

Diffusion tensor tractography to depict the course of facial nerve displaced by large vestibular schwannomas.

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Purpose: The purpose of this study is to depict the course of facial nerve that is displaced by large vestibular schwannoma using diffusion tensor tractography preoperatively and to evaluate the agreement with surgical findings.

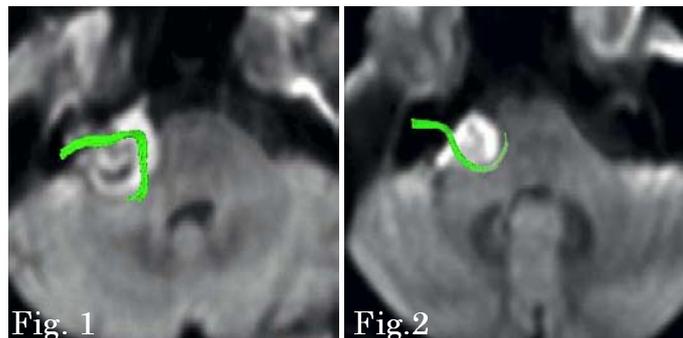
Materials and Methods: The subjects were eight cases with vestibular schwannoma which undergone surgical resection. Diameters of the tumors ranged from 18mm to 47mm.

Diffusion tensor images were obtained using a single shot echo planar sequence (1.5T clinical scanner; TR = 4900 ms, TE = 85 ms, b = 1000 sec/mm², 6 axes encoding, FOV = 230 mm, matrix = 128 x 128, slice spacing = 3 mm, averaging = 6). Tractographies were constructed using diffusion tensor imaging software developed by Masutani et. al (Tokyo University, "dTV ver. 2", available at <http://www.ut-radiology.uimin.jp/people/masutani/dTV.htm>). We constructed tractographies by following 3 steps. (1) Track lines in cerebro-pontine angle were constructed non-selectively with large start point. (2) A point within a track line that passes through the antero-superior part of internal auditory meatus was picked up from the track lines of former step. (3) A new start point for tracking was set at the point picked up in the former step, and a track line which considered to represent facial nerve was constructed.

We assessed the success rate for constructing track line that connects the internal auditory meatus and the brainstem, which is considered to represent facial nerve. We also evaluated the displaced course of constructed tract of tumor side in six directions (anterior, anterior/upper, posterior/upper, posterior, posterior/lower, anterior/lower), and compared the findings of tractography with surgical findings.

Results: We could obtain track line that connects the internal auditory meatus and the brainstem in 7 cases out of 8 vestibular schwannoma cases. We could not obtain track line in a case with the tumor of the smallest diameter (case1; 18mm).

Constructed tracts were displaced to the anterior in 3 cases (Fig. 1), to the anterior/upper in one case, to the posterior/upper in one case (Fig. 2) and anterior/lower in one case. In one case (case 5), constructed tract go straight through the tumor. The course of the constructed tract agreed with surgical findings in 5 cases out of 7 cases (Table). Two cases in which surgical agreement was not obtained included a case with mostly cystic schwannoma (case 5), and a case in which the tumor was very large and facial nerve could not observed during surgery (case 8; intracapsular resection was made).



Case No.	Tractography findings	Agreement	Surgical findings
1	Could not track	n/a	Anterior shift
2	Posterior/upper shift	yes	Posterior/upper shift
3	Anterior shift	yes	Anterior shift
4	Anterior shift	yes	Anterior shift
5	Straight	no	Anterior/lower shift
6	Anterior/upper shift	yes	Anterior/upper shift
7	Anterior/lower shift	yes	Anterior/lower shift
8	Anterior shift	n/a	Could not confirm (intracapsular resection)

Discussion and Conclusion: On surgical removal of large vestibular schwannoma, identification of the facial nerve displaced and compressed by the tumor is the point of critical importance in order to avoid injury of facial nerve₁. However, it is very difficult to depict the course of the facial nerve using conventional MRI technique including MR cisternography when the tumor is large. It is mainly because the signal intensities of facial nerve and vestibular schwannoma are almost indistinguishable, and there is no cerebrospinal fluid to split both structures when the tumor is large. In this study, using diffusion tensor tractography, we could extract the course of facial nerve which is stretched and displaced by large schwannoma, and the course of the constructed tract agreed with surgical findings in 5 cases out of 7 cases.

Technique of diffusion tensor tractography is considered to be a powerful tool for predicting the course of displaced facial nerve in vestibular schwannoma preoperatively.

Reference:

1. J Neurosurg 92:70-78, 2000