MRI of the medial plica syndrome: retrospective comparison between patients with a pathologic plica confirmed by arthroscopy, and a control group.

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Aims and objectives

Synovial plicae are remnant of the three compartments of the knee during fetal development around 8 week [1][2]. The medial plica courses coronally on the medial wall of the joint capsule and insert distally on the infrapatellar fat pad (Fig.1). Medial plica is found in 24% of cadaver in autopsic study, whereas the frequency is 72% in arthroscopic study [3][4]. Medial plica is also called plica synovialis patellaris, lino band, plica alaris, synovial shelf, or patellar meniscus [5].

This synovial fold is usually non symptomatic. It can become symptomatic causing the medial plica syndrome. The patient is generally young, with a repetitive activity requiring flexion-extension. Even a knee contusion can cause symptoms. The medial plica can also become thickened and potentially symptomatic in any knee pathology (traumatic, inflammatory). There is inflammation and fibrosis of the plica which impinges on the trochlear or femoral cartilage, and generates a medial patellar pain, usually above the joint line [6]. Physical findings are non specific: crepitus, pseudo-locking or effusion. A painful cord palpable is pathognomonic, but this sign has a poor sensitivity.

Arthroscopy is the gold standard to confirm the diagnostic. Sakakibara classified mediopatelar plica into four types (A,B,C and D). Type C and D are considered symptomatic when the plica is trapped between the medial condyle and patella [7].

Treatment is first conservative, with drugs and physical therapy. If no success, arthroscopic resection is performed [8][9].

Magnetic Resonance (MR) signs to predict a medial plica syndrome are non univocal in the literature. The purpose of this study was to identify MR characteristics of the medial plica to lead to a non invasive diagnosis of a medial plica syndrome.
Fig. 1: Anterior view of a knee slightly declined. Illustration of the common plicae.

Methods and materials

Study population

The institutional review board approved this retrospective study, and the requirement to obtain informed consent was waived. 19 teenagers suspect of medial plica syndrome underwent MRI of the knee and arthroscopy, which confirmed a pathologic medial plica (Sakakibara C or D) with resection of this plica (Fig. 2). We established a control group with 25 patients who underwent knee MRI and arthroscopy for another reason, without medial plica identified. All the arthroscopy have been performed at Amiens University Medical Center by pediatric surgeons, between August 2005 and June 2013.

Images Analysis

We reviewed the MRI, blinded to clinical data. Only axial T2 Fat-Sat weighted images of the femoro patellar joint were analysed in order not to be influenced by a knee pathology in the control group.

Images acquisition was not the same for all the patients because it was preoperatively obtained from different MRI scanner, not exclusively at Amiens University Medical Center. Images with Cube DP Fat-Sat acquisition were remodelled by a third party to obtain axial slices on the femoro-patellar joint. The review was done on Advantages Windows console 4.6.

The criteria studied were: presence of the plica, floating aspect, interposition into the femoro-patellar joint, number of slices with interposition, height of the interposition, total length and length after the interposition line, length of the floating part, thickness, high signal in T2 FatSat weighted image, contact with femoral or trochlear cartilage, focal femoral or trochlear chondromalacia (on the medial facet), focal or diffuse synovitis, intraarticular effusion, and fenestrated aspect.

We practiced a « learning session » on random knee MRI for evaluating this criteria. Usually for radiologists, a medial plica exists when there is a linear structure floating at the expected location. During our learning session, this finding was rare. Thus, in order to be coherent with the epidemiological data available in the literature, we considered a medial plica present when we found a linear structure floating but also when there was a thickening or a bulge of the joint capsule back the retro patellar fat pad, supposing that this thickening is composite of the joint capsule and the medial plica collapsed against the capsule (Fig. 3 and 4). The medial plica was considered floating when we could individualize a linear band with local effusion (Fig. 5). The interposition was defined as a medial plica crossing the interposition line (Fig. 6). The interposition line was defined as a line extended between the medial tip of the patella and the point X. This point X
was variable on each slice, and was defined as the intersection of the tangents of the medial condylar facet and the medial trochlear facet (Fig. 7). Height of the interposition was automatically calculated from the slice thickness and the gap value of the acquisition. Thickness of the plica was graded in 4 levels: grade 0 was absence of plica, grade 1 less than 1 mm, grade 2 less than 2 mm, grade 3 less than 3 mm. Intra-articular effusion was also graded in 4 levels: grade 0 was no effusion or physiological effusion, grade 1 small effusion, grade 2 intermediary effusion and grade 3 important effusion. The plica was considered fenestrated when there had fluid inside making a windows.

**Statistical Analysis**

The distribution of patients according to gender was compared with that of control group by using Fisher exact test. The age of patients was compared with the control group distribution by using the Mann-Whitney U test.

We used non-parametric statistical tests with a significance level for p-value <0.05: Fischer test for qualitative criteria, Mann-Whitney test for quantitative criteria.

A p-value less than 0.05 was considered to indicate a significant difference.

XLStat software (version 2013.4.05) with Microsoft Excel (for Mac 2011 version 14.2.0) was used.
Images for this section:

**Fig. 2:** Arthroscopic view: Sakakibara type D.

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Fig. 3: Continuous arrow: thickening of the joint capsule back the retro patellar fat pad: Medial plica considered present.

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**Fig. 4:** Continuous arrow: hypointense capsule. Successive slices: no bulging of the joint capsule. No medial plica considered.

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Fig. 5: Continuous arrow: retro patellar fat pad. Dashed arrow: medial plica floating.

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**Fig. 6:** Red line: interposition line. Dashed arrow: medial plica interposed.

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Fig. 7: Intersection point defining the point X.

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Results

Clinical Data

The mean age was 14.2 years for the study group (15 females and 4 males; range age: 8-20) and 15.3 years for the control group (15 females and 10 males; range age: 10-18). There had no significant difference for age (p=0.08) and gender (p=0.45) (Table 1). The medial plica syndrome predominantly affected females (Sexe Ratio=3.75). 4 patients presented a bilateral plica syndrome at different times (21%), supposing a genetic predisposition.

We found 27 medial plica among the 44 MRI reviewed, performing a prevalence of 61%. We approach the arthroscopic data (72%), which is in favour of the way we considered a medial plica present during the review [6].

In the study group, a frequent sporting activity was present in 26% of cases (5 of 19) and a triggering trauma in 31% (6 of 19). Patients presented crepitus in 5% of cases (1 of 19), instability in 11% (2 of 19), pseudo-locking in 47% (9 of 19), and quadriceps atrophy in 52% (10 of 19). There had no significant differences with the control group (p>0.05). The sensibility of a painful medial cord rolling under the skin was in 79% (15 of 19), with a specificity of 100%. There had not any patellar tap (Table 1). All the patients underwent an arthroscopic resection of the plica, with complete regression of the pain at 6 months in 74% of cases (14 of 19 patients).

Imaging data

For all the criteria studied in MRI, there had no significant differences between both groups (p>0.05). Only intra articular effusion was significantly different (p=0.004) with predominance in the control group, explained by the choice of the control group (pathology generating intra articular effusion). The only criterion approaching 0.05 was the thickness of the plica, with a tendency to grade 1.16 in the study group and grade 0.8 in the control group (p=0.2). In the control group, there was a tendency to a floating aspect for the medial plica (p=0.11), a patellar chondromalacia (p=0.11), and a superior length of the floating part (p=0.16). (Table 2 and 3).
### Table 1

**Characteristics of the population**

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Study Group</th>
<th>Control Group</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4 M 15 F</td>
<td>10 M 15 F</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td>0.45</td>
</tr>
<tr>
<td>Age when arthroscopy</td>
<td>14.2±2</td>
<td>15.3±3.05</td>
<td>0.08</td>
</tr>
<tr>
<td>Trauma</td>
<td>6</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Sport</td>
<td>5</td>
<td>7</td>
<td>0.97</td>
</tr>
<tr>
<td>Quadriceps atrophy</td>
<td>10</td>
<td>6</td>
<td>0.45</td>
</tr>
<tr>
<td>Pseudo-locking</td>
<td>9</td>
<td>4</td>
<td>0.15</td>
</tr>
<tr>
<td>Instability</td>
<td>2</td>
<td>4</td>
<td>0.46</td>
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<tr>
<td>Crepitus</td>
<td>1</td>
<td>2</td>
<td>0.42</td>
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<tr>
<td>Medial cord palpable</td>
<td>15</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Patellar tap</td>
<td>0</td>
<td>8</td>
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</table>

**Table 1**

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### Table 2

**Analysis of qualitative criteria**

<table>
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<td>YES</td>
<td>NO</td>
<td>YES</td>
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<tr>
<td>Presence of the medial plica</td>
<td>14</td>
<td>5</td>
<td>13</td>
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<tr>
<td>Floating aspect</td>
<td>2</td>
<td>17</td>
<td>7</td>
</tr>
<tr>
<td>Interposition</td>
<td>7</td>
<td>12</td>
<td>8</td>
</tr>
<tr>
<td>High Signal in T2 Fat Sat Weighted Image</td>
<td>0</td>
<td>19</td>
<td>1</td>
</tr>
<tr>
<td>Contact with cartilage</td>
<td>4</td>
<td>15</td>
<td>3</td>
</tr>
<tr>
<td>Patellar chondromalacia</td>
<td>1</td>
<td>18</td>
<td>3</td>
</tr>
<tr>
<td>Trochlear chondromalacia</td>
<td>0</td>
<td>19</td>
<td>1</td>
</tr>
<tr>
<td>Focal Synovitis</td>
<td>1</td>
<td>18</td>
<td>2</td>
</tr>
<tr>
<td>Diffuse synovitis</td>
<td>0</td>
<td>19</td>
<td>7</td>
</tr>
<tr>
<td>Fenestrated aspect</td>
<td>0</td>
<td>19</td>
<td>0</td>
</tr>
<tr>
<td>Presence of the medial plica without intra articular effusion</td>
<td>10</td>
<td>9</td>
<td>6</td>
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</tbody>
</table>

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<table>
<thead>
<tr>
<th>Criteria</th>
<th>Study Group</th>
<th>Control Group</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of slices with interposition</td>
<td>1.8±2.4</td>
<td>1.32±2.2</td>
<td>0.47</td>
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<tr>
<td>Height of the interposition (mm)</td>
<td>6±8.3</td>
<td>4.8±7.8</td>
<td>0.55</td>
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<tr>
<td>Total length (mm)</td>
<td>5±3.45</td>
<td>4.25±4.79</td>
<td>0.55</td>
</tr>
<tr>
<td>Length after interposition line (mm)</td>
<td>1.8±2.3</td>
<td>1.36±2.2</td>
<td>0.51</td>
</tr>
<tr>
<td>Length of the floating part (mm)</td>
<td>0.38±1.3</td>
<td>1.1±1.9</td>
<td>0.16</td>
</tr>
<tr>
<td>Thickness (grade)</td>
<td>1.16±0.9</td>
<td>0.8±0.9</td>
<td>0.2</td>
</tr>
<tr>
<td>Intra-articular effusion (grade)</td>
<td>0.2±0.4</td>
<td>1±1</td>
<td>0.004</td>
</tr>
</tbody>
</table>
Conclusion

Our study demonstrates the poor contribution of MRI for the diagnosis of a medial plica syndrome. In particular, the criteria usually described in the literature, such as a thick long and hypo intense band that covers the anterior surface of the medial femoral condyle are not associated with a medio patellar syndrome.

These results are in according with Boles and al who did not find MR characteristics (width, thickness, relation to the trochlear cartilage, and effusion) significantly predictive of resection [10].

Monabang and al found a significant association when the plica was interposed on more than 5 transverse slices with focal fluid adjacent to the plica [11], and Jee and al suspected a pathologic medial plica with a criterion of extension beyond the medial end of the patella on axial images [6]. We did not find these results in our cohort.

The result for the floating aspect was unexpected because it is predominant in the control group, and the length is greater, supporting the hypothesis that plicae are collapsed and more visible after intra-articular distension. On the contrary, floating aspect is rare in the study group. This data probably explains a large number of plica shown in daily practice explained by a knee pathology generating intra articular effusion, without being associated with a medio patellar syndrome. Tendency to patellar chondromalacia in the control group makes us wonder about the pathogenic role of the floating plica on cartilage of these patients.

This assumption could also explain the dissonance between epidemiological and autopsic data, because the cadaveric phenomena would prevent the visualizing of the medial plica. Conversely, intra-articular distension applied during arthroscopy would facilitate its visualization. Then, we can ask ourselves about the role of MR arthrography to help diagnosis of a medial plica, but it remains an invasive procedure for teenagers.

Furthermore, our study provides epidemiological information on patients suffering of a medial plica syndrome. This pathology affects teenagers (average age: 14,2 years old), with a female dominance (Sexe Ratio=3,75), and with bilateral involvement in 21% of cases (genetic predisposition suspected). Sport was present in 26% of cases, triggering trauma in 31%, crepitus in 5%, instability in 11%, pseudo-locking in 47% and quadriceps atrophy in 52%. In our cohort, the sensibility of a painful medial cord rolling under the skin was 79% with a specificity of 100 %, making it a strong diagnosis sign. There had not any patellar tap. Complete regression of symptoms was obtained in 74% after arthroscopic resection, which demonstrates surgery efficiency.
In our work, several limitations should be taken into account. The major one comes from the control group that is not fully asymptomatic but presents a pathology generating an intra-articular effusion, which potentially causes alterations of the plica on MRI images. Second, patients and control subjects were not matched individually for age and gender. Third, this is a retrospective study with a small population. Fourth, all imaging were not performed on the same machine, and they were not acquired in the same conditions (some were 3D Cube acquisition). Finally, despite a blind analysis and a strict analysis of axial T2 Fat-Sat weighted images of the femoro patellar joint, ligament injury or bone oedema can suggest belonging to the control group.

Others studies with more patients are necessary to confirm this results, in particular thickness of the medial plica that tends to be greater in the study group. Paczesny and Kruczynski suggested the aid of dynamic sonography to detect abnormalities of medial plica, with good sensitivity (90%) and specificity (83%). Three sonographic criteria were studied: continuous echo sliding over the medial femoral condyle during medial and lateral movement of the patella, entry of the echo under the patella during medial movement of the patella and pain or discomfort during dynamic sonography [12].

To conclude, if suspicion of a medial plica syndrome, MRI is primarily used to eliminate differential diagnosis. Diagnostic should not be questioned without a long and thick band impinging the femoro-patellar joint. On the contrary, a large number of medial plica shown in daily practice are probable incidentalomas revealed by intra-articular effusion.
Personal information

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References


