The detection of loose bodies in the elbow

THE VALUE OF MRI AND CT ARTHROGRAPHY

J. H. Dubberley, K. J. Faber, S. D. Patterson, G. Garvin, J. Bennett, W. Romano, J. C. MacDermid, G. J. W. King

From the University of Western Ontario, London, Canada

Arthroscopic surgery is highly effective for the removal of loose bodies in patients presenting with mechanical symptoms in the elbow.1,2

Our aim was to determine the clinical value of MRI and CT arthrography in predicting the presence of loose bodies in the elbow.

A series of 26 patients with mechanical symptoms in the elbow had plain radiography, MRI and CT arthrography, followed by routine arthroscopy of the elbow. The location and number of loose bodies determined by MRI and CT arthrography were recorded. Pre-operative plain radiography, MRI and CT arthrography were compared with arthroscopy.

Both MRI and CT arthrography had excellent sensitivity (92% to 100%) but low to moderate specificity (15% to 77%) in identifying posteriorly-based loose bodies. Neither MRI nor CT arthrography was consistently sensitive (46% to 91%) or specific (13% to 73%) in predicting the presence or absence of loose bodies anteriorly. The overall sensitivity for the detection of loose bodies in either compartment was 88% to 100% and the specificity 20% to 70%. Pre-operative radiography had a similar sensitivity and specificity of 84% and 71%, respectively.

Our results suggest that neither CT arthrography nor MRI is reliable or accurate enough to be any more effective than plain radiography alone in patients presenting with mechanical symptoms in the elbow.

Arthroscopic surgery is highly effective for the removal of loose bodies in patients presenting with mechanical symptoms in the elbow.1,2

Our aim was to determine the clinical value of MRI and CT arthrography in predicting the presence of loose bodies in the elbow.

A series of 26 patients with mechanical symptoms in the elbow had plain radiography, MRI and CT arthrography, followed by routine arthroscopy of the elbow. The location and number of loose bodies determined by MRI and CT arthrography were recorded. Pre-operative plain radiography, MRI and CT arthrography were compared with arthroscopy.

Both MRI and CT arthrography had excellent sensitivity (92% to 100%) but low to moderate specificity (15% to 77%) in identifying posteriorly-based loose bodies. Neither MRI nor CT arthrography was consistently sensitive (46% to 91%) or specific (13% to 73%) in predicting the presence or absence of loose bodies anteriorly. The overall sensitivity for the detection of loose bodies in either compartment was 88% to 100% and the specificity 20% to 70%. Pre-operative radiography had a similar sensitivity and specificity of 84% and 71%, respectively.

Our results suggest that neither CT arthrography nor MRI is reliable or accurate enough to be any more effective than plain radiography alone in patients presenting with mechanical symptoms in the elbow.

Arthroscopic surgery is highly effective for the removal of loose bodies in patients presenting with mechanical symptoms in the elbow.1,2

Patients and Methods

We studied 26 patients (25 men and one woman) with a mean age of 36 years (15 to 59). All had a history of mechanical symptoms such as locking or catching, prompting surgical treatment. They all had pre-operative plain radiography (anteroposterior and lateral), MRI and CT arthrography. The study was approved by the Human Ethics Board of the University of Western Ontario.

All MRI studies were performed on a 1.5 Tesla magnet (Siemens, Erlanger, Germany) using a flexible 15 cm surface coil. The patients’ arm was placed at their side with the hand in a neutral position stabilised by a foam support. The following images were produced using 3D gradient echo (FISP; TR 30, TE 10, flip angle 55°) T2-weighted with a slice thickness of 1.5 mm reconstructed in all three planes, axial and sagittal T1 (TR 720, TE 15 slice thickness 3.0 mm) and axial proton and weighted T2 (TR 2400, TE 20/80) using a slice thickness of 3.0 mm.

All CT arthrography studies were performed on a helical scanner (General Electric Medical, Milwaukee, Wisconsin). The patient’s arm was placed above their head with the patient in a prone position on the CT table. Images were performed helically in an axial plane with a slice thickness of 1.0 mm and a pitch ratio of 1:1. The CT studies were performed within 30 minutes of a double-contrast arthrogram for which air and a diluted iodinated contrast were injected into the elbow through a lateral approach. The three sets of images were reported by three radiologists (WR, GG, JB) who were aware of the clinical diagnosis but did not know the result of the arthroscopy. They recorded the location and the number of loose bodies identified.
Routine arthroscopy of the elbow was performed by two authors (GJWK, SDP) at a mean interval of 2.4 ± 1.8 months (1 to 8) after imaging. Using multiple portals, care was taken to evaluate fully all the compartments of the elbow.

The results of the MRI and the CT arthrography were compared with each other. The agreement between the three radiologists with respect to the number of loose bodies which they observed on both MRI and CT arthrography was determined using an intraclass correlation coefficient (ICC). The sensitivity and specificity of plain radiography, CT arthrography and MRI for the overall presence or absence of a loose body in either compartment were compared with those of arthroscopy. Kappa values were also calculated for accuracy to reflect chance corrected agreement.

## Results

There was little difference between CT arthrography and MRI in regard to agreement between radiologists (Table I). There was more agreement when assessing the posterior (ICC = 0.72) than the anterior compartment (ICC = 0.52 for CT arthrography and 0.41 for MRI). This would suggest that neither MRI nor CT arthrography is better than the other in terms of reliability or accuracy.

The agreement on the number of loose bodies observed on MRI and CT arthrography compared with arthroscopy was also greater in the posterior compartment (Table II). If 0.75 was taken as a benchmark of excellent reliability, observer 1 was able to attain this level for both CT arthrography and MRI in the posterior compartment whereas observer 2 was unable to do so with either test and observer 3 did so for MRI only. None of the anterior compartment ICCs reached this level for any radiologist.

The superior diagnostic accuracy for the posterior compartment was also demonstrated when the data were expressed as the presence or absence of loose bodies rather than the number present. The Kappa values were statistically better than chance agreement for the posterior compartment but not the anterior compartment (Table III). When these data were simplified to determine the presence or absence of loose bodies anywhere in the joint, Kappa values tended to be midway between those for the anterior and posterior compartment since the error in the anterior compartment adversely affected overall reliability.

When the diagnostic accuracy was presented in terms of sensitivity and specificity, it was evident that most of the errors in the posterior compartment were false-positive rather than false-negative. In the anterior compartment neither sensitivity nor specificity was consistently high. When data were collapsed to the presence or absence of loose bodies anywhere in the elbow, sensitivity was very high but specificity tended to be low, suggesting that false-positive results were a clinical concern (Table IV). There was no clinically relevant difference between CT arthrography and MRI in terms of the detection of loose bodies and they were no better than the original pre-operative radiological reports.

## Discussion

Pain in the elbow and mechanical symptoms such as ‘locking’ and ‘catching’ are often caused by loose bodies which typically are the result of osteoarthritis, osteochondritis...
Loose bodies may have moved from one compartment to another during all of the investigations. These limitations would have applied equally across imaging modalities and therefore were unlikely to have contributed any bias to our conclusions. Another limitation was the relatively small sample size which resulted in statistical comparisons which were underpowered. Studies with larger sample sizes may establish statistical differences between CT arthrography, MRI and plain radiography, but also need to determine whether observed differences fall within a clinically meaningful range. Finally, since we carried out the study, advances have been made in both CT and MRI. Currently at our centre, CT arthrography is performed with a single-contrast technique, thinner slices and multiplanar reconstruction. MRI is done with thinner 3D slice profiles for the gradient sequences and better reconstruction algorithms. These advances may improve the accuracy of both of these tests.

Recently, both ultrasonography and MRI arthrography have been proposed to be efficacious for the diagnosis of loose bodies. Further studies are required to validate the effectiveness of these newer methods compared with those which we have studied.

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

References