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Rapid review

Diagnostic arthroscopy for conditions of the knee

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The Royal Australasian College of Surgeons

Diagnostic arthroscopy for conditions of the knee

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ASERNIP-S
PO Box 553,
Stepney, SA 5069
AUSTRALIA
Ph: 61-8-8363 7513
Fax: 61-8-8362 2077
E-Mail: asernips@surgeons.org
http://www.surgeons.org/asernip-s

The rapid review of Diagnostic arthroscopy for conditions of the knee

was ratified by:

The ASERNIP-S Advisory Committee in

August 2008

and

The Executive of the Council of the Royal Australasian College of Surgeons in

May 2009

ASERNIP-S rapid review

Disclaimer

This is a rapid systematic review in which the methodology has been limited in one or more areas to shorten the timeline for its completion. Thus, modifications have been made in at least one of the following areas: search strategy, inclusion criteria, assessment of study quality and data analysis. It is considered that these amendments would not significantly alter the overall findings of the rapid review when compared to a full systematic review.

The methodology used for the rapid review is described in detail, including the limits made for this particular topic. These limitations have been made possible mainly by restricting the specific clinical questions asked. These limits were applied following the requirements of the specific review topic, together with clinical guidance from a protocol surgeon.

Therefore, this rapid review is a limited evidence-based assessment that is based on a simple systematic search of studies published in the peer reviewed literature. As a result, this rapid review may be used to inform certain questions on the specific review topic.

Executive summary

Aim and scope

This rapid review aimed to assess the accuracy and safety of arthroscopy for diagnosing knee conditions, in comparison with magnetic resonance imaging and ultrasound, through a rapid systematic review of the literature. Included for review were systematic reviews of primary studies and primary studies with an independent, blinded comparison of the index and reference test among consecutive or non-consecutive patients. Diagnostic performance outcomes examined included specificity, sensitivity, likelihood ratios and predictive values. Safety outcomes examined included pain, patholaxity, complications related to anaesthesia, haemarthrosis, infection, deep vein thrombosis and knee stiffness.

Methods

Studies were identified by searching BMJ Clinical Evidence, the York (UK) Centre for Reviews and Dissemination (CRD), the Cochrane Library, PubMed and EMBASE from January 1977 to March 2008. Extended searching of internet websites and conference abstracts, handsearching of journals, contacting authors for unpublished data or pearling references from retrieved articles was not undertaken. Literature considered eligible for critical appraisal and inclusion was restricted to English language publications. Data from the included studies was extracted by an ASERNIP-S researcher using standardised extraction tables developed a priori and checked by a second researcher.

Key results and conclusions

From the search strategy, 1140 potentially relevant articles were identified of which 21 articles were retrieved. Two systematic reviews, both published in 2007, were eligible for inclusion. Both of the included reviews compared the results of MRI to that of the reference standard arthroscopy. One review focused on the diagnosis of meniscal lesions and ACL tears, while the other study focused primarily on meniscal tears. Conclusions based on the two included reviews are summarised below.

1. For meniscal lesions and ACL tears, MRI is an effective diagnostic tool when compared to diagnostic arthroscopy. In particular, MRI has a high specificity and negative predictive value, suggesting that screening MRI studies can effectively rule out the presence of meniscal lesions and ACL tears and reduce the number of unnecessary diagnostic arthroscopies performed. MRI is useful in situations where the results of a clinical examination are uncertain, and it is the most appropriate diagnostic screening tool to use before therapeutic arthroscopy.
2. Arthroscopy should be reserved for patients with a lesion that is treatable by arthroscopic methods.
3. Safety outcomes were not reported in any of the included systematic reviews or in the primary studies included in these reviews, thus it was not possible to assess the safety

of arthroscopy for diagnosing knee conditions in comparison with other diagnostic procedures. As with all surgical procedures, diagnostic arthroscopy may be associated with certain adverse events, including anaesthetic complications. Therefore, where reliable and accurate diagnosis of knee pathologies can be achieved using non-invasive procedures, diagnostic arthroscopy should be avoided.

The ASERNIP-S review group

ASERNIP-S Surgical Director

Professor Guy Maddern
ASERNIP-S
Royal Australasian College of Surgeons
Stepney SA 5069

Protocol Surgeon

Mr Gordon Morrison
Orthopaedics SA
Kermode Street
North Adelaide SA 5006

ASERNIP-S Researcher

Mr Tim Lathlean
ASERNIP-S
Royal Australasian College of Surgeons
Stepney SA 5069

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Introduction

Objective

To assess the accuracy and safety of arthroscopy for diagnosing knee conditions, in comparison with magnetic resonance imaging and ultrasound, through a rapid systematic review of the literature.

Background

Conditions

There are a variety of knee conditions that require the use of diagnostic tools for their identification. Such conditions range from acute trauma injuries, including meniscal injuries, medial collateral, anterior and posterior cruciate ligament injuries and osteochondritis dissecans, to more chronic problems such as chondromalacia patellae, osteoarthritis and rheumatoid arthritis.

Meniscal injuries

A systematic review conducted by Howell and Handoll (1999) stated that the menisci of the knee are quite complex and serve a number of functions, including load transmission and bearing, provision of stability, assistance with circulation and storage of synovial fluid.

Meniscal injuries tend to occur predominantly in young, active individuals. Sudden changes in direction while running, forceful squatting, twisting of the knee or application of external forces to the knee (for example, rotation, varus, valgus or hyperextension) subjects the meniscus to tension, compression and shear. If such forces exceed the strength of the meniscus in any direction, tears result (Senter and Hame 2006).

Cruciate ligament injuries

The cruciate ligaments, particularly the anterior cruciate ligament (ACL), are among the most commonly injured structures of the knee (Benjaminse et al 2006). These structures provide important stability to the knee and help minimise stress across the knee joint. The anterior cruciate ligament restrains excessive forward movement of the tibia in relation to the femur and limits rotational movements of the knee. Ligament tears result from overstretching the anterior or posterior cruciate, or the medial collateral ligaments within the knee, and are usually due to a sudden stop and twisting motion of the knee or a force at different angles to the knee. Depending on the ligament injured, these tears may be partial or complete (Benjaminse et al 2006).

Osteochondritis dissecans

Osteochondritis dissecans (OCD) is a disorder in which a fragment of articular cartilage, together with avascular subchondral bone, becomes either partly or completely separated from a joint surface (Marlovits et al 2004). Along with trauma-related damage typically from sporting injuries, OCD is a major cause of damage to knee hyaline cartilage. Previous hyaline cartilage damage may predispose individuals to osteoarthritis, probably as a result of the limited capacity of hyaline cartilage to repair itself (Clar et al 2005). In instances of advanced cartilage degeneration or damage, knee replacement surgery may be required.

Chondromalacia patellae

Chondromalacia patellae ('runner's knee') is a condition which also tends to occur predominantly in the young, active population. It is characterised by abnormal softening of the cartilage along the undersurface of the patella, and is commonly caused by trauma, repeated stress and patellofemoral instability (Christian et al 2006).

Osteoarthritis and rheumatoid arthritis

Primary osteoarthritis is mostly associated with age-related cartilage degeneration. Loss of cartilage cushion causes friction between the bones, leading to pain and limited joint mobility (Stacy and Basu 2007). Secondary osteoarthritis is caused by another condition, such as obesity, repeated trauma or surgery to the joint structures, congenital abnormalities, gout, diabetes and other disorders (Stacy and Basu 2007).

Rheumatoid arthritis is the most common form of inflammatory arthritis and is characterised by joint swelling, pain, heat and destruction. It is caused by the immune system attacking the tissues lining the joints, which can lead to inflammation of connective tissue, blood vessels and organs (Australian Bureau of Statistics 2006). Similarly, joint inflammation and degeneration can also take place in the autoimmune disease systemic lupus erythematosus.

Clinical need and burden of disease

Arthritis and other musculoskeletal indications are not immediately life-threatening and have a low associated mortality rate. Nonetheless, they can substantially affect a patient's quality of life, with the resulting economic burden for the community accounting for 9.2% of allocated recurrent health system expenditure in the year 2000–2001 (Australian Bureau of Statistics 2006).

In 2001, around 2.6 million Australians (13.6% of the population) suffered from some form of arthritis (AIHW 2005). Prevalence rates increased significantly with age and tended to be greater in females than males from early adulthood onwards, with the highest rates occurring among people older than 64 years of age (AIHW 2005). An Australian study showed a large increase in total knee arthroplasty for osteoarthritis from 1988 to 1998 and an increase in osteoarthritis with age, with incidence highest in those late in their seventh decade (Wells et al 2002).

Diagnosing knee conditions

Initial screening usually involves a comprehensive patient history and preliminary physical examination. Physical tests for meniscal injuries include the McMurray test, the joint line tenderness test and the Apley compression test (Scholten et al 2007; Ryzewicz et al 2007). The three physical tests commonly used to assess ligamentous injuries are the anterior drawer test, the Lachman test and the pivot shift test. Various other tests are then used, including X-rays, magnetic resonance imaging (MRI), blood tests and arthroscopy, to determine the nature of the knee problem.

Traditionally, X-rays or radiographs were the most common method of evaluating knee injury (Cone 2003). X-rays are a relatively cheap, universally available method of delineating between soft-tissue planes and adjacent cortical bone (Sonin et al 2001). However, technological advances have provided a number of alternative diagnostic imaging modalities, including computed tomography (CT), diagnostic ultrasound, contrast arthrography and MRI. CT involves rotating an X-ray beam generator and detector, which are fixed relative to each other, around the patient to produce images of thin slices of tissue. Digital geometric processing is then used to construct a three-dimensional image from the multiple two-dimensional X-ray scans (Youngson 1999). CT can detect and distinguish the nature of a mass as small as 1 cm to 2 cm, regardless of whether it is muscle, fat, fluid or tumour (Sonin et al 2001).

Ultrasound is a relatively low cost and readily available option for detecting soft-tissue abnormalities. Limitations of ultrasound include the inverse relationship between image resolution and depth of penetration, and the fact that its accuracy is very operator dependent (Sonin et al 2001). Thus, ultrasound is better suited for identifying injuries of the ligaments around the knee rather than structures deep within the knee, such as the menisci.

MRI uses a radiofrequency coil or antenna which is placed over the body part to induce hydrogen nuclei within the patient's tissues to resonate. The weak radio signal produced when the atoms relax back into their pre-resonant state is detected by the radiofrequency coil and analysed by a computer to create a cross-sectional image of the body. MRI is relatively safe, requires no anaesthesia and is particularly good for visualising soft tissue, but not bone (Bureau et al 1995).

Knee arthrography is particularly useful in the search for patellae chondromalacia or meniscal tears and in the evaluation of the postoperative knee, and appears to be safe and accurate. Arthrography can use single-contrasts which are normally water-soluble, or double-contrasts in which a thin radiopaque coating is contrasted by air or gas-distended joint cavities (Bearcroft and Dixon 2001; Coumas and Palmer 1998). Magnetic resonance arthrography (MRA) involves injecting the contrast gadolinium into deeper structures of the knee. This can be direct or indirect and appears to be more accurate than MRI in detecting recurrent meniscal tears postoperatively (Fox 2007). MRA is more accurate in detecting meniscal tears due to the fact that gadolinium is able to achieve greater penetration of deep structures of the knee when compared to synovial fluid (Fox 2007).

Almost all of the above diagnostic imaging modalities have been found to have lower specificity and sensitivity than MRI for most knee issues (Bearcroft and Dixon 2001; G Morrison 2008, personal correspondence). Nonetheless, non-MRI methods are still valuable tools in contemporary diagnosis. Plain radiography is helpful in the initial screening examination, whereas diagnostic ultrasound is useful for detecting ligamentous injuries and tears and localising juxta-articular cysts for injection or aspiration. CT presents a useful option for delineating complex fracture fragments, while arthrography is highly sensitive and specific for identifying and characterising meniscal tears and chondromalacia patellae (Cone 2003). In addition to these non-MRI procedures, "MRI allows unparalleled accuracy in the initial diagnosis of athletic injuries to the knee and specific preoperative planning as well as a non-invasive means of postoperative follow-up" (Cone 2003). However, MRI is not without complications. Exposure to an MR scanner can be potentially fatal for patients with metal implants, such as pacemakers or aneurysm clips, or metal remnants in their body from previous injuries. The paediatric population may be difficult to diagnose without sedation and MRI would also be difficult to undertake in patients of substantial size or those who suffer from claustrophobia.

Accessibility is an issue when considering diagnostic procedures and MRI scanners are not as widespread or readily available as other diagnostic imaging techniques (G Morrison 2008, personal correspondence). The accuracy of MRI scans is also affected by operator factors, picture variation due to movement and variation in interpretation of the MRI images (G Morrison 2008, personal correspondence).

All of the techniques, except for MRA, have been superseded by MRI because of its high diagnostic accuracy. The literature suggests that MRA is useful in diagnosing issues deep within the knee (Fox 2007). However, according to expert opinion (J Reece 2008, personal correspondence), while MRA is quite useful in diagnosing conditions of the elbow and shoulder, it does not have any particular advantage over MRI for diagnosing conditions of the knee.

Arthroscopy

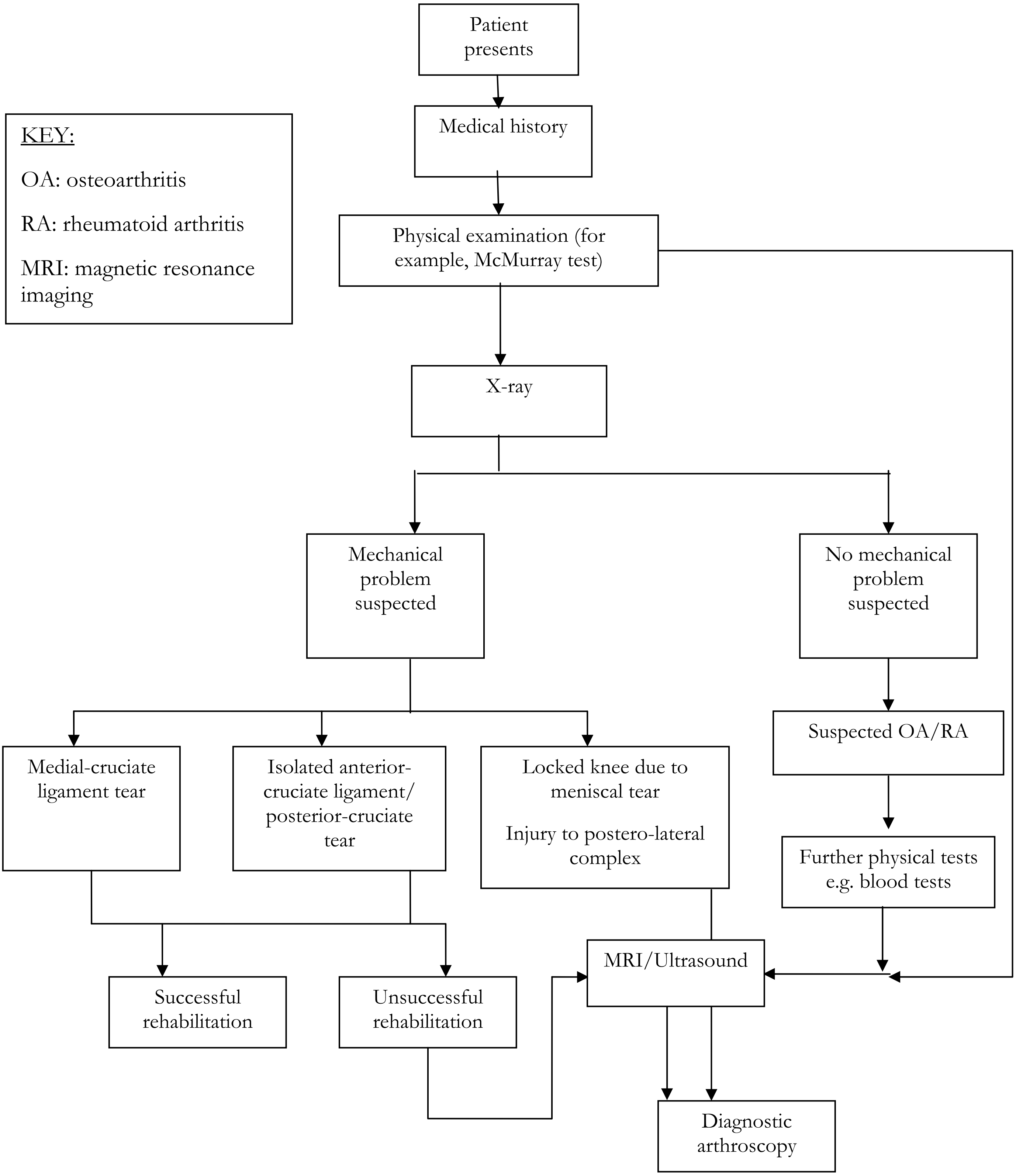
Arthroscopy is a minimally invasive surgical procedure that allows the surgeon to directly visualise the inside of the knee joint. In Australian practice, arthroscopy is most often carried out under general anaesthesia as a day surgery procedure. The arthroscope is an optical instrument that can be rigid or flexible. Rigid arthroscopes contain one of three types of lens systems: a) the classic thin lens system; b) the rod-lens system; or c) the graded index lens system. Flexible arthroscopes are usually fibre-optic and consist of a rod-lens system surrounded by multiple light-conducting glass fibrils (Phillips 2003). In an arthroscopy, the probe is also an important part of the diagnostic instrument and helps the surgeon (Phillips 2003):

- 'feel' the consistency of a structure;
- determine the depth of chondromalacic areas;
- identify and palpate loose structures within the joint (for example tears of the menisci);
- manoeuvre loose bodies into more accessible positions for grasping;
- palpate the anterior cruciate ligament and determine the tension in ligamentous and synovial structures within the joint;
- retract structures within the joint for exposure;
- elevate a meniscus so that its undersurface can be viewed; and
- probe the fossae and recesses, such as the popliteal hiatus within the joint.

Arthroscopy has been used to diagnose knee conditions, determine prognosis and often to provide treatment because of its high degree of clinical accuracy and low morbidity (Phillips 2003). Although arthroscopy is considered the gold standard technique for diagnosing knee conditions, it is an invasive procedure with associated morbidity that can include osteonecrosis of the knee (Pape et al 2007), infection (Binnet and Basarir 2007) and thromboembolic events (Ilahi et al 2005; Demers et al 1998; Ettema et al 2006). In some cases, arthroscopy may reveal no abnormality or possibly minor non-pathological lesions such as plicae or chondromalacia patellae, which means that a patient is exposed to surgical risk with no obvious benefit.

Diagnostic techniques listed on the Medicare Benefits Schedule (MBS)

All of the techniques listed above, with the exception of knee arthrography, are listed on the MBS. Currently in Australia, diagnostic and interventional arthroscopies are carried out simultaneously and billed under MBS item number 49557 (Australian Government Department of Health and Ageing, 2007). According to expert clinical opinion, this item number is being used for surgical interventions to treat infection, carry out biopsies and remove the plica (G Morrison 2008, personal correspondence).



NOTE: In some cases surgeons bypass MRI when the patient has obvious signs of a locked knee or a meniscal injury, something that reduces the number of true positive results in MRI imaging

Figure 1 Clinical decision pathway for the diagnosis of conditions of the knee

Research questions

In this review the diagnostic test of interest, arthroscopy, is also the current gold standard reference test for diagnosing knee conditions against which all other diagnostic tests are compared. Therefore, the specific research questions of this review must be worded differently from the objectives in order to fit the diagnostic test paradigm prevalent in the field. Thus, the specific research questions that will be addressed in this review are as follows:

- What is the accuracy of magnetic resonance imaging and ultrasound in diagnosing knee conditions, compared to arthroscopy?
- What is the safety profile of magnetic resonance imaging and ultrasound, compared to arthroscopy?

Methodology

Inclusion criteria

Studies were selected for inclusion in this rapid review on the basis of the criteria outlined below.

Population

Studies of individuals with osteoarthritis, rheumatoid arthritis, osteochondritis dissecans, ligament tears, meniscal tears or other knee conditions requiring diagnosis were included.

Index Test

The index tests were ultrasound and MRI. MRA was not considered because it does not have any particular advantage over MRI for diagnosing knee conditions (J Reece 2008, personal correspondence).

Reference Test

Arthroscopy for the diagnosis of conditions of the knee.

Outcomes

Studies were included if they contained information on at least one of the following outcomes:

Safety

- death
- pain
- patholaxity
- complications related to anaesthesia
- haemarthrosis
- infection
- deep vein thrombosis
- damage to cartilage, meniscus or ligaments of the knee
- knee stiffness.

Effectiveness

- specificity
- sensitivity
- likelihood ratios

- predictive values

Study design

Recently published, well-conducted systematic reviews, rather then primary studies were selected preferentially for including in the review and critical appraisal. Systematic reviews were defined as those studies that met all the following criteria as defined by Cook et al (1997):

1. Focused clinical question
2. Explicit search strategy
3. Use of explicit, reproducible and uniformly applied criteria for article selection
4. Critical appraisal of the included studies
5. Qualitative or quantitative data synthesis.

Where there were two or more systematic reviews with the same inclusion and exclusion criteria, the latest and most complete study was included. In addition, primary studies of test accuracy published after the search dates of the most recent systematic review were also included.

If no suitable systematic reviews on the topic were available, primary studies with an independent, blinded comparison of the index and reference test among consecutive or non-consecutive patients were considered eligible for inclusion and critical appraisal.

When overlapping patient groups were reported in studies, only the paper quoting the most complete data set was used.

Publication date

Studies included were restricted to those published from January 1977 onwards, as this was when the first MRI scanners became available.

Language of publication

Included studies were restricted to those published in English.

Literature search strategies

Databases searched

The following databases were searched from 1 January 1977 to 5 March 2008:

- BMJ Clinical Evidence
- The York (UK) Centre for Reviews and Dissemination (CRD)
- The Cochrane Library
- PubMed

- EMBASE.

The review did not include extended searching of internet websites and conference abstracts, handsearching of journals, contacting authors for unpublished data or pearling references from retrieved articles.

Search terms

The search terms used for each of the databases listed above are provided below, while details of the full strategy (based on a PubMed platform) are provided in Appendix A.

BMJ Clinical Evidence

Arthroscopy

York CRD and the Cochrane Library

MeSH: Arthroscopy, Diagnosis, Knee, Knee Joint, Knee Injuries

Text words: arthroscop*, diagnosis, knee, knee joint, knee injuries

PubMed

MeSH: Arthroscopy, Diagnosis, Knee Joint, Knee, Knee Injuries

Text words: arthroscop*, diagnos*, knees, knee, knee joint, knee joint*, random*, RCT, systematic review*, meta-analys*

EMBASE

MeSH: Arthroscopy, Knee Arthroscopy, Diagnosis, Musculoskeletal Diagnosis, Knee, Knee Pain, Knee Instability, Knee Disease, Knee Injury, Knee Function, Meta Analysis, Systematic Review

Text words: arthroscop*, diagnos*, knee, knees, knee joint*, random*, RCT, systematic review*, meta-analys*

Note: * is a truncation character that retrieves all possible suffix variations of the root word; for example, surg* retrieves surgery, surgical, surgeon, etc.

Selection of studies

The reviewer (TL) applied the inclusion criteria to identify those studies potentially eligible for selection and appraisal based on their abstracts; these studies were retrieved as full text. The selection criteria were then applied fully to the retrieved studies to identify those to be appraised and included in the review. Full publications subsequently found not to meet the inclusion criteria were excluded and reasons for exclusion were documented.

Data extraction and appraisal of study methodology

Data from all included studies were extracted by one reviewer (TL) and checked by a second reviewer (PT) using standardised data extraction tables that were developed a priori. The studies included in the review were classified according to a modified version of the National Health and Medical Research Council (NHMRC) hierarchy of evidence (NHMRC 2005) (Table 1).

Table 1: National Health and Medical Research Council hierarchy of evidence

Level of evidence	Diagnosis Study design
I	A systematic review of level II studies
II	A study of test accuracy with: an independent, blinded comparison with a valid reference standard, among consecutive patients with a defined clinical presentation
III-1	A study of test accuracy with: an independent, blinded comparison with valid reference standard, among non-consecutive patients with a defined clinical presentation
III-2	A comparison with reference standard that does not meet the criteria required for Level II and III-1 evidence
III-3	Diagnostic case-control study
IV	Study of diagnostic yield (no reference standard)

Source: NHMRC 2005

Where systematic reviews were eligible for inclusion in the review, the methodology of these secondary studies was evaluated with respect to the following factors:

- Did the review ask a focused research question that incorporated the elements of the patient population, intervention, comparator intervention and outcomes (PICO)?
- Were the inclusion and exclusion criteria of included studies clearly stated?
- Did the review use a clear and comprehensive search strategy?
- Did the review assess the validity of included studies, and if so which validity criteria were used?
- Was the analysis or synthesis of the results appropriate?
- Did the review include a summary of its main results, including a discussion of its strengths and limitations?

Where primary studies were eligible for inclusion in the review, the methodology of these studies was evaluated with respect to the following factors (Whiting et al 2003):

- Were selection criteria clearly described?
- Was the time period between the reference and index test short enough to be reasonably sure that the target condition did not change between the two tests?
- Did the whole patient sample undergo the reference test?
- Was the reference standard independent of the index test (i.e. the index test did not form part of the reference standard)?
- Was the execution of the reference and index test described in sufficient detail?
- Were the index test results interpreted without knowledge of the results of the reference test?
- Were the reference test results interpreted without knowledge of the results of the index test?

- Were uninterpretable/intermediate test results reported?
- Were withdrawals from the study explained?

One reviewer (TL) appraised the studies, which were checked by the second reviewer (PT). Any differences were resolved through discussion.

Results

From the search strategy, 1140 potentially relevant articles were identified of which 21 were retrieved. Retrieved papers included systematic reviews and primary research. In total, 19 retrieved articles were excluded and these are listed in Appendix B.

A total of two systematic reviews (Crawford et al 2007; Ryzewicz et al 2007) were eligible for appraisal and inclusion in this rapid review. No supplementary primary studies published after the most recent search end date in the included systematic reviews were found. Both of the included reviews compared the results of MRI to that of the reference standard arthroscopy. One review focused on the diagnosis of meniscal lesions and ACL tears (Crawford et al 2007) while the other study focused primarily on meniscal tears (Ryzewicz et al 2007). These reviews did not have any primary studies in common. Neither of the included systematic reviews discussed the diagnosis of chondromalacia patellae, osteoarthritis or rheumatoid arthritis. Evidence tables of these included studies are presented in Appendix C.

Neither of the included systematic reviews reported safety outcomes. As a result, all of the primary studies included in each of the systematic reviews were also searched for safety data; however, no safety outcomes were reported in any of these studies.

Systematic review evidence

Crawford et al (2007)

Appraisal of study methodology

Crawford et al (2007) undertook a systematic review to evaluate the use of arthroscopy and MRI in the diagnosis of internal derangements of the knee. The main purpose of the review was to adapt and implement a reproducible system for evaluating the methodology of studies comparing arthroscopy and MRI in the diagnosis of intra-articular knee pathology using an adapted version of the Coleman scoring system.

The authors performed a Medline search for studies that used both MRI and arthroscopy for the diagnosis of knee injuries, and that were published between 1966 and 2006. No language restriction was applied. In addition to database searches, materials on this topic in the library of the Department of Trauma and Orthopaedic Surgery of Keele University Medical School, University Hospital of North Staffordshire were searched manually, and any relevant articles identified through this search were also included. Studies were included in the review if they were based on the relevant knee pathology and used MRI and arthroscopy in some of their patients. Abstracts were excluded.

The authors adapted criteria originally developed by Coleman et al (2000) for comparing surgical techniques, to assess the methodology of each included study. Crawford et al (2007) modified the original scoring system, which had 10 criteria scored out of 10, giving a maximum mark of 100. The authors of this review modified this scoring system, removing sections related to surgical complications and recovery time following surgery, and adding sections relevant for a systematic review of arthroscopies and MRI scans. The new scoring system had five criteria (study size (number of MRI scans), number of radiologists, type of study, diagnostic certainty/arthroscopy to confirm diagnosis and description of MRI given), which were scored out of 20, giving a total Coleman score of between 0 and 100. If a study achieved a score of 100, this indicated that its design largely avoided the influence of chance, various biases and confounding factors. Each of the included studies was blindly assessed twice to determine its Coleman score. All studies were assessed by one reviewer, so there was no inter-observer bias. This review did not report any attempts to quantify the heterogeneity of the included studies, and also did not report the settings where patients in the included studies were recruited from.

A total of 59 studies, reporting on 7367 MRI scans and 5416 arthroscopies were identified for inclusion in the review, including one RCT and 47 prospective studies, with the remaining 11 studies comprising a mixture of retrospective cohort studies, audits, outcome reviews and case series studies. The patients in these studies ranged in age from 3-87 years. Each of these studies evaluated the use of MRI and arthroscopy in the diagnosis of knee pathology. Diagnostic arthroscopy was taken as the reference standard, against which results for MRI were compared. The types of knee injuries covered in these studies included medial meniscus, lateral meniscus, ACL tears and 'other knee pathology', which included posterior cruciate ligament (PCL) tears, bone oedema and chondral lesions. When the methodology of each included study was assessed twice, the Coleman scores were highly reproducible. The mean Coleman methodology score for the 59 included studies was 54.46 (standard deviation 18.33, range 10 to 90).

The sensitivity, specificity, positive predictive value and negative predictive value for tears of the medial meniscus, lateral meniscus and ACL, as well as for the other knee pathologies were calculated for each of the included studies. One of the limitations of this review was that it failed to report on any measures of dispersion such as ranges or standard deviations. The individual primary studies did not report any safety outcomes.

Diagnostic performance

For lateral meniscus tears, mean sensitivity was 76%, specificity was 93.3%, positive predictive value was 80.4% and negative predictive value was 91.6%. For medial meniscus tears, mean sensitivity was 91.4%, specificity was 81.1%, positive predictive value was 83.2% and negative predictive value was 90.1%. For ACL tears, mean sensitivity was 86.5%, specificity was 95.2%, positive predictive value was 82.9% and negative predictive value was 96.4%. When lateral meniscus, medial meniscus and ACL tears were combined, the mean sensitivity was 86.2%, specificity was 90.7%, positive predictive value was 82.4% and negative predictive value was 92.8%. For other knee pathologies, the mean sensitivity was 68.7%, specificity was 97.9%, positive predictive value was 91.3% and negative predictive value was 90.7%.

Authors' conclusions

Crawford et al (2007) concluded that when compared to diagnostic arthroscopy, MRI is able to detect most internal derangements of the knee efficiently. Specifically, it is highly accurate in diagnosing meniscal and ACL tears. The diagnostic performance of MRI does differ for lateral and medial menisci and the ACL; however all were above 85% accuracy. The high specificity and negative predictive value of MRI indicate that its use as a screening tool can help to avoid unnecessary arthroscopies, and in fact the authors of the review suggest that it is the most appropriate screening tool before therapeutic arthroscopy. In most patients MRI is preferable to diagnostic arthroscopy because it is faster and avoids the surgical risks associated with arthroscopy.

Ryzewicz et al (2007)

Appraisal of study methodology

The aim of the systematic review by Ryzewicz et al (2007) was to evaluate the use of MRI and clinical examination compared to arthroscopy, for the diagnosis of meniscal tears. Specifically, this systematic review aimed to evaluate (a) whether routine MRI could reduce the incidence of negative arthroscopy, compared to proceeding with arthroscopy alone based solely upon history and clinical examination, (b) the statistical performance of clinical meniscal tests, and (c) the effectiveness of MRI in the correct identification of patients with meniscal tears found on arthroscopy. For the purposes of this rapid review however, it was only the selection and evaluation of studies addressing question (c) that was of interest.

The authors performed a PubMed and Cochrane database literature search for articles that evaluated the use of MRI studies for the diagnosis of meniscus tears. The search was limited to English language studies. Prospective cohort studies are the preferred study design for determining the reliability and validity of diagnostic tests (Spindler et al 2005), and in this systematic review all prospective cohort studies reporting on a consecutive series of patients with a universally applied reference standard were reviewed with the aid of a worksheet including the title, author, journal, year, reference, hypotheses, and type of study. Sources of selection, measurement and confounding bias were evaluated for each paper, and if bias was subjectively assessed as severe, the article was excluded. Two of the authors independently reviewed each of the studies, and when there was disagreement, it was discussed with the senior author until consensus was reached. This review did not report any attempts to quantify the heterogeneity of the included studies, and also did not report the settings where patients in the included studies were recruited from.

A minimum of 40 patients was required for studies evaluating the performance of MRI. In addition, the magnetic field strength (Tesla), number of sequences obtained and criteria for a positive diagnosis had to be reported in these studies. It was also a requirement of all included studies that data for the total number of tears, as well as explicitly stated, or derivable, values for sensitivity, specificity, positive predictive value and negative predictive value for medial and lateral meniscal tears, were available. Further to this, studies containing substantial verification bias, which occurs if patients are selected to undergo the reference standard test (arthroscopy) on the basis of the test being evaluated (MRI), were excluded. This is known to overestimate sensitivity and underestimate specificity.

A total of eight prospective cohort studies were identified for inclusion in the review. The number of patients in these studies ranged from 47-244, while the strength of the MRI's magnetic field was 0.1 T in one study, 0.2 T in two studies, 1.0 T in one study, and 1.5 T in four studies. The sensitivity, specificity, positive predictive value and negative predictive value for tears of the medial and lateral meniscus were reported for each of the included studies. One of the limitations of this review was that it failed to report on any measures of dispersion such as ranges or standard deviations. The individual primary studies did not report any safety outcomes.

Diagnostic performance

For lateral meniscus tears, mean sensitivity was 67.3%, specificity was 95.6%, positive predictive value was 85.8% and negative predictive value was 86.1%. For medial meniscus tears, mean sensitivity was 89.9%, specificity was 87.8%, positive predictive value was 82.5% and negative predictive value was 93.8%.

Authors' conclusions

Ryzewicz et al (2007) concluded that when compared to arthroscopy, MRI is able to reliably diagnose meniscal tears, but should be reserved for situations where there is uncertainty in clinical examination and an experienced clinician requires further information before arriving at a diagnosis. It was suggested that routinely proceeding to arthroscopy for purely diagnostic purposes should be considered obsolete, and that arthroscopy should only be undertaken with the intention of treating a specific clinical diagnosis.

Summary of review findings

Overview

This rapid review identified two eligible systematic reviews, both of which were published in 2007. One systematic review focused on the use of diagnostic arthroscopy and MRI for the diagnosis of meniscal lesions and ACL tears (Crawford et al 2007), while the remaining systematic review focused primarily on meniscal tears (Ryzewicz et al 2007). No systematic reviews comparing diagnostic arthroscopy with ultrasound, or any other mode of diagnosis, were identified.

The methodological quality of both systematic reviews was high. Both studies had a focused research question and explicit inclusion/exclusion criteria, and used defined search strategies and appraisal methodology (Crawford et al 2007; Ryzewicz et al 2007). However neither review addressed the issue of between-study heterogeneity.

Using diagnostic arthroscopy as the reference standard, both systematic reviews reported diagnostic performance data for the use of MRI in diagnosing a variety of knee pathologies. The most common measures of diagnostic performance reported included sensitivity, specificity, the positive predictive value and the negative predictive value; however, likelihood ratios were not reported in either of the studies.

Safety

No safety outcomes were reported in any of the included systematic reviews.

Diagnostic performance of MRI

Medial meniscus tears

The mean sensitivity and specificity of MRI for detecting medial meniscus tears ranged from 89.9% to 91.4% and 81.1% to 87.8%, respectively. The mean positive predictive value and negative predictive value of MRI for detecting medial meniscus tears ranged from 82.5% to 83.2% and 90.1% to 93.8%, respectively. These results suggest that MRI is effective in diagnosing the absence and presence of medial meniscus tears, when compared to the reference standard diagnostic arthroscopy.

Lateral meniscus tears

The mean sensitivity and specificity of MRI for detecting lateral meniscus tears ranged from 67.3% to 76% and 93.3% to 95.6%, respectively. The mean positive predictive value and negative predictive value of MRI for detecting medial meniscus tears ranged from 80.4% to 85.8% and 86.1% to 91.6%, respectively. This indicates that when compared to the reference standard diagnostic arthroscopy, MRI is effective in diagnosing the absence, rather than the presence of lateral meniscus tears.

ACL tears

The mean sensitivity and specificity of MRI for detecting ACL tears was 86.5% and 95.2%, respectively. The mean positive predictive value and negative predictive value of MRI for detecting ACL tears was 82.9% and 96.4%, respectively. These results suggest that MRI is effective in diagnosing the absence and presence of medial meniscus tears, when compared to the reference standard diagnostic arthroscopy.

Other knee pathologies

The mean sensitivity and specificity of MRI for detecting other knee pathologies, including PCL tears, bone oedema and chondral lesions, was 68.7% and 97.9%, respectively. The mean positive predictive value and negative predictive value of MRI for detecting other knee pathologies was 91.3% and 90.7%, respectively. These findings indicate that MRI is effective in diagnosing the absence, rather than the presence of other knee pathologies, when compared to the reference standard diagnostic arthroscopy.

Conclusions

Two systematic reviews, both published in 2007, comparing the use of MRI with arthroscopy for the diagnosis of meniscal lesions and ACL tears were identified as eligible for inclusion in the rapid review. No systematic reviews comparing the use of ultrasound with arthroscopy for diagnosing knee conditions were identified. Conclusions based on the results of these reviews are summarised below.

1. For meniscal lesions and ACL tears, MRI is an effective diagnostic tool when compared to diagnostic arthroscopy. In particular, MRI has a high specificity and negative predictive value, suggesting that screening MRI studies can effectively rule out the presence of meniscal lesions and ACL tears and reduce the number of unnecessary diagnostic arthroscopies performed. MRI is useful in situations where the results of a clinical examination are uncertain, and it is the most appropriate diagnostic screening tool to use before therapeutic arthroscopy.
2. Diagnostic arthroscopy should be reserved for patients with a lesion that is treatable by arthroscopic methods.
3. Safety outcomes were not reported in any of the included systematic reviews or in the primary studies included in these reviews, thus it was not possible to assess the safety of arthroscopy for diagnosing knee conditions in comparison with other diagnostic procedures. As with all surgical procedures, diagnostic arthroscopy may be associated with certain adverse events, including anaesthetic complications. Therefore, where reliable and accurate diagnosis of knee pathologies can be achieved using non-invasive procedures, diagnostic arthroscopy should be avoided.

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Appendix A: Search strategy

#1 Search arthroscopy Field: MeSH Terms [no explode]

#2 Search arthrocscop Field: Text Word

#3 Search #1 OR #2

#4 Search diagnosis Field: MeSH Terms [no explode]

#5 Search diagnos* Field: Text Word

#6 Search #4 OR #5

#7 Search knee joint Field: MeSH Terms [no explode]

#8 Search knee Field: MeSH Terms [no explode]

#9 Search knee injuries Field: MeSH Terms [no explode]

#10 Search knee Field: Text Word

#11 Search knee joint Field: Text Word

#12 Search knee injuries Field: Text Word

#13 Search #7 OR #8 OR #9 OR #10 OR #11 OR #12

#14 Search #3 AND #6 AND #13

#15 Search #14 Limits: Human, English language, Published 1977 onwards

Appendix B: Excluded studies

No critical appraisal of included studies

Boeve BF, Davidson RA, Staab EV Jr. Magnetic resonance imaging in the evaluation of knee injuries. *Southern Medical Journal* 1991; **84**(9):1123–1127.

Focus on physical tests

Benjaminse A, Gokeler A, Van der Schans CP. Clinical diagnosis of an anterior cruciate ligament rupture: a meta-analysis. *Journal of Orthopaedic and Sports Physical Therapy* 2006; **36**(5), 267–288.

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Not a systematic review

Bryan, S., Bungay HP, Weatherburn G, Field S. Magnetic resonance imaging for investigation of the knee joint: a clinical and economic evaluation. *International Journal of Technology Assessment in Health Care* 2004; **20**(2): 222–229.

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Cost-effectiveness study

Bryan S, Weatherburn G, Bungay H, Hatrick C, Salas C, Parry D. The cost-effectiveness of magnetic resonance imaging for investigation of the knee joint. *Health Technology Assessment* 2001; **5**(27): 95.

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Non-English language

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Surgical intervention

Ilahi OA, Reddy J, Ahmad I. Deep venous thrombosis after knee arthroscopy: A meta-analysis. *Arthroscopy - Journal of Arthroscopic and Related Surgery* 2005; **21**(6): 727–730.

Ramos J, Perrotta C, Badariotti G, Berenstein G. Interventions for preventing venous thromboembolism in adults undergoing knee arthroscopy. *Cochrane Database of Systematic Reviews: Reviews* 2007, Issue 2. Art. No: CD005259. DOI: 10.1002/14651858.CD005259.pub2.

Different focus (on validity and reliability of scoring systems)

Oakley SP, Lassere MN. A critical appraisal of quantitative arthroscopy as an outcome measure in osteoarthritis of the knee. *Seminars in Arthritis and Rheumatism* 2003; **33**(2): 83–105.

Lack of diagnostic arthroscopy outcomes

Oei EHG, Nikken JJ, Verstijnen ACM, Ginai AZ, Hunink MGM. MR imaging of the menisci and cruciate ligaments: A systematic review. *Radiology* 2003; **226**(3): 837–848.

Magnetic resonance arthrography excluded as diagnostic procedure for analysis

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Appendix C: Evidence tables

Table C1 Evidence table of included systematic reviews investigating diagnosis of conditions of the knee

<table>
<tr><th>Author(s), date</th><th>Aim + search method</th><th>Study design and inclusion/exclusion criteria</th><th>Results + author(s) conclusions</th><th>Comments</th></tr>
<tr>
<td>Crawford et al 2007

University of Keele, Keele University Medical School, Staffordshire, UK</td>
<td>Aim:
To adapt and implement a reproducible system for evaluating the methodology of studies comparing arthroscopy and MRI in the diagnosis of intra-articular knee pathology using an adapted version of the Coleman scoring system.

Search period:
1966–2006

Databases searched:
Medline

Search terms:
Arthroscopy, MRI, meniscal lesions, meniscal tears and knee pathology

Language restriction:
None</td>
<td>Level of evidence (NHMRC):
Systematic review (not level I evidence)

Inclusion criteria:
Papers included if they were based on knee pathology and used MRI and arthroscopies in some of their patients.

Exclusion criteria:
Abstracts excluded

Method of critical appraisal:
Criteria developed by Coleman et al, for comparing surgical techniques, were adapted and used to blindly assess methods of each article twice.</td>
<td>Number of included studies:
59 articles reporting on 7367 MRI scans and 5416 arthroscopies

Study type:
One RCT, 47 prospective studies, 11 retrospective cohort studies, audits, outcome reviews and case-series

Age range of patients:
3–87 years

Safety:
NR

Diagnostic performance: MRI when compared with the gold standard diagnostic arthroscopy
Sensitivity:
<table>
<tr><th></th><th>Medial Meniscus</th><th>Lateral Meniscus</th><th>ACL</th><th>Combined MM, LM ACL</th><th>Other knee pathology</th></tr>
<tr><td>Mean (%)</td><td>91.4</td><td>76.0</td><td>86.5</td><td>86.2</td><td>68.7</td></tr>
</table>
Specificity:
<table>
<tr><th></th><th>Medial Meniscus</th><th>Lateral Meniscus</th><th>ACL</th><th>Combined MM, LM ACL</th><th>Other knee pathology</th></tr>
<tr><td>Mean (%)</td><td>81.1</td><td>93.3</td><td>95.2</td><td>90.7</td><td>97.9</td></tr>
</table>
Positive Predictive Value:
<table>
<tr><th></th><th>Medial Meniscus</th><th>Lateral Meniscus</th><th>ACL</th><th>Combined MM, LM ACL</th><th>Other knee pathology</th></tr>
<tr><td>Mean (%)</td><td>83.2</td><td>80.4</td><td>82.9</td><td>82.4</td><td>91.3</td></tr>
</table>
Negative Predictive Value:
<table>
<tr><th></th><th>Medial Meniscus</th><th>Lateral Meniscus</th><th>ACL</th><th>Combined MM, LM ACL</th><th>Other knee pathology</th></tr>
<tr><td>Mean (%)</td><td>90.1</td><td>91.6</td><td>96.4</td><td>92.8</td><td>90.7</td></tr>
</table>
Likelihood Ratio:
NR

Author/s conclusions:
When compared with the gold standard of diagnostic arthroscopy, MRI is able to detect most internal derangements of the knee efficiently. Specifically, it is highly accurate in diagnosing meniscal and ACL tears. The high specificity and negative predictive value of MRI indicate that its use as a screening tool can help to avoid unnecessary arthroscopies.</td>
<td>• Limited search strategy, one database and handsearching of journals.
• Selection criteria provided.
• Study quality assessed using defined scoring system.
• Detailed discussion, including strengths and weaknesses of the study.</td>
</tr>
</table>

Table C1 *continued*: Evidence table of included systematic reviews investigating diagnosis of conditions of the knee

<table>
<tr><th>Author(s), date</th><th>Aim + search method</th><th>Study design and inclusion/exclusion criteria</th><th>Results + author(s) conclusions</th><th>Comments</th></tr>
<tr>
<td>Ryzewicz et al 2007

Department of Orthopaedic Surgery, University of Colorado, Colorado, USA</td>
<td>Aim:
To evaluate the use of MRI and clinical examination compared with arthroscopy, for the diagnosis of meniscal tears. Specifically, this systematic review aimed to evaluate (a) whether routine MRI could reduce the incidence of negative arthroscopy, compared with proceeding with arthroscopy alone based solely upon history and clinical examination, (b) the statistical performance of clinical meniscal tests, and (c) the effectiveness of MRI in the correct identification of patients with meniscal tears found on arthroscopy. For the purposes of this rapid review however, it was only the selection and evaluation of studies addressing question (c) that was of interest.

Search period:
NR

Databases searched:
PubMed and Cochrane

Search terms:
‘meniscus’ and ‘knee’, ‘MRI, arthroscopy’

Language restriction:
English language only.</td>
<td>Level of evidence (NHMRC):
Systematic review (not level I evidence)

Inclusion criteria:
Prospective cohort studies with a minimum of 40 patients. Magnetic field strength, number of sequences obtained and criteria for a positive diagnosis, total number of tears, all reported.
Explicitly stated or derivable values for accuracy, sensitivity, specificity, positive predictive value, and negative predictive value.

Exclusion criteria:
Studies containing substantial verification bias.

Method of critical appraisal:
Sources of selection, measurement and confounding bias were evaluated.</td>
<td>Number of studies:
Eight studies (a total of 32 studies were included in the review, however only eight studies evaluated the effectiveness of MRI in the correct identification of patients with meniscal tears found on arthroscopy).

Study type:
Prospective cohort studies with consecutive patients.

Safety:
NR

Diagnostic performance: MRI when compared with the gold standard diagnostic arthroscopy
Sensitivity:
<table><tr><th></th><th>Medial Meniscus</th><th>Lateral Meniscus</th></tr><tr><td>Mean (%)</td><td>89.88%</td><td>67.25%</td></tr></table>
Specificity:
<table><tr><th></th><th>Medial Meniscus</th><th>Lateral Meniscus</th></tr><tr><td>Mean (%)</td><td>87.75%</td><td>95.63%</td></tr></table>
Positive Predictive Value:
<table><tr><th></th><th>Medial Meniscus</th><th>Lateral Meniscus</th></tr><tr><td>Mean (%)</td><td>82.5%</td><td>85.75%</td></tr></table>
Negative Predictive Value:
<table><tr><th></th><th>Medial Meniscus</th><th>Lateral Meniscus</th></tr><tr><td>Mean (%)</td><td>93.75%</td><td>86.13%</td></tr></table>
Likelihood Ratio:
NR

Author/s conclusion:
When compared with the gold standard of arthroscopy, MRI is able to reliably diagnose meniscal tears, but should be reserved for situations where there is uncertainty in clinical examination, and an experienced clinician requires further information before arriving at a diagnosis. It was suggested that routinely proceeding to arthroscopy for purely diagnostic purposes should be considered obsolete, and that arthroscopy should only be undertaken with the intention of treating a specific clinical diagnosis.</td>
<td>• Sound search strategy, two database and defined search terms.
• Detailed selection criteria provided.
• Two authors independently reviewed each of the included studies.
• Study quality assessed.</td>
</tr>
</table>

Table notes: ACL: anterior cruciate ligament, LM: lateral meniscus, MRI: magnetic resonance imaging, MM: medial meniscus, NR: not reported