Diffuse Tensor Imaging Changes of Trigeminal Nerve in Trigeminal Neuralgia Patients Receiving Percutaneous Radiofrequency Rhizotomy

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Introduction

Trigeminal Neuralgia is a common chronic cranial-facial pain disorder. We previously reported that diffuse tensor imaging (DTI) could be applied to assess the microstructural changes in the affected trigeminal nerve. In this study, the relationships between DTI changes before and after percutaneous radiofrequency rhizotomy, intraoperative rhizotomy needle position, and postoperative clinical outcome were evaluated.

Methods

Thirty-three patients with trigeminal neuralgia were recruited, and DTI was performed before and two weeks after radiofrequency rhizotomy. The cistern segment of the trigeminal nerve was selected manually, the volume of the nerve, fractional anisotropy, apparent diffusion coefficient, and axial, radial and mean diffusivities were measured. During the operation, the distance between the rhizotomy needle and trigeminal cistern was measured by intraoperative CT and MRI fusion images. Numerical rating scale (NRS) was used to estimate the pain intensity before and after operation. Recurrence of neuralgia and postoperative complications were also recorded for treatment outcome assessment.

Results

Percutaneous radiofrequency rhizotomy significantly increased the volume (72.73±14.88 vs 83.88±21.92mm3, p=0.04), fractional anisotropy (0.273±0.094 vs 0.310±0.049, p=0.05), and decreased in apparent diffusion coefficient (1.61±0.25x10-3 vs 1.47±0.20x10-3mm2/s, p=0.009), radial diffusivity (1.52±0.29x10-3 vs 1.38±0.18x10-3mm2/s, p=0.009) and mean diffusivity (1.26±0.30x10-3 vs 1.10±0.19x10-3mm2/s, p=0.004) of the trigeminal nerve. However, these changes of DTI parameters did not correlate with intraoperative rhizotomy needle position or recurrence of neuralgia.

Conclusions

The differences in DTI following percutaneous radiofrequency trigeminal rhizotomy showed the significant degree of trigeminal nerve change. However, it has no prognostic value in predicting clinical outcome with respect to pain relief or recurrence. Further studies with serial DTI data over a longer period are required to determine the true clinical value of DTI changes.

Learning Objectives

By the conclusion of the study, we can identify the image changes in trigeminal nerves after radiofrequency rhizotomy in trigeminal neuralgia patients. The change may indicate there's difference in signal conduction in the nerve, and therefore pain is resolved. However, the image change could not be correlated with clinical outcome in our study. We plan to further analyze the image of more patients to see if pre-treatment image can help us select patients who are more responsive and suitable for percutaneous radiofrequency rhizotomy.

References

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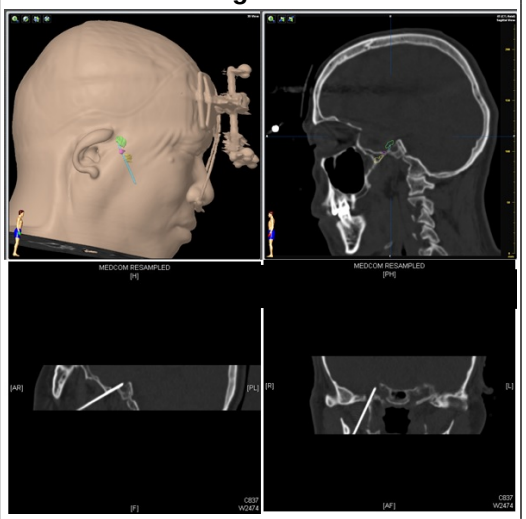
Table 1

	Pre-rhizotomy (SD)	Post-rhizotomy (SD)	P value
Volume (mm^3)	72.73(14.88)	83.88(21.92)	*0.04
Fractional anisotropy	0.273(0.094)	0.310(0.049)	*0.05
Apparent diffusion coefficient ($10^{-3}mm^2/s$)	1.61(0.25)	1.47(0.20)	*0.009
Axial diffusivity ($10^{-3}mm^2/s$)	2.04(0.23)	1.94(0.25)	0.075
Radial diffusivity ($10^{-3}mm^2/s$)	1.52(0.29)	1.38(0.18)	*0.009
Medial diffusivity ($10^{-3}mm^2/s$)	1.26(0.30)	1.10(0.19)	*0.004

Differences in DTI metrics between pre-rhizotomy and post-rhizotomy of trigeminal nerve (N=33)

Figure 1



LEFT UPPER: Three-dimensional reconstruction image from intraoperative CT fused with pre-treatment MRI which showed the needle tip entering trigeminal cistern (Blue: needle, Green: trigeminal cistern, Yellow: bone, Purple: CSF). RIGHT UPPER: Original intra-operative CT for navigation. Trigeminal cistern and CSF were outlined according to image fusion with pre-treatment MRI. LOWER: Radiofrequency rhizotomy needle navigated by intra-operatvie CT.