



## Research paper

# The evaluation of surgical treatment results of medial plica syndrome

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## ABSTRACT

**Introduction:** The medial plica of the knee is a thin inward fold of synovium which is quite often found during arthroscopic surgery, especially in adolescents. Its exact presence is a subject of wide discussion, and incidence reports ranging from 21% to even 95%.

**Aim:** The purpose of this study was to evaluate the long-term results of arthroscopic resection of medial plica in adolescents and find the main symptoms in plica syndrome of a successful arthroscopic plica resection.

**Material and methods:** Patients with hypertrophic medial plica were divided into 2 main groups, A and B. Group A ( $n = 26$ ) suffered from pain associated with popping and clicking, catching, pseudo-locking and snapping. Group B ( $n = 23$ ) suffered from pain only. Functional outcome indices (orthopaedic Tegner, Lysholm, and IKDC scores) were evaluated during this study.

**Results and discussion:** Considerably better postoperative results were obtained for the patients of group A (Tegner score 8, Lysholm score 90, IKDC 90) vs. patients of group B (Tegner score 6, Lysholm score 68, IKDC score 68).

**Conclusions:** Only anteromedial knee pain with popping, clicking, catching, pseudo-locking and snapping should be interpreted as a medial plica syndrome that will benefit from arthroscopic resection.

## 1. INTRODUCTION

The medial plica of the knee is a thin inward fold of synovium which is quite often found during arthroscopic surgery, especially in adolescents. Its exact presence is a subject of wide discussion, with reports ranging from 21.8% to even 95%.<sup>1–11</sup>

According to the Ewing<sup>6</sup> definition, medial plica syndrome is a painful impairment of knee function in which the only finding to explain its symptoms is the presence of thickened hypertrophic plica. Nonetheless, there are controversial opinions concerning the medial plica syndrome itself. The main controversy stems from the relationship between the size of plica and associated clinical symptoms. A recent study, however, suggests that impingement might be more common than previously reported, and less dependent on the size of the plica.<sup>12</sup> Also, the symptoms of medial plica syndrome are quite different and non-specific. The physical examination aspects of medial plica syndrome are therefore still controversial. In light of recent reports<sup>1,13</sup> a diagnostic test known as ‘taut articular band reproduces pain’ demonstrated good sensitivity and specificity. However the diagnostic basis of the presence and possible cause of plica syndrome in a particular patient is made by exclusion of clinical and radiological processes, ultrasound (US), or magnetic resonance imaging (MRI). The physical findings of the preoperative clinical examination with respect to symptomatic medial plica were un-specific or absent. According to Hagino et al.,<sup>14</sup> preoperative clinical evaluation failed to diagnose conditions such as medial plica syndrome. This opinion accords with Weckstrom et al.<sup>15</sup> who found that the preoperative clinical examination is not a reliable detector of medial plica. Definitive and most reliable diagnosis can be made using arthroscopy.<sup>1</sup>

Arthroscopy is regarded as a gold standard tool in diagnosing medial plica syndrome because it gives surgeons the ability to inspect the whole joint; assess the individual personality of plica; and moreover, determine the appropriateness of resection in the same session. This surgical procedure is neither complicated nor time-consuming. But there is a question as to whether each hypertrophic medial plica is indeed the primary cause of patients’ complaints, such that it justifies resection in each case.

Although there have been studies demonstrating that symptomatic plicae can be successfully treated with arthroscopic resection, they had limited follow-ups.<sup>5,8,16,17</sup> There is only one study, performed by Weckstrom et al.,<sup>15</sup> where long-term results of arthroscopic resection of the medial plica of the knee in young adults were evaluated. In this study 32% of patients had fair to poor results, although it is likely that the resected plica was not the actual cause of symptoms.<sup>15</sup>

## 2. AIM

We experienced a number of difficulties in diagnostics when faced with the different results that emanated from surgical intervention of medial plica. Consequently, we had to assume that additional symptoms, existing prior to surgery in the

form of popping, clicking, catching, pseudo-locking or snapping, would reveal the main symptoms of plica syndrome.

For these reasons it was decided:

- (1) to evaluate the long-term functional results of arthroscopic resection of a medial plica;
- (2) to find the main symptoms in plica syndrome of a successful arthroscopic plica resection.

## 3. MATERIAL AND METHODS

### 3.1. Subject selection

We conducted a retrospective study of adolescents who had undergone arthroscopic resection of a medial plica. All of the patients with medial plica whom we treated between 2002 and 2009 were subsequently reviewed in order to identify which of them met our inclusion criteria.

Inclusion criteria were:

- a history of anteromedial knee pain which the patient experienced between at least 6 months but no greater than 12 months;
- pain experienced primarily over the femoral condyle;
- visible or palpable plica with localized tenderness over plica;
- failure of conservative treatment;
- a history of popping, clicking, catching, pseudo-locking, and snapping;
- no other abnormalities in the knee joint being evident during arthroscopy.

Excluded from this study were:

- patients who had previously injured, or had undergone surgery, on either knee;
- patients with anterior cruciate ligament (ACL) and/or posterior cruciate ligament (PCL) insufficiency;
- patients with lateral and/or medial collateral ligament (LCL and MCL, respectively) tear.

Furthermore, patients with a full thickness cartilage lesion and meniscal lesions were also excluded. The aforementioned criteria were chosen to indicate the existence of a homogenous group of patients with plica syndrome who did not have other pathologies of the knee.

Written informed consent was obtained from the patients and their parents for publication of this research report. A copy of the written consent is available for review by the Editor of this journal.

### 3.2. Source population

The 67 patients meeting our criteria were included to this study, 18 of them were lost for follow up. Finally we enrolled 49 patients (36 females and 13 males). The average age of patients at the time of operation was 15.5 years (range 11–17 years, SD 1.10). The mean postoperative follow-up was 6.4 years (range 4–11 years, SD 1.92). All patients before the operation had been treated ineffectually, conservatively, or for more than 6 months. Initial treatment involved:

- (a) rehabilitation ( $n = 49$ );
- (b) reduction of sporting activity ( $n = 49$ );

- (c) pain relief and anti-inflammatory drugs, i.e. paracetamol 10 mg/kg b.w. per 24 h, or ibuprofen 10 mg/kg b.w. per 24 h for 2 weeks ( $n = 49$ );
- (d) intra-articular steroid injection; i.e. diprophos 1 mL single dose ( $n = 21$ ).

The patient rehabilitation program focused on local heat, US, and short-wave diathermy, together with stretching exercises for the quadriceps and hamstring muscle groups.

### 3.3. Study design

All patients suffered from intermittent dull pain located in the area medial to the patella area above the joint line and in the supramedial patellar area, whilst some patients reported additional popping, clicking, catching, pseudo-locking and snapping. Consequently, the patients were divided into 2 main groups, A and B. Group A contained 33% of males and 67% of females, whereas group B contained 20% of males and 80% of females. Group A ( $n = 26$ ) suffered from pain associated with popping and clicking (subgroup A1), catching (subgroup A2), pseudo-locking (subgroup A3) and snapping (subgroup A4). Group B ( $n = 23$ ) suffered from pain only (Table 1).

### 3.4. Preoperative examinations

During our pre-surgical examination tests of patients in the prone position, namely, 'taut articular band reproduces pain', lateral patella apprehension sign, McMurray's test (test of meniscal injuries), and ACL stability tests, we were looking for signs of patellofemoral crepitation, pathological Q-angle, and location of palpable tenderness and effusion of knee joint. All patients were submitted to pre-operative analyses using Tegner scores. In the case of 12 patients, MRI was performed, with US studies undertaken in 37 cases.

### 3.5. Operative techniques

All the arthroscopic plica resections were performed by no less than 3 orthopedic surgeons of the institution, each using the same approach and techniques of resection. In each case, the relevant plica was incised near its base with a cautery knife and shaver with synovial resector blade.

Postoperatively, the patients were mobilized (non-weight-bearing) on forearm crutches for 5–10 days, with full range of knee motion being permitted. In the absence of pain and swelling, progression to full weight bearing was allowed. Gradual return to sporting activity was further allowed 3 months postoperatively.

### 3.6. Intraoperative findings

Hypertrophy of the medial plica was the only syndrome that we saw in all our patients during arthroscopy, with its size being presented according to the Sakakibara scale (Figure 1).<sup>18</sup>

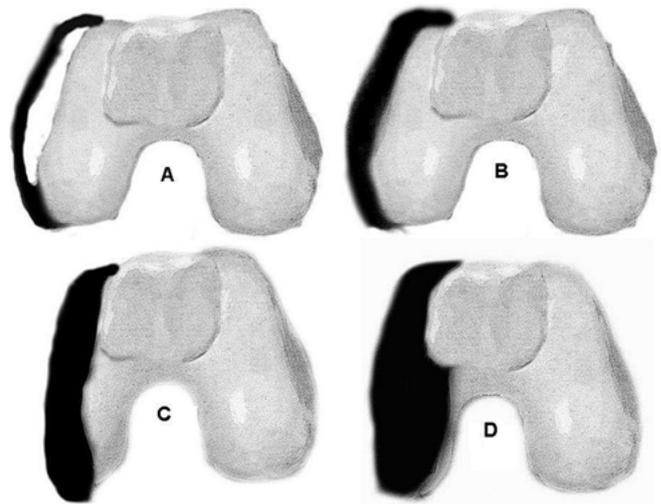
### 3.7. Postoperative findings – follow-up

Postoperative analyses using Tegner scores, with further analyses using Lysholm and International Knee Docu-

**Table 1. The clinical symptoms in patients of groups A and B before the surgical treatment.**

Clinical symptoms	Group A $n = 26$	Group B $n = 23$
Pain	26	23
Popping or clicking	20 <sup>a</sup>	–
Catching	15 <sup>b</sup>	–
Pseudo-locking	25 <sup>c</sup>	–
Snapping	16 <sup>d</sup>	–

Comments: <sup>a</sup> Subgroup A1, <sup>b</sup> Subgroup A2, <sup>c</sup> Subgroup A3, <sup>d</sup> Subgroup A4.



**Figure 1. Sakakibara scale.**

mentation Committee (IKDC) subjective forms were conducted, each being undertaken. Each postoperative analysis was done once 6.4 years (4–11 years, SD 1.92) after surgery. Besides the parameters of the IKDC subjective score, we used other subjective questions, such as: 'Would you have surgery again?', 'Have you suffered from any knee afflictions after the surgery?', and 'How long after the surgery did your previous condition reappear?'. Postoperative signs and symptoms such as clicking, catching, locking, or swelling were documented. Clinical evaluations were performed by a physician who was not involved in the surgery. Our purpose was to find any signs of patellofemoral crepitation with anterior knee pain, palpable tenderness and effusion of the knee joint, symptoms of hypoplasia of the quadriceps muscle, and passive range of motion.

### 3.8. Statistical analysis

To compare ordinal variables between two groups, the non-parametric *U* Mann-Whitney test was used. To compare the related samples, the Wilcoxon signed-rank test was used. The significance level was defined at  $P < 0.05$  for all tests. Statistical analyses were performed using the Statistica 10.0 software (StatSoft Inc).

## 4. RESULTS

### 4.1. Preoperative clinical assessment

We subsequently found in all patients: ‘taut articular band reproduces pain’, palpable tenderness in the anteromedial region of the knee joint, and painful lateral patella apprehension test without instability of the patella. We did not, however, find any patellofemoral crepitation, Q-angle more than 20°, effusion in the knee joint and signs of ACL injuries. Meniscal tests for medial meniscus were positive in 18% patients of group A, and in 17% patients of group B. In 36 cases (11 in MRI and 25 in US) hypertrophic medial plica was detected.

For all patients in group A, the preoperative Tegner median score was 7.0 without statistical differences between subgroups A1, A2, A3 and A4, whereas the score for group B was Me = 8.0. No significant differences between the two groups were therefore evident (Figure 2).

### 4.2. Intraoperative findings

In all patients dominated type C (in group A: 81.5%, in group B: 82.6%). No significant (NS) differences between the investigated groups and subgroups were found. The presence of a mechanical conflict of plica with patellofemoral joint was observed in all our patients during arthroscopy. No full thickness cartilage lesion was found.

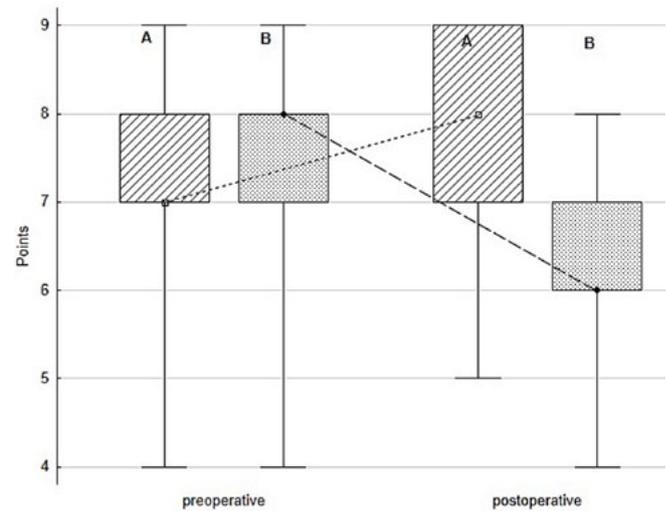
### 4.3. Postoperative findings – follow-up

For all patients in group A, the ‘postoperative’ Tegner score was Me = 8.0 without statistical differences between subgroups A1, A2, A3 and A4, whereas the score for group B was Me = 6.0 (Figure 2). Postoperatively, group A showed an improvement in the Tegner score with statistical significance ( $P = 0.0009$ ). All the patients returned to sport with the same or higher intensity than before their respective operations. In group B postoperatively there was deterioration in the Tegner score with statistical significance ( $P = 0.00006$ ). Almost a half of group B (47.8%) did not re-

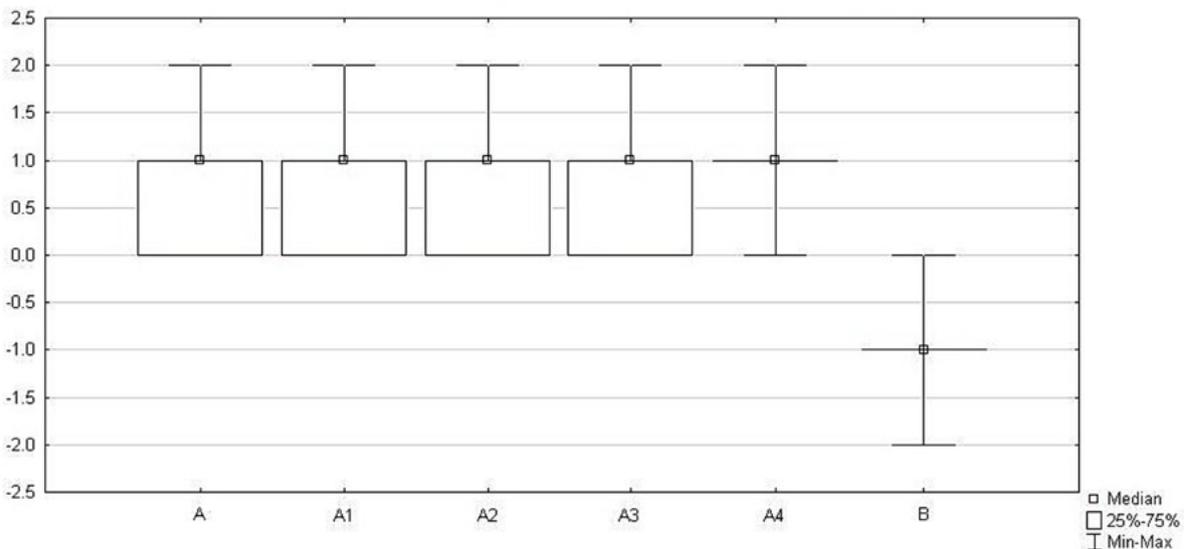
turn to sport. Preoperative comparison of groups A and B gave very similar results which is statistically NS. However, postoperative results of those groups in Tegner score showed statistical correlation to additional symptoms of medial plica syndrome (popping or clicking, catching, pseudo-locking and snapping) ( $P = 0.0001$ ).

It is apparent from Figure 3 that the mean changes in the Tegner scores before and after surgery in all subgroups of group A were statistically insignificant. For all group A the change in Tegner score was Me = 1.0. Whereas in group B the change in Tegner score was Me = -1. The change in the Tegner score between groups A and B were statistically significant ( $P < 0.000001$ ).

The postoperative Lysholm score for subgroups: A1 was Me = 90.0 points, A2 was Me = 90.0 points, A3 was Me = 90.0 points, A4 was Me = 90.0 points and for group B was Me = 68.0 points (Figure 4). No significant differences be-



**Figure 2. The comparison of Tegner scores in group A and B before surgical treatment and after long-term follow-up (6.4 years).**



**Figure 3. Change in Tegner scores after surgery comparing groups A (plus subgroups) and B.**

tween all subgroups A were found. In contrast to those, the postoperative Lysholm scores between groups A and B were statistically significant ( $P = 0.000001$ ). The main problems in patients with low Lysholm scores in both groups were pain and swelling during severe exertion and also impaired kneeling and squatting.

The postoperative IKDC subjective score for subgroup A1 was Me = 90.0 points, A2 was Me = 89.0 points, A3 was Me = 90.0 points, A4 was Me = 89.0 points and for group B was Me = 68.0 points (Figure 5). As in the case of Lysholm score no significant differences between A subgroups were observed, whereas the postoperative difference in IKDC scores between groups A and B was statistically significant ( $P < 0.0000001$ ).

#### 4.4. Subjective questions and postoperative clinical assessments

All patients of group A indicated that they would have the operation again, if necessary. Only 40% of group B patients being likely to choose the option of having the surgery again. Recurrence of ailments in group A occurred in 26% of patients in that

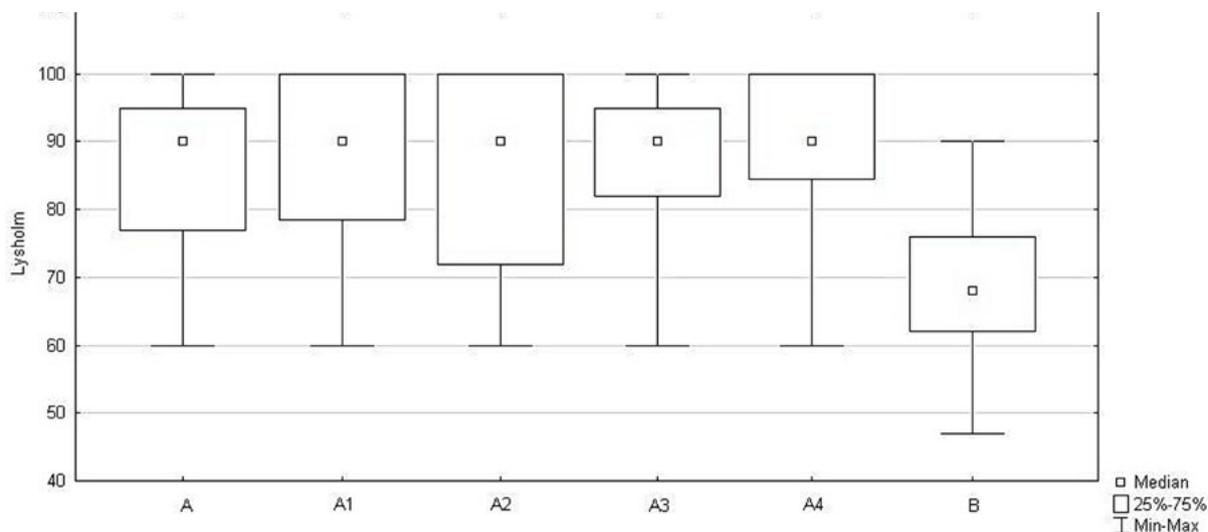
group, and with 80% in group B. The average remission time in both groups was similar, approximately 2 years after surgery.

Postoperatively the passive range of motion in all patients of both groups was physiologically symmetrical compared to that of the normal knee. None of the patients of the whole cohort had an effusion assessed by balloting the knee. Eight patients of group B (34.8%) demonstrated the symptoms of quadriceps muscle hypoplasia. A decrease of circumference of the thigh by at least 2 cm in comparison to the symmetrical thigh was observed.

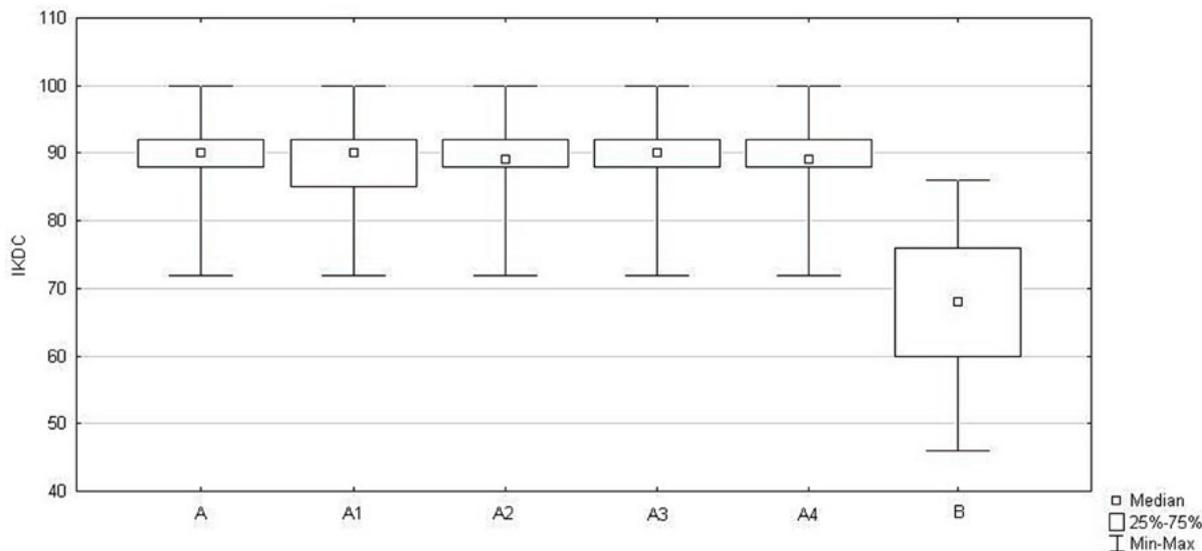
Patellofemoral crepitation with anterior knee pain was found in 29.6% of patients in group A, and 91.3% of patients in group B (Table 2).

**Table 2. The clinical symptoms in patients of groups A and B after long term follow-up (4–11 years).**

Clinical symptoms	Group A <i>n</i> = 26	Group B <i>n</i> = 23
Quadriceps muscle hypoplasia	0	8
Patellofemoral crepitation	8	21



**Figure 4. Comparison of postoperative Lysholm scores in groups A (plus subgroups) and B.**



**Figure 5. Comparison of postoperative IKDC scores in groups A (plus subgroups) and B.**

#### 4.5. Gender comparison

Our study did not reveal any significant differences between the males and females in either group A or B.

#### 4.6. Complications

Postoperative complications were not observed in any patient of the whole cohort.

### 5. DISCUSSION

The main result of our findings is that a condition of antero-medial knee pain associated with popping, clicking, catching, pseudo-locking, and snapping should be interpreted as a medial plica syndrome that would benefit from arthroscopic resection.

The main complaints of patients presenting with medial plica syndrome are dull, aching pains over the medial aspect of their knees that increase with physical activity. They may also complain of a snapping, popping clicking, and locking sensation when flexo-extenso movements of the knee are undertaken. Instances of this additional complaints have been reported in approximately 50% of all patients who presented with medial plica irritation.<sup>1,16,19–21</sup> The mentioned complaints are caused by a mechanical conflict of plica with patellofemoral joint. The presence of such conflict was observed in all our patients during arthroscopy. It is known that the high pressure generated by arthroscopic pumps in joint cavities change the anatomical arrangement of joint components, including synovial plicae. The high pressure in the knee joint during arthroscopy tightens the medial plica and suggests its conflict with articular surfaces. This occurrence during arthroscopy may lead to an incorrect assumption of the existence of medial plica syndrome resulting in misdiagnosis. In light of recent reports<sup>10,12,22</sup> some benefit from resection of a medial plica may be where the plica is hypertrophic and acting as a shelf that catches over the medial femoral condyle, causing some erosion of the articular cartilage in this area. Based on arthroscopic findings, Sakakibara<sup>18</sup> has classified medial plica into four types:

- (1) type A – chord-like elevation in the synovium;
- (2) type B – shelf-like appearance not covering the anterior surface of medial femoral condyle;
- (3) type C – large shelf of synovium covering the anterior surface of medial femoral condyle;
- (4) type D – shelf with central defect, having tags which impinge upon patellofemoral joints.<sup>22</sup>

According to most authors<sup>1,2,4,7</sup> only the hypertrophic plica, Sakakibara type C or D, gives rise to the resultant pain in the knee. Although all our patients had hypertrophic medial plica, we nevertheless obtained good treatment results only when mechanical symptoms prior to surgery were evident. It appears that not only hypertrophy of medial plica, observed during arthroscopy, but symptoms of popping, clicking, catching, pseudo-locking and snapping, associated with knee pain, qualify patients to successful arthroscopic resection of medial plica.

In all of our patients, no case of articular cartilage damage was found. The absence of such lesion may result from short time of disease (6–12 months), domination of type C hypertrophy that deals only the anterior surface of medial condyle, and high elasticity of cartilage in children. Furthermore, Gerbino et al.<sup>9</sup> describe the early patellofemoral pain in many young people that appears before the symptoms of patellar chondromalacia. We believe that hypertrophy of the medial plica is a main cause of any pain being experienced. Similar conclusions can be drawn from the observations described by Chow.<sup>3</sup> Uysal et al.<sup>23</sup> concluded that pain is generated by inflammatory changes caused by the medial plica and that the cartilaginous lesions do not contribute significantly to clinical symptoms of this syndrome.

Preoperative comparison of groups A and B gave similar results. No statistically significant differences between them was found. It seems that patients of group B may have additional patellofemoral pain syndrome (PFPS) generated by medial patellofemoral ligament (MPFL).<sup>24</sup> Similar results of clinical tests were obtained both in the cases of the medial plica syndrome and PFPS. The arthroscopic detection of hypertrophic medial plica does not exclude other pathological changes within the knee joint.

Definitely better results were obtained in group A. Interestingly, group A contained less of females (67%), whereas group B (80%). This deference between males and females in both groups was not statistical significant. It is commonly accepted that females are more sensitive to pain than men, having less physical activity, more frequent valgus knee deformity, weaker quadriceps muscles, higher Q angles, and higher internal rotation of the femoral neck.<sup>25,26</sup> It seems that these features may well predispose to the development of medial plica syndrome and/or PFPS. It is of additional interest that about 35% of group B patients demonstrated hypoplasia of the quadriceps muscle. It appears that hypofunction of this muscle may be a main cause of unexpected failure in the treatment of medial plica syndrome and/or PFPS.<sup>1,10,19,27</sup> We believe that the improvement of quadriceps muscle function by intensive rehabilitation should therefore precede the prospective suitability of patients to surgical treatment. It may also be useful in the event of PFPS. Furthermore, arthroscopic surgery may eliminate any clicking, popping, or pseudo-locking, and thus facilitate the improvement of quadriceps muscle function, thereby making it possible for patients to regain normal physical activity.

Moreover, patients and their families should always be informed that resection of medial plica will not obviate the need for continued improvement of quadriceps muscle function. It would, however, be more of an adjunctive procedure to give the individual the ability to perform more effective physiotherapy by decreasing the mechanical symptoms of clicking, popping, pseudo-locking, and snapping.

## 6. CONCLUSIONS

We conclude that only anteromedial knee pain with popping, clicking, catching, pseudo-locking and snapping is to be interpreted as a medial plica syndrome that will profit from an arthroscopic resection. Furthermore, this procedure is not associated with postoperative complications. We suggest that patients experiencing pain as the only symptom of this syndrome should be treated conservatively.

Since there is no preoperative IKDC or Lysholm score, our research has some limitations as a prospective study in that we do not have a control group being treated in a conventional manner.

### Conflict of interest

All of the authors declare no conflict of interest.

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