Temporal dissociation of white matter fasciculi in post-stroke aphasia outcomes

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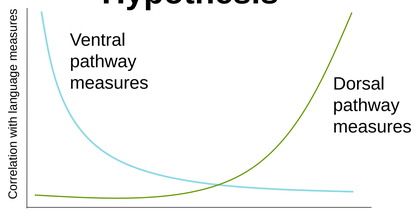
Background

- Recovery in post-stroke aphasia (PSA) seems to have different milestone timepoints, but research on their differences is scarce[1] .
- Prediction of the chronic recovery (from 6 mo. on after stroke) has been the main focus[2,3], while early phase (<1 mo.) has been little explored.
- Recent models of language processing based on anatomical studies claim the importance of white matter tracts [4,5], such as the ventral and dorsal pathways, over the traditional focus on cortical areas.
- Whereas the dorsal pathway, specially the **arcuate fasciculus (AF),** has been found related to chronic outcomes, little it is known about its relation to earlier outcomes (acute and subacute time points), or the implication of the ventral pathway tracts (such as the **inferior frontal occipital fasciculus**, IFOF).

Question

1) Can we predict PSA recovery at early as well as in chronic phases?
2) How good are white matter fiber bundles measures as recovery predictors?

Hypothesis

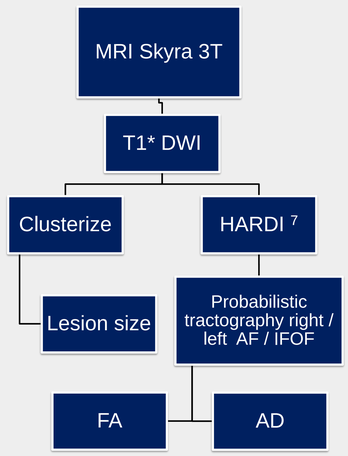


Methodology

Participants

n	16
Sex	5 ♀
Age (yr)	49 – 95
Education (yr)	6 – 19
Thrombolysis	9
Stroke subtype	Ischaemic stroke MCA territory
Initial aphasia severity	Mild = 7 Moderate = 5 Severe = 4

Neuroimaging



COMPOSITE SCORE [6]

Naming (10)	Repetition (10)	Comprehension (10)
DO-80 Naming task (PMEC) Semantic fluency (PMEC)	Word repetition (MT-86) Phrase repetition (MT-86)	Token test Word/Sentence Comprehension test (MT-86)

Measures

1) CS at each timepoint (*Scores*)
2) CS change between timepoints *(Change)*
3) Subscores at each timepoint

Results

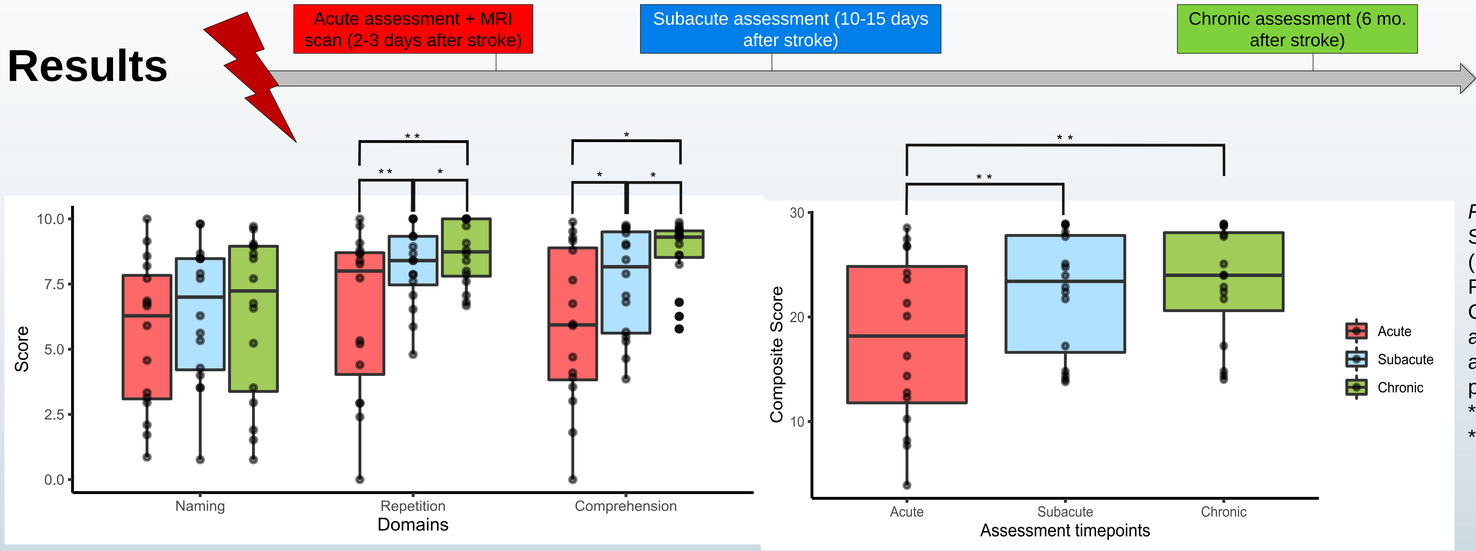


Figure 1. Subscores (Naming, Repetition and Comprehension) and CS at each assessment point. *p < 0.05; ** p < 0.005

Early recovery analysis

Table 1. Regression analyses on subacute outcomes of the Composite Score (CS) and early change. Significance threshold was set at α = 0.05

Predictors	Dependant variable	R^2 / Anova	Significant coefficients
1) Backwards regression of white matter measures on prediction of subacute scores			
(FA right , FA left, AD right , AD left) $_{AF}$	$CS_{subacute}$	0.297 / 1.914 (p = 0.188)	n.a.
(FA right , FA left, AD right , AD left) $_{IFOF}$	$CS_{subacute}$	0.452 / 10.73 (p = 0.006)	**FA from left IFOF** (β= 0.672)
2) Univariate regression of classical variables on subacute scores			
Initial severity (CS_{acute})	$CS_{subacute}$	0.657 / 26.82 (p < 0.001)	**CS_{acute}** (β= 0.811)
Lesion size	$CS_{subacute}$	0.3 / 5.989 (p = 0.028)	**Lesion size** (β= -0.547)
3) Hierarchical multivariate regression on subacute scores and change between time points			
Cs_{acute} , Age, Lesion size, left $IFOF_{FA}$	$CS_{subacute}$	0.798 / 9.85 (p = 0.002)	**CS_{acute}** (β= 0.871), **left $IFOF_{FA}$** (β= 0.479)
Cs_{acute} , Age, Lesion size, left $IFOF_{FA}$	Early change ($CS_{subacute}$ – CS_{acute})	0.706 / 5.996 (p = 0.01)	**left $IFOF_{FA}$** (β= 0.578)

Late recovery analysis

Table 2. Regression analyses on chronic scores of the Composite Score (CS) and late recovery. Significance threshold was set at α = 0.05

Predictors	Dependant variable	R^2 / Anova	Significant coefficients
1) Backwards regression of white matter measures on prediction of chronic scores			
(FA right , FA left, AD right , AD left) $_{AF}$	$CS_{chronic}$	0.275 / 5.303 (p = 0.037)	**FA from left AF** (β= 0.524)
(FA right , FA left, AD right , AD left) $_{IFOF}$	$CS_{chronic}$	0.163 / 0.488 (p = 0.745)	n.a.
2) Univariate regression of classical variables on chronic scores			
Initial severity (CS_{acute})	$CS_{chronic}$	0.077 / 1.161 (p =0.3)	n.a.
Lesion size	$CS_{chronic}$	0.3 / 5.99 (p = 0.028)	n.a.
3) Hierarchical multivariate regression on chronic scores and change between time points			
CS_{acute} , Age, Lesion size, left AF_{FA}	$CS_{chronic}$	0.312 / 1.247 (p = 0.347)	**n.a.**
CS_{acute} , Age, Lesion size, left FA_{FA}	Late Change ($CS_{chronic}$ – $CS_{subacute}$)	0.506 / 2.815 (p = 0.07)	**CS_{acute}** (β= -1.058)

Key points

1) FA from left IFOF predicts early language scores and changes, which may indicate **early contributions of ventral pathway in PSA early recovery**
2) Initial severity remains as the **best predictor of early outcome of PSA** [6]
3) FA from left AF was the only measure to predict significantly **chronic outcome**
4) Future directions: different parcellations of white and grey matter to distinguish factors for this temporal dissociation

Take home message

Measures from white matter tracts of ventral and dorsal pathways seem to be good predictors of post-stroke aphasia outcomes at different phases of recovery

References

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