Diagnostic performance of conventional MRI vs machine learning based algorithms for brain tumors

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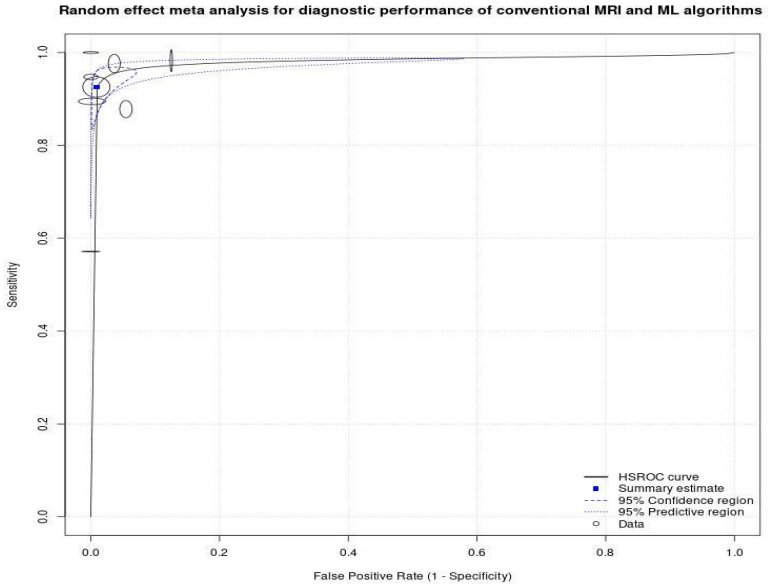
Background- T1WI MRI forms the basis for diagnosis at present but it faces several limitations. Machine learning algorithms requires less expertise and has comparable diagnostic accuracy.

Objective- This systematic review and meta-analysis was performed to compare the diagnostic performance of conventional MRI v/s Machine learning (ML) algorithms for brain tumors.

Methodology-

The study protocol was registered with PROSPERO CRD42021289726.
A Systematic Review of PubMed, EMBASE, Google Scholar and Cochrane databases along with registries (WHO ICTRP and Clinical trials) through 1980-2021 was done.

Inclusion criteria-
Original articles in English evaluating Conventional MRI or ML algorithms with/without usage of reference standard (histopathological analysis) were included. The studies which reported sensitivity, specificity or information for creation of a 2 x 2 contingency table were included Data was extracted by 2 independent reviewers and Meta-analysis was performed using a bivariate regression model.



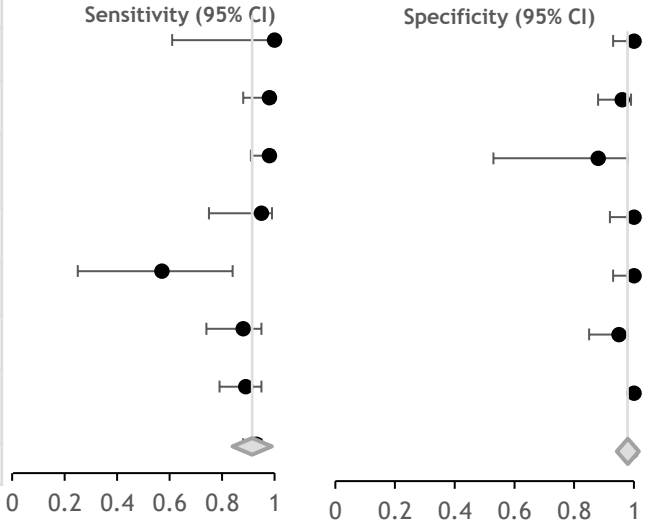
Results .

- Twelve studies with 1247 participants were included for systematic analysis and 3 studies for meta-analysis.
- ML algorithms had better aggregate sensitivity and specificity (80%, 83.14%) than Conventional MRI (81.84%, 74.78%) in the systematic review.
- The pooled sensitivity, specificity, DOR for the meta-analysis were 0.926 (95% CI, 0.840-0.926), 0.991 (95% CI, 0.955-0.998) and 1446.946 (312.634-6692.646) with AUC=0.904 under HSROC.
- On comparing, the pooled sensitivity, specificity and DOR for Conventional MRI were 0.866 (95% CI, 0.785-0.920) ,0.995 (95 % CI, 0.927-1.00), and 1191.33 whereas that of Machine learning algorithms at 0.975 (95% CI, 0.920-0.992) and 0.984 (95% CI, 0.913-0.997) , 2415.74.

Conclusion-
Machine learning algorithm have superior diagnostic performance and accurate predictive capability than Conventional imaging for brain tumors.

Meta analysis and forest plots of the included studies

Author (Name and year)	TP	FN	FP	TN	Sensitivity (95% CI)	Specificity (95% CI)
Gates et al (ML MRI LGG, 2020)	41	1	2	53	0.98(0.88,1.00)	0.96(0.88,0.99)
Gates et al (ML MRI HGG, 2020)	6	0	0	53	1.00(0.61,1.00)	1.00(0.93,1.00)
Jun et al (ML MRI per patient, 2018)	18	1	0	46	0.95(0.75,0.99)	1.00(0.92,1.00)
Jun et al (ML MRI per lesion, 2018)	56	1	1	7	0.98(0.91,1.00)	0.88(0.83,0.98)
Gates et al (CMRI HGG, 2020)	4	3	0	52	0.57(0.25,0.84)	1.00(0.92,1.00)
Gates et al (CMRI LGG, 2020)	36	5	3	52	0.88(0.74,0.95)	0.95(0.85,0.98)
Dort et al (CMRI, 2001)	51	6	1	542	0.89(0.79,0.95)	1.00(0.99,1.00)
Pooled					0.93(0.88,0.95)	0.99(0.98,1.00)



References-

Bae, S. et al. (2020). Robust performance of deep learning for distinguishing glioblastoma from single brain metastasis using radiomic features: Model development and validation. *Scientific Reports*, *10*(1), 12110.

Gates EDH, Lin JS, Weinberg JS, Prabhu SS, Hamilton J, Hazle JD, et al. Imaging-Based Algorithm for the Local Grading of Glioma. AJNR Am J Neuroradiol. 2020 Mar;41(3):400–7.