THE RESULTS OF PARTIAL AND TOTAL EXCISION OF THE PATELLA

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Opinions differ on the effects of excision of the patella. Good results were reported by Blodgett and Fairchild (1936), by Dobbie and Ryerson (1942) and by Horowitz and Lambert (1946). Indeed Brooke (1937) stated that the function of the knee was better than the normal after removal of the patella, and that the patella was not morphologically an integral part of the quadriceps tendon.

These opinions are in conflict with those of Haxton (1945) and Jensenius (1951) who showed that extension of the knee was impaired by removing the patella. Bruce and Walmsley (1942) demonstrated early and severe arthritic changes in the femoral condyles of rabbits when the patella had been removed. Cohn (1944) showed that these changes were reduced when part of the patella was retained, and recommended partial excision whenever possible. Thomson (1942) recorded good results from this procedure in a follow-up by questionnaire.

TABLE I
ANALYSIS OF PATIENTS EXAMINED

Total excision of patella	..	56
For chondromalacia		32
For fracture		24
Partial excision of patella	.	21

TABLE II
DURATION OF FOLLOW-UP

	1-2 years	3-5 years	6-10 years
Total excision of patella			
For chondromalacia	9	18	5
For fracture	9	8	7
Partial excision of patella	7	12	2

Since there is no firm opinion of the merits of complete, as distinct from partial, excision, it was decided to review the results of the two operations, as practised in one unit during the past ten years.

MATERIAL

In the ten years under review the patella was excised completely or in part in 146 patients. Seventy-seven of these were examined (Table I).

The remaining sixty-nine patients were not seen for the following reasons: seven had died; thirty-six had moved and could not be traced; ten reported satisfactory results by letter but were too far away to attend; and sixteen failed to respond.

The follow-up was from one to ten years after operation (Table II).

All the patients with fractures were operated upon within two weeks of the accident, except one in whom other injuries caused a delay of two months. The following operations were performed.

Partial excision for fracture—The proximal pole was retained and the ligamentum patellae were reattached to the bone (Thomson 1942). The lateral expansions of the quadriceps were repaired.

Total excision for fracture—The patella was excised. In approximately half the patients the quadriceps tendon was sutured to the ligamentum patellae, and in the remainder an overlapping repair of the aponeurosis was done. These variations of technique did not affect the ultimate result.

Total excision for chondromalacia—The patella was excised through a transverse incision in the aponeurosis in eighteen patients, and through a vertical incision in the remaining fourteen.

In twenty-four patients the knee was splinted in a plaster cylinder for two to four weeks after the operation; in the remainder only a compression bandage was used. Quadriceps contractions were begun the day after operation; knee flexion was allowed after two weeks when the patella was removed through a vertical incision and after three to four weeks in the rest. Weight bearing was allowed when the knee could be flexed to a right angle under good muscle control. The type or duration of splintage did not affect the results.

Complications were recorded in seven patients: haematoma (four cases); haemarthrosis requiring aspiration (two cases); rupture of the suture line necessitating further repair (one case).

METHOD OF ASSESSMENT

Each patient was interviewed and examined, and radiographs were taken. Note was made of the development of the quadriceps muscle, and the quadriceps power in fullest extension of the knee was determined against a spring balance (Fig. 1). An

average of three readings was taken and expressed as a percentage of the power in the normal knee.

The results were graded by the following subjective and objective criteria. In cases classed as *excellent* the knee was indistinguishable functionally from normal. With a *good* result there was minor stiffness or aching after prolonged sitting, slight subjective weakness, slight tenderness, or wasting by less than half an inch. Power was at least 90 per cent of the normal. With a *fair* result there were pain and stiffness after sitting, weakness on stairs, sufficient tenderness to make kneeling uncomfortable, loss of flexion up to 30 degrees, or loss of extension up to 5 degrees. Power was not less than 75 per cent of normal. The result was classed as *bad* in all patients who failed to attain the above standards.

FIG. 1

Apparatus used for estimating quadriceps power in maximum extension. One observer applies the force represented by the arrow and notes when the big toe is pulled away from the mark. The other observer records the tension as shown on the spring balance.

The function of the knee was judged to have been seriously affected, although the patient may have returned to his former employment.

RESULTS

The results in the seventy-seven patients are shown in Table III.

In many cases considerable time elapsed after the operation before the patient considered that the knee had ceased to improve. The time taken for greatest recovery is detailed in Table IV.

The main symptoms and clinical findings at follow-up are listed in Table V.

DISCUSSION

Most patients do not recover greatest function in the knee until between six and twelve months after operation—a longer delay than has usually been reported. The better results

TABLE III
RESULTS OF SEVENTY-SEVEN OPERATIONS FOR TOTAL OR PARTIAL EXCISION OF THE PATELLA

	Result			
	Excellent	Good	Fair	Bad
Total excision of patella				
For chondromalacia (32 cases)	5	16	7	4
For fracture (24 cases)	2	10	4	8
Partial excision of patella (21 cases)	3	6	5	7

TABLE IV
TIME TAKEN FOR FULLEST RECOVERY

	Time to greatest recovery			
	1-3 months	4-6 months	7-12 months	13-18 months
Total excision of patella				
For chondromalacia (32 cases)	5	4	14	9
For fracture (24 cases)	3	2	15	4
Partial excision of patella (21 cases)	5	4	11	1

TABLE V
MAIN SYMPTOMS AND CLINICAL FINDINGS AT TIME OF FOLLOW-UP EXAMINATION

	Total excision of patella		Partial excision of patella (21 cases)
	For chondromalacia (32 cases)	For fracture (24 cases)	
Aching at rest	8	6	7
Pain	8	9	7
Subjective weakness	15	19	14
Stiffness after rest	16	14	15
Loss of full extension	4	5	4
Loss of flexion			
10-30 degrees	—	2	4
Over 30 degrees	4	6	4
Wasting of thigh			
$\frac{1}{2}$ -1 inch	11	3	6
Over 1 inch	5	10	7
Quadriceps power			
75-90% of sound side	8	4	5
Less than 75% of sound side	1	8	10
Degeneration of femoral condyle			
Moderate	4	10	12
Severe	2	2	3
Ossification in quadriceps tendon			
Slight	10	8	2
Severe	3	6	—
Change of occupation	3	3	3

in the subjects of chondromalacia than in those with fracture, however treated, may be explained partly by the younger age of the patients (average 25.6 years as against 47.7 years). After complete excision of the patella, subjective weakness was present more often than demonstrable wasting or loss of power of the quadriceps muscle (Fig. 2). Jensenius (1951) suggested that weakening of knee extension after excision of the patella is due to shortening

FIG. 2

Comparison of subjective and objective findings expressed as percentage of group totals.

of the distance between the axis of movement of the knee and the quadriceps tendon. Were this the case one would expect subjective and objective weakness. The feeling of weakness found in so many patients has not been satisfactorily explained. This symptom, which was in many cases trivial, could not be related to operative technique or clinical findings. However, when only part of the patella is removed, weakness and loss of power are related to the presence of radiological arthritis (Fig. 2).

To clarify further discussion the fair and bad results have been analysed together under the heading of poor results (Table VI).

The average age of patients with poor results in all groups was 45.4 years compared with 38.9 years in those with good results and 28.3 years in those with excellent results.

Most of the patients with poor results had ossification in the quadriceps tendon, and this was marked in about two-thirds of these patients (Fig. 3). Ossification of similar degree was found in only 6 per cent of those with good results. It seems likely, therefore, that discomfort in the knee has a direct relationship to ossification in the quadriceps tendon.

It has been suggested that regeneration of bone in the patellar bed is an advantage, and "subperiosteal" excision of the patella has been advised (Dobbie and Ryerson 1942). In the series there were two cases with regeneration of the patella (Fig. 4), both with poor results.

The greater incidence of arthritis of the femoral condyle in the cases of fracture may be due partly to the initial injury. We could find no evidence that excision of the patella itself

FIG. 3

FIG. 4

Figure 3—Radiograph showing ossification in the quadriceps tendon after total excision of the patella.
Figure 4—Radiograph showing regeneration of the patella after total excision.

FIG. 5

FIG. 6

Figure 5—Tilting of the patellar remnant towards the femoral condyles after partial excision of the bone.
Figure 6—Radiograph showing good alignment of the patellar remnant.

produced arthritis, as in animals. Nevertheless a significant cause of patello-femoral arthritis was evident in the cases of partial excision of the patella, for, when gross arthritic changes occurred, the lower pole of the patellar remnant was tilted towards the articular surface of the femur. This tilting was present in five out of seven patients with arthritis (Figs. 5 and 6).

TABLE VI
ANALYSIS OF FAIR AND BAD RESULTS

	Total excision of patella		Partial excision of patella (12 cases)
	For chondromalacia (11 cases)	For fracture (12 cases)	
Age over 40	4	7	10
Ossification in quadriceps	8	10	2
Femoral arthritis	4	8	11
Wasting of thigh over $\frac{1}{2}$ inch	5	9	8
Obvious weakness over 10%	8	8	10

This malalignment is due to reattachment of the ligamentum patellae to the front of the remaining fragment of the patella. It is therefore suggested that the ligament should be sutured to the bone as near to the articular surface as possible (Fig. 7).

FIG. 7
Attachment of patellar tendon after partial excision giving (*left*) tilting of patellar remnant, and (*right*) good alignment.

No disadvantage has been found in excising the intact patella through a vertical split in the aponeurosis, in spite of the suggestion that this leads to loss of full extension of the knee (Smillie 1951). Among the fourteen patients in whom the patella was excised through a vertical split there was only one who could not extend the knee fully.

CONCLUSIONS

The results of our series fall between the extremes of some previous reports. The treatment of fracture of the patella is still a difficult problem, and neither of the procedures reviewed is much superior to the other. As arthritic symptoms were the main cause of disability after partial excision of the patella, it is suggested that when there is already evidence of patello-femoral arthritis before the operation it is preferable to excise the whole bone. In the younger patients partial excision may be expected to give a good result when care is taken to reattach the ligamentum patellae to the correct site.

SUMMARY

1. Seventy-seven operations on the patella have been reviewed.
2. There is no evidence that arthritic changes in the femoral condyles are an inevitable sequel of complete excision of the patella.
3. There is a direct relationship between the severity of symptoms after complete excision of the patella and the extent of ossification in the quadriceps tendon.
4. Patello-femoral arthritis after partial excision of the patella may be due to faulty realignment of the patellar ligament and consequent tilting of the patellar remnant towards the femoral condyles.

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