Arrow Project

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Correlation between clinical parameters and DTI metrics in multiple sclerosis patients

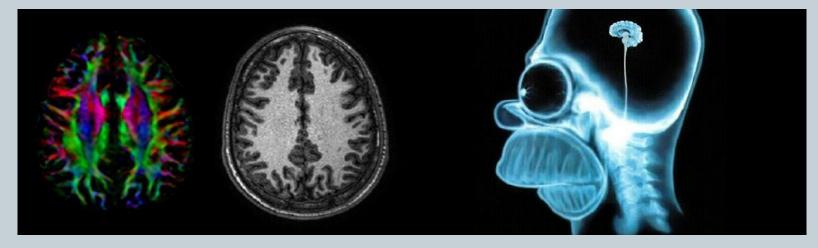
<u>Aim</u>:

Interpret MRI & DTI image results for analysis of brain **neuroprotection** and neurodegeneration in multiple sclerosis patients.



Diffusion Tensor Imaging

Diffusion tensor imaging (DTI) is the only available non-invasive imaging techniques to display and quantitatively analyze <u>white matter nerve fibers</u> *in vivo*, via alterations in the diffusion properties of water.



DTI can assess processes of neuroprotection in MS patients treated with Fingolimod, providing insights into **early tissue alterations**, **individual disease severity, treatment response and long-term prognosis.**

DTI Parameters

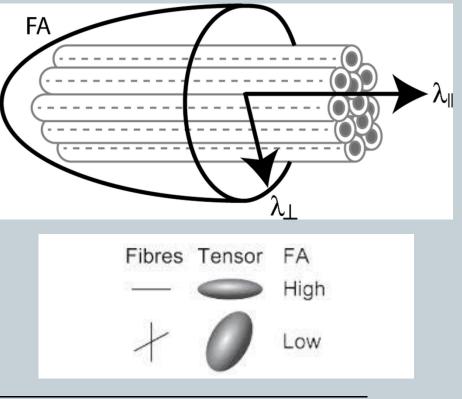
AD – Axial Diffusivity = Principal axis...*Axonal integrity*

RD – Radial Diffusivity = Perpendicular axes...*Myelin status*

MD – Mean Diffusivity = Directionless diffusion

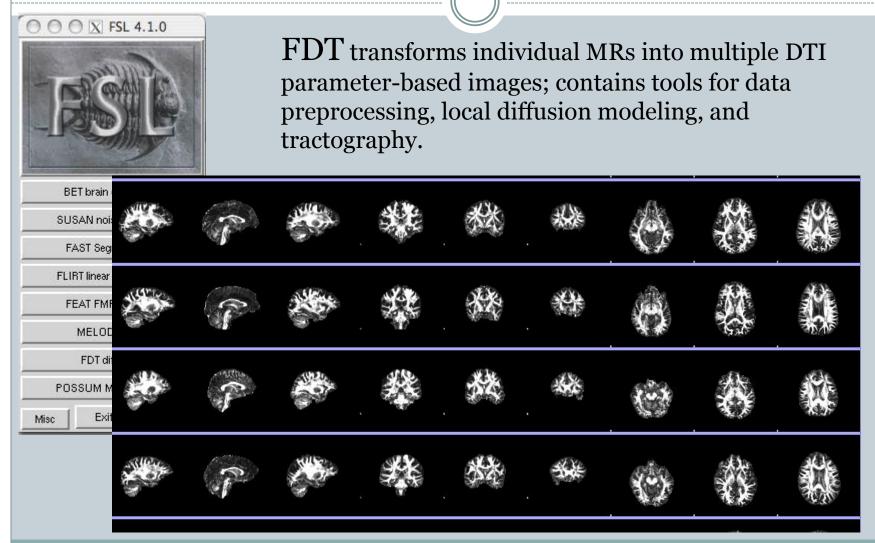
$$MD = \frac{\lambda_1 + \lambda_2 + \lambda_3}{3},$$

FA – Fractional Anisotropy

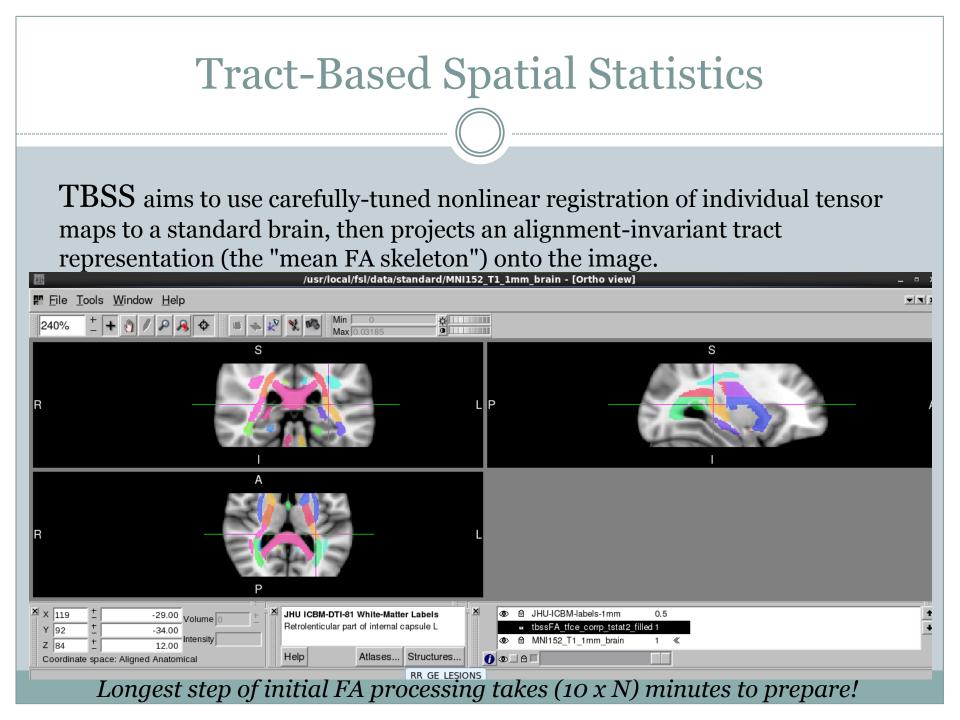


$$FA = \sqrt{\frac{1}{2}} \frac{\sqrt{(\lambda_1 - \lambda_2)^2 + (\lambda_1 - \lambda_3)^2 + (\lambda_2 - \lambda_3)^2}}{\sqrt{(\lambda_1^2 + \lambda_2^2 + \lambda_3^2)}}$$

Methods = FSL



Each individual takes ~1 hour to prepare with FDT



MRI Lesion Evolution T1 Gadolinium-enhanced MRI **T2** Arrows show lesions caused by MS disease activity Gadolinium \longrightarrow T2/T2 FLAIR \rightarrow T1

Inclusion Criteria

1. Relapsing-Remitting MS with EDSS not greater than 5.5

2. Disease duration greater than 3.5 years

3. Age between 18 and 44

4. Relapse rate 0.5/yr or greater; relapse within two years previous to test date

5. EDSS determined by closest date to test date unless within 30 days of relapse

Demographics

Gadolinium +

N = 17 4 male, 13 female Gadolinium -

N = 15 6 male, 9 female

	GD +	GD -	
Subjects	17	15	N = 32
Age (Testing Date)	31.4 ±6.9	33.2 ±7.0	p = 0.46
Disease Duration	7 .5 ±3.5	6.2 ±2.3	p = 0.22
Relapse Rate	1.0 ±0.5	1.0± 0.4	p = 0.90
EDSS Score	2.1 ±1.3	1.7±1.2	p = 0.47

Data and Results

FA	RD	MD	AD
No Lesion	No Lesion	No Lesion	No Lesion
<u>0.479 ± 0.018</u>	0. 544E-03 ± 0.024E-03	<u>0. 771E-03 ± 0.021E-03</u>	<u>1.217E-03 ± 0.020E-03</u>
Lesion	Lesion	Lesion	Lesion
0.456 ± 0.031	<u>0. 579E-03 ± 0.047E-03</u>	<u>0.796E-03 ± 0.041E-03</u>	1.224E-03 ± 0.028E-03
T-test	T-test	T-test	T-test
p < 0.011	p < 0.015	p < 0.032	p = 0.417
	A R	L L	R

However, GD + *group had significantly more T1, T2, and FLAIR volumes!*

Correlational Analysis

GD+T1V

	r	p-value	Ν
RD	0.658	0.008	15
FA	-0.621	0.013	15
MD	0.618	0.014	15
AD	0.421	0.118	15

GD-T1V

	r	p-value	Ν
RD	0.200	0.492	15
FA	-0.220	0.450	15
MD	0.152	0.604	15
AD	0.041	0.887	15

GD+ T2-T1 V

	r	p-value	Ν
RD	0.607	0.036	12
FA	-0.601	0.039	12
MD	0.538	0.071	12
AD	0.329	0.297	12

GD- T2-T1 V

	r	p-value	Ν
RD	0.235	0.486	12
FA	-0.292	0.384	12
MD	0.267	0.427	12
AD	0.251	0.456	12

Conclusion

Whole brain DTI parameters correlate significantly with T1 and T2 lesion volume... ...only in GD + patients.

-Would need multiple timepoints per patient to show if gadolinium evolution or remission leads to changes in whole-brain DTI parameters.

-Would need a higher sample size of patients that *all* have gadolinium, T1, and T2 lesions.

We intend to investigate this correlation *and* apply to analyze brain neurodegeneration /neuroprotection levels in MS patients