

Operative versus closed treatment of primary dislocation of the patella

Similar 2-year results in 125 randomized patients

Risto Nikku¹, Yrjänä Nietosvaara², Pentti E Kallio², Kari Aalto² and Jarl-Erik Michelsson³

To assess whether initial surgery is beneficial for patients with primary dislocation of the patella, we carried out a prospective randomized study. Knee stability was examined under anesthesia, and associated injuries were excluded by diagnostic arthroscopy. 55 patients then had closed treatment and 70 patients were operated on with individually adjusted proximal realignment procedures.

Surgery gave no benefit based on 2 years of follow-up. The subjective result was better in the non-operative group in respect of mean Houghston VAS knee score (closed 90, operative 87), but similar in terms of the patient's own overall opinion and mean

Lysholm II knee score. Recurrent instability episodes (redislocation or recurrent subluxation) occurred in 20 nonoperated and in 18 operated patients. Of these, 15 and 12, respectively, then suffered redislocations. Function was better after closed treatment. Serious complications occurred after surgery in 4 patients.

In conclusion, the recurrence of patellar dislocation may be more frequent than reported, whatever the form of treatment. Routine operative management cannot be recommended for primary dislocation of the patella.

¹Malmi City Hospital, Talvelantie 6, FIN-00700 Helsinki, Finland, ²Childrens Hospital, Helsinki University Central Hospital, Helsinki, Finland, ³Department of Orthopedics and Traumatology, Surgical Hospital, Helsinki, Finland. Tel +358 0-3106611. Fax -31067226

Submitted 96-05-04. Accepted 96-12-23

Traditional closed treatment of primary patellar dislocation was first challenged by Sargent and Teipner (1971). They suggested immediate repair of the torn medial retinaculum. Later, the high incidence of associated osteochondral fractures (Scheller and Mårtenson 1974) and the rate of redislocations after closed treatment (Cofield and Bryan 1977) made some institutions, especially in Scandinavia and central Europe, adopt an operative policy.

We have found no prospective randomized trials on the management of primary patellar dislocation. In a randomized study, we assessed whether surgical realignment offers any advantage over mere immobilization after primary patellar dislocation.

Patients and methods

Altogether 176 consecutive patients with 180 episodes of primary dislocation of the patella were admitted to two referral trauma centers in Helsinki, Finland, during the study period of 1991–1992. Inclusion criteria for the trial were:

1. Acute (≤ 14 days old) first-time lateral dislocation of the patella.
2. No previous knee operations or major knee injuries.
3. No ligament injuries to be repaired.
4. No osteochondral fractures needing fixation.

51 patients were excluded: 31 of these patients would have met the criteria for the trial, but 19 received treatment by consultants not involved in the study, 7 refused to participate, 4 had erroneous randomization and 1 was lost to follow-up. Of the remaining 20 excluded patients, 13 had sustained major associated injuries necessitating operation, 4 were returned to their local trauma units and 3 had contraindications for surgery or anesthesia. 125 randomized patients, 82 women, completed the 2-year follow-up protocol. In 3 patients, who suffered a subsequent dislocation of the contralateral patella during the study period, the knee included in the trial was chosen at random.

The diagnosis was based on a locked dislocation in 66 patients. In 47 patients, the patella was dislocatable during examination under anesthesia. 12 patients had typical synovial and chondral lesions at arthro-

scopic examination and minor asymmetric patellar displacement, i.e., subluxation in anesthesia (Ficat 1970).

With permission of the ethics committees of both hospitals, randomization was based on the year of birth (even/odd). The 31 patients excluded, but meeting the criteria for the trial, would have been equally allocated into the two study groups.

On admission, all patients underwent clinical and radiographic examinations, examination under anesthesia and diagnostic arthroscopy. A tourniquet was used. 55 patients were allocated to the closed (C) group and 70 patients to the operative (O) group (Table 1). 30 and 40 patients in these groups, respectively, were younger than 16 years. Small osteochondral fractures were found and removed during arthroscopy in 8 patients in group C and 19 patients in group O.

In the operative group, patients had individually adjusted procedures. 63 patients had repair of the medial retinaculum, by suturing in 39 patients, by duplication in 18 patients and by additional augmentation of the patellofemoral ligament with the adductor magnus tendon (Avikainen et al. 1993) in 6 patients. Of these 63 patients, 54 had lateral release. 7 patients, all with subluxation under anesthesia, had only lateral release for realignment. Two orthopedic consultants (KA, PEK) and two registrars (YN, RN) did 88% of the arthroscopies and operations. Special care was taken to preserve the saphenous nerve and its terminal branches.

After-care was identical in both groups. Thigh muscle exercises and full weight bearing were started as soon as tolerated. All 113 patients with dislocatable patellae under anesthesia had 3 weeks' immobilization with the knee in neutral extension. Adults were given a cylinder cast and children a plastic splint (Immobilizer, Camp International, Jackson, Michigan, USA). Mobilization was started with a patellar stabilizing orthosis (Patella stabilizer, Camp International, Jackson, Michigan, USA) used for the following 3 weeks. 12 patients with subluxation under anesthesia were primarily mobilized with an orthosis for 6 weeks. All patients were recommended to use the orthosis when participating in rehabilitation sessions and athletic activity during the following 6 months.

At final evaluation, the mean follow-up period was 25 (20–45) months. The subjective result was assessed by 3 standard methods: patient's own overall opinion (excellent, good, fair or poor), Lysholm II score (Tegner and Lysholm 1985) and Hughston VAS (visual analog scale) knee score (Flandry et al. 1991). The Hughston VAS score was adjusted to a range from 28 to 100 points. The Hughston VAS question-

Table 1. Characteristics of 125 randomized patients

	Group C (n 55)	Group O (n 70)
Demographics		
Mean age (SD) (range)	19.1 (7.5) (9–36)	19.5 (9.0) (9–47)
Women/Men	30/25	52/18
Median pretrauma Tegner activity level (range)	6 (3–9)	5 (0–10)
Primary injury		
Low energy trauma ^a	8	14
Spontaneous patellar relocation	27	32
Fall on ground	52	58
Under the influence of alcohol	7	8
Hemarthrosis	52	58
Constitution		
Mean body mass index (SD) ^b	22.2 (3.9)	21.8 (4.0)
Generalized ligamentous laxity ^c	1	1
Mean Insall-Salvati index (SD) ^d	1.23 (0.2)	1.26 (0.2)

^a Low energy trauma: dislocation occurred while walking, standing, etc.

^b Body mass index: weight/(height)²

^c (Carter and Wilkinson 1964)

^d Length of patellar ligament/length of patella on radiographic side-view (121 knees)

naire was mailed to the patient and Lysholm II score was filled out at the hospital.

Recurrences were asked about twice: by a mailed questionnaire and by the examiner at the final evaluation. The semantic difficulties in defining recurrences led us to combine the redislocations and recurrent subluxations under the heading of "instability episode". Later operations on the knee and recent Tegner activity level (Tegner and Lysholm 1985) were also documented.

The performance test was a modification of the method described by Tegner et al. (1986). It consisted of a warm-up practice on a bicycle ergometer for 10 minutes, running in a figure-of-8 and one-leg hop. 3 laps on a figure-of-8 were run, and the time was recorded. In one-leg hop, the quotient between the best distance for the injured and the uninjured side was used. In a provocation test developed for this study, the maximum number of squat-downs within one minute was then counted, whereafter the pain in the affected knee was registered on VAS.

The clinical examination was performed by two of the authors (YN, RN). We recorded thigh circumferences 10 cm above the patella, range of knee motion, patellofemoral crepitus and apprehension sign, the surgical scar and prepatellar sensibility. The patient's generalized joint laxity was analyzed by 5 tests (Carter and Wilkinson 1964): apposition of the thumb to forearm, and hyperextension of the fingers, elbows, knees and feet. Laxity was diagnosed if more than 3 of these tests were positive. 123/125 patients attended

Table 2. Subjective results and instability at 2 year-follow-up after primary dislocation of the patella

	Group C (55)	Group O (70)	95% CI between groups ^a	P-value
Patient's opinion: excellent/good (fraction)	12/27 (0.7)	7/42 (0.7)	–15 to 17	0.9
Patient's opinion: fair/poor (fraction)	15/1 (0.3)	21/0 (0.3)	–17 to 15	0.9
Mean Lysholm II score (SD)	89.2 (10.7)	88.2 (9.7)	–2.6 to 4.6	0.6
Mean Hughston VAS score (SD) ^b	90.1 (10.9)	87.3 (11.2)	–1.2 to 6.8	0.04
Instability episodes, patients (fraction)	20 (0.4)	18 (0.3)	–3 to 31	0.2
Redislocation, patients (fraction)	15 (0.3)	12 (0.2)	–5 to 25	0.2
Recurrent subluxation, patients (fraction)	8 (0.2)	10 (0.1)	–12 to 13	1

^a Percent or mean, counted group C – group O^b Flandry et al. 1991

Table 3. Functional and clinical results at 2-year follow-up after primary dislocation of the patella

	Group C (55)	Group O (70)	95% CI between groups ^a	P-value
Performance test ^b , n 54/67				
Mean figure-of-8 run, seconds (SD)	22.6 (3.2)	25.9 (10.1)	– 6.1 to –0.5	0.004
Mean one-leg hop quotient (SD)	0.93 (0.17)	0.91 (0.24)	–0.1 to 0.1	0.8
Mean squats/minute (SD)	43.2 (10.6)	37.9 (12.3)	1.1 to 9.5	0.03
Mean postexercise pain VAS (SD)	1.6 (1.3)	1.8 (1.5)	–0.7 to 0.3	0.4
Mean change in Tegner activity level (SD)	–0.2 (1.7)	–0.3 (1.5)	–1.4 to 1.6	0.5
Clinical examination, n 54/69				
Apprehension sign +, patients (fraction)	16 (0.3)	22 (32)	–19 to 14	0.8
Patellofemoral crepitus +, patients (fraction)	18 (0.3)	31 (45)	–29 to 6	0.2
Mean reduction in thigh muscle circumference, cm (SD)	0.3 (1.0)	0.4 (0.9)	–0.4 to 0.2	0.5

^a Percent or mean, counted group C – group O^b Tegner et al. 1986

the performance test and clinical examination. 2 patients returned only the questionnaires.

Comparisons of means and medians between groups were performed with the Mann-Whitney rank-sum test and Student's two tailed t-test. The chi-square test with continuity correction of Yates and Fisher's exact test were used to compare the differences in proportions. The level of significance was set at 0.05. 95% confidence intervals for the differences between the groups were also determined.

Results

The subjective result was better in group C, as measured by the Hughston VAS knee score, but the two other methods gave similar results between the groups. Recurrent instability episodes (redislocation or recurrent subluxation) were slightly commoner in group C but the difference was not statistically significant ($p = 0.20$). The mean interval from the primary dislocation to the first redislocation was 11 (2–24) months in group C and 15 (3–27) months in group O.

6 patients had more than one redislocation in group C and 2 patients in group O (range 2–4 in both groups) (Table 2).

The patients undergoing closed treatment managed better in the performance test, but the figure-of-8 run and the squat-down test were the only ones to show statistically significant differences. On clinical examination, both groups were found to be equal, except in respect of prepatellar sensibility. All patients had normal knee mobility. Mean Tegner activity score at follow-up was 5.3 (SD 2.0) in group C and 4.7 (SD 1.8) in group O ($p = 0.08$) (Table 3).

Later operations. 9 patients with closed treatment subsequently underwent 11 knee operations: 4 arthroscopies and 7 proximal realignment procedures. 12 patients with primary surgery had 15 reoperations: 6 arthroscopies, 8 proximal realignment procedures and 1 exploration of the sciatic nerve. Most of these later procedures were performed in patients younger than 16 years.

Complications and sequelae of treatment. Major complications occurred only after operative treatment in 4 patients (6%). A 12-year-old boy suffered paresis

of the sciatic nerve, probably caused by the tourniquet compression, resulting in severe permanent disability. A middle-aged woman developed a deep wound infection and bacterial arthritis, which resolved with revisions and antibiotic therapy. A superficial wound infection and a burn injury on the insensible anterior skin of the knee each occurred in one patient.

Minor sequelae after primary treatment and reoperations occurred in an additional 12 patients (22%) in group C and in 52 patients (74%) in group O. These included lesions of the infrapatellar nerve (3 vs. 39), cosmetically unsatisfactory scars (8 vs. 31) and less than 90° of flexion of the knee at 6 weeks (5 vs. 18), requiring manipulation under anesthesia (2 vs. 2).

Discussion

In this randomized study on primary patellar dislocation, conservative and operative treatment gave almost identical results in terms of subjective score, recurrent instability and function. All serious complications and most of the minor sequelae of treatment occurred after operative treatment.

The former studies on primary patellar dislocation vary in respect of the follow-up period after the treatment which ranged from a couple of months to over 30 years (Boring and O'Donoghue 1978, Larsen and Lauridsen 1982). In summary, the subjective result seems to be favorable in three quarters of the patients, whatever the mode of management. Yet 4 authors (Lavarde 1974, Hejgaard et al. 1980, Pedersen and Pedersen 1989, Savarese and Lunghi 1990) have recommended operation for all patients with primary dislocation of the patella. The risk of redislocation seems to be fivefold greater after closed treatment (Larsen and Lauridsen 1982, Cash and Hughston 1988) compared to previous operative series (Knopp et al. 1986, Vainionpää et al. 1990). The difference may be due to shorter follow-up periods in most of the operative series. Only Harilainen (Harilainen and Myllynen 1988, Harilainen and Sandelin 1993) has reassessed his material and observed an increase in the rate of redislocation from 2% to 17% in his operatively treated patients after a follow-up of 1 and 6.5 years, respectively. Young patients tend to have redislocations, if followed long enough (Larsen and Lauridsen 1982, Cash and Hughston 1988). It is not clear whether the trend is similar in older patients with less physical activity.

Our study included patients of all ages and the age distributions were equal in both treatment groups. Our collection of patients ensures a true age distribution in the pediatric population. The number of adult patients, however, is smaller than expected, since

there are other referral trauma units in Helsinki. The redislocation rate in our material was twice that in previous non-operative and three times that in previous operative series. As there are no major differences between the age distributions of the materials compared, the high rate of redislocations in our study may be explained by semantics (redislocation vs. recurrent subluxation) and by the prospective setting: all kinds of instability episodes were asked about twice in this trial.

The clinical manifestation of primary dislocation of the patella varies from a massive hemarthrosis to a nearly painless knee. Correspondingly, the damage caused by dislocation varies from large chondral or capsular injuries to virtually unharmed joints, as judged by arthroscopy and surgical exploration. The optimal operative management could not be uniform for all patients (Delince et al. 1989). Distal realignment procedures of the tibial tubercle seem to prevent redislocation (Boring and O'Donoghue 1978). Their major disadvantage, as compared with soft tissue operations, is a higher risk of complications including late patellofemoral arthrosis (Crosby and Insall 1976, Barbari et al. 1990). We adjusted the proximal realignment operation in proportion to the extent and location of soft tissue trauma (Sallay et al. 1996) in our study protocol.

We used 3 weeks' immobilization to be able to compare the result with previous studies. Although the trend today seems to favor primary mobilization, Knopp et al. (1986) found best results in patients treated by immobilization alone for 4 weeks or more. The ideal length of immobilization is unknown.

In the assessment of the result, the importance of redislocation has probably been exaggerated. This may have led to operative overtreatment. Modern knee evaluation should include some of the subjective scores, activity level grading and tests of stability and function (Tegner and Lysholm 1985). We attempted to combine these various aspects in an index, but found no further information in the data analysis.

In the future, a critical analysis of the prognostic factors should identify patients who would benefit from operative primary treatment.

Acknowledgements

The authors thank Dr. Hannu Kautiainen for statistical analysis of the data and Dr. Martti Kekomäki for revising the manuscript. This study was supported by the Finnish Orthopedic Association, the Medical Society of Finland and the Finnish Office for Health Technology Assessment.

References

- Avikainen V J, Nikku R K, Seppänen-Lehmonen T K. Ad-ductor magnus tenodesis for patellar dislocation. Technique and preliminary results. *Clin Orthop* 1993; 297: 12-6.
- Barbari S, Raugstad T S, Lichtenberg N, Refvem D. The Hauser operation for patellar dislocation. 3-32-year results in 63 knees. *Acta Orthop Scand* 1990; 61 (1): 32-5.
- Boring T H, O'Donoghue D H. Acute patellar dislocation: results of immediate surgical repair. *Clin Orthop* 1978; (136): 182-5.
- Carter C, Wilkinson J. Persistent joint laxity and congenital dislocation of the hip. *J Bone Joint Surg (Br)* 1964; 46: 40-5.
- Cash J D, Hughston J C. Treatment of acute patellar dislocation. *Am J Sports Med* 1988; 16 (3): 244-9.
- Cofield R H, Bryan R S. Acute dislocation of the patella: results of conservative treatment. *J Trauma* 1977; 17 (7): 526-31.
- Crosby E B, Insall J. Recurrent dislocation of the patella. Relation of treatment to osteoarthritis. *J Bone Joint Surg (Am)* 1976; 58 (1): 9-13.
- Delince P, Hardy D, Lafontaine M, Simons M. Première luxation de rotule; quel traitement adopter? *Acta Orthop Belg* 1989; 55 (3): 411-27.
- Ficat P. Pathologie fémoro-patellaire. (1 ed.) Paris: Masson et Cie 1970; 1: 234.
- Flandry F, Hunt J P, Terry G C, Hughston J C. Analysis of subjective knee complaints using visual analog scales. *Am J Sports Med* 1991; 19 (2): 112-8.
- Harilainen A, Myllynen P. Operative treatment in acute patellar dislocation: radiological predisposing factors, diagnosis and results. *Am J Knee Surg* 1988; 1: 178-85.
- Harilainen A, Sandelin J. Prospective long-term results of operative treatment in primary dislocation of the patella. *Knee Surg Sports Traumatol Arthroscopy* 1993; 1: 100-3.
- Hejgaard N, Skive L, Perrild C. Akut traumatisk patellaluk-sation behandlet med simpel medial kapsulorafi. *Ugeskr Laeger* 1980; 142 (4): 238-40.
- Knopp W, Muhr G, Hesoun P, Neumann K. Konservative oder operative Therapie nach Patellaluxation. Pathophysiologie, Symptomatik und Diagnostik; Therapie und Behandlungsrichtlinien. *Unfallchirurg* 1986; 89 (10): 463-72.
- Larsen E, Lauridsen F. Conservative treatment of patellar dislocations. Influence of evident factors on the tendency to redislocation and the therapeutic result. *Clin Orthop* 1982; 171 (171): 131-6.
- Lavarde G. Traitement des luxations traumatique récentes de la rotule. *J Chir (Paris)* 1974; 107 (4): 499-514.
- Pedersen P, Pedersen T. Conservative treatment of acute patellar dislocation. *Adv Orthop Surg* 1989; 12: 205-7.
- Sallay P I, Poggi J, Speer K P, Garret W E. Acute dislocation of the patella. A correlative pathoanatomic study. *Am J Sports Med* 1996; 24 (1): 52-60.
- Sargent J R, Teipner W A. Medial patellar retinacular repair for acute and recurrent dislocation of the patella: a preliminary report. *J Bone Joint Surg (Am)* 1971; 53 (2): 386.
- Savarese A, Lunghi E. Traumatic dislocations of the patella: problems related to treatment. *Chir Organi Mov* 1990; 75 (1): 51-7.
- Scheller S, Mårtenson L. Traumatic dislocation of the patella. A radiographic investigation. *Acta Radiol Suppl Stockh* 1974; 336 (1): 1-160.
- Tegner Y, Lysholm J. Rating system in evaluation of knee ligament injuries. *Clin Orthop* 1985; 198: 43-9.
- Tegner Y, Lysholm J, Lysholm M, Gillquist J. A performance test to monitor rehabilitation and evaluate anterior cruciate ligament injuries. *Am J Sports Med* 1986; 14 (2): 156-9.
- Vainionpää S, Laasonen E, Silvennoinen T, Vasenius J, Rokkanen P. Acute dislocation of the patella. A prospective review of operative treatment. *J Bone Joint Surg (Br)* 1990; 72 (3): 366-9.