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Total X Irradiation helper: publicly available scripting toolset to assist in VMAT planning for total body and total marrow plus lymphoid irradiation

Chunhui Han, PhD[1], Caleb Raman[2], Lesley Rosa, CMD[2], Kareem Rayn, MD[2], An Liu, PhD[1], Jeffrey Y.C. Wong, MD[1], Terence Williams, MD, PhD[1], Anthony Magliari, MS CMD[2]

1 Department of Radiation Oncology, City of Hope, Duarte, CA, USA

2 Varian Medical Systems, Inc., Palo Alto, CA, USA

City of Hope

INTRODUCTION

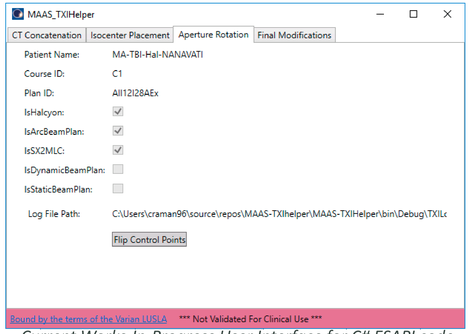
Ring gantry beam delivery systems preclude the use of the conventional TBI and TM(L)I treatment techniques and utilizing VMAT methods are becoming popularized on C arm linacs. However, the cumbersome treatment planning burden poses a challenge to these methods being adopted[1]. This work, along with recent availability of commercial turntable type positioning devices[2] can significantly reduce barriers so more patients are able to receive high quality VMAT based TBI/TM(L)I. Especially in low- and middle-income countries, where laborious treatment planning or buying expensive additional software to concatenate CT scans can result in these treatments not reaching patients when they might otherwise.

AIM

In this study, we aimed to develop a toolset to replace several of the tedious steps required to manually generate TBI/TMI/TMLI treatment plans using VMAT technique.

METHOD

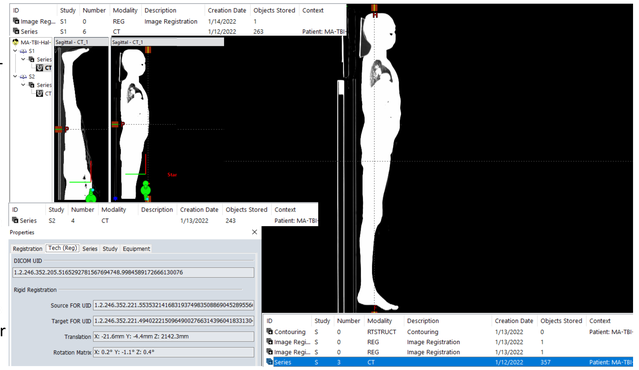
Eclipse Scripting Application Programming Interface (ESAPI), Visual Studio 2022 C# programming language was used to create a toolset which can: concatenate HFS and FFS CT scans with current registration object and process/resample/export a single concatenated CT dataset; Auto-place a beam template with VMAT isocenters equally spaced head to foot for a single optimization treatment plan; flip MLC control points on all isocenters/arcs from a plan in the Head First Supine position (HFS) that are outside the couch translation range and will need to be treated with the patient in Foot First Supine (FFS) orientation; approve and split each isocenter's arcs into separate plans adding KV CBCT for treatment delivery.



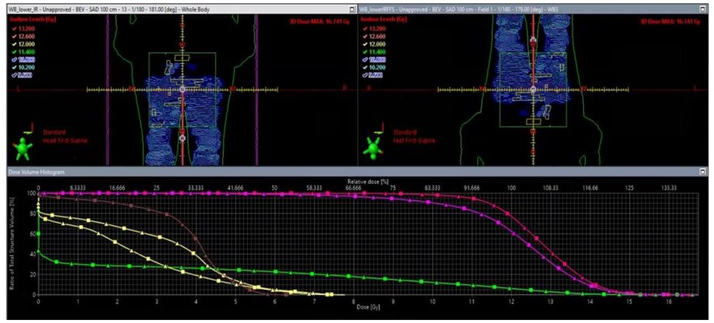
Current Works-In-Progress User Interface for C# ESAPI code

RESULTS

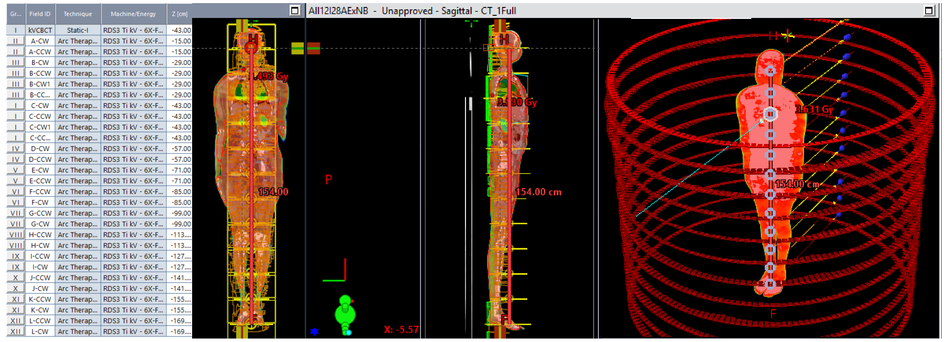
The toolset allows users to create VMAT total body or total marrow plus lymph node irradiation VMAT plans for Varian linear accelerators (either C arm or ring gantry) with all head to foot arcs simultaneously optimized (≥64GB RAM recommended on client and/or CPU calculation server). In the past, multiple treatment plans were required to be separately created for HFS and FFS orientations. Users are no longer required to use specialty CT scanners to scan the entire patient's body at once or utilize third party tools to concatenate separate HFS and FFS scans.



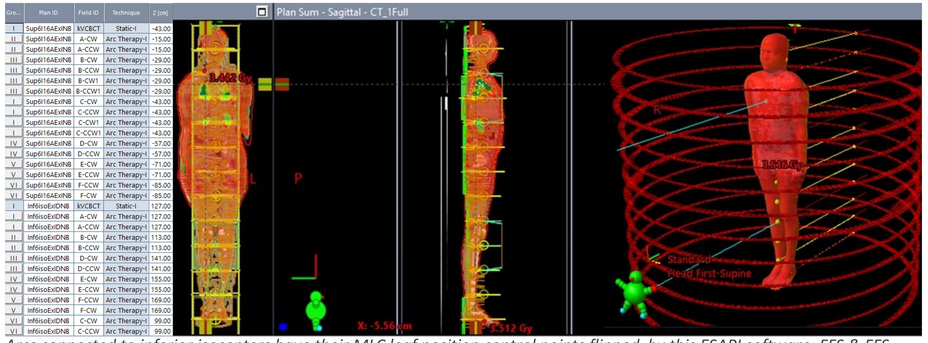
Before and after CT concatenation ESPI code (leveraging simpleITK open source imaging library) on two (HFS & FFS) registered CT series



Before and after running control point flipping ESPI code on a single VMAT arc, dose unchanged.



TBI Eclipse treatment plan, all arcs optimized on a single CT series and a single HFS treatment plan.



Arcs connected to inferior isocenters have their MLC leaf position control points flipped by this ESAPI software, FFS & FFS plans summed, no need for second optimization for FFS arcs.

CONCLUSIONS

TXIhelper is under active development and the source code is shared publicly at the Varian Medical Affairs Applied Solutions (MAAS) GitHub code repository with releases including easy adopted precompiled binaries for several popular Eclipse versions[3]. While this toolset can help relieve some treatment planning burden, Varian delivery systems require extra steps (such as visits into the treatment room between isocenters) to treat these patients, treatment workflows are not yet optimized for plans with greater than two isocenters but are possible.

REFERENCES

[1] TBI planning for Halcyon: "Technical Plan Comments"
https://medicalaffairs.varian.com/othertotalbodyirradiation-tbi-vmat2

[2] CDR Systems – Equilibrium
https://cdrpositioning.com/tbi/

[3] Varian Medical Affairs Applied Solutions
TXI helper (GitHub)
https://github.com/Varian-MedicalAffairsAppliedSolutions/MAAS-TXIhelper

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CONTACT INFORMATION

Email: chan@coh.org Office phone: 626-218-5174

Dept of Radiation Oncology, City of Hope, Duarte, CA

Or, create an "issue" or (ideally) a "pull request" on GitHub