Individualized robustness in treatment planning for head and neck proton radiotherapy.

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During 2020 I worked on two subprojects. The first project consisted of making new radiotherapy plans (photons and protons) for 24 sinonasal cancer patients treated previously in a single institution. The new plans were recalculated on the daily CBCT (daily CT acquired before each treatment to ensure the patient is in the right position) to evaluate the effect of the day-to-day anatomical and setup variations in the delivered dose. It was observed a considerable loss of target coverage for the proton plans. However, the daily recalculated doses were accumulated and it was confirmed that the cold spots in the targets were moving on a day-to-day basis and that, in combination with more high-dose areas within the target for the protons plans, resulted in acceptable accumulated target dose coverage. Nevertheless, since it is not known if the accumulated dose will be acceptable before the end of the treatment, new methods are still needed to boost the robustness of the proton plans and ensure good coverage throughout the whole treatment. Towards that goal, I worked on the second project. Using the first five CBCTs, the most prominent modes of variation were extracted using principal component analysis. A model was created for each patient to include these principal modes of variation present in the first week of treatment. This model was validated, and it was observed that it could predict further variations in the treatment. Two research papers with these results are in preparation and will soon be submitted for publication.

For 2021, I plan to use the model created in subproject 2 and include it in the dose planning process. The aim is to evaluate if the robustness of the protons plans increases by including the principal modes of variation of the first week. If positive, we will have a method to increase the robustness of the patients from week one, and therefore we will reduce the need for plan adaptation throughout the treatment.