

An OAR Trace method to enable highly conformal FLASH treatment for proton pristine Bragg peak delivery technique

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Introduction

- Single-energy Bragg Peak (**SEBP**) is a novel proton FLASH technique using range compensators and universal range shifters to precisely adapt the proton to the target's distal edge.
- Through multiple fields optimization (MFO), SEBP achieves plan quality comparable to intensity-modulated proton therapy (**IMPT**), outperforming transmission beam (**TB**) FLASH.
- This approach faces challenges in cases where OARs are surrounded by tumor target, achieving OAR sparing is conflict with maintaining sufficient tumor coverage, since SEBP proton need to go through the spinal cord to reach the distal edge of the target as showing in Fig2 (a).

Methods

A raytracing algorithm was used to detect the boundaries of OAR contours.

- MatRad_rayTracing
- OAR tracking

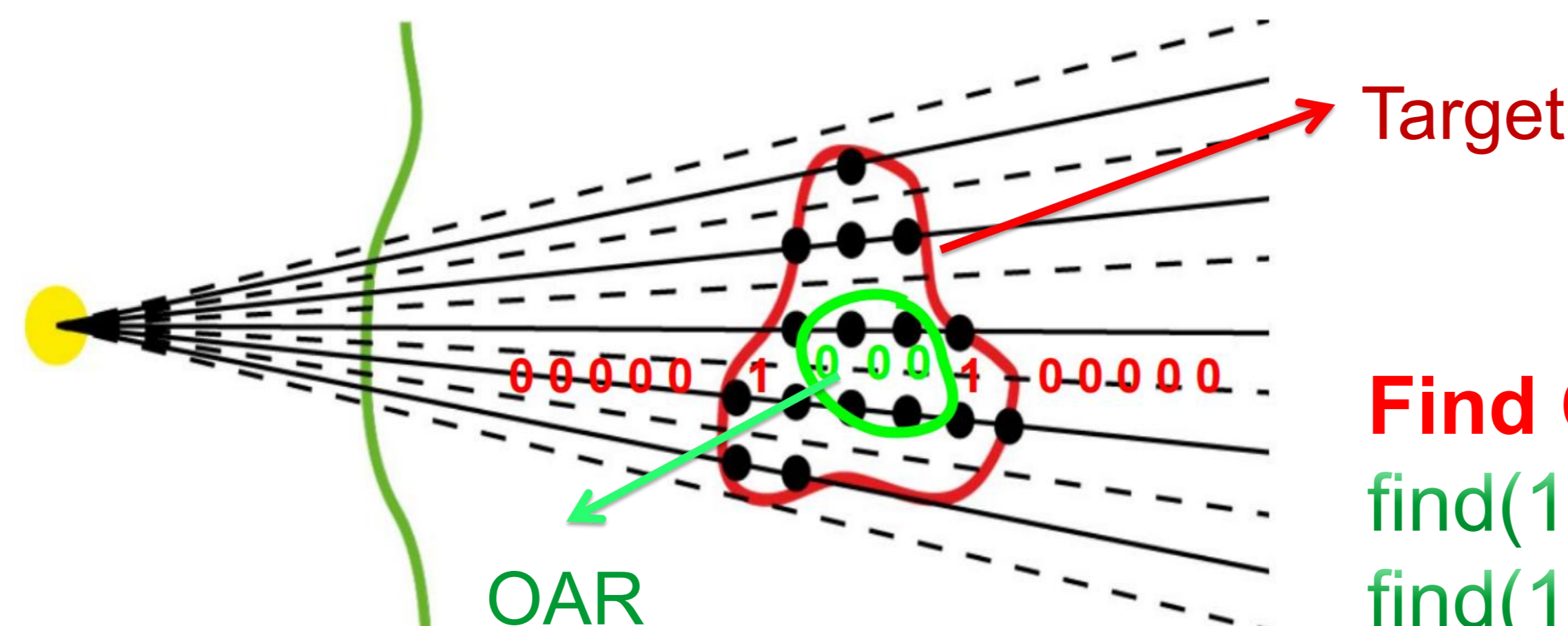
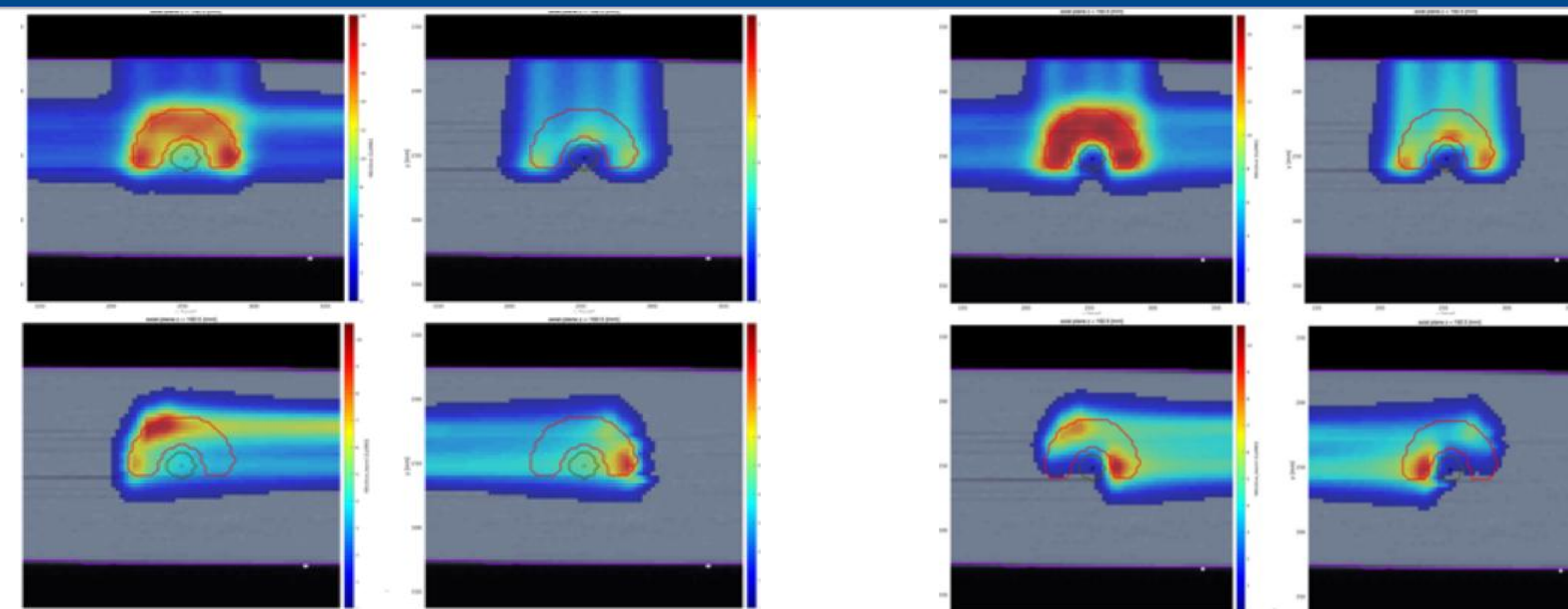


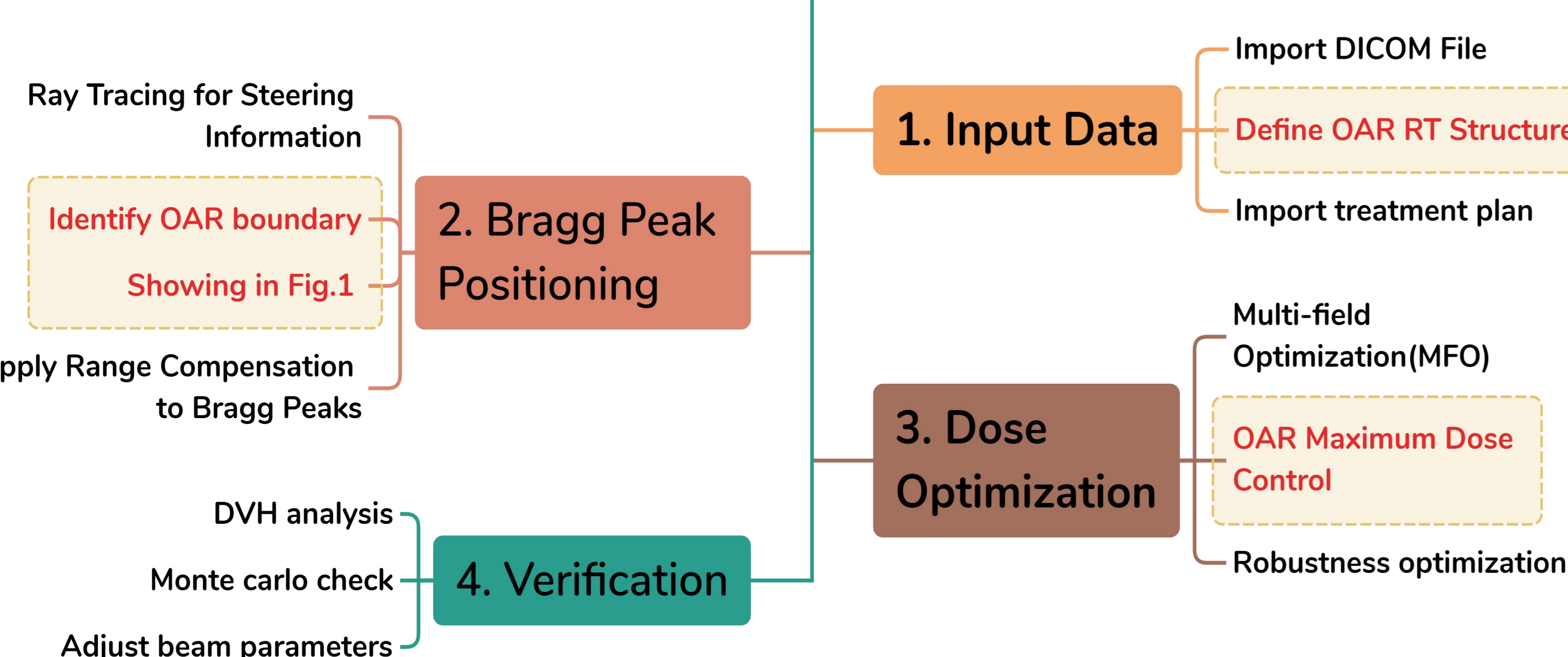
Fig. 1: Find OAR Mark

Find OAR Mark:
`find(1,0,0,0,1,'OAR tracing')`
`find(1,1,1,1,1,'Distal tracing')`



(a) (b)
 Fig. 2: Dose Distribution maps of Distal tracking(a) and OAR tracking(b)

OAR Tracking Workflow



Results and conclusion

SEBP plans incorporating OAR tracking exhibited superior performance in reducing both mean and maximum doses to the OAR, as well as enhancing dose uniformity to the target

- **OAR sparing**[1]: The mean dose to the OAR was reduced by approximately **40%**. The maximum dose was decreased from **13 Gy** to **8 Gy**
- **Tumor coverage**[2]: Reduce the dose to OARs while simultaneously improving target coverage
- **Target dose uniformity**[3]: Improved by **20%**

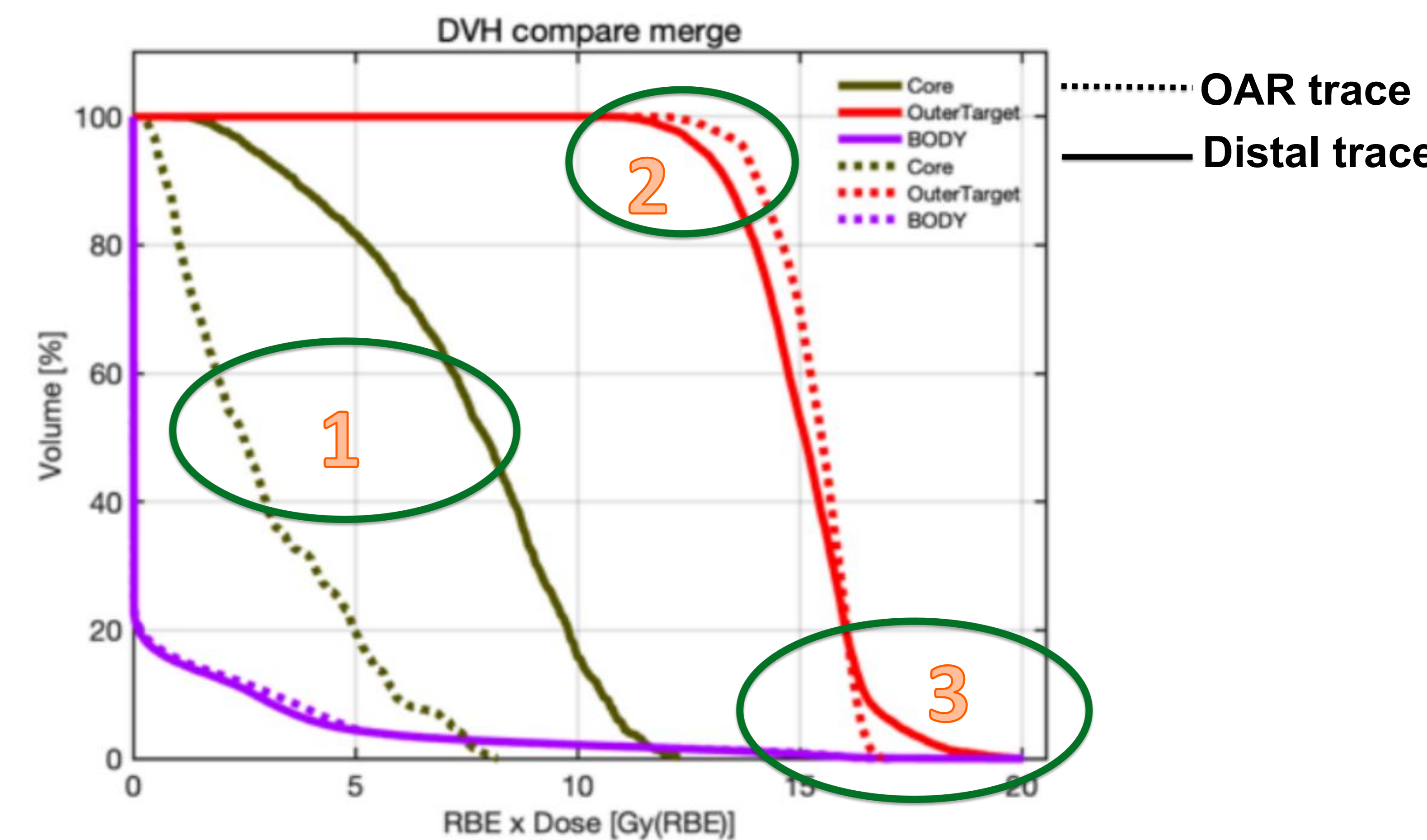


Fig. 3: The dose-volume histograms (DVHs) of OAR tracking and Distal tracking