

# **Triple-layer Appearance of The Primary Motor Cortex on Thin-section Double Inversion-recovery Imaging: Validation Study by Using Intraoperative Cortical Mapping**

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## **Introduction**

Double inversion-recovery (DIR) imaging can suppress the signals from both white matter and CSF, selectively depicting cortex with bright signal intensity (1). The primary motor cortex contains prominent myelin in its layers 3 and 5 (more in layer 3), which is seen as triple-layer appearance on thin-section DIR (outer hyperintense, middle hypointense, and inner mildly hyperintense layers) (2). In the previous study, although it has been suggested that the primary motor cortex in patients without major neurologic deficits shows triple-layer appearance on thin-section DIR, the primary motor cortex was determined only with anatomical landmarks (2). Therefore, validation study for this finding should be performed. Intraoperative cortical mapping has been considered as a gold standard for determining the primary motor cortex. Therefore, we performed validation study of the triple-layer appearance in patients who have brain tumors and underwent both DIR imaging before surgery and intraoperative cortical mapping.

## **Methods**

All patients gave an informed consent. The institutional review board approved this study. Nine patients with brain tumors (female, 4; mean age, 46 years) involving frontal or parietal lobe underwent MRI at 3.0 T (Intera Achieva, Philips Medical Systems). MR imaging consisted of routine T1-, T2-weighted imaging, FLAIR, 2D DIR, postcontrast T1-weighted imaging. The scan parameters of 2D DIR are as follows: field of view, 230 mm; slice thickness, 2.0 mm; slices, 30; TR/TE = 11000/25 ms; long inversion time, 3400 ms; short inversion time, 325 ms; matrix, 256x196 (reconstruction, 512x512); SENSE factor, 0; number of excitation, 2; acquisition time, 5 minutes and 52 seconds. DIR images were obtained from the vertex downwardly. A neuroradiologist defined the primary motor cortex by using triple-layer appearance on 2D DIR before surgery. A neurosurgeon performed awake surgery in all patients and cortical mapping in the predefined primary motor cortex according to the findings on 2-D DIR.

## **Results**

Tumors consisted of 4 oligodendrogliomas, 3 meningiomas, one mixed oligoastrocytoma, and one glioblastoma. In all patients, the triple-layer appearance was noted only in the presumed primary motor cortex. Intraoperative cortical mapping confirmed that the cortex identified by using triple-layer appearance on 2D DIR was the primary motor cortex in all 9 patients (Fig. 1 and 2).

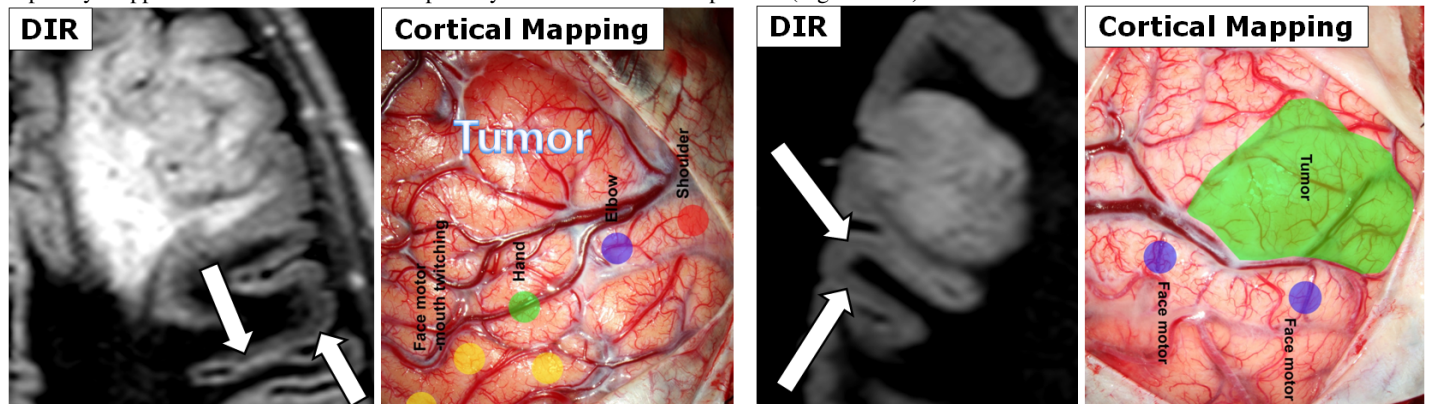


Fig. 1. A 52-year-old female with oligodendroglioma in the left frontal lobe. DIR shows triple-layer appearance in the primary motor cortex (arrows), which is confirmed at cortical mapping during awake surgery.

Fig. 2. A 56-year-old male with oligodendroglioma in the right frontal lobe. DIR shows triple-layer appearance in the primary motor cortex (arrows), which is confirmed at cortical mapping during awake surgery.

## **Discussion and Conclusion**

Preoperative determination of the primary motor cortex is crucial. For this purpose, many methods such as specific morphology of this particular cortex and central sulcus localization have been suggested. However, no studies suggested the method using substructure of the primary motor cortex on MRI. We previously demonstrated the triple-layer appearance on thin-section 2D DIR is seen in all subjects more than 10 years of age (2). However, validation has not been performed at that time. In this study, we validated that the triple-layer appearance on thin-section 2D DIR represents the primary motor cortex and can be used for determination of this cortex. Besides the role of determination of the primary motor cortex, the triple-layer appearance may be used for research involving this crucial cortex such as amyotrophic lateral sclerosis or corticobasal degeneration. In conclusion, the triple-layer appearance on thin-section 2D DIR is a new imaging marker of the primary motor cortex.

## **References**

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