

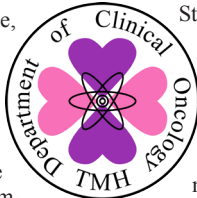
Utility of Dose Accumulation in Cancer Recurrence Case Study

Three Phases sent to MIM for Dose Summation

At a Glance

Background

For patients with cancer recurrence, determining a safe dose to deliver to organs at risk because of retreatment with radiation is a challenging problem. Changes in weight or patient positioning and distortion of the anatomy from the tumor can cause simple visual comparison of the two plans, or rigid addition of the two dose distributions, to be inaccurate.



bone scan. The patient was determined to be Stage IVc, T2bN1M1 (lung).

Treatment

The patient received chemoradiation for the initial occurrence of cancer. An IMRT plan was developed to deliver 70Gy in 33 fractions to the primary tumor along with chemotherapy (Cis-platin Q3wks 100mg/m² x 3 cycles).

In January of 2009, the patient began to experience right-sided vision loss. A right choroidal metastasis was found upon a repeat CT of the brain. Another 20 Gy in 10 fractions was delivered in January 2009 to the choroidal metastasis.

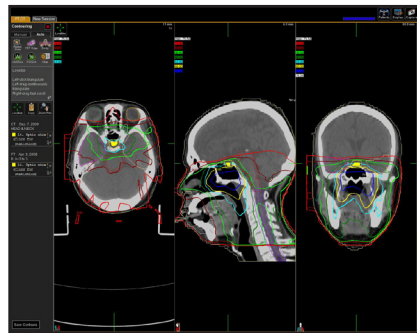
During a follow-up visit in August of 2009, a CT of the brain showed an increase in the right choroidal mass.

Problem

The summed dose to the optic nerves and chiasm cannot exceed tolerance (OAR < 54 Gy and 54 Gy < 1% of PRV 2/3mm < 60 Gy), however, with multiple treatment courses this can be difficult to ascertain without a way to estimate the total dose delivered to a structure. With differences in weight, anatomy, and positioning, a rigid method of alignment is insufficient.

Solution

Using deformable dose accumulation, the total dose delivered to critical structures can be estimated. A workflow was used to accomplish this task. First, the original treatment planning CT was deformably registered to the second treatment planning CT. The same deformation was applied to the original RT dose, allowing the dose from the original plan to be seen on the second CT. The doses from these two plans were then added (plan 1 + plan 2).



Addressing this problem, the ASTRO IMRT Documentation Working Group¹ recommended that RT software provide the ability to deform previously delivered dose distributions to the current anatomy and allow the dose and anatomy to be displayed together.

This case study highlights how providing this functionality for deformable accumulation of the dose can aid in the treatment planning process.

Patient Case

The patient is a 50-year-old male who presented with nasopharyngeal carcinoma with metastasis to the lung in November 2008. Imaging workup included X-ray, CT, MRI, and a

Dosimetrist	Tai Kar Kin
Patient	50-year-old male.
Nov 2008	Diagnosed as NPC with lung metastasis, received chemoradiation.
Jan 2009	A right choroidal metastasis was found and treated with chemoradiation.
Aug 2009	CT showed an increase in the right choroidal mass.
Summed dose	Two previous doses and a planned dose were sent to MIM for dose summation and DVH.
Result	Third planned treatment was withheld as dose would exceed safe limits.

Tuen Mun Hospital

Tuen Mun Hospital of Hong Kong opened in 1990 as an acute regional hospital. Today, TMC provides a full range of medical and allied health services with 1,822 beds, 525 doctors, 1,754 nursing staff, and 2,500 support and administration staff.



Next, the second treatment planning CT was deformably registered to the third treatment planning CT and the same deformation was then applied to the accumulated dose (plan 1 + plan 2) to view the accumulated dose on the third treatment planning CT. The accumulated dose (plan 1 + plan 2) was then added to the third plan to determine the overall dose that would be delivered from the three plans.

The accumulated dose (from plan 1 + plan 2 + plan 3), calculated prior to delivering the third course of treatment, showed that the dose limits for the OAR would be exceeded and the third treatment was not delivered.



1. Low D, Yin F, Homes T, et al. *American Society of Radiation Oncology Recommendations for Documenting Intensity-Modulated Radiation Therapy Treatments*. IJROBP 2009; 74(5):1311-1318.

OAR/PRV	Summed Dose from Treatment 1+2	Summed Dose from Treatment 1+2+3
Optic chiasm	Within tolerance	82.2% > 54 Gy Dmax - 59.7 Gy
Optic chiasm + 3mm	26.0% > 54 Gy Dmax - 58.0 Gy	63.6% > 54 Gy Dmax - 63.3 Gy
Rt Optic nerve	3.0% > 54 Gy Dmax - 56.1 Gy	3.0% > 54 Gy Dmax - 56.2 Gy
Rt Optic nerve + 3mm	7.2% > 54 Gy Dmax - 58.0 Gy	4.6% > 54 Gy Dmax - 57.1 Gy



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