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CMEArticle

# Lipoma arborescens

*Sarat Kumar Sanamandra*[1], MBBS, FRCR, *Keh Oon Ong*[1], MRCS, FRCR

**ABSTRACT** Lipoma arborescens is a chronic, slowly progressive intra-articular lesion characterised by villous lipomatous proliferation of the synovium, usually involving the suprapatellar pouch of the knee joint. It is an uncommon cause of intra-articular masses that presents as slowly progressive painless swelling of the joint, which persists for many years and is accompanied by intermittent effusions. We highlight this condition to raise awareness of its clinical spectrum and imaging features, so that early diagnosis and appropriate treatment can be given, and misinterpretation of this condition as other more complex intra-articular masses is avoided. This pictorial essay aims to provide a brief yet comprehensive review of the clinical features, distribution, morphological types and imaging characteristics of lipoma arborescens, including its common differential diagnoses and management.

*Keywords: benign, joint masses, lipoma arborescens, magnetic resonance imaging, synovial membrane*

## INTRODUCTION

Lipoma arborescens (diffuse articular lipomatosis) is a rare articular lesion consisting of subsynovial villous proliferation of mature fat cells,[1] usually involving the suprapatellar pouch of the knee joint. Albert Hoffa, a German surgeon, made the first description of lipoma arborescens in 1904; the Latin term 'arborescens' means 'tree-like appearance', describing the characteristic villous and frond-like morphology of this condition.[2] While the exact cause of lipoma arborescens is unknown, it has been hypothesised to be a nonspecific reactive synovial fatty proliferation in response to chronic traumatic or inflammatory stimuli rather than a neoplastic process.[1,3,4]

We discuss the clinical features, morphological types and imaging findings of lipoma arborescens, with particular attention on the role of magnetic resonance (MR) imaging, which is considered the best,[3,4] and often the first, imaging modality in the evaluation of articular masses in the current era. The value of imaging in lipoma arborescens lies in its early diagnosis, delineating the exact anatomical extent, identifying associated abnormalities and differentiating it from other closely mimicking intra-articular masses.[5-17]

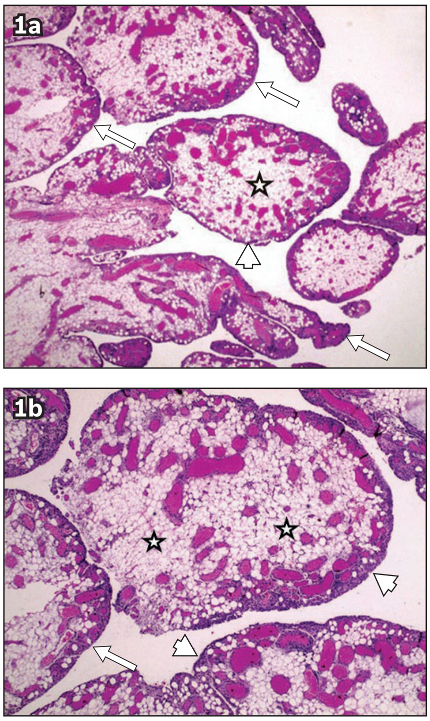


**Fig. 1** Photomicrographs of extra-articular lipoma arborescens show several papillaroid structures (arrows) with synovial lining cells (arrowheads), which contain a stroma that exhibits increased mature adipose tissue (stars) [Haematoxylin & eosin (a) × 2; (b) × 4].

## CLINICAL FEATURES

Clinical presentation usually consists of an insidious onset of painless swelling of the affected joint, usually persisting for many years, followed by progressive pain accompanied by intermittent episodes of joint effusion.[1,4] Intermittent worsening pain and swelling of the involved joint may be related to the trapping of hypertrophied fatty villi between the moving joint surfaces. Although the knee joint is the most common site of involvement, lipoma arborescens has also been reported in several other joints, including the shoulder, hip, elbow, ankle and wrist, as well as in periarticular bursae and tendon sheaths.[6-8,11] Although it is usually monoarticular, polyarticular and bilateral involvements are not uncommon; for example, involvement of both knees have been reported in up to 20% of affected patients in some studies.[2,9,16]

Lipoma arborescens has been observed in patients aged between 9 and 68 years, with equal predominance in men and women. There are two aetiological types of lipoma arborescens, primary and secondary, depending on the age of onset and underlying precipitating condition.[4,10,12] The more common secondary type is defined as synovial lipomatosis associated

[1]Department of Diagnostic and Interventional Radiology, Singapore General Hospital, Singapore
**Correspondence**: Dr Sarat Kumar Sanamandra, Registrar, Department of Diagnostic and Interventional Radiology, Singapore General Hospital, Outram Road, Singapore 169608. sarat.kumar.sanamandra@sgh.com.sg

with an underlying chronic irritation, such as degenerative disease, trauma, meniscal injury or synovitis, and is usually seen in elderly patients.[4,9-11] The less common primary type is idiopathic and occurs in patients of a younger age group, between the second and third decades of life.[10,11] Laboratory tests such as erythrocyte sedimentation rate, rheumatoid factor and uric acid levels are normal in this condition. Similarly, the joint aspirate is usually negative for crystals, cells and bacterial growth. Gross specimen of lipoma arborescens typically shows a characteristic frond-like pattern, which on microscopy demonstrates papillary proliferation of synovial villi with substitution of subsynovial tissue by mature adipocytes (Fig. 1).[6,12]

## IMAGING FEATURES

Although radiography is of limited value in the diagnosis of lipoma arborescens, lucent areas may infrequently be evident in the periarticular soft tissue mass-like opacity (Figs. 2a & b), which may represent underlying prominent fatty projections of the lipoma arborescens.[6] More often, in most cases of knee joint involvement with associated background degenerative changes in the secondary form, radiographs demonstrate nonspecific fullness and soft tissue opacity in the suprapatellar pouch (Figs. 3a & b). In addition, a few negative radiographic findings such as the absence of sclerosis and articular surface erosions may be an important clue in the differential diagnosis with pigmented villonodular synovitis (PVNS) and gouty arthropathy.

On ultrasonography, the villous fatty projections of lipoma arborescens typically display a high echopattern, similar to that of adjacent subcutaneous fat, and may undulate in real time within the surrounding effusion. The mass is usually soft in consistency and compressible (Fig. 2c & d), as opposed to the firm and noncompressible masses of PVNS. Moreover, as ultrasonography is inexpensive, easily available and fairly accurate in determining the location and extent of lipoma arborescens in various synovial surfaces, it can be used in the initial diagnostic step before the application of more expensive cross-sectional imaging.[6,13]

Computed tomography, although rarely used in the evaluation of lipoma arborescens, may demonstrate characteristic fat density villous or frond-like projections that are interspersed in the surrounding soft tissue density synovial thickening and effusion of the involved joint (Figs. 2e & f).[6] The absence of high attenuation soft tissue and ossified loose bodies in the articular mass differentiate lipoma arborescens from closely mimicking PVNS and synovial osteochondromatosis, respectively. In addition, similar to that of radiographic findings, the absence of articular or juxta-articular bony erosions (Fig. 2g) may be an important negative feature that helps exclude the possibility of PVNS or gouty arthropathy.

Lipoma arborescens, like any other fat-containing lesion, generally displays a specific signal on MR imaging that distinguishes it from other intra-articular mass-like lesions. Therefore, MR imaging is considered the diagnostic modality of choice in the evaluation of this condition.[3-5] Lipoma arborescens shows high signal intensity villous or nodular foci on both T1- and T2-weighted images (Figs. 2h & i) that are suppressed on short tau inversion recovery (STIR) or fat saturation sequences (Fig. 2j), similar to that of any subcutaneous fat. The remaining non-fatty component of hypertrophied synovium in the condition displays heterogeneous high signal intensity on T2 or STIR sequences and intermediate-to-low signal intensity on T1-weighted sequences (Fig. 2h–j). The absence of susceptibility artefact related to haemorrhagic products on gradient imaging (Fig. 2k) differentiates this condition from PVNS, an otherwise closely mimicking entity.[5,6,12,14] On contrast administration, although the hypertrophied subsynovial fatty tissue does not enhance, the overlying thickened synovium often displays diffuse enhancement (Figs. 2l; 4d & e; 6d).

MR imaging may also demonstrate associated abnormalities such as joint effusion (Figs. 4, 5 & 6), which is seen in almost all cases at the time of presentation.[4,9] In addition, in the secondary type of lipoma arborescens, there may be background degenerative changes and meniscal tears (Fig. 3); this is not observed in the primary type (Fig. 4). The subsynovial fatty proliferation in lipoma arborescens usually attains one of three morphological patterns: (a) diffuse villous form, involving the entire hypertrophied synovium (Fig. 5); (b) focal nodular frond-like form (Fig. 6); or (c) a mixed form of the two aforementioned patterns (Fig. 7).[15]

Although lipoma arborescens is usually monoarticular, involvement of bilateral and multiple joints is not uncommon, particularly in the secondary forms (Figs. 3c & e).[2,9,16] Very rarely, lipoma arborescens may occur in extra-articular tissues of synovial origin, such as in the bursae and tendon sheaths (Figs. 2 & 8). These are usually idiopathic primary forms and have been previously reported in the subacromial bursa of the shoulder, in the bicipito-radial bursa, and along the ankle and radiocarpal periarticular tendon sheaths.[6,8,11,17]

## DIFFERENTIAL DIAGNOSIS

Clinically, any of the five classified subgroups of articular masses (i.e. noninfectious synovial proliferative lesions, infectious granulomatous conditions, depositional joint diseases or articular masses of neoplastic and vascular origin) can mimic lipoma arborescens.[5] Among these, synovial osteochondromatosis, PVNS, rheumatoid arthritis, tuberculous arthritis and gouty arthropathy are the most common differential diagnoses for this condition, which may pose a diagnostic dilemma, even on imaging.

However, many of these conditions have specific imaging features, particularly on MR imaging, which allows for a confident diagnosis when interpreted together with their presenting clinical features. The absence of bony erosion and sclerosis on radiographs, firm consistency of any periarticular soft tissue mass on sonography, high-density internal contents, the lack of articular surface erosion on computed tomography, and

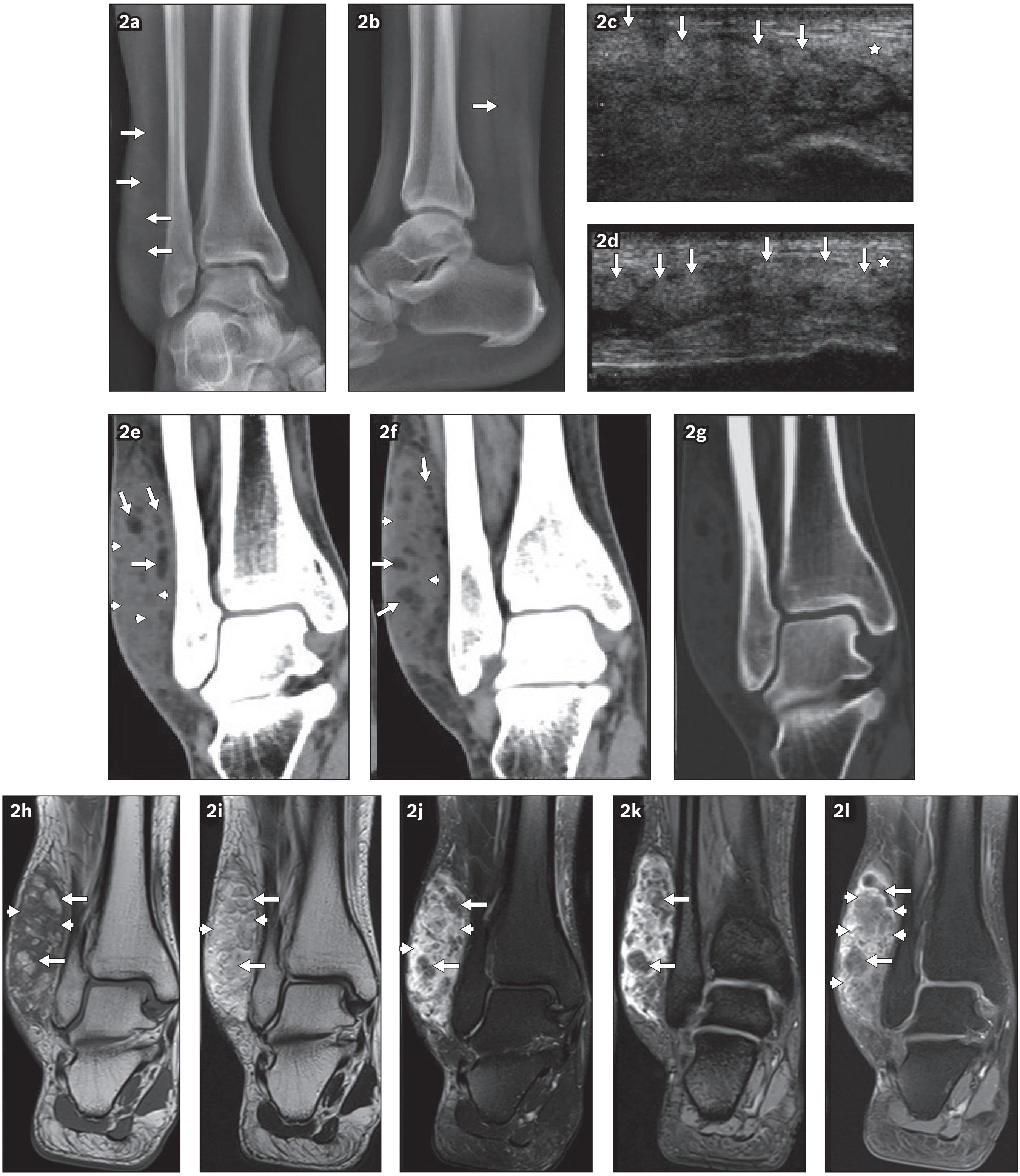


**Fig. 2** A 43-year-old woman with slowly progressive painless swelling along the lateral aspect of the right ankle joint. (a) Frontal and (b) lateral view radiographs of the ankle typically show lobulated soft tissue opacity on the lateral aspect that contains a few internal faint lucent foci (arrows), compatible with underlying prominent fatty projections. US images of the lesion (c) without and (d) with probe compression demonstrate soft consistency of the lesion (as opposed to the firm and noncompressible nature of pigmented villonodular synovitis [PVNS]), containing heterogeneous hyperechoic nodular areas (arrows) that are similar in echotexture with adjacent subcutaneous fat (star). Coronal reformatted CT images in (e & f) soft tissue and (g) bone windows reveal a lobulated mass at the lateral aspect of the ankle, containing several fat density nodular foci (arrows) interspersed in fluid or soft tissue density component (arrowheads). Note that there is an absence of bony or articular surface erosions in Fig. 2g, an important clue in the differential diagnosis for PVNS or gouty arthropathy. Coronal (h) T1, (i) T2 and (j) T2 fat-saturated MR images of the ankle display several nodular and villous fatty masses (arrows) within the lesion that are surrounded by a trace of effusion and hypertrophied synovium (arrowheads). (k) Coronal gradient image shows an absence of susceptibility artifact, which would indicate the lack of haemorrhagic products in the lesion. (l) Post-contrast T1 fat-saturated MR image of the lesion shows several non-enhancing fatty masses (arrows) with enhancing surrounding soft tissue/thickened synovium (arrowheads).

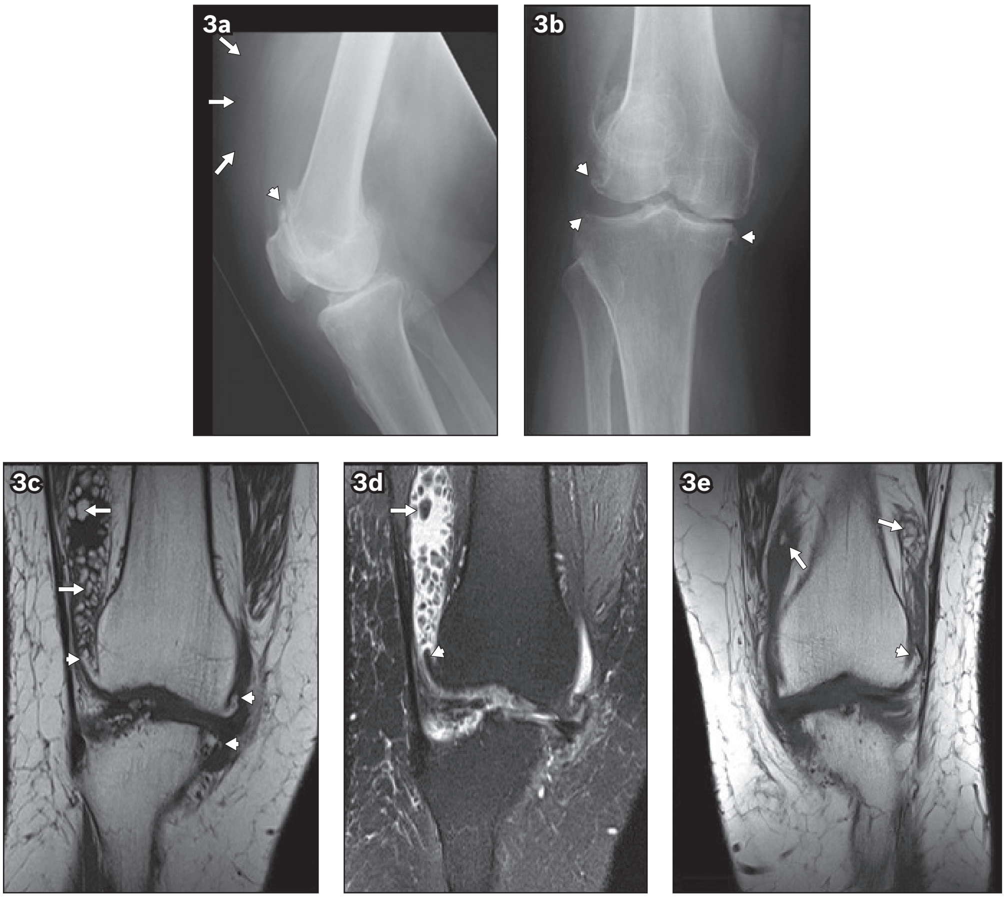


**Fig. 3** A 65-year-old woman with longstanding intermittent bilateral knee joint swelling and discomfort, which is more severe on the right side. (a) Frontal and (b) lateral view radiographs of the right knee joint show nonspecific suprapatellar fullness and a soft tissue, mass-like opacity (arrows) associated with marked background degenerative changes (arrowheads). Coronal (c) T1 and (d) T2 fat-saturated MR images of the right knee joint show the typical features of lipoma arborescens (arrows) with background degenerative changes in the form of marginal osteophytes (arrowheads), compatible with the secondary form of lipoma arborescens. (e) Coronal T1 MR image of the left knee joint also shows several intra-articular fatty villous projections, although to a lesser extent, in the suprapatellar bursa (arrows) associated with background degenerative changes (arrowhead), which is an example of multifocal secondary lipoma arborescens.

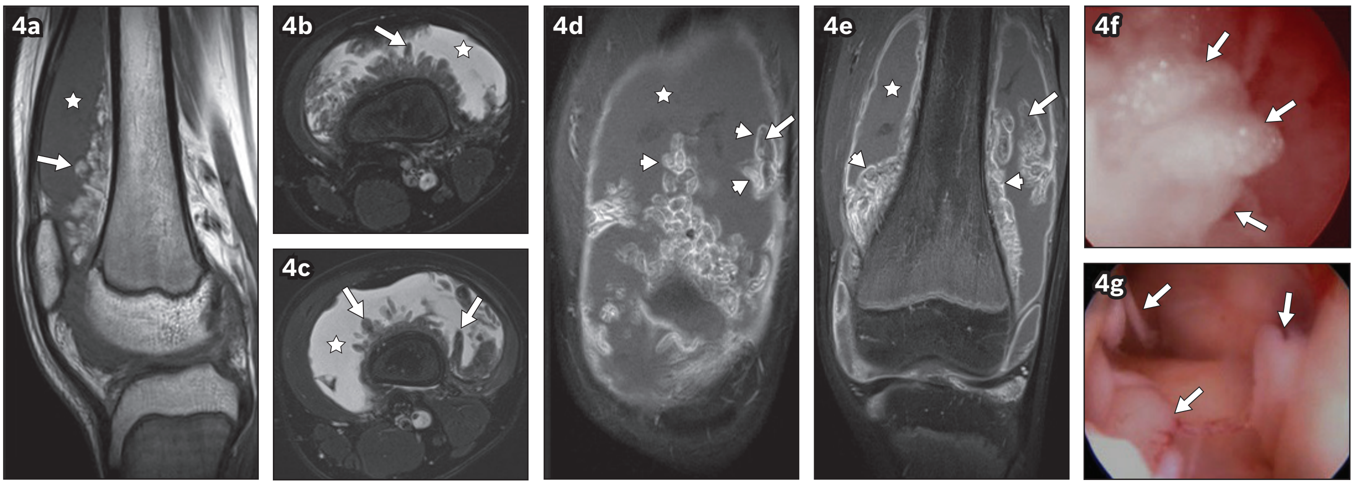


**Fig. 4** A 13-year-old boy with insidious onset of painless progressive left knee swelling that persisted for three years. (a) Sagittal T1 and (b & c) axial T2 fat-saturated MR images of the left knee show diffuse villous and frond-like intra-articular fatty masses (arrows) in the suprapatellar bursa with associated marked joint effusion (star). (d & e) Coronal post-contrast T1 fat-saturated images show non-enhancing fatty masses (arrow) and an enhancing overlying thickened synovium (arrowheads). The younger age of onset, absence of background degenerative change or meniscal/ligament tears in this patient are indicative of a primary form of lipoma arborescens. (f & g) Arthroscopic images of the affected knee joint demonstrate several villous and frond-like fatty projections (arrows) arising from the synovial lining.

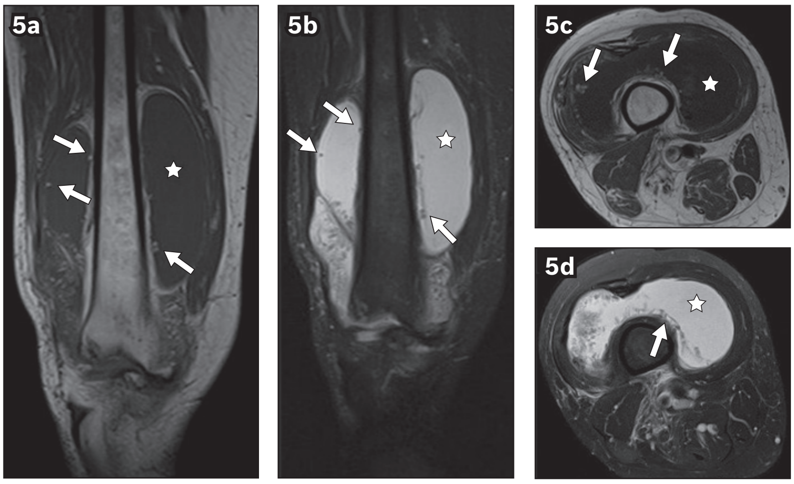


**Fig. 5** A 63-year-old woman with a longstanding history of intermittent swelling and pain in the right knee. Coronal and axial (a & c) T1 and (b & d) T2 fat-saturated MR images of the right knee show several tiny intra-articular fatty villous projections (arrows) scattered throughout the suprapatellar bursa, compatible with diffuse lipoma arborescens associated with background degenerative changes and large effusion (star).

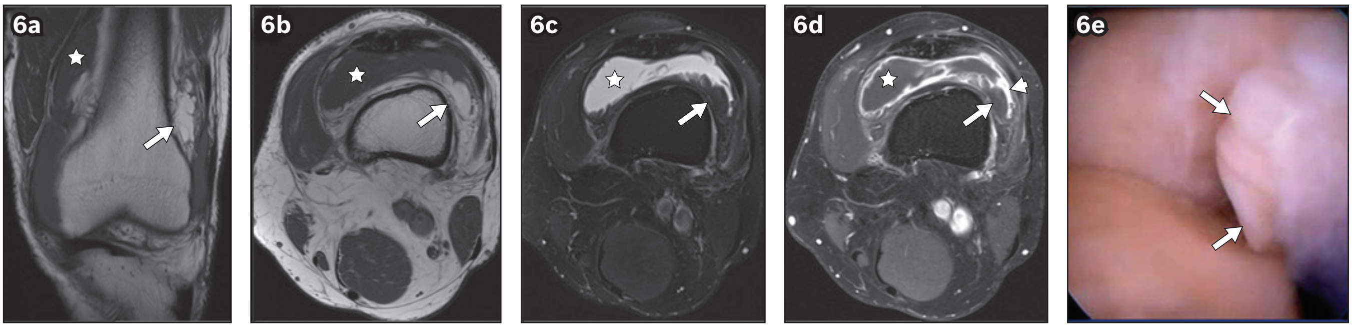


**Fig. 6** A 61-year-old man with chronic left knee pain and intermittent swelling. (a & b) Coronal and axial T1 and (c) axial T2 fat-saturated MR images of the left knee show a nodular frond-like intra-articular fatty mass (arrow) at the lateral aspect of the suprapatellar bursa with surrounding effusion (star), consistent with nodular lipoma arborescens. (d) Axial post-contrast T1 fat-saturated MR image also shows a typical non-enhancing fatty mass (arrow) and an enhancing overlying thickened synovium (arrowhead), which were confirmed on subsequent arthroscopy (e).

the absence of haemorrhagic products or susceptibility signal on MR imaging exclude the possibility of PVNS. On the other hand, the absence of typical juxta-articular bony erosions and calcified soft tissue masses, together with negative laboratory findings such as a lack of crystals in the joint aspirate, would be helpful in ruling out gouty arthropathy. Similarly, the absence of typical cartilaginous or ossified loose bodies in the swollen joint excludes the possibility of synovial osteochondromatosis. Infective lesions such as tuberculous arthritis can be ruled out based on clinical presentation, specific imaging and laboratory findings. In cases of doubt, an arthroscopic examination could be performed to directly visualise the lesion (Figs. 4f & g; 6e; 7e & f), obtain tissue sampling for histopathological correlation and treat any underlying precipitating condition.

## TREATMENT AND PROGNOSIS

Lipoma arborescens is a benign indolent condition, which does not require aggressive surgical treatment unless symptomatic despite conservative management. The primary treatment of lipoma arborescens should be directed toward mitigating any underlying precipitating condition, so as to reduce further progression of secondary lipoma arborescens and its associated symptoms. However, in advanced primary cases and difficult cases of secondary lipoma arborescens, surgery can be considered. The surgical treatment of choice for lipoma arborescens is either open or arthroscopic synovectomy. The latter is minimally invasive and able to facilitate early post-operative recovery. Recurrence after synovectomy is uncommon. Rare extra-articular lipoma arborescence can be treated by open surgical excision, similar to that for any other benign periarticular mass.[17]

## CONCLUSION

Lipoma arborescens is a benign indolent synovial proliferative disease and an uncommon cause of articular masses. It primarily involves the knee joint, with rare occurrences in the periarticular bursae and tendon sheaths. This entity can be confidently diagnosed by its characteristic features on various imaging modalities, particularly MR imaging. Awareness of its clinical and imaging findings and possible differential diagnoses is essential for early diagnosis and treatment, as well as to avoid misinterpretation of this condition as other aggressive articular masses.

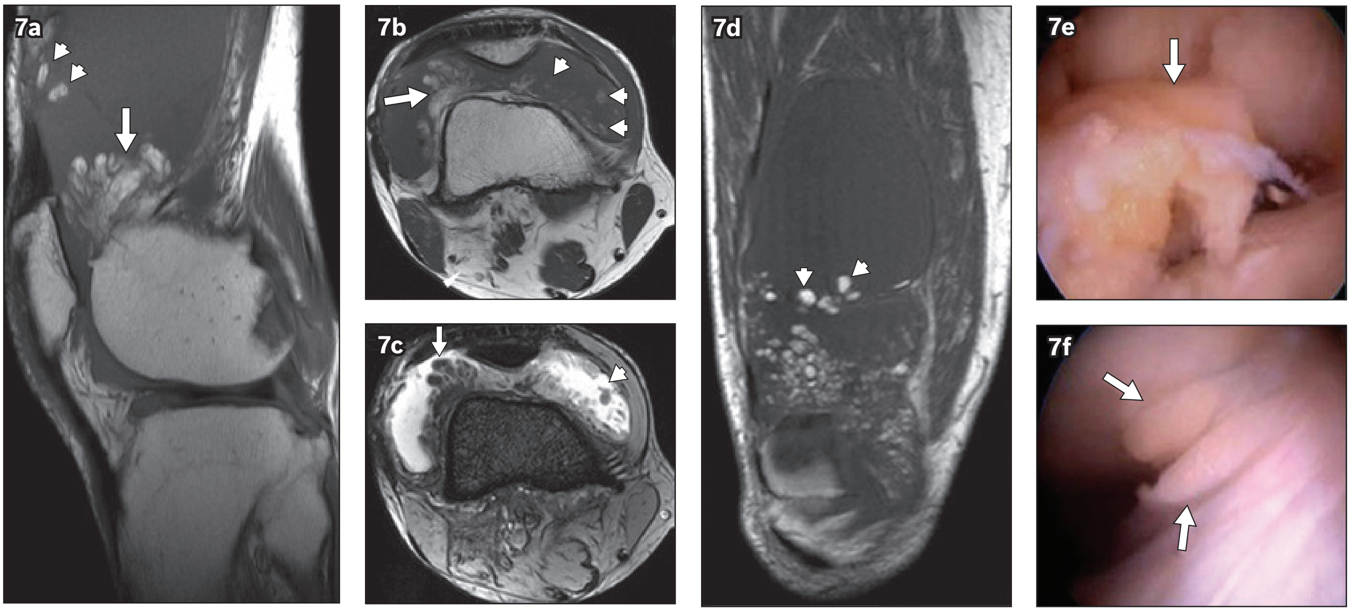


**Fig. 7** A 59-year-old woman with longstanding intermittent joint swelling and low-grade pain in the left knee. (a, b & d) Sagittal, axial and coronal T1; and (c) axial T2 fat-saturated MR images of the left knee show an intra-articular frond-like fatty mass (arrow) in addition to several scattered fatty villous projections (arrowheads) in the suprapatellar bursa, consistent with a mixed morphologic pattern of lipoma arborescens. Arthroscopy of the concerned knee joint correspondingly demonstrates (e) a nodular fatty mass, and (f) a few scattered villous projections in the suprapatellar fossa.

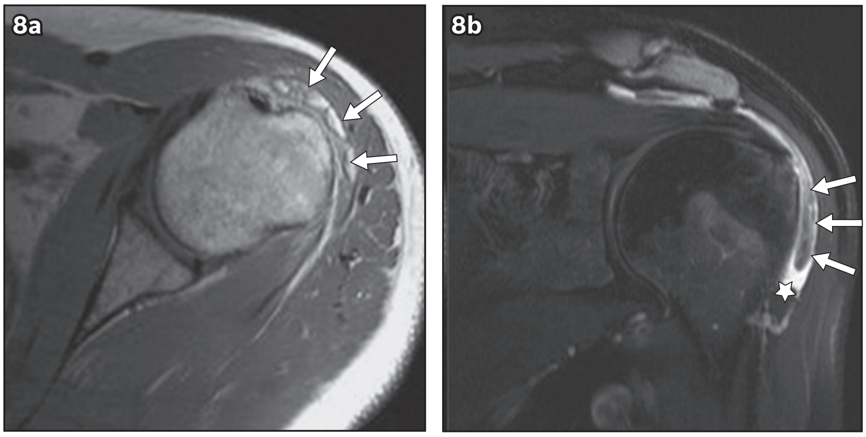


**Fig. 8** A 45-year-old woman with longstanding right shoulder joint discomfort. (a) Axial T1 and (b) coronal T2 fat-saturated MR images of the shoulder joint show a lobulated fatty mass in the subacromial-subdeltoid bursa (arrows) associated with a small effusion (star), consistent with extra-articular lipoma arborescens.

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# SINGAPORE MEDICAL COUNCIL CATEGORY 3B CME PROGRAMME

*(Code SMJ 201401A)*

| | True | False |
|---|---|---|
| **Question 1.** Regarding the clinical features of lipoma arborescens: | | |
| (a) It can be bilateral or multifocal. | ☐ | ☐ |
| (b) The knee joint is the most common site of involvement. | ☐ | ☐ |
| (c) Extra-articular involvement excludes the diagnosis of lipoma arborescens. | ☐ | ☐ |
| (d) The primary form is the most common. | ☐ | ☐ |
| **Question 2.** Regarding magnetic resonance (MR) imaging of lipoma arborescens: | | |
| (a) MR imaging is considered the diagnostic modality of choice. | ☐ | ☐ |
| (b) The lesion typically shows high signal intensity villous foci on both T1 and T2 sequences that are suppressed on fat saturation sequences. | ☐ | ☐ |
| (c) It demonstrates susceptibility artifact on gradient imaging. | ☐ | ☐ |
| (d) Contrast administration shows non-enhancing fatty foci with enhancing overlying thickened synovium. | ☐ | ☐ |
| **Question 3.** Regarding imaging of lipoma arborescens: | | |
| (a) The lesion is soft in consistency and compressible with an ultrasonography probe. | ☐ | ☐ |
| (b) Underlying fatty projections of the lesion are frequently demonstrated on radiographs as faint lucent foci. | ☐ | ☐ |
| (c) Bony or articular erosion is an established feature of lipoma arborescens. | ☐ | ☐ |
| (d) Joint effusion is seen in almost all patients at the time of presentation. | ☐ | ☐ |
| **Question 4.** Regarding imaging of lipoma arborescens: | | |
| (a) Ultrasonography can be used in the initial diagnostic step before the use of more expensive cross-sectional imaging. | ☐ | ☐ |
| (b) The villous fatty projections of lipoma arborescens typically display a high echopattern and may undulate in real time ultrasonography. | ☐ | ☐ |
| (c) Computed tomography shows high attenuation soft tissue and ossified loose bodies. | ☐ | ☐ |
| (d) Radiography and computed tomography have limited role in its diagnosis. | ☐ | ☐ |
| **Question 5.** Regarding the management of lipoma arborescens: | | |
| (a) Surgical excision is the treatment of choice in most cases. | ☐ | ☐ |
| (b) Advanced or difficult cases can be treated by arthroscopic synovectomy. | ☐ | ☐ |
| (c) The primary treatment should be directed toward mitigating any underlying precipitating condition. | ☐ | ☐ |
| (d) Rare extra-articular lesions are usually idiopathic primary forms and can be treated by open surgical excision. | ☐ | ☐ |

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