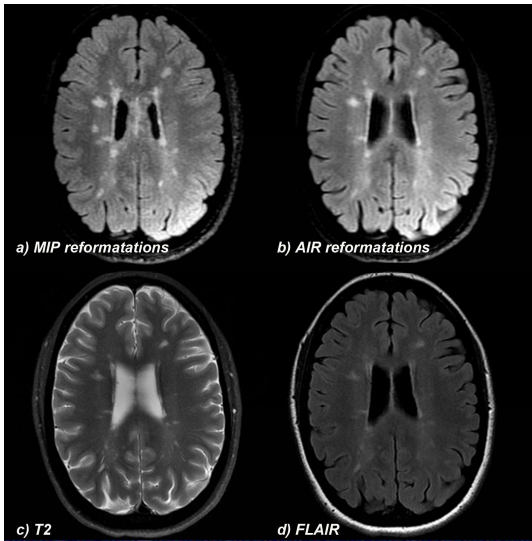# FLAIR MIPS: increased white matter lesion conspicuity

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Purpose: Maximum intensity projection (MIP) has been used to great advantage in MRI, most notably MR angiography. Our study was performed to determine whether MIP axial reformations derived from sagittal 3D fluid-attenuated inversion-recovery (FLAIR) source images increase the conspicuity of white matter lesions.

a) MIP reformatations b) AIR reformatations c) T2 d) FLAIR

Materials & Methods: Thirty-three patients were studied; 24 with multiple sclerosis (MS) (19-62 years old; 19 women, five men), six with hearing loss and/or vertigo (34-71 years; four women, two men), and three with sarcoidosis (50-56 years; all women). Multisequence brain MRI, including 4mm interleaved axial FSE T2 and FLAIR; and sagittal 3D FLAIR (TR/TE 6000/127, ETL 160; 1.6 mm section thickness/-0.8 spacing, fat-saturation) with subsequent 2 or 4 mm thick MIP and average intensity projection (AIP) axial reformations was performed on a 3.0T GE MRI scanner (GE, Waukesha, WI). Three neuroradiology fellows compared the conspicuity of white matter lesions on corresponding axial slices using four methods: a)MIP reformations, b)AIR reformations, c) direct T2, and d) direct FLAIR sequencing. (Figure 1) Primary outcome measures are counts of slices wherein lesions are rated most conspicuous for each method. A Poisson model was used to compare counts between methods after accounting for within patient correlation using a GEE method. Between rater reliability was assessed using an intra class correlation (ICC). McNemar's exact tests were used to compare frequencies of cases with conspicuous lesions between methods. For each case we compared counts of conspicuous slices between MIP and one of the other methods to determine if MIP out-performed its competing method.

Table1 Summary of conspicuous measures

Patient type	Method	Count of conspicuous imaging slices Mean (95% CI)
	MIP	8.68 (6.61, 11.41)
	FLAIR	2.08 (1.47, 2.94)*
	MPR	3.21 (2.31, 4.48)*
All	T2	1.09 (0.71, 1.68)*
	MIP	10.22 (8.00, 13.06)
	FLAIR	2.36 (1.67, 3.33)*
	MPR	5.81 (4.11, 8.20)*
2mm MS	T2	2.39 (1.51, 3.77)*
	MIP	11.72 (9.64, 14.26)
	FLAIR	4.11 (2.73, 6.19)*
	MPR	5.14 (3.33, 7.94)*
4mm MS	T2	3.00 (1.83, 4.91)*
	MIP	3.50 (1.47, 8.35)
	FLAIR	0.67 (0.27, 1.63)*
	MPR	0.56 (0.23, 1.32)*
IAC	T2	0.22 (0.09, 0.54)*
	MIP	13.56 (7.59, 24.20)
	FLAIR	2.89 (1.15, 7.24)*
	MPR	6.44 (2.79, 14.87)
Sarcoid	T2	0.89 (0.24, 3.30)*

Results: The mean (95% confidence interval or CI) of conspicuous image slices was 8.68 (6.61, 11.41) using MIP, higher than those of 3.21 (2.31, 4.48), 1.09 (0.71, 1.68), and 2.08 (1.47, 2.94), using AIP, T2 and FLAIR respectively (p-values<0.05). 31 out of 33 (93.9%) patients showed conspicuous lesions using MIP, higher than those of 72.7%, 51.5% and 45.5% using AIP, T2 and FLAIR respectively (p-values<0.05). The odds of out-performance were 5.6, 10, 10, and 5.6 as MIP being compared against AIP, T2, FLAIR and T2/FLAIR respectively (p-values<0.05). MIP showed more conspicuous image slices in patients with MS, hearing loss/vertigo and sarcoid respectively (Table1). The inter-rater reliability was good with an ICC of 0.60.

Conclusion: White matter lesions are more conspicuous on MIP reconstructions of 3D FLAIR data than they are on corresponding AIP reconstructions, direct FLAIR or direct T2-weighted axial imag