

Ex-vivo visualization of the human trigeminal pathways using 11.7T diffusion MRI and unique microscopy data

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Introduction

- Chronic orofacial pain → 7% of the chronic pain cases
- Major challenge for healthcare professionals
- Considerable economic impact on society
- Neuromodulation as treatment via thalamic and trigeminal pathways
- Trigeminal pathways involved in orofacial pain
- Most of the trigeminal anatomy relies on animal-based studies

Objective

To optimize neuromodulation therapy of orofacial pain, a more profound insight in the trigeminal pathways in the human brainstem needs to be acquired.

Material and Methods

- Ex-vivo 11.7T magnetic resonance imaging. Anatomical images and dMRI data were acquired (*Bruker Biospec preclinical MR system*).
- Probabilistic tractography. Using FSL, by seeding from the left trigeminal rootlet.
- Waypoint mask. Near the PSN, a mask was placed to ensure that diminutive tracts would not be overshadowed.
- Polarized light imaging. To investigate fiber orientation of architectural patterns with higher detail.
- Myelin staining. To investigate trigeminal fibers in the brainstem.

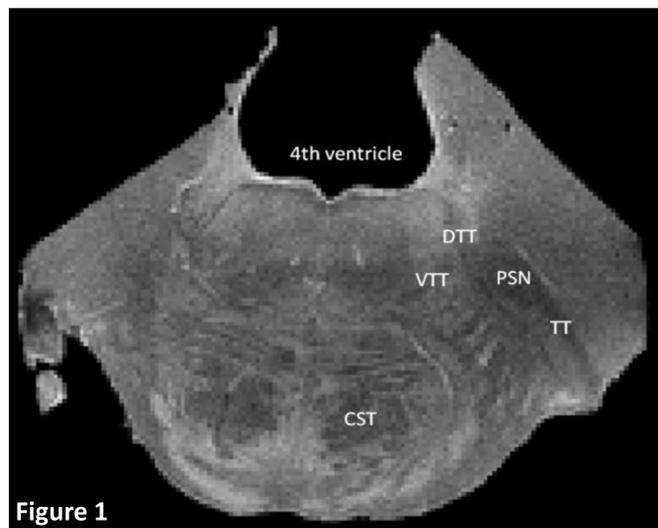


Figure 1

Abbreviations

CST= corticospinal tract, DTT= dorsal trigeminothalamic tract, ML= medial lemniscus, PSN= principal sensory nucleus, SCP=superior cerebellar peduncle, TT=trigeminal tract, VTT= ventral trigeminothalamic tract

Results

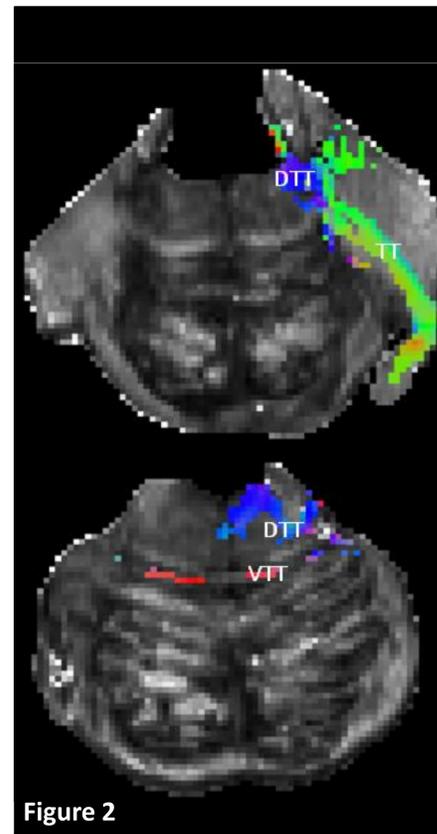


Figure 2

With MR imaging, the anatomical structures that are related to the trigeminal nerve can be appreciated (Figure 1). The tractography results in Figure 2 show a division of the trigeminal tract into a dorsal and ventral trigeminothalamic tract.

The histological findings show the subdivision near the PSN as well (Figures 3 and 4).

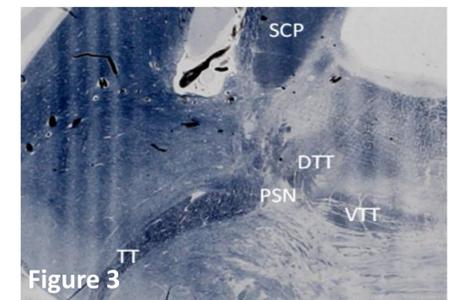


Figure 3

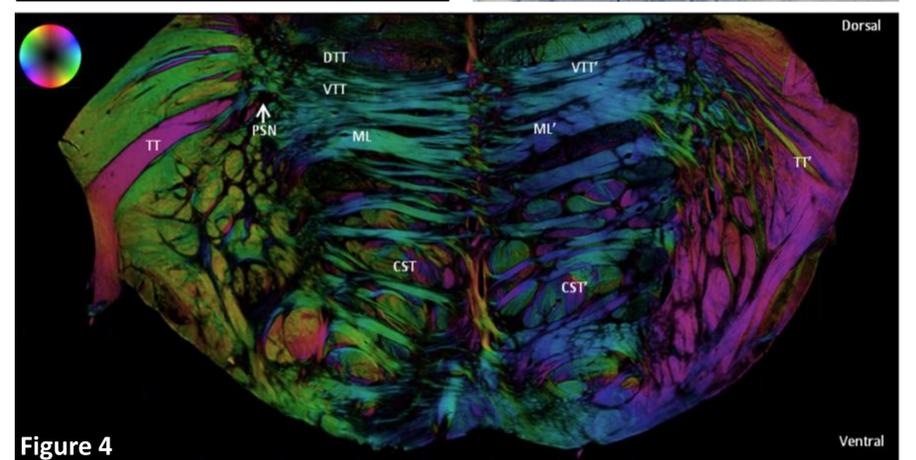


Figure 4

Discussion

- Both DTT and VTT in humans. Limited number of each technique (n=1); no linear registration possible.
- Neuromodulation targets. Future research must investigate whether both tracts conduct orofacial pain.

Conclusion

This study provides evidence that next to the VTT, the DTT is also present in humans. This new insight might lead to new neuro-modulation targets that can enhance the treatment of chronic orofacial pain.