MAGNETIC RESONANCE IMAGING OF ANTERIOR CRUCIATE LIGAMENT RUPTURE

A NEW DIAGNOSTIC SIGN

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The finding, on magnetic resonance imaging, of a 'sigmoid', or curled up, posterior cruciate ligament reliably indicates rupture of the anterior cruciate ligament.

Magnetic resonance imaging (MRI) has proved to be very reliable in evaluating the menisci and anterior cruciate ligament (ACL) (Polly et al 1988; Boeree et al 1991; Fischer et al 1991). In a few cases, however, the appearance of the ACL may be equivocal. Previously, we have observed that when the ACL is ruptured the posterior cruciate ligament (PCL) may appear to be curled up or 'sigmoid' (Boeree et al 1991). We have evaluated this finding as a diagnostic sign.

MATERIAL AND METHODS

We compared two groups of patients; a study group (25 patients) in which MRI had indicated and arthroscopy confirmed rupture of the ACL, and a control group (25), matched for age and sex, in which the same investigations had shown the ACL to be entirely normal.

We used a Picker 0.5 Tesla MRI body scanner with a surface coil placed around the relaxed, slightly flexed and internally rotated knee. For each patient the image which best demonstrated the PCL was identified and isolated and then examined independently and randomly by two observers (NRB and CEA) in a blind fashion, the observer being unaware of the status of the ACL.

We defined the PCL as normal if its posterosuperior border was either straight or convex throughout its entire length (Fig. 1), and as 'sigmoid' if any of it was concave (Fig. 2). Statistical analysis was by the chi-square test. The sensitivity, specificity and accuracy were determined in the usual manner.

Table I. Observer comparison of the appearance of the posterior cruciate ligament (PCL) in knees with a ruptured anterior cruciate ligament (ACL) (study group) and knees in which the anterior cruciate ligament was normal (control group)

<table>
<thead>
<tr>
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<th>PCL</th>
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<tbody>
<tr>
<td>Observer</td>
<td>Normal</td>
</tr>
<tr>
<td>Study group</td>
<td>NRB 3</td>
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<tr>
<td></td>
<td>CEA 2</td>
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<tr>
<td>Control group</td>
<td>NRB 22</td>
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<td>CEA 24</td>
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RESULTS

The results for both observers are given in Table I. There was a highly significant association between a ruptured ACL and a sigmoid-shaped PCL (p < 0.0001). As a diagnostic sign this finding had a sensitivity of 88% to 92%, a specificity of 88% to 96% and an accuracy of 88% to 94%. There was complete agreement between observers in 94% of cases.

DISCUSSION

The accuracy of MRI in assessing the ACL has been variously quoted to be between 78% and 93% (Polly et al 1988; Boeree et al 1991; Fischer et al 1991). In most cases the integrity or otherwise of the ligament can be established without difficulty. The intact ACL characteristically has two or three dark bands which run longitudinally. It is presumed to be ruptured if it is not visualised or appears as a diffuse, amorphous area of high signal (Turner et al 1985). Sometimes, however, characterisation may be difficult. There may be a suggestion of a band on one image but, because it is not seen clearly, the diagnosis remains uncertain. This problem of image definition of the ACL probably arises because of partial
MRI of four knees with normal anterior cruciate ligaments. They all show a normal posterosuperior border of the posterior cruciate ligament, which is either straight or convex throughout its length.

Four examples of sigmoid-shaped posterior cruciate ligament images in knees with ruptured anterior cruciate ligaments.
voluming. By contrast, imaging of the PCL is usually excellent.

Deficiency of the ACL may be seen clinically in the Lachman test in which the tibia is made to sublux forward in relation to the femur. The curling up of the PCL, seen on MRI, is probably due to the same mechanism. With the knee slightly flexed and resting on a pillow the femur drops back slightly in relation to the tibia, resulting in some redundancy in the length of the PCL. It should be emphasised that the demonstration of this sign depends upon the knee being relaxed and slightly flexed. As with Lachman's test, full extension stabilises the knee and if imaging is undertaken in this position the appearance of the PCL will cease to be an aid to diagnosis.

The accuracy of this sign compares favourably with conventional assessment from the MRI of the ACL itself. As additional supportive evidence, particularly in doubtful cases, the MRI appearance of the posterior cruciate ligament should permit an assessment of the ACL to be made with an improved and high level of accuracy.

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

REFERENCES


