# Dose, Targets, OARs for Brain Radiosurgery with Previous Treatments by Various Modalities at Different Hospitals

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## Background:

- With the emergence of various radiation modalities available for stereotactic radiosurgery, the chance of brain patients with metastatic lesions or other diseases being treated by different modalities like Gamma Knife, Linacs, Proton Therapy or others at the same & different hospitals is increasing. A patient previously treated for brain metastatic lesions with Linac-based SBRT, now with newly occurring lesions may be treated with Gamma Knife, CyberKnife, Proton Therapy, or other modalities at the same or different hospitals.
- While the availability of various radiosurgery modalities offers more options for patients to be treated with the optimal treatment modality, it brings the challenge of merging the previous treatment plans from different treatment platforms/modalities at the same or different hospitals to identify correct targets and prescribe the correct dose for the new treatment. There is a need for developing a good strategy and an efficient clinical flow for planning new radiosurgery treatments.
- At our hospital, we have Gamma Knife, Varian TrueBeam Linacs, and Proton Therapy available for brain treatments. Oftentimes a patient is treated across different modalities and even has been treated at other hospitals. We have built up systematic strategies and workflow to perform radiosurgery for these patients by using commercial software MIM [1] to communicate between image servers to handle different treatment modalities.
- We report on our experience in clinical practice on how to co-register images, structures/contours of targets and organs at risk (OARs), and doses from different radiation modalities for brain patients treated with multiple radiation therapies/radiosurgeries at the same or different hospitals for planning a new radiosurgery.

## Method and Materials:

- Install the commercial software MIM [1] and use it as a transit station to store treatment plan DICOM files and communicate between the image servers of different treatment modalities - export/import treatment plans from different treatment modalities (Gamma Knife, Linac-Based, Proton therapy, and outside hospital treatments). See **Fig. 1**.
- Any new plan (Gamma Knife/Linac-based/Proton therapy) of a completed treatment is exported to MIM for a potential future treatment by other modalities.
- If a new treatment is planned for Gamma Knife, or Linac-based, or Proton therapy, all previous treatment plan DICOM files (images, structures, and doses) are imported from MIM to the local treatment planning system and co-registered with the new plan images (generally MRI or CT). The co-registration includes all previous treatments of different modalities at the same or outside hospital(s).

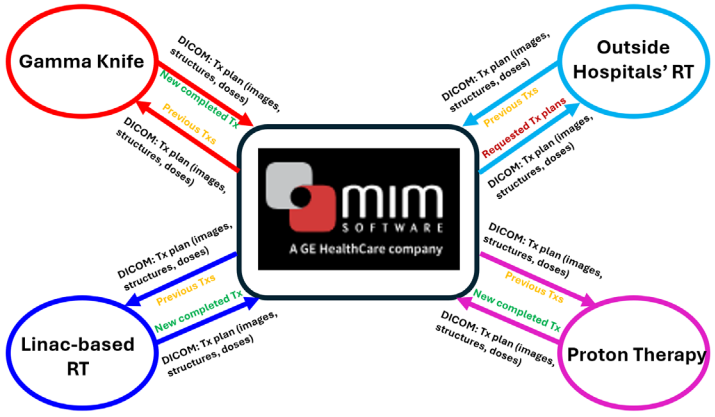
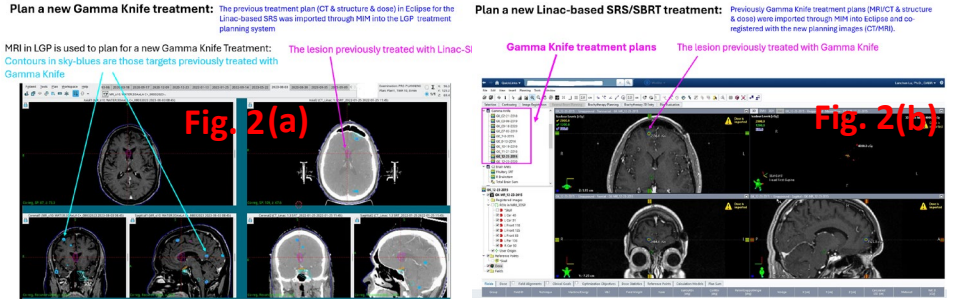



**Fig. 1**: *Schematic view of multi-modalities of radiation therapy.*

## Results and Summary:




- As an example, **Fig. 2** shows: **(a)** a patient with previous Linac-based SRT is planned for a new Gamma Knife treatment – all previous treated lesions and the dose had been imported and co-registered with the new planning MRI; **(b)** a patient with previous multiple Gamma Knife treatments is planned for a new Linac-based SRS - all previous treated lesions and dose had been imported and co-registered with the new planning image and a Total Brain Sum plan accounting for the dose contributed from all previous treatments is created for new dose prescription and the plan evaluation.
- Treatment planning for patients treated with proton therapy or with previous radiation therapy at outside hospitals goes through a similar workflow.
- On the quality assurance (QA) aspect, this workflow is very efficient and helpful for distinguishing the new lesions from previous treated lesions, which can prevent unintended repeat treatments on the latter.
- On the medical aspect, this workflow is crucial for prescribing dose to the new lesions and the evaluation of total dose to the organs at risk (OARs).
- We have been applying this clinical strategy and workflow for all brain radiosurgery, which has greatly enhanced the efficiency and quality of patient care.

## References

1. MIM Software (GE HealthCare Company ), https://www.mimsoftware.com/

ISRS International Stereotactic Radiosurgery Society