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# Medical students' skills in research: unveiling their potentials. Shoulder MRI as a model

A. KHANFAR[1,2], B. AL QAROOT[3], L. ALSHABATAT[4], S. ALAROOD[4], Z. ZURIKAT[4]

[1]Department of Special Surgery (Orthopedics), School of Medicine, University of Jordan, Amman, Jordan
[2]Department of Orthopedics, Jordan University Hospital/The University of Jordan, Amman, Jordan
[3]Department of Prosthetics and Orthotics, School of Rehabilitation Sciences, University of Jordan, Amman, Jordan
[4]School of Medicine, University of Jordan, Amman, Jordan

*Both Aws Khanfar and Bashar Al Qaroot are jointly the first authors of this manuscript*

**Abstract. – OBJECTIVE: Medical research is an ever-growing discipline in medical practice and education. Unveiling the potential capabilities of medical students requires unusual research protocols. Magnetic resonance imaging (MRI) is a standard method for assessing medical conditions. Encouraging students to be part of medical research and/or decision-making is of paramount importance.**

**MATERIALS AND METHODS: Thirty shoulder MRI series were selected randomly from the Jordan University Hospital database. Three medical students took five measurements in each MRI series. The measurements were repeated twice on two different days. A consultant orthopedic surgeon performed measurements on the selected series. The measurements of the students were compared to those of the consultant; interobserver and intraobserver reliability was calculated.**

**RESULTS: Intraobserver reliability was determined from two readings per student; the ICC was 0.984 ($p < 0.05$). Interobserver reliability between measurements was 0.995 ($p < 0.05$). Finally, the absolute agreement between the students and consultant was assessed, and the k-value was 0.991 ($p < 0.05$), indicating that interobserver and intraobserver concordance was highly significant.**

**CONCLUSIONS: The agreement between the students and the orthopedic surgeon was highly significant. The intraobserver and interobserver reliabilities were also highly significant. Findings of the current study show that MRI series measurements can be performed with high accuracy after proper instruction is given to readers, regardless of their level of training.**

*Key Words:*
Interobserver, Intraobserver, Medical research, Medical students, MRI.

## Introduction

Magnetic resonance imaging (MRI) is an essential diagnostic tool that is becoming integral for obtaining accurate clinical assessments in many diseases. It is also a reliable tool for medical research. The widespread use of MRI scans is due to their availability, multiplanar properties, and advantages in revealing structures that are not readily revealed by conventional radiography or computerized tomography, such as soft tissue[1]. Also, MRI scans are used widely to evaluate joint and tendon pathologies[2]. Thus, the use of this tool is considered an integral step in the assessment of many orthopedic conditions[3]. The importance of MRI scans cannot be overemphasized. To the best of our knowledge, data on medical students' skills in dealing with MRI measurements are lacking. However, it is widely accepted that medical students should receive more training in this field[4]. Proving their reliability in reading MRI scans would encourage more integration of research into their curricula. In addition, this strategy could increase the self-confidence of medical students and encourage them to become part of more sophisticated research projects. On the other hand, should we show the accuracy of medical students and/or ju-

*Corresponding Author:* Aws Khanfar, MD; e-mail: a.khanfar@ju.edu.jo

nior doctors in dealing with MRI scans, it would be rational to get them more involved in patients' care. This would increase their competence as well as their confidence from their involvement in "participation in practice"[5]. Furthermore, integrating the medical students in patients' care is of utmost importance in areas where the number of the medical staff is small.

We noticed that medical students tended to avoid participating in research involving performing MRI measurements. We believe that this attitude is ubiquitous among medical students worldwide. The aim of this study was to determine the capability of sixth year (last year) medical students in interpreting MRI scans and performing measurements in a shoulder MRI series. Interobserver and intraobserver reliabilities of the medical students' readings were assessed. In addition, their results were compared to the readings taken by a consultant orthopedic surgeon. The findings of the current study could widen our perception of the real capabilities of medical students in terms of both research and patient care.

## Materials and Methods

After obtaining approval from the Ethics Committee, a series of 30 shoulder MRI scans from patients with shoulder dislocations were selected randomly from the Jordan University Hospital database by an orthopedic consultant. Simple random sampling was used based on patients' file numbers, regardless of gender, side involved, age, mechanism of injury, or MRI findings. In addition, official radiologists' reports of these series were hidden throughout the study.

Three medical students at the University of Jordan were assigned to participate in the current study by the Research Committee of the School of Medicine as part of the requirements for earning an MD degree. The students did not have any prior knowledge of the research that they would be part of, and they had no previous experience in reading shoulder MRI scans.

The current study involved performing five measurements on each MRI series: 1) glenoid depth, 2) humeral containment angle, 3) glenoid retroversion, 4) humeral head diameter, and 5) glenoid diameter (explained later). The assigned students took the measurements after being tutored on how to perform them. One week later and before embarking on the study, the students performed these measurements in front of the consultant orthopedic surgeon to emphasize proper understanding, and they were given further instructions if mistakes were noted.

Each student, separately and independently, repeated measurements twice on two different days to investigate interobserver and intraobserver reliability. The consultant orthopedic surgeon performed the measurements on the same selected MRI series to verify agreement with their measurements.

Each student performed 300 measurements (five measurements in each of the 30 MRI series performed twice). A total of 900 different MRI measurements were available for interobserver and intraobserver reliability analyses. These results were then compared to 150 measurements performed by the consultant orthopedic surgeon (five measurements per series).

The interclass correlation coefficient (ICC) estimates, and their 95% confidence intervals were calculated using SPSS software (version 16 IBM NY) based on a mean rating (k = 3), absolute-agreement, two-way mixed-effects model, which was utilized to assess interobserver and intraobserver reliability. The results were considered significant if the p-value was less than 0.05, and the confidence interval (CI) was set to 0.95. The absolute agreement was considered identical if the result was 1.0, and no correlation was found if the result was 0. Excellent reliability was set at ICC > 0.9, good at 0.75-0.9, moderate at 0.5-0.75, and poor if < 0.5[6].

The students' measurements, which were performed on days one and two, were pooled and compared to the consultant orthopedic surgeon measurements using absolute agreement (kappa statistics).

### Shoulder Measurements Description

All measurements were performed using the axial T1 sequences. The specific cut was determined by the student and was not predetermined; that is, the student went through the entire series and selected the appropriate cut to perform the measurements. The appropriate cut was the one with the largest glenoid diameter. The glenoid diameter was measured from the anterior to the posterior margins of the glenoid[7] (Figure 1). The depth was measured from the perpendicular line connecting the glenoid diameter line to the deepest point of the glenoid[7] (Figure 1).

The glenoid version angle was measured according to the angle formed from the intersection of two lines: a line from the anterior to the poste-

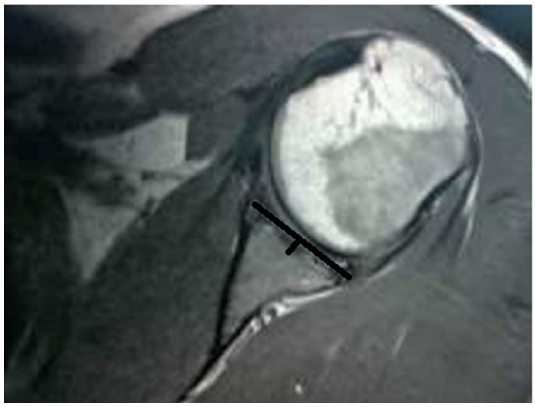

**Figure 1.** Gleniod diameter and depth measurement technique.

rior margins of the glenoid and a line drawn from the scapular base to the mid-glenoid level[8]. The lower outer angle was measured. This angle was deducted from 90°, and the result was the glenoid version. Retroversion was considered a negative value, and anteversion was considered a positive value (Figure 2).

The humeral containment angle was measured according to the angle formed between the center of the humeral head and the margins of the glenoid[7] (Figure 3).

The humeral diameter was measured from the anterior to the posterior borders of the humeral head[7] (Figure 4).

## Results

The absolute agreement between the participating students' measurements and the consultant's measurements was 0.991 (0.988-0.993, CI 0.95, $p < 0.05$).

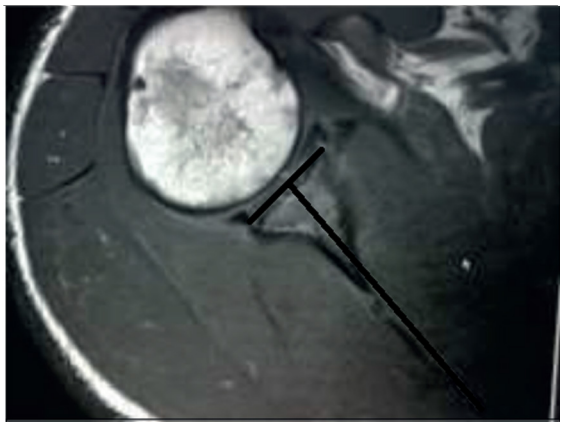

**Figure 2.** Gleniod version measurement technique.

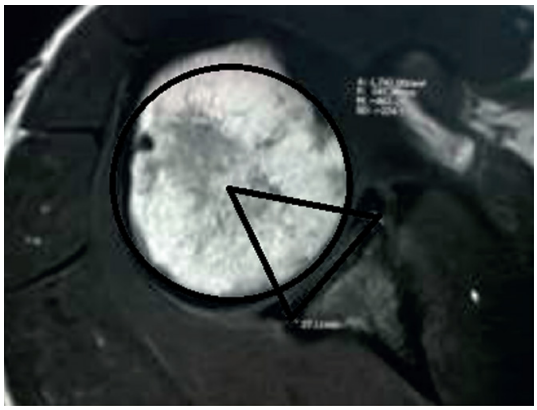

**Figure 3.** Humeral containment angle measurement technique.

After calculating the average student measurements performed on days one and two, the absolute agreement was 0.998 (0.997-0.998, CI 0.95, $p < 0.05$).

Both results proved the high concordance of the students' measurements with the consultant's measurements.

Intraobserver reliability assessing the readings of each student on two separate days was measured by interclass correlation. It was also very significant at 0.984 (0.980-0.987, CI 0.95, $p < 0.05$).

Interobserver reliability was assessed using the same test, again showing high significance (0.993-0.996, CI 0.95, $p < 0.05$) (Table I).

## Discussion

The results showed a high concordance of the students' measurements with the consultant's measurements, pointing to their veracity. In ad-

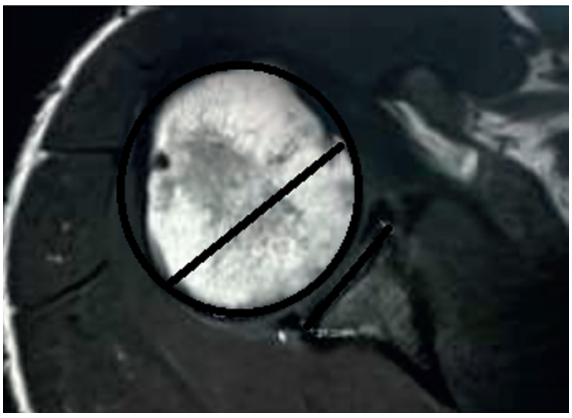

**Figure 4.** Humeral head diameter measurement technique.

**Table I.** ICC results.

| | ICC | Upper bond | Lower bond | *p*-value |
|---|---|---|---|---|
| Intraobserver | 0.984 | 0.987 | 0.980 | 0.000 |
| Interobserver | 0.995 | 0.996 | 0.993 | 0.000 |

dition, the measurements showed high interobserver and intraobserver reliability. These results show the high reliability of medical students' independent performance in measuring the MRI series. The measurements were accurate, reliable, and reproducible. Even with no prior experience, accuracy was achievable after tutoring the students on how to perform these five measurements. These results may reflect students' high commitment and precision while taking these measurements.

Our results were in accordance with those of a previous study that showed high interobserver and intraobserver reliabilities when dealing with medical students' MRI measurements[9]. In addition, our results contradict the study by Verhulst et al[10], who showed low intraobserver reliability for a medical student's measurements. However, their conclusion was based on results obtained by a single medical student who performed multiple measurements on different radiological modalities (i.e., radiographs, CT scans, and MRI scans). On the other hand, the authors did not specify whether the student had undergone proper training before commencing the study.

Recently, the research culture in medical schools has received more attention and acceptance among medical students[11]. Thus, in addition to instructing medical students in clinical practice, research is crucial for the development and improvement of tools to establish guidelines for good clinical practice, patient care, and decision-making[12,13]. However, many medical students in our institution are reluctant to participate in research involving detailed measurements of MRI scans. This study addressed this crucial area and showed encouraging results, unveiling the potential capabilities of medical students in participating in research relying on MRI measurements after brief tutoring.

The MRI is a well-established diagnostic tool in current clinical practice[14]. Since it is extremely important to build evidence-based medicine in medical research, it is of paramount importance to study the accuracy of medical students' measurements when conducting research relying on MRI scans.

The results of the current study should be taken into consideration when determining the role of medical students and/or junior doctors in the overall care of patients. Their potential capabilities are extremely high, and we should rely on them more. Exposing medical students to more clinical duties would improve their confidence and competence[5]. This is especially important in situations wherein the number of medical personnel is limited, or medical services are overwhelmed, as in the COVID-19 pandemic. We can let medical students and or/junior doctors cover areas of medical services depending on the type of instructions we give them and redirect the more trained medical staff to cover critical areas and/or situations.

### *Limitations*

The main limitation of this study was the small number of medical students taking the measurements. Although the number of MRI measurements performed by the students was high (900), the number of participating students was three. Future research should involve more medical and/or junior doctors. Furthermore, this study relied on shoulder MRI series. We do not know whether the conclusions of the current study would be applicable to MRI series of other joints or areas. Nonetheless, the medical students had no prior experience or exposure to shoulder MRI scans. Therefore, we assume that the results of the current study would be relevant to other MRI studies, regardless of the system or area studied, if participating students receive proper tutoring.

## Conclusions

The potential of medical students remains largely undiscovered. We should be enthusiastic about our expectations when dealing with them either clinically or in research. This investigation proves that they may be reliable even in difficult areas of medical research. They can perform accurate measurements on MRI series after receiving sound tutoring. We encourage tutors in medical faculties to consider medical students as active and reliable members of their teams.

### Conflicts of interest

The authors declare no conflicts of interest.

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