

The Painful Knee: Arthroscopy or MR Imaging?

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Abstract

While neither arthroscopy nor magnetic resonance (MR) imaging is perfect, both can delineate pathologic changes in the knee with reasonable accuracy. The greatest advantage of MR imaging is that it is noninvasive and can be used to detect pathologic changes both inside and outside the synovial cavity. Arthroscopy has the distinct advantage of allowing definitive treatment at the time of diagnosis in most cases, but carries with it the potential risks associated with any invasive diagnostic technique. Both modalities are expensive, and their judicious use is therefore dictated, especially in this era of cost containment. The decision to use one or both studies is best made by the orthopaedic surgeon.

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Body imaging took a giant step forward with the development of magnetic resonance (MR) imaging. With regard to the painful knee, however, a diagnostic dilemma was created. The increased ability of MR imaging to demonstrate pathologic changes in the knee has prompted the question whether most symptomatic knees should undergo MR imaging before definitive treatment. The role of arthroscopy, considered the ultimate diagnostic test for the past two decades, has also been brought into focus. The purpose of this article is to review both modalities and to provide some perspective on their appropriate use in the painful knee. Several factors must be considered, such as the established accuracy, the ability to identify coexisting lesions, the economic aspects (which are becoming more important in this cost-conscious era of medicine), and other advantages and disadvantages of each modality.

Accuracy of Diagnosis

Arthroscopy

Arthroscopy of the knee provides the experienced examiner with three-dimensional visual and tactile information that is highly accurate. Early studies confirmed accuracy rates as high as 98%, with a complete diagnostic profile of the interior of the knee being achieved.¹ It is important to note, however, that such accuracy is directly related to the experience of the examiner. A poorly trained arthroscopist, using poor technique, can easily miss pathologic changes within a joint. In contrast, a competent arthroscopist will use angled lenses, probes, and the appropriate varus or valgus pressure to open compartments; will maintain a clear visual field with a good flow of irrigating solution; and will use distention to keep soft tissues from obscuring the underlying structures. The competent examiner will also be able to enter the posterior aspects of the joint

and quickly and easily move the scope from one portal to another, thereby better visualizing the intra-articular structures.

If these technical aspects are mastered by the arthroscopist, painful knee conditions can be diagnosed with great accuracy. Anterior and posterior cruciate ligament tears (complete or partial) can be identified, the depth and extent of damage to articular surfaces and menisci can be evaluated (Fig. 1), and synovial abnormalities and loose bodies can be identified. In addition, the dynamic tracking of the patella can be assessed, and lesions can be documented with either photographic or video techniques. Arthroscopy is therefore extremely helpful in facilitating treatment, by providing a full appreciation of the status of the intra-articular structures of the knee.

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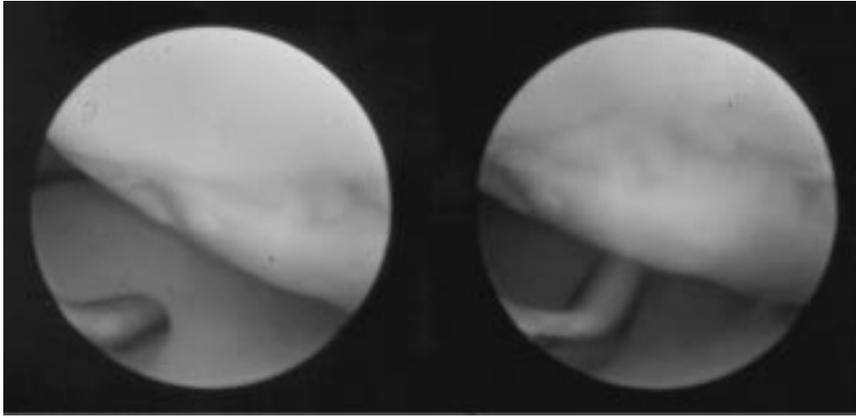


Fig. 1 Typical chondral lesion well shown by arthroscopy, but not well demonstrated by MR imaging.

MR Imaging

The MR examination and the interpretation of the data that it provides require specialized training and experience, which is the acknowledged role of the radiologist. The accuracy of MR imaging is steadily improving, as the technical quality of the equipment improves, and as radiologists become more adept at relating the abnormalities visualized to the pathologic conditions that are identified at open surgical or arthroscopic procedures.

Numerous studies²⁻⁷ have shown the diagnostic accuracy of MR imaging to be relatively good. Most of these studies have compared the accuracy of this modality with that of arthroscopy. In a recent large study involving several centers,⁸ the accuracy in depicting medial meniscal lesions was 64% to 95%; lateral meniscal problems, 83% to 94%; anterior cruciate ligament problems, 78% to 97%; and posterior cruciate ligament lesions, 99%. Other studies have shown slightly greater accuracy in depicting lesions of the lateral meniscus.³ Grade 3 lesions of the meniscus (Fig. 2), in which the defect in the meniscus clearly exits through a surface of the meniscus,

are most accurately diagnosed.² Grade 1 and grade 2 lesions, which are intrameniscal lesions that appear globular or linear, probably represent asymptomatic early degenerative changes, which will not be seen at arthroscopy.

An important study by Glashow et al⁹ confirmed a very high negative predictive value for MR imaging. This study demonstrated that if the MR findings are normal, there is



Fig. 2 Grade 3 lesion of posterior horn. In this instance the patient was only minimally symptomatic, and surgery was not carried out.

more than a 90% chance that significant pathologic changes will not be present within the joint. In instances in which there is a possibility of secondary gain, such as getting out of military duties or profiting from workmen's compensation,¹⁰ MR imaging might be the primary investigative tool because of its fairly high predictability, its noninvasive nature, and its ability to rule out or establish the presence of a lesion. An MR imaging study might also be of value in older individuals for whom the treating physician, whether a general practitioner or an orthopaedic surgeon, is reluctant to advise arthroscopy. In these situations, a negative MR study is often as important as a positive one.

Advantages of Both Modalities

Arthroscopy

Diagnostic Certitude

With arthroscopy, there is no guessing and no need for interpretation of images. The intra-articular structures are visualized, and any lesions can usually be seen. A complete knowledge of normal and variant anatomy is required, however, to appreciate a deranged or torn structure.

Therapeutic Capability

Treatment under arthroscopic control is possible in approximately 60% to 80% of all cases.¹¹ In cases in which treatment through the scope is not feasible (e.g., advanced degenerative arthritis), it is possible for the arthroscopist to assess the problem and proceed with an open operation to correct it at the same sitting.

Faster Recovery

Because there is no delay between definitive diagnosis and definitive

treatment and the operative morbidity is relatively minimal, arthroscopy allows an earlier return to normal activity.

MR Imaging

Noninvasive Diagnosis

One of the major advantages of MR imaging is that it is noninvasive. Therefore, the risk of complications, such as infection and breakage of instruments, is eliminated.

Low-Risk Procedure

The fact that no anesthesia is necessary is obviously an advantage over invasive procedures, and the lack of ionizing radiation is an inherent advantage over other radiologic studies.

Diagnostic Potential

Three-dimensional reconstructions can be done in various planes, which is helpful in establishing the exact type and extent of pathologic change. This is especially useful in assessing ligamentous and meniscal lesions (Fig. 3).

Perhaps the most significant advantage of MR imaging is the ability to identify subchondral bone le-

sions, such as osteonecrosis, non-displaced fractures, bone tumors, and other extra-articular soft-tissue lesions (e.g., partial ruptures of the collateral ligaments, popliteal cysts, meniscal cysts, popliteal tendinitis, and synovial ganglia). Such lesions, which are outside the synovial cavity or deep to an intact articular surface, cannot be seen at arthroscopy. Therefore, MR imaging can provide a more complete picture of the knee, including visualization of other lesions that might be present, which, even if they are not the cause of the primary presenting problem, should nevertheless be addressed at the time of definitive treatment.

Disadvantages of Both Modalities

Arthroscopy

Invasive Procedure

The main disadvantage of arthroscopy is the invasive nature of the technique, carrying with it the potential for complications due to infection, cartilage damage, and instrument breakage.¹¹

Need for Anesthesia

Arthroscopy requires the use of some form of local, general, or regional anesthetic.

Morbidity

Due to the invasive nature of arthroscopy, pain and depressed muscle function are present to some degree, and a short hospital stay and a period of wound healing are involved.

Potential for Overtreatment

The less skilled arthroscopist can damage articular cartilage surfaces by scratching or gouging and can create further bleeding and scarring by the unnecessary debridement of normal structures, such as the fat pad, for the limited purpose of improving visualization. Damage can also be done if asymptomatic structures, such as plicae, synovial fronds, and fibrillar articular cartilage, are removed.

MR Imaging

No Therapeutic Potential

A major disadvantage with MR imaging is that treatment is necessar-



Fig. 3 A, Complete disruption of anterior cruciate ligament. B, Typical "bone bruise" on anterior aspect of femoral condyle. C, Partial disruption of anterior cruciate ligament. Note presence of some intact fibers.

ily delayed after diagnosis. If a pathologic condition is encountered, the orthopaedic surgeon must then be contacted, so that arrangements can be made for appropriate treatment.

Technical Problems

Small loose bodies and chondral lesions are difficult to demonstrate. There are also instances in which what is interpreted as a lesion on MR imaging turns out to be an artifact or a finding of no clinical significance when one views it arthroscopically.¹²⁻¹⁴ False-positive findings are more frequent than false-negative ones.^{9,12,14} However, as stated earlier, MR imaging has a very high negative predictive value, and the treating surgeon will make few mistakes if he or she withholds surgical treatment in the presence of a negative examination.

Another technical drawback is that, to obtain an adequate study, the patient must lie still for a fairly lengthy period of time. If the patient moves, the examination is compromised.

Claustrophobia-inducing Potential

Many patients experience claustrophobia when positioned within the MR imaging gantry. Although the newer, "open" equipment does not require placement of the patient in a narrow chamber, the quality of the examination obtained with such equipment is generally compromised. If claustrophobia is a significant problem, arthroscopy should be the first and only diagnostic procedure.

Economic Aspects

The cost of an MR imaging study has been in the \$900 to \$1,000 range for several years. This amount covers a prorated portion of the original cost of the unit, overhead expenses, the salary of the technicians, and the radiologist's fee. Therefore, there is significant economic waste if this

study is performed unnecessarily. When properly used, however, MR imaging can decrease the necessity for the more expensive and invasive diagnostic arthroscopy.⁷

The cost of a diagnostic arthroscopic procedure is frequently more than twice that of an MR study, because the fee for the surgeon, the facility fee, and the fee for the anesthetist all have to be considered. It may well be that with office-based arthroscopy there could be a significant reduction in the cost of an arthroscopic diagnostic (and possibly therapeutic) procedure. If pathologic changes are encountered and the arthroscopist carries out a definitive surgical treatment under arthroscopic control, the cost of treatment would naturally be added to the bill. However, rapid diagnosis and treatment can be a cost-saving measure overall, as both a second consultation and a delay in definitive management are avoided.

It has been observed that there are wide geographic variations in the utilization of surgical procedures in the United States. Although there is no single cause for these variations, economic incentives are thought to play a role. Insurers currently compensate well for relatively simple arthroscopic procedures, such as resection of plica, shaving of the patella, and trimming of menisci, and rarely dispute the diagnosis. It should be anticipated that new systems of health-care financing will focus on reducing these variations in utilization and their attendant costs. Therefore, arthroscopic procedures, particularly those of debatable efficacy, can be expected to come under closer scrutiny.

If an MR imaging study is ordered by the primary-care physician and the findings lead to arthroscopic surgery, the total cost of treating the patient is significantly increased. However, if ordering the MR study is generally the prerogative of the treating orthopaedic surgeon, a con-

siderable saving, in terms of both financial expense and time to recovery, can be realized (Fig. 4).

Importance of Clinical Evaluation

The least expensive, most reliable, and most informative means of diagnosis of knee pain remains the history and physical examination. It is well recognized that many types of pathologic changes can cause swelling and pain and can produce the mechanical symptoms of giving way or locking. Nevertheless, one would expect that the provisional diagnosis of an experienced clinician or arthroscopist would be accurate in the vast majority of cases. In the event of uncertainty, the decision could then be made to proceed with arthroscopy (based on factors such as the severity and duration of the problem and the likelihood that the problem would be amenable to surgery) or to obtain further information through MR imaging.

It is my belief that the surgeon with the greatest clinical experience is less likely to need MR imaging to establish a diagnosis. It is also becoming apparent that many unnecessary MR studies are ordered by general practitioners and internists who are confronted by a patient who presents with a clinical history with which they are not familiar. Only the experience of having examined many joints allows one to determine whether there is a subtle physical abnormality that can be a clue to the presence of a pathologic condition.

As mentioned previously, the clinical picture as evidenced by the history and physical examination should lead to a correct diagnosis in most instances. For example, traumatic hemarthrosis after a significant injury is associated with a torn anterior cruciate ligament in

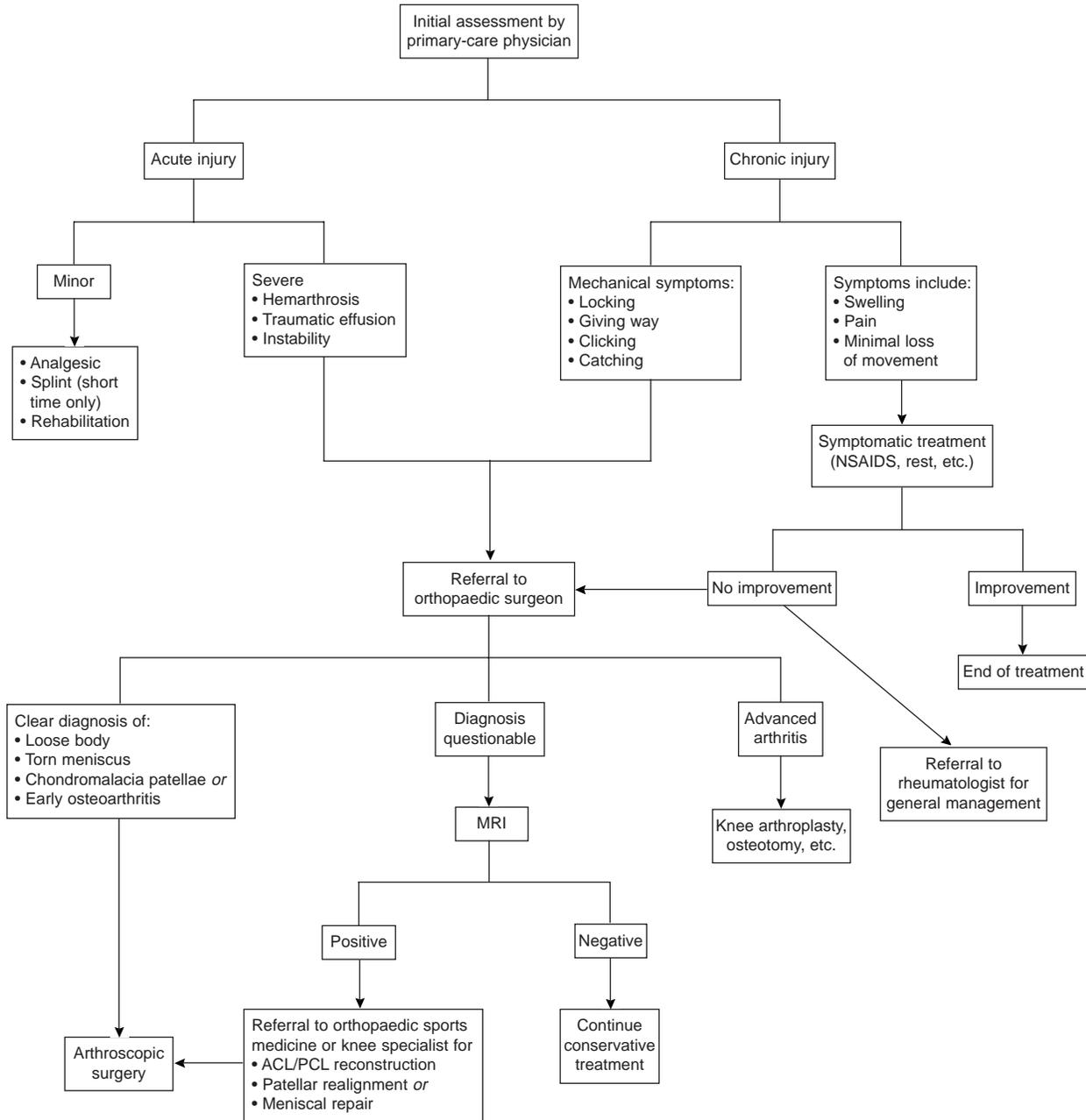


Fig. 4 Algorithm for the diagnosis and treatment of knee pain. ACL = anterior cruciate ligament; MRI = magnetic resonance imaging; PCL = posterior cruciate ligament.

more than 70% of cases. Other lesions that can produce bleeding include a peripheral tear of the meniscus, an osteochondral fracture, or a significant collateral ligament tear, with capsular and synovial rupturing. Therefore,

when hemarthrosis occurs after a significant injury, there is a strong possibility of a surgically amenable lesion. If the knee becomes swollen overnight or after several hours, however, it is usually a sign of traumatic effusion or an inflamma-

tory reaction to the injury, rather than hemarthrosis. This often means that damage has been done to a relatively avascular structure, such as a meniscus or the articular cartilage. The presence of mechanical symptoms (e.g., giving way or

blocking of movement) suggests a torn meniscal fragment or some other mechanical problem that causes instability and impaired range of motion. Again, such a clinical picture would strongly suggest that surgical treatment is appropriate. Swelling, of course, can be caused by any pathologic condition, but it usually is due to irritation of the synovium from trauma, bleeding, or the shedding of articular cartilage fragments into the joint.

The experienced clinician, armed with plain radiographs (to rule out tumors, occult fractures, etc.) and a careful history and physical examination, can make the diagnosis in the vast majority of cases and can then proceed directly to definitive treatment, either operative or nonoperative. In only a small percentage of cases are additional diagnostic tests, such as MR imaging, needed, either to confirm a diagnosis (if it is slightly doubtful) or to gain information regarding other pathologic conditions that might be present in the knee.

Accurate interpretation of the MR imaging study may also be a problem as the radiologist rarely, if ever, sees the lesion in situ. In the ideal hospital situation, the radiologist is in close communication with his surgical colleagues, so that the abnormal appearance on MR imaging can be confirmed by reviewing video or still photographs, and his expertise in the interpretation of the two-dimensional images can be augmented.

Recommended Approach

An algorithm illustrating my recommended approach to the painful knee is shown in Figure 4. I believe that if a painful knee is originally seen by a general practitioner or internist, a good history and plain radiographs should be obtained, and a thorough physical examination should be performed. If recent trauma has occurred and the primary care physician can identify mechanical symptoms, such as locking or giving way, or if the painful swelling is likely due to a traumatic hemarthrosis, the patient should be quickly referred to an orthopaedic surgeon. If there are no specific symptoms or signs and the radiographs are negative, the knee should be treated symptomatically with the expectation that the condition will resolve. If the knee continues to be symptomatic, however, the primary care doctor should then proceed to the next step in the algorithm, which is referral to an orthopaedic surgeon or rheumatologist. I believe that the general practitioner or internist should not order an MR study before referral. This should be the prerogative of the specialist.

The orthopaedic surgeon can then decide whether MR imaging is necessary or whether arthroscopy and arthroscopic surgery should be carried out as soon as possible. If there are mechanical symptoms, arthroscopic evaluation is the logical choice, as treatment methods can be initiated at the same time. If the patient's pain is not associated

with any significant physical findings and the diagnosis is therefore questionable, MR imaging would be of value. Again, the orthopaedic surgeon should be the one who makes this decision. Special situations, such as the treatment of an elite athlete, may dictate that an MR study should be obtained regardless of the clinical evidence before any surgical intervention is carried out.

In the patient with a chronic knee problem, the general practitioner should refer the patient to an orthopaedic surgeon if mechanical symptoms are present or if poorly defined symptoms are of sufficient severity or duration or have been unresponsive to routine conservative treatment. The orthopaedic surgeon should usually be the one to decide whether definitive treatment would be facilitated by having an MR study.

Summary

The judicious combination of clinical skills and plain radiography should provide the orthopaedic surgeon with sufficient information to treat most knee problems. In certain instances, MR imaging will add to the accuracy of the diagnosis and will facilitate decision making regarding treatment. In my opinion, the ordering of MR imaging should be the prerogative of the treating surgeon and should not be used routinely as a diagnostic screening test.

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