CASE REPORT

MRI-confirmed tear and spontaneous healing of the anterior cruciate ligament

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Introduction

Injuries to the anterior cruciate ligament (ACL) and the medial collateral ligament (MCL) of the knee account for 90\% of all knee ligament injuries in young and active individuals.\textsuperscript{11} In contrast to the MCL, the primary healing potential of the ACL has been reported to be extremely poor in both clinical and experimental studies.\textsuperscript{1,4,7,13,15}

This inferior healing capability has encouraged surgeons to reconstruct the ACL to help patients maintain athletic activities and to manage symptoms of instability.\textsuperscript{14} We report the case of a young male who suffered a tear of his ACL deemed suitable for reconstruction. This was confirmed by magnetic resonance imaging (MRI). At the time of surgery, 2 years later, the ACL was found to be healed. This too was confirmed on MRI. He subsequently made a full functional recovery and returned to full sporting activity.

Case report

A 27-year-old male television producer, who was a keen roadrunner, sustained an injury to his right knee whilst playing football. He had come to an abrupt halt, twisting his right knee, and heard a loud pop. He reported immediate swelling of the knee and withdrew from the game due to pain and inability to weight bear. He was assessed the same day at our Accident & Emergency department where he was told to rest, ice, elevate and compress the knee. Specialist assessment was organised.

Two weeks later he was seen in the sports injuries clinic, where a physical examination revealed a grade 2 effusion and a range of movement from 5 to 100\textdegree of the right knee. Minimal joint line tenderness was elicited but stability was still difficult to assess. It was felt that he had >5 mm of AP translation but he strongly resisted all tests. There was no posterior sag. Plain radiographs of his right knee were normal. An MRI scan was requested.

The MRI scan revealed findings consistent with a complete tear through the femoral attachment of the ACL (Fig. 1a). This finding was confirmed in the axial and coronal planes. Bone marrow oedema of the posterolateral tibial plateau and the posterior femur were the other abnormalities detected.
Fig. 1  (a) Sagittal oblique T1 weighted image of the right knee. The femoral attachment of the ACL (large arrow) is very poorly defined. There is a change in angle of the fibres in the mid-body of the ACL (small arrows). This appearance therefore supports an ACL tear. T = tibia, F = femur, P = patella. (b) Sagittal oblique T2 weighted image of the right knee. Bone marrow oedema of the lateral tibial plateau and posterior femur are arrowed, both ancillary signs of an ACL tear.

Fig. 2  (a) Sagittal oblique T2 weighted image of the right knee. The well-demarcated femoral attachment of the ACL is arrowed. (b) Sagittal oblique T1 weighted image of the right knee. The restoration of the normal alignment of the ACL fibres is shown.
The appearances of the posterior cruciate ligament (PCL) were normal.

Nine weeks post-injury, an examination of his right knee revealed a grade 2 positive anterior draw and Lachman’s test (compared to negative on the other side). The pivot shift test was equivocal. The patient did not have a restricted range of movement and had no significant clinical instability. He was referred for rehabilitation and kept under regular follow-up in the sports injuries clinic.

Ten months after the initial injury, the patient had not returned to full sporting activity and complained of a weak right knee. An arthroscopy was planned with a view to confirming the presence of an ACL tear and proceeding to reconstruction. Meanwhile progressive physiotherapy was continued (closed kinetic chain and quadriceps strengthening).

One year later, at the time of surgery, examination under anaesthetic revealed a grade 1 positive anterior draw and Lachman’s test. The pivot shift and reverse pivot shift tests were negative. At arthroscopy, there was no effusion. The medial compartment appeared to be normal and there were no loose bodies. The anterior horn of the lateral meniscus was frayed and subsequently shaved. The ACL was found to be in the correct position. No adhesions between the ACL and the PCL were detected. There was no empty lateral wall sign. There was no deficiency of the ACL on probing; and a maximal AP translation of 2–3 mm was seen. A notchplasty was performed because of an overhanging superolateral wall, which impinged on the ACL in extension; the posterolateral insertion of the ACL was visualised more clearly as a result and was normal. The PCL was probed and was normal.

As the patient did not have any rotational instability and the ACL appeared healed, further careful supervised physiotherapy and muscle strengthening were organised, with periodic review visits to the hospital. The patient was not braced.

A repeat MRI scan, performed almost 2 years after the injury, showed the ACL to have a normal appearance and position (Fig. 2a and b). There was minor signal change in the lateral meniscus probably related to the arthroscopic shaving. The MRI scans were reviewed by two blinded musculoskeletal radiologists who agreed with the aforementioned findings.

At final review, the patient volunteered no symptoms of instability or discomfort. He is running, swimming, cycling and playing football. His quadriceps bulk matches the contralateral thigh.

Discussion

There is very little in the way of documentation of spontaneous ACL healing in the literature. The poor healing response of the ACL is thought to be influenced by various intrinsic and extrinsic factors.4,15

Murray et al.,12 described four phases in the histological response to injury of the human ACL: an inflammatory phase, an epiligamentous repair phase, a proliferative phase and a remodelling phase. During the epiligamentous repair phase, synovial tissue was formed that covered the ends of the ruptured ACL (unlike extra-articular ligaments that heal after injury). Most of the synovial lining cells were myofibroblast-like cells that contained alpha-smooth muscle actin. The synovial tissue is thought to impede repair of the ligament confirmed by the absence of tissue bridging across the site of rupture of the ACLs in this study. Moreover, they concluded that muscle actin containing cells may play a role in retraction of the ends of the ruptured ligament accounting for the extremely low incidence of spontaneous healing.

The other important factor may be that of reattachment of the torn ACL to the PCL. In a study of 101 patients undergoing arthroscopic ACL reconstruction, Lo et al.,9 demonstrated that 72% of knees showed this type of reattachment, confirming that healing can occur in the intra-articular environment, previously thought to be unfavourable for this biological process. However, the function of these reattachments is clearly inadequate in the majority of cases.

In patients of low athletic demand, conservative management of acute ACL injuries can lead to satisfactory results. Fujimoto et al.,3 studied a group of these patients, with ACL injuries, who showed high intensity in the mid-substance of the ACL on MRI, but with ligamentous continuity. The injured knees were treated using an extension block soft brace without anterior stabilisation for 2–3 months. Seventy-four per cent of the knees were stable at the follow-up examination. They concluded that the acutely injured ACL has healing capability and that conservative management of this injury can yield satisfactory results in patients with low athletic demands, provided the patients are willing to accept the slight risk of late ACL reconstruction and meniscal injury.

The case we report in this paper had a tear at the femoral attachment with the majority of the ligament in good condition and no compromise in the length of the ligament. This may have been a favourable location for healing. Similar cases have been reported by Kurosaka et al.,8 and Malanga et al.,10 but the patients in these reports wore double hinged braces for up to 6 months which perhaps afforded some protection to the ligament from excessive stress until they had remodelled with sufficient strength. The patient in this report did not
play football or any cutting/turning sports for approximately 16 months which may have offered similar protection, but no brace was worn. Ihara et al.\textsuperscript{5} reported successful results after non-operative treatment and early exercises with the use of a brace but although continuity of the ligament was confirmed by repeat arthroscopy 3 months later, no follow-up data or subsequent activity levels were recorded.

This report differs in that the patient had MRI confirmation of a torn ACL in the acute period, an arthroscopy confirmed a healed ACL 2 years later, and a repeat MRI scan confirmed healing of the ACL. Furthermore, the MRI scans were reported independently by two musculoskeletal radiologists. We have also observed a return to full pre-injury activity levels.

With regard to our MRI scans, although they were performed on an open, low-field system, they are of diagnostic quality. The successful use of low-field scanning in the assessment of acute knee injuries is well documented in the literature.\textsuperscript{2,6} The diagnostic accuracy of open, low-field MRI has been shown to be comparable to high-field units. The experience level of the examiner has also been reported as an important factor.\textsuperscript{6} Our reporting radiologists are both experts in musculoskeletal radiology.

We are aware that the absence of injury to the secondary stabilising structures may have aided spontaneous healing in this case. Although we do not recommend non-operative treatment of every acute ACL tear, protection of the injured knee from undue stresses and an adequate rehabilitation program (with or without the use of a brace) might favourably alter the course of healing in selected patients in whom the injury is near the femoral origin of the ACL. The clinical and MRI evidence in this case suggests that the ACL has some healing potential.

**Conclusion**

Spontaneous healing of the ACL can occur with satisfactory results in patients with low to moderate athletic activity demand. The position of the injury may play an important role. The intra-articular environment of the knee may be suitable for healing, although the exact mechanisms and their biochemical and molecular pathways are still unclear.

**References**