ISOLATED POSTERIOR CRUCIATE LIGAMENT INJURY: MR DIAGNOSIS

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ABSTRACT

MRI findings in a case of isolated avulsion of posterior cruciate ligament (PCL) was described. They were seen as separation of the tibial insertion of the PCL with hypersignal lesions on T_1WI between the tibia and the avulsed fragment. The anatomy and mechanism of PCL injury was reviewed.

INTRODUCTION

MRI is now the examination of choice in noninvasive diagnosis of knee ligament injuries. The evaluation of the menisci and the anterior cruciate ligament (ACL) was widely established (5), in contrast to the evaluation of the posterior cruciate ligament (PCL) (1-2) PCL injury is uncommon and occurs either as intrasubstance tears or avulsion from the site of origin or insertion. In this report, we present a case of an isolated avulsion of the PCL, describing the MR appearance and discuss anatomy and mechanism of PCL injury.

CASE REPORT

In August 1995, a 40 year old man was sent to the Ramathibodi Hospital for an MRI study of the knee. He injured his left knee 3 weeks ago. Initial physical examination of the left knee revealed an intact neurovascular status, but the ligamentous stability of the knee could not be determined. A lateral radiograph of the knee showed an avulsion fracture at the posterior aspect of proximal tibia suggesting associated posterior cruciate ligament (PCL) insufficiency (Fig. 1). MR imaging of the left knee showed the site of impact fracture of the tibia (Fig. 2) and the avulsed fragment at the tibial insertion of the PCL (Fig. 3). The collateral and anterior cruciate ligaments, the menisci and the capsule were normal.

DISCUSSION

Injury of the PCL occurs in about 2%-23% of all knee ligament injuries, and in 30% of these cases, the PCL injury is isolated (2). However, the actual incidence may be greater because many injuries remain clinically undetected (4). Because clinical evaluation can often be difficult or misleading, the diagnosis of a PCL tear can be missed. The PCL may be difficult to evaluate at arthroscopy when the ACL is intact and usually connot be directly seen by the surgeon from the anterior approch unless the ACL is torn. An intact menisco femoral ligament of Humphry can simulate an intact PCL during arthroscopy even if the PCL is ruptured. Thus, an isolated tear of the PCL may not be confirmed at arthroscopic evaluation even when suspected clinically on the knee of posterior

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tibial laxity. MR imaging provides reliable visualization of the PCL and can accurately demonstrate the presence and degree of injury to the PCL as well as associated ligamentous, meniscal and bone abnormalities (1,2).

The PCL is a spirally oriented fiber bundle that courses from the leteral aspect of the medial femoral condyle to its insertion in a depression in the posterior aspect of the intraarticular tibia, approximately 1 cm below the articular surface. The PCL is thicker (thickness 1.3 cm) and stronger than the ACL and has twice the tensile strength of any other knee ligament. The PCL is extrasynovial but intracapsular. It is taut in flexion and becomes predominantly lax in extension, with tension retained in the posterior aspect. The ligament subtends a reticent angle of 30°-45°, depending on the degree of flexion. The PCL serves as the major stabilizing structure in the knee, preventing posterior translation of the tibia on the femur and working in concert with the ACL and collateral ligament to limit rotatory motion.

On MR images, the normal PCL apears as a well defined band of very low signal intensity that courses between the medial femoral condyle and the posterior tibia. In the sagittal plane, the normal PCL is essentially always visualized, appearing near the midline of the joint on two or three consecutive images. In extension, the PCL is lax and describes a thick, gentle arc posteroinferiorly from the femur to the tibia. The meniscofemoral ligaments of Humphry and Wrisberg are often seen immediately adjacent to the PCL as they course from the medial femoral condyle to the posterior horn of the lateral meniscus; they are situated anterior and posterior to the PCL, respectively. On coronal images, the posterior vertical portion of the PCL is seen in the intercondylar notch, adjacent to the lateral aspect of the medial femoral condyle. The ligament curves forward anteriorly, and the horizontal portion appears as a circular or ovoid area of low signal intensity within the intercondylar notch. Axial images are useful in visualizing the vertical portion of the PCL from its tibial insertion to the genu, where it is seen as an ovoid signal void.

Three common mechanisms of the PCL injury are recognized

1. A direct blow to the proximal anterior tibia in a flexed knee, forcefully displacing the tibia posteriorly, and usually resulting in a midsubstance tear of the PCL and often in injury to the posterior joint capsule. This mechanism is often seen in the setting of motor vehicle accidents where impact with the dashboard results in posterior tibial displacement. Alternatively, a fall on a hyperflexed knee can drive the tibia posteriorly, tearing the PCL with posterior tibial displacement, the collateral ligaments usually remain intact. Bone contusion tend to occur at the site of impact between the anterior tibial plateau and the posterior femoral condyle.
2. Hyperextension may cause PCL injury or avulsion of the tibial attachment of the PCL with preservation of the ligamentous substance with continued extension, the ACL may rupture as well. Contusion are often seen in the anterior portion of the tibial articular surface and in the anterior aspect of the femoral condyles
3. Severe abduction or adduction forces associated with rotational forces may rupture the cruciate ligaments after the collateral ligament fail. With valgus stress, in particular, the ACL tends to rupture before the PCL.

Sonin AH. et al. retrospectively reviewed the results of 2,739 consecutive MR imaging examination of the knee performed at Northwestern University Medical School from January 1990 through February 1994. Seventy-one patients (2.6%) met the MR imaging criteria for a partial or complete tear of the PCL. Only five patients (7% of the positive PCL tear) had avulsive injury of the tibial insertion with the PCL apparently intact. Avulsion injuries of the tibial insertion site of the PCL were identified on the basis of focal discontinuity of the tibial articular surface, with a discrete bony fragment attached to an otherwise intact PCL and separated from the remainder of the tibia. Plain lateral radiograph of the knee was required to confirm the presence of an avulsed fragment of bone at the posterior aspect of the knee joint.

If unrecognized, PCL disruption leads to post traumatic osteoarthritis, principally of the medial femorotibial and patello fermoral compartments, resulting from instabilily.

Bone avulsion injuries are treated by reimplantation of the tendon and attached fragment with screw fixation or pull-through suture.

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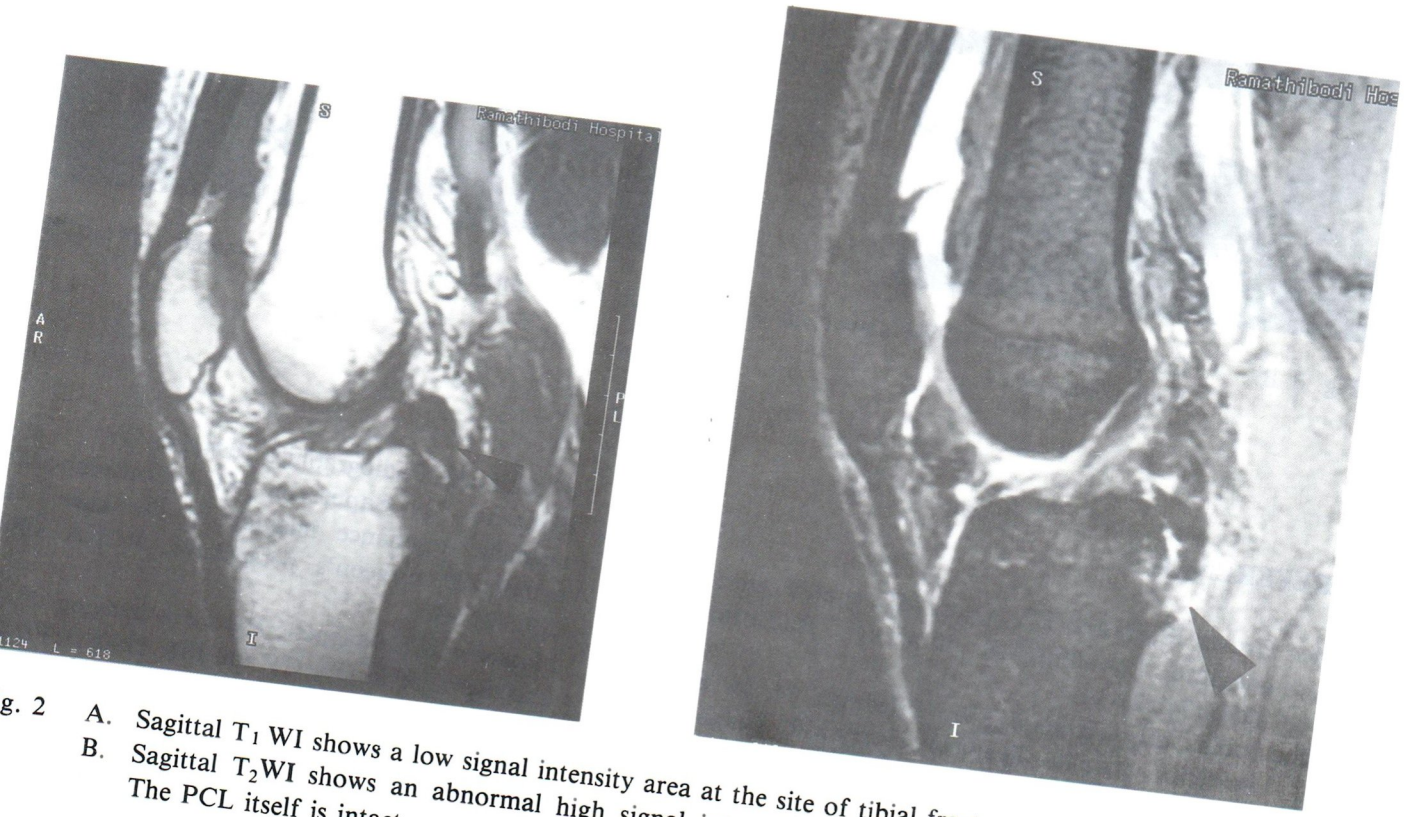
Fig. 1 Lateral radiograph of left knee shows an avulsion fracture (arrow head) at the site of posterior cruciate ligament (PCL) insertion.



g. 2 A. Sagittal T_1 WI shows a low signal intensity area at the site of tibial fracture and the separated PCL.
B. Sagittal T_2WI shows an abnormal high signal intensity between the tibia and avulsed fragment. The PCL itself is intact.

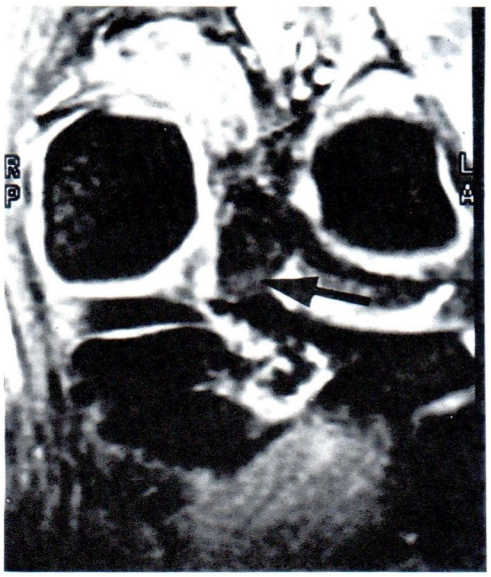
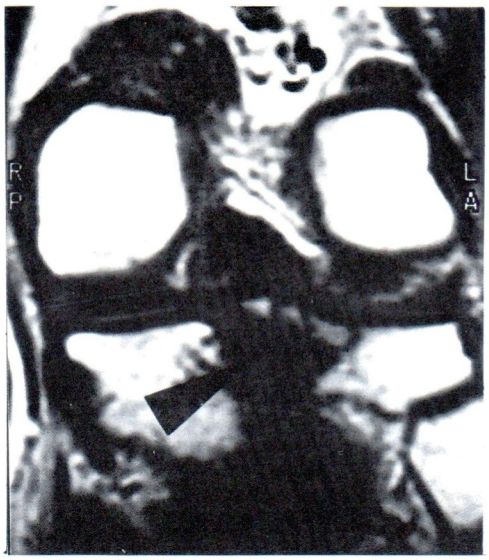


Fig. 3 A. Coronal T_1WI through the posterior knee demonstrates the separated fragment attached to the PCL.



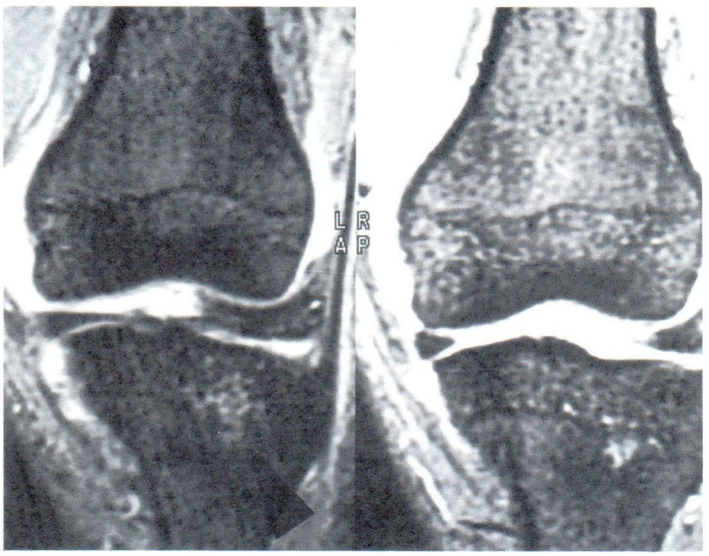


Fig. 3 B. Coronal gradient T_2 WI shows an area of high signal intensity in the tibial plateau representing bone contusion.

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