Visualization of the Meyer’s loop in 3D T1-weighted images in infants: Demonstration of interhemispheric asymmetry of anterior extent of the Meyer’s loop

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Introduction

The optic radiation (OR) is a tract that connects the lateral geniculate body (LGB) to the primary visual cortex. Of the 3 bundles, the inferior or ventral bundle, makes a anterior and lateral loop from the LGB around the temporal horn of the lateral ventricle to the anterior inferior calcarine cortex, also known as the Meyer’s loop (ML). This bundle is easily injured during temporal lobe surgery and results in various degrees of field defects.

Recently, there was prospective study analyzing 105 cases undergoing temporal lobe resection, that concluded that there is hemispherical asymmetry in the ML, suggesting a more anterior location of the Meyer’s loop in the left.

It is well known that magnetic resonance images (MRI) allows assessment of myelination of a child, due to change in MR properties. In this study, we hypothesized that ML can be defined and evaluated in early life during myelination, and be evaluated for asymmetry on 3D T1WI.

Material and Methods

Between the period of January of 2009 and October of 2010, 308 infants less than 24 months of age underwent brain MRI including 3D T1W imaging for various reasons at our institute, to rule out structural abnormalities of the brain. From the above group, subjects were selected by the following criteria: a) normal to minimally abnormal findings without significant artifacts on MRI and b) subjective clear visual identification of the ML from the adjacent white matter, the ML appearing hyperintense. Since the clear visualization of the ML is highly dependent on the difference in degree of myelination of the adjacent WM according to age, the term equivalent age at the time of image acquisition (term equivalent age; TEA) was calculated by the following equation, to account for many subjects that were born before term: Term equivalent age (months) = (Age of infant at birth documented by the obstetrician (days) – term age (38±7 days; 38 weeks) + time from birth to image acquisition (days) / 30. After sorting the infants according to the calculated TEA, the range in which the anterior extent of the ML is clearly distinguishable, was determined by visual assessment. The range was 3 to 10 months in TEA (50 to 78 weeks after gestation).

As a result, 47 infants (M:F=27:20; mean TEA, 5.7 months; range of TEA, 3.0-9.8 months) infants were finally included in the analysis.

The infants were scanned on 4 different scanners (Philips Intera 1.5T (n=1), Philips Achieva 1.5T (n=8), and Philips Achieva 3.0T (n=36), Philips Healthcare, The Netherlands; Siemens TrioTim 3.0T (n=2), Siemens Healthcare, Erlangen, Germany) with different image sequences. For the Philips scanners, 3D T1 TFE sequence was used. On the 1.5T scanners, TR/TE ranged from 9.1-11.3/3.8-5.6 msec, flip angle 8 degrees, FOV 150x150 to 220x220mm, matrix 224x224, slice thickness 1-2mm. On the 3.0T scanners, TR/TE ranged from 9.5-9.9/4.6 msec, flip angle 8 degrees, FOV 170x170 to 220x220mm, matrix 172x172 to 224x224, slice thickness 1-1.5mm. For the Siemens scanner, magnetization prepared rapid gradient echo (MPRAGE) sequence was used. TR/TE were 2300/2.98 msec, flip angle 9 degrees, FOV 256x192mm, matrix 256x184, slice thickness 1mm.

The 3D T1WIs were examined on AquariusNET (TeraRecon, Foster City, California, USA). The distance from the coronal plane crossing the anterior-most part of the ML and the temporal pole (DTT) on a plane parallel to the hippocampal axis, on sagittal reformatted images, referencing orthogonal planes, for both sides, by one radiologist.

The difference between left and right DTT was tested by paired t-test. For each side of DTT, differences between boys and girls were tested by Mann-Whitney U test. A p-value of less than 0.05 was considered statistically significant. PASW 16 (SPSS Inc, Chicago, USA) was used for all statistical analyses.

Results

The DTT measurement of each subject is shown in Table 2. The mean values of the DTT on the left and right were 22.5±2.7 mm, 24.0±2.4 mm, respectively. The DTT on the left was significantly shorter than that on the right (p<0.0001). There was no significant difference of the DTT on both sides between male and female infants (p>0.05)

Figure 1 Visualization of myelinated Meyer’s loop and measurement of DTT (a) T1W axial image, (b) sagittal maximum intensity projection (MIP) image, (c) Captured image during measurement of DTT on sagittal T1WI, of a female infant born at term and imaged at 5.1 months term equivalent age. Axial image and the sagittal MIP image well delineates the myelinated optic radiation and the right Meyer’s loop (red arrows) as hyperintense structures. The reason because the measurement is extending beyond the cortex is because the temporal lobe is not in the same sagittal plane with the anterior-most part of Meyer’s loop.

Conclusion

To our knowledge is the first study to backup the study by Jeelani et al image-wise, that there is interhemispheric asymmetry of DTT. We believe our result will encourage other groups to compare the in which the data is obviously included their previous studies.

In our study, we showed that during a certain stage in infancy during myelination, the presumed ML can be visualized as high signal intensity on T1WI .

We believe that our method may complement and the cadaveric fiber dissection technique, which is still the gold standard, and the widely used DTI however with flaws, in better understanding the anatomy of the optic radiation in vivo, and in specific, the ML.

Reference

1. Jeelani et al., J Neurol Neurosurg Psychiatry 2010; 81:985-991