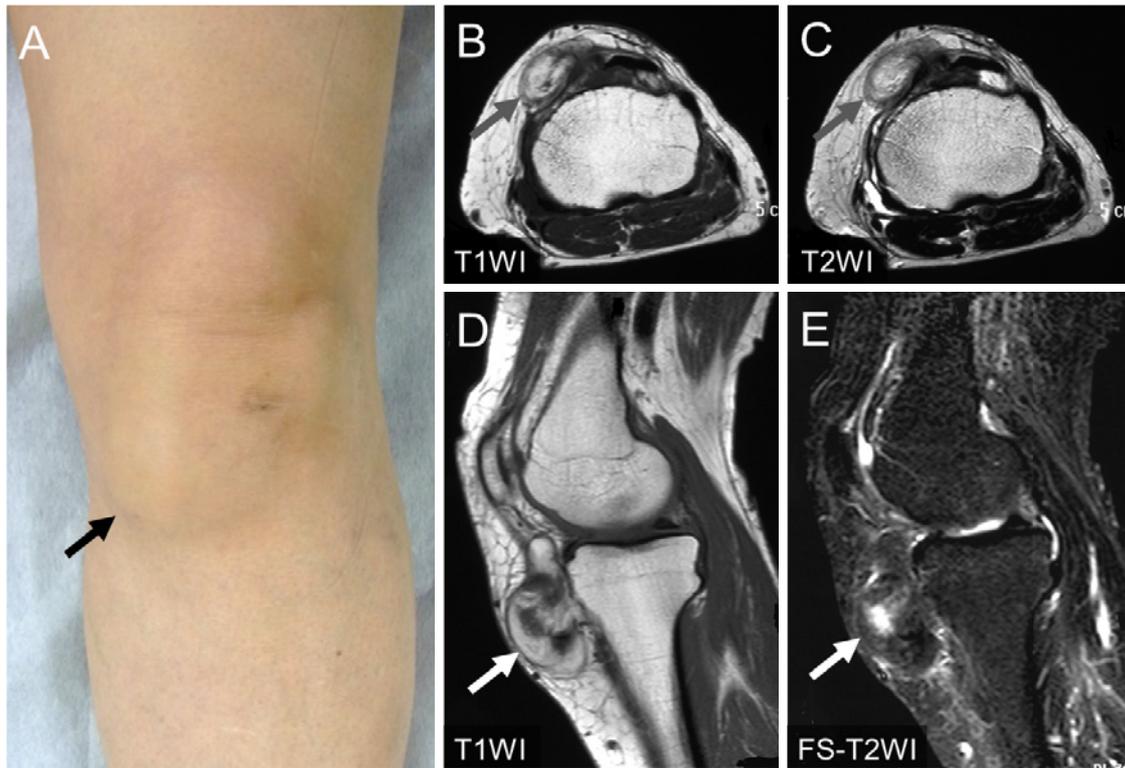


Figure 3 Patient 2

A: Photograph of the left knee of a 74-year-old woman showing a knee mass (arrow). B and C: A lipomatous tumor extends subcutaneously from the infrapatellar fat pad through the joint capsule. Axial T1-weighted (B) and T2-weighted (C) images showing a dumbbell-shaped mass; the extra-articular component has high signal intensity, and the intra-articular component has a lower signal intensity. D and E: Sagittal T1-weighted image (D) showing a lower signal intensity area in the center of the mass, and a fat-suppressed image (E) showing enhancement of the area of lower signal intensity.

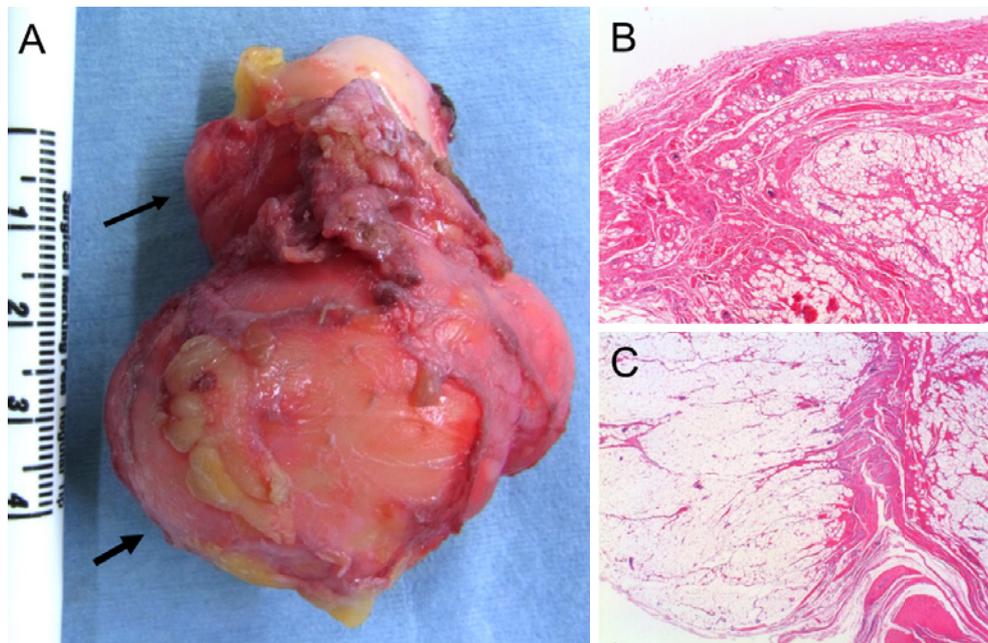


Figure 4 Patient 2

A: Photograph of the tumor showing a yellow snowman-shaped mass. The extra-articular component (arrow) is round. B and C: Histological appearance of the tumor at low magnification (H&E staining). The tumor comprises mature adipose cells with a fibrotic periphery (B) and center (C).

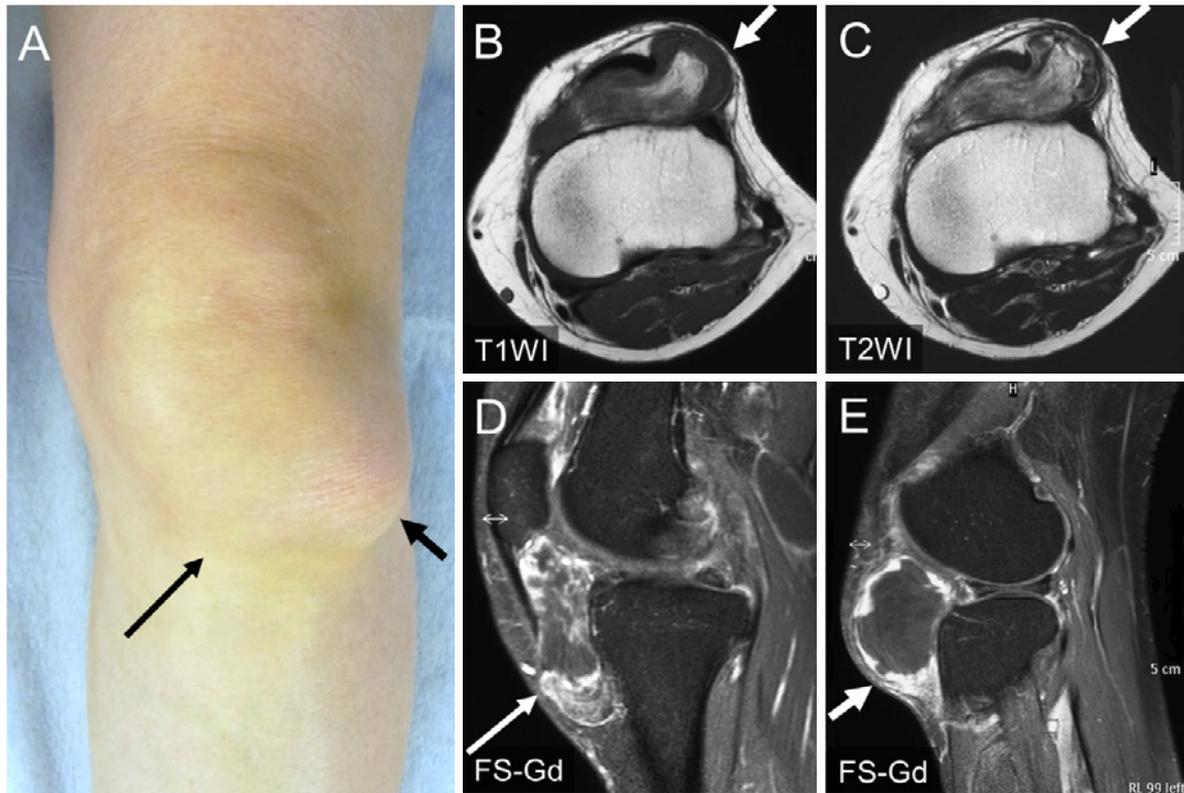


Figure 5 Patient 3

A: Photograph of the left knee of a 64-year-old woman showing a mass in the lower anterolateral aspect (arrow) and lower anterior aspect (long arrow) of the knee. B and C: MRI scans show a lipomatous mass extending subcutaneously from the infrapatellar fat pad through the joint capsule bilaterally to the patellar tendon. Axial T1- (B) and T2-weighted (C) images show a mass of complex shape with high signal intensity, surrounded by a wide peripheral band of low signal intensity. D and E: Sagittal fat-suppressed images after intravenous contrast injection show enhancement of the peripheral band area of the lesion in the medial (D) and lateral (E) components adjacent to the patellar tendon.

revealed fibrosis or a combination of fibrosis and cartilage metaplasia in the tumors. It has been reported that the IFP undergoes significant deformation with flexion and extension of the knee joint, making it prone to interference from trauma or repetitive overload¹³. Furthermore, a previous study reported that the internal pressure of the IFP increases significantly when the knee joint is flexed by approximately 100 degrees or more or extended by approximately 20 degrees or more¹⁴. We speculate that this internal pressure may increase further as the lipoma grows within the IFP. In all three cases, the tumor extended subcutaneously through a tear in the joint capsule, suggesting exposure to substantial external force. Therefore, we hypothesize that mechanical pressure applied to the lipoma led to bleeding and necrosis within the tumor, which subsequently resulted in fibrosis.

In cases of extra-articular extension, such as the present lesions, the differential diagnosis includes Hoffa disease and ALT. Hoffa disease is a painful condition caused by impingement and inflammation of the IFP resulting

from acute or chronic repeated minor trauma. It is usually treatable with conservative therapy¹⁵. When Hoffa disease becomes chronic, hyperplasia and fibrosis occur in the IFP, sometimes resulting in cartilage or bone metaplasia. In addition, hypertrophy of the IFP may progress to form soft tissue tumor-like lumps, which may need to be differentiated from lipoma or ALT^{10,15}. MRI is useful in diagnosing Hoffa disease^{15,16} and typically shows hyperintense areas in the IFP on T2-weighted images, suggesting edema or bleeding. MRI may also reveal bowing of the patellar tendon from the effect of the mass^{15,16}. In chronic Hoffa disease, fibrosis and hemosiderin deposition may result in hypointensity on T1- and T2-weighted images^{15,16}. When an IFP lipoma exhibits minimal extension into surrounding tissue, using MRI to distinguish it from Hoffa disease can be challenging. Although MRI is generally effective in differentiating lipomas from ALT¹⁷, severe secondary changes in IFP lipomas can complicate such differentiation. The present three masses were difficult to distinguish from ALT by MRI alone; thus, biopsy speci-

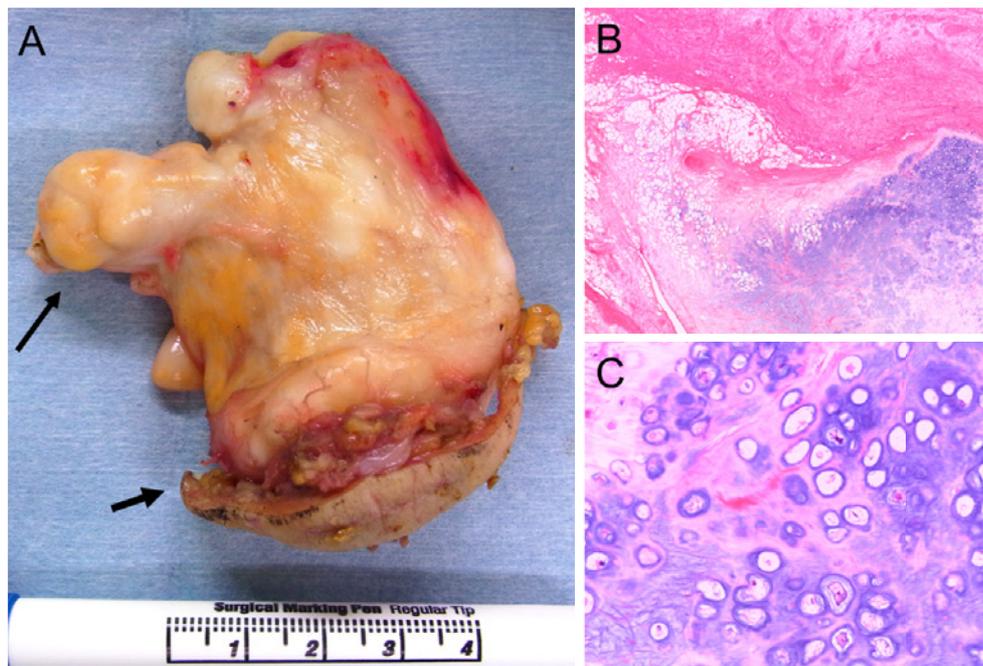


Figure 6 Patient 3

A: Photograph of the tumor showing a yellow irregular shaped mass. The long and short arrows indicate the medial extra-articular component and lateral extra-articular component, respectively. B: Histological appearance of the tumor at low magnification (H&E staining). The tumor comprises mature adipocytes, extensive fibrosis, and cartilaginous metaplasia. C: Cartilaginous metaplasia at high magnification.

Table 1 Characteristics of reported cases of lipoma of the infrapatellar fat pad

Author (year)	Y/S ^a	LD ^b	Histological features	Pain	ROM ^c	Extension ^d	T1 ^e	T2 ^f
Bernsten et al. ¹¹ (2001)	27/F	2	Lipoma	+	-	Intra-articular	High	High
Marui et al. ¹⁰ (2002)	16/F	4	Lipoma + mucoid materials	+	-	Intra-articular	Low	High
Yeomans et al. ⁹ (2003)	32/F	1	Lipoma + necrotic fat	+	+	Intra-articular	NA ^g	NA
Keser et al. ⁸ (2005)	42/F	2	Lipoma + necrotic fat	+	+	Intra-articular	Low	High
Tudisco et al. ⁷ (2008)	8/M	2	Lipoma + fibrous septa	+	+	Intra-articular	High	High
Gigis and Gigis ⁶ (2012)	44/F	6	Fibrolipoma + B/CM ^h	+	+	None	Mixed	Mixed
Moraux et al. ⁵ (2017)	55/F	NA	Lipoma	-	-	Extra-articular	High	High
Kim et al. ⁴ (2022)	63/F	5	Lipoma + B/CM	+	+	None	Low	High
Present case 1	63/F	6	Lipoma + Fibrosis	-	-	Extra-articular	Mixed	Mixed
Present case 2	74/F	7	Lipoma + Fibrosis	-	-	Extra-articular	Mixed	Mixed
Present case 3	64/F	7	Lipoma + Fibrosis, CM ⁱ	-	-	Extra-articular	Mixed	Mixed

^a age and sex, ^b long diameter (cm), ^c restricted range of motion, ^d tumor extension, ^e signal intensity on T1-weighted images, ^f signal intensity on T2-weighted images, ^g not available, ^h osteo-cartilaginous metaplasia, ⁱ cartilaginous metaplasia.

mens were collected before surgery.

In summary, in three patients with IFP lipomas exhibiting extra-articular extension, histological examination revealed secondary changes such as fibrosis and cartilage metaplasia, as well as atypical MRI findings. Biopsy was necessary to differentiate these lesions from ALT in all cases. IFP lipoma can extend intra-articularly or extra-articularly, and the intra-articular type is often associated with pain. Further accumulation of clinical data on IFP lipomas and clarification of the pathological conditions

and characteristic MRI findings are necessary.

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