Outcome of surgery for recurrent patellar dislocation based on the distance of the tibial tuberosity to the trochlear groove

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We evaluated the outcome in a series of patients with recurrent patellar dislocation who had either medial transfer of the tibial tuberosity and lateral release or an isolated lateral release as the primary treatment. The decision to use one or other procedure was based on a pre-operative distance between the tibial tuberosity to the trochlear groove (TTTG) of less than 10 mm to include the tibial tuberosity transfer in addition to the lateral release.

Between April 2002 and December 2006, 49 patients (63 knees) underwent one of these procedures. A total of 35 patients (46 knees) was evaluated at a mean of 38 months (13 to 71) post-operatively. Medial transfer of the tibial tuberosity was performed in 33 knees and isolated lateral release in the remaining 13. Evaluation included the International Knee Documentation Committee (IKDC), the Kujala and the Short-form 36 scores. From the tibial tuberosity group 23 knees also underwent radiological examination at follow-up.

There were further episodes of patellar dislocation in six of the 46 knees available for review. Further dislocation was noted in five of 33 knees (15.2%) in the tibial tuberosity transfer group and in one of 13 knees (7.7%) in the lateral release group. The mean subjective IKDC score was 80.4 (SD 11.6), the mean Kujala score 88 (SD 8.2) and the mean objective IKDC score was 79% normal and 21% nearly normal. The mean post-operative TTTG distance in the tibial tuberosity transfer group was 8.9 mm (3.2 to 15.7) compared with the mean pre-operative value of 16.8 mm (12.2 to 24.4).

Many surgical procedures have been proposed to treat recurrent patellar dislocation. Some of these involve anatomical features thought to be important as predisposing factors such as lateralisation of the tibial tuberosity,1 patellar alta and trochlear dysplasia1 while others address acquired deficiencies which contribute to the recurrent nature of the condition such as disruption of the medial patellofemoral ligament.2,3

There appears to have been a geographical influence on the strategy followed in different centres. Certain anatomical aspects have received different emphasis in different parts of the world. However, reasonably successful results have been reported with a wide variety of treatments.

We have reviewed the results of two surgical procedures medial transfer of the tibial tuberosity combined with a lateral release or lateral release alone. The decision to use one or other operation was based on the distance from the tibial tuberosity to the trochlear groove (TTTG) which was originally described by Dejour et al1 and involves measuring the horizontal distance between the prominence of the tibial tuberosity and the apex of the trochlear groove on standard superimposed CT slices. Although they performed the CT with the knee in 0° of flexion, others have also measured it with the knee in 15° or 20° of flexion.4,6 Different angles of flexion will result in different values since the tibia rotates externally when the knee moves into full extension, thereby lateralising the tibial tuberosity relative to the trochlear groove.

While transfer of the tibial tuberosity has been widely used,7-14 lateral release has been a controversial procedure and there are many papers which do not support its use.15,17 In general, it is now regarded as being, at best, ineffective and, at worst, a deleterious procedure. Nonetheless, it has been used locally over many years and some satisfactory results have been reported.18 As such a further assessment of the outcome after lateral release was warranted.

In recent years there has been a move to a more considered approach to recurrent patellar dislocation, which tailors the surgical procedure to the anatomical features that are felt to be the most significant in a given individual. Recognising this, our aim was to review the
results of one strategy in order to have a baseline against which to compare the results of a more tailored approach in the future.

**Patients and Methods**

Between April 2002 and December 2006, 49 skeletally mature patients (63 knees, 14 bilateral) had surgery for recurrent patellar dislocation by a single surgeon (JF). All had reported at least two episodes of patellar dislocation within one year before their surgery and none had any ligamentous or meniscal injury of the affected knee. Of the 49 patients, 29 were female and 20 were male with a mean age at the time of surgery of 22.7 years (15 to 44). The study received approval from the Health Sciences Faculty Ethics Committee of the University.

Spiral CT (Somatom Emotion 6; Siemens, Erlangen, Germany) of both knees was performed with the patient supine and the knee in 15° of flexion, with the quadriceps relaxed. Stable positioning was achieved by placing a triangular wedge under each knee and a sponge between the ankles which were then strapped together. An experienced musculoskeletal radiologist (AE) measured the TTTG distance on superimposed axial slices (Fig. 1). A medial transfer of the tibial tuberosity combined with an arthroscopic lateral release (TTT/LR) was performed in 46 knees with a TTTG distance of more than 10 mm. The aim was to reduce the latter distance to 9 mm. An arthroscopic lateral release. A full-thickness release of the capsular structures was performed using a radiofrequency probe (Mitek VAPR; Johnson & Johnson, Langhorne, Pennsylvania) through an additional superolateral portal. The release extended from the anterolateral portal along the lateral margin of the patella and the lateral margin of vastus lateralis.

**Operative technique.** All the operations were performed under general anaesthesia using a tourniquet. Initial arthroscopy was performed using standard portals and any chondral damage was treated by debridement with a shaver.

**Medial transfer of the tibial tuberosity.** A transverse incision of 4 cm to 5 cm was made at the junction of the upper and middle thirds of the tibial tuberosity. The distal attachment of the patellar tendon was exposed and a biplanar (coronal and transverse) osteotomy of the tiberosity made to create a long bone flap of 4 cm to 6 cm. The transverse component of the osteotomy was made at the proximal end of the tuberosity and angled slightly proximally from lateral to medial. The periosteum was left intact at the distal end of the osteotomy as a hinge. The proximal end of the tuberosity was shifted medially by the distance required to bring the TTTG distance down to 9 mm, which was a direct calculation from the CT measurements. For example, for a TTTG of 20 mm a medial shift of 11 mm was used. No anteriorisation of the tuberosity was undertaken. The osteotomy was fixed by two lagged 4.0 mm cancellous bone screws with washers.

**Follow-up assessment.** In all, 35 patients (46 knees) were contacted and reviewed at a mean of 38 months post-operatively (13 to 71). There were 14 men (17 knees) and 21 women (29 knees). Of these 32 patients (42 knees) were evaluated in person and the remaining three (four knees) were reviewed by telephone interview. This resulted in a follow-up of 33 of 46 knees (71.7%) after TTT/LR and 13 of 17 (76.5%) after lateral release.

The clinical evaluation was conducted by an independent examiner (KT). The subjective International Knee Docu-
mentation Committee (IKDC) score, the patellofemoral pain score of Kujala et al., and the Short-Form (SF)-36 score for general health assessment were obtained. Any further patellar dislocation was recorded. Objective evaluation consisted of the objective IKDC score and the patellar apprehension test. For the three patients (four knees) (3 TTT/LR, 1 LR) whose assessment was by telephone, questionnaires for the subjective IKDC, the Kujala score and the SF-36 score were completed.

Of those patients who had undergone TTT/LR, 17 (21 knees) consented to radiological follow-up. The CT protocol was the same as the pre-operative evaluation. All the post-operative measurements were performed by the same radiologist who had made the pre-operative measurements, but he was blinded with regard to the pre-operative values. The follow-up values of the TTTG were compared with the pre-operative values. Patellar height was again assessed on lateral radiographs using the Insall-Salvati index. Only one patient had an index of less than 0.8. This patient had an index of 0.7 with an index of 0.8 in the non-operated leg. There was pre-operative patella alta in 22 knees (TTT/LR 15 of 23, lateral release 7 of 8) with a mean Insall-Salvati index of 1.3 (SD 0.26) in the TTT/LR group and 1.3 (SD 0.26) in the lateral release group. At review the mean Insall-Salvati index was 1.3 (SD 0.23) in the TTT/LR group.

Results

Recurrence. One or more further episodes of dislocation occurred in six of the 46 knees (13%), five in the TTT/LR group (15.2%) and one in the lateral release group (9.7%). These numbers were too small to allow meaningful statistical analysis. Only one patient, who had a tibial tuberosity transfer, reported more than one episode of instability. Another had one post-operative dislocation in each knee after bilateral tubial tuberosity transfer.

A review of the files of those patients who were not contacted for further episodes of patellar dislocation up to their last review.

Clinical evaluation. The mean subjective IKDC score for the overall group was 80.4 (SD 11.6), for the TTT/LR group it was 79.4 (SD 12.7) and for the lateral release group 85.1 (SD 3.1). Again the numbers were too small to allow meaningful statistical analysis. The overall mean Kujala score was 88.0 (SD 9.7) with mean scores of 88.2 (SD 8.2) and 86.1 (SD 12.9) for the TTT/LR and lateral release groups, respectively. The patients scored least well for pain during squatting, and for pain with prolonged sitting with the knees flexed. The objective IKDC score for the overall group was 79% normal (A) and 21% nearly normal (B). There were no significant differences between the overall group or the TTT/LR and lateral release groups compared with standardised population values for the SF-36 questionnaire (Fig. 2). The patellar apprehension sign was positive in 12 of 42 knees (28.6%). There was no difference between the groups.

Radiological evaluation. For the 17 patients (21 knees) in the TTT/LR group who had follow-up radiological assessment the mean post-operative TTTG distance was 8.9 mm (3.2 to 15.7) compared with the mean pre-operative value of 16.8 mm (12.2 to 24.4). In all, 15 (71%) of post-operative values were 10 mm or less and 18 (86%) were 11 mm or less, with 15 (71%) of the post-operative values between 6 mm and 12 mm. The mean change from the pre-operative TTTG was 11.9 mm (3.0 to 15.5).

The mean Insall-Salvati index was 1.0 (SD 0.1). Only one patient had an index of less than 0.8. This patient had an index of 0.7 with an index of 0.8 in the non-operated leg.

There was pre-operative patella alta in 22 knees (TTT/LR 15 of 23, lateral release 7 of 8) with a mean Insall-Salvati index of 1.3 (SD 0.25) in the TTT/LR group and 1.3 (SD 0.26) in the lateral release group. At review the mean Insall-Salvati index was 1.3 (SD 0.23) in the TTT/LR group.
group and 1.3 (SD 0.27) in the lateral release group. There were no instances of patella infera post-operatively.

**Complications.** A clinically significant haemarthrosis in the early post-operative period occurred in three patients (1 TTT/LR, 2 lateral release). In one, an arthroscopic wash-out was required.

**Discussion**

We evaluated a selective approach for a group of patients undergoing primary surgery for recurrent patellar dislocation choosing between medial transfer of the tibial tuberosity with a lateral release or an isolated lateral release, based on only one variable, the TTTG distance. This strategy did not address other factors such as patella alta, trochlear dysplasia or medial patellofemoral ligament insufficiency and did not accord with current thinking in terms of the case of a more tailored approach to surgery for patellar instability. Nonetheless, the overall redislocation rate of 13%, although clearly imperfect, was still a reasonable outcome of patellar stabilisation.

After medial displacement of the insertion of the patellar ligament combined with a lateral release and medial capsular reefing, Carney et al reported a rate of recurrence instability of 7% at three years. Similarly, Barber and McGarry found a recurrence rate of 9% after a medial transfer of the tibial tuberosity combined with arthroscopic thermal shrinkage of the medial retinaculum. In our series the transfer was combined with a lateral release, but no surgery was undertaken on the medial capsuloligamentous tissues.

In our patients the selective use of an isolated lateral release appeared to be associated with a reasonable result in terms of recurrence. This is in contrast to an increasing body of literature which suggests that this procedure does not give satisfactory results, particularly in the long term. Although we make no attempt to promote the routine use of lateral release, our results are not without precedent. Miller and Bartlett reported that two of 39 (5.1%) patients who had undergone an isolated lateral release had sustained a further dislocation at more than two years post-operatively. In another study only one of 16 patients (6.3%) had recurrent dislocation after an arthroscopic lateral release. However, because of concerns regarding the deleterious biomechanical effects of a lateral release, caution should be used when contemplating it and it is probably appropriate to use this procedure only when excessive tightness of the lateral retinacular structures is felt to be a considerable factor in a particular patient.

The persistence of a positive patellar apprehension sign in 29% of patients suggested that some may well have had persistent subtle instability which had not manifested itself as a frank dislocation. A broader approach addressing other anatomical components contributing to the persistent instability, such as patellar height, the medial patellofemoral ligament and trochlear dysplasia would presumably reduce the rate of recurrent dislocation and the incidence of persistent patellar apprehension. This strategy has been associated with a recurrent dislocation rate of only 5.2% at a mean follow-up of five years. The key appears to be in achieving a balance between addressing all the anatomical components which may contribute to instability and keeping the surgical intervention to a minimum in order to reduce morbidity.

The overall outcome for patients in our series was good as judged by the IKDC scores and grading, and the Kujala and the SF-36 scores. The mean IKDC subjective score of 80 needs to be seen in the context of healthy young subjects scoring a mean of 89, although it is recognised that longer follow-up may show some deterioration in the outcome. For the Kujala score the two items on which the patients scored lowest were squatting and prolonged sitting with flexed knees.

For the 21 knees in which the pre- and post-operative TTTG distances, after medial transfer of the tibial tuberosity were available, the mean post-operative TTTG was 8.9 mm which was consistent with our aim of reducing this to 9 mm. However, there was considerable variability as indicated by the range of values recorded. The reliability of CT measurement of this distance has not been clearly established and concerns about interpretation have been raised. Given that excessive medialisation of the tuberosity should be avoided because of the risk of increasing forces across the medial half of the patellofemoral joint, we feel that having most of the measurements within 3 mm of the desired 9 mm represents a reasonable outcome and is consistent with previous recommendations. Although the numbers were small, we were unable to distinguish between those patients with and without recurrent dislocation on the basis of the post-operative TTTG. Whether one or another angle of knee flexion during CT results in greater reliability remains to be established.

The purpose of measuring patellar height post-operatively in our series was to establish the presence of patella infera which is a potential complication of transfer of the tubial tuberosity. Using an Insall-Salvati index of 0.8 as a cut-off, no patient had patella infera post-operatively.

There are a number of limitations in our study. The principal one is the number of patients who were unable to be contacted for follow-up. Although we were able to achieve the generally accepted minimum follow-up rate of 70%, the relatively small number of patients available meant that those lost to follow-up may have had a significant influence on the findings. However, we were encouraged by the absence of recurrent dislocation at the most recent clinical review of those patients who were unable to be contacted, even although for some patients the follow-up remained short. It would have been preferable to have pre-operative Kujala and IKDC scores with which to compare the follow-up outcomes. Additionally, it needs to be recognised that the IKDC form was principally designed for the evaluation of ligament injuries and its use has not been validated for patellofemoral disorders. The issue of reliability of CT measurement of the TTTG distance has already been raised.
References