

**Computer-assisted strategies to automated quantification of multiple sclerosis lesion evolution on brain magnetic resonance imaging**

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**Background:** Aiming to reduce the intra and inter-observer variability, several automated approaches have been proposed with the goal of assessing the multiple sclerosis (MS) lesion evolution, including both lesion detection and lesion load change quantification.

**Aim:** To study different methods used to perform the MS lesion evolution analysis on serial brain MRI.

**Methods:** We analyzed more than 30 automated MS lesion change detection techniques with the aim of pointing out their advantages and drawbacks. These methods can be divided into lesion detection and change detection techniques. The former are those that rely on a lesion segmentation process done individually at each patient scan, needing a posterior quantification step to compute the volumetric changes. The latter involve a direct comparison of temporal MRI patient scans and are classified between intensity based approaches (image subtraction or temporal analysis techniques) and deformation based approaches, which use the obtained deformation field from a non-rigid registration process to perform the lesion analysis.

**Results:** Observing the reported results, we have noticed the following trends. Using additional information in the segmentation process (i.e. atlases or supervised methods) produces better results but increases the user interaction and the computational time. The work of Duan et al. is an example of this pipeline which provides remarkable results with low values of the coefficient of variation measure suggesting a good agreement between experts and the automatic segmentation.

Determining lesion evolution based on change detection techniques is extremely dependent on the registration accuracy. We observed that intensity based methods produce more accurate results but introduce more complexity in the process. Moraal et al. presented recently high inter-observer agreements on the lesion count by using a 3D subtraction approach. Finally, the mass effect detection of the lesions and the distinction between the tissue deformation and the tissue transformation is only possible by applying a deformation based approach. However, these methods are hard to develop and require a huge amount of computational time.

**Conclusion:** There is not a single approach that can emerge as a standard for the clinical practice, providing an automated and accurate MS lesion evolution quantification. Future trends will focus on combining strategies to improve the available tools for the diagnosis and follow-up of MS patients.

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