

# AUDIT ON ADEQUACY OF MAGNETIC RESONANCE IMAGING OF THE SHOULDER IN A TERTIARY CARE ONCOLOGICAL SETUP IN PAKISTAN

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## Descriptor

- An audit to assess and optimize the imaging planes and coverage of shoulder MRI.

## Background

- MRI is the preferred method to evaluate the shoulder joint mainly for ligamentous and tendon related pathologies. Moreover it also plays a vital role for assessment of bones.
- Routine MRI examination of the shoulder typically includes images acquired in the axial, oblique axial and oblique sagittal planes. It is important to angle the oblique coronal axis such that the rotator cuff tendons can be visualized in continuity.

## Guidelines

The American College of Radiology (ACR)<sup>1</sup> and European Society of Musculoskeletal Radiology (ESSR)<sup>2</sup> have published separate guidelines on the image planes and coverage of shoulder MRI.

Based on the guidelines there are two parameters:

- Adequate coverage
- Adequate imaging planes

## The Standards

(Fig. 1) shows planning planes on axial, oblique sagittal and coronal acquisitions. (Fig. 1A) on left shows planning of oblique coronal sequence on axial scanogram. Entire humeral head is covered, while the plane is parallel to the scapular body as well as the supraspinatus tendon. (Fig. 1B) (the middle image)

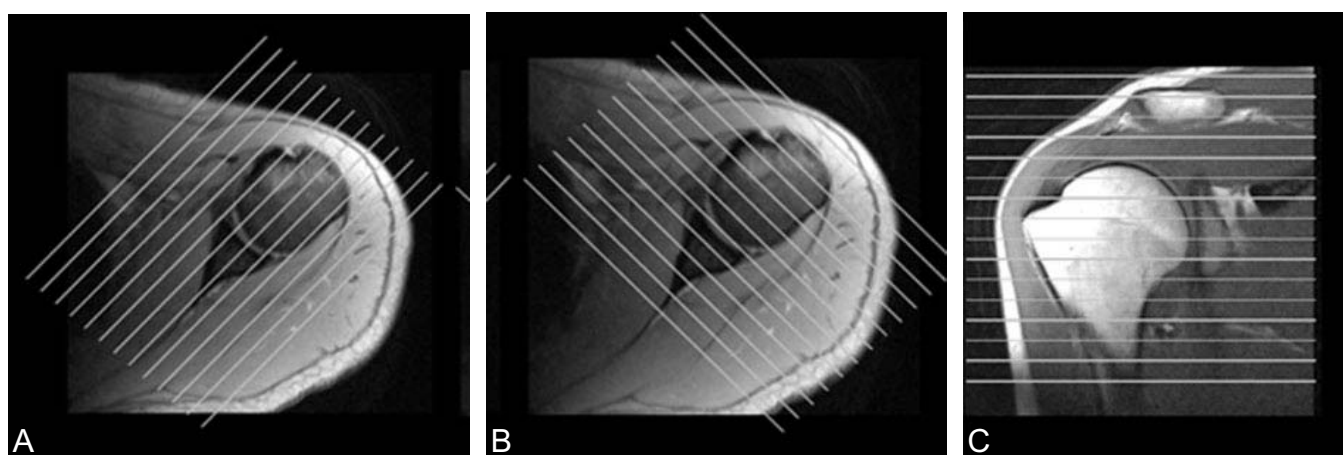


Figure 1A, B, C: Courtesy European Society of Skeletal Radiology Sports Sub-committee 2016

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shows scanogram planning for oblique sagittal sequences in which the coverage included lateral deltoid body till the scapular body. The imaging planes are perpendicular to the scapular body. (Fig. 1C) on right shows the planning for axial sequences in which the acquisition is done from above the level of acromioclavicular joint to below axillary pouch.

COVERAGE	
Axial	From above acromioclavicular joint to below axillary pouch
Oblique coronal	From coracoid process and include entire humeral head
Oblique sagittal	From lateral deltoid to scapular body

**Table 1:** Showing parameters based on ACR and ESSR guidelines for proper coverage of shoulder joint on MRI scan.

IMAGING PLANES	
Oblique coronal	Parallel to supraspinatus tendon or scapular body.
Oblique sagittal	Perpendicular to the supraspinatus tendon or scapular body

**Table 2:** Showing parameters based on ACR and ESSR guidelines for proper imaging planes of shoulder joint on MRI scan.

## Material and Methods

Retrospective analysis done on all the shoulder joint MRI scan following the guidelines by ACR and ESSR. The guidelines govern the alignment of the localizer parallel to the supraspinatus tendon or scapular blade. Adequate coverage is also necessary to ensure complete assessment of shoulder pathology.

### Resources:

- After taking permission from the institutional Audit committee, the previous data of patients for which MRI shoulder acquired accessed and MRI scans have been reviewed.
- Data collected and analyzed using an Excel sheet
- Picture archiving and communication system (PACS) and Radiology information system (RIS) record access taken for the study.

**Inclusion criteria:** All the adult patients with both genders having age 18 years or above were included in the study whose MRI shoulder joint acquired for the purpose of query related to non-oncological musculotendinous or ligamentous or osseous abnormalities.

**Exclusion criteria:** Pediatric patients were not included. All the patients whose MRI shoulder acquired on sarcoma / cancer protocol were excluded.

### Suggested number:

Retrospective cross-sectional analysis made for the total number of shoulder MRI done over 5 years of period. Total 136 patients were assessed after applying inclusion and exclusion criteria.

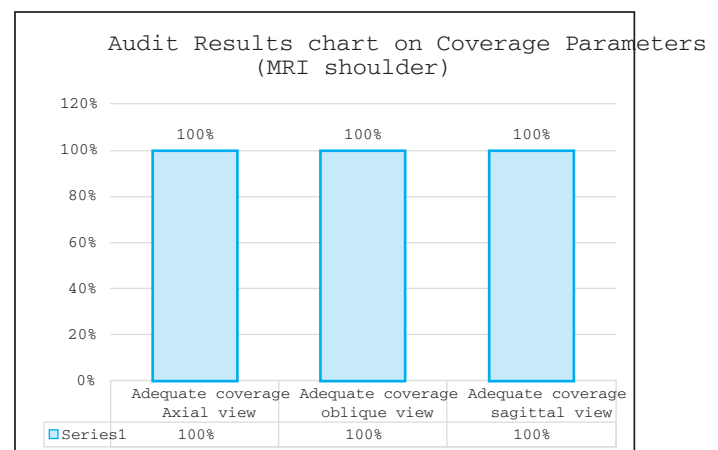
### Indicators:

- Percentage of examination with adequate coverage.
- Percentage of oblique coronal and sagittal planes orthogonal to the supraspinatus tendon.

Data analyzed in percentage for adequate and inadequate imaging based on set standards.

## Results

Coverage of the shoulder joint was assessed on three imaging sequences including Axial plane, oblique sagittal plane and oblique coronal plane. On assessment, all of these sequences show 100 % adequacy as far as adequate coverage was concerned.



**Figure 2:** Showing Audit results of Coverage parameters of MRI shoulder sequences at Radiology dept Shaukat khanum Hospital.

The imaging planes assessed on two planes i.e. oblique sagittal images and oblique coronal images. The angle was measured using PACS software and was measures with the scapular body/ blade. Most of the angle mistakes were identified on oblique

sagittal images. Angles of 10 degrees more or less to that of the 90 degrees were accepted as an operator or positional error. The scans in which the angle varied more than 10 degrees more or less were labeled inadequate. (Fig. 3 and 4) depict the examples of inadequate plane acquisition.

(Fig. 3B) on right showing wrongly acquired oblique sagittal view which renders inadequate evaluation of rotator cuff in the scan. (Fig. 3A) shows the plane of scan acquisition as depicted with yellow line. We can see the angle between the plane of acquisition and scapular body is 112 degrees which is not true perpendicular and is 22 degrees more than the 90 degree standard.

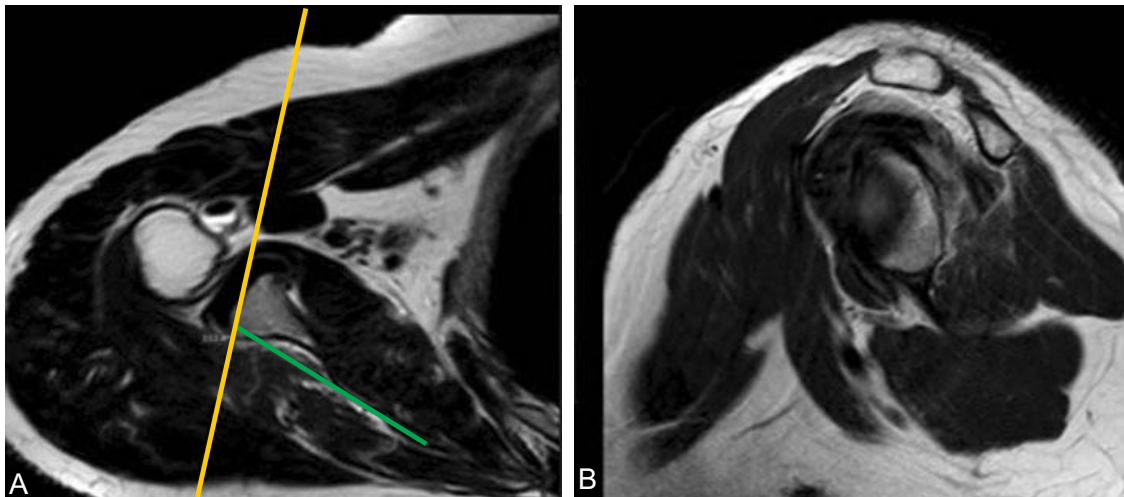


Figure 3A, B:

(Fig. 4B) on right shows wrongly acquired oblique coronal sequence with inadequate planes. This leads to misinterpretation and misdiagnosis. (Fig. 4A) on left is showing the plane of acquisition depicted as

yellow line. We can notice the angle between the plane of image and scapular body to be 20 which is quite more than the acceptable variable range on 10 degrees.

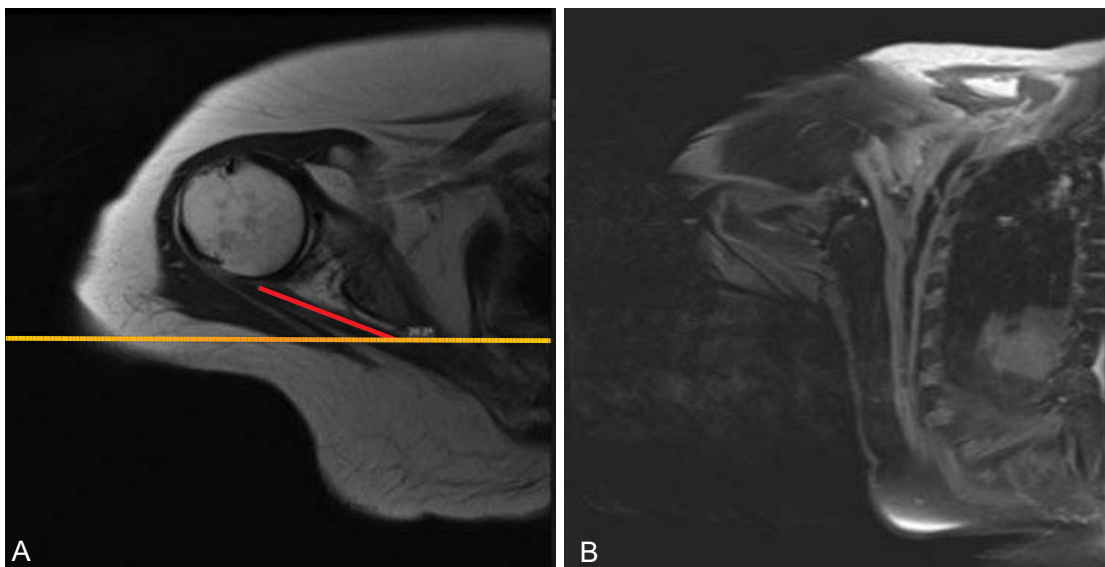
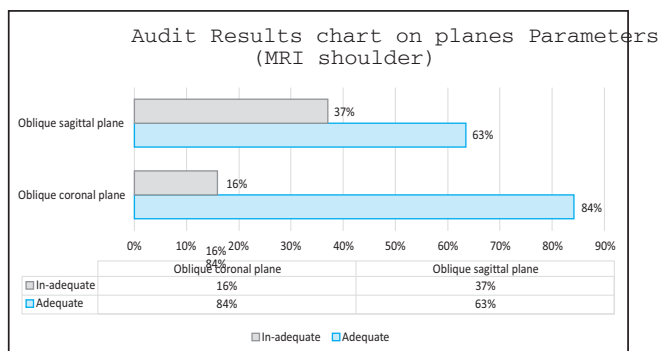


Figure 4A, B:



**Figure 5:** Showing Audit results of planes parameters of MRI shoulder sequences at Radiology dept Shaukat khanum Hospital.

The audit results illustrate that the main problem zone is in the proper acquisition of planes in oblique planes with more problems are faced in the oblique sagittal planes. The total adequate oblique sagittal scans are calculated to be 63% (N=85) with inadequate scans of 37% (N=51). Oblique coronals through less yet need improvement with inadequate scan of 16% (22) making adequacy of 84%(N=114). No doubt the coverage of the scans is adequate and meeting 100% criteria yet this should be maintained in future also.

#### Suggestions and recommendations:

- Provide education to MR radiographers on anatomy of rotator cuff and localization of central tendon of supraspinatus on axial planes.
- Handouts/poster displaying details of technique and adequate image parameters of MRI shoulder examination, highlighting importance of placing localizer orthogonal to central tendon of supraspinatus or scapular body.

## References

1. ACR-SPR-SSR Practice Parameter for the Performance and Interpretation of Magnetic Resonance Imaging (MRI) of the Shoulder. <https://www.acr.org/-/media/ACR/Files/Practice-Parameters/mr-shldr.pdf?la=en>
2. European Society of Skeletal Radiology Sports Sub-committee. Guidelines for MR Imaging of Sports Injuries - Shoulder, 2016. <https://essr.org/content-essr/uploads/2016/10/ESSR-MRI-Protocols-Shoulder.pdf>

3. Michael BZ. MRI of the shoulder, 2<sup>nd</sup> edition. Lippincott Williams & Wilkins, 2003.