Conclusions: Results obtained with the glass beads agree with those obtained from conventional detectors including alanine, film and ionisation chambers. This together with the waterproof characteristics and minimal fading associated with glass bead TLDs confirm their potential as a postal dosimetry audit tool.

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Small field dosimetry: a valid concern or the latest medical physics trend?

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Purpose/Objective: For small radiation fields, the uncertainty in dose measurement is higher than for conventional radiotherapy fields (Castro 2008). To address this, manufacturers have custom designed dosimeters specifically for this niche physical treatment condition. Several types of small field dosimeters, although convenient, still need small field correction factors [SFCF] to achieve a valid measure of dose. The aim of this work is to quantify the performance of a range of specialized small field dosimeters and to show the effect of incorrect application of SFCFs. This is done by calculating the result of propagating these errors through treatment.

Materials and Methods: Two sample patient treatments are considered: the first case a trigeminal neuralgia and the second a brain metastasis. Each patient plan is evaluated using the smallest 4mm BrainLAB cone on a Varian Novalis linear accelerator. For each case the plan was calculated using measured data made with the following small field dosimeters: IBA SFD, PTW 60012, PTW microdiamond, Australian Air-core dosimeter, Standard Imaging Exradin and Gafchromic EBT film.

Results/ The diodes and the microdiamond were found to over-respond. The dose delivered was found to be up to 10% less than that prescribed to the target volume, depending on the dosimeter used to commission the planning system and whether SFCF and volume averaging corrections are applied. For small fields, the scintillation dosimeters and film required only correction for volume averaging, minimizing dosimetric uncertainties.

Conclusions: A specific patient prescription is tailored to account for the individual patient's needs. However once a prescription is made, it should be delivered as accurately as possible, irrespective of whether it is a small or large treatment field. There is an accepted variability in prescriptions for the treatment of brain lesions with small fields (e.g. trigeminal neuralgia and brain metastasis), which may be attributed in part to the present variability in small field dosimetry. Two prescriptions may be delivering the same dose, but the dosimetry may be reporting it as different. Since clinical response has been used to determine the dose prescription protocols, solutions to the challenges of small field dosimetry should be agreed upon.

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Sensitivity of various commercial QA systems to MLC errors and correlation between gamma analysis results and DVH

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Purpose/Objective: To investigate the variability of the global gamma index analysis in various commercial IMRT/VMAT (Intensity Modulated Radiation Therapy/ Volumetric Arc Therapy) Quality Assurance (QA) systems. In addition, this study evaluates the relationship of these gamma analysis results and clinical dose volume histogram (DVH) for VMAT treatment plans and to understand how systematic VMAT multileaf collimator (MLC) positional errors affect the patient dose distribution.

Materials and Methods: Five commercial QA systems (IBA MatriXX, SunNuclear ArcCHECK, PTW 2D-Array, Varian EPID, and Gafchromic EBT2 film) were used for defining the global gamma index variability in IMRT /VMAT plans and two of QA systems (IBA MatriXX and SunNuclear ArcCHECK) and their commercial QA system software (IBA-COMPASS and ArcCHECK- 3DVH) were used to evaluate the relationship of these gamma analysis results and DVH in VMAT plans. Five prostate plans (two IMRT and three VMAT) and five larenks plans (two IMRT and three VMAT) were modified by the introduction of systematic MLC errors and were evaluated in each sytem. Systematic MLC errors were simulated for error magnitudes of 0.25, 0.5, 1, 2 and 5 mm. The two types of systematic MLC errors were: (1) MLC banks are shifted in the same direction (left or right) and (2) MLC banks are shifted in opposing directions resulting in smaller or larger field shapes. Error-induced plans were measured on a linear accelerator and were evaluated against the error-free dose distribution calculated using Varian Eclipse treatment planning system in the relevant phantom CT scan. A theoretical gamma analysis was calculated in each commercial QA system software (IBA OmniPro, SNC Patient, PTW Verisoft,Varian Portal Dosimetry and IBA OmniPro, respectively) using treatment planning system. For evaluating the relationship of the gamma analysis and DVH, all QA verification plans were delivered and estimated 3D patient dose on the 3DVH and COMPASS software. QA gamma analysis of 3%/3 mm and 2%/2 mm were implemented and relationships to dose differences in DVH metrics encountered due to MLC errors were determined.

Results: The 2 mm systematic errors were difficult to detect using 3%/3 mm but were detectable for criteria of 2%/2 mm. This study has shown that various commercial software agree well with each other in calculating the predicted global gamma index passing at even tight passing criteria of 2%/2 mm. There is lack of consistently strong correlation between gamma indexes and clinical DVH metrics for PTV and OARs.

Conclusions: There was considerable variation in the type of errors that the various systems detected. It was also found that the calibration and measuring procedure could benefit from improvements for some of the patient QA.