

# The Three-In-One Proximal and Distal Soft Tissue Patellar Realignment Procedure

## Results, and Its Place in the Management of Patellofemoral Instability\*

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### ABSTRACT

The three-in-one procedure for extensor mechanism realignment of the knee combines lateral release, vastus medialis obliquus muscle advancement, and transfer of the medial one-third of the patellar tendon to the tibial collateral ligament. We observed 37 patients (42 knees) receiving this treatment at a minimum 25-month follow-up (range, 25 to 85 months; mean, 44). Thirty-two of 42 knees (76%) with recurrent patellar dislocation had good or excellent results after surgery. Redirection occurred in four knees (9.5%). Skeletal immaturity, chondral damage, and generalized ligament laxity did not seem to affect outcome. Thirty patients (37 knees) were studied 2 years earlier as well (mean follow-up, 29 months). When comparing the results 2 years later, there was a significant deterioration in outcome over time. These results are comparable with the published results for other techniques of patellar stabilization. We describe the place of the three-in-one operation in our surgical protocol for patellofemoral instability, which is based on the principle that a procedure should be selected to address the underlying pathologic features in an individual case rather than always using one operation for all cases.

Patellar instability and its surgical treatment (after a period of rehabilitation has failed) remains controversial.

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We present the results of a technique used by the senior author (PM) and discuss its place in our current protocol for surgical treatment of patellar instability. Preexisting patellofemoral chondral damage<sup>8,13</sup> and generalized ligament laxity<sup>10,16</sup> have been reported to be adverse factors in extensor mechanism realignment surgery. Furthermore, a deterioration of results with time has been reported for some techniques.<sup>8,10</sup> We assessed these observations in the context of our series.

### PATIENTS AND METHODS

The senior author (PM) performed a combined proximal and distal soft tissue patellar realignment procedure (the three-in-one procedure<sup>24</sup>) for 48 knees with recurrent lateral dislocation of the patella. All patients had undergone a rehabilitation program and, in some cases, lateral release surgery. In skeletally mature patients, only those with a Q angle<sup>3</sup> less than 25° underwent the three-in-one procedure. A modified Elmslie-Trillat tibial tuberosity transfer was preferred for knees having larger Q angles (see "Discussion" section). In the skeletally immature patient, because of the risk of premature epiphyseal closure, only soft tissue surgery was offered and therefore any magnitude of Q angle was accepted for the three-in-one procedure. The Q angle was measured with the patient supine and the knee flexed 30° over a wedge support to engage the patella in the trochlear groove. To reduce errors in measurement due to rotation, the medial border of the foot was kept vertical. A specially adapted goniometer with a hinge to conform to the limb and a long arm to reach to the anterosuperior iliac spine was employed. An assessment for generalized joint laxity was made using the criteria of Carter and Wilkinson.<sup>5</sup>

Clinical records were reviewed and patients completed postal questionnaires that incorporated the Hughston

Knee Disorders Subjective History Visual Analog Score (Hughston VAS), which has previously been validated.<sup>12</sup>

Adopting the practice of the Hughston Clinic (Columbus, Georgia), we equated a score of 90 to 100 with an excellent result, one of 75 to 89 with a good result, one of 50 to 74 with a fair result, and one less than 50 with a poor result (G. C. Terry, personal communication, 1994). Any patient suffering a recurrent patellar dislocation after surgery was reported as having a poor result, regardless of his or her questionnaire score.

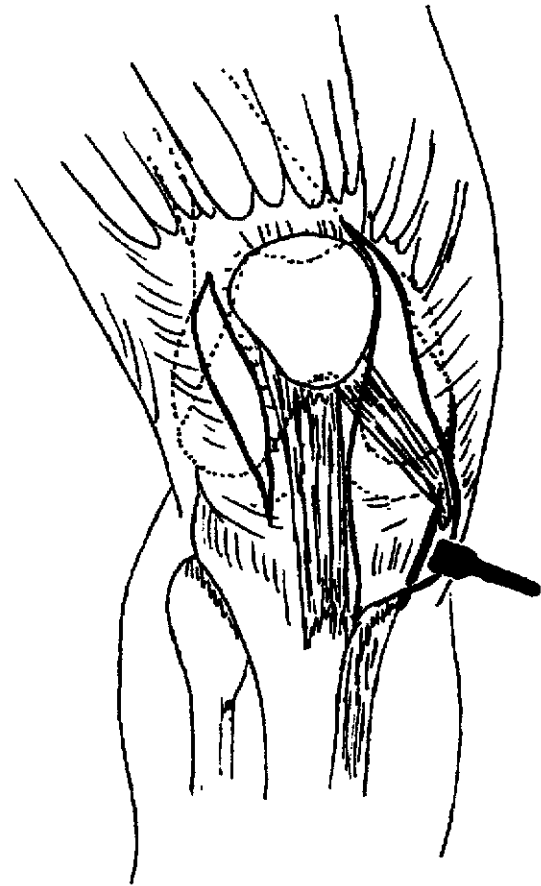
Thirty patients (37 knees) included in this study were the subjects of a similar study made using the same criteria for assessing outcome 2 years earlier.<sup>24</sup> The period of follow-up then was a mean of 29 months (range, 10 to 70). Comparison of outcome data from that study with the data collected here, 2 years later, allowed assessment of any changes in the result with time.

#### Operative Technique

An initial arthroscopic examination of the knee was performed. In particular, any lesions that could be responsible for symptoms, such as plica or fat pad abnormalities, were sought. Any unstable flaps of the patellar articular cartilage were trimmed, but no shaving or drilling was performed. Once arthroscopic examination was complete, a skin incision was made starting over the midpoint of the patella and continuing inferiorly to the medial side of the tibial tuberosity. The incision was usually about 8 to 10 cm long. The incision was deepened through the subcutaneous fat to the fascia, from which the fat layer was elevated to allow visualization of the lateral and medial retinacula, patellar tendon, and superomedial patella where the vastus medialis obliquus tendon inserts.

Division of the lateral retinaculum was performed with an electric needle, taking care to leave the synovium intact and not to extend the division proximal to the superior pole of the patella nor into the muscle fibers of the vastus lateralis muscle.

The medial retinaculum was divided to release the vastus medialis obliquus insertion and to reveal the medial patellar tendon. The incision started adjacent to the superomedial corner of the patella and passed inferiorly about 5 mm from the edge of the medial patella, then ran down the medial border of the patellar tendon to the tibial tuberosity. Only the retinaculum was opened; the joint was not breached. The sheath of the patellar tendon was opened medially. The retinaculum was elevated medially from the tibia to expose the anterior edge of the tibial collateral ligament superior to the pes anserinus. The medial one-third of the patellar tendon was detached from its tibial insertion by sharp dissection and split from the remaining tendon, leaving it attached proximally to the patella. This portion of the patellar tendon was then transferred medially and sutured to the tibial collateral ligament so that the transferred portion made an angle of 40° to 45° with the intact patellar tendon (Fig. 1). The

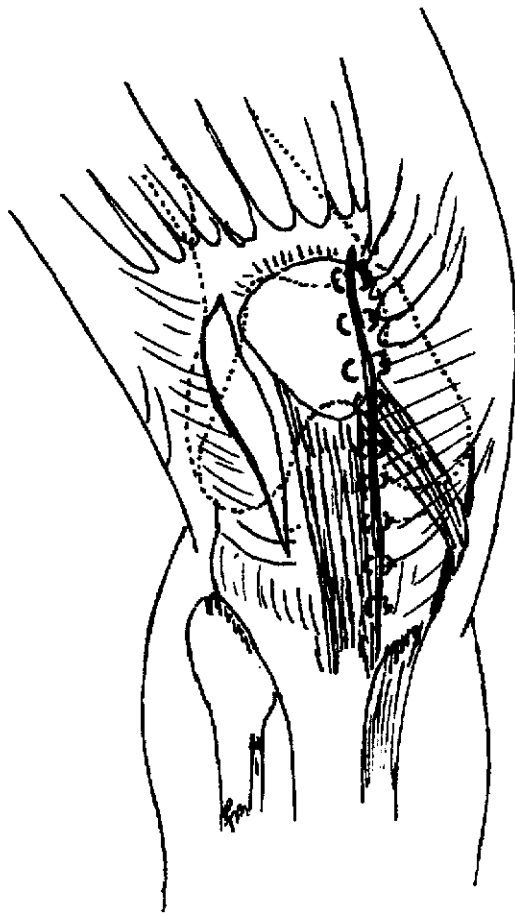


**Figure 1.** Lateral release and transfer of the medial one-third of the patellar tendon to the tibial collateral ligament in a right knee.

knee was flexed approximately 30° during the insertion of sutures to prevent overtightening of the transferred portion of the patellar tendon relative to the intact two-thirds.

The vastus medialis obliquus tendon insertion was advanced 5 to 10 mm distally and laterally by means of stout, interrupted plicating sutures. Usually three or four sutures were required. Then a continuous suture was used to close the retinaculum (Fig. 2).

The tourniquet used during the procedure was deflated and hemostasis was achieved before the wound was closed in layers over a suction drain. Local anesthetic was infiltrated into the wounds, the lateral release site, and the knee joint. Dressings and a brace (to maintain 20° of flexion) were applied. The postoperative regimen was 2 weeks of nonweightbearing followed by a transition from partial to full weightbearing over the next 2 weeks, during which time the patient was "weaned" off the brace to begin limited movement. At 6 weeks after surgery, a program of strengthening and restoration of range of movement was commenced. At 12 weeks after surgery, a period of sport-specific rehabilitation was started.



**Figure 2.** Technique for advancement of the vastus medialis obliquus tendon insertion and closure of the medial retinaculum.

**RESULTS**

Data were available on 42 (88%) knees from the 48 operated on. The minimum period of follow-up was over 2 years (range, 25 to 85 months; mean, 44). The mean patient age was 21.1 years (range, 13 to 56). There were 12 male and 25 female patients and 11 patients had generalized ligament laxity. Prior surgical interventions are summarized in Table 1.

There were 76.2% good (17 knees) or excellent (15 knees) results. Of the five knees with poor results, three had overall scores on the Hughston VAS of less than 50, and two of these had recurrent patellar dislocations. The other two knees with poor results also had recurrent dis-

**TABLE 1**  
Prior Surgeries Undergone by Patients in this Study

Previous surgery	Number
Diagnostic arthroscopy	7
Lateral release	4
Removal of loose bodies	1
Unknown operation	1

locations but had better Hughston VAS scores. One of these patients was back to full sporting activity, and the other was rated fair according to the Hughston VAS score. Overall, the redislocation rate was 9.5% (four knees). Two of those patients with redislocations have undergone subsequent Elmslie-Trillat patellar realignment procedures with satisfactory outcomes.

No significant difference was found in the rate of good or excellent results for skeletally immature compared with skeletally mature patients by application of the chi-square test with Yates correction ( $P > 0.1$ ). The grades of patellar articular surface damage (according to Outerbridge<sup>26</sup>) and subsequent surgical outcome scores are summarized in Table 2. Applying the statistical analysis described earlier, no significant relationship of patellar chondral damage and outcome was found ( $P > 0.1$ ).

Overall outcome scores for the 30 patients (37 knees) who were assessed in the preliminary study were compared with the outcome scores for the current study. In the earlier report, at a mean 29 months' follow-up, there were 87.5% good or excellent results (32 of 37 knees) compared with 76.2% (32 of 42) 2 years later using the same criteria for assessing outcome. Applying the signed Wilcoxon rank sum test revealed that the deterioration in functional outcome was statistically significant ( $P < 0.05$ ).

Complications after surgery were seen in two patients. One developed a deep vein thrombosis that was treated with warfarin. Another patient required open arthrolysis. Many of the patients' scars spread, but none were hypertrophic. Despite this, there were no complaints of scar sensitivity.

**DISCUSSION**

The technique described here is a modification of the procedures described by Goldthwait,<sup>15</sup> Slocum et al.,<sup>30</sup> and Mansat.<sup>21</sup> The effect of the medial soft tissue surgery is to reinforce the medial patellofemoral and patellotibial ligaments in "fascial layer 2"<sup>31</sup> and the medial patellomeniscal ligament in "fascial layer 3."<sup>31</sup> These ligaments combine to provide more than 75% of the passive resistance to lateral patellar displacement.<sup>7</sup> They are usually attenuated in cases of recurrent patellar instability. In addition, the medial surgery combined with the lateral release counters the laterally directed force on the patella during knee motion. Medial transfer of the medial one-third of the patellar tendon rather than the lateral one-third, as in the Roux-Goldthwait procedure, avoids problems of inducing lateral patellar tilt.

**TABLE 2**  
The Relationship Between the Outerbridge Grade of Patellar Chondral Damage and Postoperative Outcome Grade

Patellar chondral damage (Outerbridge grade)	Outcome	
	Good/Excellent	Fair/Poor
0-2	28	6
3-4	4	4

We believe our patient-assessment method by means of the Hughston VAS is appropriate. It is a valid clinical outcome measure. The Hughston VAS allows objective assessment of subjective symptomatic and functional status. Furthermore, it has been compared favorably<sup>12</sup> with the Larson,<sup>19</sup> Lysholm,<sup>20</sup> and Noyes<sup>25</sup> knee scores.

Over 100 surgical procedures have been described for the treatment of patellofemoral instability. Although each has its merits and disadvantages, none is ideal for all cases. The major problems in comparing published results of surgical treatment of patellofemoral instability are that the indications for surgery and the patient groups are dissimilar, and the methods of patient assessment vary greatly among studies.

Some surgeons advocate lateral release alone, even for recurrent patellar dislocation.<sup>11,23</sup> Good results have been reported for proximal soft tissue procedures.<sup>17,28</sup> The Roux-Goldthwait soft tissue realignment procedure has been well documented.<sup>6,13</sup>

Bonnard et al.<sup>2</sup> reported results similar to ours using a technique different from the one we describe, but they included medial transfer of the medial patellar tendon to the tibial collateral ligament in children. The Elmslie-Trillat procedure (involving tibial tuberosity transfer) has had satisfactory results reported.<sup>4,8,27,32</sup> The results we present for the three-in-one operation are comparable with those published for other procedures. Compared with the published literature, our series is significant in size and length of follow-up.

Our 9.5% rate of recurrent dislocation compares well with the rates reported by other authors. Scuderi et al.<sup>28</sup> recognized redislocation as a "common complication" after a patellar realignment procedure. In their review of publications they found redislocation rates varied from 5% to 25%. A problem in interpreting the literature is that it is not always possible to be sure whether recurrent instability refers to dislocation or subluxation or both. Unfortunately, unlike the report by Shelbourne et al.,<sup>29</sup> most studies do not clearly differentiate recurrent subluxation from recurrent dislocation.

Several authors have been able to correlate chondral damage of increasing severity on the patella with a poor outcome after patellar realignment surgery.<sup>8,13</sup> However, like other authors<sup>17,28</sup> we did not find this relationship. Similarly, we did not find an association between the presence of generalized ligament laxity and a poor outcome, although this has been previously reported.<sup>10,16</sup>

Dandy and Desai<sup>10</sup> noted a deterioration in the results according to the system of Crosby and Insall<sup>9</sup> from 50% graded excellent at 4 years after lateral release in cases of frank recurrent lateral dislocation of patella to 37% at 8 years. We, too, noticed a deterioration in functional outcome for the patients evaluated in our earlier study.<sup>24</sup> Presumably, this is due to a degree of stretching of the soft tissues, declines in patients' compliance with rehabilitation exercises, occurrence of new knee abnormalities, and possibly a decline in activity levels with age.

The management of anterior knee pain is controversial. A problem is that there is a range of disorders that can have similar clinical findings. Merchant<sup>22</sup> has proposed a

classification system for patellofemoral disorders. In keeping with this type of approach, most orthopaedic surgeons now appreciate the importance of careful patient evaluation to allow identification of an underlying cause for the patients' symptoms, rather than simply assigning a diagnosis such as the previously overused chondromalacia patellae.<sup>14</sup> Some cases are due to occult patellofemoral instability. Furthermore, if rehabilitation treatment fails to provide symptomatic relief, then patellar realignment may be considered. However, our experience with the three-in-one procedure for patients with anterior knee pain has been disappointing. Twenty-two knees with anterior knee pain but no overt dislocations or subluxations that were believed to have clinical signs suggestive of a predisposition to patellofemoral instability underwent the procedure. Only 12 (54.5%) of these knees had good or excellent results (assessed by the same means as in the current study). We do not recommend the three-in-one operation in these cases and no longer use it for them.

In patellofemoral instability, identification of an underlying abnormality should allow selection of the surgery, when appropriate, designed to specifically address the underlying cause. This is the basis for our current rationale for surgical treatment of patellofemoral instability once a rehabilitation program has been unsuccessful.

If clinical evaluation reveals a positive lateral patellar glide test,<sup>18</sup> then pathologically tight lateral parapatellar soft tissues are likely to be responsible for symptoms. This test is performed with the thigh relaxed and the knee flexed to 20° to 30°. A positive result is judged when passive lateral displacement of the patella is possible to two patellar quadrants or more combined with less than one quadrant of medial displacement. In the uncommon situation that this is the only abnormality found, we will perform an isolated arthroscopic lateral release, if rehabilitation treatment has failed.

Those patients with bone abnormalities (as evidenced by features such as increased tibiofemoral valgus or persistent lower limb torsional abnormalities) who require surgery are treated by the modified Elmslie-Trillat procedure (medial tibial tuberosity transfer and lateral retinacular release) to address the bone malalignment. If patella alta is present, the patella is also moved distally to a normal height by moving the tibial tuberosity inferiorly as well as medially. Before definitive fixation of the displaced tibial tuberosity, temporary fixation with a stout Kirschner wire is undertaken and "dynamic" stability of the patella, with the knee flexed at 30°, is tested by intraoperative femoral nerve stimulation. The optimal position for the transferred tibial tuberosity is found where neither net lateral nor medial displacement of the patella occurs when the quadriceps muscle is activated by means of stimulation of the femoral nerve in the groin. If patellar stability is still poor after patella alta has been addressed, the usual cause is an excessively shallow trochlear groove. In this situation we have occasionally deepened the groove by means of the Albee procedure,<sup>1</sup> whereby the lateral femoral condyle is elevated by inserting a wedge of bone graft.

In skeletally mature patients we now reserve the three-in-one procedure for those who have presumed failure of their medial parapatellar soft tissue restraints, usually after significant trauma, and lack the bone abnormalities described previously. The surgery here is to restore normal soft tissue balance. The poor results of the three-in-one procedure we obtained when used for patients with anterior knee pain may reflect the fact that many of these patients, although having clinical evidence of patellofemoral instability, also had features of abnormal bone configuration and the three-in-one procedure did not address these.

In view of the risk of physeal arrest, the modified Elmslie-Trillat procedure cannot be offered to the patient who is not skeletally mature. In this situation, if surgery is absolutely necessary, the three-in-one procedure is an option (although it cannot address bone malalignment). If the postsurgical stabilization achieved deteriorates with time, the modified Elmslie-Trillat procedure can be performed when skeletal maturity is reached. In our experience, of the few cases requiring this sequence of operations there is no particular technical difficulty in performing the second procedure and the results have been gratifying.

We believe that the results of the three-in-one procedure when used in appropriate patients are comparable with those of other satisfactory operations. According to the protocol we have described for surgical management of patients with patellofemoral instability, this procedure is especially useful for the skeletally mature patient with recurrent patellar instability and normal bone configuration, and occasionally in those who are skeletally immature even if a bone abnormality is present.

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