RECURRENT DISLOCATION OF THE PATELLA

A Study of its Pathology and Treatment in 106 Knees

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Despite the many methods of surgical treatment that have been described for the relief of recurrent dislocation of the patella, there is still no general agreement on its surgical management, and few long-term follow-up studies have been reported. The present study was undertaken to investigate the natural history of the condition, and to assess the value of some of the operations in current use, and also to assess in particular the long-term results of patellectomy and transplant of the tibial tubercle.

CLINICAL MATERIAL

Case notes were studied from hospitals in Liverpool, Warrington, Preston and Oswestry. The criteria for inclusion—adequate records and a follow-up period of at least a year—were satisfied in operations on ninety knees in seventy-six patients, and in a further sixteen knees not subjected to operation. Fifty-four patients were seen personally; the remainder were assessed from their case notes and from replies to questionnaires. The average follow-up period was seven years and the longest thirty years. The age of onset of the dislocations is shown in Figure 1.

ETIOLOGY

Injury—In only five patients (5 per cent) could a major accident be considered the cause of recurrent dislocation. In the remainder the initial dislocation was precipitated by a trivial twist in a congenitally abnormal knee.
Below-knee amputation—Two patients developed recurrent dislocations of the patella after otherwise satisfactory below-knee amputations done twenty-two and thirty-five years previously. Since the patients were forty-seven and fifty-five years old when the dislocations started, it is assumed that the abnormal mechanics of walking with a prosthesis were responsible. This complication of below-knee amputation has not been reported previously.

The congenital diathesis—The various factors comprising the congenital diathesis have been well documented; of these, genu valgum, tibial torsion and ligamentous laxity need further elaboration.

Genu valgum—When genu valgum is found in association with recurrent dislocation of the patella it is an incidental finding and not the cause of the recurrent dislocations. Supracondylar femoral osteotomy failed to stop the recurrent dislocations in five out of seven patients in this series; and it is common knowledge that very few children with knock-knees also have recurrent dislocation of the patella.

Lateral rotational deformity of the tibia—This was noted in two children. In one, the deformities and the dislocations were bilateral. In the other, it was present only on the side on which the dislocation occurred, and limitation of lateral rotation of the hip suggested that the tibial torsion was compensatory to anteversion of the femoral neck. In these children the considerable lateral displacement of the insertion of the patellar ligament must have had some bearing on the recurrent dislocation, though this could not have occurred without laxity of the medial joint capsule as well.

**TABLE 1**

<table>
<thead>
<tr>
<th>Ligamentous laxity associated with recurrent dislocation of the patella in fifty-four patients</th>
</tr>
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<tbody>
<tr>
<td>Lateral mobility of patella—all other joints stable</td>
</tr>
<tr>
<td>Ligamentous laxity:</td>
</tr>
<tr>
<td>Knees only</td>
</tr>
<tr>
<td>Knees and other joints</td>
</tr>
</tbody>
</table>

Ligamentous laxity—De Palma (1954) and Carter and Sweetnam (1958) have shown the relationship between recurrent dislocation of the patella and ligamentous laxity. Sometimes generalised ligamentous laxity, as in the Ehlers-Danlos syndrome (Johnson and Falls 1949), chondro-osteodystrophy (Fairbank 1951), arachnodactyly and osteogenesis imperfecta, is associated with recurrent dislocation of the patella.

Table I shows the incidence of ligamentous laxity in the patients examined personally in this series. Those with the generalised condition could extend their knees and elbows to more than 185 degrees, and had lax collateral ligaments. Their thumbs and fingers could be hyperextended.

Eight patients of the series had congenital deformities of the feet which included pes cavus, hammer toes, microdactyly and vertical talus.

**PATHOLOGICAL CHANGES IN THE PATELLA**

In some patients the patella subluxates with each genuflexion; in others it occasionally dislocates completely. Each time it dislocates or subluxates it jumps the edge of the lateral femoral condyle, and then has to jump back again to regain its central position. Since the trauma of being dragged back over the edge is greater than that of slipping laterally, the medial facet of the patella is the first to be damaged. The pathological changes that are seen include: 1) *chondromalacia of the patella* (McFarland 1948, Macnab 1952) with degeneration and erosion
of the cartilage (Fig. 2). These changes do not usually show radiographically. Loose bodies form in a small number of knees. 2) Osteochondritis dissecans. 3) Marginal osteochondral fracture (Coleman 1948). This differs from osteochondritis dissecans in that the fragment is separated from the patella immediately by a severe injury. 4) Patello-femoral arthritis, which may develop from any of the above changes.

Chondromalacia occurs in almost all of the patellae, but osteochondritis dissecans and marginal fractures are rare (Table II).

![Advanced erosion of patellar cartilage, exposing an area of eburnated bone.](image)

**TABLE II**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Number of knees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chondromalacia patellae</td>
<td>19</td>
</tr>
<tr>
<td>Osteochondritis dissecans</td>
<td>1</td>
</tr>
<tr>
<td>Marginal osteochondral fracture</td>
<td>1</td>
</tr>
<tr>
<td>Patello-femoral arthritis</td>
<td>2</td>
</tr>
<tr>
<td>Normal cartilage</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>25</strong></td>
</tr>
</tbody>
</table>

**FIG. 2**

Advanced erosion of patellar cartilage, exposing an area of eburnated bone.

**THE RESULT IN THE UNTREATED PATIENT**

**Generalised osteoarthritis of the knee**—Although this series is too small to warrant statistical conclusions it does show that osteoarthritis of the knee increases if the recurrent dislocation is allowed to continue indefinitely (Table III).

**Spontaneous cure**—In sixteen knees (15 per cent) the symptoms ceased, never to recur, after physiotherapy had developed the quadriceps. These were all young adults, in whom the patella went through a period of dislocation about the time of skeletal maturation.
TABLE III
THE INCIDENCE OF OSTEOARTHRITIS OF THE KNEE RELATED TO THE DURATION OF THE DISLOCATION

<table>
<thead>
<tr>
<th>Duration of dislocation in years</th>
<th>0-5</th>
<th>6-15</th>
<th>16-25</th>
<th>Over 25</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of knees in each group</td>
<td>58</td>
<td>16</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>Number of knees showing arthritis</td>
<td>0</td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Percentage showing arthritis</td>
<td>0</td>
<td>19</td>
<td>33</td>
<td>100</td>
</tr>
</tbody>
</table>

TABLE IV
METHOD OF GRADING RESULTS OF OPERATION FOR RECURRENT DISLOCATION OF THE PATELLA

(A) Subjective grading
Excellent: No trouble at all.
Good: Occasional pain after severe exertion, or slight weakness of the knee only when descending stairs, etc.
Fair: Persistent moderate pain; inability to walk for more than a mile without having to rest.
Poor: Recurrence of dislocations. Incapacitating pain, swelling or weakness.

(B) Objective grading
Excellent: Full movements, active and passive. No tenderness.
Good: As above, but with some synovial thickening with or without wasting of the quadriceps. Inability to stand on the affected leg with the knee semi-flexed to less than 135 degrees. Persistent laxity of the patella is acceptable provided that no subluxation occurs with knee movements.
Fair: Slight tenderness of under-surface of patella or of joint margins. Tender retropatellar crepitus. Extensor lag of more than 5 degrees.

TABLE V
THE METHOD OF CALCULATION OF COMBINED RATING FROM THE SUBJECTIVE AND OBJECTIVE GRADINGS IN TABLE IV

<table>
<thead>
<tr>
<th>Subjective</th>
<th>Combined rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>0</td>
</tr>
<tr>
<td>Good</td>
<td>1</td>
</tr>
<tr>
<td>Fair</td>
<td>2</td>
</tr>
<tr>
<td>Poor</td>
<td>3</td>
</tr>
</tbody>
</table>

The table above shows the method of calculating the combined rating from the subjective and objective gradings. The combined rating ranges from 0 to 4, with 0 representing Excellent, 1 representing Good, 2 representing Fair, 3 representing Poor, and 4 representing Failure.
Hauser (1938) gave a comprehensive historical review of the many operations that have been tried. In this series four operations are available for study: supracondylar femoral osteotomy, plastic operations on the capsule, realignment of the tibial tubercle, and patellectomy. The results of operation were investigated in three periods: one to five years; six to ten years; and over ten years. The clinical grading was done from the patient’s own account (subjective), and from the physical findings (objective) along lines similar to those used by Macnab (1952). Table IV sets out the criteria used for grading. By plotting the subjective against the objective findings in Table V a combined rating on a five-point scale was obtained. Radiological findings were of no help.

Supracondylar femoral osteotomy—This operation was used on seven knees in five patients suffering from genu valgum with recurrent dislocation of the patella. Five continued to dislocate in spite of an adequate correction.

Plastic operations—These were performed as the sole procedure on four knees. A strip of
medial parapatellar capsule was transferred either as a free graft (Davis 1919) or as a pedicle graft (Krogius 1904) to the lateral side. The dislocations occurred in two of the four knees.

**Tibial tubercle transplant**—This was performed on fifty-three knees of forty-two patients varying in age from five to forty-nine years, the average being eighteen. With minor variations, the technique followed that of Hauser (1938). After release of the lateral capsule the tubercle was moved medially and downwards, usually into an exactly fitting socket, but four knees required screws as well. In eight the medial capsule was reseed in addition, but this did not alter the results in any way. After eight weeks in a plaster back-slab, rehabilitation continued for three to six months.

**Results**—There was one death (in 1930) from purpura on the fifth post-operative day. Figure 3 shows the number of knees falling into each group in the various follow-up periods. Even after ten years there is a preponderance of “excellent” results. When one knee only was affected it remained the weaker one, and there was usually half to one inch of quadriceps wasting, even in the “excellent” knees. Knees graded “good” or “fair” had varying degrees of aching and tenderness after strenuous exertion.

Knees were graded “poor” or “failure” in the following circumstances. 1) **Recurrence of the dislocation** (three knees) (6 per cent). In one, the transplanted tubercle became infected and was removed, so the mechanical effect of the operation was lost. In another, the lateral capsule was not incised at the initial operation; a revision operation and ultimately a patellectomy failed to cure the dislocations. The third was not cured by transplant of the left tibial tubercle and later accepted patellectomy. 2) **Pain, swelling and tenderness** (seven knees) (15 per cent). In one, these symptoms came on slowly after operation and became worse over twelve years, in spite of the fact that the dislocations were relieved. Another, graded “poor” at five years, improved spontaneously to “good” at ten years. One improved after removal of a screw. One improved after removal of a loose body. Two were improved by patellectomy for pre-existing osteoarthritis, and another patient is awaiting patellectomy for this reason. 3) **Poor recovery of flexion** (two knees) (4 per cent). One took a year to regain flexion to 90 degrees; the other had two manipulations and a patellectomy in unsuccessful efforts to regain more than 30 degrees of flexion. Both these patients were over forty at the time of operation. 4) **Genu recurvatum** (four knees). This will be discussed later.

Ten knees (20 per cent) required a total of sixteen further operations after transplant of the tibial tubercle. These included three tibial osteotomies for recurvatum, and three patellectomies: one had a tender neuroma excised; one had a screw removed for low-grade sepsis; three had transplanted tibial tubercles drilled or trimmed for pain; and one had a loose body removed.

**Tibial tubercle transplant in children**—Macnab (1952) and Harrison (1955) emphasised the danger of this operation before fusion of the epiphyses. In this series the tibial tubercle was transplanted in thirteen knees in children under fourteen. In one the operation failed to cure the recurrent dislocations; four knees developed recurvatum deformity, two of these with severe valgus, requiring tibial osteotomy. The remainder gave good results.

Genu recurvatum may be caused by epiphysiodesis, which is liable to occur if the block of bone removed with the tubercle damages the upper tibial epiphysis, and especially if the cavity left by the removal of the tibial tubercle is filled by the piece of bone taken from its new bed (Figs. 4 to 6). Another cause is downward migration of the tibial tubercle; if the ligamentum patellae alone is removed, with or without a sliver of bone, the epiphysial line may escape damage, but being transferred from its epiphysial insertion into the metaphysis, it migrates downward with growth. Pulling the patella down too far causes chondromalacia (Macnab 1952) and recurvatum (Harrison 1955) because of the excessive tightness of the extensor mechanism.

**Tibial tubercle transplant in older adults**—The best results were obtained when the operation was performed between the ages of fifteen and thirty years; in older patients the results were spoilt by persistent pain and stiffness.
Severe genu valgum and recurvatum caused by antero-lateral epiphysial arrest from tibial tubercle transplant. Figure 4 shows that part of the epiphysial plate has been removed and has been replaced by the bone taken from the new bed for the tubercle. Figure 5 shows that solid epiphysiodesis has occurred nine months later. Figure 6 shows that, after five years, there is severe tilting of the tibial table.
Patellectomy—This operation was performed on twenty-nine knees in twenty-four patients aged from fourteen to sixty-five years, with an average of twenty-nine. Five knees were osteoarthritic.

There was a variation in the technique of the operation in dealing with the quadriceps expansion. To prevent recurrent dislocation of the “patella substitute” which may form at the site of the excised patella, McFarland (1948, 1959) advised a Krogius (1904) type of capsulorrhaphy, a strip of medial capsule being transferred to the lateral side. This was done in some patients. Others were repaired in the usual transverse manner, and some had no repair at all (Table VI).

After patellectomy there was usually a delay of about two years before the final stage of recovery was reached, with a 5–10 degree extensor lag until that time.

Results—Figure 3 shows the numbers of knees falling into each grade in the various post-operative periods. The average result after each operation was “fair,” with a combined rating of 1·6 to 2·2.

The usual disability in “fair” and “good” results after patellectomy was a variable degree of extensor weakness associated, as after tibial tubercle transplant, with half to one inch of quadriceps wasting. Three of these knees were mildly painful with joint line tenderness related to change in the weather. The five osteoarthritic knees were relieved of patellar pain, even after ten years.

### Table VI

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Number of operations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simple excision</td>
<td>6</td>
</tr>
<tr>
<td>Excision and quadriceps repair</td>
<td>12</td>
</tr>
<tr>
<td>Excision and capsulorrhaphy</td>
<td>10</td>
</tr>
<tr>
<td>Excision and tibial tubercle transplant</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>29</td>
</tr>
</tbody>
</table>

Knees were graded “poor” or “failure” after patellectomy in the following circumstances.

1) Recurrent dislocation of the “patella substitute” (two knees) (7 per cent); in neither was capsulorrhaphy done at the time of operation, and both were later relieved by tibial tubercle transplant. 2) Pain, swelling and tenderness (three knees) (10 per cent); in one no reason could be found; the other two had generalised osteoarthritis before operation. 3) Poor recovery of flexion (two knees) (7 per cent), in both of which a capsulorrhaphy had been done. One patient, aged thirty-eight, regained 90 degrees of flexion after manipulation, but the other, aged twenty-seven, did not. 4) Extensor lag over 10 degrees with severe weakness (three knees) (10 per cent). Two of these knees were osteoarthritic and all three are still improving two to three years after operation.

These findings were encountered in the first five-year period after operation. Most knees seen more than five years after operation were “fair”: this is in accord with the findings of Scott (1949) and Smillie (1951), who emphasised that a knee without its patella is partly disabled.

**DISCUSSION**

Most authorities have favoured one or other of the two principal operations reviewed in this survey (McFarland 1948, Smillie 1951, 1959, Harrison 1955, West and Soto-Hall 1958), though Macnab (1952) advised inspection of the deep surface of the patella before deciding which operation to do. From the material available in the present series it is possible to learn something more about the selection of patients for operation.
Degeneration of the patellar articular cartilage is usually present by the time the patient comes to operation. If left untreated for many years this process is liable to culminate in generalised osteoarthritis of the knee. It is essential to decide whether a realignment procedure will prevent this progressive degeneration, because if not there is no place for the operation. The fact that transplant of the tibial tubercle can give a majority of "good" and "excellent" results in a five to thirty year follow-up supports the contention of Harrison (1955) and Smillie (1959) that the degeneration will stop after adequate realignment. This only obtains when the operation is performed with meticulous attention to detail in adolescents and young adults who have not yet developed patello-femoral arthritis.

In transplanting the tubercle a lateral release of the quadriceps expansion should be done to allow the tubercle to swing medially and downwards to obtain a secure fit without the use of a screw.

Below the age of fourteen years four out of thirteen children developed genu recurvatum after transplant of the tibial tubercle to the metaphysis, even when the epiphysis was not disturbed. The operation is therefore contra-indicated in any form in children, as was stressed by Macnab (1952) and Harrison (1955). This study does not provide a useful alternative: supracondylar femoral osteotomy and plastic operations on the lateral quadriceps expansion were unsuccessful, and no example of patellectomy could be traced in this age group. However, when conservative measures fail, surgery may be indicated to prevent further articular damage. There is a reluctance to remove the patella in children on the grounds that its absence renders the knee more susceptible to the injuries of childhood, and that the quadriceps expansion may rupture from attrition. These objections are not sound, because repeated dislocations are more damaging than is the absence of the patella; and no rupture from attrition occurred in this series. If patellectomy is performed it must be accompanied by plastic rerouting. In children the situation is not satisfactory, and more work is required in this field.

Over the age of thirty an increasing number of tibial tubercle transplants do badly. In these patients patellectomy should be considered more frequently, and over forty patellectomy is the operation of choice. At any age pain with retropatellar tenderness, crepitus and a thickened, tender synovium may be caused by patello-femoral arthritis, and the articular surfaces should be opened for inspection at operation. A circumscribed area of erosion on the under-surface of the patella does not contra-indicate tibial tubercle transplant, but a more extensive denudation of the bony surfaces does, in which case the patella should be removed.

Patellectomy was found to be a sound operation in this series. While yielding but few excellent results, it can generally be relied upon to give a fair result with little risk of failure; it should be done when tibial tubercle transplant is contra-indicated by any of the above reasons. Recurrent dislocation of the "patella substitute" after patellectomy must be prevented at the time of operation by rerouting the quadriceps mechanism either by a plastic procedure or by tibial tubercle transplant.

In patients in whom the patella is permanently dislocated—the so-called congenital type—realignment is unsuccessful. There is no jumping of the condylar ridge, so the disability may not be severe. If surgery becomes inevitable, simple patellectomy is the best procedure, without any attempt at rerouting the quadriceps mechanism. The same holds good when the dislocation is caused by the muscular imbalance after poliomyelitis or in spastic paraplegia, in which intermittent dislocations may become permanent in the course of time.

SUMMARY

1. A study has been made of the treatment of recurrent dislocation of the patella in 106 knees in seventy-six patients.
2. In young adults in whom degenerative changes in the knee were not severe at the time of operation transplant of the tibial tubercle gave the best results.
3. In older patients and in those in whom osteoarthritic changes were present in the knee transplant of the tibial tubercle was unsatisfactory, but patellectomy with rerouting of the quadriceps mechanism gave fair results.

4. Tibial tubercle transplant is contra-indicated in children because it may give a recurvatum deformity.

5. When the dislocation is permanent, operation may be unnecessary, but if it becomes inevitable simple patellectomy is the best procedure.

6. The results of plastic operations on the quadriceps expansion and of supracondylar femoral osteotomy are bad.

7. No operation can give consistently good results because the knee is usually congenitally weak, often as part of generalised ligamentous laxity.

I would like to express my sincere thanks to the consultant staff of the following hospitals for allowing me access to their records and patients: the Liverpool Royal Infirmary, the Royal Southern Hospital, the David Lewis Northern Hospital, the Alder Hey Hospital, the Robert Jones and Agnes Hunt Orthopaedic Hospital, Oswestry, the Birkenhead General Hospital, the Preston Royal Infirmary, the Warrington Infirmary and the Bootle Hospital.

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REFERENCES


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