Magnetic Resonance Imaging Arthrograms for Labral Tear Diagnosis: Comparative Clinical Effectiveness and Guidelines
Authors: Casey Gray, Aleksandra Grobelna


Acknowledgments:

Disclaimer: The information in this document is intended to help Canadian health care decision-makers, health care professionals, health systems leaders, and policy-makers make well-informed decisions and thereby improve the quality of health care services. While patients and others may access this document, the document is made available for informational purposes only and no representations or warranties are made with respect to its fitness for any particular purpose. The information in this document should not be used as a substitute for professional medical advice or as a substitute for the application of clinical judgment in respect of the care of a particular patient or other professional judgment in any decision-making process. The Canadian Agency for Drugs and Technologies in Health (CADTH) does not endorse any information, drugs, therapies, treatments, products, processes, or services.

While care has been taken to ensure that the information prepared by CADTH in this document is accurate, complete, and up-to-date as at the applicable date the material was first published by CADTH, CADTH does not make any guarantees to that effect. CADTH does not guarantee and is not responsible for the quality, currency, propriety, accuracy, or reasonableness of any statements, information, or conclusions contained in any third-party materials used in preparing this document. The views and opinions of third parties published in this document do not necessarily state or reflect those of CADTH.

CADTH is not responsible for any errors, omissions, injury, loss, or damage arising from or relating to the use (or misuse) of any information, statements, or conclusions contained in or implied by the contents of this document or any of the source materials.

This document may contain links to third-party websites. CADTH does not have control over the content of such sites. Use of third-party sites is governed by the third-party website owners’ own terms and conditions set out for such sites. CADTH does not make any guarantee with respect to any information contained on such third-party sites and CADTH is not responsible for any injury, loss, or damage suffered as a result of using such third-party sites. CADTH has no responsibility for the collection, use, and disclosure of personal information by third-party sites.

Subject to the aforementioned limitations, the views expressed herein are those of CADTH and do not necessarily represent the views of Canada’s federal, provincial, or territorial governments or any third party supplier of information.

This document is prepared and intended for use in the context of the Canadian health care system. The use of this document outside of Canada is done so at the user’s own risk.

This disclaimer and any questions or matters of any nature arising from or relating to the content or use (or misuse) of this document will be governed by and interpreted in accordance with the laws of the Province of Ontario and the laws of Canada applicable therein, and all proceedings shall be subject to the exclusive jurisdiction of the courts of the Province of Ontario, Canada.

The copyright and other intellectual property rights in this document are owned by CADTH and its licensors. These rights are protected by the Canadian Copyright Act and other national and international laws and agreements. Users are permitted to make copies of this document for non-commercial purposes only, provided it is not modified when reproduced and appropriate credit is given to CADTH and its licensors.

About CADTH: CADTH is an independent, not-for-profit organization responsible for providing Canada’s health care decision-makers with objective evidence to help make informed decisions about the optimal use of drugs, medical devices, diagnostics, and procedures in our health care system.
Research Questions

1. What is the comparative clinical effectiveness of MRI arthrograms (MRA) versus conventional MRI scans for the detection of labral tears in adult patients?

2. What are the evidence-based guidelines associated with the diagnosis of labral tears in adult patients?

Key Findings

Six systematic reviews (three with meta-analysis) and thirteen non-randomized studies were identified regarding the comparative clinical effectiveness of MRA versus conventional MRI scans for the detection of labral tears in adult patients. Additionally, one evidence-based guideline on the diagnosis of labral tears was identified.

Methods

A limited literature search was conducted on key resources including PubMed, the Cochrane Library, University of York Centre for Reviews and Dissemination (CRD) databases, Canadian and major international health technology agencies, as well as a focused Internet search. No filters were used to limit the retrieval by study type for question 1. A methodological filter was applied to limit retrieval to guidelines for question 2. Where possible, retrieval was limited to the human population. The search was also limited to English language documents published between January 1, 2008 and August 10, 2018. Internet links were provided, where available.

Selection Criteria

One reviewer screened citations and selected studies based on the inclusion criteria presented in Table 1.

Table 1: Selection Criteria

<table>
<thead>
<tr>
<th>Population</th>
<th>Adults with labral tear (shoulder, hip, wrist, knee) requiring MRI for diagnosis who are</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Greater than or equal to 50 years of age</td>
</tr>
<tr>
<td></td>
<td>Less than 50 years of age</td>
</tr>
<tr>
<td>Intervention</td>
<td>Magnetic Resonance Imaging (MRI) arthrograms</td>
</tr>
<tr>
<td>Comparator</td>
<td>Q1: Conventional MRI (routine/plain MRI)</td>
</tr>
<tr>
<td></td>
<td>Q2: No comparator</td>
</tr>
<tr>
<td>Outcomes</td>
<td>Q1: Clinical effectiveness (comparative)</td>
</tr>
<tr>
<td></td>
<td>Q2: Guidelines on most appropriate imaging to diagnose labral tears in the joints</td>
</tr>
<tr>
<td>Study Designs</td>
<td>Health technology assessments, systematic reviews, meta-analyses, randomized controlled trials, non-randomized studies, evidence-based guidelines</td>
</tr>
</tbody>
</table>
Results

Rapid Response reports are organized so that the higher quality evidence is presented first. Therefore, health technology assessment reports, systematic reviews, and meta-analyses are presented first. These are followed by randomized controlled trials, non-randomized studies, and evidence-based guidelines.

Six systematic reviews (three with meta-analysis) and thirteen non-randomized studies were identified regarding the comparative clinical effectiveness of MRI arthrograms (MRA) versus conventional MRI scans for the detection of labral tears in adult patients. Additionally, one evidence-based guideline on the diagnosis of labral tears was deemed eligible for inclusion. No relevant health technology assessments or randomized controlled trials were identified.

Overall Summary of Findings

Six systematic reviews\(^1\)\(^-\)\(^6\) (three with meta-analysis)\(^1\)\(^-\)\(^3\) and thirteen non-randomized studies\(^7\)\(^-\)\(^19\) were identified regarding MRA arthrograms for the detection of labral tears. Detailed study characteristics are provided in Table 2.

Two systematic reviews\(^1\)\(^-\)\(^2\) and seven non-randomized studies\(^8\)\(^-\)\(^9\),\(^14\)\(^-\)\(^17\),\(^19\) indicated that MRA had superior diagnostic performance to MRI for the detection of labral tears of the shoulder. One non-randomized study showed no statistical difference between 1.5-T MRA and 3-T MRI\(^7\).

Four systematic reviews\(^3\)\(^-\)\(^6\) showed MRA was superior to MRI for the detection of labral tears of the hip. Conventional MRA was superior to conventional MRI in three non-randomized studies,\(^12\)\(^-\)\(^14\) whereas there was no difference for two studies that contrasted 1.5-T MRA versus 3-T MRI\(^8\) or 3-T MRA versus 3-T MRI\(^10\).

One evidence-based guideline\(^20\) was published by the American College of Radiology. This guideline indicates that MRI is effective for diagnosing most traumatic labral tears. MRA is the gold standard for imaging traumatic shoulder pain and is superior to MRI for diagnosing SLAP tears; however, is not an ideal initial imaging method due to the need for an invasive procedure\(^20\).

No included studies examined the comparative effectiveness of MRA versus MRI for the detection of labral tears of the wrist or knee and no included studies examined the effectiveness of any approach according to age groupings. However, one study concluded that MRA should be reserved for young adults with a strong clinical suspicion of femoroacetabular impingement who had normal findings on 3-T non-contrast MRI\(^9\).
### Table 2: Summary of Included Studies on MRI Arthrograms

<table>
<thead>
<tr>
<th>Author, Year</th>
<th>Study Characteristics: Intervention; Comparator</th>
<th>Outcomes</th>
<th>Results</th>
<th>Author Conclusions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Systematic Reviews and Meta-Analyses</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Labral Tears of the Shoulder</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ajuied, 2018(^1)</td>
<td>N = 929 patients 3-T MRA in 2D neutral position or abduction-external-rotation position; 3-T MRI</td>
<td>Diagnostic accuracy of labral shoulder tears</td>
<td>3-T MRI was less accurate than 3-T 2D neutral MRA for detecting anterior labral lesions</td>
<td>“At 3-T, MRA improved sensitivity for diagnosis of anterior and posterior labral lesions, but reduced specificity in diagnosis of SLAP tears. 3T MRA with ABER positioning further improved sensitivity in diagnosis of anterior labral tears. LEVEL OF EVIDENCE: IV(^1)”</td>
</tr>
<tr>
<td>Arirachakaran, 2017(^2)</td>
<td>N = 3511 shoulders MRA; MRI</td>
<td>Diagnostic accuracy of SLAP lesions</td>
<td>The summary sensitivity, specificity, likelihood ratio, and AUROC were superior for MRA versus MRI</td>
<td>“The diagnostic performance of MRA was superior to MRI by both direct and indirect comparisons for the detection of SLAP lesions.”(^2)</td>
</tr>
<tr>
<td><strong>Labral Tears of the Hip</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Saied, 2017(^3)</td>
<td>N = NA Direct MRA or indirect MRA; MRI</td>
<td>Diagnostic accuracy of labral tears of the hip</td>
<td>Pooled sensitivity, specificity and AUC were superior for direct MRA versus conventional MRI</td>
<td>“The present meta-analysis showed that the diagnostic test accuracy was superior for dMRA when compared with cMRI for detection of labral and chondral lesions.”(^3) “Promising results are obtained concerning iMRA but further studies still needed to fully assess its diagnostic accuracy.”(^3)</td>
</tr>
<tr>
<td>Smith, 2012(^4)</td>
<td>N = 4574 MRA; MRI</td>
<td>Diagnostic accuracy of Glenoid labral tears</td>
<td>Diagnostic test accuracy appeared superior for MRA over MRI for the detection of overall glenoid labral lesions</td>
<td>“Based on the available literature, overall MRA appeared marginally superior to MRI for the detection of glenohumeral labral lesions. LEVEL OF EVIDENCE: Level 2a.”(^4)</td>
</tr>
<tr>
<td>Burgess, 2011(^5)</td>
<td>N = NA MRA; MRI</td>
<td>Diagnostic accuracy of acetabular labral tears</td>
<td>Diagnostic accuracy of MRA was superior to MRI</td>
<td>NA</td>
</tr>
<tr>
<td>Smith, 2011(^6)</td>
<td>N = 881 hips MRA; MRI</td>
<td>Sensitivity, specificity, diagnostic accuracy</td>
<td>MRI and MRA both had moderate sensitivity and specificity, diagnostic accuracy of MRA was superior to MRI in detecting acetabular labral tears</td>
<td>“MRA appears to be superior to conventional MRI.”(^6)</td>
</tr>
</tbody>
</table>
## Non-Randomized Studies

### Labral Tears of the Shoulder

<table>
<thead>
<tr>
<th>Author, Year</th>
<th>Study Characteristics: Intervention; Comparator</th>
<th>Outcomes</th>
<th>Results</th>
<th>Author Conclusions</th>
</tr>
</thead>
</table>
| Chopra, 2018$^7$ | N = 68 patients  
1.5-T MRA;  
3-T MRI | Sensitivity for detecting tears of the acetabular labrum | No statistical difference between 3-T MRI versus 1.5-T MRA for sensitivities of detecting labral tears or acetabular cartilage defects | “Conventional 3T MRI may be at least equivalent to 1.5T MRA in detecting acetabular labrum” defects$^7$  
“Conventional 3T MRI is equivalent to 1.5T MRA for diagnosing labral tears.”$^7$ |
| Magee, 2018$^8$ | N = 100  
MRA; MRI | Detection sensitivity of labral tears of the shoulder | MRA was more accurate than MRI | “MR arthrography is more accurate than conventional MR in assessment of post-operative shoulder pathology.”$^8$ |
| Sheridan, 2015$^{11}$ | N = 444 patients  
MRA; MRI | Diagnosis of SLAP lesions | MRA had lower accuracy, higher sensitivity and higher positive predictive value compared with MRI (not statistically compared) | “While MRI could exclude a SLAP lesion (NPV = 95 %), MRI alone was not an accurate clinical tool. MR arthrography had a large number of false-positive readings in this study. We concluded that even with intra-articular contrast, MRI had limitations in the ability to diagnose surgically proven SLAP lesions.”$^{11}$ |
| Fallahi, 2013$^{14}$ | N = 91 patients  
Indirect MRA; MRI | Diagnosis of tears of the glenoid labrum, including SLAP tears | The sensitivity and accuracy of diagnosis was superior for indirect MRA versus conventional MRI. Specificity did not differ between indirect-MRA and MRI for detection of labral tears of all types. | “I-MRA is a highly accurate and sensitive method for the detection of labral tears. The data obtained supports the use of I-MRA as standard practice in patients with shoulder instability due to suspected labral pathology where further investigative imaging is indicated.”$^{14}$ |
| Pavic, 2013$^{15}$ | N = 200 patients  
Mean age 39 years (Range 15 to 83)  
MRA; MRI | Diagnostic accuracy for assessing labral capsular ligamentous complex lesions | MRA was superior to MRA in detecting SLAP lesions. (III and IV Type lesions | “In the case of labral capsular ligamentous complex lesions, MR arthrography is superior.”$^{15}$ |
| Amin, 2012$^{16}$ | N = 59 patients  
MRA; MRI | Diagnosis and grading of SLAP lesions | Two thirds of patients with a negative MRI who went on to MRA had SLAP lesions. | “MR arthrography is a sensitive minimally invasive technique for detection and grading of SLAP lesions, it can help in avoiding patients unnecessary diagnostic arthroscopy.”$^{16}$ |
<table>
<thead>
<tr>
<th>Author, Year</th>
<th>Study Characteristics: Intervention; Comparator</th>
<th>Outcomes</th>
<th>Results</th>
<th>Author Conclusions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major, 2011</td>
<td>N = 42 patients Mean age 33 years 3-T MRA; 3-T MRI</td>
<td>Diagnostic accuracy for assessing labral abnormalities in the shoulder</td>
<td>Compared with 3-T MRI, 3-T MRA appeared to have superior diagnostic accuracy for the detection of labral tears of the shoulder, but this apparent difference was not statistically analyzed.</td>
<td>“Although the power of our preliminary study is small, the results suggest that intraarticular contrast material is helpful in diagnosing labral tears in the shoulder, particularly tears of the anterior labrum. Our preliminary results suggest that MR arthrography adds value for diagnosing labral tears in the shoulder compared with conventional MRI even at 3 T.”</td>
</tr>
<tr>
<td>Magee, 2009</td>
<td>N = 150 shoulders Patients aged 50 years or younger 3-T MRA; 3-T MRI</td>
<td>Diagnostic sensitivity for detection of shoulder labral tears</td>
<td>MRA was statistically superior to 3-T MRI regarding sensitivity for detection of anterior labral tears, and SLAP tears</td>
<td>“MR arthrography showed statistically significant increased sensitivity for detection of partial-thickness articular surface supraspinatus tears, anterior labral tears, and SLAP tears compared with conventional MRI at 3 T. On the basis of the above findings, we perform 3-T MR arthrography on patients for whom anterior labral tears, SLAP tears, and partial-thickness supraspinatus tendon tears are suspected clinically.”</td>
</tr>
<tr>
<td>Crespo-Rodriguez, 2017</td>
<td>N = 50 patients Mean age 42.5 years 1.5T MRA; 3T MRI</td>
<td>Diagnostic accuracy of labral lesions of the hip</td>
<td>1.5-T MRA did not appear to differ from 3-T MRI for detection of labral lesions of the hip</td>
<td>“3-T non-contrast MRI could replace MRA as the workhorse technique for assessing hip internal damage. MRA would then be reserved for young adults with a strong clinical suspicion of FAI but normal findings on 3-T non-contrast MRI.”</td>
</tr>
<tr>
<td>Magee, 2015</td>
<td>N = 43 patients 3-T MRA; 3-T MRI</td>
<td>Diagnosis of acetabular labral tears</td>
<td>3-T MRI did not appear to differ from 3-T MRA in the diagnosis of acetabular labral tears</td>
<td>“3.0-T MR demonstrated sensitivity for detection of acetabular labral tears that rivals the sensitivity of 3.0-T MR arthrography of the hip. In this series, 3.0-T MR arthrography was more sensitive than conventional 3.0-T MR for detection of acetabular chondral defects.”</td>
</tr>
<tr>
<td>Sutter, 2014</td>
<td>N = 28 patients Mean age 31.8 years MRA; MRI</td>
<td>Diagnosis of labral defects of the hip</td>
<td>MRA was superior to MRI for detecting labral tears at the anterosuperior quadrant (statistically significant for 1 / 2 readers)</td>
<td>“MR arthrography was superior to conventional MRI for detecting labral tears and acetabular cartilage defects and showed a higher interobserver agreement.”</td>
</tr>
</tbody>
</table>
### Magnetic Resonance Imaging Arthrograms for Labral Tear Diagnosis

<table>
<thead>
<tr>
<th>Author, Year</th>
<th>Study Characteristics: Intervention; Comparator</th>
<th>Outcomes</th>
<th>Results</th>
<th>Author Conclusions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tian, 2014&lt;sup&gt;13&lt;/sup&gt;</td>
<td>N = 90 patients MRA; MRI</td>
<td>Diagnosis of acetabular labral tears</td>
<td>The sensitivity and negative predictive value of MRA were significantly higher than those of conventional MRI.</td>
<td>“Hip MR arthrography is a reliable evaluation modality for diagnosing the acetabular labral tears, and its diagnostic performance is superior to that of conventional MR at 3.0 T.”&lt;sup&gt;13&lt;/sup&gt;</td>
</tr>
<tr>
<td>Zlatkin, 2010&lt;sup&gt;18&lt;/sup&gt;</td>
<td>N = 14 patients Indirect MRA; MRI</td>
<td>Diagnostic accuracy for acetabular labral lesions of the hip</td>
<td>MRA appeared to have superior diagnostic accuracy compared with MRI and produced better delineated images of labral tears.</td>
<td>“IV contrast-enhanced indirect MR arthrography appears to be an effective means of hip evaluation for labral tears.”&lt;sup&gt;18&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

3-T = 3-Tesla; ABER = abduction-external-rotation; AUC = area under the curve; AUROC = area under the receiver operating characteristic; cMRI = conventional MRI; FAI = femoro-acetabular impingement; MRA = magnetic resonance arthrogram; MRI = magnetic resonance imaging; NA = not available; SLAP = superior labrum anterior to posterior.

### References Summarized

Health Technology Assessments

No literature identified.

Systematic Reviews and Meta-analyses


**Randomized Controlled Trials**

No literature identified.

**Non-Randomized Studies**


Guidelines and Recommendations