Surgical validation of extracranial facial nerve magnetic resonance tractography

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Target Audience: Neurologists, Otolaryngologists, Radiologists, Researchers in tractography

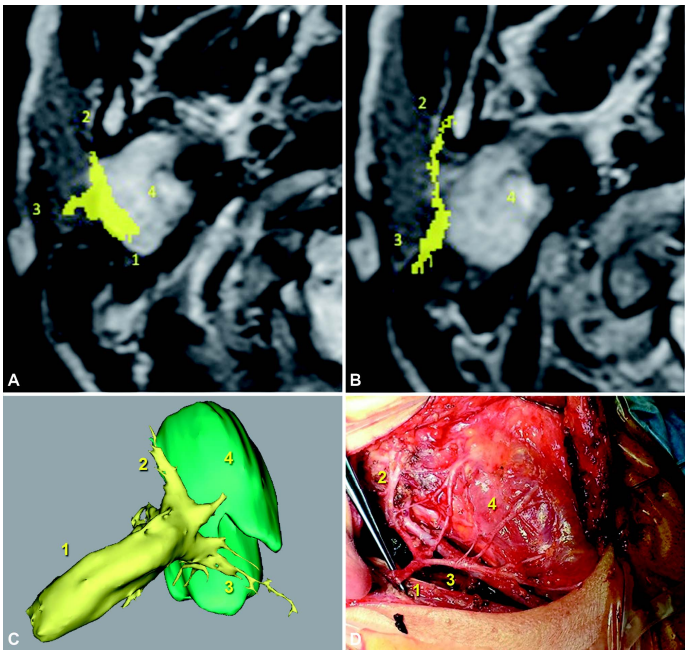
Purpose: Magnetic resonance tractography of the cranial nerves is a promising tool for surgical planning and microstructural analysis. Yet, in order to validate the quality of quantitative data yielded from this technique, the course of nerve fibres must be confirmed surgically. The parotid gland is divided into two parts by the facial nerve, which requires careful dissection during the surgical resection of a parotid tumour. In this prospective study, we evaluated a high order tractography model of facial nerve, by surgical correlation, in patients referred for parotid surgery.

Methods: Study ethics approval for a prospective work was obtained from our institutional review board (CECIC Rhône-Alpes-Auvergne, Clermont-Ferrand, IRB 5891). Patients underwent magnetic resonance scans with tractography of the facial nerve, and the reconstructed 2 and 3-dimensional tracts, calculated with the constrained spherical deconvolution model (1,2), were then forwarded to the relevant surgical teams. The diffusion acquisition parameters were: 2x2x2 mm^3 voxel size, b=1000 s/mm^2 and 32 diffusion directions (Philips Achieva 3.0T TX, 32 channel head coil). Facial nerve division and its relationship to the tumour were assessed during surgery by photographing the direct course of the nerve, and stimulating the nerve using a standard monopolar probe. The MR-derived fractional anisotropy values were calculated for the facial nerve, after segmentation of the trunk.

Results: We successfully identified facial nerve, in relation to the parotid tumours, in all 26 patients (mean age of 55.2 years, female to male ratio of 8:18) using magnetic resonance tractography. In 2 patients, the surgical procedure failed to confirm findings, as the tumours were located too far from the facial nerve division. The mean facial nerve fractional anisotropy was estimated as being 0.43 both for the side of surgery and contralaterally.

Discussion: In this work, we established *in vivo* MR anatomical references useful for further diagnostic or therapeutic trials, by highlighting the course of the temporofacial and cervicofacial branches, in accordance with previous cadaver studies (3,4). Furthermore, by calculating normal FA values of the VIIn trunk on both sides in patients without facial palsy, we defined new quantitative data for 52 facial nerves.

Conclusion: This is the first study, reporting on the feasibility of tractography, to identify the extracranial facial nerve. The expected outcome is to aid future medical studies examining nerve dysfunction. Diffusion sequence imaging seems to be the method of choice for effective highlighting of the intraparotid facial nerve.



VIIn Tractography with MRTrix® (J-D Tournier, Brain Research Institute, Melbourne, Australia, http://www.brain.org.au/software/) (5). **Example of a pleiomorphic adenoma that was located in the deeper part of the parotid gland.**

A-B: Two T2 weighted axial slices overlaid onto diffusion slices. The facial nerve trunk (1) originated at the stylomastoid foramen before dividing into the temporofacial (2) and cervicofacial (3) branches.
B-C: The temporofacial branch was uplift by the tumour (4) on 2D and 3D representations.
D: Photographs of the surgical dissection of the VIIn before tumour resection, which was, in this case, still located under the FND.

References

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