

A Clinical Audit – Magnetic Resonance Imaging Knee Image Acquisition Adequacy

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Abstract

Objective: The objective of the study was to evaluate the adequacy of magnetic resonance imaging (MRI) scans of knee, performed at the Radiology Department of Dr. D Y Patil Medical College, Hospital and Research Centre, Pimpri, Pune, according to the American College of Radiologist guidelines.

Type of Study: This study was a clinical audit.

Place and Duration of Study: This study was conducted at Dr. D Y Patil Medical College, Hospital and Research Centre, Pimpri, Pune, from January 2018 to July 2018.

Materials and Methods: Retrospective study of approximate 40 patients who underwent MRI of knee in January 2018 for assessment of the quality of images obtained in the initial audit. Depending on the results of this first audit, a suggestion was made and reaudit was done 6 months later in July 2018 to look for improvement quality in local practice.

Results: In the initial audit, images were acquired in all the three necessary planes and the sagittal and coronal images had appropriate slice thickness as well as adequate anatomical coverage in all the patients. However, field of view (FOV) was inappropriately set in 34% of cases in axial plane, 90% in sagittal plane, and 95% in coronal plane. Furthermore, the anatomical coverage was not up to the mark in axial plane with 13 studies (66%) having adequate superior coverage, and 16 cases (80%) having recommended inferior anatomical coverage. The reaudit performed 6 months later showed improvement with 100% compliance to standards.

Conclusion: Initially, the first audit showed few lackings in acquiring of MRI knee images specifically with FOV to reduce the decrease in all planes and slight increase in anatomical coverage in the axial plane. These shortcomings and recommendations were made in departmental meetings and reaudit was done after 6 months. This reaudit showed 100% compliance.

Key words: Clinical audit, Image adequacy, Knee magnetic resonance

INTRODUCTION

Magnetic resonance imaging (MRI) is the imaging modality of choice to detect meniscal and ligament abnormalities. It is also good modality for the evaluation of bony and

cartilage abnormalities, malignancy, and fluid accumulation.^[1] As compared with diagnostic arthroscopy for evaluation of anterior cruciate ligament and menisci, MRI is superior.^[2] However, this can be only possible if it is adequately performed and analyzed. Few pivotal image quality parameters include anatomical coverage, appropriate image plane, and slice thickness. Later two are highly important for good signal to noise ratio. It is crucial for optimal evaluation and for diagnosis of significant pathology. The aim of this audit was to evaluate the quality of imaging in MRI of knee joint, performed in the Radiology Department of Dr. D Y Patil Medical College, Hospital and Research Centre, Pimpri, Pune.

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MATERIALS AND METHODS

The first audit was performed in the Radiology Department, Dr. D Y Patil Medical College, Hospital and Research Centre, Pimpri, Pune, in January 2018. The data were collected retrospectively from MRIs of knee, performed during the month of January. Forty-two knee MRIs were performed for various indications during this month, of which 40 were included in the audit. Two cases were excluded because the extensive motion artifacts and post-operative knee. The studies were assessed for various parameters, including both anatomical coverage and technical parameters (field of view [FOV] and slice thickness) and the data collected in a specially designed pro forma. Percentages were then calculated. The standard was set as 100% compliance to ACR guidelines.^[1] These guidelines included technical parameters and anatomical coverage [Annexure]. Technical parameters considered imaging acquired in three orthogonal planes (sagittal, coronal, and axial), FOV of 16 cm or smaller and slice thickness of 4 mm in coronal and sagittal planes. Anatomical coverage extended proximally to include distal aspect of quadriceps tendon and suprapatellar recess and distally to include insertion of patellar tendon and pes anserine (insertion of Sartorius, Gracilis, and semitendinosus). Based on the findings of the first audit, recommendations were made and suggested to the whole radiology department through meetings. Display of printed ACR guideline poster was put in the console room for the MR technicians as well as for resident doctors. A reaudit was targeted after 6 months to check the compliance of these recommendations. Subsequently, a reaudit was done in the same department, 6 months later in the end of July 2018 without any information to technicians and resident doctors. Data of 32 patients, who had undergone MRI knee in the month, were assessed for different parameters as per previous pro forma. Excel sheet data were entered in Epi Info 7.0 version and percentages were then calculated.

RESULTS

As summarized in Table 1, images were acquired in all three, i.e., axial, coronal, and sagittal planes in 40 cases. However, the FOV was not set according to the recommendations in most of these cases; FOV was inadequate (more than 16 cm) in axial images in 14 of the 40 studies (34%) and in 36 cases in sagittal plane (90%). In the images acquired in coronal plane, an FOV of <16 cm was used in all the cases. The slice thickness had been appropriately set. Hundred percent of the cases studied had been performed using slice thickness of 4 mm or less in both coronal and sagittal planes. The anatomical coverage was adequate both superiorly as well as inferiorly in both sagittal and coronal planes as advised in the ACR guidelines in all the 40 studies. However, this was not the case with axial imaging where superior coverage was according to guidelines in only 26 (66%) cases and the inferior coverage was adequate in 32 cases (80%). However, the reaudit done 6 months later showed achievement of target compliance with standards of 100% as summarized in Table 1. The anatomical coverage in all three planes as well as all the technical parameters including FOV and slice thickness was according to the standards set showing 100% compliance.

DISCUSSION

MRI is the most commonly used imaging modality for the evaluation of knee joint.^[3] Indeed, it is now the noninvasive imaging modality of choice complimentary to the clinical examination in the evaluation of injuries of the knee.^[4] MRI is an excellent tool for the evaluation of bony, cartilaginous, ligamentous, and synovial pathologies of knee joint such as trauma to infection and neoplasm. However, image analysis can only be as good as the quality of the original images acquired.^[5] Hence, proper image

Table 1: Comparison between initial audit and re-audit inadequacies

Parameter	Plane	Initial audit – total number of patients n=40	Inadequacy of initial audit in percentage n=40	Reaudit total number of patients n=32	Inadequacy of reaudit in percentage n=32
Images in 3-plane (sagittal, axial, and coronal)	(Sagittal, axial, and coronal)	40 (100)	0 (0)	32 (100)	0 (0)
Field of view (<16 cm)	Sagittal	4 (10)	36 (90)	32 (100)	0 (0)
	Coronal	2 (5)	38 (95)	32 (100)	0 (0)
	Axial	26 (66)	14 (34)	32 (100)	0 (0)
Slice thickness<4 mm	Coronal	40 (100)	0 (0)	32 (100)	0 (0)
	Sagittal	40 (100)	0 (0)	32 (100)	0 (0)
Superior coverage (suprapatellar joint recess)	Sagittal	40 (100)	0 (0)	32 (100)	0 (0)
	Coronal	40 (100)	0 (0)	32 (100)	0 (0)
	Axial	26 (66)	14 (34)	32 (100)	0 (0)
Inferior coverage (patellar tendon insertion)	Sagittal	40 (100)	0 (0)	32 (100)	0 (0)
	Coronal	40 (100)	0 (0)	32 (100)	0 (0)
	Axial	32 (80)	8 (20)	32 (100)	0 (0)

acquisition is crucial for proper diagnosis and evaluation. MRI quality relies on different parameters including magnetic field strength, sequences, slice thickness, inter-slice gap, image matrix and FOV, inherent contrast, and the use of surface coils.^[6] When imaging knee joint, it is important to acquire images in all three planes sagittal, coronal, and axial for better evaluation and diagnosing abnormalities,^[7] as the structures cannot be evaluated properly in a single plane. For cruciate ligaments, sagittal view is the better for evaluation; however, for menisci and collateral ligaments are best evaluated on coronal view and lastly, axial images are best for evaluation of periarticular fluid collection, plicae, patellofemoral joint, and femoral attachments of cruciate ligaments.^[8]

In our department, image acquiring had been performed in all three planes in all the patients of MR knee. FOV is indirectly related to the spatial resolution which is the crucial parameter which determines the image quality.^[6] For this reason, FOV in case of MRI of knee should be kept 16 cm or less and this was a parameter that had been inadequate in most of the cases specifically in sagittal and coronal planes. Another important factor is slice thickness which affects image quality and fortunately in all cases a slice thickness of 4 mm was present. Furthermore, it is important that all the structures related to knee joint are imaged. Superiorly, distal aspect of quadriceps tendon and suprapatellar joint recess should be included while scanning. Suprapatellar joint recess can have a number of conditions.^[9] There are high chances to miss pathology in these areas if not images. These were included in all patients for coronal and sagittal planes, however, missed in axial plane for 14 MRI performed in our department. The second audit, done 6 months later, showed 100% compliance with the standards set. The main factor for compliance improvement was guidance to the technicians about correct protocol while performing MRI scans of the knee.

CONCLUSION

For assessment of knee abnormalities, MRI is the imaging modality. Proper image acquisition is important for evaluation of pathology which depends on the proper technical parameters and adequate anatomical coverage. To put in nutshell, audit and reaudit done for MR knee adequacy was helpful to improve the quality and diagnosis of various knee abnormalities.

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ANNEXURE

**Dr. D Y Patil Medical College, Hospital and
Research Centre, Pimpri, Pune
Knee MR Audit Pro forma**

Date-

Investigator-

Parameters	Plane	Yes	No
Images in 3-plane	Sagittal		
	Coronal		
	Axial		
Field of view (<16 cm)	Sagittal		
	Coronal		
	Axial		
Superior coverage (suprapatellar joint recess)	Sagittal		
	Coronal		
	Axial		
Inferior coverage (patellar tendon insertion)	Sagittal		
	Coronal		
	Axial		
Slice thickness <4 mm	Sagittal		
	Coronal		

Source: ACR (American College of Radiology)