Posterolateral corner injuries of the knee
A SERIOUS INJURY COMMONLY MISSED

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We retrospectively reviewed the hospital records of 68 patients who had been referred with an injury to the posterolateral corner of the knee to a specialist knee surgeon between 2005 and 2009. These injuries were diagnosed based on a combination of clinical testing and imaging and arthroscopy when available. In all, 51 patients (75%) presented within 24 hours of their injury with a mean presentation at eight days (0 to 20) after the injury. A total of 63 patients (93%) had instability of the knee at presentation. There was a mean delay to the diagnosis of injury to the posterolateral corner of 30 months (0 to 420) from the time of injury. In all, the injuries in 49 patients (72%) were not identified at the time of the initial presentation, with the injury to the posterolateral corner only recognised in those patients who had severe multiple ligamentous injuries. The correct diagnosis, including injury to the posterolateral corner, had only been made in 34 patients (50%) at time of referral to a specialist knee clinic. MRI correctly identified 14 of 15 injuries when performed acutely (within 12 weeks of injury), but this was the case in only four of 15 patients in whom it was performed more than 12 weeks after the injury.

Our study highlights a need for greater diligence in the examination and investigation of acute ligamentous injuries at the knee with symptoms of instability, in order to avoid failure to identify the true extent of the injury at the time when anatomical repair is most straightforward.

The posterolateral corner of the knee consists of a number of static and dynamic restraints described previously in the literature.1,2 Static restraints include the lateral collateral ligament, arcuate ligament, fabellolabral ligament, popliteal ligament, joint capsule and coronary ligaments. Dynamic restraints include the biceps femoris and popliteus muscle tendon units. Injuries to the posterolateral corner are potentially disabling, causing reduced function3 and they present with any combination of instability, symptoms associated with the peroneal nerve and pain.4 Despite increasing awareness of the importance of early recognition of injury to the posterolateral corner, these injuries remain under-reported. Their incidence ranges from 5% to 9% of all injuries to the knee.5 Although low-grade isolated injuries of the posterolateral corner recover well after conservative management,6 higher-grade or combined ligament injuries give poor results after conservative management.7,9 If grade-III10 posterolateral corner injuries are left untreated, long-term complications including osteoarthritis may occur.9 Surgical treatment is the method of choice in such cases.11-13 Stannard et al14 reported favourable results after reconstruction and the results from early repair are considered to be better,5,13,15-17 except when there is an associated dislocation of the knee, in which case delayed or staged reconstruction may be preferable.18 However, repair becomes technically very difficult, if not impossible, at two to three weeks after injury. These serious injuries should therefore be correctly identified and receive urgent appropriate management. If, however, an early diagnosis is not made, correct identification of the subsequent instability is essential, since functional improvement and increased stability can be gained by anatomical reconstructive surgery.19

In combined injuries to the knee ligaments failure to identify and treat involvement of the posterolateral corner may result in the failure of reconstruction as a result of altered biomechanics of the knee.13 In vitro biomechanical studies have shown increased force on cruciate-ligament grafts in the presence of grade-III posterolateral corner injuries.20-22 Furthermore, O’Brien et al23 reported that...
15% of reconstructions of the anterior cruciate ligament (ACL) failed as a result of an unrecognised or untreated injury to the posterolateral corner. In agreement with LaPrade we suspected that injury to the posterolateral corner often remained undiagnosed at the initial presentation and at the time of referral to specialist knee clinics, and that these patients were often referred late, after the critical time period during which anatomical repair could take place. Our aim, therefore, was to assess the interval between injury and diagnosis in patients with this injury.

**Patients and Methods**

We retrospectively reviewed the hospital records of patients with an injury to the posterolateral corner of the knee who were seen by a specialist knee consultant (SRB) between 2005 and 2009 in one of two specialist knee clinics, one within a large NHS teaching hospital and the other in a private hospital. We reviewed the hospital records to identify those patients with an associated ligament injury, the mechanism of injury, the interval to diagnosis, whether injury was identified at the initial presentation or at the time of referral, and the subjective history. The timing and results of any imaging which had been undertaken were also reviewed.

A total of 68 patients with a posterolateral corner injury was identified. There were 59 men and nine women with a mean age of 27 years (15 to 51) at the time of injury. The diagnosis was established by a combination of clinical assessment and imaging, including plain radiography, MRI and arthroscopy when available.

Clinical assessment included the tibial external rotation (DIAL) test with the patient prone as described previously at both 30° and 90° of flexion. In this test the tibia is externally rotated relative to the femur and it is deemed to be positive if external rotation is increased by 10° or more in the injured leg when compared with the uninjured side. Although the accuracy of the DIAL test has not been established it has some validity. A cadaver study confirmed that tibial external rotation increased in both isolated and combined injuries of the posterolateral corner, and a prospective study showed that 76% of patients with an injured posterolateral corner had increased external rotation at 90°. We also visually assessed tibial external rotation in the supine position in order to rule out anteromedial rotary instability as the cause of any increased external tibial rotation. The posterolateral drawer test and external rotation recurvatum tests were performed as described by Hughston and Norwood. Varus stress tests were performed at both 0° and 30° of flexion and the reverse pivot shift was also performed. Signs of a varus thrust gait pattern were also used to aid diagnosis. These clinical tests have been considered to be the most reliable for diagnosing injury to the posterolateral corner. If arthroscopy was undertaken (14 patients) it included assessment of the ‘drive-through’ sign.

**Results**

We found that eight (11.8%) of the injuries were isolated while 29 (42.6%) were associated with injury to the ACL; 19 (27.9%) with an injury to the posterior cruciate ligament (PCL), 11 (16.2%) within an injury to both the ACL and PCL and one (1.5%) was combined with an injury to the ACL, PCL, and the medial complex. A total of 63 (93%) of the patients complained of instability of their knee.

The causes of the injury were sport-related, such as football and rugby in 44 (65%) patients, or due to road traffic accidents in 18 (26%) or the result of falling or fighting in six (9%). A non-contact injury was reported in 36 (53%) patients.

Presentation to hospital occurred within one day of injury in 51 patients (75%) although the mean time to presentation from injury was eight days (0 to 120). In all, 49 of the injuries (72%) were not diagnosed correctly at presentation. Only those associated with multiligamentous injuries in the 11 patients with a dislocation of the knee were correctly noted at presentation. At the time of referral more than half of the patients remained incorrectly diagnosed, with referral having been made by orthopaedic consultants, orthopaedic registrars, general practitioners, physiotherapists and sports club doctors. The alternative diagnoses given on referral are shown in Figure 1. In all, 13 patients (19.1%) were seen within two weeks of the injury with the remainder seen after this time. The mean delay to diagnosis was 30 months (0 days to 420 months). If we excluded four patients as outliers, who had all waited over seven years for a diagnosis, the mean delay to diagnosis was 12 months (0 to 72).

![Pie chart showing alternative diagnoses on referral when injury to the posterolateral corner was not identified.](image-url)
A total of 41 patients (60.3%) had undergone a modified Larson reconstruction and four (5.9%) repair to the posterolateral corner. The remaining patients were either awaiting treatment at the time of writing or were stabilised after high tibial osteotomy and did not wish to proceed with anatomic reconstruction. Plain radiography had been performed on 50 patients (73.5%). The weight-bearing anteroposterior views of the knee showed lateral joint opening in 27 patients (54%) of the injuries with 20 (44%) of the patients needing an opening wedge high tibial osteotomy to correct varus malalignment before the ligament reconstruction.

MRI was performed on 15 patients within 12 weeks of injury, and on another 15 at more than 12 weeks after the injury. It identified injury to the posterolateral corner in all but one who underwent scanning within 12 weeks of injury. In those patients in whom MRI was performed more than 12 weeks after the injury, it correctly identified only four of 15 injuries.

Discussion
Our study has shown that injury to the posterolateral corner of the knee remains frequently overlooked. This supports the views of LaPrade.3 We found that 70% of our patients had been diagnosed incorrectly at the time of initial presentation (usually to accident and emergency), and those in whom the diagnosis had been correctly established had suffered severe multiple ligament injuries. At the time of referral to the specialist knee clinic, 50% had still not been appropriately diagnosed despite some being assessed by an orthopaedic consultant in the intervening period. Even among some patients referred by other orthopaedic consultants the injury had been overlooked in most cases, although other concurrent pathology had often been identified correctly.

There are a number of reasons for not diagnosing this injury. These include failure to perform appropriate clinical tests by using tests which have a low sensitivity, poor training in the assessment of ligament laxity and failure to undertake supplementary investigations such as MRI.

A review of the literature shows the difficulty in interpreting clinical tests designed to identify injury to the posterolateral corner. LaPrade and Terry26 prospectively evaluated the results of a number of clinical tests on the integrity of the posterolateral corner and showed that the injury pattern was usually related to the clinical signs, for example, a varus injury was associated with varus instability. Veltri et al30 suggested that external rotation at 30° may not be routinely reliable in detecting a combined injury to the ACL and posterolateral corner. More recently, Jung et al31 showed that the extent of increased external rotation seen in the DIAL test depended on the amount of posterior tibial sag when the PCL was also injured. LaPrade, Thaun and Griffith32 showed that the external rotation recurvatum test was only positive in patients with a posterolateral corner injury combined with an ACL deficiency. In the light of this inconsistency we recommend that a combination of tests be used to assess the posterolateral corner.

We found an extensive delay to diagnosis in spite of the fact that these patients tended to present to medical professionals promptly after injury. Acute repair is generally considered to be better than reconstruction at a later stage. Of the 45 patients who had already undergone ligament stabilisation, 41 had reconstruction rather than repair. This may be because only 13 (19.1%) of patients were referred within the first two weeks after injury, which is the period when anatomical repair is feasible. In a study by Baker et al33 only 17 of 157 posterolateral corner injuries were identified early enough to have anatomical repair.

We found that injuries of the posterolateral corner were most often combined with injury to the ACL, secondarily with that of the PCL, and that only 11.8% were isolated. Our results are comparable with those of previous studies showing that the posterolateral corner is rarely injured in isolation,26,32 although LaPrade et al32 found a greater incidence of isolated injury to the posterolateral corner than we did (26.8%). The distribution of combined injuries in our series was similar to that found by LaPrade et al.32 Both in our series and elsewhere,26 instability was found to be one of the main features associated with these injuries. Furthermore, since most injuries to the posterolateral corner occur in association with an injury to the cruciate ligaments, careful evaluation of the posterolateral corner should be carried out in all patients with suspected cruciate ligament pathology. Such evaluation may help to reduce the number of failed reconstructions of the cruciate ligament because of an unrecongnised injury to the posterolateral corner.23

In our study the most common mechanism of injury was a non-contact twisting injury. This agrees with the finding of LaPrade and Terry26 who in a prospective study found that 51% of patients who had suffered injury to the posterolateral corner had a history of either a twisting injury or non-contact hyperextension.

When performed within 12 weeks of injury, MRI identified all but one of the injuries to the posterolateral corner, but when performed after 12 weeks it was considerably less accurate. From our data, it is clear that a negative MRI, especially when performed at more than 12 weeks after injury, does not exclude the possibility of an injury at the posterolateral corner. LaPrade et al33 also found that acute injuries appeared to be relatively accurately identified by MRI. However, there are more differences in the accuracy reported for chronic cases between our study and that of LaPrade et al.32 This may have been due to our inclusion of all grades of injury to the posterolateral corner, whereas LaPrade et al33 included only surgically-verified grade-III injuries.10

We acknowledge the limitations of our study. We had no single reference standard for diagnosing an injury of the posterolateral corner, but relied on a combination of history, clinical testing, arthroscopic findings and imaging investigations when available. However, this assessment method is both pragmatic and reflects clinical practice. Furthermore,
since the posterolateral corner consists of a number of intra- and extracapsular structures no single test would adequately confirm or exclude injury to these structures.

Our conclusions are that the diagnosis of injury of the posterolateral corner is often overlooked apart from cases in which severe multiple ligamentous injury has occurred. The taking of a careful clinical history and thorough examination is essential to avoid misdiagnosis of this condition. We recommend that clinical assessment of the posterolateral corner involving a number of different tests should be routinely undertaken if there is any suspicion that this injury could be present. MRI accurately identifies a posterolateral corner injury in the acute phase, but may be of limited use at longer intervals. Injuries to the posterolateral corner are often associated with symptoms of instability.

References