**Influence of prematurity on local cortical development**

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Introduction

Premature birth increases infants’ risk for adverse neurodevelopmental outcome. The goal of this study is to investigate the effect of prematurity on local cortical structure via morphometric analysis, capitalizing on the availability of good quality MR scans of the newborn brain and on the recent development of automated tools for neonatal brain image segmentation. Such analyzes have the potential of identifying structural markers of atypical neurodevelopment, allowing for early detection of infants at risk, and the development of adequate intervention strategies.

Material and Methods

**MR acquisition:** Brain MR images of 50 preterm infants (GA 27.6±1wks) and 11 term-born infants (GA 40.4±1.1wks) were acquired at term-equivalent age (GA 40.5±1.5wks) on a Siemens Trio 3T. For each infant, T1- and T2-weighted images covering the whole head were obtained using the MPRAGE protocol (3D), TE = 2.5 ms, TI = 1100 ms, TR = 2200 ms for the T1 image, and the turbo spin echo protocol (2D coronal slices), TE = 150 ms, TR = 4600 ms for the T2 image, with resolution 0.8x0.8x1.2mm³ for both scans (Fig.1a-b).

**Data post-processing:** T1 and T2 images of each infant were segmented with a novel atlas-free automatic method based on morphological constraints. The following tissues and structures were segmented: the two hemispheres, cortical & subcortical gray matter, myelinated & unmyelinated white matter, brainstem, cerebellum and CSF (Fig.1c-d).

**Morphometry analysis:** T2 images of each infant were registered to a T2 template of the neonatal brain, obtained by averaging 20 coregistered T2 brain images of infants scanned at term-equivalent age, with the same protocols described above. Image registration was performed by affine registration, followed by nonlinear registration using the SPM8 software. The registration transformation of each T2 image was also applied to its corresponding cortical mask resulted from the segmentation. This was followed by multiplication of the aligned mask with the inverse of the Jacobian determinants of the deformation field (to preserve the amount of cortical tissue from the original image) and smoothing with a Gaussian kernel of 4x4x4mm³ (FWHM). A visual confirmation of the segmentation and registration quality is offered by the average of smoothed coregistered gray matter masks of our cohort (coronal).

**Results**

Our morphometry analysis revealed a significant positive dependence on GA at birth (P<0.05 FWE corrected) of two main cortical regions: one in the gyrus rectus (bilaterally) and one in the left calcarine fissure (Fig. 2).

**Conclusion**

We used a novel automatic method to segment the cortical gray matter from MR images of a cohort of preterm and term-born neonates examined at term-equivalent age. Then we performed a morphometric analysis of the cortex, which reflected a deficit of cortical density for neonates of lower GA at birth in the gyrus rectus (bilaterally) and in the left calcarine fissure. The gyrus rectus is a primary olfactory area, and the calcarine fissure is a primary visual area, thus our results suggest an altered development of these areas associated with prematurity. These results concord with the findings of M. Groppo et al., which indicate a significant correlation between GA at birth and impaired development in the optic radiation (measured as reduced fractional anisotropy by Diffusion Tensor Imaging).

**References**