in a standard deviation, i.e. dosimetric precision, of 0.14 Gy between the gel and film measurement while differences of 0.11 Gy for the gel and 0.13 Gy for the film was found when comparing to the calculated dose distribution.

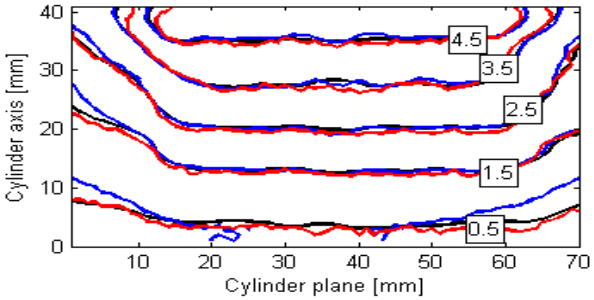


Figure 1: Contour plot of the gradient section of the calculated dose distribution (black), the gel measurement (blue) and the film measurement (red). The dose values are shown in units of Gray.

Conclusions: Both gel and film reproduced the delivered dose distribution with only small deviations. In addition, the gel measurement showed slightly higher dosimetric precision than the film when compared to the calculated distribution. This study therefore shows that this 3D dosimetry system can provide dosimetric precision that is comparable with radiochromic film dosimetry.

PO-0816

Feasibility of luminescence screen based quality assurance system for verification of SRS beams

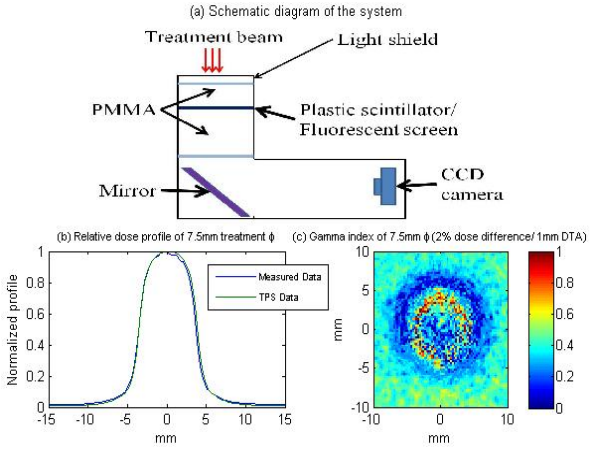
T.L. Chiu[1], B. Yang[1], H. Geng[1], W.W. Lam[1], C.W. Kong[1], C.W. Cheung[1], K.Y. Cheung[1], S.K. Yu[1]

[1]Hong Kong Sanatorium & Hospital, Medical Physics & Research Department, Happy Valley, Hong Kong (SAR) China

Purpose/Objective: To evaluate and characterize a luminescence screen based QA system as implemented in SRS treatment field verification of a linac system.

Materials and Methods: The home-made QA system consists of a set of PMMA block, a luminescence screen (interchangeable between plastic scintillator and fluorescent screen), a CCD camera and a light-tight box. The characteristics of fluorescent screen (Kodak, Lanex regular screen) and plastic scintillator (Apex, Anthracene with base polyvinyltoluene) were quantified on a linac (VARIAN TrueBeam). The PMMA block has a size of 30cm x 30cm and different build up thickness can be used depending on beam energy and the depth of beam profile to be evaluated. 10 cm thick PMMA was put behind the screen to ensure enough backscatter radiation. The signal light was reflected by a mirror below the transparent PMMA to a CCD camera away from the PMMA block. Dose linearity was examined on both materials by applying a range of MU from 1 to 300 under a 10cm X 10cm radiation field. After applying a median-filter to remove radiation induced noise from the captured image, the mean signal of a small ROI (10 cm^2) at the centre were calculated and correlated with the corresponding doses. The system can then be calibrated. Dose rate dependence was tested by varying dose rate from 200 MU/Min to 600 MU/Min. Energy dependence was also investigated with different radiation energies including 6MV and 15MV photon beams and 6MeV, 9MeV, 12MeV, 16MeV, 20MeV electron beams. Parasitic Cherenkov emission signals were eliminated by applying a deconvolution kernel on the original signals. Small circular field size measurements, from 7.5mm to 30 mm in diameter, were done at the appropriate depth. Both inline and crossline absolute radiation profiles of the circular fields were then obtained.

Results: The pixel values increase linearly with the delivered dose up to 3Gy and a linear regression analysis yields R^2 > 0.99. In this system, the minimum detectable dose is 12 mGy for plastic scintillator and 2 mGy for fluorescent screen on 6MV beam. In dose rate dependence test, plastic scintillator has a maximum deviation of 1.3% from 200MU/Min to 600 MU/Min on 6 MV while fluorescent screen has a maximum deviation of 1.1%. Plastic scintillator shows a maximum deviation of 4.2% for photon beam energy up to 15MV and electron beam energy up to 20MeV. Fluorescent screen shows clear energy dependence. The pixel size of the system is about 0.26 mm. In small circular field sizes measurement, measured dose distributions agree with the data generated by TPS. The gamma index passing rate for 7.5mm and 30 mm diameter collimator is 98.8% (2% dose difference /1 mm DTA) and 99.0 % (2% dose difference /1 mm DTA) respectively.



Conclusions: The luminescence screen based quality assurance system we developed has excellent dose linearity and dose rate independence. The system can provide fast and precise absolute dose verification of a treatment beam after calibration. The high precision characteristic of the system makes it valuable for dose verification of small treatment beams.

PO-0817

Clinical evaluation of intrafraction motion in mask system for Gamma Knife measured with IR tracking and cone-beam CT

C. Chung[1], W. LI[1], G. Bootsma[1], Y.B. Cho[1], O. Von Schultz[2], P. Carlsson[2], D.A. Jaffray[3]

[1]UHN-Princess Margaret Cancer Centre, Radiation Oncology, Toronto, Canada

[2]Elekta Instrument AB, Box 7593, Stockholm, Sweden

[3]UHN-Princess Margaret Cancer Centre, Radiation Oncology/Techna, Toronto, Canada

Purpose/Objective: Incorporation of image-guidance using cone-beam CT (CBCT) and infrared (IR) tracking to the Gamma Knife® unit allows for monitoring of intra-fractional and inter-fractional movement during radiosurgery and introduces the ability to immobilize non-invasively with a thermoplastic mask. The purpose of this study was to clinically evaluate the accuracy and stability of this non-invasive immobilization system using CBCT and IR image-guidance first in patients receiving standard fractionated radiotherapy (RT) prior to application in patients treated with longer treatment times on the Gamma Knife Perfexion. The sensitivity of IR tracking to detect motion was also compared against CBCT.

Materials and Methods: Adult patients with brain tumors who were planned for fractionated RT were eligible for this research ethics board approved prospective study. Patients were immobilized in a thermoplastic mask with a nose opening and custom fit head rest. Patients had CBCT1 pre-treatment and verification CBCT2, only if any translational correction was made for interfraction set-up variation. Following treatment, they had CBCT3 to calculated intra-fraction motion. During each treatment, the patient's head and target movement was estimated continuously using a reflective marker on the nose tip and IR camera fixated to the patient´s couch along with a rigid reference coordinate system on the couch near the patient's head. Using pre- and post-treatment CBCT data, intrafraction translational and rotational movements of the target were measured. Intrafraction movements were then compared between CBCT and optical tracking methods.

Results: A total of 75 CBCT and IR image data sets were analyzed from 6 patients treated with a mean of 23 fractions of RT (range: 5-30 fractions). The mean treatment time per fraction was 9.36 minutes (range: 5.45-15.05 minutes). The inter-fraction motion detected on cone-beam CT ranged between 0.11 to 2.37 mm, for which translational correction was applied prior to treatment. The overall mean intrafraction motion of the target was 0.34 mm while the motion of the nose tip based on CBCT data was 0.47 mm compared with 0.65 mm using optical tracking. When evaluating each patient individually, the mean motion detected for the target was equal to or smaller than the mean motion detected for the nose tip using either CBCT or IR tracking.

Conclusions: This initial clinical evaluation of the immobilization accuracy of a thermoplastic mask system intended for use on Gamma Knife Perfexion using optical tracking and CBCT demonstrated mean inter- and intra-fraction movements of less than 1 mm. Good correlation was observed between the intrafraction motion measured using CBCT and IR tracking. Target motion (measured on CBCT) was generally smaller than patient (nose/head) motion detected by CBCT and optical tracking, suggesting that use of head/nose motion for image-guidance and intrafraction motion management will ensure accurate targeting on Gamma Knife Perfexion.

PO-0818

Spirometric gated VMAT: QA of potential breath hold interruptions

R. Garcia[1], V. Bodez[1], C. Khamphan[1], E. Jaegle[1], M.E. Alayrach[1], A. Badey[1], P. Martinez[1]
[1]*Institut Sainte Catherine, Physics, Avignon, France*

Purpose/Objective: Thoracic and abdominal radiotherapy needs to include breathing controls. Among various possibilities, the breath hold provides a simple process. Planning, delivery and all imaging protocols are easily managed once the internal anatomy remains immobile. However, to obtain the benefit of a modulated irradiation with the VMAT option, we need to secure potential breath hold interruptions during the irradiation.

Materials and Methods: The SDX™ /Dyn'R Breath Hold spirometric system used daily for some patient treatments is connected to the Varian accelerator with an Automatic Gating Module™ (AGM). A phantom plan, two QA plans and two patient plans were used to voluntary test interruptions during the irradiations. To evaluate the potential impact of breath hold interruptions, we used the Delta4™ /Scandidos system and Log files records. The % of gamma index passing the criteria (3% - 3mm) were collected. The Log Files were analyzed with the FractionCheck™ /Mobius Medical System module. We collected the 95th percentile and the maximum leaf Root Mean Square (RMS) error.

We compared measurements and records with and without interruptions during the irradiation.

The QA plans are provided by Varian Inc to test gantry rotation, MLC leaves and Dose-rate variations. The Phantom and patients plans were based on four successive arcs which favor the correlation between the patient breath hold ability and the arc irradiation duration. During each arc, two breath hold interruptions were obtained with the use of the QA syringe placed in the control room.

Results: The dosimetric plans selected cover the domain of modulation used for the patient treatments. Table 1 presents the % of gamma index passing the criteria, for all the plans, with and without interruptions. The maximum difference of % gamma index, with and without interruption , was only 0,71%. This result indicates that there is no significant differences which could alert on a dosimetric effect of breath hold interruptions. The Log Files analyze do not contain any dose comparison but gives a vision of the delivery process. The mean and maximum 95th percentile difference, with and without interruptions, were 0,04mm and 0,29 mm respectively. The mean and maximum leaf RMS difference with and without interruptions were -0,02 mm and 0,29 mm. The log files stored data are consistent with the Delta4 dosimetric analyze.