KNEE FUNCTION AFTER PATELLECTOMY

A 12- TO 48-YEAR FOLLOW-UP

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We describe 83 knees (69 patients) which had had patellectomy for anterior knee pain (52), patellofemoral osteoarthritis (25) or comminuted fractures (6) between 1942 and 1978. The patients were questioned about their symptoms and the function of the operated knee 14 to 50 years after operation. In the group with anterior knee pain, 76% achieved good results and were satisfied with the operation. Only 54% of the osteoarthritis group had satisfactory relief of pain and most had progressive deterioration of function.

Sixteen patients who had had unilateral patellectomy were assessed by dynamometry, ultrasound and radiography. The average quadriceps muscle power was 60% of that on the normal side although two patients had stronger muscles in their operated than in their unoperated legs.

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After anatomical, dissection and dynamometric studies on patients who had been treated by patellectomy for fracture, Brooke (1937) concluded that, in man, the patella "subserves no useful function" and that the knee performs better without it, "both as regards rapidity of movement and power". This work was confirmed by Hey Groves (1937). Scott (1949), however, after reviewing 101 patients who had undergone patellectomy for fracture, reported that only 5% of patients considered that they had normal knee function, and Wilkinson (1977), who examined 31 patients 4 to 13 years after patellectomy for fracture, found good or excellent results in only 61%. Patellectomy for osteoarthritis seemed even less satisfactory in the series of 81 patients reported by Ackroyd and Polyzoides (1978); only 53% of their patients had a good result at a mean of 6.5 years after operation and 50% had weakness of extension of the knee. The senior author of this paper (Bentley 1970, 1978) in his review of four surgical treatments for chondromalacia patellae, concluded that in adults with grade III or IV changes, patellectomy was the treatment of choice. Evidence from animal studies (Bruce and Walmsley 1942) that degenerative change occurs in the articular cartilage of the femoral sulcus after patellectomy, suggests that the long-term results may be less than satisfactory.

Our aim was to investigate the long-term morbidity of patellectomy.

PATIENTS AND METHODS

Our hospital records showed that 130 patients had undergone patellectomy for anterior knee pain, osteoarthritis or comminuted fracture of the patella between the years 1942 and 1978. All were traced; one patient had since undergone an arthrodesis of the knee, 31 were known to have died, and of the remaining 98 patients, 69 (70%) responded to a questionnaire (Table 1).

<table>
<thead>
<tr>
<th>Number of patients</th>
<th>Anterior knee pain</th>
<th>Osteoarthritis</th>
<th>Fracture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age at follow-up (yr)</td>
<td>48 (31 to 88)</td>
<td>75 (58 to 88)</td>
<td>59 (36 to 81)</td>
</tr>
<tr>
<td>Length of follow-up (yr)</td>
<td>24 (12 to 48)</td>
<td>19 (12 to 31)</td>
<td>20 (15 to 23)</td>
</tr>
<tr>
<td>Male (per cent)</td>
<td>29</td>
<td>32</td>
<td>67</td>
</tr>
<tr>
<td>Right side (per cent)</td>
<td>58</td>
<td>56</td>
<td>50</td>
</tr>
</tbody>
</table>

Sixteen of the 69 patients were able to attend for full clinical, radiological and biomechanical assessment of both knees. All had undergone unilateral patellectomy. Their mean age was 49 years (31 to 78) and the mean time since patellectomy was 17 years (12 to 39). The operation had been performed for anterior knee pain in 11, for osteoarthritis in three and for fracture in two. The maximum power of the quadriceps muscle was measured eccentrically (paying out) and concentrically (shortening),

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using a ‘kinetic communicator’ apparatus (KIN/COM, Chattanooga Corp, Chattanooga, Tennessee). The dynamometer had been tested for its reliability and validity (Farrell and Richards 1986). The tests were carried out between 10° and 90° of knee flexion to allow for any quadriceps lag. After several practice attempts, the best of three measurements was recorded for each knee; a rest was allowed before recording the opposite leg. From a graph of quadriceps power against angle of knee flexion, the maximum torque, the angle at which maximum torque was achieved and the work done during each contraction were calculated. Ultrasound scans, in the transverse plane, of both thighs 5, 10, 15 and 20 cm above the knee, were used to measure the anteroposterior diameter of the quadriceps muscle at each level (Fig. 1) and the cross-sectional area of the muscle was calculated as \( \pi r^2 \). The volume of a 15 cm portion of each quadriceps was then estimated and the two sides compared. Anteroposterior, lateral and 30° tangential radiographs were taken of both knees of all 16 patients to compare the degree of degenerative change.

RESULTS

Degenerative arthritis. The radiographs of the 16 patients with unilateral patellectomy showed Ahlbäck (1968) grades of tibiofemoral osteoarthritis in both knees which ranged between 2 and 5 (mean 2.4) but in no case was there a difference between the operated and the unoperated knee. Seven of the 16 operated knees which were radiographed had evidence of degenerative change in the femoral sulcus (Fig. 2) and most had some calcification in the patellar tendon.

Subjective observations. Twelve of the 25 knees which had undergone patellectomy for osteoarthritis were still causing severe pain at follow-up but only four of the 52 treated for anterior knee pain were still painful. This difference is significant (\( p < 0.001 \), chi-squared test). None of the six knees which had undergone patellectomy for fracture was painful.

In all three groups a large proportion of patients reported episodes of giving way (Table II). There was no significant difference between the incidence of giving way in the three groups (\( p > 0.05 \), chi-squared test).

In the 55 patients who underwent unilateral patellectomy, the range of extension compared with the normal side was limited in 14 and the range of flexion was limited in 15. There was no significant difference in the limitation of flexion or extension between the three groups (Table III; \( p > 0.05 \)).

Activity levels reported at follow-up were compared with the patients’ recollections of their activities before and one year after patellectomy. This comparison suggested that function at follow-up was generally better after patellectomy for anterior knee pain (unilateral or bilateral) despite the fact that the patients were on average 24 years older at follow-up. In contrast, knee function had deteriorated after patellectomy for osteoarthritis. Function in the patients treated for fracture had remained at the same high level despite the patellectomy.

The level of patient satisfaction reflected these results. Of those treated for anterior knee pain, 31 (76%) thought that the operation had been helpful and 4 (10%)...
thought that it had made them worse. Of those treated for osteoarthritis, 12 (54%) thought that the operation had been helpful and 6 (27%) thought that it had made them worse. There is no statistical difference in the levels of satisfaction or dissatisfaction between the two groups.

**Muscle power.** The mean maximum torque achieved and the mean work done during concentric and eccentric contractions were found to be one-third less in the operated than in the normal legs (Table IV).

The mean concentric torque was 118 Nm (SD 60) in the normal knee and 81 Nm (SD 55) in the operated knees. The difference between these groups was significant (p = 0.0078, paired t-test).

The mean eccentric torque was 164 Nm (SD 84.5) in the normal knee and 107 Nm (SD 58) in the operated knee. The difference between these two groups was significant (p = 0.021, paired t-test).

The mean angle of flexion at which the quadriceps exerted maximum concentric or eccentric power was not altered by patellectomy (Table IV).

Six of the 16 operated knees regularly experienced episodes of giving way; their quadriceps strength averaged only 31% of that on the normal side. Four knees had occasional episodes of giving way; their strength averaged 60% of the normal side. Six knees did not give way; they averaged 81% of the strength of the other side. There was a significant difference in the strength of the quadriceps in those knees which gave way compared with those which did not (p < 0.001, Wilcoxon rank-sum test). Two patients who had had vigorous rehabilitation postoperatively, a former professional footballer (male aged 44 years) and a former body-builder (female aged 68 years), had more power in the operated than in the normal knee.

The average volume of the quadriceps muscle of the operated legs was 15% less than on the normal side.

**DISCUSSION**

The results of patellectomy seem to depend very much on the preoperative diagnosis. As a treatment for painful osteoarthritis of the patellofemoral joint the operation is most disappointing. The results of patellectomy for idiopathic anterior knee pain, however, were as good as those of patellectomy for comminuted fracture. Levack, Flannagan and Hobbs (1985) have already shown that the long-term results in the latter case are better than after the preservation of a malunited patella.

The most common symptom in all three groups was giving way and we have shown that weakness of knee extension is probably the reason for this feeling of instability. Since patellectomy did not alter the angle of flexion at which concentric and eccentric strength was greatest the weakness must be due to loss of muscle bulk rather than to mechanical disadvantage. In most patients, wasting and weakness of the quadriceps persist in the long term. Since we found no evidence of loss of bulk in the opposite quadriceps, we deduce that quadriceps strength does not recover after patellectomy, by virtue of performing the normal activities of daily living, but that it may be restored, as in two of our patients, by formal rehabilitation.

**Conclusion.** The results of patellectomy are not universally unfavourable. For patients with osteoarthritis they are poor, but in patients with anterior knee pain 76% reported a good result. While the activity level of the osteoarthritic patients had declined by 25% during the 19 years of follow-up, that of the patients with anterior knee pain had doubled in the 24 years of follow-up, both in those with unilateral and those with bilateral patellectomies. If patients with normal tibiofemoral joints are selected and sufficient rehabilitation is provided, the success rate should be even higher. This would make the operation a sensible option for patients with intractable anterior knee pain.

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**


