Arthroscopic resection of medial plica of the knee in young adults

Maria Weckström a,⁎, Maria H. Niva a,⁎, Antti Lamminen c, Ville M. Mattila a,d,⁎, Harri K. Pihlajamäki a,c

a Centre for Military Medicine, Research Department, Helsinki, Finland
b Central Military Hospital, Department of Orthopaedic Surgery, Helsinki, Finland
c Helsinki Medical Imaging Center, University of Helsinki, Finland
d Department of Orthopedic Surgery, Tampere University Hospital, Tampere, Finland

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A B S T R A C T

The purpose of this study was to evaluate the long-term results of arthroscopic resection of a medial plica and to describe the usefulness of the clinical findings and MRI for preoperative diagnostics. From the baseline population of 172,777 military conscripts, thirty-three consecutive young adult patients with normal preoperative MRIs of the knee and a sole postoperative diagnosis of medial plica were treated with arthroscopic plica resection. Functional outcome was evaluated at a final follow-up in 25 patients with 34 knees with Kujala, Lysholm and visual analog scale (VAS) scores. Functional results were excellent to good in 17 patients, fair in three patients, and poor in 3 patients. The median Kujala score was 92 (25–100), the median Lysholm score 89 (26–100), and the median VAS 1.4 (0–8.8). Median follow-up time was 6.6 years (3.6–8.7 years). Most patients had no history of direct knee trauma preceding the symptoms. No statistically significant correlation was seen between MRI classification of the plica size or clinical findings compared to arthroscopic classification. Resection of the medial plica in a symptomatic knee has good to excellent functional long-term outcome in the majority of cases, and the procedure is not associated with postoperative complications. MRI and preoperative clinical examination seem to be unreliable in detecting medial plicae.

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1. Introduction

The medial plica is a synovial fold and a normal anatomic structure of the knee. It courses from the superior parts of the medial wall obliquely down to the synovial lining of the infrapatellar fat pad, and is etiologically considered a remnant of the cavitation development in the fetal knee [1]. The medial synovial plica is a common finding in knee arthroscopies, especially in the age range of 11 to 40 years [2–5]. It presents mostly as a thin, pink and pliable, asymptomatic synovial fold, but great variation has been demonstrated in terms of size, location, shape and appearance of the medial plica even in asymptomatic knees [2–5]. Direct trauma to the knee or repetitive indirect trauma of continuous strenuous exercise [6–8] may provoke inflammation in the synovial tissue of the plica leading to increasing fibroticity, loss of elasticity, and varying degrees of synovitis. Owing to the anatomic location of the medial plica, a loss of normal elasticity can cause it to impinge on the femoral medial condyle or the medial facet of the patella during flexion–extension motion of the knee [4,9]. This kind of repetitive contact may result in a chondral lesion of varying severity, sometimes referred to as an impingement lesion [9–11]. A recent study suggests that impingement might be more common than previously reported and less dependent on the size of the plica [4]. It has also been suggested that normal-looking medial plicae, not impinging on the articular surfaces, could be symptomatic as well [12]. This is supported by recent findings which have demonstrated an increase in the amount of nerve endings in the plica after trauma or overuse, indicating increased pain sensitivity and sensation of pain [13].

The usefulness of magnetic resonance imaging (MRI) as a preoperative diagnostic tool for plicae of the knee has been studied [14–16]. Although plicae have been visible on MRI, no significant correlation has been found between MRI and arthroscopic classification [16] or between MRI findings and probability of resection at arthroscopy [14].

In terms of surgical techniques we have seen a shift from the earlier practice of division of the plica [8,9,17], which proved prone to scar formation [6,17], to the more complete resection of the plica, which is widely used today. Although studies have demonstrated that symptomatic plicae can be successfully treated with arthroscopic resection [6,7,18–21], these studies had limited follow-ups and, to our knowledge, no long-term investigations exist. The aims of the present study were, therefore, (1) to evaluate the long-term functional results of arthroscopic resection of a medial plica (2) to describe the clinical symptoms and findings of patients with plica (3) to assess the association between the symptoms before surgery and the outcome in

⁎ Corresponding author. Centre for Military Medicine, Research Department, Tommillanranta 1a, 36270 Kangasala, Finland. Tel.: +358 405821356.
E-mail address: ville.mattila@uta.fi (V.M. Mattila).
the follow-up and (4) to study the usefulness of MRI for preoperative diagnostics.

2. Methods

A retrospective search of the database of the Central Military Hospital of Finland was conducted. The baseline population for this study consisted of 172,777 military conscripts, who were under the catchment area of the Central Military Hospital between 1997 and 2002. From this population, we first selected all patients who had undergone both MRI examination and arthroscopy of the knee during a 6-year period (578 patients). The main inclusion criterion for this study was an MRI examination followed by arthroscopy of the same knee and with (1) a sole postoperative diagnosis of a medial plica; (2) a normal preoperative MRI of the knee; and (3) an arthroscopic plica resection performed at the Central Military Hospital after the MRI. Altogether 36 patients (48 knees) met these final inclusion criteria and were invited to long-term follow-up examinations.

The operations were performed at the authors’ institution which provided all surgical services for the entire Finnish Defence Forces at that time. All male citizens in Finland become liable for compulsory periodic military service at the age of 18 years, female citizens have had the opportunity to volunteer for military service since 1995. The majority of the conscripts are 19 years old at the beginning of their basic training. The study was approved by the Medical Ethics Committee of the authors’ institution, and an informed consent was obtained from each participant.

The original, complete medical records of the patients including preoperative MR images were retrieved and reviewed. Initial treatment was conservative with rest, physiotherapy, and nonsteroidal anti-inflammatory drugs as needed for all patients. If incapacitating knee pain persisted despite conservative treatment, a thorough arthroscopic examination of the entire knee joint was performed. If no other pathology was identified, the medial plica was deemed responsible for the symptoms and resected. The arthroscopic plica resections were performed by altogether six orthopaedic surgeons of the institution using the same approach and technique of resection, with either basket forceps or a shaving device. All plicae in this study were arthroscopically resected, not divided. In eight knees, additional synovial tissue bulging into the knee joint was resected (anteromedially or medially around the plica in six knees; in the posterior area of the medial compartment in one knee; and in the anterolateral area in one knee). The size of the medial plicae seen in arthroscopy was classified as small, moderate, shelf-like or fenestrated; corresponding to the common classification often referred to as the Sakakibara classification scheme [5] with type A indicating a cordlike elevation in the medial wall; type B, a shelf-like formation not covering the anterior surface of the medial condyle; type C, a large shelf-like formation covering the anterior surface of the medial condyle; and type D, a fenestrated plica.

Images were preoperatively obtained on a 1.0-T scanner (Signa Horizon, GE Medical Systems, Milwaukee, Wisconsin) using a knee coil with a field of view of 10 to 16 cm. Slice thickness was 3 to 4 mm, with a 0.5– or 1.0-mm intersection gap. Sagittal T1 and T2* images, coronal proton density images with fat suppression, and either axial gradient-echo (3D T1 FSPGR) images, axial proton density images or axial T2-weighted images with fat suppression were obtained. Intra-articular contrast medium was not used.

For this long-term follow-up study, two musculoskeletally-oriented radiologists reviewed the MR images in consensus, blinded to clinical data and previous radiological investigations, and with the emphasis on identifying medial plicae. The plicae were graded from axial images according to the Sakakibara classification scheme [5] described earlier. Data on patients’ symptoms and general health status before surgery were collected from the original medical records.

From the 36 patients, three patients (five knees) were lost to follow-up before the study commenced (two had died and one had moved abroad). Of the 33 patients invited for long-term examinations, eight patients not responding to repeated invitations were lost to final follow-up. Twenty-five patients (69%) with 34 knees (71%) attended the final follow-up. Nine patients (36%) had bilateral operations. All patients were young adults with a median age of 20 years (18–28) at the time of surgery. Their average height was 179 cm (166–195), average weight was 76 kg (58–108), and average BMI was 23.7 kg/m2 (20.5–29.3). Seven patients were slightly overweight [22] (BMI 25.0 kg/m2 to 29.9 kg/m2). The median follow-up time was 6.6 years (3.6 to 8.7) for the 25 patients (24 men, 1 woman) with a total of 34 knees studied (18 right and 16 left knees).

During the final follow-up the patients underwent a physical examination and completed a questionnaire recording information about the functional outcome after resection. In addition, the patients were interviewed and asked about their general health status and symptoms following surgery, and possible subsequent operations were recorded. The Kujala [23] and Lysholm [24,25] scores were used to measure functional outcomes. In both scoring systems, a score of 95 points or more was considered excellent, 94 to 85 points good, 84 to 65 points fair, and less than 65 points was considered a poor result. To determine the degree of subjective pain experienced by the patients at follow-up, a ten-point (0 cm to 10 cm) visual analog scale (VAS) was used; a score of 0 denoting none, 1 to 3 light, 4 to 6 moderate, 7 to 9 hard, and 10 the worst imaginable pain.

Mean values were calculated for the continuous unskewed data and median values for the continuous skewed data, with range (min–max). Associations between groups in continuous skewed variables were measured using the Kruskall–Wallis test. Bivariate correlations were calculated for continuous variables. Cross tabulations and chi-square test were used when testing associations between classified variables. We used SPSS for Windows software (version 14.0; SPSS Inc, Chicago, Illinois) for statistical analysis. The significance level was defined at p<0.05 for all tests.

3. Results

The long-term follow-up data of the functional results as determined by the Kujala or Lysholm knee scores were excellent to good in 17 patients (68%), fair in 5 (20%) and poor in three (14%). The median Kujala score was 92 (25–100), and the median Lysholm score was 89 (26–100). The median VAS score for knee pain experienced at final follow-up was 1.4 (0–8.8). The functional outcomes measured by either scoring system (Kujala p=0.182, Lysholm p=0.391) or the amount of knee pain at final follow-up (p=0.256) did not correlate with the size of the resected plica. The median duration of symptoms prior to plica resection was 4.5 months (2 to 72), which did not correlate with the functional outcome scores at the final follow-up (Kujala p=0.097, p=0.586; Lysholm 0.0006, p=0.974).

The clinical symptoms and findings of these patients varied. Preoperatively, the patients listed various activities as pain-provoking: all 25 patients experienced knee pain during exertion such as marching or running. 19 had knee pain when kneeling and/or climbing stairs, 6 experienced knee pain at rest and 8 in normal walking. Eleven knees had no preoperative physical findings indicative of a symptomatic medial plica, 13 knees had less specific symptoms such as crepitation, snapping or a positive McMurray test, and 10 knees presented with medial patellar pain, the most constant sign of the syndrome, with or without other less specific findings. We found no statistically significant association between symptoms (positive lateral McMurray (p=0.87), positive medial McMurray p=0.48), patellar crepitation (p=0.72), genu varum (p=0.12) or genu varus (p=0.04). None of the knees presented with the almost pathognomonic sign; a painful cord, palpable alongside the medial edge of the patella or quadriceps atrophy. A direct trauma to the knee had preceded the symptoms in ten knees (8 patients), including eight with the plica classified on arthroscopy as type C and one classified as a scarred type D.

In the reevaluation of the preoperative MR images, performed by the two musculoskeletal-oriented radiologists, a medial plica was detected in 21 of the 34 knees. The appearance of the medial plica was a cordlike elevation in 17 knees (type A, Fig. 1), shelf-like without covering the anterior surface of the medial condyle in one knee (type B, Fig. 2) and large, shelf-like, covering the anterior surface of the medial condyle in three knees (type C, Fig. 3). No fenestrated plicae (type D) were detected. Thirteen knees were not classified due to nondifferentiation of the plica, mostly resulting from the use of fat-suppression sequences and lack of intra-articular fluid or soft-tissue

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The unfavorable sequences also prevented assessment of possible chondral damage or identification of fibrotic plicae from the MR images. Arthroscopic observations and MRI evaluations matched in ten of the 34 knees; most of the matches (eight knees) were type A. Association between the plica size on MR images compared to arthroscopic classification was not seen ($p = 0.74$).

In the arthroscopic reports, the medial plica was described as small (corresponding to Sakakibara type A) in 14 knees, moderate (type B) in three, shelf-like (type C, Fig. 4) in 16 and fenestrated (type D) in one knee. Four of these plicae were described as fibrotic or having a hard rim, and in the patient who had undergone a previous plica incision 4 years earlier, the plica was described as a tight band of scar tissue (Fig. 3). In one knee with a fibrotic fairly large plica, an area of $1.5 \, \text{cm} \times 1.5 \, \text{cm}$ of chondral damage could be seen on the responding surface of the medial femoral condyle. One patient had grade 1 chondral changes in the sulcus and patellar area.

No postoperative complications were detected during follow-up. All patients were mobilized on the day of surgery or the first postoperative day, and active quadriceps exercises were encouraged. The median length of hospital stay was 3 days (2–5), and the median time for using crutches was 7 days (1–30). Five patients returned to the hospital for a follow-up visit, for others, the postoperative follow-up was done in military garrison outpatient clinics until the patients were fit for normal military training. They returned to work or normal military training after a median of 3 weeks (2–8).

Four patients underwent subsequent arthroscopy before the final follow-up, but neither significant new findings nor a need for re-resection of the medial plica was revealed. Of these patients, two received an arthroscopic intervention, one patient had a resection of the infrapatellar fat pad, and one had a lateral retinacular release. The other two patients had diagnostic arthroscopy but no arthroscopic procedures were deemed necessary. The diagnoses for continued knee problems in these patients were: chondral lesion of the femoral condyle in one patient (visible at plica resection), recurrent patellar subluxation in two, and in one patient the reason for knee pain remained unclear.

4. Discussion

The principal finding of the present study showed an excellent to good functional long-term outcome in the majority of the young adult...
patients after arthroscopic resection of medial plica, the only exceptional finding in their symptomatic knee in arthroscopy. In addition, preoperative MR imaging or clinical symptoms were poorly associated with arthroscopical findings. Resection of the medial plica in a symptomatic knee has a good to excellent functional long-term outcome in the majority of cases, and the procedure is not associated with postoperative complications. MRI and preoperative physical examination seem to be unreliable in detecting medial plica.

Our findings showed good to excellent pain relief at final follow-up for the majority of patients, regardless of the size of the plica and of whether the duration of symptoms had been short or long. Previously, Hansen and Boe reported excellent to good results after a shorter (3.6 years) follow-up in the majority of their 46 resected medial plicae [7]. There are several other authors reporting short-term results consistent with our findings [18–21] and others who have included various plicae, also other than medial plicae in their short-term studies [6,8,9,17]. Comparability between study results is impaired to some extent by the variation in the scoring and evaluation systems and surgical techniques used in these short-term follow-ups. However, it must be kept in mind, that eight out of 25 patients had fair to poor results, and it is probable that the resected plica was not the actual cause of symptoms and thus arthroscopic resection of plica must be considered carefully. Certainly, randomized controlled studies are needed to assess the effectiveness of plica resection.

In the current study, half of the resected plicae were small or moderate and half were large or fenestrated, but no correlation could be established between the size of the plica and the final outcome. This is in concordance with previous reports, which note that the size of the plica and severity of symptoms are not proportional [10,16] and that even smaller plicae may in fact impinge [4]. A study by Farkas et al. suggests enhanced pain sensitivity in medial plicae when provoked by trauma, even without the presence of actual impingement [13]. More than two-thirds of our patients had suffered no specific trauma to the knee prior to onset of symptoms, and it could be argued that the intensified exercise typical in military training did in part precipitate the exacerbation of symptoms. In light of recent reports [4,10,13,26], even though parts of the pathomechanism of the plica syndrome still remain unclear, arthroscopic resection should be considered if incapacitating knee pain is accompanied with an arthroscopic finding of a medial plica of the knee. As shown by the present study, the long-term outcome of this procedure is good and unassociated with complications.

The present study is the first follow-up study with categorical use of MRI in the preoperative evaluation of patients with symptomatic plicae, aiming to assess the usefulness of MRI in preoperative diagnostics of this condition. We found poor and non-significant correlation between preoperative MR imaging and arthroscopy findings. According to previous radiological studies [14,15], gradient-echo T2-weighted, fat-suppressed T2-weighted, or proton density-weighted images are the most valuable for the evaluation of plicae. The poor visibility of medial plicae in our patients can be explained partly by the retrospective collection method and the different preferences and practices among the radiologists in choosing the MRI protocol for the diverse preoperative diagnoses. It seems crucial that the above mentioned plica-specific sequences be used, as sequences producing ‘general, all-purpose’ images will not necessarily have the visibility needed to detect or evaluate synovial plicae. However, it must be kept in mind in clinical diagnostics, that normal MR imaging does not exclude medial plica.

In addition to poor diagnostic value of MRI, the physical findings of the preoperative clinical exams with respect to symptomatic medial plicae were unspecific or absent. In fact, none of the patients presented with a painful palpable mediopatellar cord, and one-third had no findings indicative of symptomatic medial plica. It seems, therefore, that the preoperative clinical examination is not a reliable detector of medial plica. As limitations in preoperative radiology and clinical diagnostics persist, arthroscopy has remained the gold standard in plica diagnosis.

The retrospective patient data collection method for the follow-up could be considered a limitation of the study, in terms of the impact on the exactness of the arthroscopic evaluation of the plica size. A second limitation, also due to the retrospective aspect, was that secondary plicae known to accompany other internal derangements of the knee [4] might have been excluded. However, the authors believe that the study setting enabled better assessment of the effects of medial plica resection without the impact of confounding factors. The strengths of the present study included the longest follow-up ever reported (median 6.6 years) and a relatively good percentage of the patients attending the final follow-up (25 out of 33, 69%).

We conclude that arthroscopic resection of the medial plica of the knee yields good to excellent results in relieving incapacitating knee pain in young adults. Furthermore, this procedure is not associated with complications or recurrence of symptoms. Preoperative clinical examination and the type of routine MRI used in the current study seem unreliable in detecting medial plicae. In the future, randomized controlled trials are needed to compare the outcome of the resection of the plicae with the non-operative treatment.

5. Conflict of interest statement

The authors do not have any competing interests, additional affiliations, financial agreements, or other involvements with any other authors.

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