

Evaluation and treatment of Patellar Instability

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Introduction

Patellar problems are frequently encountered in knee surgery clinics.

The patellofemoral joint has a low degree of congruency. Its passive stability depends on the shape of the trochlea and the patella, while its active stability is provided by the surrounding muscles, which allow the patella to be actively centred over the trochlea during knee movements. The main anatomical factors responsible for patellar instability are trochlear dysplasia, an excessive distance between the tibial tubercle and the trochlear groove (TT-TG), excessive patellar tilt, and a high-riding patella (patella alta).

Secondary factors affecting the stability of the patella are excessive femoral anteversion, external rotation deformity of the tibia, genu recurvatum, and genu valgum.

Proper patient selection for surgery is predicated upon an understanding of the different patterns of patients presenting with unstable or painful knees. In patellofemoral disorders, the need for a definition of the different patient populations is greater than in many other conditions encountered by the surgeon.

In 1987, H. Dejour established a classification of patellofemoral disorders, with three patterns, involving the four main anatomical factors and the four secondary factors described above.

The three patterns are :

- objective patellar instability (OPI). Patients presenting with this pattern will have a history of at least one true dislocation of the patella (permanent loss of contact between two joint surfaces), and at least one anatomical abnormality.
- potential patellar instability (PPI). Patients in this group will not have had any true patellar dislocation, but will have pain and anatomical abnormalities.
- painful patella syndrome (PPS). These patients will have neither dislocation nor anatomical abnormalities; however, they will have pain.

As a rule, surgery will be required for the management of objective patellar instability; sometimes, patients with potential patellar instability will also need operative treatment.

Surgical procedures may be divided into those that address the soft tissues (ligaments, muscles), and those that effect bony changes. In order to remedy patellar instability, the surgeon will need to combine soft-tissue and bony procedures.

Lateral release

Lateral release is required as part of any surgical procedure to remedy patellar instability; it is not, however, sufficient to prevent further dislocation. Patellar pain syndrome with a feeling of "locking" as the chief complaint. Surgery should be considered in exceptional cases only, in patients who have not responded to correctly applied non-operative treatment (stretching of anterior and posterior muscle groups).

Vastus medialis advancement

In 1976, Insall et al described their technique of proximal realignment, which involves an advancement towards the midline of the vastus medialis insertion and the retinaculum.

This procedure should be performed in patients who are found at surgery to have dysplasia of the vastus medialis, as shown by the absence of oblique fibres and a vertical insertion of the muscle away from the superomedial margin of the patella. The decision to perform a proximal realignment may also be taken preoperatively, on the strength of the patient's clinical pattern, if the examination shows a major lateral tilt of the patella. The best selection criterion is the amount of patellar tilt, as judged on CT scans. The threshold value beyond which a patellar tilt (measured with the quadriceps contracted and relaxed) is abnormal is 20 degrees. Patellar tilt exceeding this value should be managed with the vastus medialis advancement described above.

Repair of the medial patellofemoral ligament

Anatomical studies involving sectioning of the medial soft-tissue retinacular fibres investigations of traumatic dislocation, and biomechanical studies have shown the importance of the medial ligamentous structures. In particular, the medial patellofemoral ligament has been identified as the major medial soft-tissue restraint that keeps the patella from dislocating. In the light of their studies, Hautamaa et al suggested that proximal alignment or medial ligament repair should particularly address the repair of the medial patellofemoral ligament, since failure to do so might lead to persistent or recurrent dislocation. However, rupture of this ligament is caused by, rather than causative of, dislocation. Repair of the medial patellofemoral ligament may be necessary,

but it is not in itself sufficient for the control of patellar instability.

Bony procedures

Tibial tubercle transfers

The principle of tibial tubercle transfer is credited to Elmslie; it was subsequently popularized by Trillat, and further modified by other authors. The procedure involves displacing the insertion of the patellar tendon, in order to realign the extensor mechanism and/or to correct the patellar index.

Medial tibial tubercle transfer

The tibial tubercle is fully detached on three sides only, leaving a distal bony hinge. Fixation is with a single screw. The pilot hole for the screw is made prior to the osteotomy, with a 3.2-mm drill bit, and overdrilled with a 4.5-mm drill bit, to allow lagging.

Distal tibial tubercle transfer

For this transfer, the tibial tubercle is detached completely, and will, therefore, require fixation with two screws.

Indications

Medial tibial tubercle transfer is indicated in patients with extensor mechanism malalignment. However, malalignment is somewhat difficult to define. The diagnosis may be made on clinical grounds, using the Q angle in flexion and/or extension as a criterion. More objective evidence will be provided by imaging techniques. The pattern of the patella on a 30-degree axial (Merchant) view allows the angle of congruence to be measured, while the distance between the tibial tubercle and the trochlear groove (TT-TG) may be determined from superimposed CT images obtained with the knee in extension. The TT-TG is the most accurate and precise parameter. A TT-TG exceeding 20 mm is considered to be abnormal. Therefore, the goal of tibial tubercle transfer is to reduce the TT-TG to between 10 and 15 mm. Goutallier et al stressed that the shape of the trochlea also has to be taken into account in the correction of the TT-TG: the deeper the trochlea, the greater the risk of overmedialization, which would result in patellar impingement on the medial facet of the trochlea, and pain.

If the patella is high as measured by the Insall-Salvati or the Caton-Deschamps method, the tubercle should be distalized by the amount needed to correct the index. This way, there will be no risk of an iatrogenic patella infera.

The rationale for anterior tibial tubercle transfer derives from biomechanical studies, which showed that this procedure should reduce patellofemoral stress levels. However, the clinical

results obtained with anteriorization are less convincing [31]: the prominence of the tibial tubercle makes kneeling painful. Results were not superior to those of medialization alone. Also, a protruding tibial tubercle is unsightly. We do not recommend this technique.

Trochleoplasty

Trochleoplasty comes into its own in patients with severely dysplastic trochleae.

A trochlea is described as dysplastic if it has lost its congruence with the patella, i.e. if it is flat or even convex. The anatomy of the femoral trochlea has been investigated by a number of authors. H. Dejour, in 1987, defined dysplasia of the trochlea in terms of the crossing sign (croisement) on strictly lateral knee radiographs. If the sulcus floor line crosses the anterior border of the two condyles, the trochlea is said to be flat. In 1998, D. Dejour et al, in the light of a new study, proposed a classification (Table 1) based upon the morphology of the trochlea on CT scans of the reference section (first slice showing cartilage), and the patterns seen on the lateral radiograph. This analysis permits a better definition of the four grades of dysplasia, and to establish the indications for trochleoplasty.

Table 1 D Dejour's classification of the grades of trochlear dysplasia

	<i>Conventional radiography</i>	<i>Computed tomography</i>
Grade A	- Crossing sign	- Trochlear morphology preserved (fairly shallow trochlea)
Grade B	- Crossing sign - Supratrochlear spur	- Flat or convex trochlea
Grade C	- Crossing sign - Double contour	- Asymmetry of trochlear facets: lateral facet convex, medial facet hypoplastic
Grade D	- Crossing sign - Supratrochlear spur - Double contour	- Asymmetry of trochlear facets, vertical join (cliff pattern)

Patellofemoral congruence may be improved either by elevating the lateral facet of the trochlea, or by deepening the sulcus.

Sulcus-deepening trochleoplasty

This procedure was first described by Masse, in 1978; it was subsequently modified and formalized by H Dejour, in 1987. It is designed to abolish the prominence of the trochlear sulcus and to establish a groove of correct depth. This trochleoplasty is technically more demanding; however, it has the merit of addressing the root cause of the dislocation, by correcting the

abnormal patterns underlying the different grades of trochlear dysplasia.

Sulcus-deepening trochleoplasty is indicated in severe (Grade B or D) dysplasia, in which the trochlea is prominent and the patella impinges on the trochlea. The procedure is contraindicated in patients with a flat (Wiberg Type IV) patella, since the end result would be incongruence between the hollow sulcus and the flat patella.

Conclusion

Objective patellar instability is a multifactorial condition. The preoperative clinical and radiological investigations will allow the surgeon to obtain a picture of the abnormalities involved. Table 2 shows the factors to be taken into account, as well as the threshold values beyond which surgical treatment will be required, and the types of procedures available for correction.

Table 2. Suggested management of objective patellar instability, as a function of the anatomical abnormalities encountered

Factor of instability	Threshold value	Type of procedure
Grade of dysplasia	Grade A	Do nothing; or lateral-facet elevating trochleoplasty
Patellar index (Caton-Deschamps AT/AP ratio)	Grade B or Grade D	Sulcus-deepening trochleoplasty
	AT/AP > 1.2	
TT-TG (in extension)	> 20 mm	Medial tibial tubercle transfer, to obtain 10 mm < TT-TG < 15 mm
Patellar tilt (quadriceps contracted and relaxed)	> 20°	Vastus medialis advancement

The surgical management of patellar instability is difficult, since each one of the factors involved may be under- or overcorrected. Undercorrection will result in recurrence of the dislocation, while overcorrection will give rise to pain. Arthroscopy has only a very limited role. It may be used for the removal of loose bodies, and as a preoperative investigation; however, as a treatment procedure it is of minor importance. The mainstay of surgery are bony procedures to effect extensor mechanism realignment. Future advances may come from trochleoplastic techniques.

In subjective patellar instability and patellar pain syndrome, surgery is very rarely required. The first line of management is non-operative, using physiotherapy with muscle stretching. Only if this conservative approach fails should surgery, along the lines described above, be considered.

D Dejour's classification of trochlear dysplasia

- (1) Grade A : Crossing sign and shallow trochlea
- (2) Grade B : Crossing sign; supratrochlear spur; flat trochlea
- (3) Grade C : Crossing sign; double contour ("double shape"); asymmetry of trochlear facets
- (4) Grade D : Grade B + C, asymmetry of trochlear facets, and cliff pattern



