

ARTHROSCOPY IN THE EARLY DIAGNOSIS OF INJURIES TO THE KNEE JOINT

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In a series of 192 patients with acute knee injuries the diagnosis at arthroscopy was compared with the clinical diagnosis with or without confirmation at arthrotomy. Arthroscopy was used in 117 cases, clinical examination in 72 cases, and arthrography in 3 cases. All patients presented for diagnosis and treatment within 4 weeks of injury, and most within 1 week. The anterior cruciate ligament (ACL) was torn in 100 cases, and in 92 this was the main injury. The incidence of complete, isolated ACL tear was 1.5 per cent. ACL tear occurred in a higher proportion of cases in the arthroscopy group compared with diagnosis by other methods. An ACL tear was usually combined with injury to the medial ligament complex. Twenty-five patients showed tear of the posterior cruciate ligament (PCL), and in one-third of these there was also injury to the ACL. The medial ligaments were injured in 77 per cent of the whole series and this was the predominant lesion in 57 cases. Tear of the postero-medial capsular ligament (PMCL) was found in more than half of our patients. The ratio lateral/medial meniscus tear was 1 : 1.6 in the arthroscopy group and 1 : 27 in the group where arthroscopy was not undertaken. Arthroscopy resulted in an increase in the number of components of injury identified owing to improved diagnosis of tears of the ACL, the PMCL, the lateral meniscus, and possibly also of the PCL. There were no complications or side-effects of arthroscopy. In 93 per cent of cases primary suture was done. Reconstruction was rarely necessary if operation was undertaken within 2 weeks of injury.

Key words: arthroscopy; diagnosis; knee injuries

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There is general agreement on the need for early and complete diagnosis in acute knee injuries (Palmer 1938, 1957, Abbot et al. 1944, O'Donoghue 1955, Liljedahl & Nordstrand 1969, Jacobsen & Töndevold 1975). The results of acute surgical repair are said to be better than the results of reconstructive procedures (O'Donoghue 1955). Enclosing of a recently injured knee in a cast without a confirmed diagnosis is contraindicated (Smillie 1978). Nevertheless, the choice of diagnostic methods when dealing with these patients is still a matter of debate. The use of arthroscopy has been documented

(O'Connor 1974, Gillquist et al. 1977), as has the accuracy of the method in comparison with arthrography (Gillquist & Hagberg 1978). No study has previously been made of the influence of arthroscopy as opposed to clinical examination on the completeness of the diagnosis and on the choice of treatment. In this department the early diagnosis and repair of acute knee injuries has been the rule for many years. Arthroscopy has been increasingly used, making it possible for us to study the influence of this method on diagnosis and treatment.

METHODS

During the period 1971–1978, 192 patients were admitted to this department for acute knee injury. Their records were scrutinized, and all data collected. All patients admitted within 4 weeks of the injury were included. Less severe injuries treated in outpatients and all patients with a history of previous ligament injury in the same joint were excluded. Nearly all patients showed haemarthrosis or acute locking of the joint. Locking was defined as an extension defect with elastic resistance to forced extension. The diagnosis haemarthrosis was made when clinical examination showed fluid in the joint and blood was aspirated at puncture. Straight X-ray films were done in all cases. Within the first few days after admission clinical examination with or without arthroscopy was done under general, spinal or epidural anaesthesia. The arthroscopic technique is described elsewhere (Gillquist et al. 1976, 1978). When indicated, open surgical repair was undertaken at the same session. The results were treated statistically by the usual methods (Snedecor & Cochran 1967).

RESULTS

Patients. The series consisted of 192 patients, 153 men and 39 women, aged 13–62 (127 were aged 15–30).

Cause of injury. Sports injuries accounted for 61 per cent of cases, with soccer injuries predominating among the men and skiing accidents

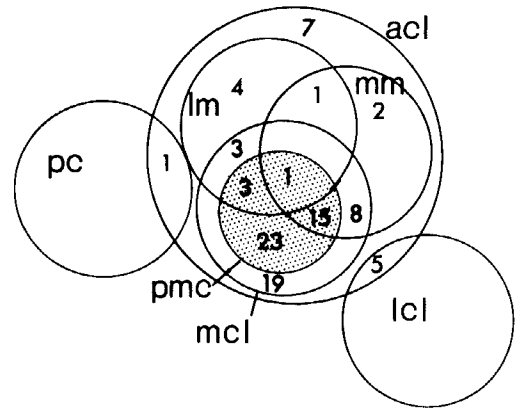


Figure 2. Anterior cruciate ligament tear (group A) n=92. Distribution of injury to other components of the joint.

- ac = anterior cruciate ligament
- mcl = medial collateral ligament
- pmc = postero-medial capsular ligament
- mm = medial meniscus
- lm = lateral meniscus
- pc = posterior capsule

among the women. Fifteen per cent had traffic injuries and 10 per cent accidents at work.

Diagnostic methods. Clinical examination alone was used in 72 cases (37 per cent), as a rule under anaesthesia. It was complemented by arthroscopy in 117 cases (61 per cent) under arthrography in only 3 (2 per cent). Arthroscopy was increasingly used over the years (see Figure 1). The distribution of diagnoses at arthroscopy in 117 cases was compared with that at clinical examination and arthrotomy in 58 cases, and with clinical findings alone in 17 patients treated conservatively. There was no systematic selection of patients for arthroscopy or clinical examination.

Diagnosis

Group A. Tear of the anterior cruciate ligament (ACL), intact posterior cruciate ligament (PCL) (n=92). The diagnosis was made by clinical examination and arthroscopy in 63 cases, by clinical examination and arthrotomy in 27 cases and by clinical examination alone in 2 cases. In 78 per cent there was associated injury to the medial ligament complex, and in 5 per cent to the lateral

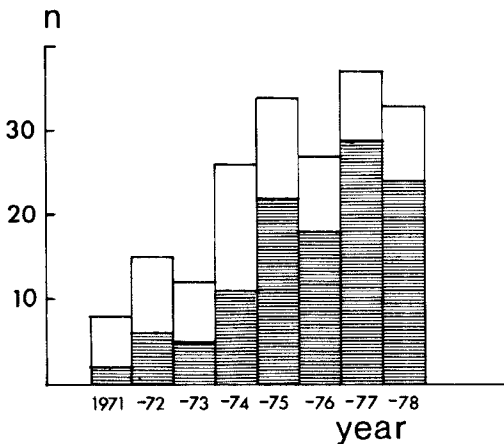


Figure 1. Use of the arthroscope in the diagnosis of acute injuries of the knee during the period of the study.

- arthroscopy
- no arthroscopy

Table 1. Details of the pathology of the ACL $n=100$ (8 ACL tears in combination with PCL injury included) () = % (% of total)

		Substance tear		Bone fragment
		total	partial	
Arthroscopy	$n=67$	38 (57)	25 (37)	4 (6)
No arthroscopy	$n=33$	20 (61)	8 (24)	5 (15)

ligaments (Figure 2). Sixty-three substance tears of the ACL were detected in the arthroscopy group, compared with 28 in the non-arthroscopy group (Table 1). Thus the frequency of substance tear of the ACL was higher in the group investigated by arthroscopy compared with other diagnostic methods ($P<0.02$). In 33 cases ($1/3$) the injury was partial, and surgery was not indicated. In 9 patients there was evulsion of the ACL from the tibia with a bone fragment; 5 of these were under 20 years and injured in traffic accidents. There was only one isolated total rupture of the ACL (1.5 per cent). This was an evulsion from the tibia with a bone fragment.

In 5 cases with total rupture of the ACL this was the only ligament injury, but there was an associated meniscus tear. In the group with partial tears (Table 1) 6 showed isolated ACL injury and in 2 the ACL tear was combined with a meniscus tear. All patients with isolated ACL tear and 5 of the 7 with ACL tears combined with a meniscus lesion belonged to the arthroscopy group.

Group B. Tear of the medial ligament complex, intact PCL and ACL ($n=57$). The diagnosis was made by clinical examination and arthroscopy in 30 cases, and by clinical examination and arthrotomy in 15 cases and by clinical examination alone in 12 cases. Injuries to other components of the joint in this group are shown in Figure 3. Of 33 isolated tears of the medial collateral ligament (MCL) 24 were partial, and operation was not indicated. There were 3 isolated tears of the postero-medial capsular ligament (PMCL). Altogether injury to the medial ligament complex occurred in 147 of the 192 knees (77 per cent). Seventy-five (51 per cent) showed a tear of the

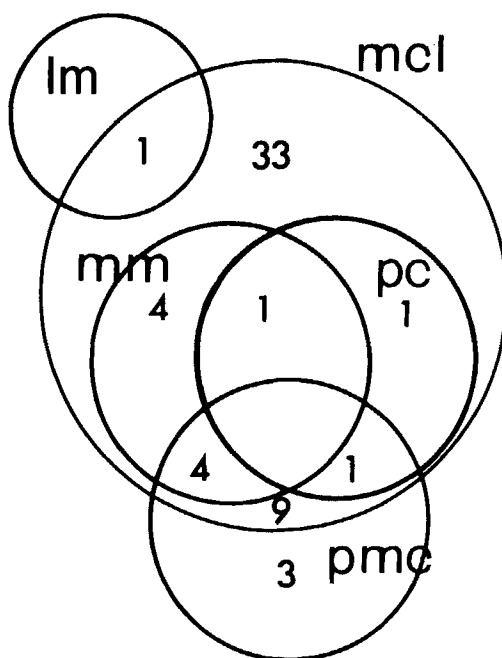


Figure 3. Tear of medial ligament complex, intact cruciates (group B), $n=57$. Distribution of injury to other components of the joint. Abbreviations: See Figure 2.

PMCL. The incidence of PMCL tear increased from 4.3 per cent ($1/23$) in the first 2 years to 63.3 per cent ($19/30$) in the last year of the study, when the technique of examining the postero-medial compartment with the arthroscope had been mastered ($P<0.001$). Tear of the PMCL in patients with injury to the medial ligament complex was commoner in the arthroscopy group than in the group diagnosed by other methods (12/30 and 5/27, $P<0.05$).

Group C. Various other diagnoses, intact PCL and ACL ($n=18$). The diagnosis was made by clinical examination and arthroscopy in 10 cases and by other methods in 8. Seven patients had lateral tears, most of them of the lateral collateral ligament. Most of the remaining 11 patients showed tears of the plica lata (Gillquist et al. 1977).

Group D. PCL tear ($n=25$). In 14 patients the diagnosis was made at clinical examination and arthroscopy, and in 11 at clinical examination and

Table 2. Details of the pathology of the PCL $n=25$

	arthroscopy $n=14$	no arthroscopy $n=11$
bone fragment	1	4
substance tear	13	7
total	8	7
partial	5	0

arthrotomy. In 4 of the 11, evulsion of the tibial insertion was shown in the preoperative X-ray (Table 2). The ratio ACL to PCL tear in the whole series was 4 : 1. In one-third of the patients with PCL tear there was also injury to the ACL and in 72 per cent to the medial ligament complex (Figure 4).

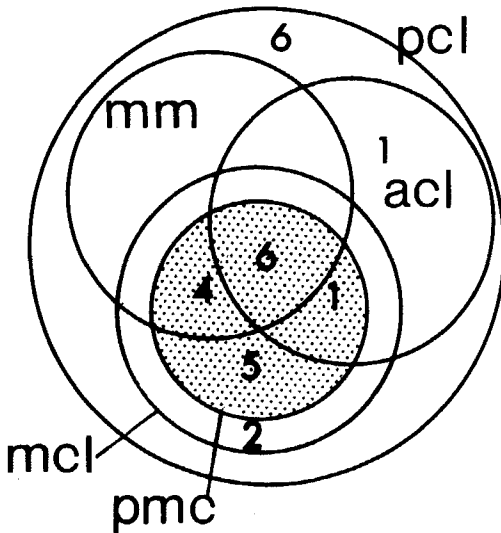


Figure 4. Posterior cruciate ligament tear (group D) $n=25$. Distribution of injury to other components of the joint. pcl = posterior cruciate ligament; for other abbreviations see Figure 2.

Distribution of the diagnoses in the arthroscopy and non-arthroscopy groups

The distribution of diagnoses classified into groups A–D is shown in Table 3. A greater proportion of ACL tears was detected in the arthroscopy group compared with the group diagnosed by other methods ($P<0.05$). The ACL to MCL ratio in groups A and B was 2.1 : 1 (63/30) in the arthroscopy group compared with 1.1 : 1 (29:27) in the group diagnosed by other methods ($P<0.05$).

Fractures

In 10 patients there was an associated intra-articular fracture, 4 of the femur (3 lateral and 1 medial) and 6 of the tibia (2 medial, 2 lateral, and 2 intercondylar). This group included 4 of the ACL and 2 of the PCL injuries. In 8 there was associated medial ligament injury, and in 2 lateral ligament injury.

Menisci

There were a total of 46 ruptures of the medial and 15 of the lateral meniscus. Two of the 15 lateral meniscus tears were components of an injury that was confined to the lateral compartment. The ratio lateral/medial meniscus tear in the series was 1:3.1. The incidence of lateral meniscus tear was much greater in the group diagnosed at arthroscopy than in the group where arthroscopy was not carried out. With the exception of patients with lateral compartment injury alone, the ratio lateral/medial meniscus tear was 1 : 1.6 with arthroscopy and 1 : 27 when arthroscopy was not used ($P<0.001$).

Number of injury components

There was a significantly higher incidence of total

Table 3. Distribution of diagnoses in groups A–D in the arthroscopy group ($n=118$) and the non-arthroscopy group ($n=74$). Groups A–C intact PCL: Group A injury to the ACL; Group B injury to the medial ligament complex without cruciate tear; Group C various others. Group D PCL tear

	A	B	C	D	Total
Arthroscopy	63 (54%)	30 (25%)	11 (9%)	14 (12%)	118
Other methods	29 (39%)	27 (37%)	7 (9%)	11 (15%)	74

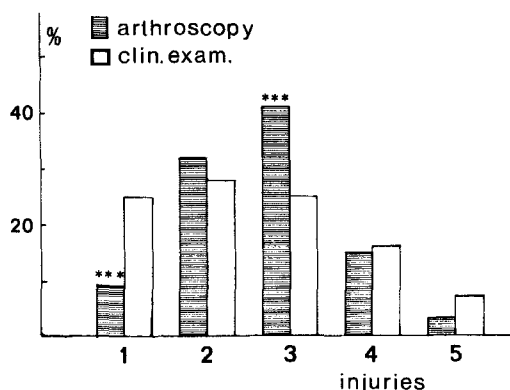


Figure 5. Number of patients with 1-5 injury components in the group of total ligament tears (% of total number; $n=132$). Diagnosis at arthroscopy compared with diagnosis by other methods.

tear of only one ligament in the non-arthroscopy group, whereas the arthroscopy group included more knees with three injury components (Figure 5). Much the same was true of partial tears except that there were very few knees with three injury components in this group.

Therapy

Altogether 132 patients had total tears of one or more ligaments requiring primary repair, but one patient, an alcoholic, refused operation. Of the 60 patients with partial injuries (plus the alcoholic patient) 13 were treated with a plaster cast and 48 by early mobilization and exercise without weight-bearing. Ninety-four of the 132 patients (72 per cent) were operated on within 1 week of the injury. A knee injury was always treated within a couple of days after the patient had presented at the hospital, except in a few cases where the injury was part of a major trauma.

Arthrotomy was commoner in patients where arthroscopy was omitted (57/75; 76 per cent) than in patients where arthroscopy was used (74/117; 63 per cent; $P<0.005$).

Suture of all involved ligaments was done in 122 cases (93 per cent). Reconstruction of the ACL was done in 7 cases, and of the PCL in 2. Three of these 9 reconstructions were done after the second week. The use of reconstruction of the

ACL varied with the time of operation. If this was done within 2 weeks, reconstruction was needed in about 4 per cent of cases (4/93). In later operations the need for reconstructive procedures was 43 per cent; $P<0.05$).

Meniscectomy was done in 47 patients. In 7 others a meniscus (6 medial and 1 lateral) was sutured back to its capsular attachment. Seven ruptured menisci were not treated because the injury was considered insignificant (1 medial and 6 lateral).

Complications

There were no infections. A few patients in whom the operation was prolonged were given prophylactic antibiotic therapy. Two patients developed lower-leg thrombosis, in neither case fatal. When arthroscopy was followed by arthrotomy there were no technical problems because of the preceding arthroscopy. Arthroscopy was performed without a tourniquet. The arthroscopy time never exceeded 20 minutes, and leakage of fluid into the periarticular tissue was therefore slight and did not interfere with the procedure.

DISCUSSION

The use of arthroscopy in acute injuries of the knee increased during the period of the study. At the start only a few patients with injuries of this type were seen in this department. At that time arthroscopy was rare, and was even alleged to be contraindicated in patients with acute haemarthrosis (Cascells 1971, Jackson & Abe 1972). However we often found the method useful (Gillquist et al. 1977), and came to use it in about three-quarters of the acute knee injuries during the latter part of the period.

Anterior cruciate ligament tear

Rupture of the ACL was the commonest injury in the series. An isolated, complete ACL tear was very rare but an isolated, partial tear of the ACL occurred slightly more often. Many surgeons have described the isolated ACL tear (Kennedy

& Fowler 1971, Kennedy et al. 1974, McMaster et al. 1974, Wang et al. 1975). The low incidence in our series contrasts with Feagin's report of 64 "isolated" ACL tears, collected over a short period of time (Feagin et al. 1972). In a study by Liljedahl & Nordstrand (1969), before the arthroscopy era, 17.7 per cent of patients had an isolated tear of the ACL with or without meniscus injury. Our present results indicate that arthroscopy or careful exploration at arthrotomy will reduce the number of "isolated" cruciate tears. Palmer (1938, 1957) and O'Donoghue (1950) also found isolated ACL tear to be uncommon. The results of treatment of "isolated" ACL tears as presented by Feagin & Curl (1976) are not encouraging. Full diagnosis may improve the results, as Nicholas (1976) has also suggested.

The incidence of substance tear of the ACL was higher in the arthroscopy group than in the group diagnosed by other methods. Partial tears of the ACL were also commoner in the arthroscopy group, although the difference was not significant. This is partly the explanation for the higher incidence of ACL tear with arthroscopy. Even though this injury does not require surgical repair, we regard the observation to be important when planning the treatment of associated injury to other components of the joint. Partial tear of the ACL may also lead to a total rupture with instability later on, and these patients must be carefully followed up.

The predominant injury associated with tear of the ACL was injury to the medial ligament complex (see also Palmer 1938, O'Donoghue 1950, Liljedahl & Nordstrand 1969). The first place to look in a case of "isolated" ACL rupture is therefore the medial and postero-medial compartment. The incidence of injury to the PMCL increased over the years as we mastered the arthroscopic examination of the postero-medial compartment (Gillquist et al. 1979). In patients with tear of the medial ligaments the incidence of PMCL injury was higher in the arthroscopy group. Meticulous dissection of the medial side of the joint with medial arthrotomy gives about the same precision as arthroscopy in the diagnosis of medial compartment injury. This is illustrated by the fact that no difference in the incidence of PMCL tears was found, whether arthroscopy was

used or not, in our patients with cruciate tears, as many of these underwent medial arthrotomy. The need for proper repair of PMCL injury has been stressed (Hughston & Eilers 1973, Fergusson & McMaster 1973). Over and above the instability, patients with PMCL injury develop medial meniscus tears (Oretorp et al. 1979) owing to pathological mobility of the meniscus during knee movements (O'Connor 1974, Gillquist & Hagberg 1978).

According to the Hughston classification (Hughston et al. 1976) most of our patients had antero-medial or antero-medial and antero-lateral rotatory instability. The incidence of lateral ligament injury with ACL tear was 5 per cent. This is similar to the findings of Liljedahl & Nordstrand (1969). The flaque-fracture sign in lateral capsular rupture described by Woods et al. (1979), Hughston (1979), and Johnson (1979) was never seen in our series, however. It has been suggested that the antero-lateral component of instability may worsen with time if the knee is left untreated, because of stretching of the lateral supporting structures (Chatard 1979).

Posterior cruciate ligament tear

We found a high incidence of PCL tear – 13 per cent in the whole series and 17 per cent in patients with ligament injuries requiring operation. O'Donoghue (1955) reported 11 per cent PCL injury and Liljedahl & Nordstrand (1969) 6.5 per cent. The unexpectedly high incidence of PCL injury is in keeping with the findings of Oretorp et al. (1979). A review of patients operated on for antero-medial rotatory instability showed poor results of surgery and unexpected signs of slight PCL injury overlooked at the primary operation in some cases. A high incidence of PCL tear is also in keeping with our findings at arthroscopy (Lysholm & Gillquist, to be published). The difficulty of diagnosing a PCL tear in acute injury of the knee has been pointed out by Hughston et al. (1976). The posterior drawer sign may be missing unless there is concomitant injury to the posterior capsule, especially the postero-lateral corner. Reducing undiagnosed PCL tears to a minimum is an essential feature of both acute and reconstructive knee ligament surgery.

We believe that arthroscopy will prove valuable here.

Meniscus

Our medial/lateral meniscus tear ratio with arthroscopy is comparable to that in the series by Gillquist et al. (1977) and without arthroscopy compares with the findings of Liljedahl et al. (1965), (1969) and O'Donoghue (1955). Arthroscopy thus improved the diagnosis of lateral meniscus tear. Hughston (1973, 1975) claims that the lateral meniscus can be assessed with acceptable precision from an antero-medial incision using a special retractor. A high incidence of lateral meniscus tear was also found at arthrotomy by Solonen & Rokkanen (1967). In many of the medial meniscus injuries in our series the lesion was not a tear in the substance of the meniscus but evulsion of the meniscus from its capsular attachment. In most cases meniscectomy was done, but during the latter period of the study we tried to preserve the menisci whenever possible, influenced as we were by the results of Wang & Walker (1974), Hsieh & Walker (1976), Hughston et al. (1976), Price & Allen (1978), and Oretorp et al. (1978, 1979).

We found that with arthroscopy more injury components could be diagnosed than when arthroscopy was not used. This reflects an increased finding of tears of the ACL and possibly of the PCL, PMCL, and of the lateral meniscus. On the other hand arthroscopy gave no more information than clinical diagnosis in cases with four or more injured structures. This probably reflects the fact that arthroscopy is not necessary in grossly unstable knees.

The need for a confirming arthrotomy was also greater after clinical examination than after arthroscopy. Thus arthroscopy gives a more reliable basis for selection of the proper treatment.

CONCLUSION

We have found arthroscopy to be superior to clinical examination under anaesthesia in the diagnosis of acute injuries of the knee, and to provide a more complete diagnosis of tears of the

lateral compartment structures than antero-medial exploratory arthrotomy. The method is not associated with complications, and does not interfere with any subsequent surgical repair. Isolated complete tear of the ACL was exceedingly rare. Tears of the PMCL proved to be quite common as revealed by arthroscopy or on antero-medial exploratory arthrotomy if the dissection was carried back to the postero-medial corner of the joint. Tear of the lateral meniscus was common, and almost as common as injury to the medial meniscus. With early diagnosis and treatment simple suture of involved ligaments was usually possible.

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