

Quality Control Analysis of 1.5 Tesla MRI Scanning Equipment at Sanjiwani Hospital Radiology Installation

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ABSTRACT

Magnetic Resonance Imaging (MRI) is an imaging modality that produces high-resolution anatomical images without the use of ionizing radiation. The quality of MRI images is influenced by the stability of the system, so the implementation of Quality Control (QC) is routinely needed to ensure image quality and support the accuracy of diagnosis. In hospitals with limited QC facilities, visual checklists and artifact evaluations are used as methods of monitoring system quality. This study aimed to analyze the implementation of Quality Control on the 1.5 Tesla MRI system at the Radiology Installation of Sanjiwani Hospital through visual checklist and artifact evaluation. This study was a descriptive observational study carried out at the Radiology Installation of Sanjiwani Hospital in February-March 2026. Data were obtained through direct observation of the implementation of QC, visual checklist assessment, and documentation of phantom image results. The data were analyzed descriptively. The results of the 30-day visual checklist showed that all parameters of the MRI system were functioning properly without any disturbances. Artifact evaluations conducted on February 26, 2026, March 5, 2026, March 12, 2026, and March 19, 2026 showed that no artifacts were found in the phantom image. Based on the guidelines of the American College of Radiology (ACR) 2015, phantom images appear round, homogeneous, symmetrical, without ghost images, abnormal shadows, or distortions. In conclusion, the implementation of Quality Control on the 1.5 Tesla MRI system at the Radiology Installation of Sanjiwani Hospital through visual checklist and artifact evaluation showed that the MRI system was operating well and had met the MRI Quality Control guidelines based on the 2015 ACR.

Keywords: quality control; 1.5 Tesla MRI System; visual checklist; artefact evaluation; american college of radiology

INTRODUCTION

Magnetic Resonance Imaging (MRI) is a non-invasive medical imaging modality that utilizes strong magnetic fields and radiofrequency pulses to generate highly detailed anatomical and functional images of the human body [1]. Since its introduction, MRI technology has undergone substantial advancements, particularly in the strength of the magnetic field and the sophistication of its acquisition and reconstruction techniques. Early MRI systems operated at approximately 0.064 Tesla, whereas contemporary clinical and research systems now routinely reach field strengths of 1.5 Tesla, 3 Tesla, and even 7 Tesla. This progressive increase in magnetic field strength has resulted in significant improvements in spatial resolution, signal sensitivity, tissue contrast, and diagnostic accuracy, thereby reinforcing MRI as one of the most indispensable imaging modalities in modern radiology [2]. The ability of MRI to visualize soft tissues with exceptional clarity makes it essential for evaluating neurological, musculoskeletal, cardiovascular, and abdominal pathologies.

Given the central role of MRI in diagnostic decision-making, the quality of MRI images becomes a critical determinant of clinical accuracy. High-quality images allow radiologists to identify subtle anatomical variations and pathological changes, whereas compromised image quality may obscure clinically relevant findings. For this reason, the implementation of Quality Control (QC) within the broader framework of Quality Assurance (QA) is essential. QC ensures the stability, reliability, and consistency of MRI system performance through systematic and periodic evaluations designed to detect deviations before they affect clinical outcomes [3]. In clinical practice, QC activities are typically categorized into daily, weekly, and monthly assessments. Daily QC, performed by radiographers using ACR ghost phantoms, includes bore inspections, patient safety checks, RF coil functionality assessments, and basic image quality verification. Weekly QC involves evaluating parameters such as central frequency, transmitter gain, Signal-to-Noise Ratio (SNR), slice thickness accuracy, wedge positioning, and geometric fidelity. Monthly QC, conducted by medical physicists, encompasses more advanced evaluations including B0 and B1 field constancy, gradient linearity, and overall system stability [4].

Quality Control (QC) constitutes a fundamental component of Quality Assurance (QA), focusing on monitoring and maintaining technical elements within imaging systems that directly influence image quality. QC activities encompass implementation procedures, equipment maintenance, performance supervision, and systematic evaluation of components that affect system reliability. The QC program generally consists of three major stages: Acceptance Testing, which identifies defects in newly installed or repaired equipment; Regular Performance Monitoring, which tracks changes in equipment performance at predetermined intervals; and Error Correction, which addresses irregularities detected during monitoring. Continuous QC implementation ensures that imaging systems consistently produce optimal image quality, uphold patient safety, and support accurate diagnostic interpretation [5].

Despite technological advancements, MRI image quality remains vulnerable to various sources of degradation, particularly the presence of artifacts. Artifacts are distortions or extraneous signals that do not represent true anatomical structures. Common artifacts include motion artifacts, ghosting, aliasing, susceptibility artifacts, and noise. These artifacts can significantly impair image quality and potentially lead to diagnostic misinterpretation [6]. Artifact formation is influenced by multiple factors, including hardware imperfections, software limitations, pulse sequence characteristics, and patient-related variables such as movement or tissue composition. System conditions, physiological processes, and tissue heterogeneity also contribute to artifact generation [7]. Hardware-related factors include magnetic field inhomogeneity, gradient nonlinearity, and radiofrequency interference, all of which may produce spatial distortions or signal inconsistencies [8]. Software-related factors arise from errors in image reconstruction, particularly in Fourier transformation and data processing, which may produce artifacts when acquired data do not align with reconstruction assumptions [9]. Pulse sequence-related artifacts may result from B1 field inhomogeneity, SAR constraints, signal fluctuations, and contrast profile variations. Additionally, subject motion during acquisition can degrade unaliasing performance and produce artifacts, especially when positional changes occur relative to coil sensitivity profiles [10]. Patient-related factors are among the most common sources of artifacts, including periodic movements such as respiration and cardiac pulsation, as well as non-periodic movements such as swallowing, peristalsis, or voluntary motion. These movements alter signal phase and amplitude, producing artifacts such as ghosting, blurring, and signal loss [8].

Physiological phenomena such as blood flow, pulsation, and respiratory motion may also generate artifacts due to data inconsistencies during acquisition [11].

To ensure consistent image quality, MRI systems are routinely evaluated using standardized phantoms such as the ACR MRI phantom. Phantom-based evaluations allow objective assessment of parameters including geometric accuracy, slice thickness precision, image uniformity, Signal-to-Noise Ratio (SNR), and ghosting percentage [12]. Quantitative evaluations such as SNR measurement and uniformity analysis are widely used to assess MRI system performance in greater detail, providing essential information for system calibration and maintenance [13].

However, in many healthcare facilities; particularly regional hospitals the availability of standardized phantoms is limited, posing challenges for comprehensive QC implementation. As a result, alternative approaches such as visual checklists and artifact evaluation are frequently employed as practical methods for routine system quality monitoring [12]. Beyond evaluation methods, MRI system stability is also influenced by hardware components such as the main magnet, gradient coils, and radiofrequency (RF) systems. Imperfections or performance degradation in these components may reduce SNR and trigger artifact formation, thereby compromising diagnostic reliability [14,15]. Consequently, systematic QA and QC implementation is essential to maintain optimal equipment performance and prevent diagnostic errors [16].

Previous studies indicate that ideal QC implementation involves quantitative testing using standardized phantoms to evaluate parameters such as SNR, geometric accuracy, image uniformity, slice thickness accuracy, and ghosting percentage [17,18]. Nevertheless, in regional hospitals, comprehensive QC implementation often faces limitations related to facility infrastructure, phantom availability, and human resources. As a result, system quality monitoring is frequently conducted using visual checklists and artifact evaluation as simpler and more feasible alternatives [19-21].

Although numerous studies have examined MRI QC methods and image quality evaluation using phantoms and automated approaches, research evaluating QC implementation based on visual checklists and artifact evaluation in regional hospitals remains limited. Yet, these methods play an important role in early detection of system disturbances, maintaining MRI performance stability, and preserving diagnostic image quality when quantitative testing cannot be fully performed. Therefore, the explicit purpose of this research is to analyze the implementation of Quality Control in the 1.5 Tesla MRI system at the Radiology Installation of Sanjiwani Hospital using visual checklists and artifact evaluation, and to assess the extent of its compliance with the American College of Radiology (ACR) 2015 guidelines. The findings of this study are expected to serve as a reference for MRI QC implementation in hospitals with similar characteristics and resource limitations [22-33]. This study provides a comprehensive overview of Quality Control implementation in the 1.5 Tesla MRI system at the Radiology Installation of Sanjiwani Hospital through the application of visual checklists and artifact evaluation referring to the American College of Radiology (ACR) 2015 guidelines. The results are expected to serve as a practical reference for MRI Quality Control implementation, particularly in hospitals that rely on routine system quality monitoring procedures.

METHODS

Study design

This research employed a descriptive observational design aimed at systematically analyzing the implementation of Quality Control (QC) procedures on a 1.5 Tesla MRI system at the Radiology Installation of Sanjiwani Hospital. A descriptive observational approach was selected because it allows for a detailed examination of QC practices as they occur naturally in the clinical environment without introducing experimental manipulation. The study was conducted over a two-month period, from February to March 2026, during which routine QC activities were monitored, documented, and evaluated.

Study setting and focus

The study was carried out at the Radiology Installation of Sanjiwani Hospital, a regional healthcare facility that routinely performs MRI examinations using a 1.5 Tesla system. The research focused specifically on QC procedures conducted by certified radiographers who are responsible for daily and weekly QC activities. The primary object of analysis was the practical implementation of QC through two main components: (1) visual checklist assessment and (2) artifact evaluation using phantom images. These two components represent the core QC strategies applied in the facility, particularly in the context of limited access to standardized quantitative phantom testing.

Data collection procedures

Data collection was conducted through direct, non-participatory observation of QC procedures performed by radiographers, complemented by a systematic review of institutional QC documentation. Observational activities included monitoring the execution of daily and weekly QC tasks, recording procedural steps, and verifying compliance with established QC protocols.

Document review encompassed several sources: 1) completed visual checklist forms; 2) QC logbooks and performance records; and 3) phantom image documentation generated during routine MRI scans. The visual checklist used in this study is the standard QC form routinely applied at the Radiology Installation of Sanjiwani Hospital. The checklist was developed based on the American College of Radiology (ACR) 2015 guidelines and includes structured items for assessing the physical condition, operational status, and functional integrity of MRI system components. Artifact evaluation was performed using phantom images obtained from T1-weighted (T1W) and T2-weighted (T2W) sequences. These images were examined to determine the presence or absence of artifacts according to the ACR 2015 criteria, including ghosting, abnormal shadows, geometric distortion, and signal inhomogeneity.

Research instruments

Several instruments and materials were utilized to support data collection and evaluation: 1) Daily visual checklist sheet, used to assess the condition and functionality of MRI system components; 2) Weekly artifact evaluation form, designed to document phantom image characteristics and identify deviations from ACR standards; 3) 1.5 Tesla MRI system, serving as the primary imaging equipment under evaluation; 4) Head-neck coil (NVC), used during phantom scanning procedures; 5) 200 mm diameter water phantom, functioning as the standardized object for image acquisition and artifact assessment; 6) T1W and T2W phantom image documentation, used to evaluate signal uniformity, symmetry, geometric accuracy, and artifact presence.

The parameters assessed through the visual checklist included system readiness, bore cleanliness, RF coil condition, gradient performance indicators, and console functionality. Artifact evaluation focused on phantom shape integrity, signal homogeneity, image symmetry, ghosting artifacts, abnormal signal shadows, and distortion patterns, all interpreted according to ACR 2015 QC guidelines.

Data analysis

Data were analyzed descriptively. The results of the visual checklist and artifact evaluation were compared against the QC criteria established in the ACR 2015 guidelines. This comparison allowed for an objective description of the MRI system's performance and stability during the observation period. Descriptive analysis was chosen because the study aimed to characterize QC implementation rather than test hypotheses or establish causal relationships.

Research ethics

This study did not involve human participants, patient data, or invasive procedures. All data collected were limited to observational records and phantom imaging results. Confidentiality of institutional documents was maintained throughout the research process, and all procedures adhered to ethical principles for non-clinical observational studies.

Testing procedure using the phantom



Figure 1. Base position of the head and neck coil



Figure 2. Ghost mount at the base of the coil



Figure 3. The T-marker faces forward at the 12 o'clock position



Figure 4. Top of the head and neck roll

The phantom preparation and scanning procedure began with positioning the NVC head-and-neck coil on the inspection table and removing the detachable base to allow proper placement of the phantom (Figure 1). The water phantom was then positioned securely on the surface of the coil base, ensuring that its orientation followed the standardized ACR configuration (Figure 2). Subsequently, the phantom was rotated into a

transverse alignment, with the “T” orientation marker facing directly forward at the 12 o'clock position, which serves as the reference orientation for geometric accuracy assessment (Figure 3). Once the “T” marker was correctly aligned, the phantom was pushed posteriorly until it fully engaged with the indentation of the phantom mount, guaranteeing stable fixation during scanning. The upper component of the head-and-neck coil was then placed over the phantom to enclose it completely and maintain optimal radiofrequency coupling (Figure 4). After the coil assembly was secured, the phantom was centered precisely within the coil's imaging volume, ensuring that the isocenter of the MRI system corresponded to the geometric center of the phantom (Figure 5). The coil was subsequently advanced into the magnet bore using the system's automated travel-to-scan-plane function. Localizer images were acquired first, consisting of sagittal scout images and three orthogonal planes to confirm correct phantom positioning. Following localization, axial imaging was performed, beginning with the acquisition of 18 slices of T1-weighted axial images using a Spin Echo sequence (TE 110 ms, TR 3996 ms, FOV 230 × 230 mm, matrix 384 × 384, slice thickness 5 mm, and 10% slice gap). This was immediately followed by the acquisition of 18 slices of T2-weighted axial images using identical geometric parameters to ensure consistency across sequences. All resulting images were stored for subsequent evaluation of uniformity, geometric accuracy, and artifact presence according to ACR 2015 Quality Control criteria (Figure 6).



Figure 5. Concentration in the center of the phantom

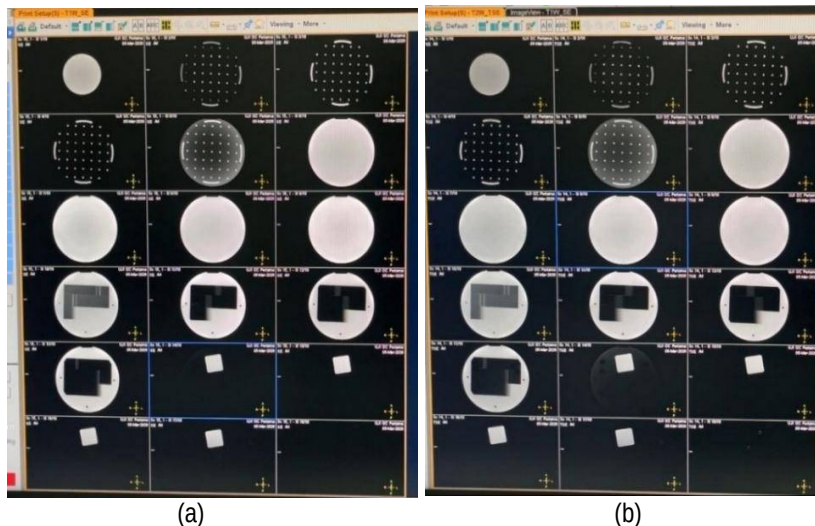


Figure 6. (a) T1W axial scan results, (b) T2W axial scan results

RESULTS

Resulting images

The test using *water phantom* was carried out according to the *MRI Quality Control* procedure applied at the Radiology Installation of Sanjiwani Hospital. The scan results produced T1-weighted (T1W) and T2-weighted (T2W) images which were then used for *artifact evaluation*. The image of the test results is shown in Figure 7.

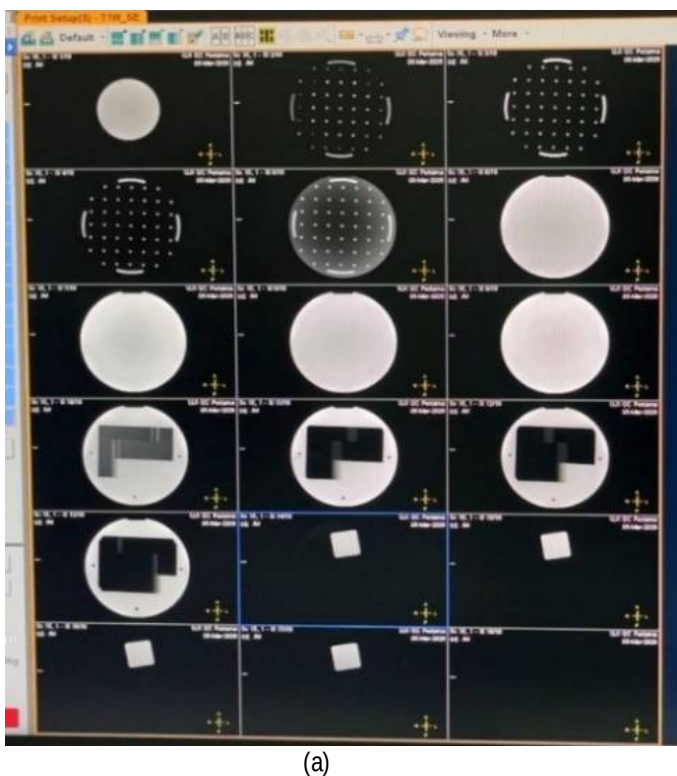
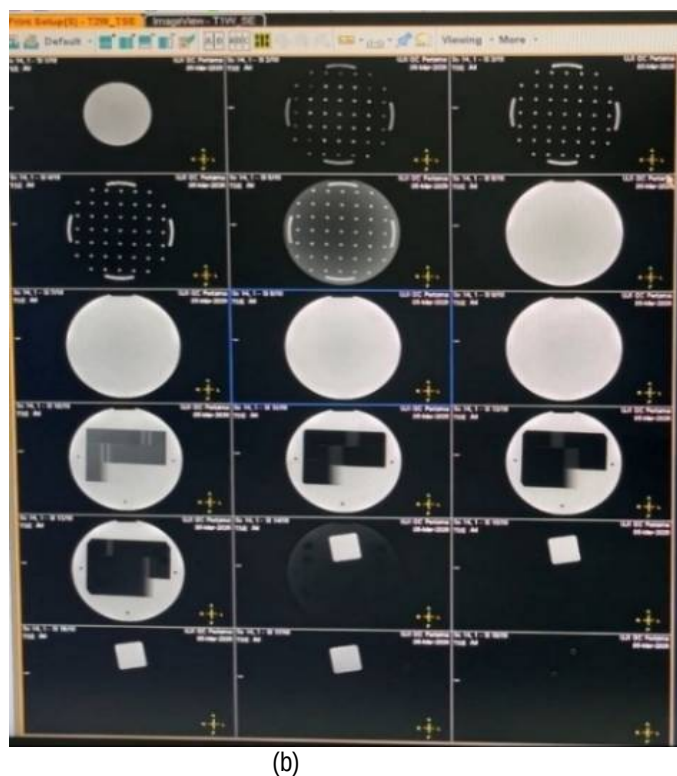


Figure 7. (a) Axial T1W scanning results, (b) Axial T2W scan results



(b)

Visual checklist test results

This test was carried out for 30 days by observing several parameters contained in the visual checklist sheet (Table 1).

Table 1. Visual checklist of daily MRI equipment quality control table for February–March 2026

Date:		23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Patient transport and gantry	Table position and other display	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Alignment lights	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Horizontal motion smoothness and stability	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Vertical motion smoothness and stability	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Vital eye	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Patient Intercom	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Filming viewing	Laser camera	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Light boxes	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
RF integrity and control room	Rf door contacts	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Rf window screen integrity	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Operator console switches/lights/ meters	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Patient monitor (if present)	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Patient intercom	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Room tmperature/room humidity	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Facility safety	Emergency chart	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Safety warning signage	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Door indicator switch (if installed)	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Cyogen/Helium (7 liter)	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√

Legend: pass = √; fail = X; does not apply = NA

Artifact evaluation test results

The results of the artifact evaluation conducted on February 26, 2026, March 5, 2026, March 12, 2026, and March 19, 2026 showed consistent results (Table 2). Throughout the test sessions, the T1-weighted (T1W) and T2-weighted (T2W) phantom images appeared to be round, homogeneous, and symmetrical with no ghost images, abnormal shadows, or image distortion. Based on the 2015 American College of Radiology (ACR) guidelines, the results showed that the MRI system was in stable condition during the testing period and no artifacts were found that could affect the image quality.

Table 2. Weekly MRI equipment quality control table month February–March 2026

Date	Artifact evaluation	
	Yes	No
26 February 2026		√
March 5, 2026		√
March 12, 2026		√
March 19, 2026		√

DISCUSSION

The results of this study demonstrated that the implementation of Quality Control (QC) on the 1.5 Tesla MRI system at the Radiology Installation of Sanjiwani Hospital; conducted through a 30-day visual checklist assessment and four structured artifact evaluation sessions consistently indicated stable system performance with no detectable abnormalities or imaging disturbances. Across the entire observation period, all parameters evaluated in the visual checklist were recorded as functioning properly, suggesting that the mechanical, electronic, and safety components of the MRI system were operating within acceptable performance thresholds. The daily checklist results showed no deviations in bore conditions, RF coil integrity, patient table motion, intercom functionality, or gradient system behavior, indicating that the system maintained

operational stability across multiple consecutive days of clinical use. This consistency is particularly important in routine diagnostic environments, where MRI systems are subjected to continuous operational demands and must maintain high reliability to support clinical workflows.

The artifact evaluation further reinforced the stability of the MRI system. Phantom images obtained during the four testing sessions consistently met all criteria outlined in the American College of Radiology (ACR) 2015 guidelines. The phantom images were uniformly spherical, homogeneous, and symmetrical, with no evidence of ghosting, abnormal shadows, geometric distortions, or signal inconsistencies. These findings indicate that the MRI system was capable of generating high-quality images with stable contrast profiles and uniform signal distribution. The absence of artifacts across multiple sequences; including T1-weighted (T1W) and T2-weighted (T2W) axial images suggests that the system's RF transmission, gradient performance, and reconstruction algorithms were functioning optimally during the study period. The consistency of these results across multiple testing sessions strengthens the conclusion that the MRI system remained in optimal condition throughout the evaluation period.

The findings of this study align closely with previous research emphasizing the importance of routine QC in maintaining MRI system stability. Chen et al. [12] highlighted that phantom-based QC is essential for ensuring long-term system reliability, particularly in clinical environments where MRI is used extensively for diagnostic decision-making. Hendriks et al. [13] similarly emphasized that routine image quality evaluation is necessary to ensure consistent MRI performance, noting that even minor deviations in system parameters can lead to significant diagnostic consequences if not detected early. Epistatou and Tsalafoutas [17] further reported that periodic QC implementation enables early detection of performance changes before they manifest as clinically significant image degradation. The consistency between the present study and previous literature underscores the importance of continuous QC monitoring, especially in healthcare facilities where resource limitations may restrict the use of advanced quantitative QC tools.

The absence of artifacts throughout the testing sessions can be explained by the optimal functioning of the MRI system during the study period. According to Krupa [8], MRI artifacts may arise from hardware malfunctions, magnetic field instability, radiofrequency interference, gradient system irregularities, or errors in the image reconstruction process. In this study, none of the phantom images exhibited characteristics associated with these types of artifacts, suggesting that the main hardware components; such as the magnet, gradient coils, RF coils, and reconstruction software were operating within their expected performance thresholds. This observation is further supported by the ACR 2015 guidelines, which state that phantom images that are round, homogeneous, symmetrical, and free from ghosting or distortions are indicative of a stable MRI system with no significant performance deviations. The consistency of these results across multiple testing sessions strengthens the conclusion that the MRI system remained in optimal condition throughout the evaluation period.

The findings of this study have important practical implications for the implementation of QC in regional hospitals and other healthcare facilities with limited access to advanced QC resources. Although quantitative QC tests; such as Signal-to-Noise Ratio (SNR) measurement, geometric accuracy assessment, image uniformity analysis, slice thickness verification, and percent signal ghosting evaluation were not performed, the regular use of visual checklists and artifact evaluations still provided valuable information regarding the operational condition of the MRI system. These methods serve as effective initial monitoring tools capable of detecting early signs of system degradation, thereby enabling timely corrective actions. In settings where standardized phantoms or automated QC software are not readily available, visual checklist assessments and phantom-based artifact evaluations can function as practical and feasible components of routine QC programs. Their implementation ensures that essential aspects of MRI system performance are monitored consistently, contributing to the overall reliability of diagnostic imaging services.

Furthermore, the results of this study highlight the importance of maintaining structured QC documentation. The 30-day visual checklist records provided a comprehensive overview of system stability, allowing for longitudinal monitoring of performance trends. The artifact evaluation images also served as objective evidence of system functionality, enabling radiographers and medical physicists to verify the absence of distortions or signal inconsistencies. In resource-limited settings, such documentation is crucial for supporting accreditation processes, ensuring compliance with national and international standards, and facilitating communication between radiographers, radiologists, and biomedical engineers.

Strengths

This study possesses several methodological and practical strengths. First, it provides a detailed and systematic evaluation of QC implementation in a real-world clinical environment, offering insights into how QC procedures are applied in regional hospitals with limited resources. Second, the study incorporates both daily visual checklists and phantom-based artifact evaluations, allowing for a comprehensive assessment of system stability across multiple dimensions. Third, the 30-day observation period provides longitudinal data that capture system performance over time rather than relying on isolated measurements. Fourth, the study contributes to the literature by documenting QC practices in a healthcare setting where quantitative QC tools may not be readily available, thereby offering a practical model for similar facilities. Finally, the study demonstrates that even in resource-limited environments, structured QC procedures can effectively maintain MRI system stability and support diagnostic reliability.

Limitations

Despite its strengths, the study also has limitations. The absence of quantitative QC measurements restricts the ability to evaluate system performance with high precision, as recommended by ACR guidelines. The reliance on a single MRI system limits generalizability, and the study does not assess the impact of environmental factors such as room temperature, humidity, or power fluctuations, which may influence MRI performance. Additionally, the study does not evaluate inter-observer variability in checklist completion or artifact interpretation, which may affect consistency. Future studies should incorporate quantitative QC parameters, multiple MRI systems, and environmental monitoring to provide a more comprehensive evaluation. Expanding the scope of QC assessments will also enable comparisons across institutions and contribute to the development of standardized QC practices in resource-limited settings.

CONCLUSION

The implementation of Quality Control (QC) on the 1.5 Tesla MRI system at the Radiology Installation of Sanjiwani Hospital was carried out through visual checklists and artifact evaluation. The results of the 30-day visual checklist showed that all system parameters were functioning properly, while the artifact evaluation of the T1-weighted (T1W) and T2-weighted (T2W) images showed no artifacts during the test period. Based on these results, the 1.5 Tesla MRI system at Sanjiwani Hospital is operating well and has met the MRI Quality Control guidelines based on the American College of Radiology (ACR) 2015.

Ethical considerations, competing interests, and funding sources

- This research has received ethical approval from the Health Research Ethics Committee of Sanjiwani Hospital, Gianyar Regency with number: 17/PEPK/III/2026.
- The author declares that there is no conflict of interest related to this publication.
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REFERENCES

1. Mukhatov A, Le TA, Pham TT, Do TD. A comprehensive review on magnetic imaging techniques for biomedical applications. *Nano Select*. 2023 Mar;4(3):213-30.
2. Utami DI, Irsal M, Sutori SG, Budiati TA. Investigation of the age factor of MRI modality 1.5 Tesla to signal-to-noise ratio. *Report*. 2025;16(2):186-93.
3. Atmaja GB, Wibowo GM, Abimanyu B. Performance test of MRI machines in the Province of Bali. *Jurnal Imejing Diagnostik (JImeD)*. 2018 Jul 1;4(2):80-4.
4. Fatemi A, Taghizadeh S, Yang CC, Kanakamedala MR, Morris B, Vijayakumar S. Machine-specific magnetic resonance imaging quality control procedures for stereotactic radiosurgery treatment planning. *Cureus*. 2017 Dec 18;9(12).
5. ILP Commitment. A CT scan of the aircraft. *Report*. 2022;6(3):396-402.
6. Ho CH, Xiao L, Kwok KY, Yang S, Fung B, Yu K, Chong WH, Yeung TW, Li A. Common artifacts in magnetic resonance imaging: a pictorial essay. *Hong Kong J. Radiol. HKJR= Xianggang Fang She Ke Yi Xue Za Zhi*. 2023 Mar 1;26:58-65.
7. Lima JAC. Introduction to common MRI artifacts and how to deal with them. *Scientific Report*. 2022;102-3.
8. Krupa K, Bekiesińska-Figatowska M. Artifacts in magnetic resonance imaging. *Polish Journal of Radiology*. 2015 Feb 23;80:93.
9. Smith TB. MRI artifacts and correction strategies. *Imaging in Medicine*. 2010 Aug 1;2(4):445.
10. Poser BA, Setsompop K, MG Hospital. Advanced MRI techniques. *Scientific Report*. 2019;101-18.
11. Budrys T, Veikutis V, Lukosevicius S, Gleizniene R, Monastyreckiene E, Kulakiene I. Artifacts in magnetic resonance imaging: how it can really affect diagnostic image quality and confuse clinical diagnosis?. *Journal of Vibroengineering*. 2018 Mar 31;20(2):1202-13.
12. Chen CC, Wan YL, Wai YY, Liu HL. Quality assurance of clinical MRI scanners using ACR MRI phantom: Preliminary results. *Journal of Digital Imaging*. 2004 Dec;17(4):279-84.
13. Hendriks J, Jan H, Richard M, Oscar J, Nogales P, Rodrigues PR, et al. Systematic review of semi-automatic T1-weighted MRI quality control. *Neuroradiology*. 2024;66(1):31-42.
14. Koh DM, Collins DJ. Diffusion-weighted MRI in the body: applications and challenges in oncology. *American Journal of Roentgenology*. 2007 Jun;188(6):1622-35.
15. Xie X, Qu X, Zhou B, Zhang B, Wang Q, Bian H, Shao J, Cai Y, Dong X. Wearable flexible sensors for cardiovascular disease monitoring. *Advanced Materials*. 2026 Jun 17:e12939.
16. Provins C, MacNicol E, Seeley SH, Hagmann P, Esteban O. Quality control in functional MRI studies with MRIQC and fMRIprep. *Frontiers in Neuroimaging*. 2023 Jan 12;1:1073734.
17. Episcopal AC, Slafoutas. Automated methods for quality control in MRI systems: Methods and considerations. *Scientific Report*. 2020;1(1):102-108.
18. Osborne DR, Kuntner C, Berr S, Stout D. Guidance for efficient small animal imaging quality control. *Molecular Imaging and Biology*. 2017 Aug;19(4):485-98.
19. Chandra S, Putu N, Jeniyanti R. The use of fat saturation (FS) sequence in MRI examination of knee joint osteosarcoma cases at the hospital radiology installation in Jakarta. *J Educ Innov Public Heal*. 2024;2(1):269-82.
20. Ganna O, Putri A. Innovation in quality control of radiology equipment: signal-to-noise ratio (SNR) calibration curve approach as an indicator of strengthening the internal quality of MRI equipment. *Jurnal Ilmiah Kesehatan Sandi Husada*. 2023 Dec 31;12(2):518-27.
21. Tan F, Delfino JG, Zeng R. Evaluating machine learning-based MRI reconstruction using digital image quality phantoms. *Bioengineering*. 2024 Jun 15;11(6):614.
22. Papoutsaki MV, Allen C, Giganti F, Atkinson D, Dickinson L, Goodman J, Saunders H, Barrett T, Punwani S. Standardisation of prostate multiparametric MRI across a hospital network: a London experience. *Insights into Imaging*. 2021 Apr 20;12(1):52.
23. DeSouza NM, Winfield JM, Waterton JC, Weller A, Papoutsaki MV, Doran SJ, Collins DJ, Fournier L, Sullivan D, Chenevert T, Jackson A. Implementing diffusion-weighted MRI for body imaging in prospective multicentre trials: current considerations and future perspectives. *European Radiology*. 2018 Mar;28(3):1118-31.
24. Parekh P, Bhalerao GV, Rao R, Sreeraj VS, Holla B, Saini J, et al. Discovery of brain disorders using stem cells. 2021;(April 2020).
25. White OA, Shur J, Castagnoli F, Charles-Edwards G, Whitcher B, Collins DJ, Cashmore MT, Hall MG, Thomas SA, Thompson A, Harrison CA. Quantitative image quality metrics enable resource-efficient quality control of clinically applied AI-based reconstructions in MRI. *Magnetic Resonance Materials in Physics, Biology and Medicine*. 2025 Jul;38(3):547-60.
26. Jalloul M, Miranda-Schaeubinger M, Noor AM, Stein JM, Amiruddin R, Derbew HM, Mango VL, Akinola A, Hart K, Weygand J, Pollack E. MRI scarcity in low-and middle-income countries. *NMR in Biomedicine*. 2023 Dec;36(12):e5022.
27. Esteban O, Birman D, Schaer M, Koyejo OO, Poldrack RA, Gorgolewski KJ. MRIQC: Advancing the automatic prediction of image quality in MRI from unseen sites. *PLoS One*. 2017 Sep 25;12(9):e0184661.
28. Esmaeili A, McGuire C, Overcash M, Ali K, Soltani S, Twomey J. Environmental impact reduction as a new dimension for quality measurement of healthcare services: the case of magnetic resonance imaging. *International Journal of Health Care Quality Assurance*. 2018 Oct 8;31(8):910-22.
29. Bhalerao G, Gillis G, Dembele M, Suri S, Ebmeier K, Klein J, Hu M, Mackay C, Griffanti L. Automated quality control of T1-weighted brain MRI scans for clinical research datasets: methods comparison and design of a quality prediction classifier. *Imaging Neuroscience*. 2025 May 28;3:IMAG-a.
30. Glide-Hurst CK, Paulson ES, McGee K, Tyagi N, Hu Y, Balter J, Bayouth J. Task group 284 report: magnetic resonance imaging simulation in radiotherapy: considerations for clinical implementation, optimization, and quality assurance. *Medical Physics*. 2021 Jul;48(7):e636-70.

31. López DV, Mendoza HS, Alcaraz EP, Santos-Cuevas CL, González-Ruíz A. An evaluation of the current status of quality assurance program in MRI: A multicenter study. *Radiography*. 2025 May 1;31(3):102908.
32. Calixto C, Gee MS. Practical strategies to improve MRI operations and workflow in pediatric radiology. *Pediatric Radiology*. 2025 Jan;55(1):12-23.
33. Arnold TC, Freeman CW, Litt B, Stein JM. Low-field MRI: clinical promise and challenges. *Journal of Magnetic Resonance Imaging*. 2023 Jan;57(1):25-44.