AI-Assisted MRI Analysis for Multiple Sclerosis: Lesion Detection and Brain Atrophy Assessment

Ioana-Andreea CÎRLIG [a*] and Ioana-Andreea GHEONEA[b]

[a] Doctoral School, University of Medicine and Pharmacy of Craiova, Petru Rareş Str., no. 2, 200349 Craiova, Romania.
[b] Department of Radiology and Medical Imaging, University of Medicine and Pharmacy of Craiova, 1 Mai Blvd., no. 66, 200349 Craiova, Romania.
E-mails: andreea.cirlig97@gmail.com, ioana.gheonea@umfcv.ro

* Author to whom correspondence should be addressed;

Abstract
Introduction: Multiple sclerosis (MS) is a chronic autoimmune disorder that leads to neurodegeneration and progressive neurological impairment. A key imaging feature of MS is the presence of demyelinating brain lesions, which vary in distribution and size. This study aimed to assess the performance and clinical relevance of AI-based MRI analysis for lesion detection and brain atrophy quantification in patients with MS. *Methods:* Patients diagnosed with MS who underwent magnetic resonance imaging (MRI) brain scans at the Medical Imaging Department of the University of Medicine and Pharmacy in Craiova were included. There were no exclusion criteria. Seventy patients (42 women, 28 men) diagnosed with MS underwent MRI examinations between 2021 and 2023 using a Philips Ingenia 3T MRI system. The artificial intelligence (AI) software mdbrain (Mediaire) was utilized for automated lesion detection and volumetric analysis, requiring sagittal T1 3D and axial FLAIR sequences. *Results:* Brain volume reduction was identified in 56 of the 70 patients (80%), predominantly in the frontal and parietal lobes. Atrophy was assessed relative to age- and sex-matched normative data generated by the software from healthy controls. The AI software detected 3,120 demyelinating lesions: 2,050 in deep white matter, 596 periventricular, 310 juxtacortical, and 164 infratentorial. Patients were grouped by age as follows: 21–30 years (14), 31–40 years (18), 41–50 years (24), and >50 years (14). Most changes were observed in patients aged 31–50 years (42 patients, 60%). *Conclusions:* These findings highlight the potential of AI-assisted MRI in identifying MS-related structural brain changes. By enabling reproducible lesion mapping and age-adjusted atrophy analysis, such tools may support improved disease monitoring and personalized care. A direct comparison with conventional radiological assessment was not performed and remains a relevant direction for future research.

Keywords: Multiple Sclerosis; Brain Atrophy; Artificial Intelligence (AI); Magnetic Resonance Imaging (MRI).