# Non-invasive assessment of connectivity in two year old infants who were born preterm: a probabilistic tractography approach

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## Introduction

Quantitative MRI studies have demonstrated abnormalities in cerebral white matter, cortical grey matter and deep grey matter nuclei in the preterm brain[1-8], thus presenting a compelling case for abnormal connectivity in preterm infants. Recently, the ability of probablilistic tractography techniques to visualise connectivity in the adult brain *in vivo*[9] have been demonstrated. This technique may be useful for assessing white matter tracts and thalamo-cortical connections in the immature brain.

## Aim

Our aim was to investigate connectivity in two year old infants who were born preterm using a probabilistic tractography approach.

## Methods

Ethical permission approval for this study was granted by the local Research Ethics Committee and written parental consent was obtained prior to scanning. We studied 12 infants who were born preterm (median [range] gestational age at birth = 31 [25.14 – 34.43] weeks) and imaged at a median corrected age of 24.6 months (range 21 – 26.36 months). MRI was performed on a Philips 3 Tesla system. 3D MPRAGE and T2 weighted imaging was obtained prior to DTI. Single shot EPI DTI was acquired in 15 non-colinear directions using the following parameters; TR 9000ms, TE 49ms, slice thickness 2mm, field of view 224mm, matrix 128 x 128 (voxel size = 1.75 x 1.75 x 2 $mm^3$), 2 NSA, *b* value = 1000 $s/mm^2$. The data were acquired with a SENSE factor of 2 and the scanning time for this sequence was ~7 minutes. Connectivity distributions were assessed in white matter tracts and thalamo-cortical connections to the motor and sensory cortices were investigated using the FMRIB diffusion toolkit (FDT).[9]

## Results

Eleven infants had no evidence of focal abnormality on MRI and one infant had a large unilateral porencephalic cyst and periventricular leukomalacia (PVL).Connectivity distributions in the regions of the posterior limb of the internal capsule (PLIC), optic radiations, forceps major, forceps minor, superior longitudinal fasciculus (figure 1) and inferior fronto-occipital fasciculus were visualised. Asymmetrical connectivity was demonstrated in the infant with the lesions (figure 2). In addition, connections between the thalamus and motor and sensory cortices were demonstrated (figure 3).

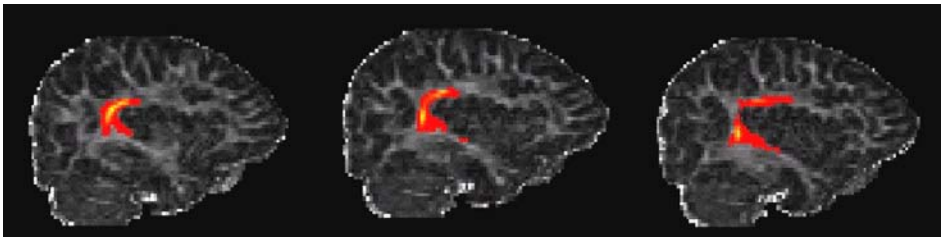

Figure 1. Connectivity distributions generated from seed points in the superior longitudinal fasciculus

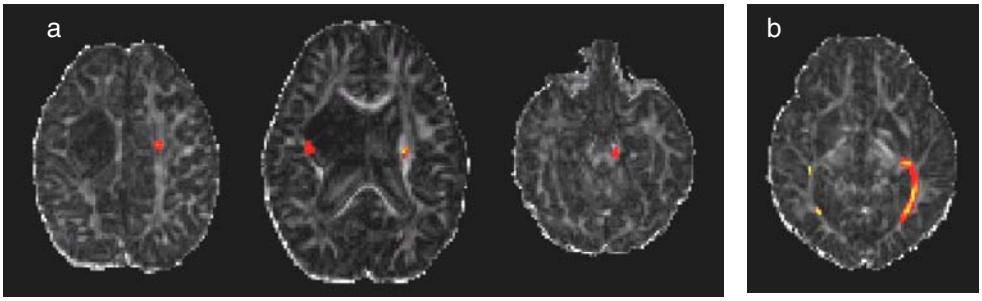


Figure 2. Asymmetrical connectivity in an infant with focal lesions. Connectivity distributions
a. generated from single seed points in the PLIC bilaterally
b. optic radiations generated from seed masks in the lateral geniculate nuclei and wayward points in the distal optic radiation.

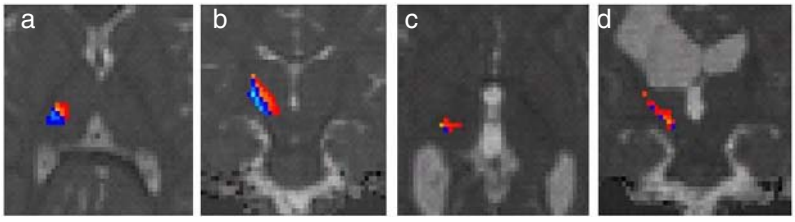


Figure 3. a. axial and b. coronal projections showing probabilistic mapping of left motor cortex (red to yellow) and sensory cortex (blue to light blue) connections on the ipsilateral thalamus in an infant with no evidence of abnormality on MRI. These regions appear diminished in the infant with white matter lesions shown in c. axial and d. coronal projections.

## Discussion

We were able to visualise connectivity in infants using a probabilistic approach, and to demonstrate abnormal connectivity in an infant with lesions in the white matter. Motor and sensory cortex projections to and from the thalamus appear to correlate to those described in the adult human brain[9], and probably correspond to ventral lateral nuclei and ventral posterior nuclei respectively. This technique promises to be a useful tool for visualising connectivity in the normal developing brain and in infants with focal lesions.

## References

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