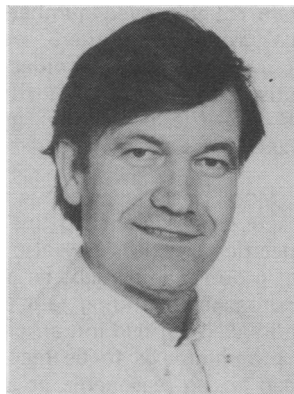
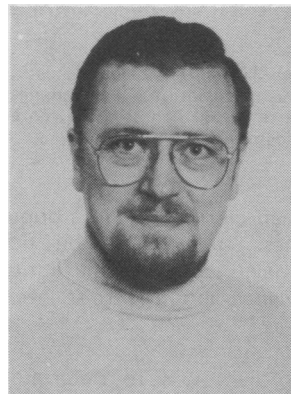




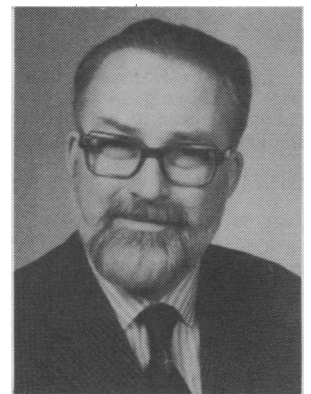
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SPORTS INJURIES OF THE KNEE LIGAMENTS — A PROSPECTIVE STRESS RADIOGRAPHIC STUDY

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ABSTRACT

Forty-six patients were entered into a prospective clinical and stress radiographic study done to assess the value of acute surgical treatment of injuries to the knee ligaments sustained during sports activities. After an average follow-up period of 5½ years (range 4-6½ years) medial instability was found only in two patients, both of whom were in the group with isolated rupture of the medial collateral ligament. Nine of the 29 patients in this group developed rotatory instability, but it was moderate and did not give rise to symptoms.

Among the 17 patients with either injuries to the anterior cruciate ligament or combined injuries, anterior drawer instability persisted in seven, with an insufficient functional result in five. None of these 17 patients were able to resume competitive sport.

Those patients who had not exercised physically just before the injury proved to have a significantly greater total instability than those who had. Therefore, routine limbering-up is recommended before sports activities.

Key words: Sport injury, Knee instability, Stress radiography, Ligament injury.

INTRODUCTION

Athletes, with their great demands on function, make up a high-risk group in any injury to the knee joint (Feagin, 1983; Slocum and Larson, 1962). A large proportion of the knee injuries occur during sports activities (Quigley, 1959) and affect young people in active occupation to whom a rapid re-attainment of a well-functioning and painless knee is of fundamental importance.

The optimal treatment of injuries to the knee ligaments is a controversial subject. Primary, surgical treatment is technically simpler, and appears to afford better results (Lysholm et al, 1982; O'Donoghue, 1959; Palmer, 1938) than secondary reconstructive surgery, and untreated severe ligamentous injuries often result in increasing instability and osteoarthritis. However, a primary, surgical treatment poses problems too, as a rapid ligament repair does not guarantee healing, possibly due to a compromised vascular and nerve supply (Kennedy et al, 1982). Consequently, we felt it would be of interest to study prospectively the results of acute surgical treatment of injuries to the knee ligaments sustained in sports activities. Changes in passive stability before and after the treatment were measured objectively by means of stress radiography.

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PATIENTS

From January 1974 to November 1979 a total of 58 consecutive patients with fresh sports-related injuries to the knee ligaments underwent operation in our Department. Of them 46 were seen at follow-up. Five refused to attend and five were excluded because of a new major knee injury. One patient had emigrated and one had died of a disease unrelated to the knee injury.

The patients who attended follow-up were 40 males and 6 females ranging in age from 15 to 67 years (median 24 years). The follow-up period was 5-6.4 years. No patient had injured both knees.

The ligament injuries were classified into two groups, group I making up isolated injuries to the medial collateral ligament and group II major injuries, i.e. injuries to the anterior cruciate ligament and combined injuries. The distribution of the injuries is listed in Table I.

TABLE I

Type of knee ligament injury demonstrated at operation in 46 patients with sports injuries.

Ligament injury	No. of pts.
MCL (medial collateral ligament)	29
ACL (anterior cruciate ligament)	4
ACL + MCL	11
ACL + MCL + PCL (post. cruciate ligament)	1
ACL + PCL + MCL + LCL (lat. collateral ligament)	1
	46

Four patients had isolated injury to the anterior cruciate ligament, including three with total rupture. All other injuries to the cruciate ligaments were total and combined with damage to the collateral ligaments. Only one patient was found to have an actual meniscal injury, while several had unstable menisci caused by injury to the capsule and collateral ligaments. Tables II and III give the type of sport and the patients' information concerning their state of training, including limbering-up, at the time of the trauma.

TABLE II

Type of sport performed at the time of injury in 46 patients with knee ligament injuries.

	No. of pts.
Football	30
Skiing	8
Team handball	4
Judo	1
Bicycling	1
Basketball	1
Volleyball	1
Total	46

TABLE III

State of training and degree of limbering-up assessed by 46 patients with sports-related knee ligament injuries.

	No. of pts.
Well-trained and had limbered up	23
Untrained and had limbered up	3
Well-trained, but had not limbered up	15
Untrained and had not limbered up	5
Total	46

All patients underwent operation within two weeks of the trauma (median 4 days), and all the operations were performed by the same surgeon (K. J.). All injuries involving ligament rupture were exposed and sutured with silk or steel wire and dressed in a high non-weight-bearing long leg cast. The cast was removed six weeks after the operation, and thereafter active rehabilitation was instituted.

METHOD

Stress radiographic measurements were carried out pre-operatively and at follow-up by means of the gonylaxometer described by Jacobsen (1981). Medial and lateral instability was measured on anterior-posterior views of both knees in 20° flexion and exposed to 88 N (Newton) abduction and adduction. Drawer instabilities and rotatory instabilities were measured on the lateral views in 90° knee flexion with the foot fixed in the anatomical normal position with 294 N stress. In this way it was possible to measure eight forms of specific instability on the X-ray films:

- Medial "valgus" laxity (ML)
- Lateral "varus" laxity (LL)
- Anterior drawer sign (AD)
- Posterior drawer sign (PD)
- Antero-medial rotatory instability (AMRI)
- Postero-medial rotatory instability (PMRI)
- Antero-lateral rotatory instability (ALRI)
- Postero-lateral rotatory instability (PLRI)

The definitions follow Nicholas (1973), further details may be read in Jacobsen (1981). Abnormal instability was taken to be present, if the relative instability (the instability of the injured less that of the uninjured knee) exceeded 2 mm for medial and lateral laxity and 3 mm for the anterior and posterior drawer signs. Medial rotatory instability was diagnosed, if the medial tibial condyle was displaced 3 mm or more forwards or backwards in relation to the lateral condyle, and correspondingly for the lateral rotatory instability. Complex instability was diagnosed, if a rotation of more than 3 mm was combined with a drawer instability exceeding 3 mm.

At the end of the follow-up period the final functional result was adjudged by a rank scale containing 17 sub-groups with a score of 0-128 points, modified after Kettelkamp and Thompson (1975). The scale gives a semi-quantitative judgement from accumulated scoring in each of the sub-groups dealing with aspects of knee-function. The modification was obtained by adding the sub-groups "walking on rough ground", "distance walked" and "posterior drawer" from Kettelkamp's scale II

to Kettelkamp's scale I. This scale was originally designed for assessing the loss of walking function in patients with osteoarthritis of the knee, emphasising the loss of function when walking with weight-bearing, while passive instability resulted in a relatively small loss of points. Nevertheless, we found this scale applicable in evaluating our relatively young and active patients in whom a loss of function when running with weight-bearing was considered important.

The patients' own assessment of the result was graded as "excellent" (no complaints, no loss of function), "good" (minor sensation of instability, occasionally mild pain and no loss of function), and "poor" (pain and instability with reduced strength and function). Moreover the patients were questioned about possible social consequences of the knee trauma. For each patient the accumulated pre-operative instability (APL) was calculated as ML+LL+AD+PD+AMRI+PMRI+ALRI+PLRI.

We also assessed the relation in this pre-operative condition between patients who reported that they had been well-trained and patients who stated that they had not been well-trained. Likewise, the APL was related to limbering-up. In both instances the non-parametric Mann-Whitney rank sum test for unpaired measurements was used.

RESULTS

Table IV shows instabilities measured by stress radiography in the patients with isolated medial collateral ligament injuries (group I). Twenty-seven patients had from 3-9 mm valgus instability. The most marked instability was found in patients with injuries to the superficial fibres at the distal insertion, while injury to the deep fibres caused less instability. Rotatory instability was found in four patients, and only to a mild extent. In addition to total rupture of the medial collateral ligament, these four patients also had injuries to the posterior oblique ligament.

TABLE IV

Types of instability in 29 patients with isolated medial collateral ligament injuries assessed pre-operatively and at follow-up (group I).

Type	Pre-operatively	At follow-up
ML (medial laxity)	27 (3-9 mm)	2 (4 mm)
LL (lateral laxity)	0	0
AMRI (antero-medial rotational instability)	3 (< 4 mm)	2 (4 mm, 5 mm)
PMRI (postero-medial rotational instability)	1 (4 mm)	7 (< 5 mm)

At follow-up valgus instability persisted in two patients, mild in both. Two patients had antero-medial rotational instability after injury to the superficial fibres of the medial ligament, whereas seven patients had a mild degree of postero-medial rotational instability, mainly as a result of injury to the posterior part of the medial capsular ligament. Only four patients did not attain the maximum Kettelkamp score.

Varus/valgus instability and drawer signs in patients with major injuries (group II) are listed in Table V. Pre-operatively, five out of the 17 patients had an appreciable anterior drawer sign > 5 mm. At follow-up the anterior drawer had disappeared in two patients and had become reduced in three. On the other hand, four patients without a pre-operative anterior drawer sign had developed anterior drawer signs (4-6 mm). None of the four patients with isolated rupture of the anterior cruciate ligament had anterior drawer pre-operatively, and none of them had antero-lateral rotational instability which is generally considered to be characteristic of isolated anterior cruciate rupture. All four were symptom-free at follow-up.

TABLE V

Types of instability in 17 patients with major ligament injuries assessed pre-operatively and at follow-up (group II).

Type	Pre-operatively	At follow-up
ML (medial laxity)	7 (5-16 mm)	0
LL (lateral laxity)	1 (21 mm)	0
AD (anterior drawer sign)	5 (5-13 mm)	7 (4-8 mm)
PD (posterior drawer sign)	1 (5 mm)	

Only two patients exhibited rotatory instabilities pre-operatively. One had posteromedial rotational instability (5 mm) after an injury to the anterior cruciate ligament and posterior capsular part of the medial collateral ligament. At follow-up this patient had no complaints, and the knee was stable. The other one had antero-medial rotational instability (4 mm) after injury to the anterior cruciate ligament and superficial part of the medial collateral ligament. At follow-up there was an anterior drawer of 4 mm, and the patient was annoyed by some sensation of instability in the knee and pain on weight-bearing which had made him give up all athletic activities.

Three patients had developed rotatory instability when seen at follow-up. One was among the four patients with isolated injury to the anterior cruciate ligament, and the antero-medial rotational instability amounted to 4 mm. As already mentioned, it did not give rise to any complaints. The second patient was the one who had four ligament injuries, and now had appreciable postero-lateral rotational instability of 9 mm. This patient suffered from a marked sensation of instability in the knee and had a persisting peroneal palsy. Lastly, the third patient had developed 4 mm antero-medial rotational instability as a sequel to rupture of both the medial collateral and anterior cruciate ligaments.

Table IV presents the patients' self-assessment in relation to the clinical score. Twenty-six patients were extremely satisfied with the result. The median score among them was 128, i.e. maximum.

TABLE VI

Relationship between subjective result of treatment and clinical score in groups I and II.

	0-105	106-121	122-128	Total
Excellent		1 I	25 I	26 I
Good		3 I 6 II	6 II	3 I 12 II
Poor	3 II	2 II	—	5 II
Total	3 II	4 I, 8 II	25 I, 6 II	46

In the group that felt the result was good, the patients had moderate complaints, such as intermittent sensation of instability and mild pain on weight-bearing. Median score 111.

In five cases the result was not satisfactory. In this group the result was a median score of 94, resulting from pain, reduced strength, and instability with recurrent subluxations.

Of the 29 group I patients 21 were football players, and among them 8 were in a division-level team. One had to give up playing football and one had to give up all sports activities after the injury. All eight high-level football players could resume their division contest playing, and only one of the non-football playing athletes had to change the type of sports activity. In group II there were 9 football players, only four of whom could resume their playing, but none at top level. Of the eight non-football playing patients two had to change the type of sports activity because of the injury, and another two had to give up any kind of sport.

Of all 46 patients one has changed his occupation because of the knee injury, while another one has been deemed 8% disabled and had been awarded financial compensation.

Comparison of the ligament injuries in well-trained and less well-trained patients showed no difference in relation to accumulated instability. On the other hand, patients who had not exercised physically before the trauma exhibited a significantly greater accumulated pre-operative laxity indicating a more extensive ligament injury, than those who had limbered up ($p < 0.05$).

DISCUSSION

Among 46 patients only five (= 11%) had a result which was "not satisfactory", although 21 out of the 46 (46%) had persisting instability. Injuries to the medial collateral ligament healed with practically no subsequent instability, while minor rotatory instability was found in about one-third of the patients, indicating weakness of the ligaments and capsule in the postero-medial corner, including the semi-tendinosus insertion. As is apparent from Table IV, these rotatory instabilities were slight, causing no social or athletic consequences except in a few cases.

In seven of the group II patients having major injuries, a drawer sign persisted as a result of cruciate ligament injuries. These ligaments are said to make up 90% of the resistance to drawer instability (Butler et al, 1980), so that even a minor atrophy must be assumed to be able to cause drawer instability with attendant, often serious consequences in sports performance. In group II of the present series seven patients (41%) had persisting drawer instability, but only two of the (12%) had an instability exceeding 6 mm which Jacobsen and Rosenkilde (1977) have stated as the limit at which symptoms

occur. In Jonasch's (1958) material — true, of not sports-selected injuries — 34% had a persisting drawer sign after conservative treatment. This apparent difference from the present 11% "not satisfied" patients should probably be viewed partly on the background of the great motivation that athletes have for rehabilitation.

In football players Ekstrand (1983) has demonstrated that the risk of all kinds of injury decreases with improved training, emphasising the fundamental importance of the ligamentous and muscular apparatus in maintaining joint stability under extreme influence. The fact that the severity of the ligament injuries did not prove dependent upon the state of training in the present material must be assumed to be due to the large proportion of non-contest sports performers to whom the state of training is definitely a subjective concept, not regularly correlated to the amount of training and results obtained.

The lesser extent of the ligament injuries in patients who had felt that they had limbered up properly at the time of the trauma, as well as their reduced frequency of injuries (Ekstrand, 1983) indicate the importance of limbering-up in preventing injuries. It should be valuable also for non-football playing athletes, and in particular for people who have previously had a ligament-injuring knee trauma with the consequent greater risk of re-injury and progression of the symptoms (Noyes et al, 1983).

Acute surgical treatment led to functionally acceptable results in one hundred per cent of patients with injuries confined to the medial collateral ligament. In patients with injury involving the anterior cruciate ligament, surgical treatment was unsatisfactory in a significant number (29%) of patients.

Limbering-up should be a fixed routine before starting any serious sports performance, as it seems to restrict the extent of ligament injuries in knee traumas.

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