White Matter Connectivity Differences in Face Processing Cortical Brain Network Between Preterm and Term Born Neonates

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Introduction

Face recognition is an important social skill that involves highly selective brain regions organized in a distributed functional network. This network has been found to be active since birth, as suggested by various researchers, with the observation that neonates have a tendency to orient towards faces [1]. The human cortical system starts to develop from the 28th gestational weeks (GW), with neuronal migration, connection formation, followed by myelination and strengthening of the connections. The cortical pathway of face processing develops during gestational period, and might be affected by preterm birth. Additionally, Infants born preterm are at increased risk of neurodevelopmental impairment of social cognition associated with white matter abnormalities. [2]

Aim of the study:
- Create a pipeline for processing tractography in the cortical regions of the created for neonatal brain.
- To compare the Fractional Anisotropy (FA) of preterm and term born neonates using diffusion tensor imaging.
- To compare the FA of males and females.

Results

A two-way ANOVA did not reveal significant mean FA differences between term-born vs preterm and female vs male neonates. No interaction effects were present; no post-hoc analyses were conducted.

Fig 2. Comparison of mean FA values for all combinations of gender and group

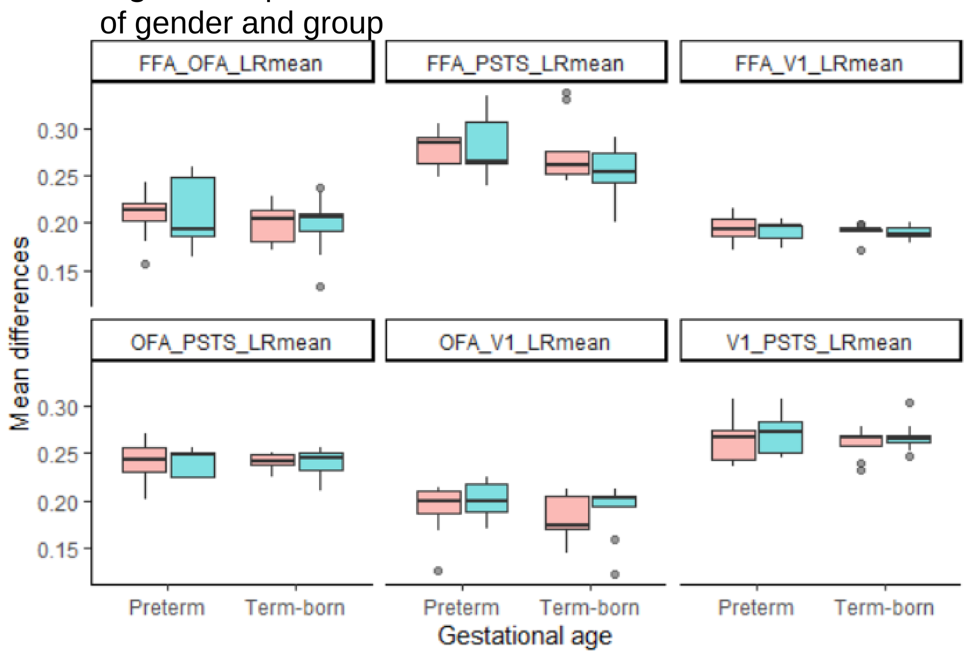


Table 1. Two way ANOVA for 6 fiber tracts, Birth age and gender

Fiber tracts	Effect	F	p
FFA - OFA	Birth age	0.952	0.336
	Gender	0.006	0.937
	Group:Gender	0.029	0.865
FFA - PSTS	Birth age	2.273	0.141
	Gender	0.467	0.499
	Group:Gender	1.548	0.222
FFA - V1	Birth age	0.446	0.51
	Gender	0.533	0.472
	Group:Gender	0.092	0.764
OFA - PSTS	Birth age	0.006	0.94
	Gender	0.028	0.868
	Group:Gender	0.002	0.969
OFA - V1	Birth age	1.398	0.246
	Gender	0.983	0.329
	Group:Gender	0.012	0.914
V1 - PSTS	Birth age	0.192	0.665
	Gender	1.391	0.247
	Group:Gender	0.006	0.941

Fig 3. Comparison of mean differences in FA values for all combinations of gender and group

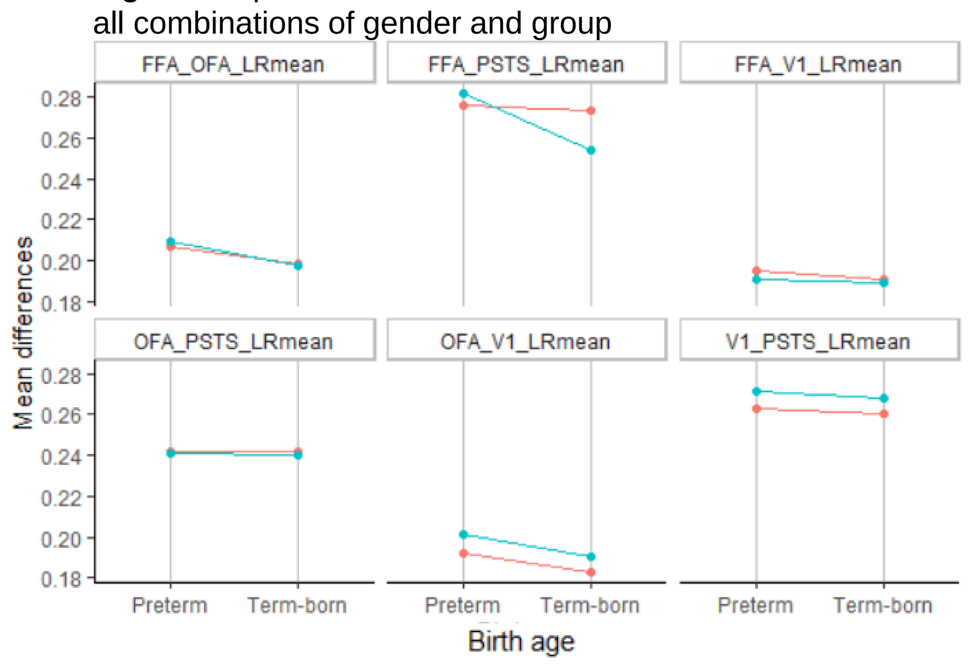


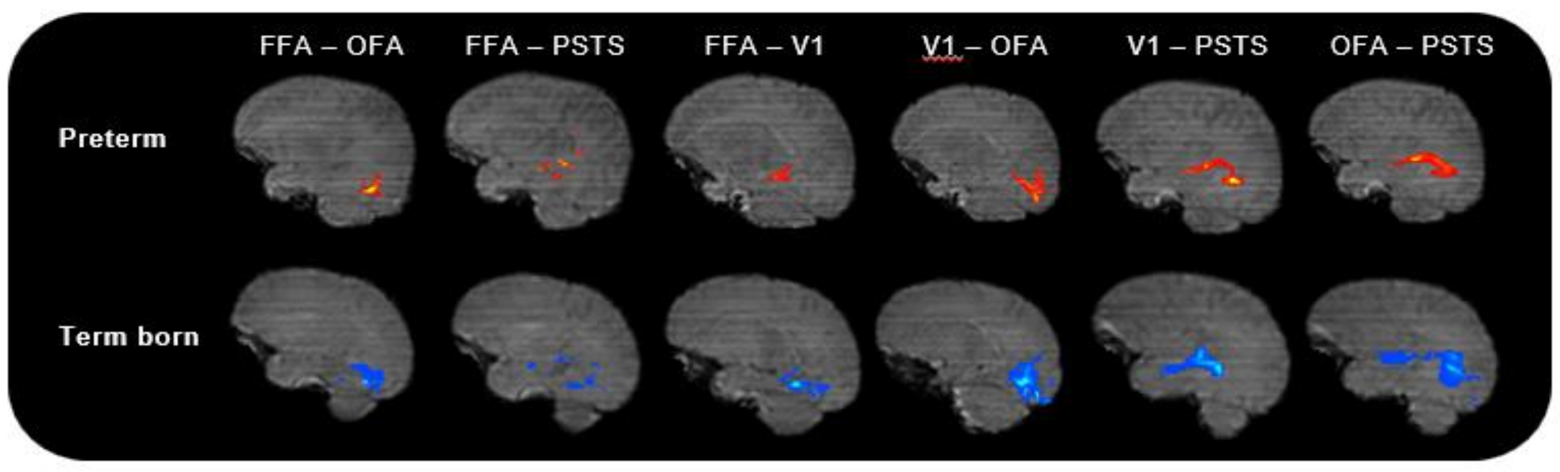
Table 2. T test of fiber tracts

ROI-pairs	Statistic	df	p	p.adj
FFA-OFA	1.0053	-1.005	33.113	0.322
FFA-PSTS	1.5071	-1.507	33.094	0.141
FFA-V1	0.6356	-0.635	22.467	0.531
OFA-PSTS	0.07882	-0.078	28.87	0.938
OFA-V1	1.2004	-1.2	33.88	0.238
V1-PSTS	0.4028	-0.402	28.45	0.69

Table 3. Mean differences for fiber tracts comparing birth age and gender.

Birth age	Gender	FFA-OFA	FFA-PSTS	FFA-V1	OFA-PSTS	OFA-V1	V1-PSTS
Preterm	Female	0.206	0.276	0.194	0.242	0.192	0.263
Preterm	Male	0.209	0.281	0.19	0.241	0.201	0.271
Term-born	Female	0.198	0.273	0.191	0.241	0.182	0.261
Term-born	Male	0.197	0.254	0.189	0.24	0.268	0.268

Fig 4. Tractography of fiber tracts comparing preterm and term born neonates.



Conclusion

The research conducted was not able to find any significant results to state that preterm birth influences upon the quality of WM fiber tracts in the cortical face pathways as compared to term born neonates. Neither, significant results were found for sex differences in the WM fiber quality. More focused research is required of WM tractography for neonates is required to gain any concrete knowledge in this direction. Further research is needed to establish solid knowledge base in this field, especially in regards to the

subcortical face areas, their connections and their role in the prenatal and early-life development of face cognition.

Limitations:
- The sample size for each group was low.
- The ENA atlas was not very accurate and well parcellated for the cortical regions.
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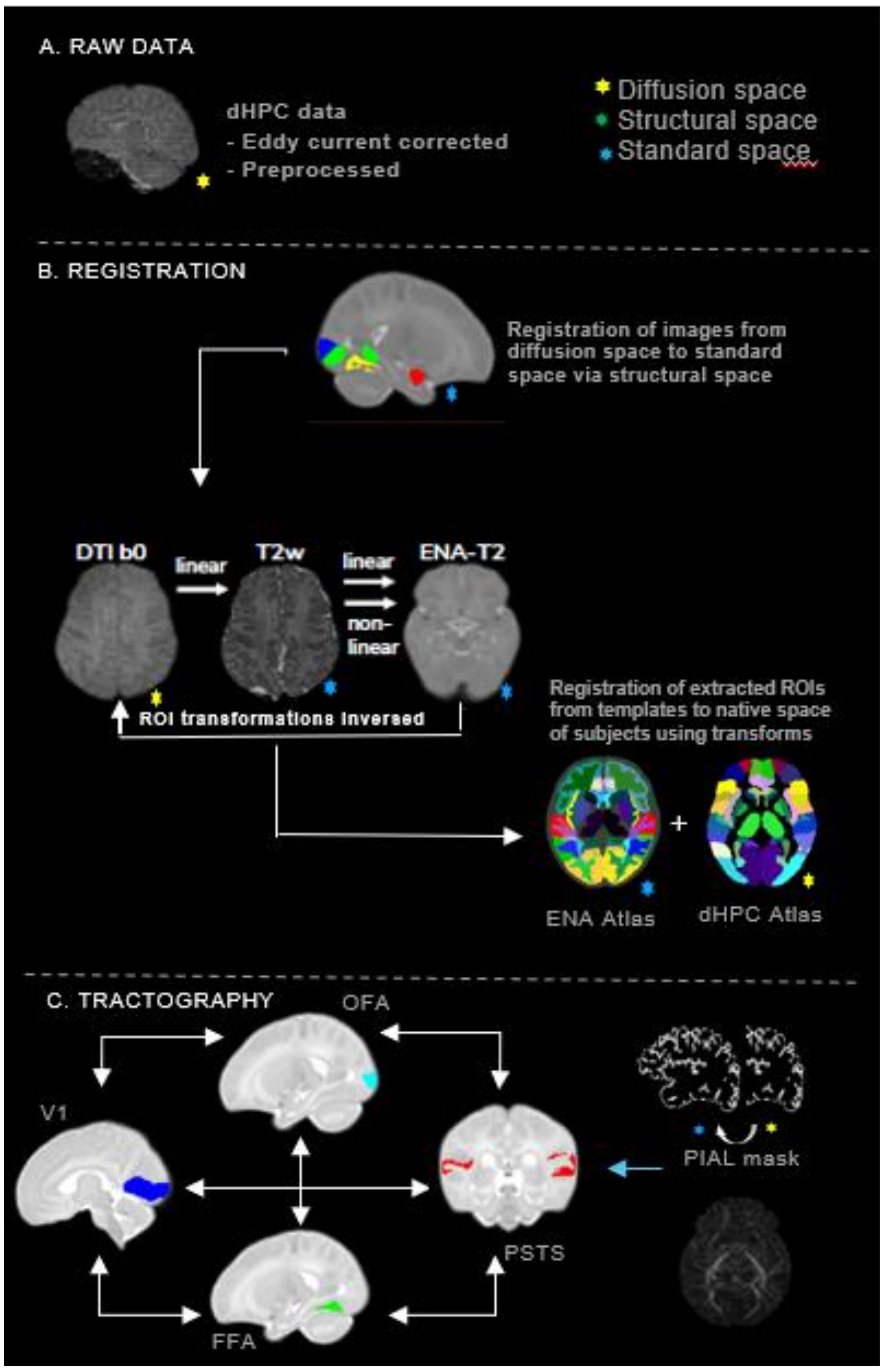
Methods

Participants: The data was taken from the open source dataset of the Developmental Human Connectome Project (dHCP). The participants selected were matched based on gender, age at birth and head circumference.
- Term-born: N = 18, (n = 9 f, n = 9 m), birth age 39.22 ± 1.50
- Preterm: N = 18 (n = 9 f, n = 9 m), birth age 31.69 ± 3.27

Anatomical regions of interest (ROI): The Cortical ROIs were selected from the Edinburg Neonatal atlas (ENA) [4], specialized for neonatal brains: Fusiform Face area (FFA), Occipital Fusiform area (OFA), Primary Visual cortex (V1), and Posterior Superior Temporal Sulcus.

Probabilistic tractography was performed between four cortical ROIs (between systems). Combinations not supported by literature were excluded beforehand.

Fig. 1. Image processing pipeline. ROIs from templates were brought into subjects' native space by: 1) obtaining transformation matrices from warping images linearly from diffusion to structural space, and both linearly and non-linearly from structural to standard space, 2) inverting these matrices; and 3) using them to warp standard space ROIs into individual diffusion space. Probabilistic tractography was performed between resulting ROI pairs. Mean FA values were calculated by overlaying a binary mask of traced fibre tracts onto a standard FA image.



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