Normal Myelination Using the Fast Inversion Recovery for Myelin Suppression Sequence

Wolansky, L. J., Moldovanyi, C., Lebovitz, Y., Seo, G., Kociorynska, E., Gor, D., Singh, S., Liu, W., Shrivastava, A.
New Jersey Medical School/University of Medicine & Dentistry of New Jersey
Newark, NJ.

Purpose
The normal progression of brain myelination as demonstrated using T1- and T2-weighted MR imaging is well established. More recently, the sequence of myelination on FLAIR has been described. The purpose of this study is to describe the pattern of normal myelination using fast inversion recovery for myelin suppression (FIRMS), which has been shown previously to have the higher gray-white matter tissue contrast than other sequences through the suppression of white matter (1, 2).

Materials & Methods
Medical histories and T1- and T2-weighted scans of 23 patients aged 0 - 24 months (adjusted for prematurity, when necessary) were reviewed to insure the absence of preexisting movement disorders or myelination abnormalities. Region of interest (ROI) measurements were obtained of the following structures: Thirteen white matter regions, specifically, inferior and middle cerebellar peduncles, decussation of superior cerebellar peduncles, anterior and posterior limbs of the internal capsule, optic radiation, genu and splenium of corpus callosum, forceps major and minor, as well as the anterior, posterior, and superior centrum semiovale and a gray matter control region (caudate nucleus). For objective determination of conspicuity, the contrast ratio (CR) was calculated for each white matter structure, where CR = intensity (white matter structure)/intensity (caudate nucleus). A CR > 1.10 indicated hyperintensity with respect to gray matter. A CR between 0.90 and 1.10 indicated isointensity with respect to gray matter. A CR of < 0.90 indicated hypointensity with respect to gray matter and was the threshold for determining that myelination had occurred.

Results
In general, white matter structures began as hyperintense with respect to gray matter until myelination takes place, leading to hypointensity of the region's signal. The pattern of myelination for the specific milestones is described in the accompanying table.

<table>
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<th>Region of Interest</th>
<th>Age</th>
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Decussation of Superior Cerebellar Peduncles Birth
Middle Cerebellar Peduncle Birth
Inferior Cerebellar Peduncle Birth – 3 Weeks
Internal Capsule (Posterior Limb) 7 Weeks
Forceps Major 5 Months
Optic Radiations 6 Months
Splenium of Corpus Callosum 6 Months
Genu of Corpus Callosum 6 Months
Internal Capsule (Anterior Limb) 6 Months
Posterior Centrum Semiovale 6 Months
Anterior Centrum Semiovale 7 Months
Superior Centrum Semiovale 7 Months
Forceps Minor 10 Months

Conclusion
The normal pattern of myelination using FIRMS is described. Using FIRMS, all 13 white
matter regions appear myelinated by 10 months. Further study may determine whether
FIRMS is superior or inferior to T1-weighted images for evaluating the infant brain
during the first 8 months of life.

References
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