# Dosimetric Effect of the Qfix Encompass™ SRS Immobilization System On Cone-Based SRS Treatment Planning

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## INTRODUCTION

We use Qfix Encompass™ SRS immobilization system for intracranial stereotactic radiosurgery. The kVue™ Encompass™ SRS insert of the system is made of fibre glass[1]. Varian Cone Planning treatment planning system (TPS) ignores the supporting structure dosimetrically[2]. This leads to unclear dosimetric effect of the Qfix Encompass SRS immobilization system when it is used together with Varian Cone planning TPS. It is necessary to investigate the potential dosimetric effect of Qfix Encompass™ SRS immobilization system in Cone Planning TPS to create reliable SRS cone plan for the patients.

## AIM

To investigate the dosimetric effect of the Qfix Encompass SRS immobilization system on cone based SRS treatment planning.

## METHOD

- Check how Varian Cone Planning TPS handles the immobilization system dosimetrically.
  - In Varian's Cone Planning TPS, created and compared two SRS circular plans sharing the same beam settings except the inclusion of the Qfix Encompass™ immobilization system as supporting structure (from Varian Eclipse v15.6).
- Check the potential dosimetric effect of the immobilization system if it's not taking into account in calculation using Brainlab iPlan TPS.
  - Two SRS circular plans in iPlan are created based using the same CT image set.
  - Structure sets in both plans include head contours with HU overridden to be water to simulate the situation in Cone Planning TPS.
  - One plan's outer contour includes Encompass immobilization structure and the other does not.
  - Both plan share the same beam settings and all arcs were configured to pass the Encompass structure.
  - Enabled heterogeneity correction for both plans.
  - The dosimetric parameters were compared.

## RESULTS

- *We do not find dosimetric difference between the two plans (with and without Encompass device included) in Varian Cone Planning TPS.*
- *For plans in BrainLab iPlan TPS, compared to the plan with Encompass device (plan1), the plan does not include immobilization system inside its outer contour (plan2) is*
  - ❖*3.2% hotter in dose at isocenter, 2.7% hotter for minimum target dose, 3.2% hotter in maximum target dose and 3.2% hotter in mean target dose.*
  - ❖*The normal brain's $V_{12Gy}$ and $V_{18Gy}$ are 2.11cc vs 1.86cc and 0.19cc vs. 0.13cc for plan2 and plan1, respectively. (normal brain = brain – GTV).*

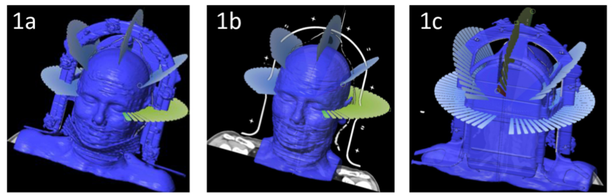


***Figure 1**. Beam arrangements and outer contours for two plans with the same beam parameters. (1a) outer contour of plan1 with Encompass device. (1b) outer contour without Encompass device. (1c) shows the arcs are arranged to pass as much as possible the Encompass device to maximize the dosimetric effect on the device.*

| | Plan1 | Plan2 | Plan2 – Plan1 (cc) | Plan2 – Plan1 (%) |
|---|---|---|---|---|
| $V_{12Gy}$ (cc) | 1.86 | 2.11 | 0.25 | 13.44 |
| $V_{18Gy}$ (cc) | 0.128 | 0.192 | 0.065 | 50.0 |

***Table 1**. Comparisons of normal brain (brain – GTV) doses.*

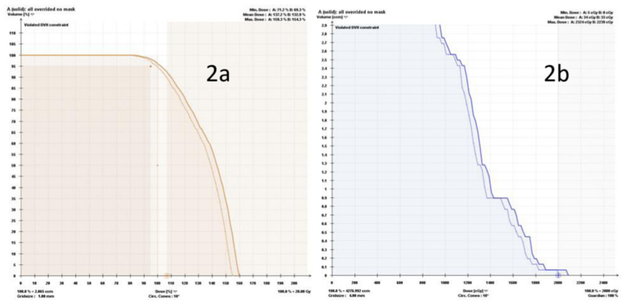


***Figure 2**. DVH's of target (2a) and normal brain (2b) for plan1 (with the Encompass immobilization device, dash line) and plan2 (without the Encompass immobilization device, solid line).*

| | Plan1 | Plan2 | Plan2 – Plan1 (Gy) | Plan2 – Plan1 (%) |
|---|---|---|---|---|
| Max. PTV Dose (Gy) | 30.86 | 31.86 | 1.0 | 3.24 |
| Mean PTV Dose (Gy) | 26.58 | 27.44 | 0.86 | 3.24 |
| Min PTV Dose (Gy) | 13.86 | 14.24 | 0.38 | 2.74 |
| Isocenter Dose (Gy) | 30.77 | 31.75 | 0.98 | 3.18 |

***Table 2**. Comparisons of PTV maximum, minimum and mean doses from plan1 (including immobilization device in dose calculation) and plan2 (not including immobilization device in dose calculation), respectively. Both plans have 20Gy in one fraction prescribed to PTV. Plans were not optimized but to demonstrate the dosimetric differences.*

## CONCLUSIONS

The Qfix Encompass™ SRS immobilization system affects the dose distribution in SRS cone treatment planning. Planners should be meticulous about the beam geometry to minimize the uncertainties if the dose calculation algorithm does not account for the Encompass support device.

## ACKNOWLEDGEMENTS

Thanks to Dr. Sicong Li for the discussion regarding BrainLab iPlan TPS.

## REFERENCES

1. Encompass Brochure, https://qfix.com/catalog/radiotherapy-thermoplastics/encompass-srs-fibreplast-system.
2. Eclipse Photon and Electron Algorithms Reference Guide v15.5, Varian medical system, 2017.

## CONTACT INFORMATION

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