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AI in Multiple Sclerosis: Early Detection and Personalized Treatment Approaches - A Review of Recent Advances

AUTHOR 1: **Mateusz FORNALSKI[1], *AUTHOR 2*: Oliwia ANDRZEJEWSKA[1], Cezary BORYSIUK[1], Patrycja KOŚCIŃSKA[1], Michał WOŚ[2]**

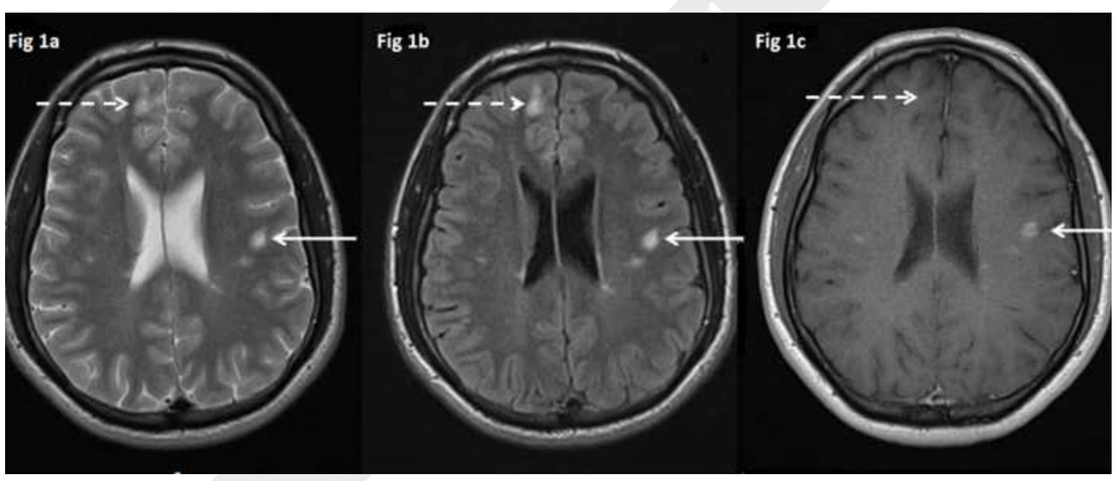
***AFFILATIONS*:**

1 – Medical University of Lublin, Faculty of Dentistry, SKN MedAI, Lublin

2 – Medical University of Lublin, Faculty of Dentistry, Zakład Informatyki i Statystyki Medycznej z Pracownią e-zdrowia, SKN MedAI, Lublin

INTRODUCTION & AIM

Multiple sclerosis (MS) is a chronic autoimmune disease affecting the central nervous system, causing demyelination, axonal loss, and neurodegeneration. Accurate diagnosis and monitoring are crucial for early treatment and slowing disease progression. However, conventional MRI and clinical assessments can be time-consuming and subject to inter-observer variability, sometimes missing subtle changes. AI, particularly machine learning and deep learning, offers promising tools for improving the detection, classification, and prediction of MS. The review aims to summarize AI applications in MS diagnosis, prognosis, and treatment monitoring.



https://ar.inspiredpencil.com/pictures-2023/multiple-sclerosis-mri

METHOD

A targeted literature search was conducted in PubMed and Scopus databases to identify original studies published between January 2020 and March 2025 that applied AI techniques to multiple sclerosis. Inclusion criteria required the use of AI methods (e.g., convolutional neural networks, support vector machines, random forests, or transformers) in MRI analysis, clinical data prediction, or treatment response evaluation. Only studies reporting quantitative outcomes were included. After screening over 120 titles and abstracts, 38 studies were selected for review.

RESULTS & DISCUSSION

The reviewed studies demonstrate that AI models significantly improve performance in MS-related tasks compared with traditional approaches. CNNs and transformer-based networks achieved high accuracy in lesion segmentation, with Dice similarity coefficients above 0.85 in several studies. Automated lesion load quantification correlated strongly ($r > 0.9$) with expert manual annotations. AI-based models also predicted disability progression (EDSS score) with accuracy up to 82% and identified patients at risk of relapse. Radiomics combined with machine learning showed potential for differentiating MS from other demyelinating diseases (AUC up to 0.95). Automated MRI lesion detection and segmentation enhance clinical workflow, while predictive models may guide treatment decisions.

CONCLUSION

AI has shown strong potential in multiple sclerosis by improving diagnostic accuracy, reducing variability, and enabling personalized disease monitoring. Future research should focus on standardized multi-center datasets, explainable AI models, and clinical integration to ensure reliability and adoption in real-world settings.

SCIENTIFIC SOURCES

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CONTACT DETAILS: mateusz.fornalski@onet.pl, +48666905548