

# Medial Plica Syndrome

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**ABSTRACT:** Synovial plicae are membranous inward folds of the synovial lining of the knee joint capsula. Such folds are regularly found in the human knee, but most are asymptomatic and of little clinical consequence. However, they can become symptomatic and cause knee pain. In this review, we will discuss medial plica syndrome. Medial plica irritation of the knee is a common source of anterior knee pain. The main complaint is an intermittent, dull, aching pain in the area medial to the patella above the joint line and in the supramedial patellar area. Pain increases with activity, especially when knee flexion and extension are required. Treatment includes physiotherapy, reducing activity, and rest. In cases that do not respond initially to an exercise program, corticosteroid injections and non-steroidal anti-inflammatory medication are given. Results of conservative treatment seem to be more appropriate in young patients with a short duration of symptoms. If conservative treatment fails, surgical treatment using arthroscopy is appropriate. During arthroscopy, excision of the whole plica should be achieved.

IMAJ 2008;11:54–57

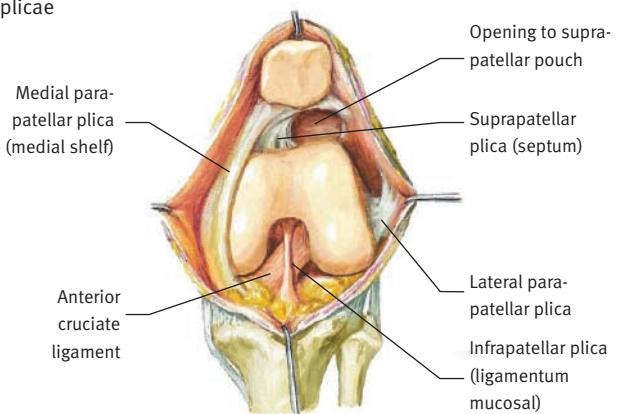
**KEY WORDS:** synovial plicae, knee pain, treatment, arthroscopy, physiotherapy

## EMBRYOLOGY

There are two theories regarding the embryological formation of the knee and the development of plicae. The first, which is widely accepted, suggests that the knee is formed into three separate compartments (medial, lateral, suprapatellar) that are divided by membranes of mesenchymal tissue. These membranes fuse together during weeks 9–12 to create a joint cavity. Plicae are remnants of the compartment-separating membranes that have not been reabsorbed [1,3,4,7]. The second theory suggests that at 8 weeks into embryo development, mesenchymal tissue fills the space between the distal femur and the proximal tibia epiphyses. In the next few weeks two processes take place: condensation of the mesenchymal tissue in areas that will become the menisci and cruciate ligaments, and resorption of the tissue in other areas to form patellofemoral, femoromeniscal and meniscotibial cavitations. Thereafter, approximately 2 weeks later, these cavities grow together into a single cavity with synovial lining [1,4,7]. Where resorption of the mesenchymal tissue fails and cavitation is incomplete, plicae form [7], signifying that the plicae develop when the joint space is formed [1].

Synovial plicae are common intraarticular structures within the knee that can become symptomatic and cause knee pain [1–3]. Three plicae are commonly found: the superior, the medial, and the inferior [4]. A fourth, lateral plica is rarely seen and there is controversy regarding its existence [3] [Figure 1]. The synovial plicae are membranous inward folds that are part of the synovial lining of the knee joint capsula [5]. They are remaining traces of the embryologic knee development [6,7]. The plica syndrome, which will be discussed in this paper, originates from the medial plica. This syndrome was defined by Ewing [8] as "a painful impairment of knee function in which the only finding to explain the symptoms is the presence of a thickened, hypertrophic plica." Though the medial plica is less common, with a prevalence of 18.5–80% [7], it is the most clinically relevant plica and thus commonly studied and reported [4]. The incidence of medial plica syndrome varies from 3.8% to 5.5% [8].

**Figure 1.** Illustration of an open knee demonstrating the different plicae



## ANATOMY

The medial plica originates from the medial wall of the pouch or under the medial retinaculum at the level of the vastus medialis oblique muscle. It runs obliquely, downward and parallel to the medial patella edge, enters the synovium that covers the infrapatellar fat pad and is large with free borders [3,4,7]. The medial plica should not be confused with four other synovial structures in the medial gutter:

- The superomedial plica, which is part of the superior plica. It is transverse and lies well above the patella.
- The plica alaris elongate, which is a longitudinal fold of synovium, just medial to the patella. A skyline view at arthrography shows it as a separate entity from the medial plica.
- The transverse arcuate folds, which are visible at the bottom of the medial gutter.
- The anteromedial fringe of synovium, which frequently covers the anterior horn of the medial meniscus. This can produce symptoms when it impinges between the medial femoral condyle and the meniscus.

Of the four synovial structures described above, the anteromedial fringe is the only one that can produce symptoms, but it is not the structure that causes medial plica syndrome [4].

The medial plica was classified by Sakakibara [9] into four types, according to size:

- **Type A:** A cord-like, thin elevation of the synovial wall, under the retinaculum.
- **Type B:** A narrow synovium, with a shelf-like appearance, which does not cover the anterior surface of the medial femoral condyle.
- **Type C:** A larger synovium, with a shelf-like appearance, which partially covers the medial femoral condyle.
- **Type D:** A type C plica that is fenestrated, creating tags.

This classification is widely accepted and has clinical significance. Types A and B are not likely to produce symptoms, while types C and D, due to their size, may become trapped and impinged between the patellofemoral joint [3,4,7].

## ETIOLOGY

The plica becomes symptomatic via several mechanisms:

- Direct trauma/blow to the plica [10,11]
- Blunt trauma [4,7,12]
- Twisting injuries [4,7]
- Activities that involve repetitive flexion-extension of the knee (e.g., rowing, cycling, running) [1,8]
- Increased activity levels [7]
- Any mechanism resulting in intraarticular bleeding or synovitis secondary to a loose body, osteochondritis dissecans, a torn meniscus, a subluxing patella or after arthroscopy [7].

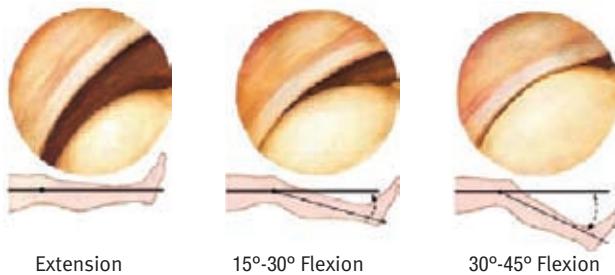
## PATHOLOGICAL PROCESS

Usually the plica is a thin, soft, flexible pink structure [5,13]. It changes orientation and dimension with knee movement [7]. Following the causes previously described, an inflammatory process occurs. The synovial tissue becomes swollen and thickened and the elastic tissue may be replaced by fibrotic components [4,12]. The plica, which becomes scarred, tight and inelastic and has a white fibrotic appearance, may develop into fibrotic bands forming a bowstring over the trochlea and the medial femoral condyle. Impingement between the patella and the femoral condyle may occur, resulting in secondary mechanical synovitis (inflammation and progressive fibrosis) and a change in the patellofemoral joint mechanism, which subsequently leads to softening and degeneration of the articular cartilage and the development of chondromalacia. A study on the kinematic relationship between the medial plica and the medial femoral condyle discovered that the two structures remained in contact during the whole range of motion. The medial plica was found to shift medially when the knee moved from extension to flexion. This pattern of medial-lateral motion may generate some shearing force acting on the cartilage of the medial femoral condyle [14], which might explain the high incidence of chondromalacia presenting with a pathological medial plica. Lyu and Hsu [6] found that cartilaginous degeneration with a typical location and pattern of presentation is commonly found on the medial femoral condyle in the presence of a pathological medial plica. Due to thickening of the plica, normal function of the quadriceps muscle might be disturbed, placing excessive traction on its synovial insertion, which will result in pain due to the rich nerve endings, particularly in its distal attachment to the infrapatellar fat pad. Direct contact between the patellofemoral joint and the plica is not necessary to cause symptoms [7,10,15]. Histologically, a pathological plica demonstrates fibrosis, hyalinization and calcification [5].

## CLINICAL FEATURES

Medial plica syndrome is common in young people of both genders, the main complaint being an intermittent dull aching pain located in the area medial to the patella area above the joint line and in the supramedial patellar area [3,7]. Pain increases with activity, especially when knee flexion and extension are required (e.g., stairs). Sustained flexion of the knee increases pain while extension relieves it [Figure 2]. Popping is another common complaint that is associated with relief of pain [13]. Other complaints include giving way, clicking, catching, pseudo-locking, snapping, and tightness around the anteromedial or anterior knee aspect [7].

**Figure 2.** Mechanism of impingement: The medial plica is impinged over the medial femoral condyle, usually between 30° and 45° of knee flexion.



Findings on clinical examination are varied. A palpable thickened cord-like plica that pops and rolls under the examiner's fingers may be felt, and may be accompanied by tenderness [8]. A mild or moderate effusion is uncommon, but may be present [5]. Crepitus during knee flexion-extension may be felt. Extension of the knee from 90° flexion, combined with internal rotation and medial gliding of the patella, may result in a popping sound, which is very characteristic. Popping that can be felt by the examiner's fingers may occur between 60° and 45° [13,16]. A holding test, during which the patient holds the knee in extension while the examiner tries to flex the knee as he or she pushes the patella medially, is a pain provocation test with or without clicking that may be positive [8]. A similar test is described by Magee [16]: when in 30° knee flexion the patella is moved medially, provoking pain as the edge of the plica is pinched between the patella and the femur. Moderate atrophy of the quadriceps may occur and shortening and tightness of the hamstrings and gastrocnemius muscles may be present [13]. Irha and Vrdoljak [11] described two diagnostic tests for medial plica syndrome:

- **The active extension test.** Lying supine with the knee flexed at 90°, quick extension of the tibia is performed, imitating a football kick. The test is defined as positive when causing pain, due to the concentric pull of the quadriceps muscle on the ends of the plica in an abrupt manner.
- **The flexion test.** Lying supine with the tibia extending out of the bed, a quick swing of the knee into flexion, stopped at between 30° and 60° of flexion = "blocking of the swing," is performed. The test is considered positive if it results in pain as the plica is stretched with the eccentric contraction of the quadriceps.

Both of these tests were found to improve the accuracy of the clinical findings and enabled diagnosis of a symptomatic medial plica [11].

The signs and symptoms of medial plica syndrome are not very specific [14]. The diagnosis is achieved through exclusion, using a combination of clinical findings and radiographic support [15].

## DIFFERENTIAL DIAGNOSIS

Knee pain is a common complaint, the cause of which is not always easy to determine due to an extensive differential diagnosis. Different tissues in the knee region can be the cause of knee pain; these include the subchondral bone, the capsula, the tendons, the fat pads, the menisci, the synovial plica and the retinaculum [5]. Common pathologies that imitate medial plica syndrome are medial collateral ligament sprain, medial meniscal tear, and pes anserine bursitis [2]. Patella bipartite, degenerative joint disease, osteochondritis dissecans and patellar maltracking are also included in the differential diagnosis [1,8,11]. It is important to remember that a pathological plica can be present in combination with other intraarticular pathologies causing associated synovitis [7].

## INVESTIGATIONS

A definitive diagnosis of medial plica irritation is usually obtained by physical examination. However, standing anterior-posterior, lateral, and axial radiographs of the knee are essential to rule out other sources of pathology. While most patients with an irritated medial synovial plica have normal radiographs, it is important to exclude underlying arthritis, areas of osteochondritis desiccans, osteophyte formation, fractures, or any other bony pathology that could be contributing to the irritation of the medial synovial plica. Several modalities can be used to diagnose medial plica irritation. Computed tomography-arthrography, though "out of fashion," enables determination of whether or not impingement is occurring, in addition to visualization of the medial plica [7]. However, difficulties in producing reproducible and reliable results, invasiveness, and exposure to radiation lead to avoidance of this modality. Ultrasonography enables dynamic examination of the plica [4]. Magnetic resonance imaging has been found useful in the evaluation of thickness and extension of medial para-patellar plicae. For optimal visualization of the medial plica, axial and sagittal T2 MR images should be obtained [17]. The plica signal is low in both T1 and T2-weighted images and thus easily identified with joint discrepancy [3]. On axial MRI, an abnormal medial patellar plica may be seen as a thickened band of low signal intensity with underlying irregularity of the medial patellar facet cartilage surface. Sagittal images through the medial compartment of the knee show longitudinal orientation of the medial plica extending toward Hoffa's infrapatellar fat pad, anterior to the anterior horn of the medial meniscus. Although plical thickness is not measured quantitatively, fibrotic hypertrophy secondary to chronic irritation can be identified and considered symptomatic when impingement on the medial femoral condyle in knee flexion is present.

It is generally not recommended to perform a diagnostic arthroscopy to verify that a patient has an isolated medial plica

irritation, because the most successful treatments for medial plica irritation are non-operative and an arthroscopy can result in further irritation and scarring of the medial synovial plica. The medial plica can be seen through the routine anterolateral portal, but is better approached from the superolateral portal [1]. A definite diagnosis can be made using arthroscopy [17].

It is important to state that the presence of a plica in the investigation is not necessarily indicative of a pathological plica or the cause of pain [11].

## PROGNOSIS

Once the diagnosis has been made there are several treatment options. Initially, conservative treatment is preferable, and includes several options: a) physiotherapy comprising quadriceps, hamstring and gastrocnemius stretching, and quadriceps strengthening, which is controversial [7,12]; b) reducing activity and resting; and c) intraplical non-steroid or corticosteroid injections and NSAIDs. Results of conservative treatment are below 20% and seem to be more appropriate for young patients with a short duration of symptoms [4,7]. Amatuzzi et al. [13] concluded differently; their findings showed a 60% improvement with physiotherapy aimed at decreasing compressive forces of the knee by stretching and strengthening exercises. An exercise program is usually recommended for the first 6–8 weeks after the initial examination. An intraarticular corticosteroid injection should be considered in patients who do not improve with a physical therapy program, or in those with such an irritated plica that a therapy program may not be directly beneficial.

Once conservative treatment has failed, surgical treatment using arthroscopy is appropriate. During arthroscopy, the whole plica should be excised. This is a quick procedure with minimum morbidity and a fast recovery. However, there are several scenarios that have to be dealt with during arthroscopy. When plica is the only pathological finding, it should be considered responsible for the symptoms and should be resected. If associated secondary pathological conditions are present (e.g., synovitis, medial patellar chondromalacia, medial condylar groove or chondromalacia, or synovial pannus on the condyle), the plica must be resected, but failure can occur, as the secondary lesions may remain or become symptomatic as well. In knees with other lesions that have no relation to the plica (e.g., osteochondritis dissecans, medial meniscal tears, patellofemoral maltracking or ligament ruptures), the plica is probably not responsible for the symptoms and resection is not therefore warranted, especially if it was not painful on physical examination. However, as some of these conditions can induce symptoms similar to those of plica syndrome, there are physicians who will recommend a plica resection to avoid a

second arthroscopy [4]. Others will recommend plica resection in patients with an asymptomatic plica and other knee pathological conditions as preventive treatment, but this is very questionable [4]. Results are considered good in 75–91% of cases, though it seems that mild symptoms may persist [8,10,12,15].

## CONCLUSIONS

The differentiation of knee pain is important for selecting the appropriate treatment and determining the prognosis. The synovial plica is a normal anatomic structure that can become symptomatic. It must be remembered that medial plica syndrome is an uncommon condition. The presence of a plica does not necessarily indicate that it is the cause of the symptoms. On the other hand, it is frequently overlooked [2] and one has to keep an open mind regarding the possibility that it is present and may be the cause of the symptoms.

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### References

- Boles CA. Synovial plicae in the knee. *AJR Am J Roentgenol* 2001; 177: 221–7.
- Calmbach WL, Hutchens M. Evaluation of patients presenting with knee pain. Part II: Differential diagnosis. *Am Fam Physician* 2003; 68: 917–22.
- Garcia-Valtuille R, Abascal F, Cerezal L, et al. Anatomy and MR imaging appearances of synovial plicae of the knee. *Radiographics* 2002; 22: 775–84.
- Dupont JY. Synovial plicae of the knee. Controversies and review. *Clin Sports Med* 1997; 16: 87–122.
- Boyd CR, Eakin C, Matheson GO. Infrapatellar plica as a cause of anterior knee pain. *Clin J Sport Med* 2005; 15: 98–103.
- Lyu SR, Hsu CC. Medial plicae and degeneration of the medial femoral condyle. *Arthroscopy* 2006; 22: 17–26.
- Schindler OS. Synovial plicae of the knee. *Curr Orthop* 2004; 18: 210–19.
- Ewing JW. Plica: pathologic or not? *J Am Acad Orthop Surg* 1993; 1: 117–21.
- Sakakibara J. Arthroscopic study on linos band (plica synovia is mediopatellaris). *J Jpn Orthop Assoc* 1976; 50: 513–22.
- Broom MJ, Fulker JP. The plica syndrome: a new perspective. *Orthop Clin North Am* 1986; 17: 279–81.
- Irha E, Vrdoljak J. Medial synovial plica syndrome of the knee: a diagnostic pitfall in adolescent athletes. *J Pediatr Orthop B* 2003; 12: 44–8.
- Dorchak JD, Barrack RL, Kneisl JS, Alexander AH. Arthroscopic treatment of symptomatic synovial plica of the knee. Long-term followup. *Am J Sports Med* 1991; 19: 503–7.
- Amatuzzi MM, Fazzi A, Varella MH. Pathologic synovial plica of the knee. Results of conservative treatment. *Am J Sports Med* 1990; 18: 466–9.
- Lyu SR. Relationship of medial plica and medial femoral condyle during flexion. *Clin Biomech (Bristol, Avon)* 2007; 22: 1013–16.
- Kinnard P, Levesque RY. The plica syndrome. A syndrome of controversy. *Clin Orthop Relat Res* 1984; 183: 141–3.
- Magee D. Orthopedic Physical Assessment. 2nd edn. Philadelphia: WB Saunders, 1992: 564.
- Jee WH, Choe BY, Kim JM, Song HH, Choi KH. The plica syndrome: diagnostic value of MRI with arthroscopic correlation. *J Comput Assist Tomogr* 1998; 22: 814–18.