AJNR

Revolutionizing MS Monitoring: The Impact of Postprocessing Techniques on Lesion Detection

A. Lecler

AJNR Am J Neuroradiol 2023, 44 (6) 656-657
doi: https://doi.org/10.3174/ajnr.A7868
http://www.ajnr.org/content/44/6/656

Revolutionizing MS Monitoring: The Impact of Postprocessing Techniques on Lesion Detection

MS is the most common chronic inflammatory disease of the CNS, with approximately 2.5 million prevalent cases worldwide. It is the leading cause of nontraumatic disability among young adults. A major challenge in managing MS is monitoring disease activity, progression, and treatment response across time. However, detecting new brain lesions by side-by-side scrolling of 2 follow-up MR imaging examinations is time-consuming, prone to reading errors, and can be extremely difficult in cases of high lesion burden. With advancements in postprocessing techniques, new digital tools have emerged to help radiologists enhance their efficiency and reproducibility, while reducing reading time and error rates. Several methods using coregistration, intensity standardization, fusion, or image subtraction have been proposed. These tools have demonstrated substantial improvements in detecting new MS brain lesions, with performance gains ranging from 35% to 80%. A few studies have revealed that simple postprocessing techniques, such as coregistration fusion of 3D FLAIR sequences or coregistration subtraction with lesion color-coding of 2D FLAIR sequences, could enhance the detection of new T2/FLAIR hyperintense brain lesions in patients with MS.[1-3]

In recent years, there has been a shift toward reducing the use of gadolinium contrast injection in MR images of patients with MS due to concerns about potential long-term health effects, making it even more critical for readers to detect new lesions on unenhanced MR images.[4] This shift has led to a demand for alternative techniques to monitor disease activity and progression in patients with MS.[5] The detection of new MS lesions is crucial in managing this chronic neurologic disease because it directly influences clinical decision-making and subsequent therapeutic strategies. Monitoring the formation of new lesions enables neurologists to assess the efficacy of the current treatment and, if necessary, adjust the therapeutic approach to prevent further disease progression. Early identification of new lesions allows the implementation of more aggressive treatment regimens, which have been shown to reduce disability accumulation, suppress inflammatory activity, and enhance long-term outcomes for patients. In this context, a vigilant approach to lesion detection is integral to the practice of precision medicine in MS because it facilitates the individualized tailoring of therapy to optimize patient outcomes while minimizing the risk of treatment-associated adverse effects.

Recently, numerous neural network–based deep learning approaches for new lesion detection have been developed to further improve the follow-up of patients with MS. These techniques can help identify new lesions and changes in lesion size or location with higher sensitivity and specificity than traditional imaging methods and can detect subtle and slight changes potentially undetectable by a human reader.[6] According to the 2020 international guidelines for MR imaging standardization and the Magnetic Resonance Imaging in MS (MAGNIMS) consensus, the development and standardization of such postprocessing tools to aid radiologists in their interpretation would improve the follow-up of patients with MS.[7,8]

In this *AJNR*-published study, Homssi et al[9] evaluated a statistical detection of change (SDC) algorithm for screening patients with MS with new lesion activity on longitudinal brain MR imaging. They demonstrated the effectiveness of their SDC algorithm in assisting human readers in identifying new lesions in patients with MS. The study found that a Reader + SDC method, which combines the use of the SDC algorithm with human readers, outperformed the Reader method, in which only human readers were used, in detecting new lesions. Specifically, Reader + SDC identified 15.0% of subjects with at least 1 new lesion, while Reader detected only 8.0%. Moreover, the study found that the SDC algorithm achieved a perfect sensitivity of 1.00 and a moderate specificity of 0.67 as a subject-level screening tool. This outcome suggests that the SDC algorithm can be a valuable tool in assisting human readers in detecting new lesions in patients with MS and can help save time and reduce the potential for errors. As the authors emphasized, one of the advantages of the SDC technique compared with neural network–based deep learning approaches is that the SDC algorithm does not require data labeling and specialized hardware such as powerful graphics processing units for network training. However, it is not yet integrated into routine clinical practice, possibly limiting its adoption by radiologists worldwide, compared with simple postprocessing tools like coregistration fusion or coregistration subtraction techniques, which are widely accessible on most postprocessing devices.

The results of this study are promising and warrant further evaluation of the SDC algorithm in prospective multireader clinical studies. If the SDC algorithm proves to be effective in larger

clinical studies, it could become an invaluable tool for diagnosing and monitoring MS, leading to improved reader accuracy, efficiency, confidence, and reproducibility. The use of these tools in clinical practice aligns well with international guidelines oriented toward a more unified and harmonized approach for the follow-up of patients with MS, ultimately leading to improved patient outcomes.

REFERENCES

1. Galletto Pregliasco A, Collin A, Guéguen A, et al. **Improved detection of new MS lesions during follow-up using an automated MR coregistration-fusion method**. *AJNR Am J Neuroradiol* 2018;39:1226–32 CrossRef Medline
2. Schmidt MA, Linker RA, Lang S, et al. **FLAIR fusion processing with contrast inversion.** *Clin Neuroradiol* 2018;28:367–76 CrossRef Medline
3. Zopfs D, Laukamp KR, Paquet S, et al. **Follow-up MRI in multiple sclerosis patients: automated co-registration and lesion color-coding improves diagnostic accuracy and reduces reading time.** *Eur Radiol* 2019;29:7047–54 CrossRef Medline
4. Brisset JC, Kremer S, Hannoun S, et al. **New OFSEP recommendations for MRI assessment of multiple sclerosis patients: special consideration for gadolinium deposition and frequent acquisitions.** *J Neuroradiol* 2020;47:250–58 CrossRef Medline
5. Boeken T, Feydy J, Lecler A, et al. **Artificial intelligence in diagnostic and interventional radiology: where are we now?** *Diagn Interv Imaging* 2023;104:1–5 CrossRef Medline
6. Roca P, Attye A, Colas L, et al; OFSEP Investigators; Steering Committee; Investigators; Imaging Group. **Artificial intelligence to predict clinical disability in patients with multiple sclerosis using FLAIR MRI.** *Diagn Interv Imaging* 2020;101:795–802 CrossRef Medline
7. Saslow L, Li DK, Halper J, et al. **An international standardized magnetic resonance imaging protocol for diagnosis and follow-up of patients with multiple sclerosis.** *Int J MS Care* 2020;22:226–32 CrossRef Medline
8. Filippi M, Rocca MA, Ciccarelli O, et al; MAGNIMS Study Group. **MRI criteria for the diagnosis of multiple sclerosis: MAGNIMS consensus guidelines.** *Lancet Neurol* 2016;15:292–303 CrossRef Medline
9. Homssi M, Sweeney EM, Demmon E, et al. **Evaluation of the statistical detection of change algorithm for screening patients with MS with new lesion activity on longitudinal brain MRI.** *AJNR Am J Neuroradiol* 2023;44:649–55 CrossRef Medline

A. Lecler
Department of Neuroradiology
Adolphe de Rothschild Foundation Hospital
Paris, France
University of Paris
Paris, France

http://dx.doi.org/10.3174/ajnr.A7868