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Treatment planning for synchrotron microbeam radiotherapy

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Introduction

Synchrotron microbeam radiation therapy (MRT) is a novel radiotherapy modality with significant clinical potential. We have produced a simple dose calculation algorithm for MRT using the Eclipse Treatment Planning System (TPS), by Varian Medical Systems.

Method

The calculation engine in Eclipse was configured to directly evaluate 'peak' doses. Monte Carlo-simulated Peak-to-Valley Dose Ratios were used to obtain the 'valley' dose displayed in Eclipse. We compared dose profiles generated by Eclipse with Geant4 Monte Carlo simulations and measurements from the Imaging & Medical Beamline at The Australian Synchrotron. We also performed a plan comparison study using anonymised patient datasets, comparing kilovoltage MRT plans with clinical megavoltage treatment plans.

Results

The Eclipse TPS performed well in calculating 'peak' doses in a water phantom. Considering the simplicity of the algorithm, the 'valley' dose and field profiles were also produced with reasonable accuracy, albeit with some underestimation of the valley dose for larger field sizes.

Compared to the clinical megavoltage treatment plans, MRT plans demonstrated adequate target coverage whilst meeting normal tissue dose constraints when target volumes were small and relatively superficial. As expected, planning goals for deep seated tumours and target regions distal to bone could not be met using MRT.

Conclusion

There are real advantages to using the familiar environment of Eclipse with a new radiotherapy paradigm such as MRT. Although, there are limitations to our MRT calculation engine in Eclipse and further work is required, the data generated in this work are overall encouraging and indicate that the potential for this calculation engine to be implemented in the future as part of a Phase 1 clinical trial.

Keywords or phrases (comma separated)

microbeam, radiotherapy, treatment planning

Are you a student?

Yes

Do you wish to take part in the Student Poster Slam?

No

Are you an ECR? (<5 yrs since PhD/Masters)

No

What is your gender?

Male

Primary author(s) : Mr DAY, Liam (Royal Melbourne Institute of Technology)

Co-author(s) : Dr POOLE, Christopher (University of Melbourne); Prof. CEBERG, Crister (Department of Radiation Physics, Lund University Hospital, Sweden); Dr CROSBIE, Jeffrey (RMIT University); Mr SMYTH, Lloyd (University of Melbourne, Epworth HealthCare); Ms HOLM, Madeleine (Department of Medical Radiation Physics, Lund University, Sweden); Dr ENGSTRÖM, Per (Department of Radiation Physics, Lund University Hospital, Sweden); Prof. ROGERS, Peter (University of Melbourne)

Presenter(s) : Mr DAY, Liam (Royal Melbourne Institute of Technology)

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