Advances in imaging, arthroscopy, and complications of soft tissue injuries of the knee

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The uses and limitations of magnetic resonance imaging in the knee continue to be defined. Recent research has compared the accuracy of magnetic resonance imaging with that of arthroscopy. Variability still exists in diagnostic accuracy among different magnetic resonance imaging centers, and the value of magnetic resonance imaging after meniscal surgery remains in question. With continued advances in operative arthroscopy, reports of new complications arise, including thermal burns, synovial fistulas, and chemically induced synovitis. Current articles concerning the safety and efficacy of local anesthetics and analgesics in arthroscopy are also presented. Additionally, recent advances in meniscal repair, repair-augmenting techniques, meniscal regeneration, and meniscal transplantation are discussed.

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Magnetic resonance imaging

Continuing advances in hardware and software technologies have expanded the use of magnetic resonance (MR) imaging at the knee. Numerous reports have appeared in the literature comparing the accuracy of MR imaging with that of arthroscopy. Heron and Calvert [1] employed three-dimensional gradient-echo techniques and achieved 97% sensitivity in the diagnosis of meniscal tears (Fig. 1). While most agree that MR imaging is an effective diagnostic tool, controversy exists with regard to the interpretation of the "negative scan."

Fischer *et al.* [2•] reviewed 1014 patients undergoing MR imaging, and subsequently arthroscopy, at a variety of centers. Diagnostic accuracy varied widely, with a range of 65% to 95% in the detection of medial meniscal lesions, 83% to 94% of lateral meniscal lesions, and 78% to 97% of anterior cruciate ligament (ACL) lesions. Despite the variability, centers with the larger 1.5-T field strength magnets had higher accuracy. Finally, of patients with grade II intrameniscal signals (219 patients), 17% were found to have clinically significant tears requiring treatment. Raunest *et al.* [3••] used a prospective blinded clinical trial of 50 patients and produced a clinical accuracy of 72%. They felt that MR imaging allowed high probability of identifying medial meniscal tears but the value of the negative MR image remains in question.

In contrast, Quinn and Brown [4••] felt that patients with negative MR imaging did not benefit from arthroscopy. They prospectively examined 254 patients undergoing MR imaging and arthroscopy. Approximately 13% of these patients had false-negative scans, the majority of which were small stable tears not requiring treatment. Weiss *et al.* [5] previously reported the lack of progressive changes in stable meniscal tears. Only 12% required later treatment and no degenerative articular lesions were seen in association with the stable meniscal tear. Ruwe *et al.* [6•] followed up on 103 patients in which MR imaging was used in the diagnosis of knee pain for which diagnostic arthroscopy was considered. Based on the MR imaging diagnosis, 59 of 103 avoided diagnostic arthroscopy. At 2-year follow-up, 89% of conservatively treated patients had successful outcomes.

Dillon *et al.* [7••] specifically examined 27 cases with grade II intrameniscal signals and immediate arthroscopy. No meniscal tears were seen at surgery although three of 27 patients showed some degenerative change. MR imaging was repeated at an average follow-up of 27 months and 30% of menisci healed completely or showed decreased signal (Fig. 2). No patients converted to grade III signals.

Whether MR imaging can predict which patients are predisposed to meniscal degeneration and tears re-

Abbreviations

ACL—anterior cruciate ligament; **MR**—magnetic resonance.

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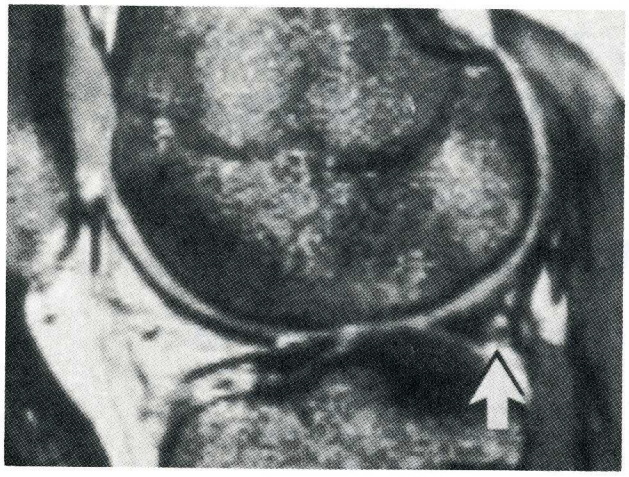

Fig. 1. Three-dimensional gradient-recalled echo (repetition time, 40 ms; echo time, 14 ms; flip angle, 40°) sagittal magnetic resonance (MR) image of the knee (externally rotated approximately 20°) obtained in a man aged 36 years. The patient had a twisting sports injury and was complaining of persistent pain and swelling. He had a tear, diagnosed with arthroscopy, at the meniscocapsular junction (*arrow*). At initial examination with MR imaging, this tear was believed to be fluid in the meniscal recess. The MR images also showed low signal intensity in the anterior subcortical region of the femoral condyle. These appearances are believed to be due to bone bruising. (From Heron and Calvert [1]; with permission.)

mains under investigation. Negendank *et al.* [8••] examined the MR images of asymptomatic knees in patients with documented tears in the opposite knee. Compared with age-matched controls, these patients showed higher levels of meniscal degeneration in the asymptomatic knee. All patients showed age-dependent degeneration.

Limitations to the use of MR imaging occur in patients with previous meniscal surgery. Both Raunest *et al.* [3••] and Quinn and Brown [4••] reported previous meniscectomy as a cause of false-positive MR images. Kent *et al.* [9•] followed up on 17 patients undergoing meniscal repair for up to 1 year. All patients showed persistent meniscal defects despite successful clinical outcomes. Bronstein *et al.* [10•] reported the follow-up of 15 asymptomatic patients 6 to 12 months after meniscal repair. The authors thought that MR imaging was not helpful in follow-up after 53% showed persistence of grade III meniscal signals.

Arthroscopic techniques and complications

A recent study questioned the effects of arthroscopic irrigation fluids. Using cadaveric menisci, Mah *et al.* [11••] found that demineralized water and glycine produced significant swelling and lysis of meniscal fibroblasts. Normal saline-soaked menisci were found to soften and lose ground substance, which caused alterations in the collagen fiber arrangement under electron microscopy. These effects were diminished but not eliminated when the temperature of the saline was raised from 25°C to 37°C.

Reports of complications resulting from arthroscopic knee surgery ranged from 0.6% to 8.2%. High-risk factors included patients over 50 years of age and tourniquet use for periods greater than 1 hour [12]. Coupens and Yates [13] found that suction drainage and avoidance of tourniquet use reduced postoperative hemarthrosis and allowed earlier return of active knee motion. Proffer *et al.* [14••] reported a synovial fistula rate of 0.6% in 976 knee arthroscopies. They recommended surgical excision if drainage persisted beyond 2 weeks of immobilization.

Despite technical advances, new complications arise with the development of new techniques. Lord *et al.* [15] reported three cases of thermal skin necrosis with the use of electrocautery in lateral retinacular release. Friden and Rydholm [16••] reported an unusual case of a severe aseptic synovitis due to the use of bioabsorbable fixation pins. A 24-year-old man underwent fixation of an osteochondritic defect using a bioabsorbable pin made of polyglycolic acid. Uneventful healing occurred and 4 years later the patient developed pain in the contralateral knee. Again, osteochondritis dissecans was diagnosed and arthroscopic fixation with bioabsorbable pins was performed. Severe

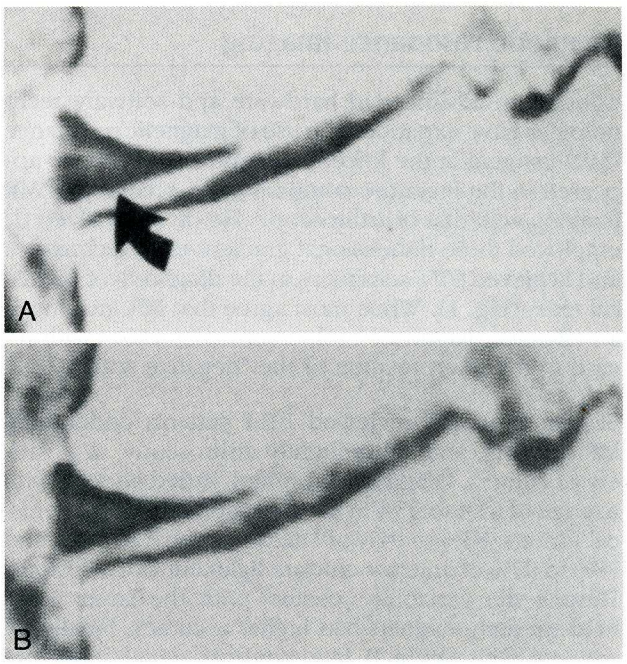

Fig. 2. Coronal view of the lateral meniscus in a patient aged 24 years. **A,** The initial magnetic resonance image shows a grade 2 lesion in the body of the lateral meniscus (*arrow*). **B,** After a 1-year follow-up, the image obtained shows a decrease in the grade 2 abnormality. The imaging parameters were as follows: repetition time, 800 ms; echo time, 20 ms; matrix, 256 x 256; section thickness, 3 mm; no spacing. (From Dillon *et al.* [7••]; with permission.)