Background

This study proposes a new method for FLASH radiotherapy *(Stitching FLASH)* that combines FLASH delivered by proton beams, with VMAT delivered at conventional dose-rates.

Aims

We will validate the *Stitching FLASH* method by comparing it to clinical VMAT plans for brain and vertebra irradiation, where underdosage of the tumor volume was allowed due to their proximity to the brainstem and spinal cord, respectively.

Methods

For calculating dose, we used Varian's *Eclipse* for VMAT and matRad for proton FLASH. We considered the FLASH effect to occur for a minimum dose and dose-rate of 8 Gy and 100 Gy/s, respectively. In the *Stitching FLASH* method, the target is divided into different sections. For the target section proximal to a OAR (FLASH section), dose is delivered with FLASH protons. For the remaining target volume (VMAT section), a VMAT arc is used to achieve optimal coverage.

Results

To trigger the FLASH effect, a proton FLASH beam with an intensity of approximately 1.0×10^{11} protons/s was used. As such, we managed to deliver higher doses to the FLASH section, proximal to critical OARs, thus increasing the target coverage (V_100%) by 10%. Despite the higher doses delivered to the targets, dose spillage to healthy tissues was observed to be the same as the clinical VMAT plans, thus achieving a similar sparing of the OARs.

Conclusions

In this work we have showed that, with the *Stitching FLASH* method, it's possible to increase tumor control, while maintaining the sparing of healthy tissues. Our method is particularly useful when a critical OAR is close to a target, which, in conventional radiotherapy, can lead to target underdosage and poor coverage. Thus, we conclude that the *Stitching FLASH* method is promising for proton FLASH radiotherapy.