

# Synovial plicae

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The first descriptions of synovial plicae were made some time ago. In 1555, Vésale had already described synovial septa at the level of the knee and had identified the inferior plica, which was called at the time the ligamentum mucosum.

In 1939, Lino (1) described these structures in an anatomical cadaveric study of adult knees. It was not until years later, in the 1970s, that their role was uncovered in the disorders of the knee, especially with the advent of arthroscopy (2,3).

Although their prevalence today is estimated at 20-60% of the population, their pathological implications remain controversial.

## Anatomy

The most collectively agreed upon origin of synovial plicae is one that originates during intra-uterine life while the knee is still constituted of 3 compartments: Medial, lateral, and suprapatellar. These compartments are separated by thin synovial membranes that regress at 4 months in utero to form a unique and single cavity. However, remnants of these synovial septa, or plicae, can sometimes persist (4). Four localizations have been described: Suprapatellar, medial parapatellar, lateral parapatellar, and infrapatellar (or ligamentum mucosum) (5).

Proximally, the superior or suprapatellar plica originates 2cm cephalad to the patella, between the quadriceps and the anterior aspect of the femoral metaphysis. It is obliquely situated with a downward and anterior direction that becomes horizontal during flexion. It is therefore always suprapatellar and does not lead to impingement with the joint cartilage.

Inferior plica, also called the infrapatellar plica or the ligamentum mucosum, is situated within the intercondylar notch, and doubles the anterior cruciate ligament with which it can sometimes fuse. Its distal insertion is on the ligament of Hoffa.

The medial or medial parapatellar plica has been extensively described in the literature under numerous designations, thus explaining why this entity causes so much confusion. Its insertion is on the medial aspect of the suprapatellar pouch, and it courses parallel to the patella. Its distal insertion is on the ligament of Hoffa. It is the most common entity responsible for plica syndrome and is very inconsistent in size, shape, and location. This led Sakakibara to establish an arthroscopic classification (6) with 4 different types:

- Type A: Consists of a cordlike elevation in the synovial wall, never pathological
- Type B: Slightly larger in thickness, has a shelflike appearance but does not cover the anterior surface of the medial femoral condyle

- Type C: Large with a shelflike appearance and covers the anterior surface of the medial femoral condyle
- Type D: Plica has a central defect (fenestrated plica) with a double insertion on its medial aspect.

The lateral or lateral parapatellar plica, very inconsistent and scarcely described in the literature, equivalent to medial plica but laterally, is found under the lateral retinaculum. It is situated 2cm lateral to the patella, is very thin, and does lead to pathology.

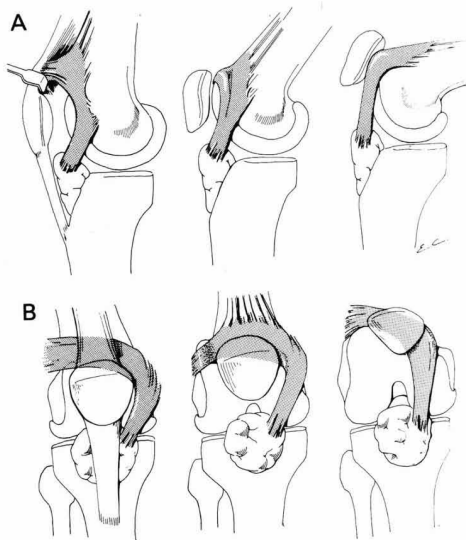


Fig. 1. A: Plica from the medial to lateral view on a right knee; B: Plica from the anterior to posterior view on a right knee.

According to Blackburn *et al.* (7)

## Pathophysiology

Two conflicting theories exist to explain the pathogenic mechanism of synovial plicae: The mechanical theory (8) and the hydraulic theory of Pipkin (9).

In the first theory, knee trauma or repetitive microtrauma lead to metaplasia of plicae into fibrocartilaginous tissue and become calcified. If it is large enough (type C or D), it can lead to impingement with the joint surface of the femoral condyle or the patella between 30° and 60° of flexion. This hypothesis has been upheld by multiple anatomical studies that have found notable chondromalacia of the medial condyle associated with a type C and D medial plica (10), although this relationship between cartilage erosion and clinical symptoms has not been clearly defined. However, according to Pipkin, hypertrophic plicae may be responsible for retention of synovial liquid, thus leading to inflammation that is responsible for the symptoms.

## Clinical findings

Synovial plicae are generally a disease of the young athlete (7,11). In about half of the cases there is a history of blunt knee trauma or a sprain with possible hemarthrosis (12), or an increase in the level of physical activity leading to repeated microtrauma.

Clinical findings are scarce. Patient reports non-specific pain on the anteromedial aspect of the knee or at the suprapatellar area, which appear mostly during knee flexion. The seated position aggravates the pain, and the patient reports a need to extend the knees (cinema sign). Other symptoms, such as knee instability and a snapping sensation are also reported.

In half of the cases, physical examination reveals quadriceps atrophy. An inconsistent but pathognomonic sign is the palpation of a medial parapatellar cord that can be rolled beneath the fingers and popped against the femoral condyle. Palpation of this cord would reproduce the pain that is recognized by the patient ("That's it, Doc!" sign).

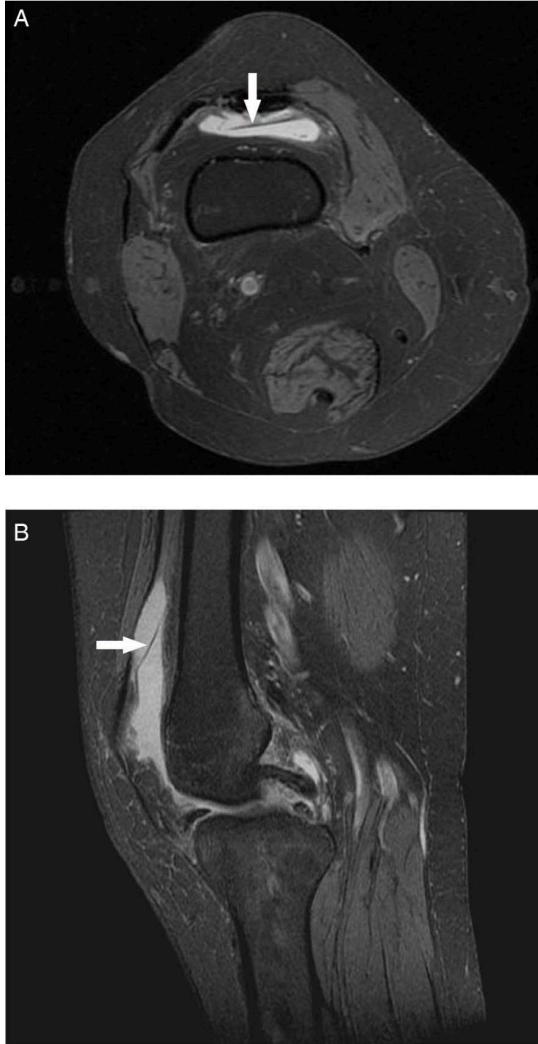
Finally, false positive signs of medial meniscal injury may be found. These signs subside after resection of the plicae, and no meniscal tears are found arthroscopically (13,14).

## **Complementary exams**

Historically, synovial plicae characteristics were assessed on knee arthrography, more easily visualized on a patellar femoral axial view. However, evaluation of the symptomatic nature of the plicae was not possible on arthrography.

Today, progress in MRI technology has rendered it the exam of choice and allows us to rule out differential diagnoses, such as meniscal lesions, with a sensitivity of 95% and a specificity of 72-81% (15,16). However, in the study by Uysal et al. (17), who arthroscopically operated 23 knees with type D symptomatic synovial plicae excision without any other intra-articular pathology and in 87% of whom the MRI was negative, some patients remained symptomatic.

Plicae first appear as rather thick hypointense bands. At this stage, it is difficult to attest to its symptomatic nature. MRI sequences include fat saturated T2-echo gradient and proton density weighted sequences. Sometimes, a hypointense band is surrounded by an increased signal corresponding to joint effusion.



**Figure 1** (A) Axial intermediate-weighted MR image with fat suppression shows a suprapatellar plica (arrow) as a band-like stricture of low signal intensity at the suprapatellar pouch, which is filled with fluid. (B) Sagittal intermediate-weighted MR image with fat suppression shows a floating low-signal suprapatellar plica (arrow), which is depicted adequately because of the presence of fluid in the suprapatellar pouch.

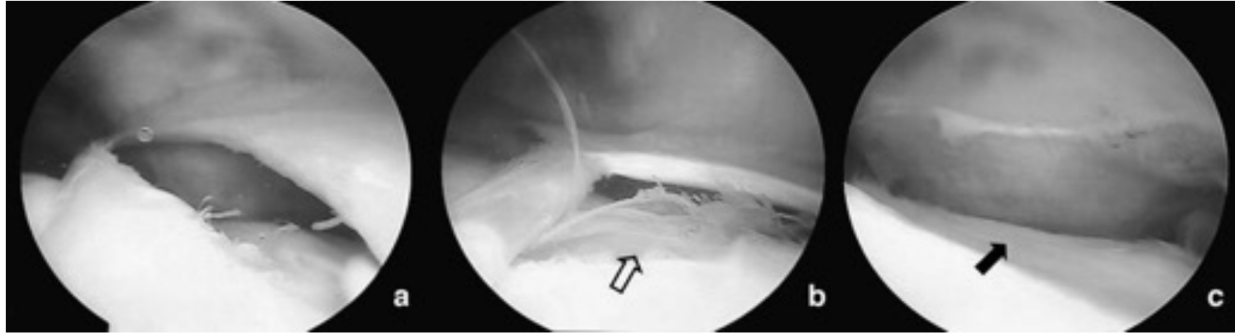
*By Vassiou et al. (18)*

As such, although the MRI is a valuable tool in the diagnostic workup of synovial plicae, it is insufficient to confirm its symptomatic nature. Arthroscopy is the gold standard in the detection and treatment of synovial plicae. As a result, plica syndrome should remain a diagnosis of exclusion.

Arthroscopy for synovial plicae can be undertaken through a classic anterolateral portal, although a superolateral portal allows better visualization. The tightness, aspect, and thickness of the plica should be evaluated, along with the other intra-articular compartments. A dynamic examination

of the knee from 0 to 90° of flexion should also be undertaken in order to rule out impingement with the medial femoral condyle or the articular surface of the patella.

According to Patel, a fibrotic and thickened plica with an abnormal size may be considered pathological (5). Dynamic testing may show impingement between the quadriceps and the medial femoral condyle after 70° of flexion (19).



*Right knee of a 40-year-old patient. The fenestrated medial plica can be seen in extension (a) and flexion (b). Impingement between the plica and the medial femoral condyle (white arrow) and the degenerative nature of the medial femoral condyle (black arrow) after resection can be seen. According to Uysal et al. (17).*

## **Treatment:**

When the diagnosis of plica syndrome is considered, and after other differential diagnoses have been excluded, conservative treatment should first be attempted. The purpose of such a therapeutic trial is to reduce pain and inflammation. The first phase of this treatment protocol includes rest and medical treatment with NSAIDs, followed by a phase of rehabilitation in order to alter the constraints on the extensor mechanism of the knee by posterior chain and quadriceps stretching exercises along with quadriceps strengthening (7,20). In the acute phase, cryotherapy may be a useful aid, and flexion should be limited.

A well-conducted trial of conservative treatment leads to good results in 50% of patients.

Intra-plicae and/or intra-articular injections of corticosteroids have been suggested in patients resistant to conservative management in order to decrease the inflammatory response and boost rehabilitation (21,22).

In the rare case of failure of conservative management, surgical treatment may be justified after ensuring that the rehabilitation protocol was correctly undertaken. In fact, this represents an exceptionally rare instance in patients with an isolated plica and should not be normalized (23). Surgical management consists of wide arthroscopic resection of the hypertrophic plica that is considered responsible for the symptoms after exploring the remainder of the intra-articular lesions. Nevertheless, care must be taken to avoid over-indicating surgical management. It should be reminded that plicae correspond to a physiological synovial fold; as such, invasive surgical

procedures of such tissues lead to scarring and to fibrotic tissue which may worsen symptoms. The appearance, size, thickness, and fibrosis of the plica as well as arthritic changes of the medial femoral condyle or the patella are powerful arguments in favor of a symptomatic (24) plica, and wide resection leads to pain relief and a return to previous levels of activity in most patients (25,26).

These criteria have been called into question in certain large case series, where no correlations were found between the size of the plica and the presence of symptoms (27).

In case of an associated intra-articular lesion, such as a meniscal injury or femoral patellar instability, the treatment strategy becomes controversial. It would seem evident to first treat secondary lesions that accentuate and perpetuate the pain and symptoms of a plica by mechanical inflammation. Therefore, some authors consider that plicae should not be resected and should be treated as a distinct pathological entity that should first be managed with rehabilitation, while others would treat all lesions simultaneously.

## **Discussion:**

The synovial plica remains to this day a controversial topic. Although its existence as an anatomic and physiologic entity has been well established, its symptomatic nature remains disputed.

Clinical findings are scarce and non-specific which may sometimes lead to erroneously diagnosing a meniscal injury or femoro-patellar syndrome in young and athletic patients. An MRI, when obtained, has a high sensitivity but low specificity when assessing synovial plicae. However, its symptomatic nature cannot be addressed. Nevertheless, it may still be used to rule out differential diagnoses.

Arthroscopy is still considered the gold standard in the evaluation and diagnosis of synovial plicae. The primary and most effective treatment modality is rehabilitation. A large portion of these patients are probably underdiagnosed, and arthroscopy is not systematically utilized for purely symptomatic reasons.

Rehabilitation consists primarily of posterior chain stretching programs, notably of the hamstrings, with quadriceps strengthening. This has been shown to be an effective management in medial plica syndrome as well as the treatment of femoro-patellar syndrome

When surgical management is required, the pathological plica should be completely resected in order to avoid scar tissue formation and recurrence. When the plica in question is hypertrophic, thick, and inflamed with an obvious impingement on the joint surfaces during testing, it is most probably the cause of the symptoms. However, when the plica is thin (type A), it is more difficult to assess whether it is the cause of the symptoms.

In the absence of other intra-articular lesions, and the clinical picture is in accordance, the plica is probably responsible for the reported symptoms and should be treated as such, owing to the discordance between clinical findings and arthroscopy.

In case of other associated lesions, these intra-articular injuries should be treated. Concomitant resection of the plica is justified if the clinical findings are in accordance, especially if there is associated chondromalacia of the joint facing the plica with obvious impingement during testing.

## **Conclusion:**

Synovial plica syndrome remains a misunderstood pathology. Therefore, although its presence as an anatomical entity is well established, its pathological implication, diagnosis, and treatment are mired in controversy. Plica syndrome is a diagnosis of exclusion and an MRI, although insufficient on its own, is the complementary exam of choice in order to rule out differential diagnoses.

Surgical management is rarely indicated, and the physician must ensure that the rehabilitation program was properly undertaken and respected.

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