Independent dose calculation for TomoTherapy dynamic jaw plans.

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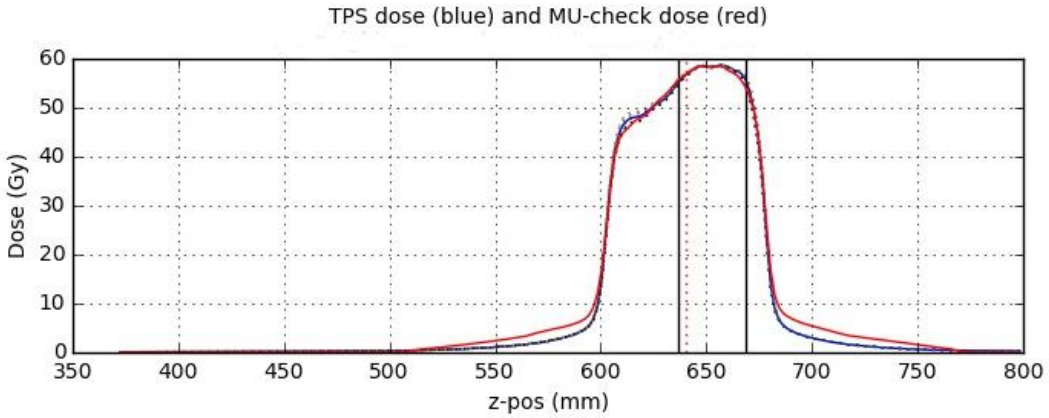
Introduction
We developed an independent dose calculation algorithm suitable for static and dynamic jaw TomoTherapy plans. By using this tool, DQA measurements are only required for plans where the dose difference between the TomoTherapy planning system (TPS) and the independent algorithm exceeds a certain threshold. Our algorithm is based on common dosimetric functions available from commissioning measurements. Despite its relative low complexity it is able to provide dose predictions of acceptable accuracy for the majority of treatment plans in our clinic. To our knowledge the modelling of dynamic jaws is a novel feature in this type of algorithm.

Methods
An existing algorithm for independent dose calculation for TomoTherapy static jaw plans (Gibbons, JACMP, 2009) was extended to calculate the dose in dynamic jaw plans. This algorithm was implemented in Python and validated by comparing the calculated dose in prostate plans to the dose calculated by the TomoTherapy TPS for sets of plans with and without dynamic jaws. The data set was restricted to prostate plans because these plans constitute the majority of our treatments, while at the same time the plan complexity is relatively low. The dynamic jaw behaviour is modelled by using interpolation between longitudinal dose profiles for jaw settings of 10 mm, 18 mm and 25 mm at various depths. The longitudinal dose profiles were obtained from commission measurements. The longitudinal profile translations relative to the isocenter that result from the dynamic jaw behaviour are also included in the algorithm.

Results
For a set of 150 clinical static jaw prostate plans we find an average relative difference of -1.5 % and standard deviation of 1.6% between the high dose region area of the longitudinal profile calculated by the TomoTherapy TPS and our independent dose algorithm. A set of 5 dynamic jaw prostate plans was used to obtain an initial estimate of the accuracy that can be obtained with our modified dose algorithm for dynamic plans. For this set of 5 plans we find an average error of -0.7% with a standard deviation of 0.7 % in the high dose regions. The modified algorithm did a good job in the calculation of the longitudinal profile penumbra (20-80% of the normalized profile).

Conclusion
An independent dose algorithm based on common dosimetric functions can calculate the dose in clinical plans with good accuracy for both static and dynamic jaw prostate treatment plans. Routine plan related DQA measurements can be reduced for large groups of patients by comparing the TPS dose to an independent dose calculation algorithm.



Calculated dose at the longitudinal axis near the isocentre for both the TomoTherapy TPS and an independent dose algorithm for a dynamic jaw treatment plan.