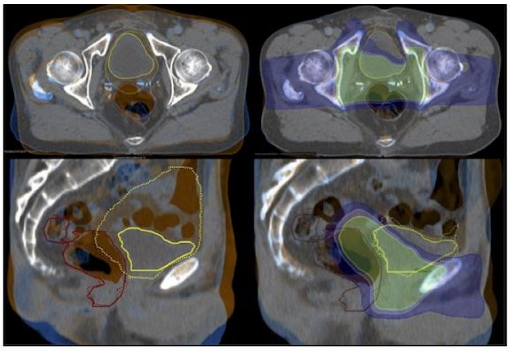

Figure 2: Example RIR (left) showing extreme bladder filling difference and DIR using the optimised method (right), showing final contour overlap and deformed dose. The dose originally delivered to the bladder is modelled correctly as having moved with the bladder. Bowel superior to the bladder at original RT is correctly modelled as having received minimal dose.

This accuracy is essential to realistically deform previously deposited dose (fig. 2), allowing accurate dose summation with radiobiological correction for planning of reRT. Combined image-based and biomechanical registration strategies may have application in dose-accumulation, adaptive re-planning, or summation of EBRT and brachytherapy doses.

PO-1002 Pseudo Computed Tomography generation using 3D deep learning – Application to brain radiotherapy

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Purpose or Objective

We used 3D convolutional neural networks designed for a high-resolution mapping of any T1-weighted Magnetic Resonance Imaging (MRI, with or without contrast agent) to a pseudo Computed Tomography (pCT). We conducted an evaluation using relevant metrics for radiotherapy based on the dose difference estimation from the Computed Tomography (CT) and the pCT. Our method achieves state of the art results and is robust to the potential use of a contrast agent.

Material and Methods

488 couples of brain 3D images including a CT and a T1-weighted or an enhanced T1-weighted MRI were used for training and validation of a 3D deep neural network architecture combined with a series of residual blocks containing dilated filter convolutions. All the network parameters were optimized based on the Mean Absolute Error (MAE) loss function (Figure 1).

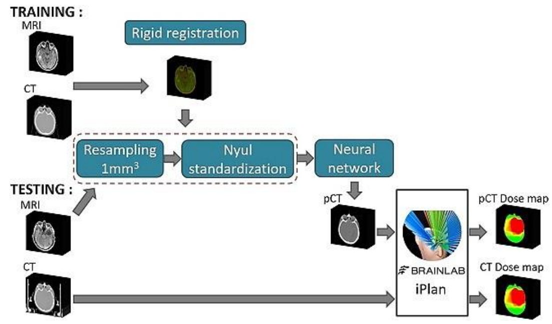

Figure 1: General workflow of the study.

For the evaluation step, we generated the pCTs of 10 grade 3 and 27 grade 4 new glioma patients (test cohort) who received either 3D conformational radiotherapy or Intensity Modulated Radiation Therapy. Prescribed doses ranged from 30Gy to 60Gy. The treatment plan based on the initial CT was transferred to the pCT. To evaluate the differences in the intensities between the initial CT and the pCT, the MAE was calculated. Global 1%/1mm, 2%/2mm and 3%/3mm gamma indexes and dose values extracted from the Dose Volume Histograms (DVHs) of the Planning Target Volume (PTV) were used to quantify the dose differences.

Results

Comparing the CT and pCT head regions of the 37 patients of the test dataset gave a MAE of 86 +/- 29 Hounsfield Units. Metrics based on the dose difference are more relevant for radiation therapy. Differences in DVHs were 0.13% +/- 0.08%, 0.14% +/- 0.10%, 0.15% +/- 0.17% for the doses corresponding to 50%, 95% and 98% of the PTV respectively. Global gamma indexes computed in the head region led to pass rates equal to 98.27% +/- 1.02%, 99.67% +/- 0.31% and 99.84% +/- 0.18% for the 1%/1mm, 2%/2mm and 3%/3mm criteria respectively (Figure 2).

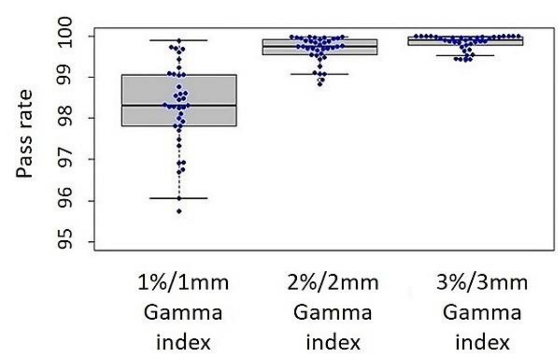

Figure 2: Gamma pass rates for the 1%/1mm, 2%/2mm and 3%/3mm global gamma index criteria.

Conclusion

To our knowledge, this is the first dosimetric study integrating 3D deep learning architectures. Promising pCT have been obtained with a high accuracy in terms of dose prediction. They outperform the state of the art dosimetric results (Dinkla et al., 2018), in which gamma pass rates of 91.1% +/- 3.0%, 95.8% +/- 2.1% and 99.3% +/- 0.4% for the 1%/1mm, 2%/2mm and 3%/3mm global gamma criteria were achieved and lead to a feasible application in clinics.

PO-1003 A deep learning based auto-segmentation for GTVs on NPC MR images

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