

Table 1 Previous studies in MS detection and evaluations of these studies

Reference	Database	Number of subject	MRI sequences	Methodology	Evaluations/limitations
Bosc <i>et al.</i> [12]	their own dataset	8	T1-w, FLAIR, multimodal RARE	automatic change detection using a non-linear intensity normalisation method	the results of the study were not measured by general metrics. Not tested with a sufficient amount of dataset
Souplet <i>et al.</i> [31]	MICCAI 2008	45	T1-w, T2-w, FLAIR	automatic segmentation MS lesions based on image pre-processing, morphological operations and expectation and maximisation algorithm	high performance was not achieved
Schmidt <i>et al.</i> [32]	their own dataset	70	T2-w FLAIR, 3D T1-w	an automated tool for MS lesion detection using the developed a segmentation algorithm	high performance was not achieved and it was not implemented on different datasets
Maleki <i>et al.</i> [41]	their own dataset	150	not available (NA)	classification of MS lesion via CNN	evaluations were limited to lesion detection only
Roura <i>et al.</i> [33]	MICCAI 2008, their own dataset (2)	70 + 45 + 14	T1-w, T2-w, FLAIR	MS lesion segmentation via an automated toolbox based on image processing techniques	requires pre-processing
Brosch <i>et al.</i> [36]	MS lesion segmentation challenge 2008	500	T1-w, T2-w, FLAIR	segmentation of MS lesions using deep convolutional encoder networks	detection performance can be increased
Zhang <i>et al.</i> [34]	eHealth	38	T2-w	MS lesion detection using machine learning methods such as k-nearest neighbours, decision tree, support vector machine and comparison results	high accuracy performance was not achieved and it was not implemented on different datasets
Brosch <i>et al.</i> [46]	MICCAI 2008 and ISBI 2015	43 + 21 + 377	T1-w, T2-w, FLAIR	MS lesion segmentation via deep 3D convolutional encoder networks with shortcuts for multiscale feature integration	the performance rate is low compared to other studies and detection performance can be increased
Wu and Lopez [35]	their own dataset	67	NA	MS slice identification using Haar wavelet transform, principal component analysis and logistic regression	the dataset is inadequate
Birenbaum and Greenspan [44]	ISBI 2015	5	T1-w, T2-w, FLAIR	MS lesion segmentation using multi-view longitudinal CNN	dataset is limited to only 5 patients
Valverde <i>et al.</i> (2017) [37]	MICCAI 2008	45	T1-w, T2-w, FLAIR	a novel automated MS lesion segmentation with a cascaded 3D CNN	the structure of the model is available to develop
Zhang <i>et al.</i> [40]	eHealth, their own dataset (private)	38 + 26	T2-w	MS lesion identification using an improved CNN based on parametric ReLU and dropout	evaluations were limited to lesion detection only
Wang <i>et al.</i> [42]	eHealth, private (Zhang <i>et al.</i> [40])	38 + 26	T2-w	identification of MS lesions using 14-layer CNN with batch normalisation, dropout, and stochastic pooling	the results of the study were not measured by metrics
Ravnik <i>et al.</i> [38]	UMCL	60	T1-w, T2-w, FLAIR	lesion segmentation via CNN based different image pre-processing and augmentation methods	detection performance can be increased
Valcarcel <i>et al.</i> [47]	their own dataset	98	T1-w, T2-w, FLAIR	an automated method for segmentation of MS lesions	detection performance can be increased
Zhao <i>et al.</i> [10]	MICCAI 2008	45	T1-w, T2-w, FLAIR	MS lesion segmentation using a level set method	other databases can also be evaluated.
Atlason <i>et al.</i> [45]	the AGES-Reykjavik, MICCAI 2017	60 + 60	3D T1-w, proton density-weighted (PD-w), 2D/3D FLAIR	lesion segmentation using a supervised CNN autoencoder	the structure of the model is available to develop
Gabr <i>et al.</i> [48]	their own dataset	1008	3D T1-w, T2-w, PD-w, 2D FLAIR	lesion segmentation in MS using fully convolutional neural network	the results can be compared with different methods
Nair <i>et al.</i> [43]	their own dataset	1064	T1-w, T2-w, FLAIR, PD-w	detection and segmentation of 3D MS lesions via CNN based on Monte Carlo dropout	detection performance can be increased
Gessert <i>et al.</i> [49]	their own dataset	89 + 33	FLAIR	MS lesion segmentation with attention-guided two-path CNNs	the results can be compared with different methods
Wang <i>et al.</i> [30]	MICCAI 2008	45	T1-w, T2-w, FLAIR	MS lesion segmentation in brain MRI using an adaptive sparse Bayesian model combined with probabilistic label fusion	detection performance can be increased