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PRESENTATION TITLE

Morphological analyses of post-treatment changes in cortical thickness in a brain tumour patient

AUTHOR(S)

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ABSTRACT

Purpose: Radiation induced brain injury consists of both anatomical and functional deficits in irradiated brain tissue. Especially cognitive and executional impairments lead to a marked decrease in the patient's quality of life. In this work, we present a framework facilitating the structural morphometry of a single patient based on clinical T1 scans, without any additional medical or imaging effort. This technique enables the assessment of specific structural changes, which can be related to the applied treatment (eg. RT dose) or symptoms.

Materials & Methods: We selected a patient, a 26 year old female, from our databases with sufficient follow-up scans. The patient presented with vertigo and headache, and on MRI a lesion was detected in the left middle cranial fossa. A subtotal resection of the tumour was performed, followed by radiotherapy. The patient received a total dose of 60 Gy, delivered in 30 fractions with VMAT. She received no chemotherapy.

In total, four follow-up MRI scans were performed after completion of therapy as part of regular clinical care. Of these scans, the T1 sequences of two scans were of sufficient quality for voxel-based and surface based morphometry. The two scans were performed with a 2 month interval, and no interventions to the brain (surgery, chemotherapy or radiation) were performed in between. The first scan was performed as a routine follow-up 3 months after completing radiation therapy, and the second was done to re-evaluate enhancing white matter lesions that were found on the first follow up scan.

The T1 weighed images were acquired on a Philips Ingenia 3T scanner with a 3D TFE sequence, voxel size: 0.96 x 0.96 x 1mm, TR/TE = 8.5/3.9 ms, without gadolinium.

The CAT12 (Computational Anatomy Toolbox) was used for the automated preprocessing, segmentation and surface estimation of the T1 scans. Fig. 1 shows a conceptual overview of the data processing. All scans were bias-field inhomogeneity and noise corrected, then segmented into grey matter, white matter and cerebrospinal fluid (CSF) and normalized to MNI152 space. Surface calculation was achieved via projection-based thickness estimation and reparametrized to the Freesurfer surface template, consisting of a 152k mesh per hemisphere.

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Results: Fig. 2 shows the surface projected cortical thickness before and after 2 months. By subtracting these two thickness maps, the change in cortical thickness can be calculated and visualised. Comparison of the cortical thickness difference with the radiation dose delivered to the cortical surface reveals several areas that received high doses of radiation and show marked cortical thinning.

Conclusions: This proof-of-concept study shows that changes in cortical thickness can be measured from regular T1 weighted MRI images acquired as part of routine clinical care. Furthermore, our results suggest a relation between radiation dose and cortical thinning. Thickness values can be extracted from these maps which, in combination with radiation dose, can be used to conduct quantitative analyses. We can use these findings to conduct further research with more subjects and scans, in order to verify our findings and try to relate them to symptoms or quality of life.

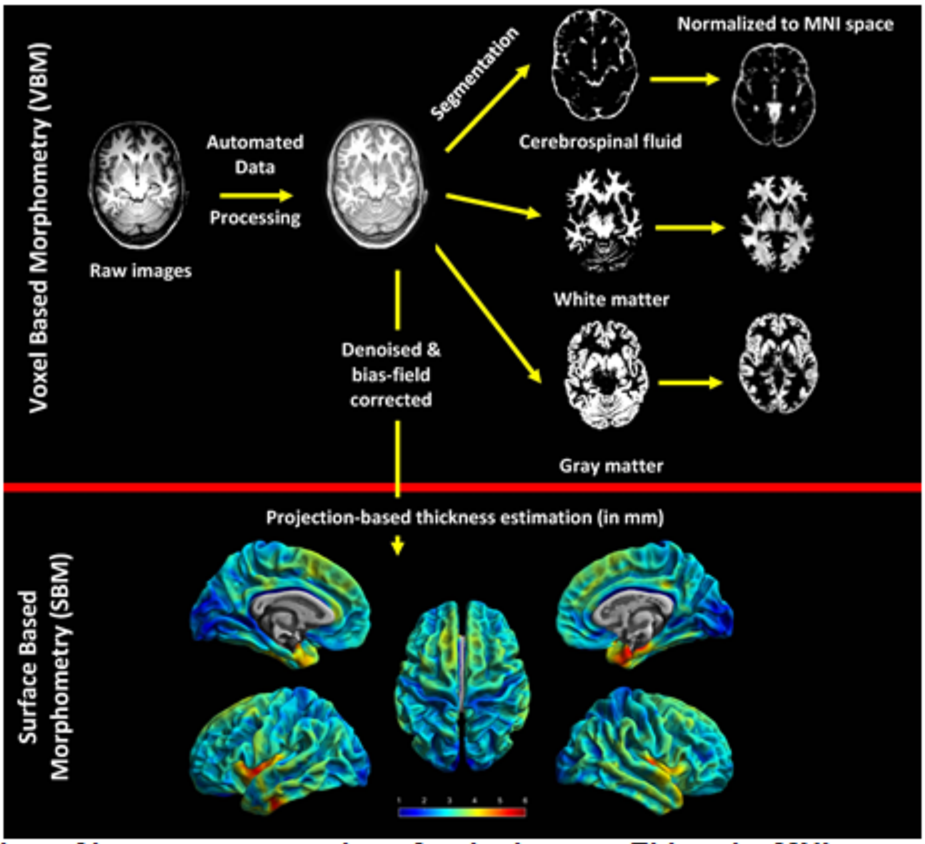

Figure 1: Overview of image preprocessing of a single scan. Either the MNI normalized segments or the surface projected scalars are subjects of further analyses.

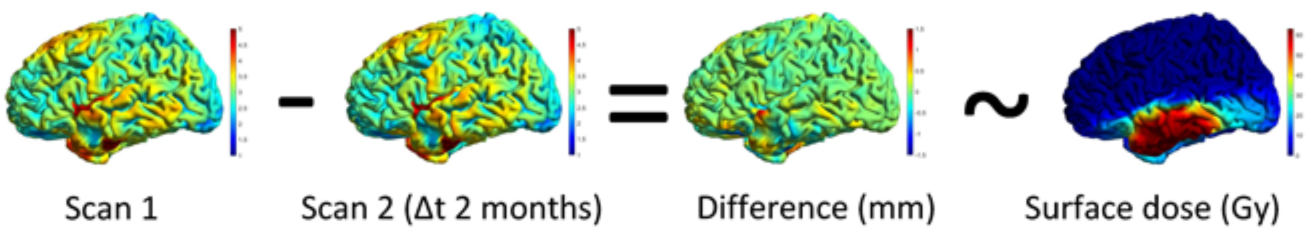

Figure 2: Concept of longitudinal analyses in the same patient. The differences between surface projected GM thickness reveal longitudinal changes.