Arthroscopy and MRI of the knee in evaluation of meniscal and cruciate ligaments lesions

During the period between March 1998 and April 2000, 125 knees for 123 patients suspected to have meniscus or cruciate ligaments injury were studied by MRI followed by arthroscopy, all included in this study. All the patients had no history of previous surgery in the same knee; there were 94 males (76.4 per cent) and 29 females (23.6 per cent), and the mean age of the patients was 34 ± 10.6 years, range (19-56). The MRI findings were studied and compared with the arthroscopic findings, using 5 parameters accuracy, sensitivity, specificity, positive and negative predictive values. The over-all results of MRI in our series were accuracy rate 90 per cent, sensitivity 83.3 per cent, specificity 92.7 per cent, positive predictive value 82 per cent and negative predictive value 94 per cent. We think that MRI is a considerable advance and may well preserve patients from unnecessary operations; Arthroscopy for diagnostic purposes should be used only with a specific purpose. Modern MRI can and should replace "having a look". (End of abstract)

Introduction

In its early days arthroscopy was used mainly for diagnosis; it saved many knees from unnecessary arthrotomy. Today, MRI is available to save knees from unnecessary arthroscopy; internal derangements can then be treated by arthroscopic surgery. Arthrotomy for internal derangement is now obsolete and the debate has moved on to the relative roles of arthroscopy and MRI in the management of knee disorders. MRI is non-invasive, free from known morbidity and is safer and less expensive than arthroscopy. The sensitivity of MRI for meniscal lesions may exceed 90% (Dixon 1996) and the accuracy is about 88% to 90% (MacKenzie et al 1996). The question is should all knees be examined by MRI before arthroscopic surgery? Symptomatic meniscal lesions demonstrated by MRI would still need arthroscopic surgery and it can be argued that the MRI was unnecessary. Magnetic resonance imaging can show osseous and soft-tissue structures without the use of ionising radiation, and it is not invasive, several authors have reported on the usefulness of magnetic resonance imaging of the knee (Dandy 1997 & Boeree et al, 1991). Wojtys et al. 1987 used specimens from cadavers to evaluate the sensitivity of magnetic resonance imaging in the detection of iatrogenic defects of the articular surface. They consistently identified lesions that were as small as three millimetres in diameter. In the early studies of accuracy of MRI Stoller et al. 1987 examined the menisci of knees of cadaver with magnetic resonance imaging and subsequent histological analysis and they demonstrated a correlation between the degree of meniscal degeneration or tearing and three different grades of signal on magnetic resonance images. Other authors have compared the findings on magnetic resonance images with those of diagnostic arthroscopy (De Smet et al 1993, Fischer et al 1991). In series ranging in size from twenty-eight to eighty-six knees, the accuracy of meniscal imaging ranged from 45 to 98 per cent and that of imaging of the cruciate ligaments, from 90 to 100 per cent (Mandelbaum et al 1987). Kocher 1997 examined the diagnostic performance of the MRI in detecting intraarticular knee disorders in children compared with arthroscopy and he found that the overall sensitivity was 72% and specificity 93.5%. Our study was prompted to compare the results of arthroscopic findings with the MRI findings, and to detect the accuracy, sensitivity, specificity, negative and positive predictive values of MRI for di-
agnosis of meniscal and cruciate ligaments at our hospital (Saudi German Hospital) and to compare our results with the published results in the literatures.

**Patients and methods:**

125 knees (for 123 patients) suspected to have meniscus or cruciate ligaments injury were studied by MRI followed by arthroscopy, during the period between March 1998 and April 2000, at Saudi German Hospital, Jeddah. All the patients had no history of previous surgery in the same knee. There were 94 males (76.4%), 29 females (23.6%), and the mean age of the patients was 34 ± 10.6 years (range between 19 and 56 years), the left knee was affected in 56 patients (44.8%) while the right knee was affected in 69 patients (55.2%).

**Imaging planes and pulse sequences:** all the patients were examined by 0.35 Tesla (Toshiba Opart) MR system. The leg was positioned feet first, supine in the isocenter of the magnetic field with maximum extension and about 10 degrees of external rotation with the use of positioning sponges to stabilize the examined knee. T1-weighted spin-echo images were obtained in the axial and coronal planes. Proton density (long TR, short TE) and T2-weighted images were obtained in the Sagittal plane. The entire knee joint were covered with maximum number of slices, a 16 cm field of view is sufficient to cover the knee area. A slice thickness of 5 mm with 1 mm interslice gaps were used. Knee surface coil were used, the circumferential coil helps to minimize popliteal artery pulsation artefacts.

Plain radiographs of the knee were made, to exclude any bone pathology before MRI. No attempts were made to evaluate the diagnostic accuracy of the magnetic resonance studies in patients who had a chondral disorder. We used the classification of Beltran 1992 for meniscal tears, type I: a round area of high signal intensity within the substances of the meniscus not communicating with the articular margin. Type II: A linear area of high signal intensity within the meniscus not communicating with the articular margin. Type III: A linear area of high signal intensity within the meniscus extending to the superior or inferior articular surfaces of the meniscus. Type IV: a gross distortion of the signal intensity or shape of the meniscus, which may or may not show fragmentation. As opposed to degenerative type I and type II lesions, type III and IV lesions represent frank acute or chronic traumatic meniscal tears (Beltran 1992). A cruciate ligament was considered to be intact if a homogeneous low-intensity signal spanned the intercondylar notch from the origin to the insertion of the ligament. Acute cruciate ligaments inter-substance tears were diagnosed if there were discontinuity of the ligament usually below the femoral attachment for the anterior cruciate and from the tibial attachment for the posterior cruciate, a weavy or irregular anterior margin of the ligament, high signal intensity change within the substance of the ligament on T2-weighted images, and a mass of haemorrhage and oedema was seen in ligament region. Partial and chronic tears were diagnosed in the presence of taut fibres in a ligament that otherwise poorly defined and with increased signal intensity.

Arthroscopy was carried out under either general or spinal (epidural) anaesthesia. The type of anaesthesia that was used was based on the age of the patient and on the preference of the patient and the anaesthesiologist. Anterolateral and anteromedial portals were used to introduce a 30-degree rod-lens arthroscope and a probe. The arthroscopic findings were recorded on videotape. At arthroscopy, a meniscus was considered to be torn if any pattern of cleavage (complex, horizontal, flap, plateau, vertical, or radial) produced a mechanical abnormality within the meniscus such that a portion of the meniscus could be displaced from its normal position in the joint by flexion or extension of the knee or by probing during arthroscopy. A cruciate ligament was considered to be torn if it was completely disrupted at one of its attachments to bone or in its substance, or if laxity (from an internal tear) could be demonstrated with a probe while the ligament was under stress from an appropriate anterior or posterior drawer manoeuvre. For each structure, the diagnosis that was made on the basis of magnetic resonance imaging was assigned to one of four categories. An image was true positive when it indicated a torn structure and this diagnosis were confirmed at arthroscopy. It was true negative when it indicated no tear and this diagnosis were confirmed at arthroscopy.
An image was false positive when it indicated a torn structure and arthroscopy revealed no tear, and it was false negative when it indicated no tear but arthroscopy revealed a torn structure. The standard terms that are used in this report are as follows. Accuracy indicates the number of true-positive tests and the number of true-negative tests divided by the total number; sensitivity, the number of true-positive tests divided by the total number of true-positive and false-negative tests; and specificity, the number of true-negative tests divided by the total number of true-negative and false-positive tests. The negative predictive value is equal to the number of true-negative tests divided by the total number of true-negative and false-negative tests. The positive predictive value is equal to the number of true-positive tests divided by the total number of true-positive and false-positive tests.

Five parameters were calculated: (1) accuracy, the percentage of patients for whom the diagnosis based on magnetic resonance imaging was correct, (2) sensitivity, the percentage of patients in whom an arthroscopically confirmed tear had been preoperatively diagnosed on the basis of magnetic resonance imaging, (3) specificity, the percentage of patients who had no tear at arthroscopy who had been found to have no tear on the basis of magnetic resonance imaging, (4) negative predictive value, the percentage of patients who were diagnosed as having no tear on the basis of magnetic resonance imaging and were subsequently found to have no tear at arthroscopy, and (5) positive predictive value, the percentage of patients who were diagnosed as having a tear on the basis of magnetic resonance imaging and were subsequently seen to have a tear at arthroscopy.

**Results**

The magnetic resonance studies that were validated by arthroscopy gave a diagnostic accuracy of 86.4 per cent for medial meniscus lesions, 77 medial meniscus lesions and 48 intact medial meniscus were found by imaging studies, arthroscopy confirms 64 true-positive tests, 44 true-negative tests, and 4 instances in which a meniscal lesion that had been seen at arthroscopy was not detected by MRI. In the remaining 13 instances, the imaging studies suggested that the meniscus was torn, whereas the arthroscopic evaluation revealed an intact meniscus. The imaging studies demonstrated a diagnostic sensitivity for the medial meniscus 94 per cent and a corresponding specificity of 77 per cent, positive predictive value 83 per cent and negative predictive value 91.6 per cent.

For the lateral meniscus there was 27 Meniscal lesions diagnosed by MRI, and 98 normal meniscus and after arthroscopy there was 22 true positive lesions and there was 6 false negative so the accuracy for imaging of the lateral meniscus 91 per cent and specificity of 94.6 per cent and the sensitivity was only 78 per cent, positive predictive value 81.4 per cent and negative predictive value 93.8 per cent. Imaging of the anterior cruciate ligament reveals 40 cases with tear in ACL whether complete or partial tear and 85 intact ACL, after arthroscopy the number of true positive was 32 only while the number of true negative results was 74, so the accuracy of MRI for ACL was 84.8 per cent, sensitivity 74 per cent and specificity 90 per cent, positive predictive value 80 per cent and negative predictive value 87 per cent.

For the posterior cruciate ligament there was two positive cases that were approved by arthroscopy with accuracy 100 percent and as there was no false positive or false negative results sensitivity and specificity cannot be detected. The accuracy of MRI for detecting meniscal tear was 88.8 per cent, sensitivity 89 per cent and specificity 88.3 per cent, positive predictive value 82.6 per cent and negative predictive value 93 per cent, while the accuracy of detecting cruciate ligaments tear was 92 per cent, sensitivity 75 per cent and specificity 96 per cent, positive predictive value 81 per cent and negative predictive value 94.7 per cent. The total accuracy of MRI in detecting meniscal or cruciate ligaments tear was 90 per cent, total sensitivity 83.3 per cent and the total specificity 92.6 per cent, the positive predictive value was 82 per cent and the negative predictive value was 94 per cent. (Table 1 and 2).