Unusual association of diseases/symptoms

Shelbourne's update of the O'Donoghue knee triad in a 17-year-old male Rugby player

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Summary

Acute athletic knee injuries are often caused by a combination of valgus impact with external rotation of the tibia leading to a triad of injuries involving medial collateral and anterior cruciate ligament disruption with associated meniscal damage. This injury pattern has been greatly discussed in the literature with conflicts of opinion and evidence as to whether medial or lateral meniscal pathology has a higher incidence. This case report introduces a 17-year-old male athlete with this unhappy triad. It will evaluate the clinical assessment which suggested a medial meniscal lesion, follow the patient through arthroscopy revealing a lateral meniscal tear in addition to complete anterior cruciate ligament rupture and grade 2 medial collateral ligament tear. It will go on to look at the evidence base for the relative incidence of lateral and medial meniscal injuries and will evaluate the role of MRI in assessing acute athletic knee injuries.

BACKGROUND

A 'combination' knee injury involving disruption to the medial collateral ligament (MCL), anterior cruciate ligament (ACL) and the medial meniscus was first described by Campbell in 1936.¹ This injury was largely brought into the consciousness of sports physicians, orthopaedic surgeons and physiotherapists alike by the work of O'Donoghue in the 1950s. He reported an incidence as high as 25% of the 'unhappy triad' in acute athletic knee injuries; and in a study of 22 patients with combined ACL and MCL injury found that 17 (77%) of them had an associated medial meniscus tear.² However, this was questioned in 1991 by Shelbourne who found that 'lateral compartment abnormality predominates over medial in athletic knee injuries involving ACL and MCL'.³ What remains unchallenged is that ACL injuries with associated MCL tear commonly result in meniscal damage.⁴⁻⁷

The ACL is one of the four major ligaments of the knee, the others being the posterior cruciate, lateral collateral and medial collateral, it connects the postero-lateral aspect of the femur to the antero-medial aspect of the tibia, on the intercondylar notch. Mechanically, the ACL resists anterior translation of the tibia, in relation to the femur; it also carries a number of proprioceptive fibres playing a key role in joint position sense. The ACL is the most commonly injured knee ligament,⁸ most often damaged from a sudden torsion or hyperextension of the knee in sports such as netball, basketball, soccer or skiing. Injury to the ACL leads to instability and is linked to the development of osteoarthritis. Lohmander suggesting this is due to an 'intra-articular pathogenic process initiated at the time of injury, combined with long-term changes in dynamic joint loading'.⁹

The MCL is a broad, flat, membranous band on the posteromedial side of the knee joint. It attaches to the medial condyle of the femur proximally, and the medial condyle of the tibia distally, acting as a stabiliser of the knee joint, preventing excessive valgus distraction of the tibia on the femur. Most injuries to the medial side of

the knee are caused by a force directed on the lateral aspect of the knee, or lower leg,¹⁰ the posterior fibres are more susceptible to damage from rotational non-contact forces;¹⁰ a similar mechanism of injury to that seen in ACL rupture. As a high proportion of knee injuries are 'caused by a combination of valgus and external rotational forces, the MCL and ACL are frequently damaged in the same knee'.¹⁰

MCL injuries are graded based on the joint space widening seen when a valgus force is applied at 0° and 30° flexion.¹¹ Opening of 5 mm is indicative of grade 1 tear, 6–10 mm grade 2 and over 10 mm is a grade 3 tear. The relative opening in each position reflects the number of injured structures, with laxity only at 30° suggesting an isolated MCL injury but laxity in both positions indicating additional capsular damage. MCL damage can lead to chronic valgus instability of the knee, with risk of resulting meniscal trauma.

The knee joint contains two fibrocartilaginous structures which separate the articulating surfaces of the femur and tibia, acting as shock absorbers, increasing the contact area between bones and reducing the peak contact force experienced. The medial meniscus is semicircular with attachments on the anterior and posterior intercondylar fossa of the tibia, its medial edge fuses with the medial collateral ligament. Its relative lack of mobility and fusion with the MCL make the medial meniscus theoretically more susceptible to injury than the lateral, which is nearly circular, covers a larger portion of the articulating surface, is more mobile and is separated from the lateral collateral ligament (LCL) by the popliteus tendon. Damage to either meniscus reduces their shock-absorbing capacity and predisposed to the development of osteoarthritis; Lohmander reports that at 10–20 years after diagnosis, 50% will have osteoarthritis with pain and functional impairment.⁹

This case report will introduce a patient who suffered a valgus impact and external rotation knee injury, resulting in the 'unhappy triad' of ACL rupture, MCL disruption

and meniscal damage. It will go on to examine the incidence of this injury in the published literature, looking specifically at the conflict between several authors as to whether lateral or medial meniscal lesions are more common in combined ACL–MCL knee injury. It will then look at the issues surrounding diagnosis, specifically the need for diagnostic imaging prior to surgery.

HISTORY

The patient is a healthy 17-year-old boy with no significant medical or surgical history, or previous major sporting injuries. He is a keen rugby player at school and club level, currently studying for his AS level exams and has aspirations to study Sports Science at University. He takes no regular medications, does not smoke and reports no alcohol use. He currently lives at home with his parents and is independent of activities of daily living. He presented to the Sports Injury Knee Clinic with a swollen and painful left knee which he was unable to weight bear on.

He was injured when playing rugby for his local club side, as a second row forward. At the time of injury, the patient was ‘bridging a ruck’, a position where he was leaning forward with his weight distributed between his hands and feet. The injury occurred when an opposition player attempted to ‘clear out’ the ruck, by running into him at maximum velocity.

He describes a high-impact valgus force being transferred through his left knee, and a twisting of the knee with his foot planted in the ground. He felt immediate pain, predominantly on the medial side of the knee and describes feeling a crack and a pop within the knee joint; he was immediately removed from the field of play. Within minutes, the knee swelled up, was very tender to palpation and he was unable to weight bear, later that evening he presented to A&E. A provisional diagnosis of a grade 2/3 MCL tear was made; the patient was given crutches, told to weight bear as able, and was referred to the clinic.

EXAMINATION

On examination, he stood with no weight on his left leg. His left knee was grossly swollen on the medial aspect, with no other inspection abnormality. He walked with an antalgic gait, demonstrated no heel strike, and a greatly reduced stance phase on his injured left side. The left knee had a significant effusion and was very tender to palpation medially, over the length of the MCL, particularly around the femoral insertion, and on the joint line. There was mild tenderness over the posterior aspect of the lateral joint line but, noticeably, less than the medial side. His range of motion was 0–130° on the uninjured right side, compared with 20°–100° for the injured left knee. This represented an extension deficit of 20° and a flexion deficit of 30°, a ‘locked’ knee. Ligament testing revealed MCL laxity, clinically assessed as grade 2 with no LCL laxity. There was no anterior drawer, or posterior sag, but anterior-posterior laxity was demonstrated by positive Lachman and pivot shift tests.

INVESTIGATIONS

The patient had undergone x-Ray imaging of his injured knee in A&E, which demonstrated no fracture, but soft tissue swelling over the medial aspect of the knee. While

acknowledging that MRI would be the diagnostic imaging of choice for the suspected injury the surgeon chose to proceed straight to arthroscopy. His reasoning was based on the fact that from the history and clinical examination findings, he was sure that there was ACL rupture, MCL tear and meniscal pathology which was causing the ‘locked’ knee. Given the loss-of-functional movement in the injured knee the patient, and the strength of the clinical findings, it was almost certain that the patient would require an arthroscopy, to relieve his locking symptoms, negating the need for further imaging to confirm diagnosis.

DIFFERENTIAL DIAGNOSIS

Based on the history and clinical findings of a ‘locked’ knee, medial joint line tenderness, MCL laxity and positive Lachman test, a MCL tear, ACL rupture and a locked bucket handle tear to the medial meniscus was diagnosed, the unhappy triad described by O’Donoghue.

TREATMENT

The patient was listed for examination under anaesthesia (EUA) and arthroscopy 2 days after his clinic appointment, on Wednesday 7 January. EUA confirmed many of the original examination findings, demonstrating a grade 2 MCL laxity, a positive Lachman’s and pivot shift tests, the only new finding was that the anterior drawer was positive where in clinic it had been hard to illicit. The arthroscopy showed a bloody effusion in the knee, highly suggestive of ACL pathology, and confirmed the complete rupture of the patient’s ACL. Interestingly, the medial meniscus was intact, but the lateral meniscus had a radial tear, not the suspected locked ‘bucket-handle’ tear. The ruptured fragment of the ACL was stuck in the trochlear groove accounting for ‘locking’ symptoms (figure 1).

Despite the notoriety of O’Donoghue’s triad, this injury pattern has actually been shown by many authors to have a significantly higher incidence, with Shelbourne reporting 71% of patients with ACL tear and grade 2 MCL tear having lateral meniscal pathology compared with just 11% showing medial meniscal lesions.³

Figure 1 A complete rupture of ACL at arthroscopy.

Figure 2 A radial tear in the lateral meniscus.

While meniscal repair has been shown to be superior to excision of lesions in both the prevention of pain, and reducing the possibility of later Osteoarthritis,^{12 13} the tear to the patient's lateral meniscus was deemed irreparable and was excised (figure 2). The surgeon decided that the grade 2 MCL tear would be managed non-operatively, in a hinged knee brace with a graded physiotherapy programme.

He underwent arthroscopic ACL reconstruction, using gracilis and semitendinosus graft, 6 weeks subsequent to the injury to allow time for the inflammatory process in the knee to settle before surgery. While the benefits of surgical versus conservative treatment of ACL-deficient knees remain controversial, reconstruction within 3 months from the time of injury has been shown to significantly reduce the incidence of secondary meniscal damage,¹⁴ which impacts on the likelihood of developing osteoarthritis.

OUTCOME AND FOLLOW-UP

Recovery from a grade 2 MCL tear has several phases of gradually increasing physical activity, all carried out wearing a hinged knee brace. In the case of an isolated injury, a patient could expect to be running by 6 weeks, and back to full sporting activity by 10 weeks.¹⁵

However, this is not an isolated MCL injury and the patient's rehabilitation must be judged in the context of his other injuries. He underwent arthroscopic ACL reconstruction 6 weeks post-EUA so followed a rehabilitation protocol for an MCL and partial meniscectomy during this period; this involved wearing a hinged knee brace with gradually increasing range of motion (ROM) exercises, and gradually increasing physical activity level. The period of recovery from ACL reconstruction varies between centres, but we favour a four-phase programme aimed at protecting the ACL and patella but achieving early full extension, assuming a graft-to-bone healing time of 12 weeks.

Phase 1 begins immediately following surgery and lasts approximately 1 month with the patient performing daily ROM exercises and hip, knee and ankle strengthening, as directed. Phase 2 is from weeks 4–12 and the target is to

achieve full flexion, progressive weight bearing, lower limb muscle condition and to begin non-impact cardiovascular work while continuing to protect the graft. Phase 3 is from week 12–24 and develops functional strength and proprioception with a combination of open and closed kinetic chain exercises with a view to facilitating return to sport, which is phase 4 and happens from 24 weeks in the form of running progressions, plyometrics and sport-specific training.

There is a report of an elite alpine skier with a similar injury being back to full team training in 6 months,¹⁶ but this is the exception rather than the rule, and patients undergoing ACL reconstruction should be advised that they would likely be off sport for 9 months.

Here, the patient's case is complicated further by the fact that he underwent a large meniscectomy and has a considerably reduced shock-absorbing capacity in his lateral meniscus. The surgeon advised the patient that it would be unwise for him to return to Rugby, or any sport which will result in repeated impact to the knee, because of his increased risk of developing Osteoarthritis.⁹ It was recommended that he take up sports such as cycling and swimming, which reduce the force of impact transmitted through the knee joint, for fitness.

The patient successfully completed this rehabilitation programme and has taken the advice of the surgeon and hung up his rugby boots. He has now been discharged from clinic after successfully returning to sport in the form of cycling.

DISCUSSION

This case raises a number of interesting learning points. This discussion will focus on the relative incidence of medial and lateral meniscal pathology in acute ACL and MCL injury, and the use of diagnostic imaging to confirm diagnosis in the acutely injured knee when arthroscopic intervention is likely.

The patient's injury represents a variation on the 'unhappy triad of O'Donoghue,' a term based upon O'Donoghue's 1950 publication. The injury combination

of ACL, MCL disruption and medial meniscal tear was first described by Campbell in 1936,¹ but the injury was brought to the public's attention by O'Donoghue. O'Donoghue quoted the unhappy triad to have an incidence as high as 25% of acute athletic knee injuries, and published figures reporting that 77% of 22 acute ACL-MCL injury had medial meniscus tears compared with just two lateral tears.² The incidence of meniscal damage in ACL-MCL injuries was far lower in work by Cerabona¹⁷ and Lucie,¹⁸ but the relative predominance of medial lesions remained. This led to considerable discussion of the 'unhappy triad' in both research articles and sports injury textbooks, to the point where the natural assumption based upon the literature would be that it was a common injury.

This early work was all carried out before the advent of arthroscopy, around 1975, and several studies carried out subsequently, using arthroscopic equipment, have reported lateral meniscal lesions to predominate by a factor of 2 to 1.^{4 19 20} Shelbourne investigated this in 1991 discovering that in acute ACL-MCL-injured knees 31% had lateral meniscus damage, 18% had damage to the medial meniscus and 33% had no meniscal damage. Interestingly, he also found that the grade of MCL injury was a factor, with grade 3 tear actually having a relatively protective effect on the menisci when compared with grade 2 lesions. He concluded that lateral meniscus tears were more common in acute ACL-MCL injury and that this should be the third component of the so-called terrible triad.³ The patient's injury is an example of the triad which Shelbourne described.

An interesting facet of the management of this case was the surgeon's decision to proceed to EUA and arthroscopy without diagnostic imaging further to the plain x-ray taken at presentation.

MRI is often requested in the management of knee injuries and is considered by many to be a good non-invasive diagnostic tool for ACL and meniscal injuries, Jackson *et al*²¹ reporting an accuracy of greater than 90% for ACL injuries.

However, Rose championed the merits of accurate history taking and clinical examination in preference to MRI, and found 'clinical accuracies of 98% and 72% for ACL and medial meniscal injuries, respectively'.²² Brooks agreed with this finding by reporting 79% correlation between clinical and arthroscopy findings, compared with 77% between MRI and arthroscopy. He also found that his negative arthroscopy rate of 4% was not improved by prearthroscopy MRI.²³ Further data were presented by Miller who again found that clinical diagnosis more closely correlated with arthroscopy findings than MRI, and also reported that blind MRI would have led to 'inappropriate treatment in 35% of patients'.²⁴ MRI was also shown by Thomas *et al*,²⁵ and Alioto *et al*²⁶ to prevent subsequent arthroscopy in just 16% and 18% of cases, respectively.

Based on these findings, while MRI has a valuable role to play in the management of knee injuries, it seems reasonable to conclude, as Thomas did, that 'where symptoms and clinical findings are suggestive, and when therapeutic intervention is already being contemplated, scanning is not always beneficial'.²⁵

Learning points

- The Shelbourne triad of injury to anterior cruciate ligament (ACL), medial collateral and lateral meniscus is a more common combination knee injury than the more widely known 'Terrible Triad of O'Donoghue' which involved injury to ACL, medial collateral and medial meniscus.
- In the presence of an acutely injured locked knee, if therapeutic intervention is already being considered, then, MRI is not always useful and may just delay the necessary treatment.
- Clinical examination has demonstrated 'clinical accuracies of 98% and 72% for ACL and medial meniscal injuries, respectively'.²²

Competing interests None.

Patient consent Obtained.

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