Personalized margins in multiple brain metastases radiosurgery

José Alejandro Rojas-López | Miguel Ángel Chesta | Daniel Venencia

Purpose

To provide a simplified way to assign PTV margins based on intra-fraction, set-up, geometric, and dosimetric uncertainties in SRS-SIMM based on artificial intelligence and open-source tools.

Materials and Methods

A new criterion is proposed to assign PTV margins from the GTV using a genetic algorithm and XGBoost method as regressor. Several plans were selected retrospectively (planned with a geometrical PTV margin criterion) and they were recalculated using the optimized margins using the predictions of the regressor. The personalized margins were calculated with an open source software in Python (https://github.com/SoftwareImpacts/SIMPAC-2023-75) considering the volume, size, number of metastases, distance to isocenter, setup uncertainties produced by rotations/translations (Fig. 1), anatomical position and dose cluster formation (Fig. 2).
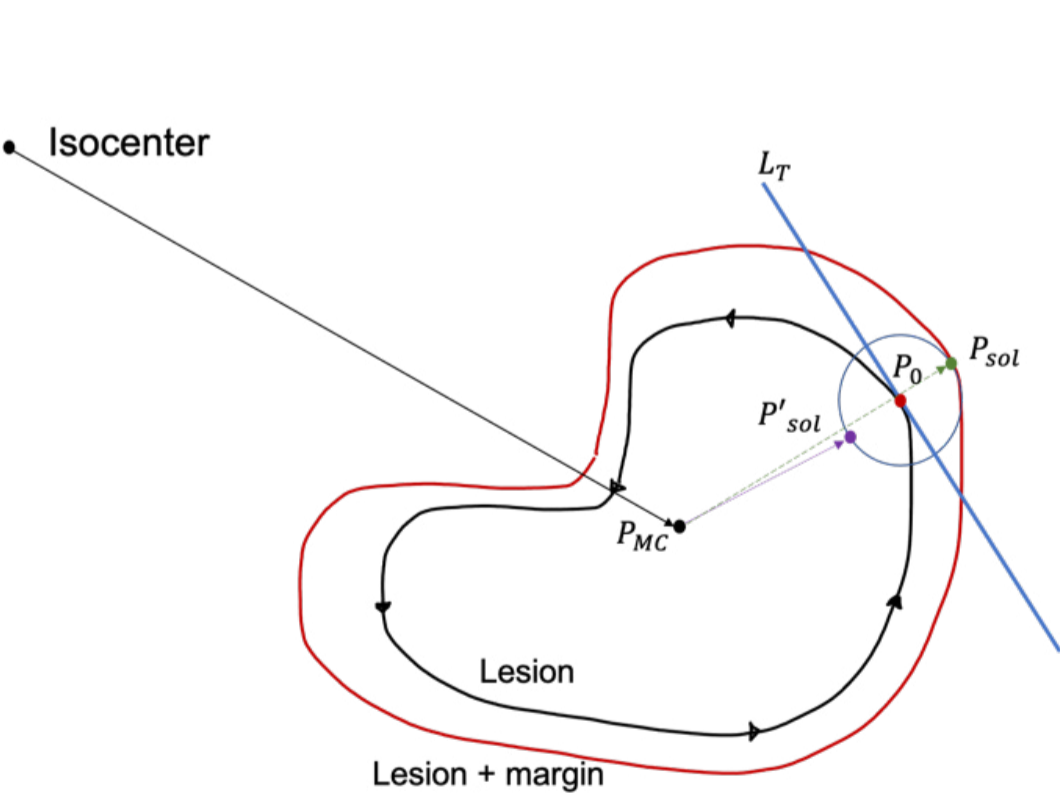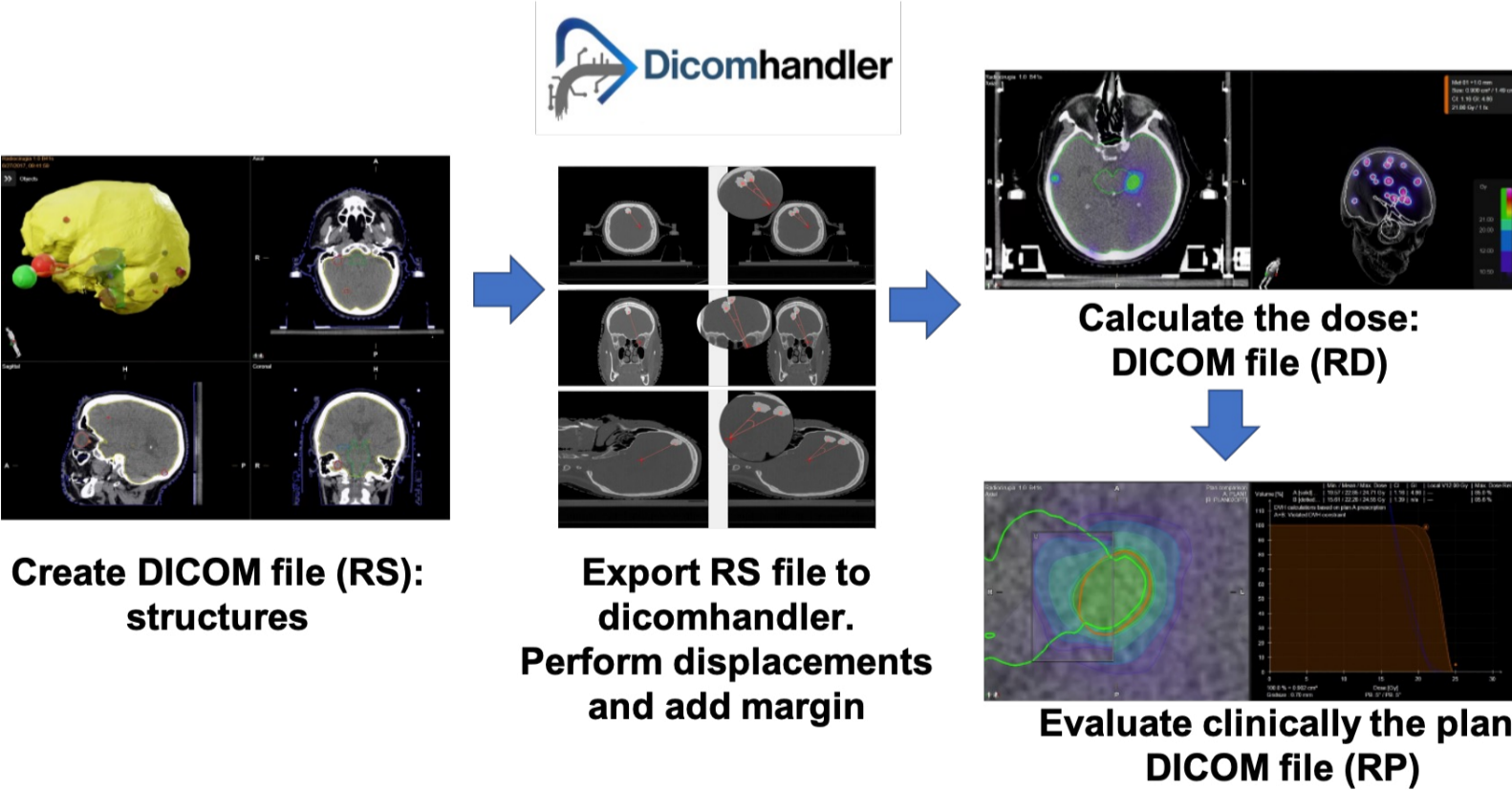

Figure 1

Figure 2

Results

No changes were observed in the quality indices, p>0.05 (Fig. 3) for optimized plans with respect to the original ones. However, a reduction in V12 was observed for the optimized plans with this new method, p=0.03 (Fig. 4).
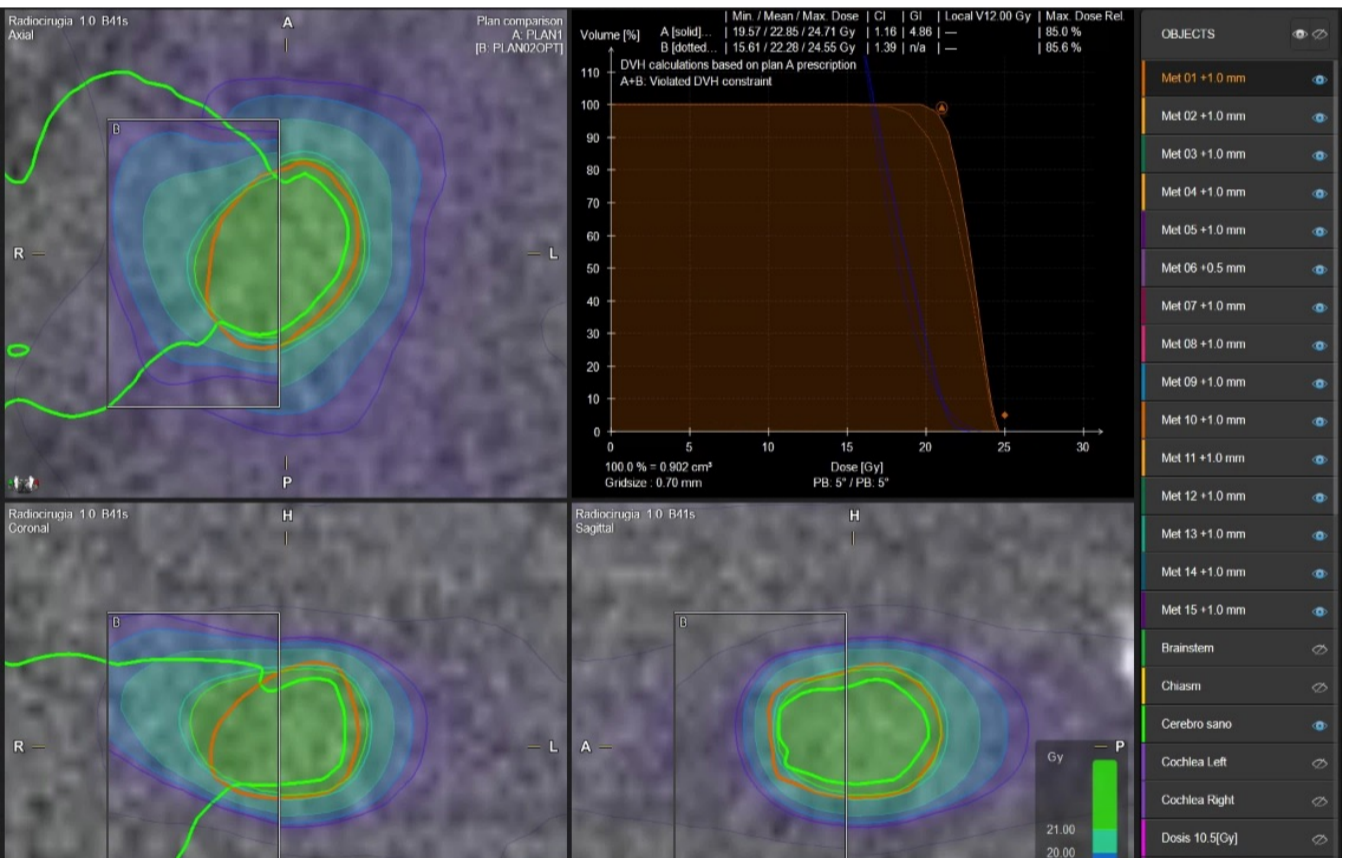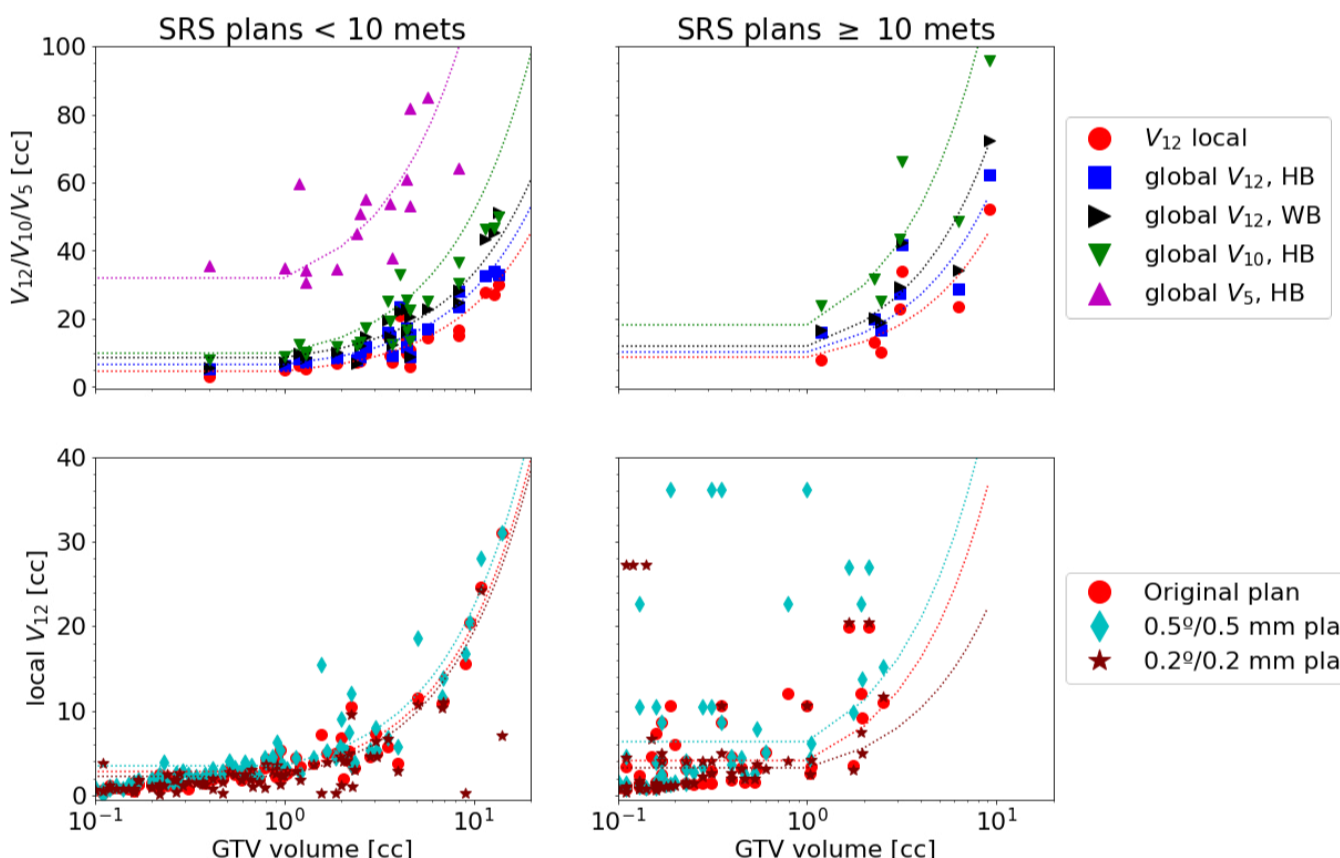

Figure 3

Figure 4

Conclusion

Through this new method it is possible to determine personalized margins for PTV. The use of these optimized margins allows to reduce the dosimetric impact due to intra-fraction and set-up uncertainties and it was found that the dose coverage is maintained, while the V12 to healthy brain is reduced with respect to a criterion based solely on the relative distance of each metastasis.