

ACL INJURY AND RETURN TO SPORT

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Abstract

We followed 110 patients who had sustained an acute traumatic Haemarthrosis for a mean of 60 months. The arthrometer measurements within 90 days of injury revealed the injured knee was stable in 35 patients and unstable in 75. Thirty-five unstable patients had an ACL reconstruction within 90 days of injury. Surgical procedures performed >90 days after injury included ligament reconstruction in 35 patients. Factors that correlated with patients who had late surgery for a meniscal tear or an ACL reconstruction < (P 0.05) were preinjury hours of sports participation, arthrometer measurements, and patient age. Follow-up data are presented for the patient's divided into four groups: I, early stable, no reconstruction; II, early unstable, no reconstruction; III, early reconstruction; and IV, late reconstruction. No patient changed occupation because of the knee injury. Hours per year of sports participation and levels of sports participation decreased in all groups. Joint arthrosis was documented by radiograph and bone scan. Joint surface injury abnormalities observed at surgery and meniscal surgery showed greater abnormalities by radiograph and bone scan scores (P< 0.05). Reconstructed patients had a higher level of arthrosis by radiograph and bone scan. Anterior cruciate ligament injuries are common. The biggest the number of these injuries occur in sports activities, mainly those that involve deceleration, torsion, shear, and jumping movements. In a study on football team injuries in Albania, reported 2.4 injuries per year on an Albanian university football squad. Many patients remain disabled for sport afterwards an ACL injury; others appear to have minimal damage. Some patients develop secondary and degenerative meniscal ttears knee arthritis; others show little joint deterioration. Few studies have documented the incidence of late meniscal tears after an ACL injury. Due to the variability of patient impairment after ACL injury and the lack of documentation that ACL surgery prevents degenerative arthritis, controversy over indications for ligament surgery. Moreover, a large number of patients do not often follow the entire functional rehabilitation process. The purpose of this prospective study was to document the outcome of the patient with ACL injury and the search for factors identifiable immediately after the injury correlating with a greater risk of functional impairment, secondary meniscus tears and joint arthrosis.

Keywords: Trauma, Surgery, Injury, Sport, ACL

Introduction

One of the most common knee injuries is an anterior cruciate ligament sprain or tear. Athletes who participate in high demand sports like soccer, football, and basketball are more likely to injure their anterior cruciate ligaments. About half of all injuries to the anterior cruciate ligament occur along with damage to other structures in the knee, such as articular cartilage, meniscus, or other ligaments. complete tear of the ACL Injured ligaments are considered "sprains" and are graded on a severity scale. The risk of re-injury and developing arthritis has become an economic burden and overall concern in the athletic arena (Flynn et al., 2005). Athletic ACL injury rates are increasing (Dodwell et al., 2014) in both D1 career athletes (Rugg et al., 2014) and youth athletes (Wiggins et al., 2016). One in four youths who suffer an ACL injury will suffer a second ACL injury in their athletic career (Wiggins et al., 2016).

Methods

Patient population

Between August 2015 and June 2018 all members of the University Trauma Hospital in Tirana which were evaluated in first aid with a swelling knee after injury were referred for clinical evaluation for knee injuries in the orthopedics department. During the study period, the health plan counted on average about 400 patients per year were evaluated for knee injuries. History knee injury and also any previous knee problems since the clinical examination was recorded on a protocol form of knee injury. Joint effusions were aspirated for identification patients with gemarthrosis. An AP and lateral x-ray was performed on all injured knees. Additional views have been

performed in some patients to identify fractures and patellofemoral anomalies. Clinical laxity examination including varus valgus stress test at 30 ° of flexion a diagnose injuries of the collateral ligament 16 and quadriceps active test between 70 ° and 90 ° of flexion to diagnose a posterior rupture of the cruciate ligament (Akeson, 1990). There were 110 patients, 23 with acute traumatic knee Haemarthrosis documented by joint aspiration who met the study admission criteria such as listed in table 1. A final follow-up evaluation was carried out between 2015 and 2018 performed. A patient classified as stable on initial examination had posterior instability during the follow-up exam and has been dropped since study. There were 70 men and 40 women in the study group. There was no significant difference between follow-up groups of 110 patients. The entered patients in the study they underwent the recovery of personal information (age, sex), and of the sports activities performed (injury activity, sport practiced) the treatment (if it was done) during the first 3 months after the injury. Index injury occurred in sporting activity in 81 (74%) of patients. The incidence in the general population who met the admission criteria in this study it was 0.36 per 1000 health plan members for year. One hundred and ten (91%) of the injured they were between 15 and 40 years old; the incidence of injury for patients in this age range was 0.8 per 1000 health plan members per year. The remainder of this report is limited to the 110 patients with a mean follow-up evaluation performed 64 months after the injury.

Sports participation

Patients were asked to name the two sports they participated in in most of the times before the injury. They were then asked to tell

the number of weeks per year and the number of hours a week they practiced every sport. The number of hours a year of participation in the two sports were then calculated. The sample studied was mixed, both professionals and amateurs (Andersson et al., 1989).

Movement measures

A knee arthrometer was used to measure the displacement of the anteroposterior joint. Between August 2015 and June 2018, arthrometric measurements are performed with the KT-2000 arthrometer, which records displacement measurements on a x-y plotter. Subsequently, the test was performed with the KT-1000 Arthrometer (MED metric), a more portable instrument which displays the output on a quadrant. In October 2018, the maximum manual test was added to the test protocol because it turned out to be a more sensitive test than an interruption of the ACL (Fig. 1). Injured less than normal in the knee displacement difference of less than 3 mm on all tests within 90 days of the injury he classified the knee as found stable early by KT-1000 arthrometer examination (early KT stable). If any testing within 90 days of the injury revealed an injury minus a normal difference of 3mm or more, the knee was classified as unstable at the beginning by the KT-1000 arthrometric examination (KT unstable at the beginning). Many patients have been examined more than once within 90 days of injury. Tests were performed in the hospital within 14 days of the injury and prior to surgery (Arnold. 1979). If the patient had a strained effusion, the joint was aspirated prior to measurement with the arthrometer to allow satisfactory stabilization of the patella during the test. A second examination was performed in the clinic on 40 patients within 14-90 days after the injury. Arthrometer measurements were performed at the time of

all follow-up evaluations. Final assessments were performed with the KT-1000 arthrometer and included the manual maximum test, flexion. The pivot shift test was performed with the tibia in neutral rotation and the hip in slight abduction. It has been evaluated such as 0 (absent), 1+ (slight glide), 2+ (moderate scroll) and 3+ (momentary block). Knee extension was measured as injured minus normal prone heel height difference, knee flexion was measured as degrees of active prone flexion.

Study admission criteria

Inclusion criteria

Acute traumatic hemarthrosis
Examination within 14 days of index injury
Lower limb injuries limited to the index knee

Exclusion criteria

History of injuries or ailment in either knee before index injury
Diagnosis of an acute patellar dislocation
Soft and point to vasus/valgus stress indicating a grade III collateral ligament injury
Positive quadriceps active test indicating a PCL injury
Standard knee radiographs reveal abnormal bone structures

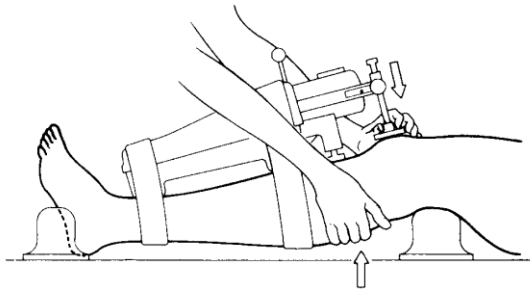


Figure 1.

The KT-1000 arthrometer manual maximum test. The relaxed limbs are supported in about 30° of flexion. The patellar sensor pad is stabilized and the testing reference position is established by pushing with an 89-N load posteriorly and then releasing the force. While the patellar sensor is stabilized with one hand, the other hand applies a strong anterior displacement force directly to the proximal calf to produce the maximum anterior displacement. Care must be taken that the knee is not extended. The proximal load application allows forces of 30 to 50 pounds (134 to 222 N) while not extending the knee. Tibial displacement is read off the dial.

Patient management

Management decisions were made by patients and their treating orthopedic surgeons. Patients were encouraged have a diagnostic arthroscopic examination; this it was especially encouraged in those patients with joint instability. It was recommended that patients with a repairable rupture of the meniscus and a disruption of the ACL have an early meniscal repair and ACL reconstruction. Other patients they were generally encouraged to rehabilitate the knees and then test them in their desired sporting activities first choosing to have ligament surgery. Young patients involved in vigorous sporting activities with joint

instability have been told they may need to have their ACLs rebuilt. Many in this group have chosen to have an early ACL reconstruction. Those patients who did not undergo early ligament surgery were directed into a home exercise program that emphasized bicycling, swimming and isotonic hamstring exercises. Joint immobilization or walking with crutches or both were used during the first 2 weeks for convenience only. Patients were advised not to participate in the race sport for a minimum of 3 months after the injury and until the range of motion of the knee was complete and there was no effusion. He was advised not to participate in level I or II sports for 6 months (Table 1). If the knee was unstable with arthrometer measurements, a functional knee brace was recommended for level I and II sports (Petersen et al., 2011). After a rehabilitation period of 6 months, if the patient with anterior instability could not participate in his favorite sport or had repeated episodes of failure, ACL reconstructive surgery was recommended. The first phase of patient care was directed by three orthopedic surgeons (Bach et al., 1990). In this relationship, patient care is divided in the initial phase (0 to 90 days after the injury) and the late stage (more than 90 days after the injury). During course of study, 70 diagnostic arthroscopies or surgery were performed in 120 patients. Description of the sporting levels and 12 procedures during the late phase, all surgical procedures were performed at the University Trauma Hospital in Tirana. Joint surface anomalies were classified as follows: Grade 0, normal; Grade 1, fibrillation / fissure less than 1.3 cm; Grade 2, fibrillation / fissuring of 1.3 cm or more or cartilage bone erosion less than 1.3 cm; and grade 3, cartilage bone erosion of 1.3 cm or more or diffuse fibrillation / cracking.

Arthroscopy was performed with a 5-mm 30 ° and 70 ° arthroscope under general or spinal anesthesia. Treatment after ligament surgery at the University Trauma Hospital in Tirana, Albania consisted of a postoperative period of immobilization followed by a structured exercise and activity modification program which continued for 10 months after surgery; Immobilization after surgery depended on the date of the operation. From August 2015 to February 2018, patients were immobilized at 30 ° of flexion for 3 weeks, followed by a movement brace with a 30 ° extension stop for another 3-5 weeks (N = 67). The patient then used a brace to keep the knee in full extension while sleeping and during the day she used a brace that allowed movement from 30 ° to 120 ° for 4 weeks.

Follow-up evaluation

The assessment included the number of hours per year that the patient was participating in pre-injury sports such as well as new sports were registered. If the patient had changed sporting activity this was recorded, as well as the reason why the pre-injury sport was discontinued. Sports and occupations were classified into functional levels as indicated in Tables 1. Radiographs of both knees of 110 patients were taken a final evaluation. These included standing 30 ° AP, 30 ° lateral and tunnel view of both knees. A grade of 0 (normal) a 3 (severe) was assigned to each of the six radiographs factors: formation of osteophytes, subchondral sclerosis, femoral flattening of the condyle, subchondral cysts, calcification of the ligaments, and narrowing of the joint space.

Table 1
Sports levels description

Level	Activity
I	Jumping, Basketball, Volleyball, Football soccer, Karate, Taekwondo
II	Lateral motion. Les jumping or hard cutting than Level I
III	Other Sport (running, jogging)

Osteophytes were classified by size: 0, no osteophytes; 1, small (1 to 2 mm); 2, moderate (3 to 5 mm); 3, large (more than 6mm). They were measured at eight sites: medial femoral condyle, medial tibial condyle, femoral notch, tibial spine, lateral femoral condyle, lateral tibial condyle, femoral aspect of the patellofemoral joint and the patella. Subchondral sclerosis was rated 0, no sclerosis; 1, mild; 2, moderate; and 3, acute. Sclerosis was measured at six sites: medial femoral condyle, medial tibial condyle, lateral femoral condyle, lateral tibial condyle, femoral aspect of the patellofemoral joint and patella. Flattening of the femoral condyle was assessed on the medial and lateral sides from 0 to 5. Subchondral cysts were evaluated as 0, absent; 1, one to two small cysts; 2, multiple small or single large cysts; and 3, several large cyst. The sites were the same as described for subchondral sclerosis (Arderm CL, et al 2011). Calcification of the ligaments was rated 0 to 3. Joint space narrowing was rated 0 to 3 for the medial, lateral, and femoral

compartments of the patella. There were 80 patients who had bone scans of both knees to final evaluation.

Recording, processing and statistical analysis of data

The study modules were used for all assessments. At the end of the study, patients were divided into four groups based on arthrometer measurements of early stage, performing ligament reconstruction surgery and the interval between index injury and the time of ligament surgery. (Burgi CR, et al., 2019) Early stable group I are patients who were stable early on and did not have a ligament reconstruction. Group II are patients who were unstable early on and dealt with their injuries without ligament surgery. Group III, early ACL reconstruction, are patients who had an ACL reconstruction within 90 days of injury. Group IV, late ACL reconstruction, are patients who have had an ACL reconstruction more than 90 days after injury. For categorical variables (e.g. rating scales used for pivot shift test, functional level, symptoms, and impairments), chi-square analysis was used to compare groups. Again, the level of significance was chosen as 0.05 for degrees of freedom. A discriminant analysis was performed to identify combined factors that were more predictive of unstable patients who had not been reconstructed during early stage would require late surgery to the meniscus. An analysis was then performed to predict late ligament surgery (Confort et al., 2009). The significance level for entry into the model was 0.20. Both imaging scores were not normally distributed and it was not possible to normalize using any of the standard transformations. Therefore, Kruskal-Wallis is not parametric ANOVA was used to analyze the scores against the four patient cohorts (groups I to IV) and other

categorical variables (pivot shift degree,) and the effects of meniscal injury and surgery). Post hoc comparisons employed Dunn's method. Frequencies of positive bone imaging scores were tested against patient groups using chi-square analysis. Correlation of imaging scores with other continuous variables such as hours of sports participation and displacement of the KT-1000 arthrometer measures employed linear least squares regression.

Results

Only one of the 34 patients with arthroscopically documented partial ACL rupture underwent ligament surgery. Two of the patients treated with late ACL reconstruction were KT stable in the early phase. Early arthroscopy revealed a patient he had a complete ACL tear and the other patient had a normal ACL. The patient with complete ACL injury became unstable over time; the patient with sustained normal ACL an ACL injury in a second injury 18 months after the index injury. Before late surgery on 31 patients' ligaments he had suffered a second knee injury. Twenty-one patients underwent meniscus surgery at the time of their late ligament surgery. In 15 of the patients, a medial meniscal repair was performed. Ligament surgery procedures are listed in (Table 2). Seven of the patients underwent post-surgical manipulation under anesthesia to restore movement; 5 of these patients were reconstructed early and 2 were reconstructed late. A total of 16 surgical procedures were performed after ligament surgery (2), meniscus removal (4), arthroscopy (8), and a second ACL reconstruction (2). Six of the patients sustained the tearful meniscus after an ACL reconstruction. One torn meniscus was repaired and five were excised.

Table 2

Ligament reconstruction surgery

Surgery	Early	Late
ACL repair and semitendinosus autograft	15	0
Bone block iliotibial band transfer	7	3
Patellar tendon autograft, over-the-top placement	10	18
Semitendinosus autograft, arthroscopic-assisted implantation	2	5
Patellar tendon autograft, double-tunnel placement	0	8
Other procedures	0	2
Total	34	36

A total of 30 medial and 1 lateral meniscus repairs were performed in 27 patients. Ten were performed early and 21 were performed late. All patients needing meniscal repair had ACL disruptions. Six of the repairs were done without rebuilding the ACL. In 3 of these patients there was no further surgery and in 3 the meniscus was repaired a second time when an ACL reconstruction was performed. Twenty-one patients had meniscal repair with an ACL reconstruction. There was no other surgery in 18 patients. One patient had a second meniscal repair with a second reconstruction, and 2 had their meniscus subsequently removed.

Profession and sport

No patient changed occupation due to knee injury. Before the injury, 38 patients worked at a functional level above level IV, and a follow-up 60 patients worked at a higher functional level compared to level IV. Before the injury, over 85% of all patients the groups participated in a level I or II sport 50 or more hours one year; at the follow-up the participation rate was reduced in all groups (Group I, 47%; Group II, 44%; Group III, 44%; and Group IV, 55%). Much of the change in sporting activity over the 5 years period was due to unrelated lifestyle changes knee injury. Before the injury, 60 patients participated in a level I or II sport 50 or more hours per year. Knee break of level I or II divided by the number of level I or II sports practiced prior to injury are patients who had late ligament surgery who said they were

better after ligament surgery; no one said they were worse.

Discussion

A high percentage of patients with acute traumatic hemarthrosis suffered an ACL injury. Clinical evaluation of anterior and anterior displacement end point with the Lachman test has been used since physician to diagnose an ACL disruption with test sensitivity ranging from 73% to 99%. The KT-1000 Arthrometer was used to measure anterior-posterior displacement and to diagnose an ACL disruption. A careful instrument is required to avoid spurious measurements positioning, stabilization of the patella and relaxation of the patient. In our study, 109 (99%) of 110 patients with confirmed complete interruptions of the ACL were unstable KT, while only 1 unstable KT knee had a normal ACL. Therefore, in this study there was a 98% chance that an unstable KT knee had an ACL rupture. The maximum manual test revealed the greatest displacement difference between injured and normal knees and turned out to be the most sensitive test for an outage of the ACL. During the first period, the doctor performing the arthroscopy diagnosed 34 partial interruptions of the LCA; 5 were stable KTs and 20 were KTs unstable. It is assumed that patients with stable hemarthrosis have a normal ACL or partial ACL injury. This population was included in this report because they follow up studies have not previously been reported in this population and serve as a comparison group for those patients with an unstable ACL injured knee. This relationship is not a impartial comparison between operators and non-operators management of the injured knee at the ACL. Patients were not randomized into treatment groups, but

selected their own own treatment program. The populations are undoubtedly different in many ways (Kiely, 2018). We have documented that the patients who chose to undergo surgery were younger and more athletically active before the injury. The main focus of this report is the outcome of the ACL injury patient who did not choose to undergo early ACL surgery. It is instructive to compare their results with the outcome of the population with stable hemarthrosis, the first patients with ACL reconstruction and the patients which has undergone a late reconstruction. Symptoms of pain and swelling were less in group II than previously reported in patients with chronic ACL injury (Eitzen et al., 2010). Symptoms of subsidence were also less than previously reported. Disability for sports after ACL the injury is the main reason patients require ligament surgery. Numerous systems have been used to document sport activity. The essential elements are sporting level, level of participation, performance, symptoms during or after participation and the frequency of play or exposure. Reporting sporting activity as hours per year of participation at a specific functional level provides a simple method of documenting a sporting activity that lends itself to comparison between groups. People involved in competitive athletics will usually attend more hours compared to those in recreational sports. The patient with major symptoms while participating will participate less hours. Therefore, the hours of play per year reflect participation level of intensity and symptoms, as well as measures directly patient exposure. This system does not measure the patient performance. If there is a change in activity, the patient asked if the change is related to the knee. There were a number of group II patients who continued to participate in level I and II sports.

Conclusions

1. Instrumented measurement of AP knee displacement it is a sensitive test of a complete interruption of the ACL. Ninety-six percent (N = 106) of patients with ACL interruption documented by arthroscopy that have been tested with the KT-1000 manual arthrometer maximum test on the first exam had an injured less than normal displacement difference of 3 mm or more.
2. There is a low probability (10%) that patients with an acute traumatic hemarthrosis that is stable on instrumented exam will develop instability over a maximum period of 5 years.
3. A high percentage (59%) of patients with acute ACL injuries have a meniscal tear. Not all patients with a meniscus tear need meniscus surgery.
4. Total pre-injury hours per year of participation in the Levels I and II sport and displacement measurements were predictive of who would not require late surgery.
5. Many ACL injury patients who did not undergo knee reconstruction continued to participate in sports activities.
6. Patients who underwent meniscus surgery had a higher incidence of joint osteoarthritis than those who did not have surgery.
7. Patients with an ACL injury who did not require meniscus surgery had a higher level of joint abnormalities from bone scans if they had ligament surgery than those who did not have ligament surgery.
8. Patients who did not initiate early rehabilitation recovery (5-10 days after surgery) found delayed healing with negative influence for returning to sport.

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