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LONG TERM RESULTS OF SURGERY FOR NON-ACUTE ANTEROMEDIAL ROTATORY INSTABILITY OF THE KNEE

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Seventy-eight patients treated by extraarticular reconstruction including pes anserinus transfer for anteromedial rotatory instability of the knee were reinvestigated 16 – 47 months (mean 28) after operation. Function before and after operation was assessed by means of a knee rating score. Of these patients, 94 per cent showed a higher score after operation. Twenty per cent showed full recovery with no limitation of knee function whatsoever. The follow-up score was higher with preserved medial meniscus function than when this structure had been removed. When not initially torn, the medial meniscus tended to become involved with time. Mild laxity in extension, possibly indicative of a posterior cruciate injury previously underestimated or not observed, was found in 15 per cent of the patients. No correlation was found between late knee function and the interval between injury and operation or the interval between operation and follow-up examination.

The long term results were good. Extraarticular reconstruction is thus indicated in cases of chronic rotatory instability of the anteromedial type. Routine meniscectomy is not recommended in these patients, however. Signs possibly indicating posterior cruciate ligament involvement should be carefully looked for, as even minor posterior cruciate injury, easily overlooked, may influence the late results.

Key words: knee; ligaments, articular; semilunar cartilage; surgical repair

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The primary results of various surgical procedures for knee joint instability have been reported as satisfactory (Jones 1970, O'Donoghue 1973, Nicholas 1973). At this clinic, good results have been obtained with intraarticular repair using the medial third of the patellar ligament (Liljedahl & Gillquist 1972), but others have found intraarticular reconstruction unrewarding (Kennedy et al. 1974). We too find it associated with certain limitations. It is technically difficult, and is not the method of choice for knees with joint degeneration. Since 1971 we have therefore used an extraarticular technique of reconstruction in cases of anteromedial rotatory instability.

The aims of this study were

(1) to evaluate the functional capacity of patients after extraarticular repair for chronic instability
(2) to find factors influencing late function
(3) to study whether function tends to become impaired with time.

PATIENTS

Ninety-two patients were operated on for chronic anteromedial rotatory instability during the period

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January 1972 – May 1975 at this department. Hospital records were scrutinized and patients requested to return for clinical re-examination. Eleven could not be traced, and three more failed to attend. Seventy-eight (69 men and 9 women) were thus fully re-examined 16 – 47 months (mean 28 months) postoperatively. The mean age of the patients at the time of operation was 26 years (range 16 – 45).

Sports injuries, mostly football, predominated. Forty-eight (61 per cent) were injured during competitive sports activity, and 19 (24 per cent) while exercising for physical fitness. Eleven were injured in traffic, aviation, and parachute accidents.

No acute cases are included in this study. Twenty-one patients were operated on within 1 year of the injury; 26 were treated 1 – 3 years post-injury, and in 31 cases more than 3 years had elapsed since the primary injury.

In 43 patients the knee had been operated on previously. Meniscectomy alone had been performed in 20 patients, ligament reconstruction in 7 patients, and in 13 both meniscectomy and repair of ligaments had been carried out. Excision of degenerated patellar cartilage had been done in two patients and exploratory arthrotomy in one. Multiple operations (2–5) had been done previously in 18 patients.

Our diagnoses (Figure 1) were based on the clinical examination plus operative findings, complemented by the findings at arthroscopy and arthrography. Stability grading was done according to the American Standard Nomenclature (AMA 1968) pre- and postoperatively. All knees fulfilled the criteria for anteromedial rotatary instability (Slocum & Larson 1968). In four patients the negative abduction stress at 30° of flexion indicated only incomplete posteromedial tear. Four other patients showed no true anterior drawer sign (ADS). Four patients had previously sustained damage to both anterior and posterior cruciates, representing by definition a medial straight instability according to the classification suggested by Hughston et al. (1976). However, after operation during the acute stage the anteromedial rotatory instability was considered to dominate completely over the residual straight component. The posteromedial injury component was observed in 33 cases.

SURGICAL PROCEDURES

Torn or avulsed menisci and torn remnants from previous meniscectomies were totally excised.

When old ligament tears were located to the proximal part the technique previously described by Alm & Gillquist (1974) was generally used. In other cases the operative methods varied according to the site and type of tear. In most cases the posteromedial capsule was advanced anteriorly and proximally, and secured with sutures to the upper part of the medial collateral and the adductor tubercle.

No intraarticular reconstructions were carried out.

Transfer of pes anserinus was carried out according to Slocum & Larson (1968). The transfer was not used as an isolated procedure, however, but only in combination with ligament repairs. Postoperatively a plaster cylinder was used for 4 weeks.

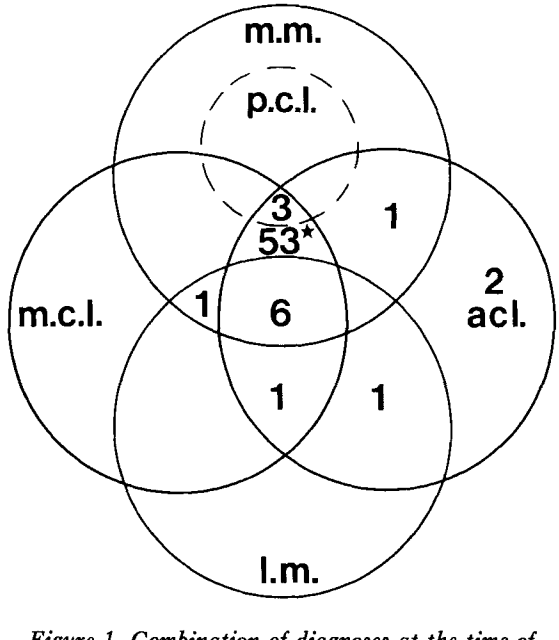

Figure 1. Combination of diagnoses at the time of operation (68 out of 78 patients).
mm = *tear of medial meniscus or remnant,* lm = *tear of lateral meniscus or remnant,* acl = *torn anterior cruciate ligament,* pcl = *torn posterior cruciate ligament,* mcl = *torn medial collateral ligament.*
**Twenty-three patients with a concomitant tear of the posteromedial capsule* (pmc) *are included. This tear was also seen in five other patients not separately indicated in the diagram. Ten patients with the following diagnoses could not be included in the diagram:*
5 with tear of mcl + acl
2 with tear of mcl + acl + pmc
1 with tear of mcl + pcl + pmc
1 with tear of mcl + mm + pmc
1 with tear of mcl + lm + pmc

FOLLOW-UP INVESTIGATION

The follow-up investigation included the following:

(1) The information from previous hospital records was checked directly with the patient.
(2) A special questionnaire including a rating system for several variables of knee function (modified from Larson, in Smillie 1974) was filled in by one and the same examiner with the patient's collaboration.
(3) Thorough clinical examination by the same examiner was carried out. Instability was recorded according to the gradation by Hughston et al. (1976), which is based upon the American Medical Association grading (1968). Any difference between the injured and the non-injured knee involving less than a 5 mm separation of the joint surfaces during the stress test was regarded as mild (1) instability, 5–10 mm as moderate (2), and more than 10 mm as severe instability (3). Measurement of rotatory instability is uncertain, and, when present, this was therefore only subjectively classified as slight or moderate.

To study whether the knee function (score) at follow-up was related to the finding of medial instability and/or anteroposterior instability the knees were classified as follows: category A, not fully stable medially in extension; B, moderate or severe anterior drawer sign; C, moderate valgus instability at 30° and not fully stable in extension; D, fully stable medially in extension but with mild valgus instability at 30° flexion; E, medially stable with mild or no anterior drawer sign. Consequently, the knees with greatest medial instability were included in category A and C and those with greatest sagittal instability in category B, with overlap between these categories.

The results were treated statistically by the usual methods (Snedecor & Cochran 1967). Values are given in the text as means ± s.e. mean.

RESULTS

Primary

There were no serious complications of any kind. Mean period in hospital after operation was 5 days (range 1–18). In one patient recovery of mobility was slow, and manipulation under anaesthesia was required.

Findings at follow-up examination

Some of the functions recorded are given in Table 1. A maximum score of 100 was reached by 16 patients (20 per cent). Seventy-three (94 per cent) showed an elevated score postoperatively. Three patients showed no score change, and two patients showed a lower score at follow-up than preoperatively. The mean score values for the whole series were 66.2 ± 1.87 preop., and 93.4 ± 1.15 postop., mean difference 26.3 ± 1.78 ($P < 0.001$). Forty-nine (73 per cent) out of the 67 patients injured while participating in athletics returned to their particular sport, and 18 (27 per cent) gave up or changed to another.

Table 1. Functional variables pre- and postoperatively. Grade 1 means no pain and full performance, grade 4 incapacitating pain and inability to climb stairs. Grade 3 for jumping means inability

Functional Variable	Grade 1	2	3	4
Pain				
preop. ($n=74$)	5	14	50	5
postop. ($n=78$)	48	23	7	—
Up-down stairs				
preop. ($n=74$)	31	29	13	1
postop. ($n=78$)	70	7	1	—
Jumping				
preop. ($n=74$)	7	33	34	
postop. ($n=78$)	57	18	3	

Table 2. Knee joint stability at follow-up (graded according to Hughston et al. 1976)

Type \ Grade	Fully stable	1	2	3
Medial				
0°	66	12	—	—
30°	51	25	2	—
Sagittal (ADS)	25	44	8	1

Knee joint stability. Anteroposterior and medial stability are shown in Table 2. Fifty-four patients showed no rotatory instability whereas 22 patients showed slight and two moderate instability.

The relations between anteroposterior,

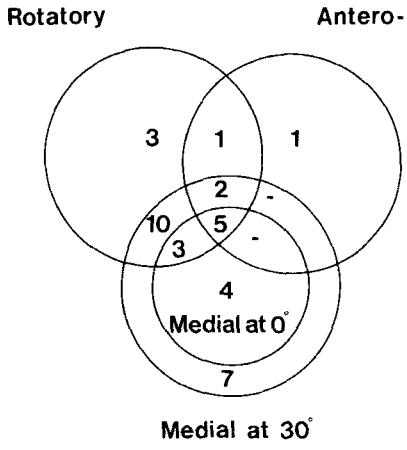

Figure 2. The relations between medial, rotatory, and moderate or severe anteroposterior instability at follow-up examination (36 out of 78 patients).

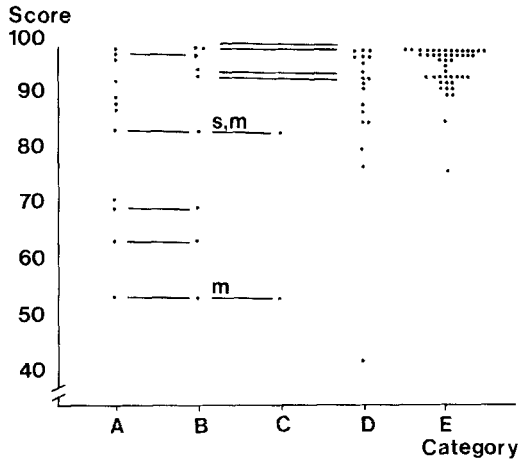

Figure 3. Scores for different classes of stability at follow-up examination (78 patients).
——indicates same patients; s, one patient with severe ADS; m, patients showing moderate rotatory instability at follow-up examination.

medial, and rotatory instabilities found are shown in Figure 2. In 25/36 patients combined ligament laxity was found. In 21/24 knees with rotatory instability some possibly significant medial and sagittal instability was also present. Eleven out of 12 knees with mild medial instability in extension showed mild or moderate laxity at 30° flexion, and in the twelfth no other laxity was found. This patient had previously been subjected to total medial meniscectomy. Moderate ADS alone was found in only one out of nine patients, and in most knees with residual moderate or severe ADS, medial and rotatory instability was also present.

Knee stability – score. Relations between rating score and different categories (A – E) of stability are shown in Figure 3. Sixty-nine patients with no or mild ADS (not separately classified in the figure) showed a higher score of 94.4 ± 1.03 than nine with moderate or severe ADS (category B), 85.1 ± 5.7 ($P < 0.01$). The score for category A ($n = 12$) (mild instability in extension) was lower than for category E ($n = 47$) (medially stable knees with or without slight ADS), means 84.1 ± 4.3 and 96.8 ± 0.6 ($P < 0.001$). The mean value for category D ($n = 19$) was 90.8 ± 2.3.

Previous operations – score. As seen in Figure 4 patients previously operated on in the same knee showed a lower score than those operated on for the first time (means 90.2 ± 1.9 and 97.3 ± 0.7, $P < 0.001$). Patients previously treated by medial meniscectomy showed a lower preoperative score than patients in whom the medial meniscus (injured or uninjured) was still *in situ* (means 60.8 ± 3.2 and 70.4 ± 2.3 respectively, $P < 0.02$). This latter group of 35 patients included 24 with torn but still unremoved medial menisci. At follow-up the highest score was found in the patients with an intact medial meniscus (mean 97.3 ± 1.02) (Figure 4). However, the number of knees with intact medial menisci progressively reduced with time after trauma (Figure 5). No correlation was found between the interval between injury and operation and the score at follow-up.

Joint degeneration – score. Patients with cartilage degeneration in two or three compartments at the time of operation showed a lower follow-up score than those with no degenerative change (means 88.1 ± 2.8 and 95.7 ± 1.4, $P < 0.001$). Degenerative changes in only one of the knee compartments did not

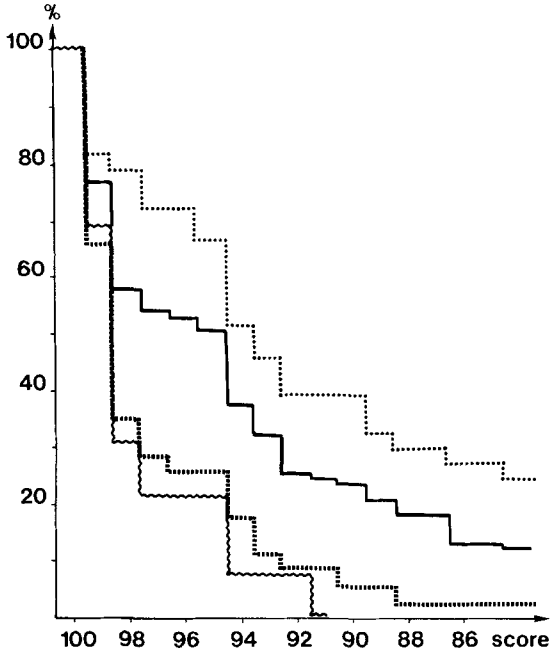

Figure 4. Proportion of patients in per cent in relation to score values for the various groups (78 patients).

——— *entire series of patients*
..... *patients previously treated by medial meniscectomy*
..... *no previous operation on the knee*
~~~~~ *patients with intact medial meniscus at follow-up examination.*

affect the functional result as reflected in the score (mean 96.3 ± 0.9).

Interval operation – follow-up. Knee function showed no tendency to deteriorate with time 16–47 months after operation.

Reoperation. Eight of the 78 patients subsequently underwent secondary operation for various reasons. No further ligament operations were done. Four operations (local anaesthesia) were carried out for suture reactions. One medial and one lateral meniscectomy were subsequently done, one after major and one after minor retrauma to the knee. One patient showed a pes tendon luxation at the joint line, and another

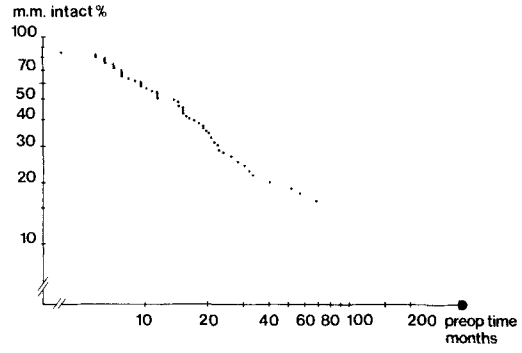

Figure 5. Proportion of patients (78 patients = 100 per cent) with intact medial meniscus in the injured knee in relation to the interval between trauma and operation (log scale).

required operation for a neuroma of the infrapatellar branch of the saphenous nerve.

DISCUSSION

For assessment of results after knee ligament surgery there is still a serious lack of objective methods that are accepted by different surgeons. The assessment of results must therefore still be based on thorough clinical examination and the pre- and postoperative function of the joint. A thorough rating of function is now increasingly used for evaluation of results (O'Donoghue, 1963, 1973, Slocum & Larson 1968, Alm & Gillquist 1974, Kettelkamp & Thompson 1975, Marshall et al. 1975, 1977, also, Hughston, J. C., personal communication, 1977). However, O'Donoghue (1973) contends that disability and instability are closely related but not identical. At the time we started this study the scale set up by Robert Larson (in Smillie 1974) seemed to be the most appropriate, and we therefore used his rating sheet as the basis for the evaluation of our results.

Most injuries in this series (86 per cent) occurred during competitive sports, which is the same incidence as Alm & Gillquist (1974) found in a series of patients treated by intraarticular transfer of part of the patellar
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tendon. Other workers have also reported the same high incidence (Slocum & Larson 1968, Liljedahl & Nordstrand 1969, Jones 1970, Jacobsen 1977), and subsequent large series consist of athletic injuries only (Hughston & Eilers 1973, Nicholas 1973).

Fifty-five per cent of our patients had previously undergone one or more operations, medial meniscectomy being the commonest, as others have also reported (Slocum & Larson 1968, Nicholas 1973). In only a few cases had the earlier procedures led to temporarily improved knee function. New relatively minor trauma had in these cases aroused new symptoms and complaints of instability and recurrent effusion. Medial meniscectomy alone failed to improve function in most patients, and many experienced reduced activity tolerance. In our patients with anteromedial rotatory instability the medial meniscus was not always torn at the time of injury, but tended to become involved with time. A possible explanation is that the primary injury to the medial and posteromedial capsule affects the attachments and secondarily also the behaviour of the medial meniscus. This can be demonstrated under arthroscopy, when valgus and outward rotatory forces are applied to the tibia, and is described by O'Connor (1974) as a pathological wave formation of the meniscus. Owing to abnormal mobility within the joint the laxity will therefore make the medial meniscus prone to tearing and degeneration in the long run. Further instability will then be added by the removal of the meniscus, as Nicholas (1973) has observed clinically, and Wang & Walker (1974) and Oretorp et al. (1978) experimentally. If operative repair is done within 1 year, the chances that the medial meniscus will survive intact are therefore greater. If ligament repair can be done without medial meniscectomy, the functional result might consequently be expected to be better, to judge from our results. We feel that routine meniscectomy (Slocum et al. 1973, O'Donoghue 1973, Nicholas 1973) should not be recommended in cases of medial ligament reconstructions, as patients with an intact medial meniscus showed the highest score at follow-up in our present series. The better results for this group than for patients also treated by meniscectomy might appear to indicate selection of more serious injuries in the latter group. This does not seem plausible, however, taking into account also the preoperative score for the same groups of patients. In fact the patients with torn but not yet excised medial menisci showed better function than those already subjected to meniscectomy for combined medial meniscus and ligament tears. This fact seems to us to rule out selection as an explanation for the difference.

Seventy-three per cent of the patients injured while participating in athletics returned to the same sport, and more than 90 per cent of all patients showed increased activity after operation. These figures are comparable to those obtained after intraarticular reconstruction of the anterior cruciate ligament in a series similar to this one (Alm & Gillquist 1974). We do not yet know whether differences will exist several years after intra- or extraarticular repair, but we have found no tendency to impairment with time during the observation period. Jones (1970), however, has asserted that anatomical normality after anterior cruciate injuries is beyond expectation. Twenty per cent with total functional restitution may therefore be considered a satisfactory result for these severe injuries.

Care should be taken about drawing conclusions on the degree of stabilization of the knee joint gained by the operative procedure. Comparing stability by clinical examination alone on different occasions several years apart is fraught with uncertainty. We feel, however, that thorough extraarticular medial and posterior repair has reduced the degree of anterior drawer sign on these patients, and others have reported the same observation (O'Donoghue 1973, Hughston et al. 1976). Even after an otherwise successful transfer of

part of the patellar tendon the anterior drawer sign is not fully eliminated (Alm & Gillquist 1974, Jacobsen & Rosenkilde 1977). Nevertheless, we have found no association between a mild anterior drawer sign and a lower score, although a significantly lower score was seen in the group with persistent moderate ADS at follow-up than among the other patients. This tallies with other clinical reports (Kennedy et al. 1974, Marshall et al. 1975, Jacobsen 1977).

Medial instability found at follow-up was not pronounced. Jacobsen (1977) has pointed out that marked medial instability is uncommon in old ligament injuries of the knee joint. Nevertheless mild medial instability may be more important than mild or moderate sagittal instability, which is commoner in such cases. We believe that the finding of mild medial instability at 0° is more important than the finding of mild anterior drawer sign, and this in fact is shown by the score values. Moderate or severe ADS was in all but one patient associated with mild medial instability at 0°, or more than mild at 30°, however. This again illustrates the fact that ligamentous injuries of the knee are usually multiple. In other words all clinical and functional factors must be taken into account, and the results not based on one single factor.

Mild laxity in extension at follow-up examination of patients originally classified as cases of anteromedial rotatory instability is not merely a sign of the absence of the medial meniscus but also of some posterior cruciate injury previously not detected. According to Hughston et al. (1976), laxity in extension is the most reliable sign of a recent tear of the posterior cruciate ligament, but he also states that the posterior drawer sign (PDS) is always present in cases of chronic injury to this ligament. Nevertheless, the possibility will always remain that a slight positive PDS might "drown" in a more marked ADS when anteroposterior instability exists. Both cruciates were visualized and examined either at arthrotomy or, before the repair, at arthroscopy, however. Some kind of posterior cruciate injury must have been underestimated or overlooked, and we feel that this kind of injury may be commoner than we suspected. This is also in keeping with our findings at arthroscopy (Gillquist et al. 1978). Noyes et al. (1974) and Kennedy et al. (1976) have found in experiments that after high tensile stress an apparently normal ligament may show some torn fibres, and that, on microscopic examination, these are seen to be surrounded by other disrupted fibres. The findings in some of our patients of medial laxity in extension might be explained by such functionally injured but on inspection apparently normal posterior cruciates. Whether additional laxity may result from the absence of the medial meniscus is not known. A significant change in medial laxity after meniscectomy has been demonstrated in dogs (Oretorp et al. 1978). It seems reasonable to assume that the same would be true in man, although experimental evidence is still lacking. In any event, we feel that the finding of any slight valgus laxity in extension should be recorded pre- and postoperatively, as this sign seems to be significant with regard to prognosis.

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