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Case Series

MR Imaging of Temporal Evolution of Suprapatellar Plica Synovialis Syndrome: Synovitis, Lipoma Arborescence and Rice Bodies

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Abstract

Synovial plicae are frequently seen in knee joint. Majority of synovial plicae are asymptomatic. Rarely, plicae become thickened and fibrosed, leading to inelasticity, which can snap over the femoral condyle and patella causing synovitis, chondral damage and pain. Hypertrophic and fibrotic plicae are found in 3% of knee arthroscopies and will be the only finding in patients with plica syndrome, most commonly seen with medial plica. Suprapatellar plica syndrome is extremely rare. The authors report the unique MR findings of suprapatellar plica syndrome in five different patients that show the temporal evolution from synovitis to lipoma arborescence and rice bodies.

Keywords: MR imaging; Synovitis; Lipoma arborescence; Rice bodies

Introduction

A plica is a fold of synovial tissue that represents remnant of the synovial membrane from the embryological development of the knee. Synovial plicae are asymptomatic unless they are thickened and fibrotic. The authors report our experience with a case series of five patients with suprapatellar plica synovialis syndrome detected on MR imaging that showed synovitis, long term synovitis progressing to lipoma arborescence, and chronic synovitis resulting in formation of rice bodies [1].

Case Reports

Case 1

12-year-old boy complained of chronic left knee pain. He had a 5,700 white blood cell count, erythrocyte sedimentation rate of 4 mm/hour and C reactive protein of 0.2. Rheumatoid factor and titers for Lyme disease, leptospirosis, and Streptococcus pyogenes were all negative. Contrast-enhanced MR exam of the left knee revealed suprapatellar plica with synovitis in suprapatellar bursa (Figure 1). The patient was treated conservatively. Two years later, a knee MR showed interval development of lipoma arborescence in the suprapatellar recess. Four year later, follow-up knee MR showed persistent lipoma arborescence and mild chondromalacia of the medial facet of the patella. Four and a half year later, the patient underwent diagnostic arthroscopy of the left knee. Examination under anesthesia showed that the patient had a palpable cord of tissue attached to the superolateral patella which clicked over the lateral femoral condyle. Arthroscopic examination revealed mild patellofemoral chondromalacia and synovitis with no intraarticular bodies within the knee joint. Following debridement of the suprapatellar plica, the patient was re-examined and no longer had a palpable click.

Case 2

18-year-old woman had chronic left anterior knee pain and swelling. Contrast enhanced MR imaging of left knee showed a thickened superior plica with synovitis in the suprapatellar pouch.

Case 3

18-year-old man complained of a lump in his left knee for about three months. He also had pain when going up and down stairs. He denied any prior injuries and had no constitutional symptoms or evidence of infection. MR imaging of the left knee showed a large suprapatellar effusion due to synovitis with MR appearance of lipoma arborescence (Figure 2A-C). Post contrast imaging showed thick irregular frond-like synovial enhancement. There were small partial thickness chondral defects in the apex of the patellar articular cartilage and the lateral femoral trochlea. About 3 months after the MR exam, the patient underwent open arthrotomy of the left knee which revealed abundant and thickened synovium with fronds of fatty tissue. A complete synovectomy was performed. Histologic evaluation showed synovial hyperplasia with expansion by mature adipose tissue and mild chronic inflammation, consistent with lipoma arborescence (Figure 2D and E). No malignancy was seen.

Case 4

44-year-old man complained of chronic right knee pain. Complete blood cell count was normal with 5,500 white blood cells. Erythrocyte sedimentation rate was 18 mm/hour.

Unenhanced MR exam of the right knee revealed suprapatellar plica with multiple non-calcified bodies within the suprapatellar recess. Chondromalacia was seen in the patella and femoral trochlea.

Case 5

24-year-old woman complained of chronic right knee pain not responding to conservative therapy. She had a 5,500 white blood cell count, erythrocyte sedimentation rate of 30 mm/hour and C reactive protein of 0.48. Rheumatoid factor, RNP, Smith ENA, lupus and HLA-B27 testing were all negative. Non-contrast MR Exam of the right knee showed an enlarged suprapatellar recess filled with multiple non-calcified intraarticular bodies (Figure 3A-C). A thick

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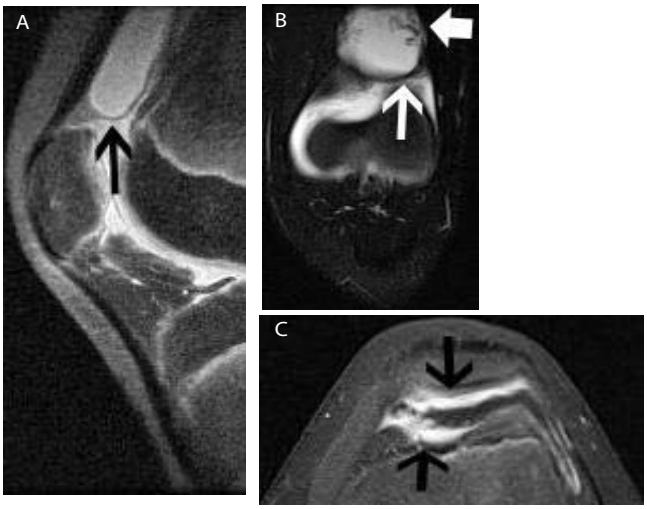

Figure 1: 12-year-old boy complained of chronic left knee pain.
Figure 1A: Sagittal PD-weighted image with fat suppression shows a complete superior plica (arrow) and distended suprapatellar bursa.
Figure 1B: Coronal T2-weighted image with fat sat shows a complete septum pattern of suprapatellar plica (thin arrow) with synovitis in suprapatellar pouch (thick arrow).
Figure 1C: Axial T1-weighted image post contrast shows thick irregular enhancement (thin arrow) of the synovium in the suprapatellar bursa.

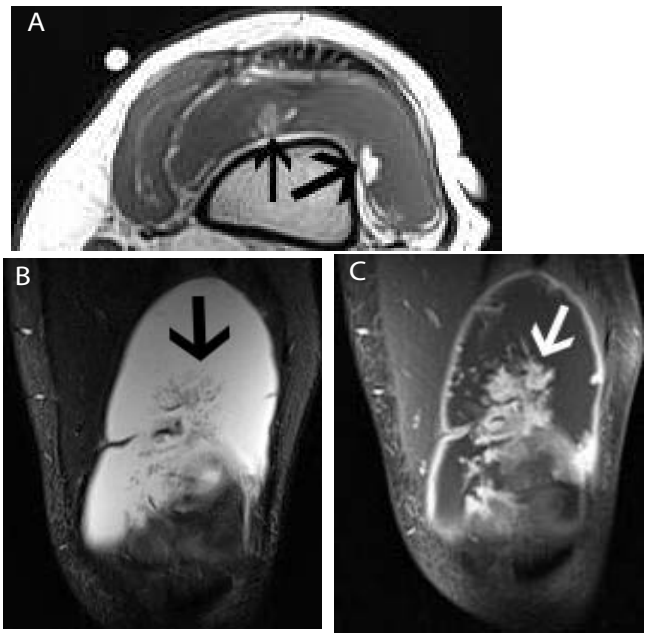

Figure 2: 18-year-old man complained of lump in his left knee for three months.
Figure 2A: Axial T1 image shows villous lipomatous proliferation of the synovial membrane (arrows) consistent with lipoma arborescence.
Figure 2B: Coronal T2-weighted image with fat sat reveals frond-like synovial proliferation (arrow) outlined by the effusion in the suprapatellar bursa.
Figure 2C: Coronal T1-weighted image with fat suppression post contrast shows frond-like enhancement of the synovium (arrow).

suprapatellar plica separated the suprapatellar recess from the knee joint. Partial thickness chondral defect was also seen in the lateral facet of patella. Post contrast, there was thick synovial enhancement limited to the suprapatellar recess consistent with synovitis. However,

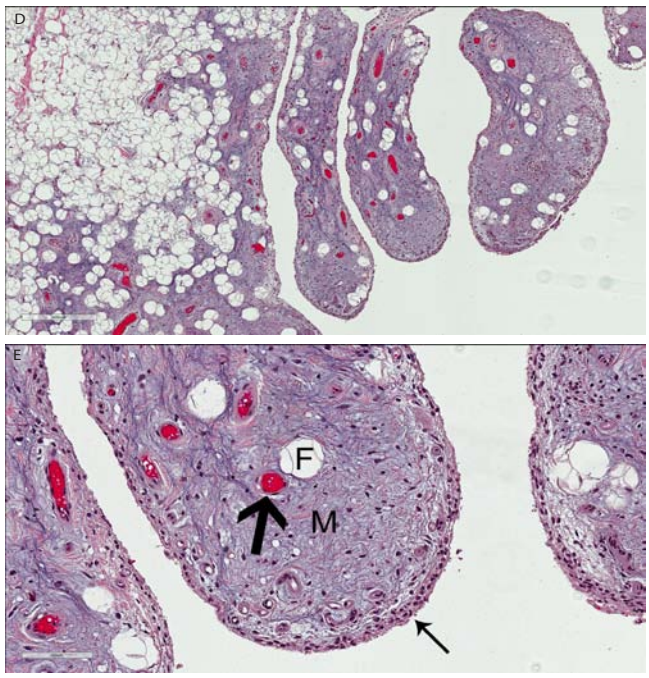

Figure 2D: H & E photomicrograph (low power) shows papillary fronds of synovial proliferation.
Figure 2E: H & E photomicrograph (high power) demonstrates mature adipocytes (F) in a myxoid stroma (M) beneath synovial epithelium (thin arrow). There are multiple dilated vessels (thick arrow) within the papillary frond consistent with chronic synovitis.

the intraarticular bodies within the suprapatellar recess did not enhance.

The patient had arthrotomy of the right knee which revealed multiple intraarticular bodies. A partial synovectomy was performed. Histologic evaluation showed synovial fibroconnective tissue with marked synovial hyperplasia and chronic inflammation consistent with chronic synovitis of no specific type. There were multiple foci of fibrinoid necrosis surrounded by fibrohistiocytic cells without giant cell reaction (Figure 3D and E). Features of synovial chondromatosis or pigmented villonodular synovitis were not evident microscopically.

Discussion

Two prevailing theories explain the existence of synovial plicae. The first theory hypothesizes that during embryological development of the knee joint, synovial membranes divide the knee into three separate compartments: medial, lateral and suprapatellar. After the 16th week of gestation, a single cavity is formed following resorption of the synovial membranes. Synovial plicae are remnants of the embryological development of the knee joint. In the second theory, at about the 7th week of gestation the knee joint is filled with mesenchymal tissue. As time progresses, cavitations develop in this tissue. Failure of cavitation and incomplete resorption of mesenchymal tissue result in plica formation [2-5].

There are four synovial plicae in the knee joint (Figure 4). In an arthroscopic study of 400 knees, Kim and Choe reported the prevalence of suprapatellar plica, infrapatellar plica, mediopatellar plica, and lateral patellar plica to be 87%, 86%, 72% and 1.3%, respectively [6]. Normal plicae are thin, soft, and flexible vascularized structures

Figure 3: 24-year-old woman complained of chronic knee pain not responding to conservative therapy.
Figure 3A: Sagittal T2-weighted image with fat suppression reveals multiple low T2 signal intense intraarticular bodies (large arrow) within a distended suprapatellar bursa. Note chondromalacia in patella (small arrow) and absence of joint fluid within the remainder of the knee joint.
Figure 3B: Coronal T2-weighted image with fat sat shows a complete septum (arrow) separating the suprapatellar bursa from the rest of the knee joint.
Figure 3C: Lateral view of the knee shows no calcified masses in the suprapatellar pouch.

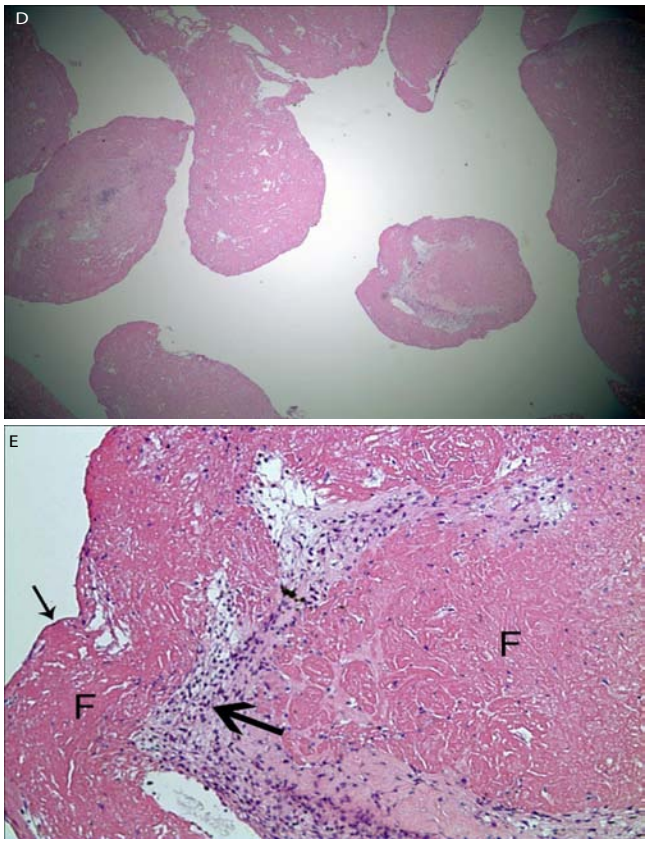

Figure 3D: H & E photomicrograph (low power) shows multiple rice bodies.
Figure 3E: H & E photomicrograph (high power) reveals amorphous aggregate of fibrin (F) intermixed with fibroblasts (thick arrow) and lined by atrophic remnant of synovial epithelium (thin arrow).

covered in synovium. Plica syndrome is a clinical diagnosis in which the symptoms and physical findings are associated with a pathologic plica. Plica syndrome is most commonly due to medial plica. The patient typically presents with medial patellar pain, usually above the joint line, that is exacerbated during flexion-extension. Pain may be due to chondromalacia of the patella and medial femoral condyle from repetitive contact with the plica. Physical findings may include crepitation, effusion, and a palpable painful cord. Pathological plicae are hypertrophied with loss of elasticity, calcification, hyalinization and fibrosis. On T2-weighted MR imaging, synovial plicae appear as bands of low signal intensity within the high signal intensity joint fluid.

There are many names for suprapatellar plica: superior plica, plica synovialis suprapatellaris, super medial plica, and medial suprapatellar plica. Kim and Choe described seven patterns of suprapatellar plica (Figure 5) [6]. A suprapatellar plica is considered absent when there is no sharp-edged fold of synovium between the suprapatellar recess and the knee joint and may be confused with the complete septum. A complete septum is a plica that separates the suprapatellar bursa from the knee joint so that there is no communication between these two compartments. When the suprapatellar plica is absent, the articularis genu insertion can be seen at the upper limit of the synovial cavity. A superior plica is considered vestigial when there is less than 1 mm protrusion of the synovium. Suprapatellar plica that lies on the medial side of the suprapatellar pouch is classified as medial. Conversely, superior plica that lies on the lateral side of the suprapatellar pouch is classified as lateral. If a suprapatellar plica is present on the medial, lateral and anterior aspects of the suprapatellar pouch but not over the anterior surface of the femur, it is classified as arch since it appears arthroscopic ally as an arch or bow.

Awareness of the existence of the complete septum variation of the superior plica can have clinical significance. Pigmented villonodular synovitis, synovial osteochondromatosis, hemophilia, and septic joint may be isolated to the suprapatellar bursa due to a complete septum [7-10]. If the orthopedic surgeon is not aware of its existence, he may rupture the septum and unnecessarily contaminate the knee joint with the pathology in the suprapatellar bursa. Alternatively, if the surgeon explores the knee joint from the infrapatellar route, he may not be able to locate the pathology in the suprapatellar pouch. Therefore, pre-operative evaluation with MR imaging is helpful to detect the complete septum and guides surgical approach.

Suprapatellar plica synovialis is commonly asymptomatic. Rarely, it can cause symptoms by two mechanisms. The superior plica may act like a ball valve action similarly seen with popliteal cyst. There is a differential hydraulic pressure between the knee joint and the suprapatellar bursa pumping fluid and debris into the suprapatellar bursa causing its distension [11]. Like the medial plica, superior plica

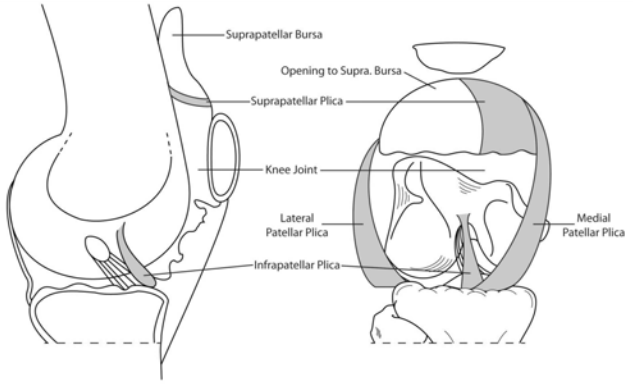

Figure 4: Diagrammatic representation of synovial plicae of the knee as seen on sagittal and coronal planes. [Modified from reference number 5].

may also cause chondromalacia of the patellofemoral joint, which was seen in our patients. Strover et al confirmed by arthroscopic technique the impingement of the suprapatellar plicae on the medial femoral condyle when the knee is flexed, known as bowstringing [12]. By interposing itself between the femoral trochlea and the quadriceps mechanism during flexion, the superior plica is traumatized and became fibrotic with time. When thickened, fibrotic, and inelastic, the suprapatellar plica may cause chondromalacia of the patella and femoral trochlea [13]. Complete suprapatellar plica may present as a soft tissue mass due to chronic synovitis and bursitis resulting in distension of the suprapatellar bursa [14-16].

Lipoma arborescenceis also known as villous lipomatous proliferation of the synovial membrane. It is most commonly found in the knee. Lipoma arborescence is a reactive process due to chronic synovial irritation, most frequently found in association with osteoarthritis but also seen in patients with rheumatoid arthritis and prior trauma. Chronic synovitis results in infiltration of fat tissue in the synovium and sub synovial tissue forming frond-like masses which may progressively enlarge to form globular, rounded masses. On T1-weighted MR images, the masses have the same signal intensity as subcutaneous fat but with a branch like appearance, hence its given name. On T2-weighted fat suppressed images, lipoma arborescence has low signal intensity due to the fat content. The inflamed synovium may even enhance. There is only one case report of lipoma arborescence in a child with bilateral plica synovialis suprapatellaris [17]. We saw two cases of lipoma arborescence in our patients with superior plicae, one of which had chronic synovitis for more than four years before the child had arthroscopic release of the suprapatellar plica.

Rice bodies, named for their macroscopic likeness to polished grains of rice, were first described in association with tuberculous arthritis. In the United States, they commonly occur in patients with rheumatoid arthritis, both early and late in the course of the disease, and are not correlated with the severity of the clinical or radiological changes. It is thought that rice bodies originate from detached fragments of degenerating synovial villi that have outgrown their blood supply and subsequently are encased by fibrin derived from synovial fluid. On T1-weighted MR images, the rice bodies are isointense to muscle and cannot be discerned from the surrounding joint fluid. On T2-weighted MR images, the intraarticular masses

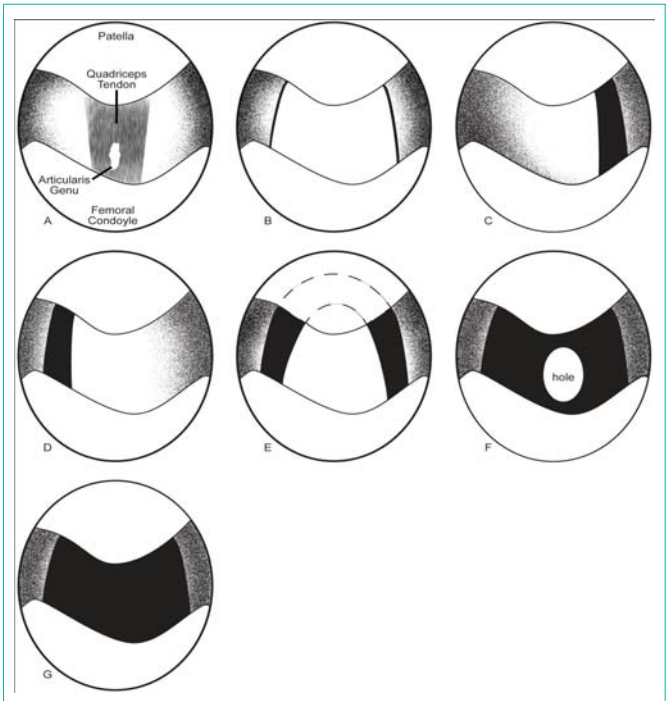

Figure 5: Illustrations for patterns of suprapatellar plicae of the knee as seen through an arthroscope. **A**. absent; **B**. vestigial; **C**. medial; **D**. lateral; **E**. arch; **F**. hole; **G**. complete septum. Each pattern may have one of various widths (up to one-third, between one and two-thirds, or more than two-thirds of the width of the suprapatellar pouch). [6].

are hypointense and clearly distinguishable from the surrounding effusion. Unlike pigmented villonodular synovitis, they do not become more prominent on GRE sequence since there is no hemosiderin deposition. Unlike synovial osteochondromatosis, the rice bodies are not calcified and are not visible on radiography. Rice bodies have been found in atypical mycobacterial tenosynovitis and bursitis and chronic subacromial subdeltoid bursitis [18,19]. However, they have not been reported in suprapatellar plica syndrome. In our case series of suprapatellar plica syndrome, we saw two cases with rice bodies, one of which had surgical confirmation. We hypothesize that the chronic synovitis had resulted in shedding of the infracted synovial villi into the suprapatellar pouch leading to the formation of the rice bodies.

In conclusion, we report the unique MR imaging appearance of five cases of suprapatellar plica syndrome that showed temporal evolution from synovitis to lipoma arborescence and rice bodies. Complete septum variant of the suprapatellar plica isolates the suprapatellar bursa from the remainder of the knee joint. Initially, synovitis results in distension of the suprapatellar pouch and bursitis which may mimic a soft tissue mass. Subsequently, long term synovitis progresses to lipoma arborescence. Eventually, the chronic synovitis leads to sloughing of the synovial villi into the suprapatellar bursa forming the rice bodies.

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