IMAGING IN NEURAL REGENERATION

Weak phonation due to unknown injury of the corticobulbar tract in a patient with mild traumatic brain injury: a diffusion tensor tractography study

In this study, we report on a patient who showed weak phonation following mild traumatic brain injury (TBI), which was demonstrated by diffusion tensor tractography (DTT).

A 56-year-old male suffered from head trauma resulting from a car accident. While the male was waiting on a signal in the driver's seat of a sedan at an intersection, a sedan collided with his car from behind. His head hit the headrest after flexion and hyperextension of his head. The patient lost consciousness for approximately 5 minutes and experienced post-traumatic amnesia for approximately 5 minutes from the time of the accident. The patient's Glasgow Coma Scale score (Teasdale and Jennett, 1974) was 15. No specific lesion was observed on brain MRI performed at 6 weeks after the onset of head trauma (**Figure 1A**). The patient complained of weak phonation and easy hoarseness since the onset of head trauma. However, he showed no abnormality on the Western Aphasia Battery (Teasdale and Jennett, 1974) (aphasia quotient: 99‰) or dysarthria. The study protocol was approved by the Institutional Review Board of Yeungnam University Hospital (IRB No. YUMC-2017-06-020).

Diffusion tensor imaging (DTI) data were scanned at 6 weeks after onset using a 6-channel head coil on a 1.5T Philips Gyroscan Intera (Philips, Ltd., Best, the Netherlands) with 32 gradients. Fiber tracking was performed using a probabilistic tractography method based on a multi-fiber model, and applied in the current study utilizing tractography routines implemented in FMRIB Diffusion (5000 streamline samples, 0.5 mm step lengths, curvature thresholds = 0.2). For analysis of the corticobulbar tract (CBT), the seed region of interest (ROI) was placed on the lower pons of the anterior blue portion on the color map, and the target ROI was placed on the lower portion of the precentral gyrus and in the section of the top of the lateral ventricles (Jang and Seo, 2015). The right CBT showed partial tearing at the corona radiata level compared with the left CBT (**Figure 1B**).

In the current study, we investigated DTT findings of the CBT in a patient who complained of weak phonation following mild TBI, and found partial tearing injury of the right CBT. Although typical symptoms of injury of the CBT are dysarthria, dysphasia, and dysphonia (Afifi and Bergman, 2005), we think that weak phonation in this patient was ascribed to the mild traumatic axonal injury of the right CBT because the CBT is involved in the control of the muscles for phonation. To the best of our knowledge, this is the first study to demonstrate injury of the CBT in patients with mild TBI (Liegeois et al., 2013; Kwon et al., 2015; Jang et al., 2015).

In conclusion, injury of the CBT was demonstrated in a patient who showed weak phonation following mild TBI. Our results suggest the necessity of evaluation of the CBT using DTT for patients who show a phonation problem following mild TBI.

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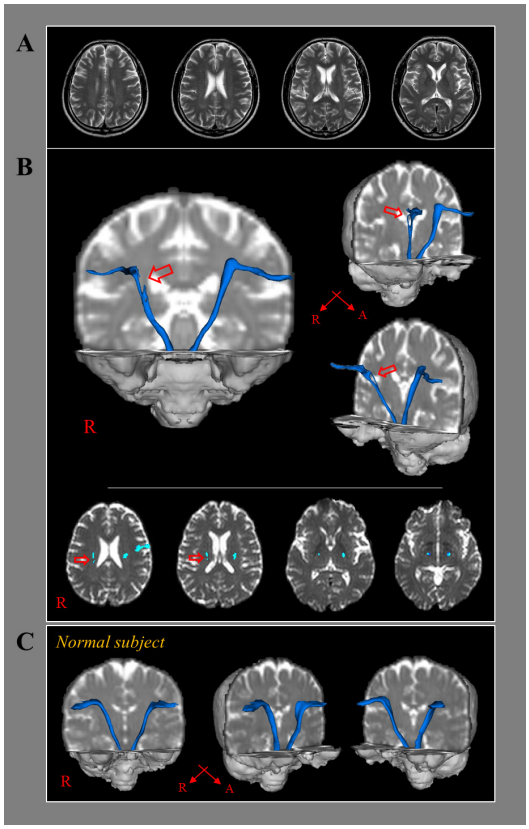

Figure 1 Brain MR imaging and diffusion tensor tractography (DTT) for a 56-year-old male patient with head trauma suffering from weak phonation.
(A) Brain MR images at 6 weeks after onset show no abnormal lesions. (B) Results of DTT for the corticobulbar tract (CBT). The right CBT shows partial tearing at the corona radiata level (red arrows). (C) Results of DTT for the CBT of a normal 58-year-old male subject.

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References

Afifi AK, Bergman RA (2005) Functional neuroanatomy: Text and atlas, 2nd ed. New York: Lange Medical Books/McGraw-Hill.
Jang SH, Seo JP (2015) The anatomical location of the corticobulbar tract at the corona radiata in the human brain: Diffusion tensor tractography study. Neurosci Lett 590:80-83.
Jang SH, Lee J, Kwon HG (2016) Reorganization of the corticobublar tract in a patient with bilateral middle cerebral artery territory infarct. Am J Phys Med Rehabil 95:e58-59.
Kwon HG, Lee J, Jang SH (2016) Injury of the corticobulbar tract in patients with dysarthria following cerebral infarct: Diffusion tensor tractography study. Int J Neurosci 126:361-365.
Liegeois F, Tournier JD, Pigdon L, Connelly A, Morgan AT (2013) Corticobulbar tract changes as predictors of dysarthria in childhood brain injury. Neurology 80:926-932.
Teasdale G, Jennett B (1974) Assessment of coma and impaired consciousness. A practical scale. Lancet 2:81-84.