Disorders of Synovium and Plica

11

11.1 Pigmented Villonodular Synovitis (PVS)

- Villous and nodular synovial proliferative disease.
- Cause is unknown, but is thought to be related to inflammation and fatty acid metabolism disorder.
- Common in young persons (20–40 years old).
- Commonly affects large joints and the knee is the most common site.
- Usually takes a monoarticular form.
- It can be classified into localized type (Fig. 11.1) in which localized synovial masses form, and diffuse type (Fig. 11.2) in which there is diffuse synovial proliferation with some nodules.
- The lesion may erode into the bone and form a cyst-like lesion.
- Clinically, the disorder is characterized by joint swelling with no known trigger, and joint aspirates contain blood.

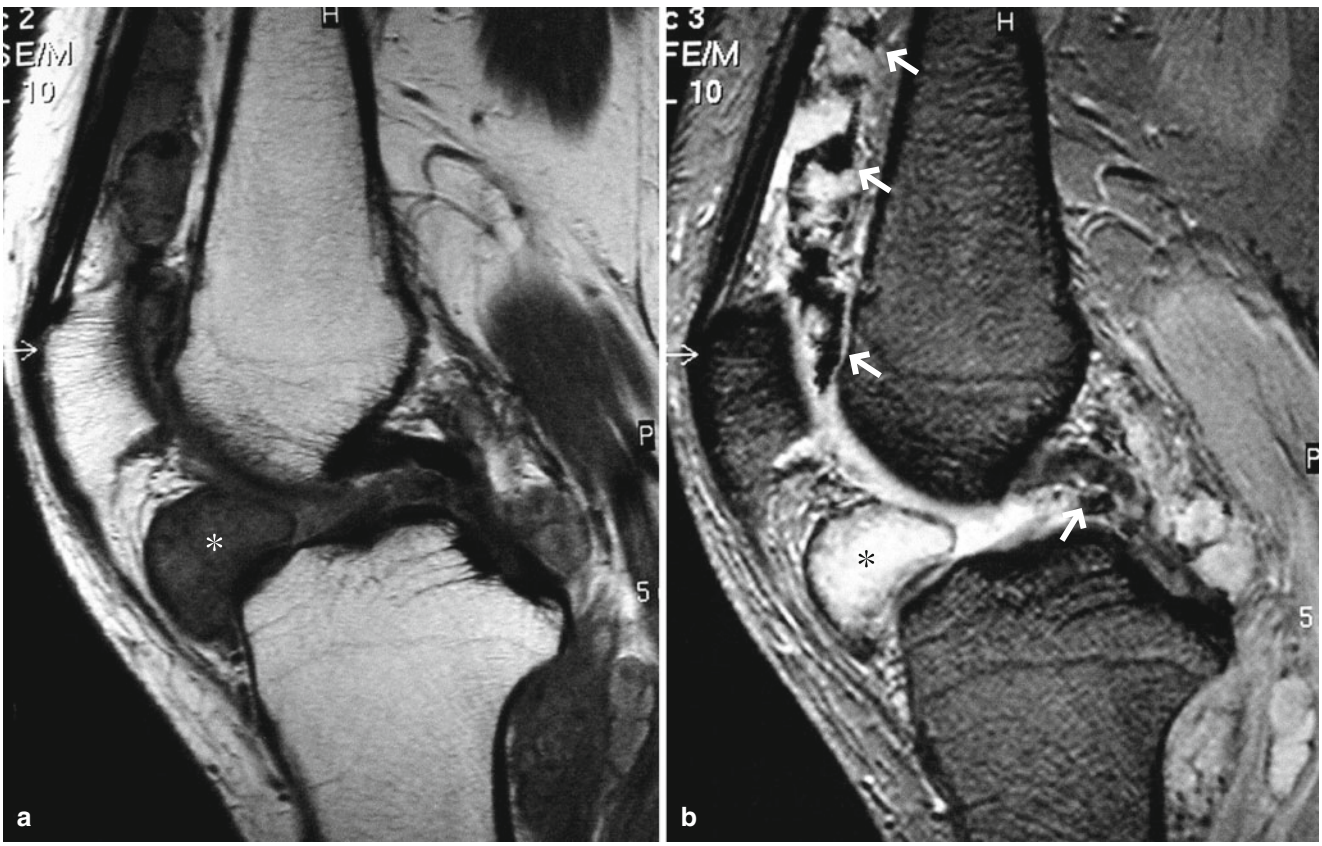

Fig. 11.1 Pigmented villonodular synovitis, localized type. A man in his 50s. (**a**) PDWI, (**b**) T2*WI, and (**c**) intraoperative photo. There is a mass lesion eroding into the Hoffa's fat pad (*). Within the joint space, there is synovial proliferation with hemosiderin deposition showing hypointensity (*arrows*). The mass lesion had a *yellowish* color and proliferated synovium contains *black* spots representing bleeding (*arrowheads*)

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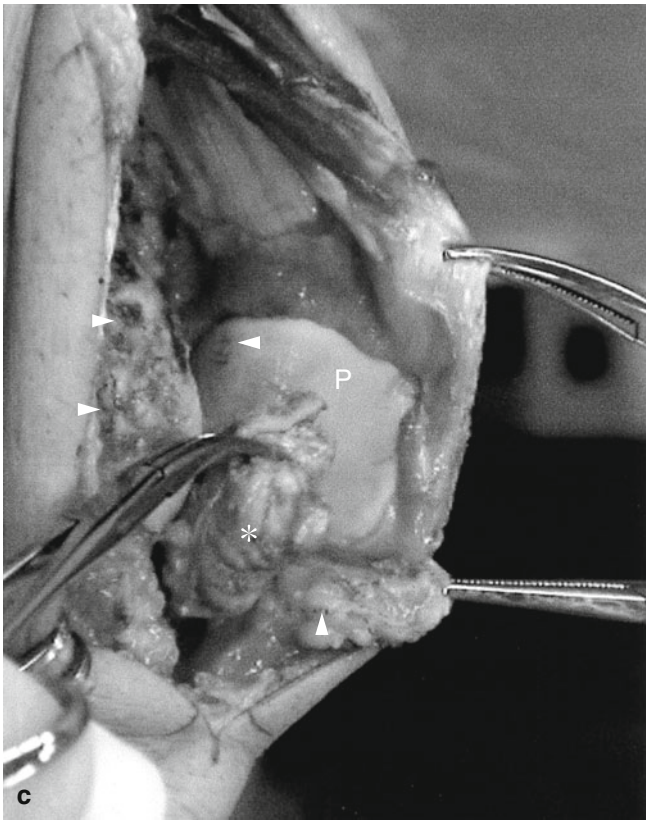

Fig. 11.1 (continued)

- Treatment is surgical removal, but if it is not completely removed, recurrence commonly occurs. It is therefore important to search for the full extent of the lesion on MRI.

Key points for MRI interpretation

- Joint space is filled by soft tissue due to synovial proliferation. Gadolinium contrast-enhanced MRI shows strong enhancement of the proliferated synovium. Due to hemosiderin deposition, the lesion shows hypointensity on T2-weighted image, particularly when gradient echo sequence (which is affected by susceptibility artifact) is used.

Reference

Narváez JA, Narváez J, Aguilera C, et al. MR imaging of synovial tumors and tumor-like lesions. Eur Radiol. 2001;11:2549–60.

11.2 Giant Cell Tumor of Tendon Sheath

- This is histologically identical to PVS described in the previous section.
- It mostly arises in the tendon sheath. In the knee joint, it commonly arises adjacent to the joint capsule.
- In old days it was called "xanthoma."

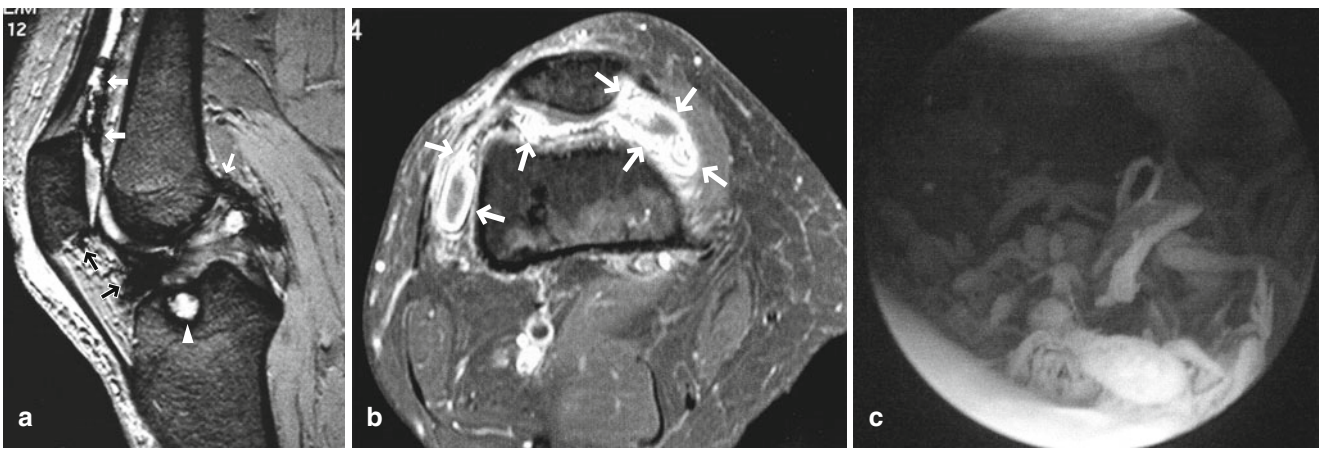

Fig. 11.2 Pigmented villonodular synovitis, diffuse type. A woman in her 50s. (**a**) T2*WI, (**b**) axial FS postcontrast T1WI, and (**c**) arthroscopic image. Within the joint space including the posterior joint capsule, there is diffuse synovial proliferation which shows hypointensity on T2*WI (*arrows*). There is a cystic change in the tibial plateau due to erosion of the synovium (*arrowhead*). Proliferated synovium shows strong enhancement after gadolinium injection. Arthroscopically, proliferated synovium has a villous appearance

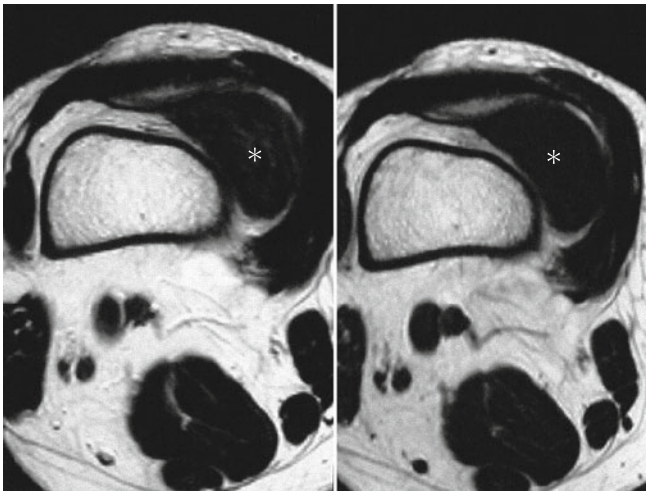

Fig. 11.3 Giant cell tumor of tendon sheath. A woman in her 50s. Axial T2WI (*left*) and T1WI (*right*). There is a mass lesion (*) which generally shows hypointensity with some faint hyperintense component on T2WI adjacent to the suprapatellar bursa. Histologically, it is proliferated synovium, which is identical to that found in PVS

11.3 Synovial Osteochondromatosis

- It is a benign condition of unknown etiology characterized by synovial nodular proliferation containing cartilaginous and osseous components.
- Common in young to middle-aged persons.
- Knee, hip, and elbow joints are most commonly affected.
- Chondroma may grow into the joint space, and fragments may break off from the synovial surface into the joint, where they may enlarge, calcify, or ossify. Appearance of such loose fragments resembles that of rice bodies seen in rheumatoid arthritis.
- Intra-articular proliferation of osteochondroma and multiple loose fragments causes widening of the joint space and overall swelling of the joint.
- Erosion of bone cortex may be seen.
- Usually monoarticular.
- If loose fragments ossify or calcify, they can be visualized on radiograph. However, this is only the case in 30–40% of cases.
- Clinically, patients initially have dull pain and swelling due to joint effusion. When loose fragments drop into the joint space, range of movement of the affected joint becomes limited and may eventually lead to osteoarthritis. Synovial proliferation is said to cease spontaneously.
- Treatment includes excision of proliferated synovium and removal of loose fragments under arthroscopy. If complete removal is not possible arthroscopically, open surgery is required. If actively proliferating synovium is not completely removed, postoperative recurrence may occur, but prognosis is good in general.

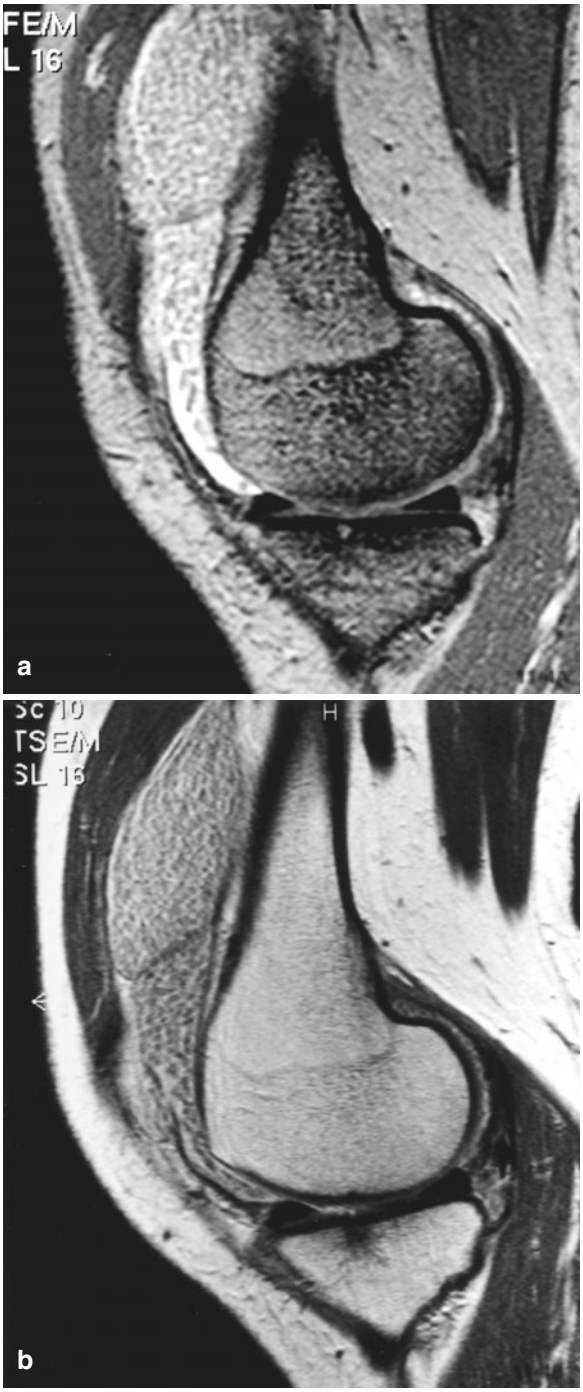

Fig. 11.4 Synovial chondromatosis. A woman in her 30s. T2*WI with MTC, (**b**) sagittal postcontrast T1WI taken 2 h after gadolinium injection, and (**c**) excised surgical specimen. Within the joint capsule, there are numerous micronodules that show signal intensity similar to that of articular cartilage (**a**). Contrast between the nodules and joint fluid can be obtained by using either MTC technique (**a**) or contrast-enhanced MRI (**b**) in which gadolinium diffuses into the joint fluid in a late phase. Proliferating synovium and loose fragments were excised arthroscopically. Numerous rice body-like micronodules (a few millimeters in size) were removed from the joint space. In this case, radiograph and CT did not reveal any ossified components, and diagnosis of synovial chondromatosis was made

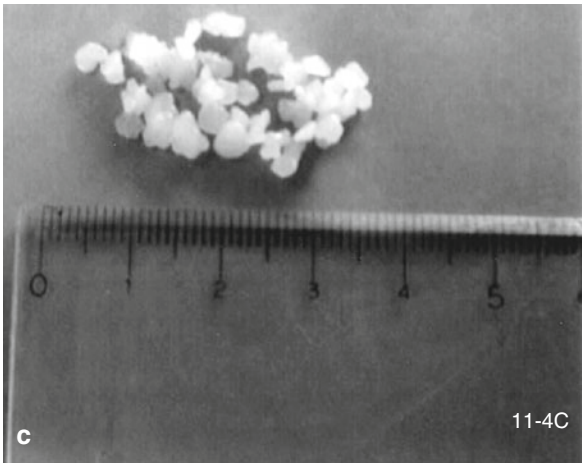

Fig. 11.4 (continued)

Key points for MRI interpretation

- Intra-articular soft tissue due to proliferation of osteochondroma is seen.
- Large osteochondroma may show heterogeneous signal intensities and may include signal void corresponding to ossified component.
- Cartilaginous component shows signal intensity similar to that of articular cartilage.
- If sufficient contrast between the cartilaginous component and joint effusion cannot be obtained, MTC technique should be applied.

Reference

Narváez JA, Narváez J, Ortega R, De Lama E, Roca Y, Vidal N. Hypointense synovial lesions on T2-weighted images: differential diagnosis with pathologic correlation. AJR. 2003;181:761–9.

11.4 Synovial Hemangioma

- Synovial hemangioma arising within the knee joint is rare.
- Histologically, it is commonly a cavernous hemangioma, or a mixture of cavernous and capillary hemangioma.
- Common in young persons.
- Repetitive intra-articular hemorrhage cause knee swelling, pain, and restricted range of motion.
- Radiograph may reveal a phlebolith.

Key points for MRI interpretation

- It shows characteristic of strong hyperintensity on T2-weighted image.
- It shows strong enhancement following gadolinium injection.
- The presence of hypointensity on T2*-weighted image reflects the hemosiderin deposition following repetitive hemarthrosis.

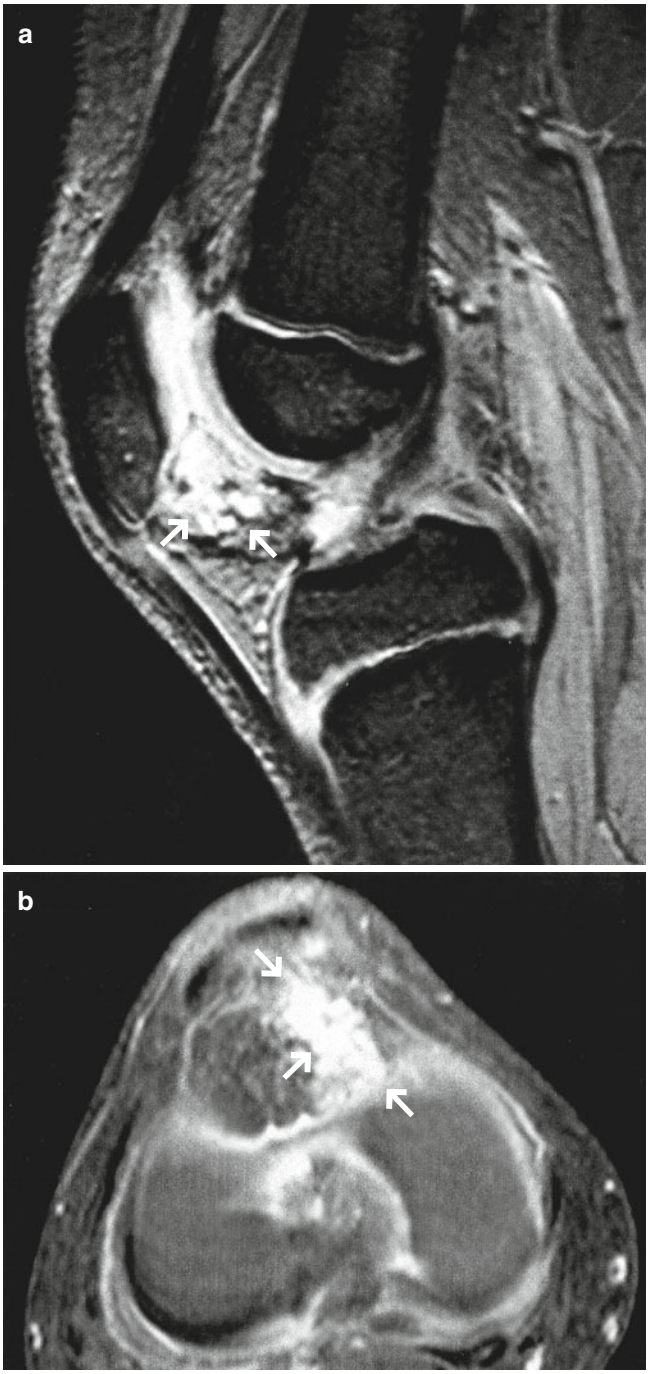

Fig. 11.5 **Synovial hemangioma**. An 8-year-old girl with history of recurrent hemarthrosis. (**a**) T2*WI and (**b**) axial gadolinium-enhanced FS T1WI. There is a multilocular mass showing hyperintensity on T2*WI eroding into Hoffa's fat pad (*arrows*, **a**). The lesion shows strong enhancement after gadolinium injection (*arrows*, **b**)

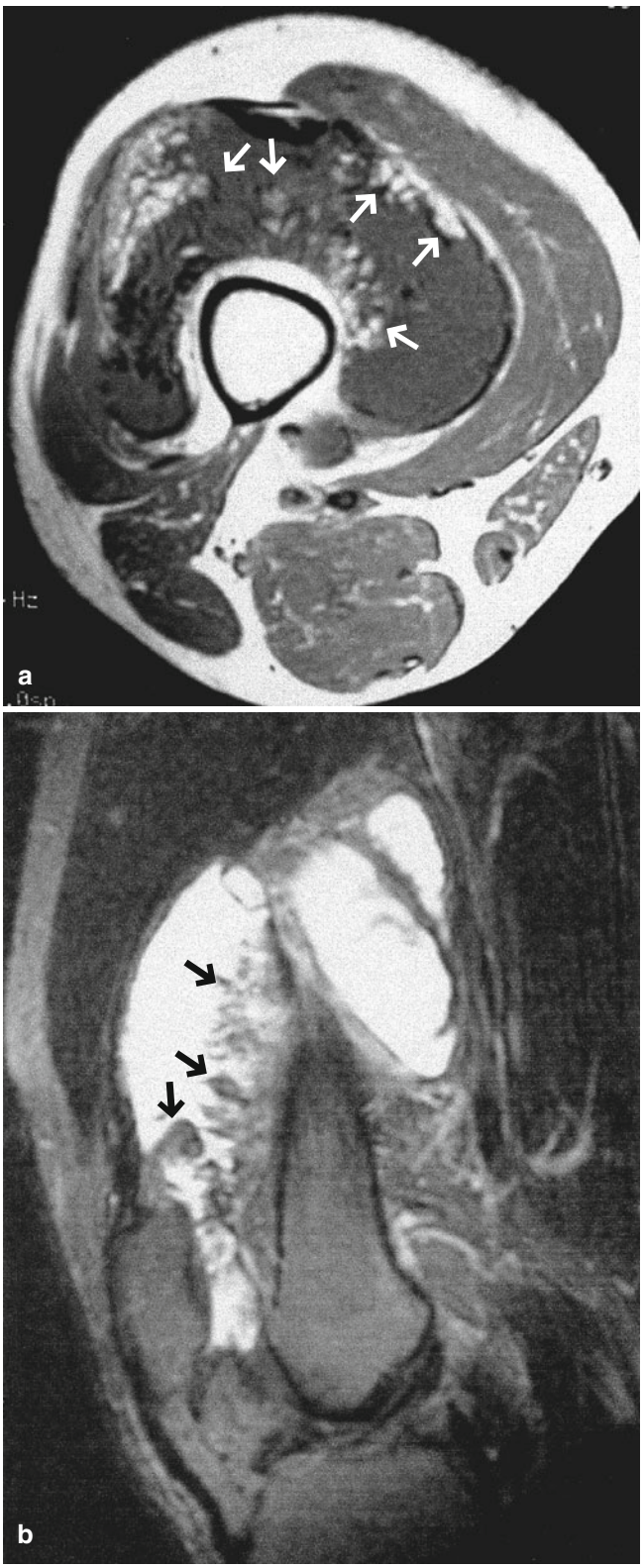

Fig. 11.6 Lipoma arborescens. A man in his 30s. (**a**) Axial T1WI and (**b**) FS T2WI. Synovial tissue showing villous proliferation contains numerous microlipomas and shows arborescent architecture (*arrows*). Severe joint effusion is noted (Images courtesy of Dr. Shigeru Ehara, Department of Radiology, Iwate Medical University)

11.5 Lipoma Arborescens

- Lipomatous proliferation of synovium.
- Synovial tissue showing villous proliferation contains numerous microlipomas and shows arborescent architecture.
- Also called diffuse synovial lipoma.
- Most commonly affect the knee unilaterally.
- Suprapatellar bursa is the primary location of this lesion.
- It is said to occur as a reactive change to chronic arthritis.
- It resembles PVS, but it can be differentiated from PVS by the fact that it has mainly lipomatous component, little hemosiderin deposition, and little bone changes such as erosion.
- Rarely, lipoma may arise within Hoffa's fat pad.

Reference

Feller JF, Rishi M, Hughes EC. Lipoma arborescens of the knee: MR demonstration. AJR. 1994;163:162–4.

11.6 Hoffa's Syndrome

- It is a general term referring to diseased state of Hoffa's fat pad due to mechanical stimulus or inflammation.
- Hoffa's disease refers to impingement of the Hoffa's fat pad, which is swollen following traumatic injury including hemorrhage, between the femur and the tibia.
- It is caused by a direct blow to the anterior aspect of the knee or repetitive mechanical stimulus.
- At acute stage, there is swelling due to edema and hematoma and point tenderness (Fig. 11.7). Hematoma shows heterogeneous signal intensity on MRI.
- At chronic stage, fibrous proliferation and limitation in the range of motion are added (Fig. 11.8). Hypointensity on T2-weighted images, representing fibrous changes as well as hemosiderin deposition, may be seen. Cystic changes and calcification of the fibrotic foci may also be seen.
- Hoffa's fat pad ganglion may cause limitation in the range of motion. This is also considered as Hoffa's syndrome (Fig. 11.9). However, it has to be differentiated from meniscal cysts that extend into Hoffa's fat pad (see Chap. 12).

Reference

Jacobson JA, Lenchik L, Ruhoy MK, Schweitzer ME, Resnick D. MR imaging of the infrapatellar fat pad of Hoffa. Radiographics. 1997;17:675–91.

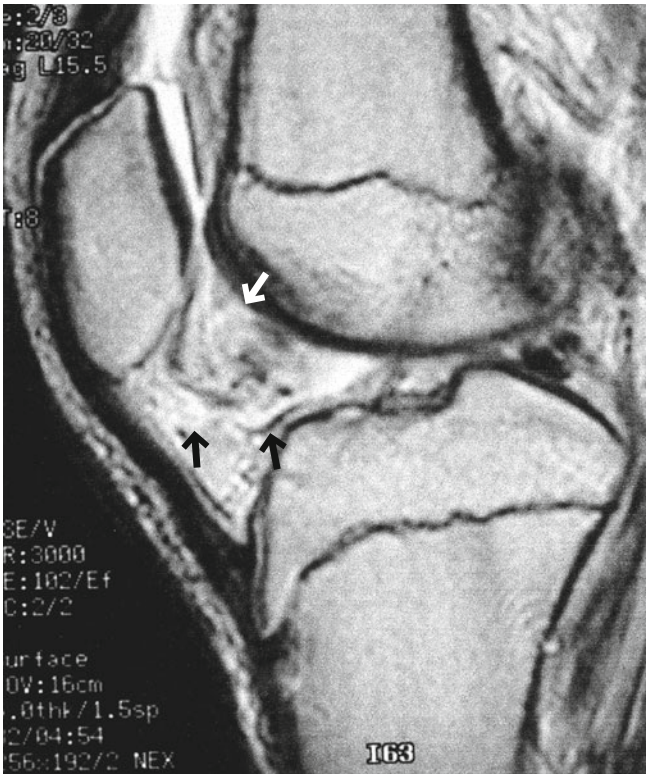

Fig. 11.7 Hoffa's syndrome. A 14-year-old boy with Reiter's syndrome. T2WI shows signal abnormality within the Hoffa's fat pad due to inflammation and swelling (Image courtesy of Dr. Shigeru Ehara, Department of Radiology, Iwate Medical University, Japan)

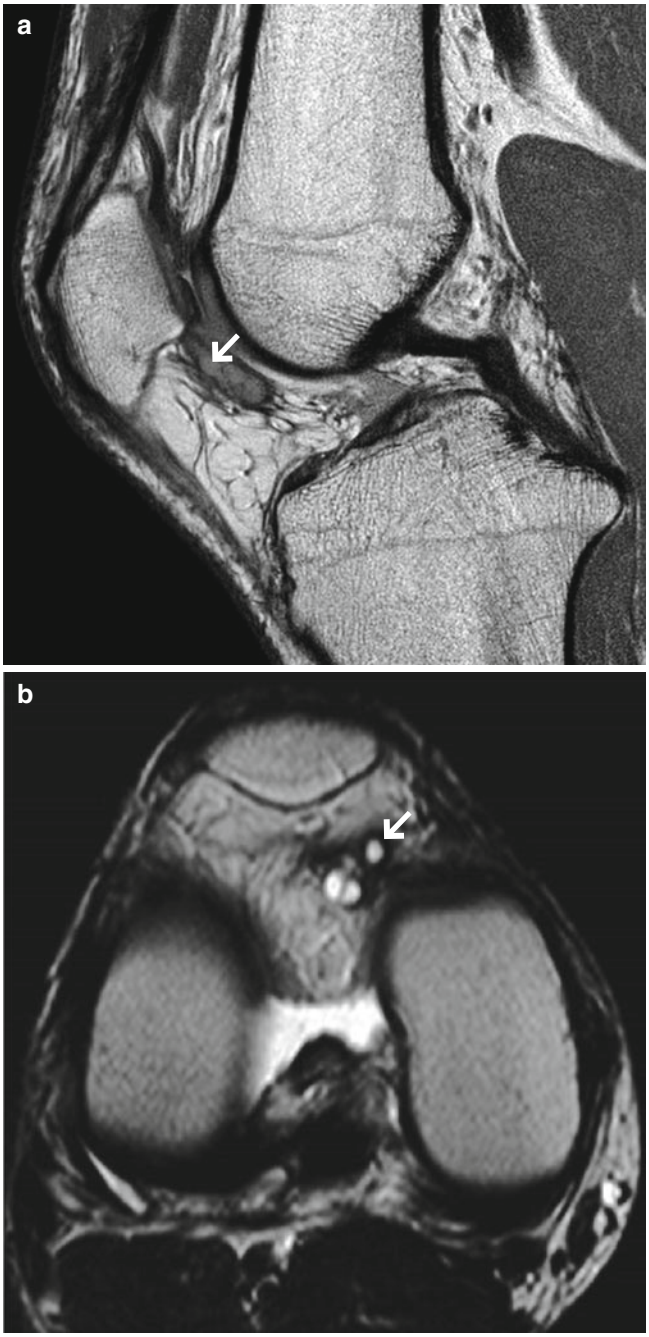

Fig. 11.8 Hoffa's syndrome. A man in his twenties, a keen soccer player. (**a**) PDWI and (**b**) axial T2WI. A portion of Hoffa's fat pad immediately posterior to the inferior pole of the patella shows a cystic change together with fibrous proliferation (*arrows*). Similar findings were seen in the contralateral knee

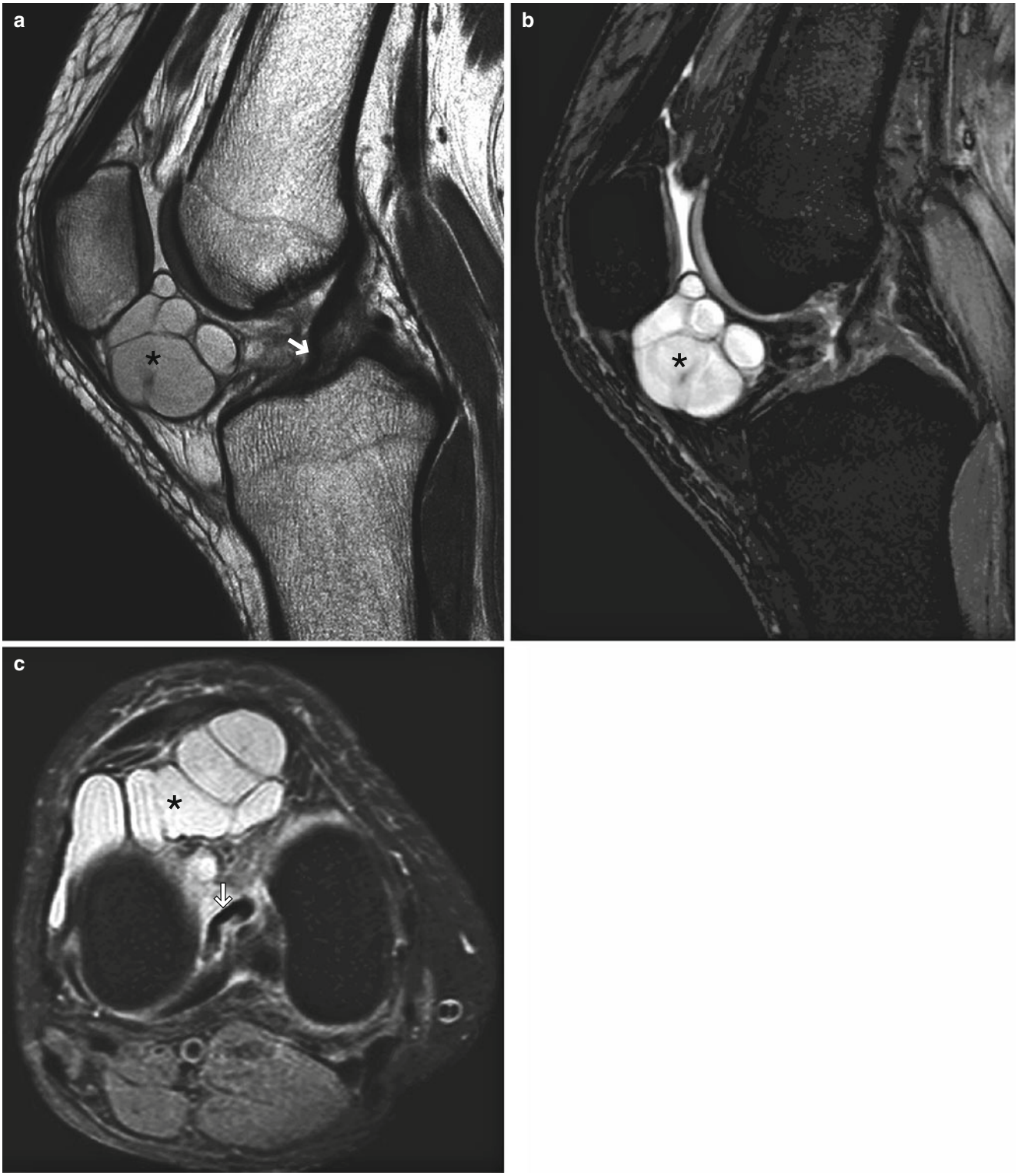

Fig. 11.9 Hoffa's fat pad ganglion. A woman in her 30s presenting with pain on knee extension. (**a**) PDWI, (**b**) FS T2*WI, and (**c**) axial FS PDWI. There is a large septated cystic lesion (*), and ACL is compressed toward posterior direction (*arrow*) (Images courtesy of Dr. Koichi Sato, Sato Orthopaedic Clinic, Japan)

Patellar tendon-lateral femoral condyle friction syndrome

- Localized injury to the superolateral aspect of the Hoffa's fat pad.
- It is said to be caused by impingement between the patellar tendon (patella) and the lateral femoral condyle, but the exact cause is unknown.
- Commonly seen in patients with patella alta and abnormally shaped patella (Wrisberg type III), and thus functional patellofemoral malalignment may be a cause.
- Chronic localized pain in the anterolateral aspect of the knee, which worsens on knee extension.
- Relatively common in young women.
- On MRI, the lesion located in the superolateral aspect of the Hoffa's fat pad shows hypointensity on T1-weighted image and hyperintensity on fat-suppressed T2-weighted image. There may be associated signal abnormalities within the patellar tendon and patella.

What Is Hoffa's Fat Pad?

Fatty tissue that occupies the anterior aspect of the knee just below the patella.

It is an intra-articular, extrasynovial structure (same as ACL and PCL).

It occupies the space created anteriorly by the joint capsule, patellar tendon, and the inferior pole of the patella, and posteriorly synovium-lined joint cavity, femur, and tibia form the posterior.

Infrapatellar plica (ligamentum mucosum) connects the posterior border of Hoffa's fat pad and the intercondylar space.

Inferiorly, it touches the anterior horn of the lateral meniscus and the tibial surface.

Mostly composed of adipose tissue, but also contains fibrous bands and septum-like structures as well as a network of blood vessels.

It is crossed by the transverse ligament which connects the anterior horns of the medial and lateral menisci.

Reference

Chung CB, Skaf A, Roger B, Campos J, Stump X, Resnick D. Patellar tendon-lateral femoral condyle friction syndrome: MR imaging in 42 patients. Skeletal Radiol. 2001;30:694–7.

Fig. 11.10 Patellar tendon-lateral femoral condyle friction syndrome. A man in his 30s who had 10-year history of anterior knee pain. (**a**) FS T2*WI, (**b**) axial T1WI, and (**c**) axial FS PDWI. There is a localized area showing hypointensity on T1WI and hyperintensity on FS T2WI in the superolateral aspect of the Hoffa's fat pad (*arrows*). Mild swelling of the affected part is noted

11.7 Amyloidosis

- Long-term dialysis treatment for renal failure leads to deposition of amyloid in the synovium and articular cartilage in the knee.
- It is mainly composed of β_2-microglobulin.
- Commonly affects the knee, shoulder, hip and wrist.
- Affected joint shows severe swelling because of amyloid deposition.
- Bone erosion and subchondral cysts occur.
- Usually affects bilateral joints.

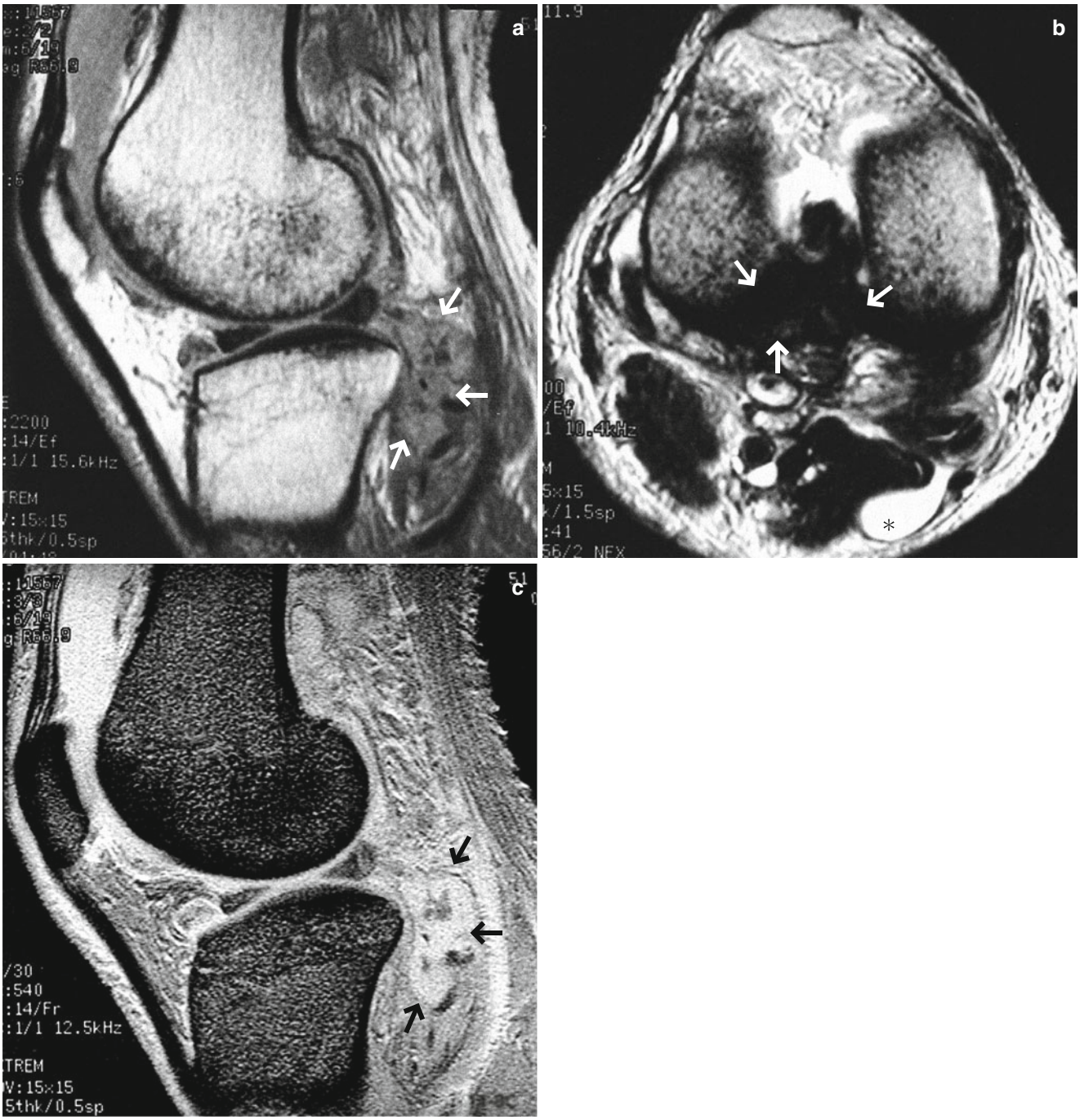

Fig. 11.11 **Amyloidosis**. A man in his 50s who had a long-term dialysis therapy. (**a**) PDWI, (**b**) axial T2WI, and (**c**) T2*WI. Severe joint effusion is noted. In the posteroinferior joint space, there is a mass-like lesion (amyloid deposition) which shows hypointensity on T2WI (*arrows*). However, it does not show strong hypointensity which is characteristic to hemosiderin deposition seen in PVS. * popliteal cyst

Table 11.1 Comparison between PVS and amyloidosis

	PVS	Amyloidosis
Deposition	Hemosiderin	β_2-microglobulin
T1-weighted image	Hypointensity	Hypointensity
T2-weighted image	Hypointensity	Hypointensity
T2*-weighted image (gradient echo)	Hypointensity (close to signal void)	Slightly low to intermediate signal intensity

Key points for MRI interpretation

- Amyloid deposition shows hypointensity on both T1- and T2-weighted image (which is similar to PVS).
- Amyloid deposition contains little hemorrhagic component, and it does not show strong hypointensity on T2*-weighted image which is characteristic of PVS (Table 11.1).

11.8 Plica Syndrome

- A plica is a remnant of an embryonic partition in the knee.
- Suprapatellar plica, mediopatellar plica, and infrapatellar plica are most commonly seen (Fig. 11.12).
- It is a normal structure which is thin and flexible, and thus its presence itself does not cause clinical problems. Arthroscopically, it is seen as a white membrane-like structure. If it is subjected to repeated mechanical stimuli, reactive synovitis may occur, causing thickening and scarring of the plica and clinical symptoms.

Reference

Boles CA, Martin DF. Synovial plicae in the knee. AJR. 2001; 177:221–7.

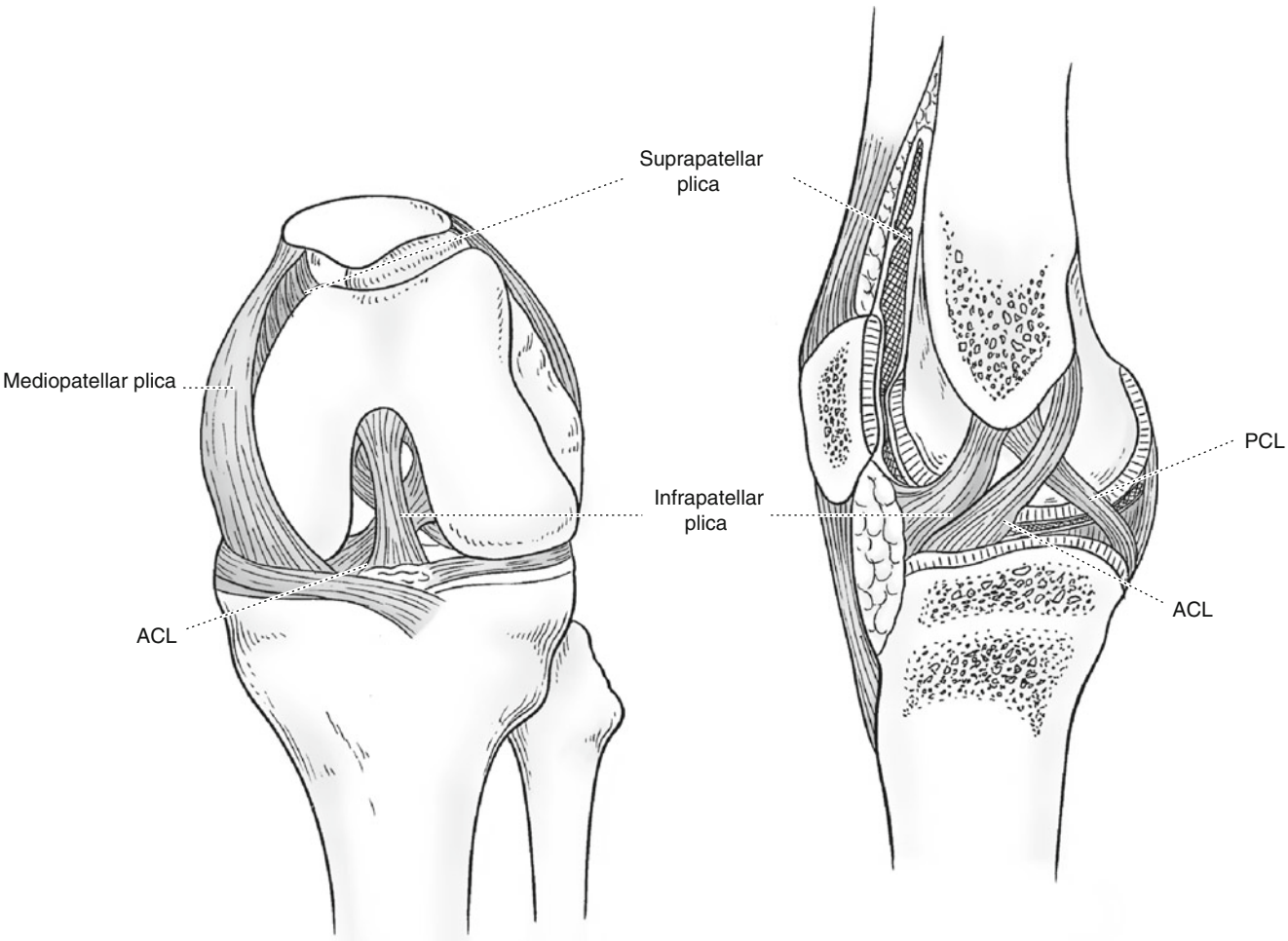

Fig. 11.12 **Knee plica**. Suprapatellar plica, mediopatellar plica, and infrapatellar plica are most commonly seen

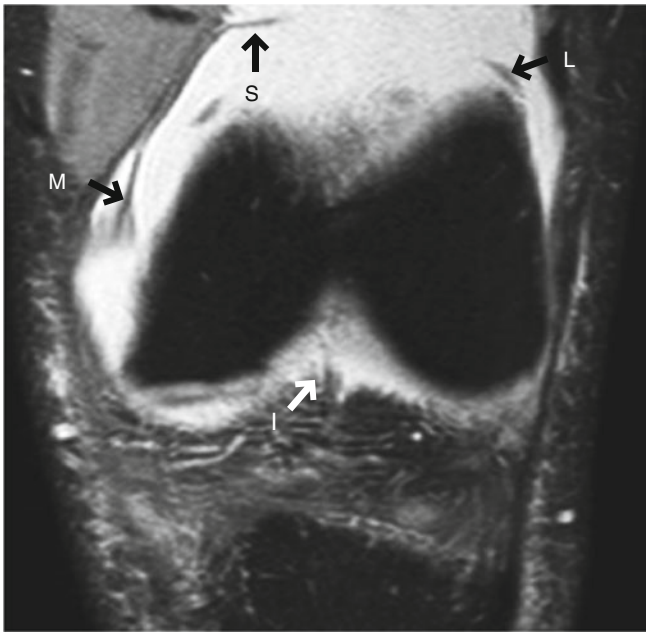

Fig. 11.13 Coronal FS PDWI of knee plicae. The presence of joint effusion enables visualization of suprapatellar plica (*S*), mediopatellar plica (*M*), infrapatellar plica (*I*), and lateropatellar plica (*L*) in this example

11.8.1 Suprapatellar Plica

- It is present in almost all normal knees and separates suprapatellar bursa and the knee joint space (Fig. 11.14).
- If the suprapatellar plica becomes enlarged, it may close off the communication between the suprapatellar bursa and the knee joint space. In this state, if trauma, inflammation, or hemorrhage occurs, fluid collection in the suprapatellar bursa becomes significantly worse and a subcutaneous mass may be palpable just superior to the patella (Fig. 11.15).

Reference

Trout TE, Bock H, Resnick D. Suprapatellar plicae of the knee presenting as a soft-tissue mass. Report of five patients. Clin Imaging. 1996;20:55–9.

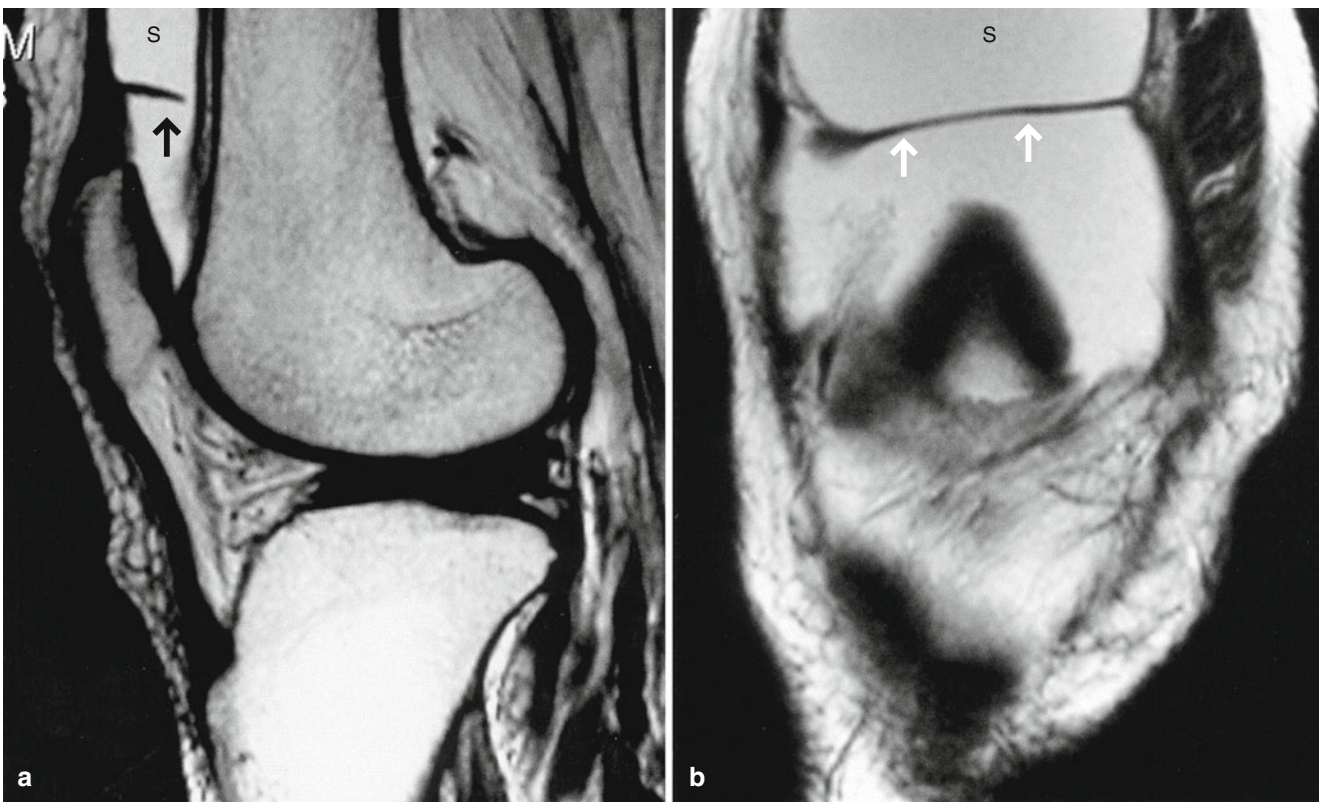

Fig. 11.14 Suprapatellar plica. A woman in her 50s. (**a**) Sagittal and (**b**) coronal T2WI. Suprapatellar plica is the sheet-like structure separating the suprapatellar bursa (S) and the knee joint space (*arrows*)

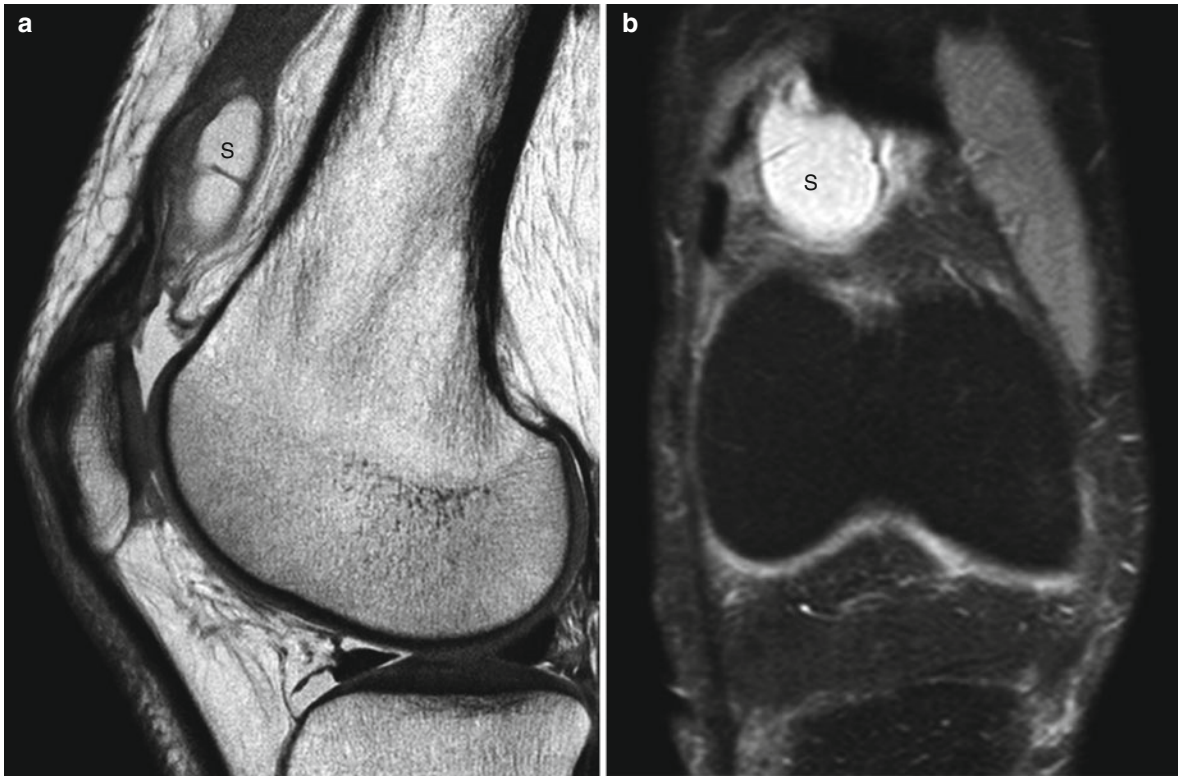

Fig. 11.15 Suprapatellar bursitis. A woman in her 50s, presenting with a few months history of suprapatellar swelling. (**a**) PDWl and (**b**) axial FS PDWl. Suprapatellar bursa is swollen due to fluid accumulation (*S*). There is also surrounding edematous swelling

11.8.2 Mediopatellar Plica

- Synovial plica located in the medial aspect of the knee joint space.
- Frequently seen in axial MR images (Fig. 11.16).
- May not be visualized if there is little joint fluid.
- Laterally located plica is rare (Fig. 11.17).
- Large mediopatellar plicae become impinged between the patellofemoral joint, causing pain and "clicking" sound (so-called plica syndrome, Figs. 11.18 and 11.19).

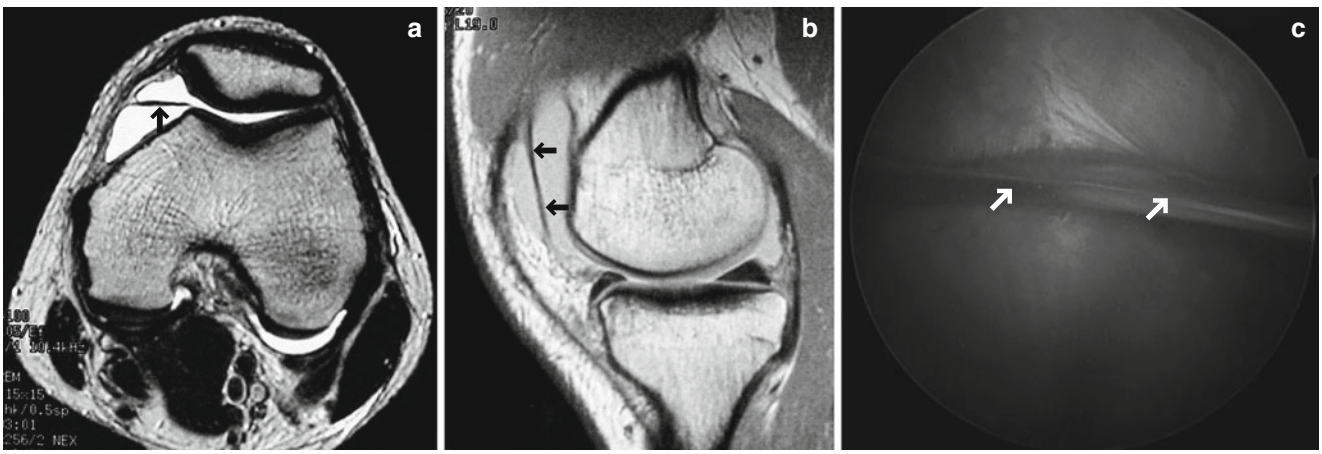

Fig. 11.16 Mediopatellar plica. A man in his late teens. (**a**) Axial T2WI, (**b**) PDWI, and (**c**) arthroscopic image. This is a typical example of a mediopatellar plica (*arrow*)

Reference

Nakanishi K, Inoue M, Ishida T, et al. MR evaluation of mediopatellar plica. Acta Radiol. 1996;37:567–71.

Fig. 11.17 Lateropatellar plica. A man in his 30s. A lateropatellar plica is rarely seen (*arrows*)

Fig. 11.18 Plica syndrome due to a large mediopatellar plica. A man in his 40s. Axial T2WI. There is a large mediopatellar plica (*arrow*)

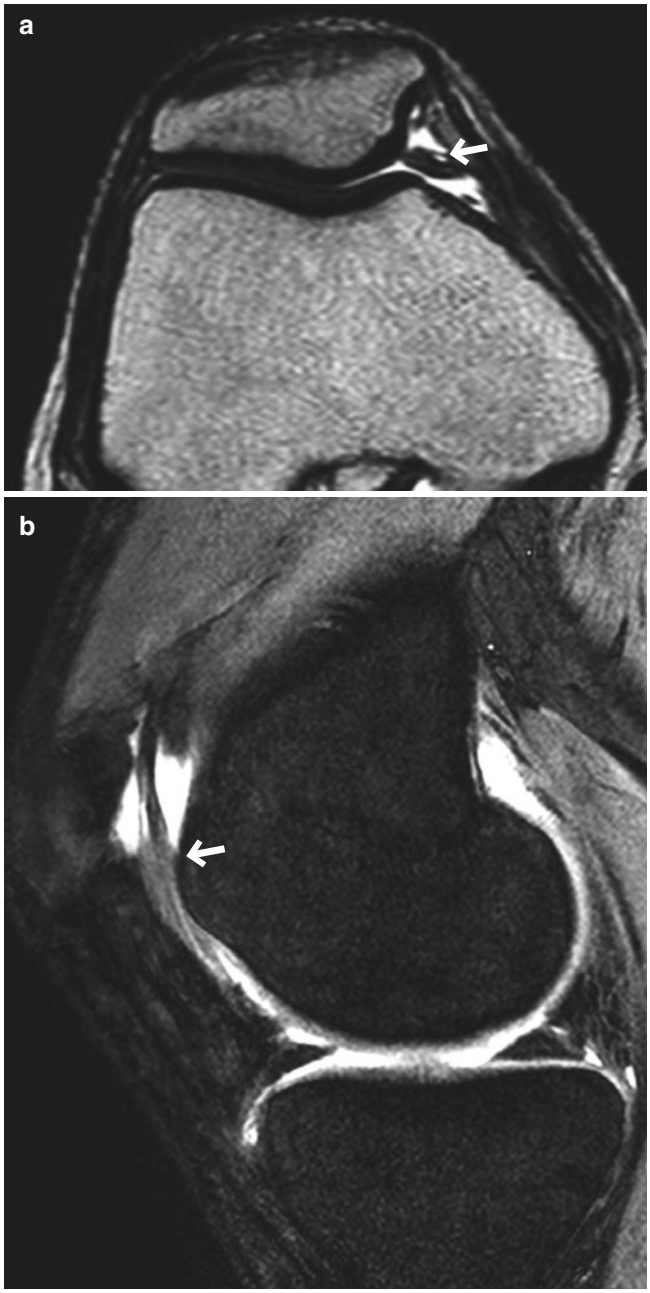

Fig. 11.19 Plica syndrome due to a large mediopatellar plica. A man in his 30s, presenting with medial patellar pain. (**a**) Axial T2WI, (**b**) FS T2*WI, and (**c**) arthroscopic image. Mediopatellar plica thickening is seen (*arrows*) (Images courtesy of Dr. Atsushi Tazaki, Department of Orthopaedics, St. Luke's International Hospital, Japan)

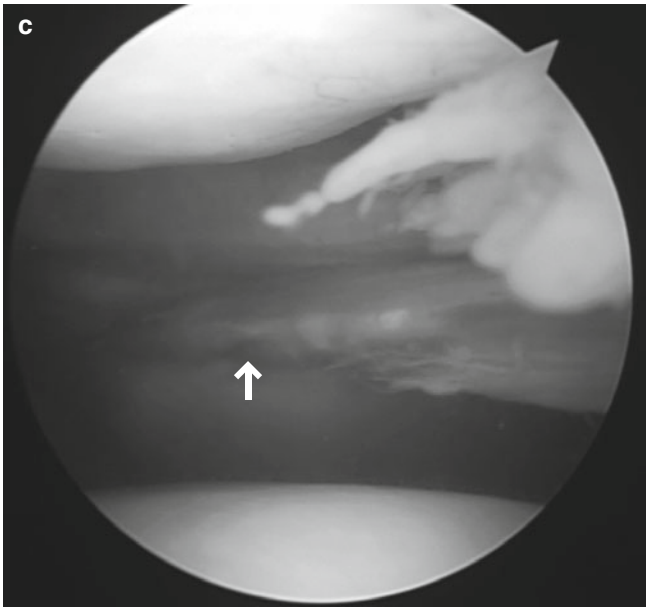

Fig. 11.19 (continued)

11.8.3 Infrapatellar Plica

- It is also known as anterior plica or ligamentum mucosum.
- It is situated anterior to the ACL, connects Hoffa's fat pad and the anterior aspect of the intercondylar space, and divides the tibiofemoral joint space into right and left sides.
- It is said to have a role in lifting Hoffa's fat pad.
- It is commonly seen during arthroscopic examination, and if it obscures the arthroscopic procedure, its resection (or piercing through it) may be required.
- It is less commonly visualized on MRI than suprapatellar or mediopatellar plicae.
- It can be visualized as a thin band-like structure running just anterior to the ACL almost in parallel to it (Fig. 11.20).
- It is rarely clinically significant, but rarely it can swell and cause knee extension disorder.

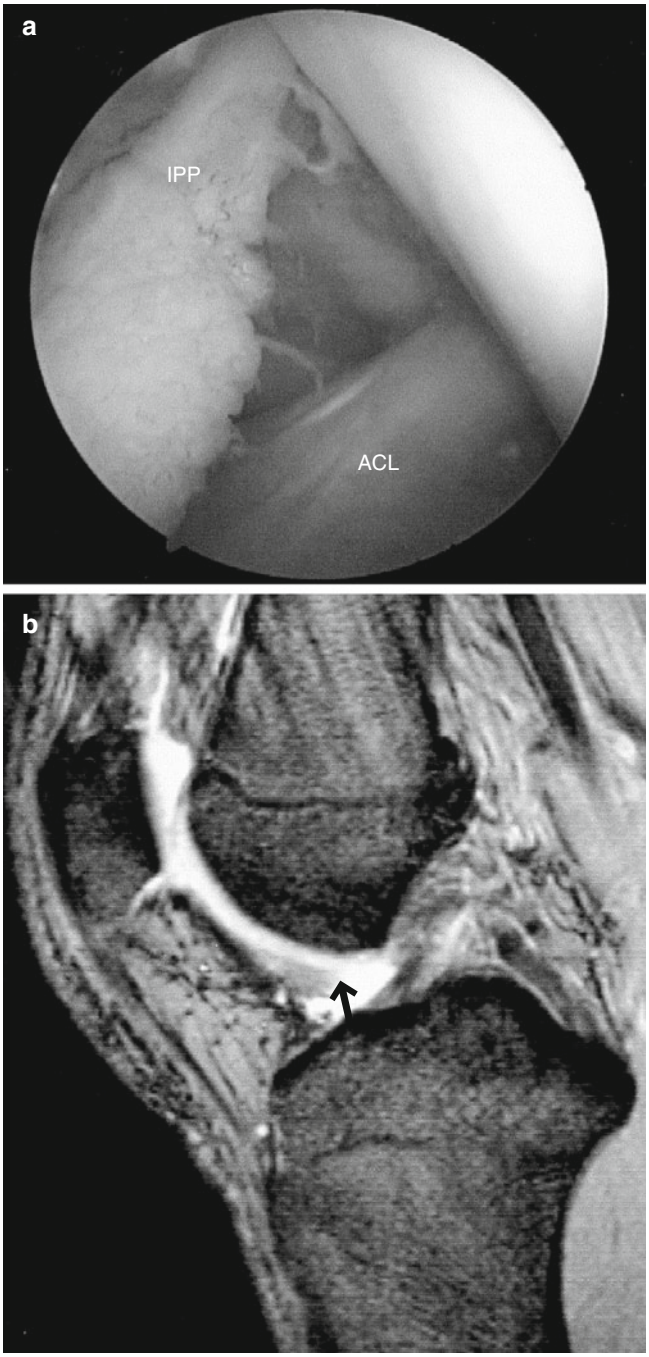

Fig. 11.20 Infrapatellar plica. A man in his late teens. (**a**) Arthroscopic image and (**b**) T2WI. There is a band-like structure just anterior to the ACL, representing infrapatellar plica (*IPP*). In sagittal MRI, it can rarely be visualized as a thin band-like structure running in front of ACL in parallel to it (*arrow*)

Reference

Kosarek FJ, Helms CA. The MR appearance of the infrapatellar plica. AJR. 1999;172:481–4.