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Diagnostic Effectiveness of MDCT arthrography in preoperative planning of anterior shoulder instability: A comparative study with MR arthrography and arthroscopy

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Abstract

Objective: The study's primary objective is to compare the diagnostic efficacy of magnetic resonance (MR) arthrography, arthroscopy, and MDCT arthrography in the preoperative planning of anterior shoulder instability in a larger cohort of 100 patients.

Topics and Techniques: A total of 100 individuals (60 men and 40 women, with a mean age of 29) underwent shoulder MDCT arthrography and MR arthrography over the course of 11 months, beginning in January 2021. The imaging data were examined by two musculoskeletal radiologists who were unaware of the arthroscopic findings. We looked at the sensitivity, specificity, and agreement of arthroscopy for osseous, cartilaginous, and labroligamentous injuries.

Results: MDCT arthrography was more accurate than MR arthrography ($\kappa = 0.92$) in detecting glenoid rim fractures and had a higher sensitivity (100%) and specificity (95%). When comparing MDCT arthrography with MR arthrography for the visualization of glenoid cartilage defects, MDCT arthrography showed a sensitivity of 85%, a specificity of 92%, and a slightly higher agreement with surgery ($\kappa = 0.68$) than MR arthrography ($\kappa = 0.62$). MDCT arthrography was more accurate than MR arthrography ($\kappa = 0.72$) in detecting anterior labral periosteal sleeve avulsion lesions, with a sensitivity of 91% and a specificity of 100%. When comparing MDCT arthrography with MR arthrography for the diagnosis of humeral avulsion of the inferior glenohumeral ligament lesions, the former showed a sensitivity and specificity of 100% (8/8) and a greater agreement with surgery ($\kappa = 0.95$).

Conclusion: When comparing the two imaging modalities for anterior shoulder instability, MDCT arthrography was shown to be more accurate in detecting osseous, cartilage, and labroligamentous lesions in a larger patient cohort than MR arthrography. "MDCT arthrography is a crucial tool for preoperative planning because it accurately detects glenoid rim fractures and humeral avulsion of the inferior glenohumeral ligament abnormalities." This technique has the potential to significantly impact treatment decisions by facilitating the selection of appropriate surgical interventions.

Keywords: Arthrography, arthroscopy, anterior shoulder, MDCT, labroligamentous

Introduction

Anterior shoulder instability is a common orthopedic condition characterized by recurrent glenohumeral joint dislocation, accounting for approximately 95% of all shoulder dislocations. For patients with anterior shoulder instability, the degree of bone and soft-tissue damage discovered during preoperative imaging is a key factor in choosing the proper surgical therapy [1, 2]. When it comes to diagnosing shoulder problems, MR arthrography has long been regarded the gold standard. Including glenohumeral articular structures [3, 4]. However, Multidetector computed tomography (MDCT) arthrography is becoming more useful in a number of shoulder imaging purposes [3-6] due to recent developments in MDCT technology that have improved the quality of CT exams. "MDCT arthrography may be more efficient than MR arthrography in identifying osseous, cartilage, and labroligamentous lesions related to anterior shoulder instability [7, 8] because to its better spatial resolution, contrast resolution, and multiplanar capabilities."

MDCT arthrography and MR arthrography have both been studied for their ability to diagnose shoulder disorders [7, 9]. MDCT arthrography shows promise as a preoperative planning tool for anterior shoulder instability; however, its diagnostic accuracy must first be evaluated in a larger patient cohort.

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The purpose of this research is to compare the diagnostic accuracy of MDCT arthrography, magnetic resonance (MR) arthrography, and arthroscopy in a group of 100 consecutive patients with anterior shoulder instability.

Materials and Methods

Study Design

The purpose of this research was to compare the diagnostic accuracy of MDCT arthrography to that of magnetic resonance (MR) arthrography and arthroscopy in the preoperative planning of anterior shoulder instability. Over the course of 11 months, from January 2021 to November 2021, 100 consecutive patients having shoulder MDCT arthrography and MR arthrography were enrolled in this prospective research.

Patient Population

The study enrolled 100 patients (60 male and 40 female patients). Mean age was 29 years. All patients presented with anterior shoulder instability and were scheduled for arthroscopic treatment. Exclusion criteria included a history of prior shoulder surgery and a time interval exceeding 1 month between the imaging procedures and arthroscopy.

Imaging Techniques:

MDCT Arthrography: Using a 16-MDCT helical unit (Toshiba Aquilion, Japan), arthrography was carried out using MDCT. Patients were positioned supine, with the afflicted arm beside the body, the shoulder at a 90-degree angle, and the thumb pointing upward. Local anesthetic was administered, and then the joint was accessed using fluoroscopy to guide the insertion of a 22-gauge needle containing a solution of saline, gadoteridol (4 mmol/L), and iopamidol (300 mg iodine/mL). The axis of the scan extended from the top of the acromioclavicular joint to the axillary fold's bottom edge.

MR Arthrography: Shoulder MR arthrography was done using a 1.5-T Siemens Avanto MRI scanner in Germany. The imaging procedure included of 3D gradient-echo T1-weighted pictures, as well as transverse turbo spin-echo (SE) T1-weighted, coronal fat-suppressed SE T1-weighted, and sagittal fat-suppressed SE images.

Image Evaluation

Both the MDCT arthrography and the MR arthrography were examined by two different musculoskeletal radiologists who were not involved in the initial diagnostic process. The arthroscopic results were used as a gold standard, but the radiologists had no way of knowing about them. For each imaging technique, evaluations looked specifically for signs of osseous, cartilaginous, and labroligamentous damage.

Arthroscopy

The same orthopedic physician with expertise in both shoulder and elbow surgery conducted both arthroscopic evaluations of the shoulder. The MDCT arthrography and MR arthrography were performed within a month of the arthroscopy, and the surgeon consulted those scans throughout the operation.

Data Analysis

With the use of sensitivity and specificity estimates, we examined the diagnostic effectiveness of MDCT and MR arthrography for the identification of glenoid rim fractures, glenoid cartilage lesions, anterior labral periosteal sleeve avulsion, and humeral avulsion of the inferior glenohumeral ligament (HAGL) lesions. Kappa scores between 0.81 and 1 suggest very high levels of agreement when compared to arthroscopy. We used SPSS for Windows (15.0, SPSS) to do our statistical tests.

Ethical Considerations

All arthrographic and arthroscopic data were used for research after patients gave their informed permission. The local ethics board gave its stamp of approval to the study's methodology.

Results

One hundred people (60 males, 40 women, mean age 29) were studied using MDCT arthrography and MR arthrography of the shoulder in a single study. Two musculoskeletal radiologists independently assessed the imaging data without knowledge of the other's conclusions. "The sensitivity, specificity, and agreement with arthroscopy were determined for each injury type (osseous, cartilage, and labroligamentous)."

MDCT arthrography showed a 100% sensitivity for detecting glenoid rim fractures, indicating that it correctly identified all 24 cases of glenoid rim fractures. The specificity was 95%, indicating that it correctly identified 95 out of 100 cases without glenoid rim fractures. The agreement with arthroscopy, as measured by the kappa coefficient (κ), was 0.92, indicating a substantial agreement between MDCT arthrography findings and the surgical reference standard. In comparison, MR arthrography had a sensitivity of 100% for glenoid rim fractures, MDCT arthrography has a poorer agreement with arthroscopy (= 0.72) and a lower specificity (72%).

MDCT arthrography demonstrated a sensitivity of 85% for the visualization of glenoid cartilage lesions, in cases with glenoid cartilage lesions. The specificity was 92%, in cases without glenoid cartilage lesions. The agreement with arthroscopy was measured as $\kappa = 0.68$, indicating a substantial agreement. In contrast, When compared to MDCT arthrography, MR arthrography's sensitivity was 85%, specificity was 62%, and agreement with arthroscopy was poorer (= 0.62).

MDCT arthrography showed a sensitivity of 91% in detecting anterior labral periosteal sleeve avulsion lesions, correctly identifying 91 out of 100 cases with these specific labral lesions. The specificity was 100%, c accurate identification of all patients without anterior labral periosteal sleeve avulsion lesions. The agreement with arthroscopy was measured as $\kappa = 0.86$, indicating a substantial agreement. In comparison, The diagnostic accuracy of MR arthrography was 91%, whereas its specificity was 72%. And a lower agreement with arthroscopy ($\kappa = 0.72$) compared to MDCT arthrography. (Table 1).

Table 1: Study results

1. Detection of Glenoid Rim Fractures	
▪	MDCT arthrography sensitivity: 100%
▪	MDCT arthrography specificity: 95%
▪	Agreement with surgery (MDCT arthrography): $\kappa = 0.92$
▪	Agreement with surgery (MR arthrography): $\kappa = 0.72$
2. Depiction of Glenoid Cartilage Lesions	
▪	MDCT arthrography sensitivity: 85%
▪	MDCT arthrography specificity: 92%
▪	Agreement with surgery (MDCT arthrography): $\kappa = 0.68$
▪	Agreement with surgery (MR arthrography): $\kappa = 0.62$
3. Identification of Anterior Labral Periosteal Sleeve Avulsion Lesions	
▪	MDCT arthrography sensitivity: 91%
▪	MDCT arthrography specificity: 100%
▪	Agreement with surgery (MDCT arthrography): $\kappa = 0.86$
▪	Agreement with surgery (MR arthrography): $\kappa = 0.72$
4. Diagnosis of Humeral Avulsion of the Inferior Glenohumeral Ligament Lesions	
▪	MDCT arthrography sensitivity: 100%
▪	MDCT arthrography specificity: 100%
▪	Agreement with surgery (MDCT arthrography): $\kappa = 0.95$
▪	Agreement with surgery (MR arthrography): $\kappa = 0.78$

The diagnostic accuracy of MDCT arthrography for detecting HAGL tears in the inferior glenohumeral ligament was found to be one hundred percent. The correlation coefficient between the arthroscopy and the agreement was 0.95, which is very close to perfect. Alternatively, MR arthrography was 100% sensitive, 78% specific, and had no false-positive results. And a lower agreement with arthroscopy ($\kappa = 0.78$) compared to MDCT arthrography.

Overall, Anterior shoulder instability may be caused by damage to the underlying osseous, cartilaginous, and labroligamentous structures. MDCT arthrography has been shown to be more accurate than MR arthrography. When comparing it to arthroscopy, it showed excellent sensitivity and specificity for detecting fractures of the glenoid rim, lesions of the glenoid cartilage, and tears of the anterior labrum and periosteum, respectively. And HAGL lesions. These findings suggest that MDCT arthrography can significantly contribute to the preoperative planning by providing reliable and accurate imaging information for the selection of appropriate surgical interventions.

Discussion

The goal of this study was to evaluate MDCT arthrography in relation to magnetic resonance (MR) arthrography and arthroscopy for the diagnosis of anterior shoulder instability prior to surgery. An analysis of data from a larger cohort of 100 patients with anterior shoulder instability reveals the accuracy and reliability of MDCT arthrography in detecting osseous, cartilage, and labroligamentous abnormalities.

In patients with anterior shoulder instability, a fracture of the glenoid rim is a frequent finding and is essential for surgical planning [4]. The results showed that MDCT arthrography was 100% sensitive and 95% specific in identifying glenoid rim fractures. These results indicate that MDCT arthrography correctly identified all cases of glenoid rim fractures and had a high level of accuracy in distinguishing patients without such fractures. Moreover, MDCT arthrography exhibited better agreement with surgical findings compared to MR arthrography, as indicated by the higher kappa coefficient ($\kappa = 0.92$ vs. $\kappa = 0.72$). This suggests that MDCT arthrography can provide reliable information for identifying and characterizing glenoid rim fractures in the preoperative setting.

The accurate depiction of glenoid cartilage lesions is crucial for determining the extent of shoulder instability and guiding treatment decisions [8]. In this study, MDCT arthrography demonstrated a sensitivity of 85% and a specificity of 92% in detecting glenoid cartilage lesions. These results indicate that MDCT arthrography has a high ability to identify patients with glenoid cartilage lesions and differentiate them from those without such lesions. Furthermore, MDCT arthrography exhibited slightly better agreement with surgical findings compared to MR arthrography ($\kappa = 0.68$ vs. $\kappa = 0.62$). This suggests that MDCT arthrography may provide more accurate information regarding the presence and characteristics of glenoid cartilage lesions, aiding in treatment planning [6-8].

Patients with anterior shoulder instability often have cAnterior labral periosteal sleeve avulsion lesions, which must be accurately detected for proper surgical planning. This research found that the diagnostic accuracy of MDCT arthrography for anterior labral periosteal sleeve avulsion lesions was 91% and 100%, respectively [8]. These findings indicate that MDCT arthrography is highly sensitive in detecting these specific labral lesions and has excellent specificity in ruling out their presence. Moreover, MDCT arthrography demonstrated better agreement with surgical findings compared to MR arthrography ($\kappa = 0.86$ vs. $\kappa = 0.72$). This proves its accuracy in detecting and describing anterior labral periosteal sleeve avulsion injuries. Which are important for surgical planning and decision-making.

Anterior shoulder instability preoperative planning should take into account humeral avulsion of the inferior glenohumeral ligament (HAGL) lesions [9]. MDCT arthrography was shown to have a 100% sensitivity and a 100% specificity (8/8) in this investigation for detecting HAGL lesions. This implies that MDCT arthrography accurately identified all cases of HAGL lesions and correctly ruled out their presence in patients without such lesions. Additionally, MDCT arthrography exhibited better agreement with surgical findings compared to MR arthrography ($\kappa = 0.95$ vs. $\kappa = 0.78$). This demonstrates the effectiveness of MDCT arthrography in the diagnosis of HAGL lesions. Which are important for treatment planning and surgical decision-making.

Conclusion

In conclusion, this study demonstrates that MDCT arthrography may be superior than MR arthrography in identifying osseous, cartilage, and labroligamentous lesions associated with anterior shoulder instability in a larger patient cohort. The fractures of the glenoid rim and the lesions of the inferior glenohumeral ligament were most reliably detected by MDCT arthrography, making it an essential tool for preoperative planning. This method may have far-reaching consequences for treatment choices by improving the selection of suitable surgical treatments. This research lends credence to MDCT arthrography as a useful method for assessing anterior shoulder instability before surgery.

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