Recent ligament injuries to the knee*

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Given the unsatisfactory results afforded by the treatment usually employed for ligament injuries to the knee, we have long completely discarded the long-term plaster immobilization protocol (up to 12 weeks) championed by such prestigious authors as Boehler[1], Bosworth[2] and Watson Jones[12] since it was often followed by sequelae like persistent knee stiffness and muscle atrophy that required a protracted rehabilitation process. We believe, according to the guidelines laid down by Palmer[9], O'Donoghue[7] and Quigley[10], that only surgical treatment can achieve a *restitutio ad integrum*. Therefore, at the Catalonia delegation of the Spanish Soccer Injury Clinic, a few years ago (as we reported in another paper) we started treating all knee ligament tears surgically. Our series includes lesions with a poor prognosis that were operated early in order to try and achieve a reconstruction whose results were invariable extremely uncertain.

Pathology

The most common injury to the medial collateral ligament (40% of cases) is avulsion from its tibial attachment, followed equally by tears at its midpoint and at its proximal portion. Much less frequent are injuries at the ligament's femoral attachment given the strength of this attachment and the firm connections the ligament has at this point with the thigh aponeurosis, which is also attached to the epicondyle; in the event of an avulsion there is generally a displacement of the bony structures. In distal tears, which can affect the whole of the attachment, the ligament appears warped, retracted and edematous. In midpoint and proximal ruptures, the edematous reaction is either scarce or nonexistent. When there is a a transverse section line, the loose ends get significantly drawn back; one of our had three tears at the level of the joint line that further to the retraction had adopted the shape of circumferences separated from each other by a column of healthy tissue. When looking at these lesions, one understands the ineffectiveness of plaster immobilization. Superiorly, the sections often adopt an oblique direction with little separation. For our repair procedures, we never select tears of the beeper layers of the ligament since the more superficial strand makes visualization and hence repair more difficult and it is precisely this superficial bundle that is vital to articular stability. In true fact, the deep layers constitute a kind of suspensory ligament for the meniscus, establishing a strong connection between the latter and the femur that is however weak and lax un its inframeniscal portion. We have not found the so-called «stepped» tears, i.e. tears at different levels and we have found out that, unlike what has been stated by O'Donoghue, the two layers of the ligament do not always get torn at different heights. In several cases, once an incision was made into the aponeurosis, a combined two-plane tear appeared, through which the surface of the femoral condyle could be seen.

In contrast to the opinion of several authors, isolated tears of the medial collateral ligament are fairly usual and, if the insult persists, these tears can become the first stage in meniscal detachment and anterior cruciate ligament (ACL) rupture. If this happens, then the O'Donoghue[7]'s unhappy triad ensues.

The lateral collateral ligament may have to withstand lesions all along its surface; these lesions are usually accompanied by capsular ruptures in the inframeniscal region or at the attachment point to the tibia, in which case bony displacement can sometimes occur.

The following three injury types are commonly found in the ACL in decreasing order of importance: *1.a* complete tear (usually of the superior attachment); *2.a* partial tear (with concomitant fraying of a few strands and ligament insufficiency); 3.a avulsion at the tibial spine with bone migration. Posterior cruciate ligament lesions are rare.

The repair process has recently been experimentally studied by Jack[4]. It occurs as a result of the conversion of the clot to granulation tissue, giving rise to the formation of new collagen fibers thanks to the proliferation of cells from the ligament; the fibers adopt a regular and longitudinal alignment. At three weeks, there is good tensile strength with no evidence of pathological mobility. At forty-five days, the appearance is normal even if an increase in the number of cells and vessels can be detected microscopically.

Mechanism of injury

The usual mechanism of injury, as regards the medial collateral ligament and the ACL, tends to be forceful abduction, on its own or combined with external rotation, which

*Presented at the IVth SECOT Meeting (Asturias, July 1955).

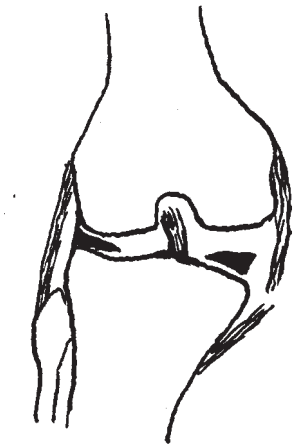

Figure 1. *«Unhappy triad».*

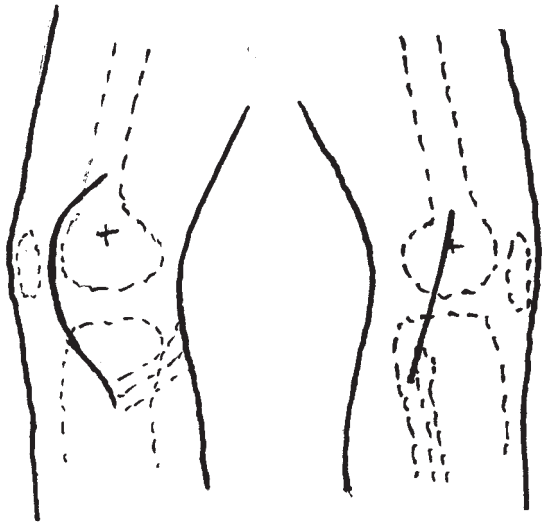

Figure 2. *Incisions for the medial and medial and lateral collateral ligaments.*

is a common occurrence in such sports as soccer, ski, rugby or parachuting (Richman[11]). The lateral ligament is normally injured by forced adduction, a far a less frequent movement. ACL injuries are typically associated with a rupture of the medial collateral ligament or of the medial meniscus; these ruptures are usually either longitudinal or involve the anterior meniscal horn and are often caused by the initial trauma, although they can also occur later on as a result of meniscal elongation provoked by repeated joint locking. Injuries often result from hyperextension. The posterior cruciate ligament is rarely injured.

Diagnosis

These lesions usually go undetected on radiological images, except for ligament avulsions from their bony attachments. It must also be stressed that: *a)* it is important and at the same time difficult to determine the nature and exact grading of these injuries; *b)* it is necessary to subject patients to a strenuous rehabilitation program.

In these lesions, it is necessary to conduct an early examination, if possible within the first few hours, before the subsequent appearance of symptoms that may enshroud the patient's actual clinical status. Stress must be laid on the importance of rapidly establishing as accurate a diagnosis as possible in order to be able to institute an appropriate treatment. O'Donoghue[7] stated that in the first few hours it is already possible to establish: 1. the degree of lateral instability; 2.the location of the injury; 3.the presence of a positive drawer sign; 4.the limitation to knee extension, which unambiguously denotes a meniscal injury.

In general patients seek medical care several hours after sustaining their injury. It is then more challenging to examine them since they often present with a more or less intense synovial reaction. Such a reaction does not unmistakably indicate the presence of an intraarticular lesion, since it only occurs in about half of all cases and, when an injury exists, its intensity is sometimes unrelated to the severity of the injury. An effusion may be completely absent because the tear may be extraarticular or because the fluid has escaped its original site through the capsule, diffusing into the neighboring tissues; in some cases patients develop eccymosis that can reach up to the ankle.

Edema on the lateral side of the knee, usually located in the area occupied by the ligaments, as well as eccymosis in the region of the pes anserinus or of the fibular head, are some of the most frequent findings, the intensity of the edematous reaction being greatest in the external area.

Mobility is considerably impaired because of the contracture and the pain. Under pressure, pain is felt all along the ligament; the pain increases sharply at the rupture site. The Moragas maneuver[6] can prove useful for the exploration of the ligament (placing the ankle of the involved leg on the healthy knee, a forceful adduction is carried out by exerting a downward pressure on the joint Under examination) since it makes it possible to feel the ligament strands as they become taut thereby identifying discontinuities or any painful spot. Platt's «ligament-peroneal nerve» has not been identified in any of our cases. Medial collateral ligament and ACL injuries lead to an increased external rotation in the semi-flexed position.

We have left till the end the two pathognomonic signs of ligament tears. In the first place, we will mention what Covaro[3] and other Argentinian authors have called the «articular gap», and subsequently we will refer to the «drawer sign», both of them indicating a deficit in ligament function. The «articular gap» manifests itself by an increase in the corresponding joint space; it should be sought not in hyperextension (in which case, as Merle d'Aubigné[5] points

out, a tear of the medial collateral ligament could provoke no laterality whatsoever given its «locked» position), but rather in slight flexion (around 10 degrees). It can be explored with the patient lying down in a position of complete muscle relaxation. The patient must place the ankle of the involved limb in the surgeon's same-side armpit. Subsequently, the surgeon places his hands on both sides on the patient's proximal tibia and uses his body to move the patient's leg into adduction and abduction. Laterality higher than 15 degrees is usually indicative of an ACL injury. The drawer test is administered with the knee flexed at 90 degrees; the test may produce a slightly positive or even a negative result and the rupture may be discovered intraoperatively. In one of our cases, a detached ACL was locking the joint and the condition was interpreted as a meniscal tear.

Since these maneuvers are usually painful, they must sometimes be carried out under slight narcotization, which allows the surgeon to carry out both the drawer and the jump signs for the cruciate ligaments and the menisci respectively. If there is a sizeable articular gap, on releasing the pressure keeping the leg abducted or adducted the surgeon often notices an impingement of the glenoid cavity on the corresponding femoral condyle (an almost impossible occurrence in an unharmed joint), which is never felt my the patient. It is also possible to hear a grinding sound in the menisci as the leg goes into abduction, provoked by a slight detachment of the base of the medial meniscus. It is always advisable to compare the range of motion of the healthy knee. A level of instability higher than 15 degrees, always with x-ray confirmation, indicates the need for surgical repair. Such repair should not be deferred more than 10-12 days since injuries can only be repaired shortly after they occur. After a few days from the accident, the status of the joint improves considerably and the surgeon may find that the only symptoms present are the articular gap and the drawer sign.

Surgical technique

In order to repair the medial collateral ligament we opted for a skin incision that provides a wide access into the whole of the internal aspect of the tibia thus allowing the surgeon, if necessary, to enter the joint and inspect the corresponding meniscus as well as the cruciate ligaments.

Under preventive ischemia, with the knee slightly flexed and the limb in external rotation, an incision of about cm is made over the epicondyle in a downward and forward direction so that it runs between the patella and the condylo-trochlear rim and goes on to cross the joint line ending up in the pes anserine region half way through the medial section of the tibial plateau. Subsequently, an incision is made into the thin aponeurosis that spans the limb over the ligament, dissecting the latter from end to end and avoiding trauma to the areolar tissue cover that nurtures it. A hematoma often denotes the location of the rupture; in some cases it is located in the depths of the ligament, its exact position being revealed by abducting of the leg.

If once the rupture has been identified it becomes necessary to explore the joint cavity, the leg must be suspended in the same position used to conduct a meniscectomy and entry is gained into the knee joint through a capsular incision that starts at the top of the patella and extends until the tibial edge. An inspection is made of the semilunar cartilage, which must be excised if it has become unattached. In an examination of the cruciate ligaments reveals an injury, the capsular incision must be extended upward in order to dislocate the patella and thus be able to visualize the intercondylar space. If the ACL is torn at its femoral attachment, the medial femoral condyle is tunnelized from the lateral epicondyle (after making a small skin incision) and subsequently reattached by means of perlon sutures. This technique is simpler than making parallel perforations and passing the suture through them. Should the rupture affect the tibial spine, a similar tunnel is driven in the medial tibial condyle. Superior detachments of the PCL are repaired in a similar way, tunnelizing the medial condyle. For inferior ruptures a more complicated technique is necessary since they require a popliteal approach. Some authors (West[13]), do not repair the cruciate ligaments. Subsequently, the medial ligament is sutured with a few U-shaped stitches when the injury falls outside the bony attachment points, taking care not to occlude the existing virtual space; between the two ligament layers (this may limit knee flexion) and including some healthy tissue in the suture so as to prevent suture extrusion If tibial detachment is found, two or three holes must be drilled through which the sutures must be passed, which affords a safe fixation of the ligament. If the injury is in the superior region, reattachment must be achieved by means of a small tunnelization in the epicondyle.

In order to expose the LCL, the patient must be placed in the lateral position on his healthy side. The skin incision must follow the direction of the ligament; once the aponeurotic section has been made, the ligament must be inspected either by adducting the leg or by the Moragas maneuver[6]. If detached, it should be reattached; if the ligament body is torn at its midpoint it is advisable to reinforce the repair with fascia lata or bicipital tendon flaps. If there is a capsule rupture, it must be repaired.

Subsequent treatment

Subsequently a compressive bandage must be applied on top of 3 or 4 thick layers of cotton (about 25 cm) above and below the knee. The pneumatic tourniquet can now be deflated.

At the fifth day, quadriceps recovery exercises must begin and sutures can be removed on the tenth day. The patient is then allowed to walk with crutches so as not to excessively load the operated limb. Full weight-bearing will not be allowed until at least 3 weeks have elapsed. In some cases, when the patient starts to ambulate he must wear a long-leg cast for external protection for two to three weeks, especially when both the cruciate and the collateral ligaments were repaired. Patients are authorized to do sports activities after two months. Some patients who had ruptured their MCL and their lateral meniscus reported pain in their lateral meniscal area (possibly resulting from articular readaptation); this pain tends to wear off without leaving any sequelae. One of our patients had to be reoperated. On revising im, we found a lateral condyle osteochondritis, with a severely degenerated meniscus, which went on to heal uneventfully.

Cases

Below is a lost of the cases we have operated, with the date of surgery and the injuries identified:

A. P. (11-21-51). Partial rupture at attachment of LCL. Capsular rupture under anterior horn of lateral meniscus. (right knee).

M. P. (05-14-52). 2 cm-long rupture at tibial attachment of MCL. (right knee).

V. M. (10-07-52). Rupture at midpoint of MCL (right knee).

A. M. (01-03-53). Detachment of MCL half way through its tibial attachment (left knee).

V. E. (11-03-53). Rupture of MCL at midpoint (left knee).

A. G. (11-19-53). Rupture of MCL at the level of jointline. Meniscus detached at midpoint (right knee).

J. D. (04-30-53). Complete detachment of MCL at tibial attachment. Rupture of medial meniscus (right knee).

R. R. (10-28-53). Rupture of upper MCL (right knee).

J. M. (11-04-53). Rupture of lower MCL (right knee).

J. P. (11-30-53). Detachment of two-thirds of MCL at tibial attachment (right knee).

J. B. (12-13-53). Rupture of upper. MCL. Complete detachment of medial meniscus. Rupture of upper PCL.

Rupture of LCL at midpoint. Capsule rupture at level of lateral meniscus (right knee).

J. M. (11-18-54). Rupture of upper MCL (left knee).

C. S. (11-30-54). Rupture of upper. LCL. Capsule rupture with bone migration at tibia (left knee).

A. E. (07-15-54). Detachment of upper ACL (right knee).

C. S. (09-07-54). Rupture of MCL at midpoint. Medial meniscus detachment. Rupture of ACL at femoral attachment (left knee).

J. P. (10-16-54). Rupture of MCL at midpoint. Detachment of medial meniscus. Rupture of upper ACL (right knee).

G. N. (11-25-54). Rupture of lower MCL (left knee).

V. M. (11-25-54). Rupture of lower LCL (left knee).

R. P. (11-27-54). Rupture of upper. MCL (left knee).

F. B. (02-18-55). Rupture of. MCL, ACL and PCL and medial meniscus (right knee).

A. R. (05-14-55). Rupture of lower LCL (right knee).

J. S. (05-14-55). Rupture of MCL at midpoint (left knee).

D. M. (04-15-55). Rupture upper MCL. Rupture medial meniscus (left knee).

J. F. (05-12-55). Complete rupture of lower attachment of MCL (left knee).

R. S. (05-24-55). Rupture of lower MCL. Rupture medial meniscus (right knee).

J. P. (05-31-55). Rupture of MCL. Rupture of medial meniscus (right knee).

Of a total of 26 knees operated we found more right knees than left ones (15 vs. 11). The injuries could be broken down as follows: 21 MCL tears (with 9 cases (40%) of meniscus detachment); 5 MCL tears; 4 ACL tears and 2 PCL tears. Trauma was usually the result of falls on an outstretched leg, and to a mush lesser degree, they occurred as a result of a blow that provoked a forceful external rotation of the leg.

Final comment

The surgeon must apply his own knowledge and personal experience to decide which injuries require immediate surgery and which are amenable to conservative treatment. For surgeons with experience of the required diagnostic and reconstructive skills it is always preferable to adopt an interventionistic attitude This explains the increase in the number of these types of surgery in the first few years. Indeed, even if some of the patients that were operated on would not have had significant discomfort when carrying out their normal activities, they would have had trouble when required to meet the high functional demands of their sport. In sporting activities, the knee tends not to function in full extension, a position in which it is protected by the muscles that surround it, but rather in semi-flexion, during which the action of the muscles is less efficient and the integrity of the ligaments becomes extremely important in order to maintain the stability of the joint.

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Commentary

Diagnosis and treatment of ligament injuries to the knee is always an interesting and topical issue. In this pithy article written in 1955, Dr. Moragas proposed a change in the therapeutic approach to recent ligament injuries to the knee, and especially of the medial and lateral collateral ligaments (MCL and LCL). In contrast, he only touches on the diagnosis and treatment of injuries to the anterior and posterior cruciate ligaments (ACL and PCL) briefly and rather superficially.

Dr. Moragas wrote tus article drawing on the experience gained in the past 4 years, during which he operated 26 knees with different ligament lesions in people from the world of sports. His decision to apply surgical treatment to these cases came as a result of the poor clinical results obtained by conservative treatment of recent ligament injuries to the knee (stiffness, muscle atrophy) and of the opinion expressed by renowned international authors that «only surgical treatment can achieve *ad integrum* restoration» further to these types of injury[1]. The usual treatment of these ligament injuries at the time was conservative, with cast immobilization for a variable period that could extend to up to 12 weeks; in a significant number of cases such treatment led to functional and sport-related limitations.

As mentioned, in his paper the author discusses mainly the treatment of tears in the collateral ligaments, mainly the MCL, in the belief that these were the ligaments most frequently involved in the pathology of the knee. Isolated ACL injuries were much less frequently observed by Dr. Moragas; when they appeared they were usually associated to a MCL tear and to a medial meniscus tear. This condition, involving the three structures mentioned, was already known as the «unhappy triad» (described by O'Donoghue)[1]. Furthermore, there is no mention of other ligament associations that are well known today, such as the possible association between a tear in the LCL and the cruciate ligaments. Moreover, the author found it exceptional to find a PCL tear. In spite of this, Moragas made a point of checking the condition of both cruciate ligaments when a tear was suspected, extended the indications for a knee arthrotomy, and repaired the cruciate ligaments if suspicions were confirmed.

The paper goes into a detailed description of the pathology of MCL injuries. Dr Moragas states that these injuries most frequently occur in the lower part of the ligament (40%), followed equally by injuries to its middle and superior parts; superior avulsions only occurred in association with a bone fragment. The author also aptly describes the two layers that make up the medial ligament, stating that the superficial layer is chiefly responsible for stability and the deep layer is merely dedicated to providing support to the medial meniscus. Lateral collateral ligament injuries are also mentioned succinctly. Dr. Moragas reports that they can be injured throughout their length and they can sometimes be accompanied by inframeniscal capsular avulsions in the tibial region. This is what is nowadays known as a «Segond fracture»[2], a sign that is indicative of an ACL tear that can occur together with tears of the MCL and/or knee posterolateral complex, which will be described below. Although all of these morphofunctional descriptions still remain valid, the anatomical realities of both the MCL and the LCL have somewhat changed in the last few years on account of the results reported by a series of studies[3,4], which have concluded that collateral ligaments are not isolated entities but rather form part of a series of capsular-ligamentous complexes, i.e. the posteriomedial and posterolateral complexes, both of which provide additional medial and lateral stability. Thus, the MCL is reinforced by the stability provided by