ACUTE HAEMARTHROSIS OF THE KNEE IN ATHLETES
A PROSPECTIVE STUDY OF 106 CASES

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We made a prospective arthroscopic study of 106 skeletally mature male sportsmen with an average age of 28.35 years (16.8 to 44) who presented with an acute haemarthrosis of the knee due to sporting activities. We excluded those with patellar dislocations, radiographic bone injuries, extra-articular ligamentous lesions or a previous injury to the same joint.

The anterior cruciate ligament (ACL) was intact in 35 patients, partially disrupted in 28 and completely ruptured in 43. In the patients with an ACL lesion, associated injuries included meniscal tears (17 patients), cartilaginous loose bodies (6), and minimal osteochondral fractures of the patella (2), the tibial plateau (3) or the femoral condyle (9). We found no age-related trend in the pattern of ACL injuries. Isolated injuries included one small osteochondral fracture of the patella, and one partial and one total disruption of the posterior cruciate ligament. Three patients had cartilaginous loose bodies, and no injury was detected in five.

Acute traumatic haemarthrosis indicates a serious ligament injury until proved otherwise, and arthroscopy is needed to complement careful history and clinical examination. All cases with a tense effusion developing within 12 hours of injury should have an aspiration. If haemarthrosis is confirmed, urgent admission and arthroscopy are indicated.

The most common mechanism producing a traumatic haemarthrosis of the knee is a twist of the flexed joint, although many patients are uncertain of the position or the direction of movement at the time of injury (Noyes et al 1980). Patients may be unable to continue playing their sport (King and Aitken 1988), but about two-thirds describe merely a popping sensation and swelling of the joint within two hours (Noyes et al 1980, 1983).

Such a story alone may indicate the diagnosis (Feagin, Abbott and Rokous 1972), and early clinical examination is unreliable (Noyes et al 1980; Rand 1984; Simonsen et al 1984). A tense effusion with muscle guarding severely limits the range of motion, and stability is therefore difficult to evaluate (DeHaven 1980). For these reasons only 9% to 29% of anterior cruciate ligament (ACL) tears which are found arthroscopically have been previously diagnosed clinically (DeHaven 1980; Noyes et al 1980).

Arthroscopy provides reliable information and is indicated less by what it can achieve than by the failure of other diagnostic measures (Glisz, Segantini and Kägi 1980). Previous reports on traumatic haemarthrosis from North America (DeHaven 1980; Noyes et al 1980) and continental Europe are available (Gilliquist, Hagberg and Oretorp 1977). From the UK, Jain, Swanson and Murdoch (1983), reporting on a mixed sedentary and athletic population, found that only 17% had an ACL tear, but they did not perform routine arthroscopy and their main line of treatment was aspiration and splintage, which is no longer an accepted practice (Mariani, Puddu and Ferretti 1982).

Our aim was to make a longitudinal study of athletes with acute haemarthrosis, using arthroscopy and examination under anaesthesia (EUA). Our hypothesis was that an acute traumatic haemarthrosis in an athlete implies significant intra-articular injury which should be accurately diagnosed.

PATIENTS AND METHODS

From January 1986 to April 1992, 106 male, skeletally mature athletes with acute haemarthrosis sustained during a sporting activity were admitted to Newham General Hospital, London. Patients with a history of a previous injury to the same joint were excluded, as were those with obvious patellar dislocation, a radiologically
evident bone injury, or an extra-articular ligamentous lesion. The average age of the patients was 28.35 ± SD 8.13 (16.8 to 44, Fig. 1). The right knee was injured in 81 of the 106 patients.

The sports played at the time of injury were soccer (33), rugby (15), hockey (14), American football (12), track-and-field athletics (12), combat sports (10), gymnastics (7), and cricket (6). Sports were played at recreational level (47), county level (12), national level (28), and international level (19). This distribution reflects the association of two of the authors (NM and JBK) with a National Sports Centre and various national sports organisations.

**Mechanism of injury.** In 73 patients the injury had been caused by a non-contact event which involved twisting, turning or jumping off the planted foot. In 18 patients there had been a direct blow on the upper third of the lower leg, with the knee slightly flexed. The other 15 athletes were unable to describe the position of their knee at the time of injury.

**Symptoms.** The most common symptom at the time of injury was sudden pain with a popping sensation and collapse of the leg. This was described by 72 patients, and was followed by a fall to the ground in 26 of them. Sixty-four patients were able to resume the sporting activity immediately after injury, but had to stop later.

Swelling and joint effusion were evident within two hours in 83 patients, and within 12 hours in all of them. When first seen, additional complaints included giving way (24), an insecure feeling (21) and true locking of the knee, defined as inability to extend it fully (16).

**Before arthroscopy.** The patients were first seen in the Accident and Emergency Department at an average of 3.2 ± 1.6 days (0 to 4) from the injury. Anteroposterior and lateral radiographs were taken in all cases. All had an effusion, and in 71 aspiration by a casualty officer confirmed the presence of a haemarthrosis. In 28 the diagnosis of a meniscal injury was made. Twenty-two patients were referred immediately to an orthopaedic surgeon without an initial aspiration.

The other 13 patients were referred to a trauma clinic without joint aspiration and without diagnosis. The orthopaedic management included a full clinical examination, and aspiration if this had not already been performed. Patients were then offered admission with a view to arthroscopy within the next 24 hours.

**Examination under anaesthesia.** No patient showed isolated medial or isolated lateral laxity on examination with or without anaesthesia. The Lachman test (Torg, Conrad and Kalen 1976) and the pivot shift test (Galway, Beaupré and MacIntosh 1972) were performed under full general anaesthesia before a tourniquet was applied.

**Arthroscopy.** All EUAs and arthroscopies were performed or supervised by one of the senior authors (JBK and CJG). At arthroscopy under tourniquet, anteromedial, anterolateral, posteromedial and posterolateral entry portals were used as required through vertical (83) or horizontal 5 mm stab wounds. Tourniquets were not used in five patients with sickle-cell trait, as determined by family history and Hb electrophoresis in some ethnic groups. In 81 patients gravity irrigation with normal saline and a medial suprapatellar drain were used; the others had gravity irrigation without a drain. Normal saline was used to wash out the joint.

The wounds were closed with a single Dexon or Ethilon suture in 34 patients and unsutured in the remainder. A modified Robert Jones compression bandage was applied before removing the tourniquet, and patients were discharged on the same day when they were able to perform an unaided straight-leg raise. When a drain had been left in place, it was removed in the day-care unit before discharge. Outpatient reviews were at two and at six weeks, or for any clinical problem.

**ACL tears.** A blunt hook-shaped probe was used to examine the ACL through an appropriate entry portal. Any synovial tissue which obscured the cruciate fibres was lifted or partially removed (Noyes et al 1980). Tension in the fibres of the ACL was judged by pulling with the hook. ACL tears were classified as partial or complete on the basis of visual inspection and probing.

**Meniscal injuries.** Meniscal tears have been classified by appearance as horizontal, longitudinal, vertical, etc (Barber 1992), by the thickness of the tear (full or partial split) and by location in the meniscus (peripheral, central, etc: Irvine and Glasgow 1992). We classified meniscal tears according to the involved side and the shape and the location within the meniscus.

All data were collected prospectively on a proforma (Fig. 2). This was completed in triplicate by the operating surgeon at the time of the procedure, providing one copy for the patient's general practitioner, one for the operating notes, and one for this study.

The data were entered into a dBASE data base on an IBM-compatible computer and were analysed using.
Dear Dr. [G P]

I enclose a copy of your patient's arthroscopy record. Yours sincerely.

Name: ..........................................................  No: .................  Date: ...........................................

Address: .................................................................................................................  Phone: ...........................................

Surgeon: ..........................................................  Age: ..........................  Side: ..........................  Hospital: .......................................................... ...

**COMPLAINTS:**  Trauma | Overuse | Spontaneous | SPORT | Recreation

**FLUID**
- DRAW
- GIVING

**PAIN**
- GIVING
- SPONTANEOUS
- POST
- MED
- LAT
- PARAPAT M
- STAIRS
- SITTING
- SQUATTING
- TWISTING
- AT REST
- AT NIGHT

**LOCKING**
- CANNOT EXT
- TWISTING
- STAIRS
- RUNNING

**STAIRS**
- SPORTS NOW

**SWELLING**
- ALWAYS
- INTERMITTENT-
- AFTER EPISODE

**EXAMINATION**
- ASLEEP
- 0-3 (RECOGNISES)

**EXAMINATION**
- HYPER EXUTI
- NORMAL
- LOW

**SCOPY**
- SCOPE
- DRAIN Y/N

**FLUID**
- CLEAR, SEROUS, BLOOD

**PORTALS**
- DRAW ON CHART - DOTTED LINES

**PROCEDURE**
- DRAW ON CHART - FULL LINES

**DESCRIBE**

Fig. 2

The proforma used to record details of each patient.
Systat (Leland 1988) for chi-squared tests and chi-square for trend tests. Significance was set at the 0.05 level.

RESULTS

**Examination under anaesthesia.** In knees with complete disruption of the ACL, both Lachman and pivot shift tests were reliable (Table I). In those with only partial rupture of the ACL, the pivot shift test was more reliable than the Lachman test. There were no false-positive results.

**ACL lesions** (Table II). The ACL was intact in 35 knees, partially ruptured in 28 and completely disrupted in 43. In 29 patients, the partial or complete disruption of the ACL was an isolated injury. In the other 42 patients with an ACL injury, associated injuries included meniscal tear (17), cartilaginous loose bodies (6), or minimal osteochondral fracture of the patella (2), the tibial plateau (3), or the femoral condyles (9). We found no age-related trend in the pattern of ACL-associated injuries, or in the development of a partial or complete ACL lesion (chi-square for trend test).

**Meniscal lesions.** Of the 16 patients with a clinically locked knee, 12 had a meniscal tear and four had an isolated ACL rupture. All 17 meniscal injuries (11 lateral, 5 medial, one of both menisci) were associated with either total or partial ACL disruption. The lateral meniscus was injured significantly more often (p = 0.042, chi-squared test). There were nine bucket-handle tears (six lateral); all the others were posterior-horn tears. In six cases, an isolated peripheral tear was the cause of the haemarthrosis (DeHaven 1980). These were repaired arthroscopically.

Three patients required arthrotomy after arthroscopy, two for subtotal lateral meniscectomy, and one for partial medial meniscectomy. The other eight patients with meniscal tears had arthroscopic partial meniscectomies.

**Haemarthrosis with no ACL lesion.** No intra-articular injury could be detected in five patients, and it was assumed that the haemarthrosis was due to synovial tears. Apart from the six isolated peripheral meniscal tears, other isolated injuries which appeared to have caused haemarthrosis were one small osteochondral fracture of the patella, and one partial and one total disruption of the posterior cruciate ligament. Cartilaginous loose bodies were found in three patients and removed arthroscopically.

**DISCUSSION**

The average age (28.35 ± 8.13) in our series is comparable with that of other studies, but our upper age (44 years) is lower than that in most other reports (O'Connor 1974; Gillquist et al 1977; Lysholm, Gillquist and Liljedahl 1981; Jain et al 1983; Harilainen et al 1988). The high incidence of knee injury during sporting activities is well documented (Gillquist et al 1977; Lysholm et al 1981) but in some reports of ACL injury only 20% were caused by sporting activities and 60% by simple falls (Jain et al 1983). Road-traffic accidents are a less common cause of knee injuries (Lysholm et al 1981).

In all our patients, the haemarthrosis developed within 12 hours of an injury. It is usually possible to differentiate these by the history from minor, non-haemorrhagic effusions that occur 24 hours or later after injury.

A significant proportion of our patients, 64 of 106, with ACL disruption were able to resume sporting activity immediately after their injury: some patients had little or no initial pain. The serious nature of the injury may not be apparent, and this is particularly true of non-contact twisting injuries.

Examination of an acutely swollen knee is difficult and unrewarding, but the easiest and most reliable test is said to be that of Lachman (Torg et al 1976). The result of this test may be subjective in that it relates to the hardness of the stop (King and Aitken 1988). Our results show that a positive Lachman test with a negative pivot shift test are indicative of partial ACL rupture. The two tests do not give significantly different results in complete ACL tears, but we found the pivot shift test to be slightly more sensitive.
Acute traumatic haemarthrosis is an indication for urgent arthroscopy with the aim of establishing a complete and precise diagnosis (O'Connor 1974; Noyes et al 1980; Rand 1984; Harilainen et al 1988). Delay in arthroscopy may allow synovial hypertrophy, which makes it difficult to visualise the ACL. Avulsion of the ACL from its femoral attachment is visible for up to two weeks, but by then mid-ligament tears are difficult to see because synovium conceals the torn ends (Noyes et al 1980). Urgent arthroscopy for acute traumatic haemarthrosis is therefore justified. Even if immediate surgical repair is not needed, full assessment is important in planning management (King and Aitken 1988). Partial rupture of the ACL may lead to a total rupture and instability, and therefore these patients require careful follow-up (King 1991).

We found partial or complete rupture of the ACL in 70% of our series, agreeing with other studies of athletes (DeHaven 1980; Noyes et al 1980, 1989; King 1991). Series of mixed origin show a lower incidence (Lysholm et al 1981; Harilainen et al 1988). The proportion with a partial ACL tear (28% of 71; 39%) is also similar to that of other series, 28% of 84 patients with haemarthrosis (Noyes et al 1980) and 34% in a series of ACL ruptures (Liljedahl, Lindvall and Wetterfors 1965). The presentation of ACL disruptions as medial meniscal injuries (four of our patients) has also been reported (Jackson and Dandy 1976; Farquharson-Roberts and Osborne 1983).

We conclude that acute traumatic haemarthrosis should be regarded as due to a serious ligament injury until proved otherwise. Arthroscopy is needed to complement a careful history and clinical examination. Patients with a tense effusion of the knee within 12 hours of an acute injury should have an aspiration. If this confirms a haemarthrosis the patient should be referred urgently with a view to admission and arthroscopy.

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REFERENCES