# A dynamic collimation system improving target conformity of spot scanning proton therapy: comparison of dose calculations for two nozzles.

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**Résumé**

**Introduction:** Spot scanning proton therapy (SSPT) treatments suffer from poor conformity, especially at low energy, due to increased lateral spot size, which is further increased with the patient scattering. The University of Iowa Hospitals and Clinics recently proposed a dynamic collimation system (DCS) for SSPT, which is capable of providing spot-by-spot collimation. The purpose of this study is to quantify by simulations improvement in target conformity from the use of the DCS, in brain and head and neck tumor treatments.
**Methods:** Two spot scanning proton therapy delivery systems (Universal Nozzle, UN, and Dedicated Nozzle, DN - IBA company) with median spot sizes of 5.2 mm and 3.2 mm over a range of energies from 100 to 230 MeV were considered. Uncollimated and collimated plans were calculated with both UN and DN beam models implemented within our in-house treatment planning system for five brain and ten head and neck datasets of patients previously treated with spot scanning proton therapy. The DCS was simulated as close as 5 cm from the patient surface. The average reduction of the mean dose to the 10-mm ring surrounding the target between the uncollimated and collimated plans was calculated for the UN and DN. Target conformity was analyzed using the mean dose to 1-mm thickness rings surrounding the target at increasing distances ranging from 1 mm to 10 mm. The dose reduction to some organs-at-risk was also quantified.

**Results:** The average reductions of the 10-mm ring mean dose for the UN and DN plans were 13.7% (95% CI: 11.6%-15.7%; $p< 0.0001$) and 11.5% (95% CI: 9.5%-13.5%; $p< 0.0001$) across all brain cases, and 7.1% (95% CI: 4.4% to 9.8%; $p< 0.001$) and 6.3% (95% CI: 3.7% to 9.0%; $p< 0.001$) respectively across all head and neck cases. The collimated UN plans were either more conformal (all brain cases and 60% of the head and neck cases) than or equivalent (40% of the head and neck cases) to the uncollimated DN plans. The collimated DN plans offered the highest conformity.

**Conclusions:** According to these simulations, the DCS improved the target conformity for both the UN and the DN, and offered better dose reduction to OARs [1-3].

**References:**

*Intervenant

Moignier A et al. IJROBP 2015. http://dx.doi.org/10.1016/j.ijrobp.2015.07.2029.

Moignier A et al. IJPT 2016. http://dx.doi.org/10.14338/IJPT-15-00036.1.
Moignier A et al. Med Phys 2016. http://dx.doi.org/10.1118/1.4942375.

**Mots-Clés:** Spot scanning proton therapy, collimation, nozzle.