The Role of Artificial Intelligence in Medical Imaging and Diagnostics – A Radiographer's Perspective

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Abstract. Artificial intelligence (AI) has become an integral part of healthcare, particularly in medical imaging. Magnetic Resonance Imaging (MRI) and Computed Tomography (CT) are essential diagnostic modalities with different technical characteristics and clinical applications. The integration of AI into these imaging techniques supports radiographers by improving workflow efficiency, image quality, and patient safety. In MRI, deep learning-based image reconstruction enables faster image acquisition while enhancing signal-to-noise ratio and spatial resolution, reducing examination times without compromising diagnostic quality. AI-driven tools, including automated anatomical region selection, slice positioning, and protocol optimization, contribute to standardized and reproducible examinations while reducing operator-dependent variability. In CT, AI-based iterative reconstruction algorithms reduce image noise and improve image quality, particularly in low-dose imaging. Automatic dose optimization systems further enhance patient safety by adapting scanning parameters to patient size and the examined anatomical region. In addition, AI-assisted post-processing and structured reporting support radiologists by improving workflow efficiency and facilitating clinical decision-making. Overall, the combination of advanced imaging technology and AI-based software solutions has significantly improved the efficiency, quality, and safety of MRI and CT examinations. These developments optimize clinical workflows, support radiographers and radiologists in daily practice, and ultimately contribute to improved patient care.

Keywords: Modern radiology, AI-based algorithms, Image reconstruction

1 Introduction

The digitalization of healthcare has evolved progressively over the past decades [1]. However, the emergence of artificial intelligence (AI) has accelerated the clinical adoption of digital technologies, driving a new era of innovation in healthcare [2]. AI now plays a central role in this transformation. The integration of AI in medical imaging

© The Author(s) 2026
S. Árvai-Homolya et al. (eds.), *Proceedings of the 2nd Innovation in Engineering Education Conference (IEE 2026)*, Atlantis Highlights in Social Sciences, Education and Humanities 58,
https://doi.org/10.2991/978-94-6239-823-8_18

changes the field completely [3]. It has become an integral part of routine clinical practice, enhancing the accuracy and efficiency of interpreting medical images such as X-ray, Magnetic Resonance Imaging (MRI) and Computed Tomography (CT). Due to their different physical principles and technical characteristics, these modalities offer distinct advantages and limitations [4]. The integration of AI-based algorithms into diagnostic imaging supports radiographers by enabling standardized, reproducible, and more efficient workflows, while simultaneously improving image quality and patient safety [5].

Borsod-Abaúj-Zemplén County Teaching Hospital is equipped with a wide range of radiological imaging systems, including 1.5T and 3T MRI scanners, as well as 64- and 128-slice CT scanners. The representative imaging cases presented in this study were acquired at Borsod-Abaúj-Zemplén County Teaching Hospital.

The aim of this review is to present recent advances in artificial intelligence applied to medical imaging while highlighting their practical relevance for radiographers involved in image acquisition, quality assurance, and patient care.

2 Magnetic Resonance Imaging (MRI)

MRI is a multiplanar and multiparametric imaging modality with expanding diagnostic capabilities due to technological advancements. Consequently, not only examination protocols but also ongoing technological developments of MRI systems are of great importance. One of the main challenges of MRI is the relatively long examination time, which typically ranges from 20 to 60 minutes depending on the examined region and the applied protocol [6], [7]. A key innovation in this field is deep learning–based image reconstruction, which enables faster data acquisition while improving signal-to-noise ratio and spatial resolution. It offers new opportunities to reduce scan times without compromising diagnostic image quality, resulting in improved patient comfort [8].
The first AI-based algorithm was approved by the FDA in 2017 and subsequently implemented in clinical practice [4].

The differences between conventional and AI-based MRI image reconstruction are illustrated in Figure 1 and 2. These figures illustrate the main steps of conventional and AI-based MRI image reconstruction. Figure 3 presents a clinical example comparing conventional and AI-based MRI image reconstruction using an axial T2-weighted image of the pelvis, illustrating the potential improvement in image quality achieved with AI-based reconstruction.

Modern MRI systems offer efficient workflows that facilitate examination planning and optimize scan time. It also provides automated patient positioning and anatomical coverage planning features, improving examination consistency. In addition, automated vertebral labeling enables accurate identification of spinal anatomy and geometry [9]. Lumbosacral transitional vertebrae are relatively common in approximately 25% of the general population [12]. Manual spine and vertebral labeling can be time-consuming. Automated vertebral labeling facilitates the identification of spinal anatomy, allowing radiologists and clinicians to review the labeling, while radiographers perform the final verification to ensure accuracy. Figure 4 shows automated vertebral labelling initiated

from the odontoid process (dens), which serves as a reliable anatomical reference for vertebral numbering throughout the spine, facilitating the identification of anatomical variations such as lumbosacral transitional vertebrae.

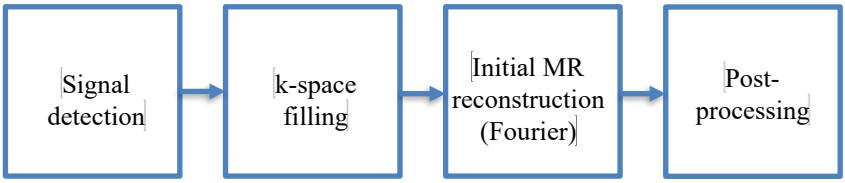


Fig. 1. The following figure provides a step-by-step illustration of the conventional MRI image reconstruction. In Conventional MRI signals acquired in k-space are reconstructed into diagnostic images using Fourier transformation and conventional reconstruction algorithms. The relatively long acquisition time of conventional MRI increases the risk of patient motion artifacts, which may negatively affect image quality [9].

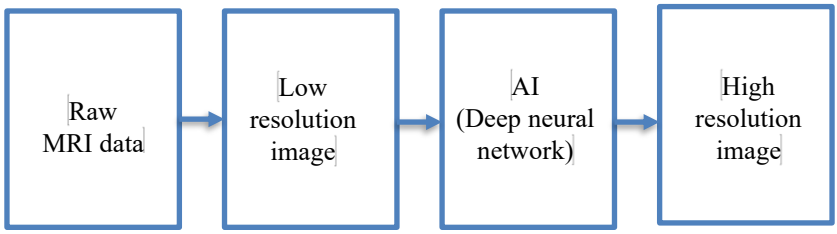


Fig. 2. The principle of AI-based MRI image reconstruction. Instead of relying on fully sampled k-space data, AI-based reconstruction uses deep learning algorithms to generate high-resolution images from under sampled MRI acquisitions. The deep neural network enhances image sharpness, suppresses image noise, and preserves anatomical details. As a result, scan times can be reduced while maintaining diagnostic image quality and improving patient comfort [10].

AI-driven tools such as automated anatomical region selection, automatic slice positioning, and protocol optimization significantly accelerate examination preparation and simplify daily clinical routine. These technologies reduce the occurrence of operator-related errors. With optimized workflows, radiologists can measure the volume of the prostate. Figure 5 shows a clinical examination, demonstrating automated volume measurement.

Moreover, cloud-based AI solutions can be integrated into the image interpretation workflow, supporting radiologists through automated measurements and structured Digital Imaging and Communications in Medicine (DICOM) reporting based on anonymized patient data. However, their implementation depends on institutional infrastructure, available resources, and associated costs [11].

As AI systems become increasingly integrated into medical imaging, transparency, clinical validation, and human oversight remain essential. Although AI can support image interpretation and clinical decision-making, its recommendations should complement rather than replace professional judgment. Responsibility for patient care ultimately remains with healthcare professionals [14]. Figure 6 illustrates the main steps of a cloud-based AI image analysis system.

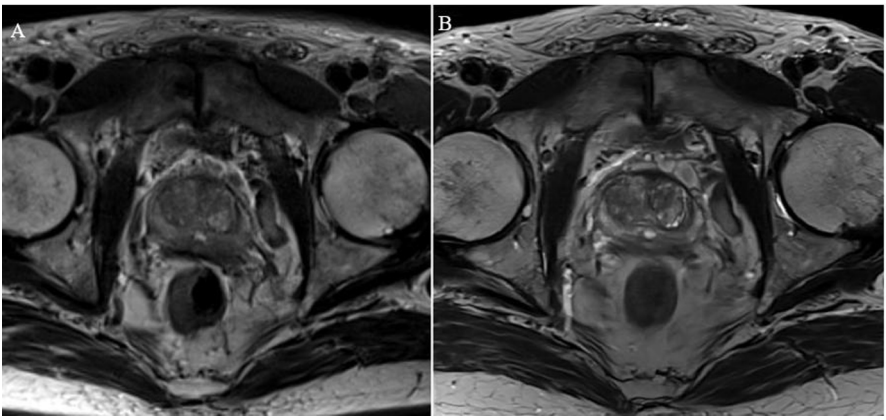


Fig. 3. A and B show axial T2-weighted MRI images of the male pelvis acquired using the same imaging sequence. (A) Conventional MRI image reconstruction (acquisition time: 3 min 5 s). (B) AI-based MRI image reconstruction (acquisition time: 1 min 5 s). Images acquired at the Borsod-Abaúj-Zemplén County Teaching Hospital, MR Laboratory. This comparison demonstrates that AI-based image reconstruction can maintain diagnostic image quality while substantially reducing acquisition time.

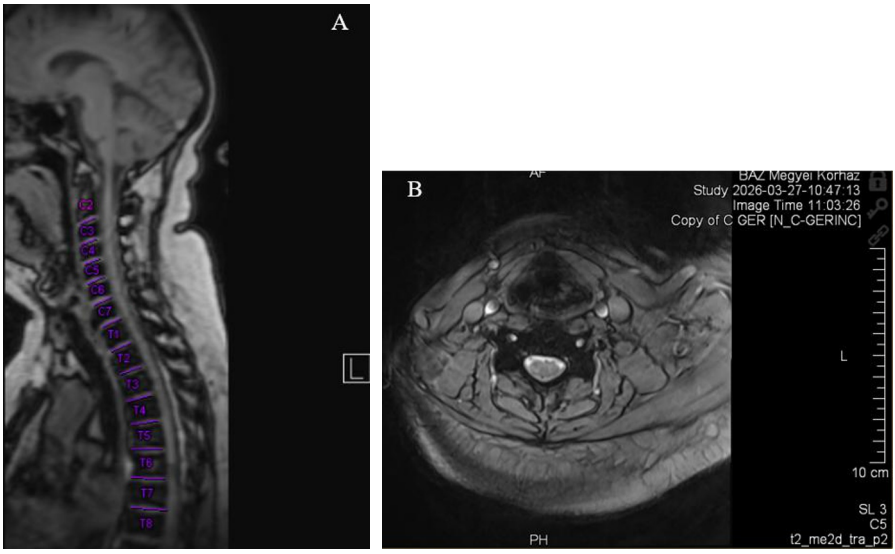


Fig. 4. A: Sagittal plane localizer of the cervical and upper thoracic spine demonstrating vertebral labelling. B: T2-weighted axial (gradient echo sequence) slice from the fifth cervical vertebra (C5, shown in bottom right corner).

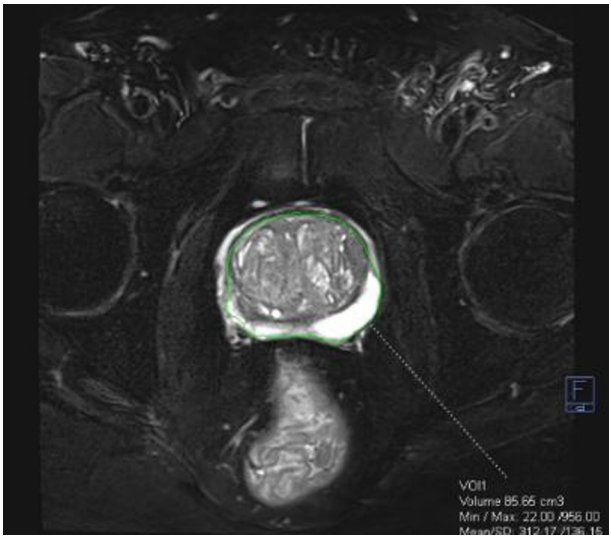


Fig. 5. T2-weighted axial slice from the prostate region with fat suppression (From: B-A-Z County Teaching Hospital, MR laboratory) The MRI image demonstrating automated segmentation of the prostate gland (green contour). The segmented region enables quantitative volume measurement (VOI), supporting objective evaluation of prostate size.

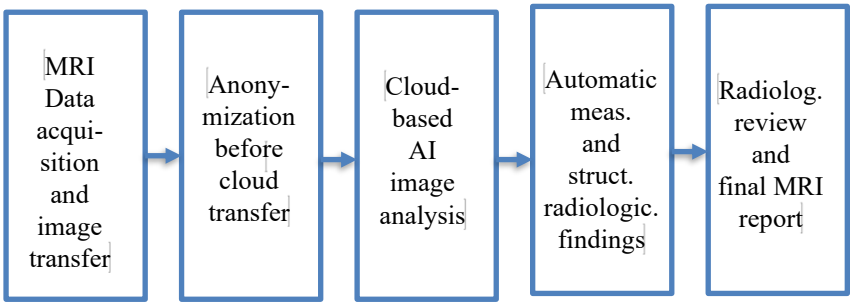


Fig.6. Main steps of a cloud-based AI image analysis system. After image acquisition, MRI data are anonymized before secure cloud transfer, where AI algorithms perform automated image analysis, quantitative measurements, and structured reporting. The AI-generated results are subsequently reviewed and verified by a radiologist before the final MRI report is issued [15].

3 Computed Tomography (CT)

CT is one of the most widely used medical imaging modalities. It is a radiation-based technique that produces cross-sectional images of the body [4]. One of the primary goals in CT imaging is radiation dose reduction while maintaining high diagnostic quality. Advanced AI-supported iterative reconstruction algorithms effectively reduce image noise and improve soft tissue contrast, which is particularly valuable in low-dose

examinations. In addition, automatic dose optimization systems adjust scanning parameters based on patient size and the anatomical region examined, thereby enhancing patient safety and ensuring consistent image quality. Automated vertebral and rib labelling can also be applied in CT imaging, facilitating accurate anatomical localization and particularly useful for surgeons during preoperative planning. Figure 7 and 8 present clinical examples of these applications.

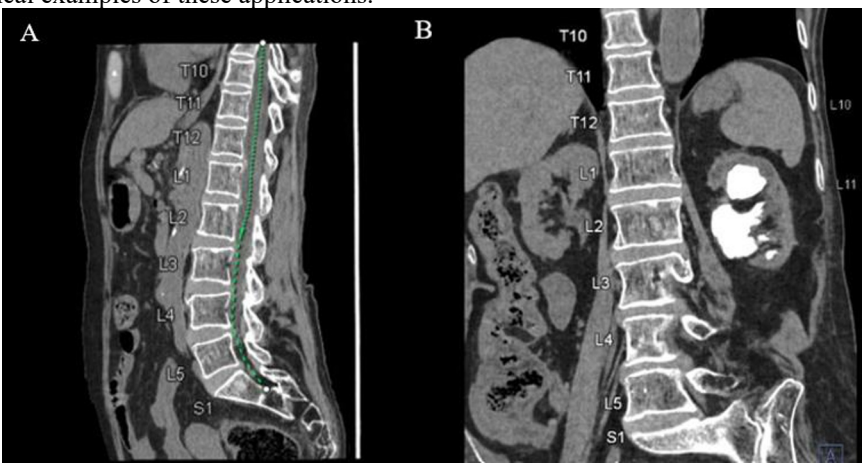


Fig. 7. Lower thoracic and lumbar spine CT examination, sagittal MPR and coronal curved MPR reconstructions. For the coronal multiplanar reconstruction, the imaging plane was aligned with the patient-specific anatomy to achieve better visualization. (From: B-A-Z County Teaching Hospital, CT laboratory)

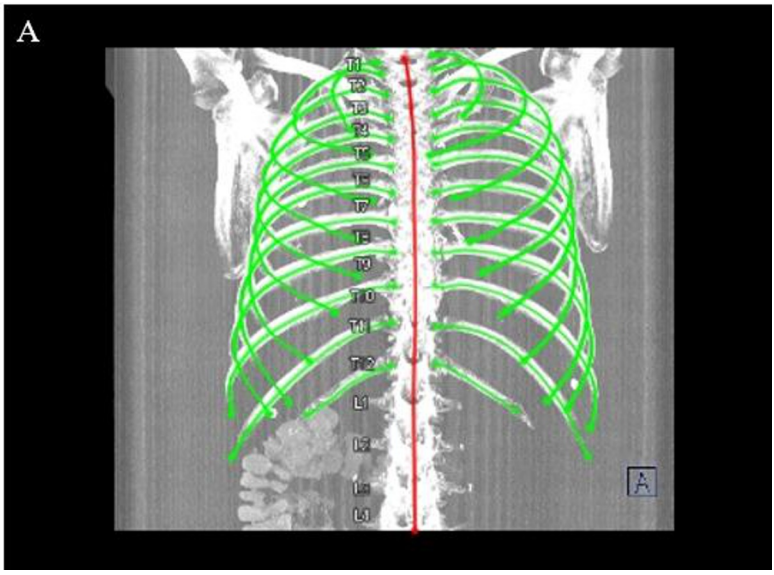
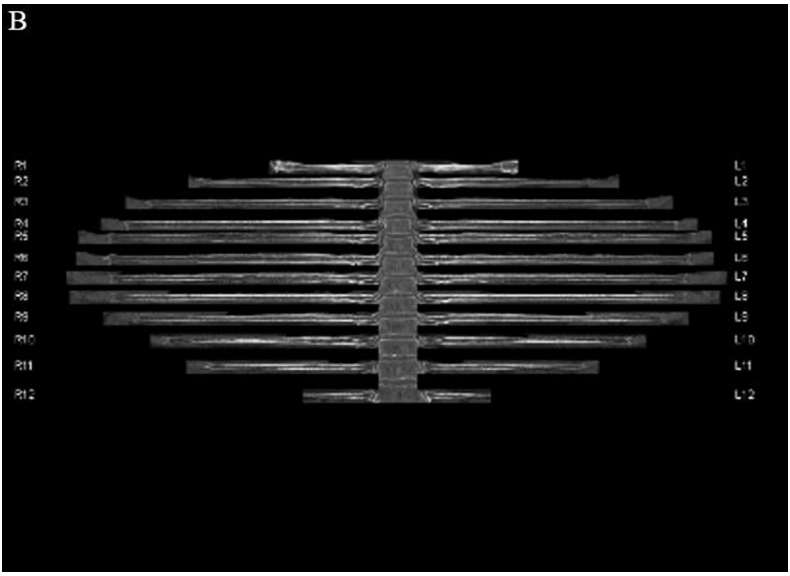


Fig. 8. A Multiplanar CT reconstruction (2D) from the rib cage and the spine. (B-A-Z County Teaching Hospital, CT laboratory)



B: Curved multiplanar reconstruction (MPR) of the rib cage, enabling simultaneous visualization of the entire rib cage in a single image.

3.1 e-Aspect software

Ischemic stroke is the third leading cause of death, when a patient presents with stroke symptoms, every minute counts [16]. The principle in stroke management "time is brain" [17]. e-ASPECTS software is an FDA-cleared and CE-marked decision support tool used to evaluate acute ischemic stroke–related changes on non-contrast brain CT scans, which can assist in radiological reporting [18]. The software automatically completes the analysis in approximately 2 minutes, quantifying early ischemic changes: standardizes ASPECTS scoring and quantifies the volume of ischemic changes, detects hypodense regions and provides a color-coded heat map to highlight affected areas [17]. It also identifies hyperdense vessel signs, enabling the detection and characterization of vascular occlusions, including estimation of occlusion length. In addition, hyperdense regions suggestive of hemorrhage are automatically highlighted and measured. Overall, e-ASPECTS enhances diagnostic accuracy and supports clinical decision-making in acute stroke management. Furthermore, CT scan results can be delivered via Picture Archiving and Communication System (PACS), e-mail, and mobile applications [18].

4 Conclusion

In summary, the combination of advanced hardware developments and AI-based software solutions in both MRI and CT has led to faster, more efficient, and safer imaging

examinations. Deep learning algorithms contribute to improved image quality, optimized workflows, and reduced examination times, ultimately supporting the work of radiographers and radiologists while improving overall patient care.

Disclosure of Interests: that the authors have no competing interests.

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