

PATELLECTOMY AFTER FRACTURE

Long-term Follow-up Results with Special Reference to Functional Disability

S. EINOLA, A. J. AHO & P. KALLIO

Department of Surgery, University of Turku, Turku, Finland.

Twenty-eight out of a group of 38 patients, who had undergone a patellectomy during the period 1950-70, were investigated clinically and radiologically. The results were compared with the subjective symptoms of the patients to see if there was a correlation. The follow-up period was 7.4 years on average. A good subjective result was reported by only six patients. The predominant subjective symptoms were weakness of the limb and pain on movement and/or exertion. The most usual findings were atrophy of the quadriceps muscle, crepitation, and palpation tenderness. The muscular power of the quadriceps was found to be greater than or equal to 75 per cent of the power of the intact knee in only seven cases (25 per cent).

Key words: patella; fracture; muscular power; quadriceps muscle; physiotherapy

Accepted 20.iii.76

The effect of patellectomy on the function of the knee is a matter of controversy. Brooke's (1937) excellent functional results (supported by Hey Groves 1937) were quite soon challenged by experimental and/or clinical studies by Bruce & Walmsley (1942), Haxton (1945), and later by O'Donoghue et al. (1952), De Palma & Flynn (1958), and recently by Kaufer (1971). Their studies showed that patellectomy diminished the extension power of the knee and caused various postpatellectomy symptoms in a considerable number of the patients.

With this information in mind, we thought it worthwhile to conduct a post-examination of a material with a long follow-up period, in which in the majority of cases a patellectomy had been

performed as an emergency operation following fracture. Special attention was paid to postpatellectomy symptoms due to the procedure, as well as to an analysis of their causes.

MATERIAL AND METHODS

During the period 1950-1970 patellectomy was performed on 38 fracture patients at the Department of Surgery, Turku University Central Hospital. The follow-up examination of the 28 patients included a clinical evaluation of subjective symptoms and objective findings. The extension power of the knee was measured using a dynamometer, and a roentgenological study was performed. In 18 cases the primary X-ray pictures were available. The results were compared with the subjective symptoms described by the patients to check for correlation. The operation had in most cases been performed as an emergency (Table 1). The right patella was

Table 1. Timing and indications for operations in 38 cases of total patellectomy.

| Time elapsed since injury | No. of cases | Indication |
|---------------------------|--------------|--|
| Emergency—2nd day | 34 | 35 comminuted fractures, among which were 2 open fractures, 1 transverse with gross chondral damage, 1 refracture after cerclage osteosynthesis. |
| 3rd—12th day | 3 | |
| At 8 weeks | 1 | Infection after cerclage osteosynthesis. |

fractured in 24 cases, and the left in 14. Ten patients had multiple injuries. Three patients had fractures of the same extremity as that with the fracture of the patella. One had a leg prosthesis on the same side and one had severe rheumatoid arthritis.

Sex and age. Seventy-one per cent of the patients were men. The average age was 47 years; the average age of the men was 42 and that of the women 60 years. The average age of patients involved in traffic accidents was 40 years, whereas for the others it was 54 years.

There were almost three times the number of the cases in the latter 11 years (1960–1970) as there were in the first half of the period (Figure 1). Traffic accidents predominated as the cause of fracture.

Operation technique. The operation was performed with a transverse incision. After the removal of fragments, the aponeurosis was sutured with silk or synthetic material in 22 cases, with chromic gut in 14 and with wire in

2 cases. Special attention was paid to the reconstruction of the lateral expansions of the aponeurosis.

Postoperative immobilization lasted 4 weeks (from 2 to 6 weeks) on average. Quadriceps training was started immediately. It was not possible, especially in the beginning of the period under study, to give every patient postoperative physical therapy under the supervision of a physiotherapist.

Postoperative complications. There was one superficial infection and one thrombophlebitis in the material, neither of which involved any residual symptoms. The choice of the suture material did not affect the stability of the tendon repair. Two patients with open fractures recovered without infection occurring.

In the mathematical calculation of the numerical values of the extension power of the knee Student's *t*-test was used.

Follow-up

The follow-up period varied from 1 to 19 years, the average being 7.4 years. The follow-up examination is based on the results of 28 patients. Six of the patients had died during the follow-up period and four were not available.

As regards subjective symptoms, the patient expressed his own view about the general condition of the knee (good, fair, poor; Table 2) and gave details of the extent of disability (Figure 2).

In the clinical study (Figure 3) the local status and function were recorded (range of movement, use of stairs, especially descending stairs etc.). The power of musculus quadriceps was measured in kiloponds using a dynamometer according to the principle presented by Duthie & Hutchinson (1958). The extension power was measured both at an angle of 90° and in full extension. Each measurement was undertaken three times, and the highest value was noted. The average of the two values (at the 90° angle and the 180° angle) as a percentage of the corresponding numerical value of the intact

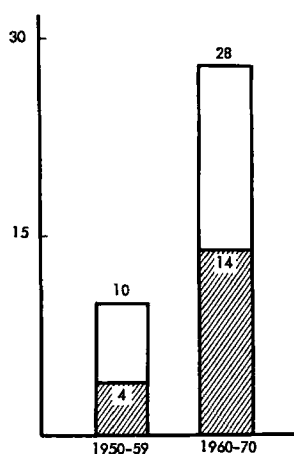


Figure 1. Patellectomy, 38 cases. The hatched part of the column shows the proportion of fractures caused by traffic accidents in the material.

Table 2. Follow-up examination of 28 patellectomy cases, comparing the patient's assessment of the knee with the extension power on the basis of measurement.

| Patient's assessment of the knee | Groups* according to the extension power of the knee | | | | Total |
|----------------------------------|--|---|---|---|-------|
| | A | B | C | D | |
| Good | 5 | | 1 | | 6 |
| Fair | 2 | 7 | 6 | 3 | 18 |
| Poor | | 1 | 2 | 1 | 4 |
| Total | 7 | 8 | 9 | 4 | 28 |

* See the text: Follow-up.

knee was taken to be the measure of the extension power of the knee.

Since the subjective symptoms seemed to correlate with the extension power of the musculus quadriceps, an analysis was made to check this possible correlation after dividing the cases into four groups according to the extension power. Group A-power greater than or equal to 75 per cent; group B-power 50 to 74 per cent; group C-power 25 to 49 per cent and group D-power less than 25 per cent, in all cases referring to a percentage of the extension power of the intact knee (Table 2). Both knees were X-rayed.

RESULTS

Subjective symptoms. The subjective result was reported as good by 6 patients (22 per cent), fair by 18 and poor by 4 patients (Table 2). Weakness was the subjective symptom most often reported, whereas pain after exertion and during movement occurred in nearly half of the material (Figure 2). None of the patients belonging to group A complained of having ache (pain at rest), and five out of seven patients in group A described the condition of the knee as good.

Objective findings. In only 7 out of 28 patients was the power greater than or equal to 75 per cent of the power of the intact knee (Table 2). On average, the extension power of the patellectomized knee had decreased significantly, being only 54 per cent (at 90°) and 53 per cent (in full extension) of the extension power of the intact knee (Table 3). Troublesome subjective symptoms occurred in the groups with the least power (groups B, C and D, Figure 2). Of the four pa-

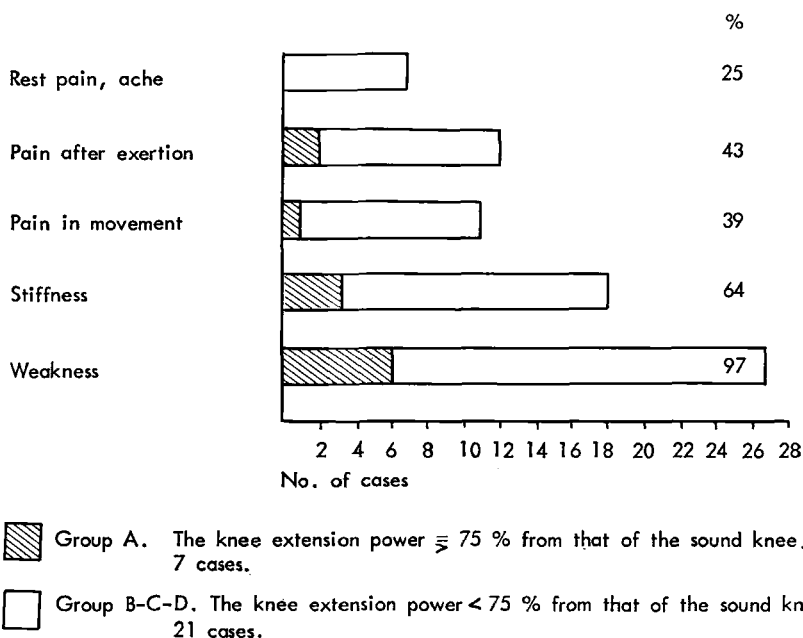


Figure 2. Subjective symptoms in 28 followed up cases of total patellectomy. Cases belonging to group A are shown in the hatched parts of the columns.

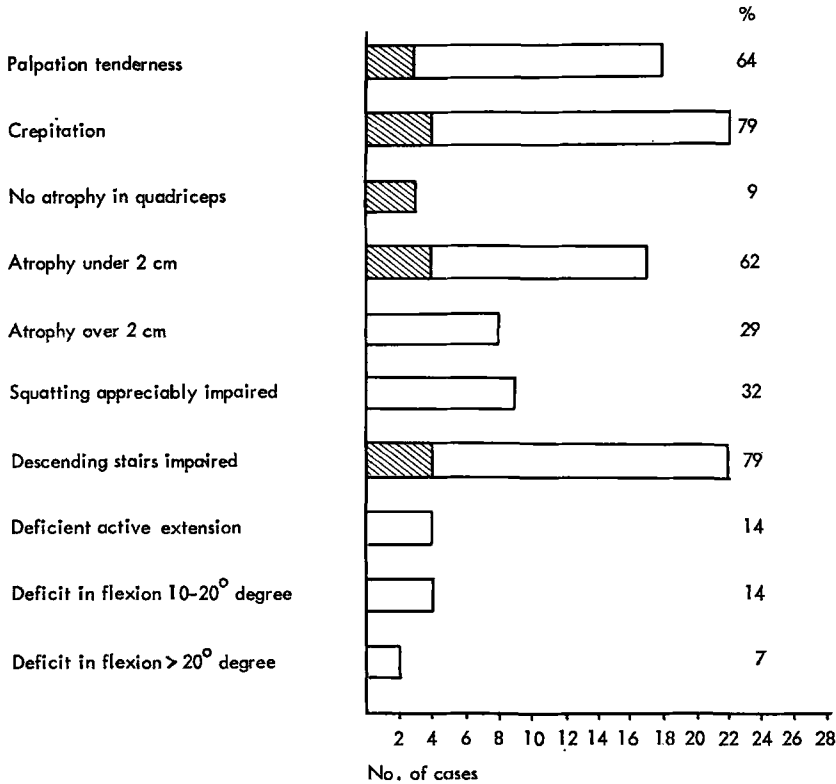


Figure 3. Objective findings in 28 followed up cases of total patellectomy. Cases belonging to group A are shown in the hatched parts of the columns.

tients in the weakest group (group D), one was 79 years old, another had totally neglected the postoperative treatment and training, the third had severe rheumatoid arthritis, and the fourth was the only case with a late patellectomy (after an infected osteosynthesis). The result was regarded by the authors as good in groups A and B, i.e., in 15 patients (54 per cent). As additional ob-

jective findings (Figure 3) impaired ability to descend stairs and muscular atrophy were observed in the majority of the cases. Atrophy of more than 2 cm was found in groups B, C and D (in 8 out of a total of 21 cases) but not in group A. The occurrence of flexion and extension limitation was slight.

The period of time off work because of the patellar fracture varied from 1 to 6

Table 3. Extension in kiloponds of the operated and intact knee. Mean and SEM values of 28 followed up cases are given.

| Position of the knee | Extension power (Kp, SEM) | | Decrease of power as a percentage of the value of the intact knee |
|----------------------|-------------------------------|----------------------|---|
| | Patellectomized knee (n = 28) | Intact knee (n = 28) | |
| 90° | 7.9 ± 0.93 | 14.5 ± 1.10 | 54 |
| 180° | 5.0 ± 0.62 | 9.4 ± 0.86 | 53 |

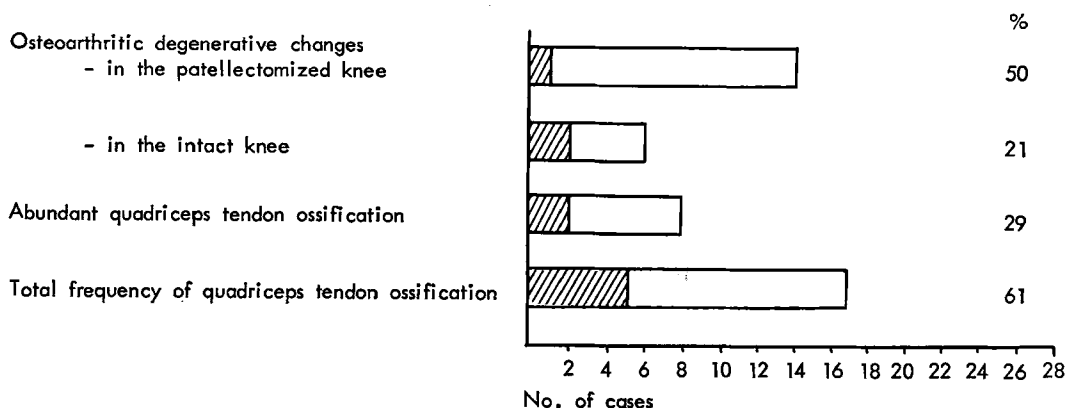


Figure 4. X-ray findings in 28 cases of total patellectomy. Cases belonging to group A are shown in the hatched parts of the columns.

months (2.6 months on average). There were no significant differences between the various groups.

Roentgenological findings (Figure 4). Osteoarthritic changes were observed in the injured knee in 50 per cent of the total material. On the other hand it was possible to observe the occurrence of degenerative condylar changes in only 4 out of 18 cases for which roentgenograms taken immediately after the trauma were available. In one of these four cases the changes had increased and in the other three patients they had appeared during the observation period (at 1, 4 and 10 years). The osteoarthritic changes also showed a tendency to be associated with a decreased function of the musculus quadriceps, because they mostly occurred in the groups with a diminished extension power (groups B, C and D).

Ossifications in the quadriceps tendon were present in more than half of the material. They were abundant in eight cases (Figure 5); in two cases belonging to group A. Thus a large calcification in the quadriceps tendon was not a hindrance in achieving a good extension power.

The duration of observation did not seem to have any significance as regards

the distribution of cases into the various groups (A-D).

DISCUSSION

According to our results, postoperative symptoms appear quite frequently. Good subjective results were only obtained in 20 per cent and good objective results in 54 per cent of the cases (groups A and B), and the results could thus be regarded as inferior to those presented in some previous reports: excellent or good results in 83 per cent (Khong & Pillay 1967), in 75 per cent (Duthie & Hutchinson 1958), in 67 per cent (West 1962), and in 69 per cent (Mishra 1972). On the other hand, Nummi (1971) stated that the result was good in 36 per cent and Boström (1972) found good results in only one out of five cases. During the follow-up examination of the material it appeared that the extension power of the quadriceps was the most reliable single factor in assessing the results of the patellectomy.

Subjective and objective weakness as well as atrophy of the quadriceps muscle associated with weakness were very common postpatellectomy findings in our material. This was also reported by West (1962) and Duthie & Hutchinson (1958).



Figure 5. Abundant calcifications in the quadriceps tendon of a patient belonging to group A.

Apparently, a good extension power is the major criterion, even in the patient's own assessment of the condition of his knee (five "good" patients out of seven belonged to group A). The impairing effect of a concomitant condition on the result of the operation (four patients in group C) must be considered when setting operative indications. There were some areas in which the results were better in our material than in previous materials, e.g., ache and pain during movement (cf. Scott 1949), limitation of flexion (cf. West 1962), and ossification of the quadriceps tendon diminishing the extension power (cf. Friberg 1941, Duthie & Hutchinson 1958). On the other hand, the incidence of secondary osteoarthritis in our material was a little more than that reported by Jani (1966).

The importance of performing a patel-

lectomy as soon as possible after trauma has been emphasized by O'Donoghue (1958), Khong & Pillay (1967) and Jani (1969). According to the cadaver experiments made by Haxton (1945) and recently by Kaufer (1971) the contribution of the patella to knee extension increases with progressive extension. A diminished power (moment arm) in the extension of the knee caused by the lack of the patella is evidenced by the fact that postpatellectomy extension may require as much as a 30 per cent increase in the necessary quadriceps power, as shown by Kaufer (1971). Thus if some time has elapsed between the trauma and the patellectomy, e.g. in unsuccessful osteosynthetic measures, the starting point for the patellectomy has already received a decisive set-back because of quadriceps atrophy and insufficiency. A long period of time (up to 1 year) needed for a full recovery (Duthie & Hutchinson 1958) places rehabilitation in an extremely important position in the treatment of patellectomized patients. Starting physical therapy immediately after the operation is imperative, according to the study mentioned above, and an immobilization period of about 3 weeks should be sufficient. Numerous subjective postpatellectomy symptoms and negative objective findings could obviously be diminished by an intensive strengthening of the quadriceps muscle.

REFERENCES

- Boström, A. (1972) Fractures of the patella. *Acta orthop. scand.*, Suppl. 143.
- Brooke, R. (1937) The treatment of fractured patella by excision. A study of morphology and function. *Brit. J. Surg.* **24**, 733-747.
- Bruce, J. & Walmsley, R. (1942) Excision of the patella. Some experimental and anatomical observations. *J. Bone Jt Surg.* **24**, 311-325.
- DePalma, A. F. & Flynn, J. J. (1958) Joint changes following experimental partial and total patellectomy. *J. Bone Jt Surg.* **40-A**, 395-413.

- Duthie, H. L. & Hutchinson, J. R. (1958) The results of partial and total excision of the patella. *J. Bone Jt Surg.* **40-B**, 75-81.
- Friberg, S. (1941) Über Totalexstirpation der Patella. *Acta chir. scand.* **85**, 361-388.
- Haxton, H. (1945) The function of the patella and the effects of its excision. *Surg. Gynec. Obstet.* **80**, 389-395.
- Hey Groves, E. W. (1937) A note on the extension apparatus of the knee joint. *Brit. J. Surg.* **24**, 747-748.
- Jani, L. (1969) Über die Patellectomie und ihre Spätergebnisse. *Arch. orthop. Unfall-Chir.* **66**, 286-296.
- Kaufer, H. (1971) Mechanical function of the patella. *J. Bone Jt Surg.* **53-A**, 1551-1560.
- Khong, B. T. & Pillay, V. K. (1967) Patellectomy for fracture. A study of the results of 40 cases. *Singapore med. J.* **8**, 230-234.
- Mishra, U. S. (1972) Late results of patellectomy in fractured patella. *Acta orthop. scand.* **43**, 256-263.
- Nummi, J. (1971) Fracture of the patella. A clinical study of 707 patellar fractures. *Ann. Chir. Gynaec. Fenn., Suppl.* **179**.
- O'Donoghue, D. H. (1958) Treatment of fractures of the patella. *Northw. Med. (Seattle)* **57**, 1592-1600.
- O'Donoghue, D. H., Tompkins, F. & Hays, M. B. (1952) Strength of the quadriceps function after patellectomy. *West. J. Surg.* **60**, 159-167.
- Scott, F. E. (1949) Fractures of the patella. *J. Bone Jt Surg.* **31-B**, 76-81.
- West, F. E. (1962) End results of the patellectomy. *J. Bone Jt Surg.* **44-A**, 1089-1108.

Correspondence to: S. Einola, Department of Surgery, University of Turku, 20520 Turku 52, Finland.