Reconstruction of the medial patellofemoral ligament for the treatment of habitual or recurrent dislocation of the patella in children

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We investigated the clinical outcome of a reconstructive procedure of the medial patellofemoral ligament for the treatment of habitual or recurrent dislocation of the patella in four children (6 knees), with a minimum follow-up of four years. The technique involves transfer of the tendon of semitendinosus to the patella using the posterior one-third of the femoral insertion of the medial collateral ligament as a pulley.

There was no recurrence of dislocation after surgery. The mean Kujala score at follow-up was 96.3 points. Radiological assessment showed that the congruence angle, the tilt angle and the lateral shift ratio were restored to normal. The lateral and medial stress shift ratios and the Insall-Salvati ratio remained abnormal.

We conclude that this technique can be recommended for the treatment of habitual or recurrent patellar dislocation in children, although hypermobility and patella alta are not fully corrected.

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Habitual or recurrent dislocation of the patella is common in children. Predisposing factors include ligamentous laxity, contracture of the lateral patellar soft tissues, patella alta and hypoplasia of the lateral femoral condyle. More than 100 different surgical techniques for the treatment of patellar instability have been described during the past 100 years.1-5 These can be grouped broadly into soft-tissue balancing or bony procedures. In children with open growth plates, bony procedures such as the Elmslie-Trillat technique are contraindicated because of damage to the growth plate and the subsequent deformity. Soft-tissue procedures, specifically a lateral retinacular release with mobilisation of vastus medialis to a more distal and lateral position on the extensor mechanism, is a widely accepted procedure for children.6

It is complicated, however, by a high rate of recurrent dislocation.7,8 Recently, the medial patellofemoral ligament (MPFL) has been recognised as being an important stabiliser of the patella, preventing lateral dislocation.9-11 It extends from the superior two-thirds of the medial patellar margin to an insertion which is distal to the adductor tubercle and proximal to the posterior aspect of the femoral attachment of the medial collateral ligament (MCL), with superficial fibres extending to the posterior capsule of the knee.10 The MPFL is damaged when the patella dislocates laterally.11 Based on the cadaver study of Ochi et al,12 we have developed a technique for its reconstruction using a semitendinosus tenodesis. The reconstruction, combined with a lateral retinacular release and mobilisation of vastus medialis to a more distal and lateral position, gives a stable patellofemoral joint. Since 1986, we have carried out more than 110 such reconstructions and in this study we considered the outcome in children below the age of ten years.

Patients and Methods

We retrospectively reviewed three children (4 knees) with habitual patellar dislocation and one child (2 knees) with recurrent dislocation, at a mean follow-up of 7.4 years (4.8 to 10) after reconstruction of the MPFL. There were two boys and two girls with a mean age at surgery of 8.5 years (6 to 10). The children were all Japanese and there was no family history of joint laxity or associated syndromes. All had a contracture of the lateral patellar soft tissues, patella alta, and hypoplasia of the lateral femoral condyle.

Operative technique. A 5 cm oblique incision is made over the pes anserinus and the semitendinosus is divided at its musculotendinous junction using an open tendon stripper leaving it attached distally (Fig. 1). Through an incision 2 cm long over the femoral attachment of the MCL, a 1 cm slit is made in its posterior one-third to act as a pulley, and through a curved incision over the patella the semitendino-
The semi-tendinosus tendon (large arrow) is transferred to the patella using a pulley in the posterior one-third of the proximal aspect of the medial collateral ligament (small arrow).

Postoperative assessment included clinical examination, assessment of symptoms and range of movement and the score of Kujala et al., which includes a variety of symptoms and signs of patellar instability and whose maximum is 100. Radiological assessment included anteroposterior (AP) and lateral views, standard Murchant’s view and a 2 kg stress skyline view in 45° flexion. Axial MRI was also undertaken. We used the Murchant’s view to measure the congruence, tilting and sulcus angles, and the lateral shift ratio. The lateral and medial stress ratios were obtained from the stress radiographs (Fig. 2). The Insall-Salvati ratio was measured on the lateral view. We evaluated the reconstructed MPFL for its signal intensity and course on MRI.

**Results**

There was no recurrent dislocation after surgery. The apprehension test remained positive in both knees of one girl. All knees had a full range of movement. The mean Kujala score was 96.3 (89 to 100). Four knees scored 100 points and two 89 points (Table I).

On radiological assessment, the mean congruence angle was $-6.2 \pm 6.4^\circ$, the mean tilt angle was $5.2 \pm 2.4^\circ$, and the mean lateral shift ratio was $15.0 \pm 5.7\%$. These values were within the normal range. The mean sulcus angle was $153.2 \pm 2.7^\circ$, and the Insall-Salvati ratio $1.4 \pm 0.1$. These were abnormal. The mean lateral stress ratio was $26.3 \pm 7.6\%$ and the mean medial stress ratio was $-21.5 \pm 3.9\%$; these values remained abnormal (Table II).

**Table I.** Clinical details of the four children (six knees) who underwent medial patellofemoral ligament reconstruction for the treatment of habitual or recurrent dislocation of the patella

<table>
<thead>
<tr>
<th>Case</th>
<th>Gender</th>
<th>Age (yrs)</th>
<th>Diagnosis</th>
<th>Side</th>
<th>Follow-up (yrs)</th>
<th>Kujala score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>M</td>
<td>16</td>
<td>Habitual</td>
<td>L</td>
<td>10</td>
<td>100</td>
</tr>
<tr>
<td>2</td>
<td>M</td>
<td>15</td>
<td>Habitual</td>
<td>R</td>
<td>9</td>
<td>100</td>
</tr>
<tr>
<td>3</td>
<td>F</td>
<td>15</td>
<td>Recurrent</td>
<td>L</td>
<td>8.2</td>
<td>100</td>
</tr>
<tr>
<td>4</td>
<td>F</td>
<td>15</td>
<td>Recurrent</td>
<td>R</td>
<td>7.5</td>
<td>100</td>
</tr>
<tr>
<td>5</td>
<td>F</td>
<td>16</td>
<td>Habitual</td>
<td>R</td>
<td>5</td>
<td>89</td>
</tr>
<tr>
<td>6</td>
<td>F</td>
<td>16</td>
<td>Habitual</td>
<td>L</td>
<td>4.8</td>
<td>89</td>
</tr>
<tr>
<td>Mean</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>7.4</td>
<td>96.3</td>
</tr>
</tbody>
</table>

Diagrams of the 2 kg stress skyline view in 45° of knee flexion, showing a) the lateral stress ratio (%) $BC/AB \times 100$ and b) the medial stress ratio (%) $BC/AD \times 100$. 

Fig. 1

Reconstruction of the MPFL. The semi-tendinosus tendon is transferred through the pulley to the patella. The site of the pulley is adjacent to the normal attachment of the MPFL to the femur. The transferred tendon is sutured to the surface of the patella with a moderate medial force with the knee flexed at 30°. The tracking of the patella and the tension of the reconstructed MPFL from 0° to full flexion is assessed; the tension should increase slightly when the knee is fully extended.

**Fig. 2a**

**Fig. 2b**
On axial MRI four knees without a positive apprehension test showed areas of low intensity, whereas two with a positive apprehension test had a loose MPFL and a high intensity area in the reconstruction.

Discussion

Many corrective procedures have been described for children with habitual or recurrent dislocation of the patella. The most common procedure is a lateral release with mobilisation of vastus medialis to a more distal and lateral position. Transfer of the tibial tubercle is contraindicated in children because of the risk of premature closure of the anterior aspect of the proximal tibial physis with the development of a recurvatum deformity. It is difficult to obtain a normal position of the patella in these children using soft-tissue balancing procedures alone.

Galeazzi and Baker et al have described good results using a semitendinosus tenodesis. Baker et al reported good or excellent results in 80% of 53 knees; there was, however, a recurrence rate of 5%. Letts et al described 22 children who were treated in this way; 88% were asymptomatic at follow-up but the rate of recurrence was 12% at a mean of three years and two months after surgery. One disadvantage of this technique is that the direction of force used to stabilise the patella is medial and inferior, whereas the patella does not usually dislocate laterally and superiorly, but only laterally. Another is that isometricity of the transferred tendon during movement of the knee is poor. If a full range of movement is obtained, the tension of the tendon may be loose near full extension. Before surgical treatment, one of the authors (MO) studied the most suitable site of insertion for the reconstructed MPFL in cadavers. The posterior one-third of the proximal attachment of the MCL, which is near the femoral attachment of the MPFL, was chosen as the site for the pulley. The excursion between this point and the patella was relatively isometric.

In our current study, this surgical technique has proved to be effective. There were no recurrent dislocations after surgery, and on radiological evaluation, the congruence angle, tilt angle and lateral shift became normal. The values for the lateral and medial stress ratios were abnormal, showing that there remained some hypermobility of the patella and the Insall-Salvati ratio also remained abnormal showing some patella alta. This indicated that the direction of the stabilisation was purely medial, and that the patellar height was not corrected.

<table>
<thead>
<tr>
<th>Case</th>
<th>Congruence angle (°)</th>
<th>Tilting angle (°)</th>
<th>Lateral shift (%)</th>
<th>Sulcus angle (°)</th>
<th>Lateral stress ratio (%)</th>
<th>Medial stress ratio (%)</th>
<th>Insall-Salvati</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-5</td>
<td>0</td>
<td>4.8</td>
<td>144</td>
<td>0.0</td>
<td>-9.5</td>
<td>1.3</td>
</tr>
<tr>
<td>2</td>
<td>-15</td>
<td>6</td>
<td>13.3</td>
<td>146</td>
<td>10.0</td>
<td>-10.0</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>-22</td>
<td>2</td>
<td>11.6</td>
<td>158</td>
<td>28.0</td>
<td>-24.5</td>
<td>1.6</td>
</tr>
<tr>
<td>3</td>
<td>-20</td>
<td>6</td>
<td>7.1</td>
<td>156</td>
<td>30.0</td>
<td>-25.0</td>
<td>1.7</td>
</tr>
<tr>
<td>4</td>
<td>10</td>
<td>16</td>
<td>43.0</td>
<td>155</td>
<td>50.0</td>
<td>-33.3</td>
<td>1.4</td>
</tr>
<tr>
<td>4</td>
<td>15</td>
<td>1</td>
<td>10.0</td>
<td>160</td>
<td>40.0</td>
<td>-26.7</td>
<td>1.5</td>
</tr>
<tr>
<td>Mean</td>
<td>-6.2</td>
<td>5.2</td>
<td>15.0</td>
<td>153.2</td>
<td>26.3</td>
<td>-21.5</td>
<td>1.4</td>
</tr>
<tr>
<td>Normal value for Japanese (range)</td>
<td>-10.7 (-21 to 0)</td>
<td>10.4 (5 to 20)</td>
<td>10 (3.2 to 20)</td>
<td>138 (126 to 146)</td>
<td>16.7 (10.7 to 22.1)</td>
<td>-0.4 (-4.6 to 3.8)</td>
<td>1 (0.8 to 1.2)</td>
</tr>
</tbody>
</table>

Radiographs showing Murchant’s view of a boy (case 1) with habitual dislocation of the patella. a) Before surgery when he was six years old, and b) ten years after surgery.
Although this is a small study there are several interesting observations. First, the transferred tendon grew at the same rate as the MPFL since no medial shift or tilt appeared with growth. Secondly, with regard to the sulcus angle, in one boy (case 1), who had his left knee operated on at six years of age, it had improved when compared with the opposite side ten years after surgery (Fig. 3). In one girl (case 4), who had had her left knee treated surgically when she was ten years old, the sulcus angle remained abnormal five years after surgery (Fig. 4). This difference suggests that the sulcus angle might have corrected if the position of the patella and its relationship within the patella groove during flexion of the knee had been corrected when the children were younger.

We conclude that this technique for reconstruction of the MPFL can be recommended for children with habitual or recurrent dislocation of the patella, who do not have associated syndromes, although hypermobility of the patella and patella alta are not corrected.

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

References