Chapter 4
The Evolution of MRI Before and After the Introduction of AI

Shruti S. Deshmukh
https://orcid.org/0009-0001-5178-5990
Datta Meghe Institute of Higher Education and Research, India

Pranjali Deshmukh
https://orcid.org/0000-0002-6557-4334
St. Vincent Pallotti College of Engineering and Technology, Nagpur, India

Kalyani N. Satone
https://orcid.org/0009-0001-3927-352X
St. Vincent Pallotti College of Engineering and Technology, Nagpur, India

Palash Gourshettiwar
https://orcid.org/0009-0007-2184-0331
Datta Meghe Institute of Higher Education and Research, India

Meher Langote
Datta Meghe Institute of Higher Education and Research, India

ABSTRACT

Magnetic Resonance Imaging (MRI) is a perfect solution of imaging diagnostically used in medicine and its related fields. However, there has been tremendous advancement in producing MRI technology in both hardware and software besides improvements in characterization of images. This paper gives a background of MRI together with early drawbacks and the introduction of Artificial Intelligence (AI). AI has improved image acquisition, reconstruction and analysis through increased

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speed of scans, higher and more accurate image results and thus better diagnosis. However, the use of AI in MRI encounters some hurdles, such as technical, ethical, and AI capabilities hurdles. This paper focuses on MRI history prior to and after AI incorporation, technological advancement on pre-AI MRI, roles of AI in MRI enhancement and challenges that continue to occur for enhanced achievement of desirable outcomes from AI MRI.

INTRODUCTION

Magnetic Resonance Imaging (MRI) is a diagnostic technique for acquiring images of body organs and tissues without having to perform surgery. MRI is safer as it doesn't use ionizing radiation like in X-rays or in CT scans common practices. It is based on Nuclear magnetic resonance imaging (NMRI) that hydrogen atoms of the body react to a magnetic field and to broadcast radio frequency inner signals. These signals are then picked by a computer to generate detailed images that assist in identifying the mentioned diseases and many others such as neurological disorders, orthopedics, cardiovascular diseases and cancers. MRI gives excellent contrast of soft tissues and pathological changes that can be arranged both anatomically and functionally without bioptic examinations (Katti, 2011) . MRI essentially operates using the field exhibited by hydrogen nuclei, or protons, which are prevalent in the human body as a consequence of the nature of water and fat molecules. In a state where they are under the influence of a powerful magnetic field being provided by a super conducting magnet, the protons prefer to align themselves either in parallel or an anti-parallel manner to the magnetic lines of force. The arrangement of these protons is vital to MRI procedure that will be explained under the working of MRI section (Glover, 2011).

The Radiofrequency (RF) coils in the MRI machine transmit particular radiofrequency pulses to excite the aligned protons to absorb energy and hence relocate out of t heir aligned position (Rajan, 1998). The energy absorbed by the protons during the RF pulse is released as radiofrequency signals when the pulse is switched off, by the receiving coils in the MRI machine. With the help of differences in these signals coming from various tissues, a computer generates clear and minute pictures of internal structures of the human body (Weishaupt, 2006). This process is called image reconstruction that forms the cross-sectional image based on the signal intensity, spatial distribution and other signal parameters which are very useful to doctors in diagnosis and treatment planning (Shahzad, 2020). An MRI machine consists of several essential components that work together to produce diagnostic images.