White Matter Integrity as a Biomarker of Gait Recovery in Patients Post-Stroke

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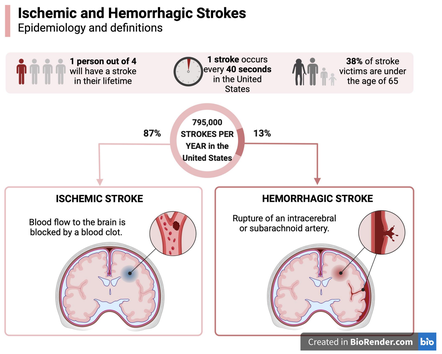
Background

- Stroke is the leading cause of serious long-term disability in the United States.
- Many individuals with stroke experience residual motor function impairments despite intensive therapy.
- Previous research focused on the corticospinal tract (CST) as a biomarker for recovery post-stroke.
    - Other neural pathways in the brain may be involved in gait recovery following stroke.
- **Objective:** To examine the neural biomarkers of gait recovery in patients with a stroke.



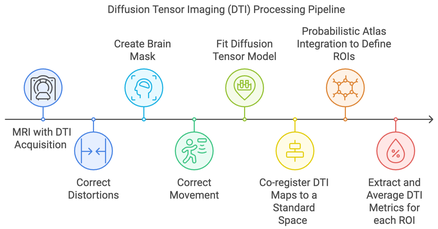
Methods and Materials

16 patients with a stroke participated in a 10-week gait training intervention consisting of two groups:

- Wearable exoskeleton robotics assist-as needed walking training (ER_{ASSIST}) group (n = 7)
- Standard of care (SOC) group (n = 9)

Clinical Measures

- Walking Speed (as fast as they can walk)
- Walking Speed (own pace)
- Dynamic Gait Index (DGI)
- Fugl-Meyer (FM)
- Berg Balance Scale (BBS)
- Timed Up and Go (TUG)
- Six Minute Walk Test (6MWT)

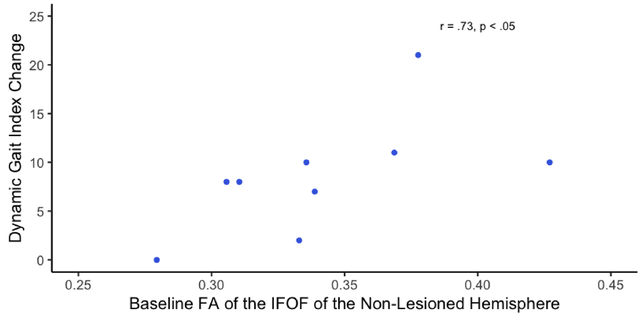


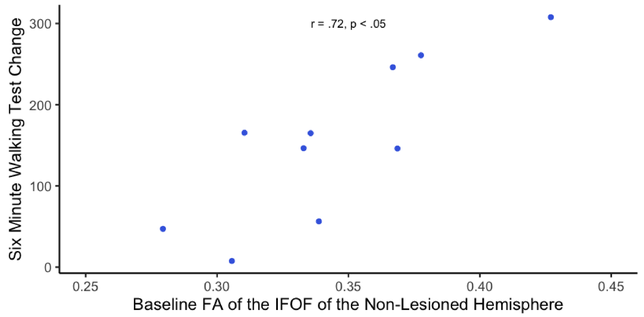
Diffusion Weighted Imaging (DWI)

- DWI is a magnetic resonance imaging (MRI) technique that is sensitive to the random motion of water molecules in tissues
- Main metric: Fractional Anisotropy (FA)

Results

Higher baseline FA (increased integrity) in the inferior fronto-occipital fasciculus (IFOF) of the non-lesioned hemisphere was associated with greater improvements in the DGI and 6MWT from pre to post intervention.





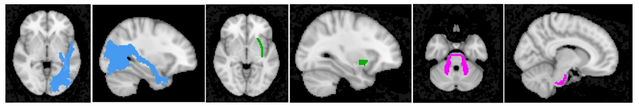
Spearman correlations between baseline FA of the IFOF of the non-lesioned hemisphere and improvement in the Six Minute Walk test and the Dynamic Gait Index.

- In this preliminary analysis, we combined groups avoiding comparison between groups in a small sample that may provide wrong conclusions.
- All patients improved in all clinical measures pre to post intervention.
- Analysis revealed significant associations between relative change of clinical measures and relative change of FA.

Results Continued

ROI	Hemisphere	Clinical Measure	Correlation Coefficient, p value
Pre Inferior Longitudinal Fasciculus	Lesioned	Mean Walking Speed (SS) Change	r = -.66, $p < .05$
Pre IFOF	Non-lesioned	6 Minute Walk Test Change	r = .72, $p < .05$
Pre IFOF	Non-lesioned	Dynamic Gait Index Change	r = .73, $p < .05$
Relative [Δ] IFOF	Lesioned	Relative [Δ] Mean Walking Speed (SS)	r = -.65, $p < .05$
Relative [Δ] MCP	-	Relative [Δ] Mean Walking Speed (SS)	r = -.64, $p < .05$

Spearman correlations between FA for the following regions of interest (ROI): Inferior longitudinal fasciculus, inferior fronto-occipital fasciculus (IFOF), middle cerebral peduncle (MCP) and clinical changes. Pre: FA during pre intervention. Change: Change in the clinical measure (post minus pre). Relative [Δ]: Relative change in FA/clinical measure, calculated as (Post-Pre)/Pre. SS: Self-selected.



Inferior Longitudinal Fasciculus | Inferior Fronto-Occipital Fasciculus | Middle Cerebellar Peduncle

Future Directions

- Baseline DTI can predict recovery of gait after stroke.
- Change in integrity of white matter can explain change in recovery of gait after stroke.
- The findings highlight the importance of examining multiple pathways beyond the CST as a biomarker for gait recovery.
- These findings could inform rehabilitation strategies, focusing on interventions to improve white matter integrity in gait-recovery related pathways.

References

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This study is funded by NIH, National Institute of Child Health and Human Development, NICHD RO1HD099200 (MPI, Saleh and Nolan)