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Case Report

Progression of Multiple Sclerosis with Cognitive and Radiological Correlates in a 32-Year-Old Female Patient: A Case Highlighting AI-Driven lesion Quantification

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Abstract

For a long period, checking on how multiple sclerosis (MS) gets worse has mostly used the Expanded Disability Status Scale (EDSS). But things seen in actual health settings and growing studies suggest that big disease action, like deterioration in thinking skills and changes seen in brain pictures, often happen without being noticed before it is found through standard neurological exam. This certain example study shows that large difference by looking at the case of a 32-year-old woman found to have relapsing-remitting MS (RRMS). Although her EDSS number stayed the same at 3.5 for some years, detailed brain skill tests showed a clear fall in how fast she could handle information, as found by the Symbol Digit Modalities Test (SDMT). Also, later MRI scans showed new spots that lit up with gadolinium and more build-up of lasting spots in brain areas tied to thinking. To exactly measure these changes, we used a thinking tool helped by computer intelligence (AI), called “Brain Snitch,” which wrote down a 22% jump in the full size of T2 spots, mostly placed around the fluid areas. Joining exact measures of thinking skills with AI-helped study of brain scans gave a full view of the disease getting worse, which was not clear when only using the EDSS. This way not only proved disease action that was not easily seen but also backed up a well-planned rise in how strong the treatment should be. The case points out the need to look further than just the EDSS for normal checks and helps with the adding of special brain tests and advanced, countable picture ways, adding AI- run spot study, to help find disease growth sooner and more fitted treatment plans for people with MS.

Keywords: *Multiple Sclerosis, Demyelination, Cognitive Impairment, Mri, Edss, Disease Activity Artificial Intelligence, Brain Snitch.*

Introduction

A persistent demyelinating illness of the central nervous system, multiple sclerosis (MS) is characterized by a variable clinical and radiological course. Clinical assessments, especially the Expanded Disability Status Scale (EDSS), and standard magnetic resonance imaging (MRI) assessment have historically been the mainstay of tracking illness activity. However, the "clinico-radiological paradox," in which radiological evidence of disease activity frequently precedes and frequently exceeds what is caught by traditional clinical tests, presents a substantial difficulty in the management of modern multiple sclerosis [1].

When assessing multifocal lesions, this disparity is very troublesome. Radiologists must cognitively integrate several 2D MRI slices—often more than a hundred each study—into a cohesive 3D picture of disease load, which is not only time-consuming but also intrinsically subjective and variable [2]. As a result, minor variations in lesion magnitude, distribution, and internal structure across consecutive scans could go unnoticed, perhaps postponing crucial treatment choices.

Artificial intelligence (AI) and sophisticated computational techniques are becoming revolutionary tools in neuroimaging in response to these constraints. Convolutional neural networks are a valuable tool for automated segmentation and three-dimensional reconstruction of demyelinating lesions, as demonstrated by recent work by Fedulov et al. [3]. Their approach, which goes beyond qualitative description to exact volumetric and structural analysis, enables quick, objective quantification of lesion dynamics through the use of advanced color interpretation tools.

The gap between radiological findings and clinical interpretation may be closed by incorporating such AI-driven technologies into clinical practice. This paradigm is demonstrated in this case study of a 32-year-old woman with relapsing-remitting MS (RRMS). It illustrates how advanced quantitative imaging can objectively record subclinical illness development that is not evident by EDSS alone, thereby directing prompt and appropriate treatment escalation.

Case Presentation

A 32-year-old, right-handed female with a higher education was diagnosed with Relapsing-Remitting Multiple Sclerosis (RRMS) in 2016, based on the McDonald criteria, with an initial symptom onset of sensory disturbances in 2013. Since 2017, she has been on first-line disease-modifying therapy (DMT) with glatiramer acetate. Despite this, her clinical history was notable for 2-3 reported relapses per year, predominantly characterized by sensory symptoms, which were not treated with acute steroids. This significant relapse rate on a first-line drug was an early indicator of inadequate disease management.

Neuropsychological and Clinical Results between 2021 and 2023, the patient's neurological examination revealed a stable Expanded Disability Status Scale (EDSS) score of 3.5, suggesting no significant change in her ambulation-based disability.

A thorough neuropsychological evaluation, however, revealed a different and more alarming picture:

- Symbol Digit Modalities Test (SDMT): The patient's performance significantly declined, with the percentage of correct answers falling from 43.6 percent to 23.6 percent. Her information processing speed, a crucial cognitive domain commonly impacted in MS.
- Schulte Table Test: Performance deteriorated, with completion time rising from 48.1 seconds to 56.6 seconds, indicating decreased attention and visual scanning efficiency. This represents a 45.9 percent relative decrease.
- Montreal Cognitive Assessment (MoCA): Scores stayed within the typical range of 30 to 29, indicating that short global cognitive screens are less sensitive than specialized tests such as the SDMT in identifying cognitive changes associated with multiple sclerosis.
- Mood Assessment: She had normal Beck Depression Inventory and PHQ-9 scores, which effectively ruled out a major depressive disorder as a cause of her cognitive decline.

Radiological and AI-Assisted Analysis

Brain and spinal cord MRI studies from 2021 and 2023 were compared.

Baseline MRI (2021): Showed a stable burden of chronic demyelinating plaques without evidence of active, gadolinium-enhancing lesions.

Follow-up MRI (2023): Revealed clear radiological progression of disease activity, including:

The appearance of **two new ring-enhancing gadolinium-positive lesions** in the right cerebral hemisphere, measuring 9 mm and 6.6 mm.

An increased burden of chronic lesions in critical areas such as the corpus callosum, brainstem, and cervical spinal cord (C2-C3, C5-C6 levels) (Fig.1)

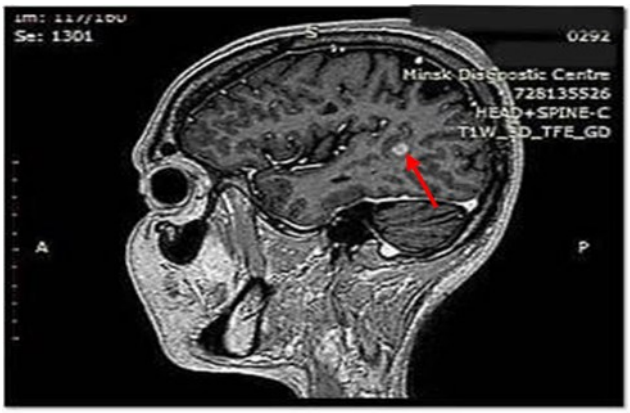

Figure 1. *MRI-scan T1 – regime with contrast sagittal projection. Remark- arrow indicates an active focus of demyelination*

To objectively quantify this change, the proprietary AI tool **«Brain Snitch»** was employed for lesion segmentation and volumetry. The AI analysis provided compelling, quantitative evidence of progression that extended beyond the qualitative read:

It confirmed a **22% increase in total T2 lesion volume** between the two scans.

The spatial distribution analysis indicated that this volume increase was predominantly located in the **periventricular regions**, areas known to be highly relevant for cognitive function due to their involvement in neural networks critical for processing speed.

The AI-generated outputs (Figs. 2 & 3 in the original) provided planar and 3D visualizations of the demyelinating foci, offering an intuitive and precise overview of the lesion dynamics. These AI findings were validated by a manual radiologist's review, which showed excellent agreement (κ = 0.91).

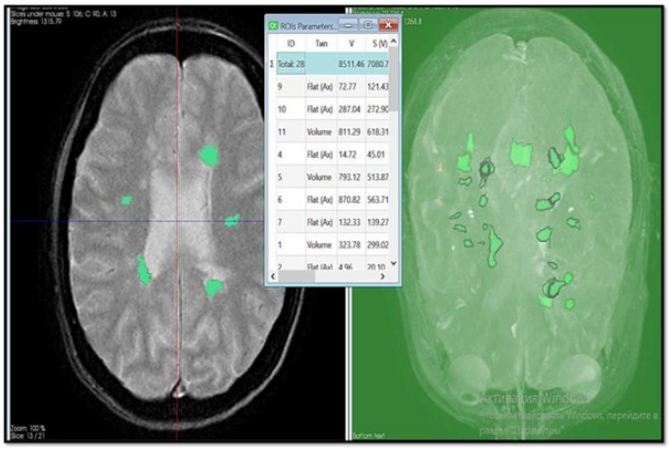

Figure 2. *Project made by «**Brain Snitch**» point 1*

Planar (left) and 3-D (right) visualization of the demyelination foci. Description of its location, size and intensity (center)

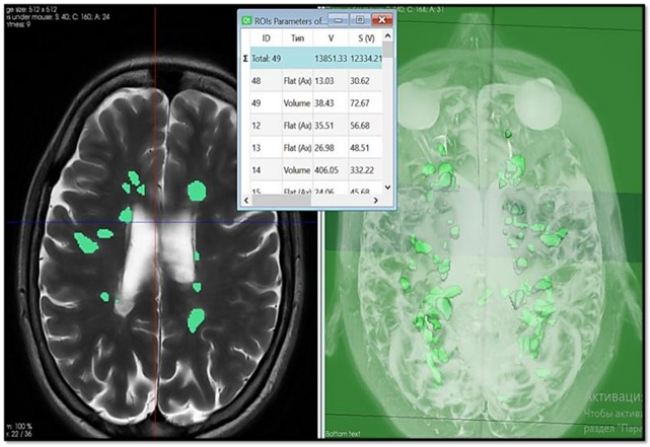

Figure 3. *Project made by «**Brain Snitch**» point 2*

Planar (left) and 3-D (right) visualization of the demyelination foci. Description of its location, size and intensity (center)

Discussion

This situation clearly shows why just using the Expanded Disability Status Scale (EDSS) isn't ideal for following multiple sclerosis (MS). Our patient, a 32-year-old woman with relapsing-remitting MS, seemed stable, as her EDSS score stayed at 3.5 for two years. But this apparent stability hid ongoing disease activity, which was found by doing more complete cognitive and imaging tests.

The most important thing was a big drop in her scores on the Symbol Digit Modalities Test (SDMT), a very accurate way to measure how fast someone can think. The drop from 43.6% to 23.6% correct answers shows a major decline in thinking skills. This agrees with past research, as Benedict and others have proven that the SDMT is one of the best ways to spot thinking problems in MS, often finding issues that the EDSS misses [4]. The stability of her MoCA score also highlights that general thinking tests might not be good enough to find the specific problems with thinking speed that are common in MS.

This "hidden" thinking decline went along with active changes seen on scans. The MRI scan in 2023 showed new lesions that lit up with gadolinium, which clearly means there was inflammation. Using the AI tool called "Brain Snitch" helped give important, unbiased numbers on this progression, measuring a 22% increase in the total amount of lesions. This numerical approach deals with the known difference between what doctors see and what scans show, where scans often show more activity than what is clinically apparent [1]. The method explained by Fedulov and his team shows how using neural networks and 3D rebuilding can objectively measure changes in lesions, going beyond the limits of just having radiologists look at the scans [3]. The AI confirmed rise in lesion amount, especially in areas near the ventricles that are key for thinking, provided the physical reason for her big drop in SDMT performance.

The combination of clear thinking decline, the appearance of new active lesions, and the AI measured increase in lesions together made it clear that the glatiramer acetate treatment wasn't working. This full picture required a strong treatment change. So, the decision was made to switch to a treatment that works better. This case supports the idea that a detailed monitoring plan, including sensitive thinking tests like the SDMT and advanced MRI measurements, is needed to spot progression that isn't obvious and improve long- term patient results by allowing for faster treatment changes. The automated method detailed by Fedulov et al., which cuts analysis time from 40 minutes to just 52 seconds while giving information on volume and intensity, shows where accurate monitoring in MS is headed [3].

Conclusion

This case, focused on a young woman with RRMS, provides a key lesson about how we treat multiple sclerosis now. At first, she seemed okay, and her EDSS score stayed at 3.5 for some time. But, without being obvious, her illness was actually getting worse, something only found with a full testing plan.

The key elements found were related and in three parts: a clear and obvious slowing in how fast her brain worked, as shown by the SDMT, new spots showing up on normal MRI scans with gadolinium, and, most importantly, the AI system "Brain Snitch" precisely figuring out a 22% increase in how much space the spots took up overall. This information changed the decision from a gut feeling to a proven reality, clearly showing that glatiramer acetate was not helping.

The main idea is simple: only using the EDSS isn't enough and could mean missing important, but small, signs of the illness getting worse. While the EDSS is useful for checking movement and basic abilities, it is not exact and doesn't catch small changes in brain function or the slow increase in the number of spots. This example really backs up the need to use careful tests of brain function, like the SDMT, along with detailed MRI scans that measure things in numbers during regular check-ups.

New tools like "Brain Snitch" and the methods explained by Fedulov et al. show a big shift in how we see things. They turn the radiologist's opinion-based and slow job into a fact-based, fast, and reliable process. By giving real numbers on the amount and behavior of spots, AI helps fix the common problem of clinical results not matching radiology images, giving a clear view of how the disease is really moving forward.

Finally, this complete method is needed to give MS treatment that is tailored to each person and looks ahead. It lets doctors react not to the late signs of physical problems, but to the early, clear signs of the disease getting worse that are seen in scans and brain function tests. For the woman in the story, this meant quickly switching to a stronger treatment, a choice made confidently to protect her long-term brain power and nerve health. Given the efficacy of modern medicines, meticulous monitoring of the illness is not merely advantageous; it is essential.

Conflict of Interest

The authors declare no conflict of interest.

Acknowledgement

None

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