to a measured dose plane derived from an EPID image. We wish to assess the relative performance of the systems before switching.
In this work, the abilities of PerFraction and Portal Dosimetry to detect various types of deliberate VMAT delivery error were investigated. The impact of such errors on patient dose was also assessed.
This is believed to be the first reported use of receiver operating characteristic (ROC) analysis to assess the performance of PerFraction.

Material and Methods

This work used 10 treatment plans for various clinical sites, at 6 MV on a TrueBeam linac. The predicted dose plane was calculated in both PerFraction and Portal Dosimetry for the unaltered plans.
Modified versions of the plans were also created. Changes were made to the total MU, central MLC positions, collimator angle and beam energy.
Unmodified treatments were delivered along with the modified versions. EPID images were acquired during delivery and analysed using both systems. Gamma analysis was used to compare the measured dose plane to the predicted dose plane for the unmodified plan.
To compare the error detection performance of the systems, ROC analysis was used. The gamma pass rates for the modified and unmodified plans were used to construct ROC curves. Greater area under the curve (AUC) indicates better error detection performance.
Modified plans were imported to Eclipse to assess the effect on patient DVHs.

Results

In both systems, larger errors had higher detectability. For machine output changes and beam energy changes, Portal Dosimetry had better error detection performance than PerFraction. For MLC and collimator errors, the systems had comparable performance. Table 1 gives AUC values for each system and error type.
All changes in patient DVH metrics for MLC shifts were found to be <2%. Energy errors had a major impact on patient dose, up to around 20% for some metrics. Collimator angle errors had an intermediate effect.

	AUC	
error	PerFraction	Portal Dosimetry
-4% output	0.913	0.948
-3% output	0.851	0.871
+3% output	0.650	0.951
+4% output	0.842	0.967
1 mm MLC	0.622	0.765
2 mm MLC	0.954	0.923
3 mm MLC	1.000	0.969
1° collimator	0.842	0.842
2° collimator	0.974	1.000
3° collimator	1.000	1.000
6 MV → 10 MV	0.939	1.000

Table 1: AUC values for all ROC analyses. The system with better performance is highlighted in green.

Conclusion

For some error types, the performance of PerFraction appears somewhat worse than Portal Dosimetry in the situations investigated. For these cases the clinical impact is small, or we have other systems capable of detecting these errors. We have therefore decided to implement PerFraction for routine pre-treatment QA as it performs adequately and gives independence from Varian systems and greater efficiency through automation of image retrieval and analysis.

PO-1384 Assessing Ir-192 as an alternative to I-125 in ophthalmic treatment

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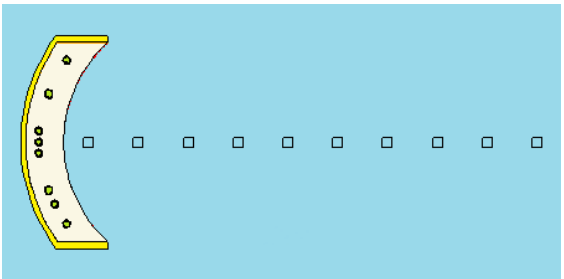
Purpose or Objective

Brachytherapy sources for ocular melanoma usually contain Co-60, I-125, Pd-103 or Ru/Rh-106 as radionuclides. Ir-192 is not a preconized radioactive material for this purpose, although it is used for other brachytherapy applications. Higher mean energy from Ir-192 emission (ca. 380 keV) may be a reason for the preference of I-125 (35 keV) or Pd-103 (21 keV) over it, since low penetration is desired on the small structures of the human eye. This is not, however, an excluding criterion, considering Co-60 and Ru/Rh-106 have even higher mean energies.
The demand in Brazil for lower-cost seeds to treat ocular melanoma lead to the development of an Ir-192 seed to make treatment more accessible, but since it is not used as an ophthalmic brachytherapy source, before its dosimetry is considered, one should care about the possibility of using it over more stablished materials.
Considering this, the aim of this work is to assess the possibility of using Ir-192 seeds as ophthalmic brachytherapy sources by comparing some dosimetric parameters of a new seed model with the most stablished I-125 seed in literature, OncoSeed 6711.

Material and Methods

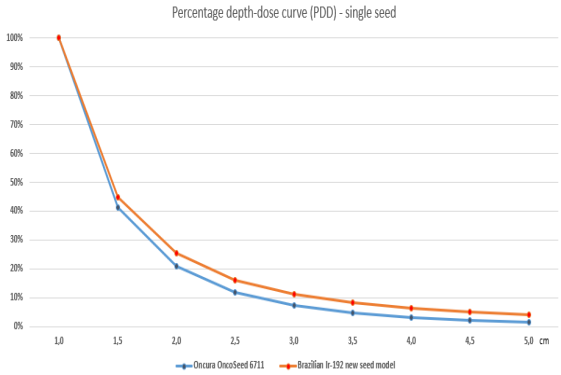
As an initial study on the topic, this work relies only on Monte-Carlo simulations using MCNP4C transport code. Parameters analyzed are air-kerma strength, dose-rate constant and depth-dose curve, attention given to points within the human eye dimensions. The medium considered was homogeneous water, as it is a good approximation to the eye tissues in terms of composition and density and allows for future comparisons with TG-43 based calculations.
OncoSeed 6711 is not produced anymore, but its long term as the reference source for dosimetry was considered. A 20 mm COMS ophthalmic applicator was also modeled and considered to be fully loaded with each seed model to compare the same parameters at a realistically clinical approach.



Results

As expected, due to the higher energy of the Ir-192 emission spectrum, dose fall-off on the transversal axis of the seeds is less pronounced for the new seed model. The steeper dose gradient for I-125 is also visible on the dose-rate constant value. The effect of using a COMS applicator only strengthens this characteristic. Depth-dose curves were calculated up to the distance of 5 cm, both for a single seed and for an applicator fully loaded with 24 seeds. All the eye components relevant for dosimetry are

located within this range, like the cells of the crystallin and the optical nerve.



Conclusion

If one expects to use Ir-192 as an alternative to I-125 in ophthalmic cancer treatment, at least the dosimetry following TG-43 protocol should be carried with utmost attention, as undesirable dose to healthy nearby tissues is unavoidable. Crafting a different applicator most suited for this radionuclide is a possibility that can be taken into account. Another recommendation is to go beyond TG-43 water-based protocol and actually estimate dose to relevant eye components.

PO-1385 CyberKnife® patient plan verification with the SRS MapCHECKTM - First clinical experience

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Purpose or Objective

The SRS MapCHECK™ (Sun Nuclear Corp., Melbourne, USA) is a two-dimensional diode array to be used in conjunction with the end-to-end phantom StereoPHAN™ for metrological verification of treatment plans. The release of the SNC Patient Software 8.3 enables its use on CyberKnife® machines by removing the previous limit on the beam angle of incidence. This study aims to evaluate the performance of the device in the clinical routine. 10 treatment plans featuring different treatment sites, collimator sizes, number of gantry angles and delivery durations were tested.

Material and Methods

The SRS MapCHECK™ is equipped with 1013 Sun Point 2 diodes (0.48 x 0.48 mm^2) distributed in a plane of 77 x 77 mm^2. The diagonal distance between the diodes is 2.47 mm. The specific arrangement of the diodes allows the measurement of the beam's angle of incidence and the correction of the angular dependence of the detector response. For positioning on the CyberKnife®, 4 fiducial markers are integrated in the housing of the device.

To prepare the device for clinical use, a CT scan of the StereoPHAN™ and the inserted SRS MapCHECK™ was taken. The suggested density overwrite was omitted in our tests. The array was calibrated in terms of absolute dose using a reference field. Two additional static beams were needed to calibrate for angular response.

The Precision® TPS (Accuray, Version 2.0.0.1) was used to create the QA plans, and to export the DICOM RT Dose and reports.xml files. The 10 test plans included 9 different treatment sites, collimator sizes between 5 mm and 35 mm, 29 to 88 nodes and 61 to 314 beams.

The positioning of the device is performed via the integrated fiducials using x-ray imaging. After delivery, the SNC Patient Software applies the necessary corrections on a 50 ms frame base before summarizing the frames. The 6 degrees-of-freedom shift was calculated to evaluate the kV positioning accuracy, but not applied.**Results**

The setup of the phantom and the array on the treatment table takes about 3 minutes. The gamma criterion of 2% / 1mm > 90% and 3% / 1mm > 95% could be achieved in almost all test plans. 6 test plans achieved a gamma criterion of 1% / 1 mm > 90%. The rms of the calculated shifts between the delivered dose distribution and the planned dose distribution was below 0.4 mm in three dimensions.

Conclusion

The SRS MapCHECK™ allows easy and meaningful verification of patient plans without film, without restrictions of the angle of incidence and with little expenditure of time. The assembly and positioning of the phantom is without problem, except for cases with far posterior target volumes, where a relocation of the alignment center is recommended.

PO-1386 Validation of a MC software for the QA of patients treated with modulated intensity photon beams

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Purpose or Objective

Nowadays patient QA is very important in the RT workflow, especially for patients with highly conformed treatment plans, and it is usually performed prior to patient treatment. Patient QA is fairly time consuming and takes up a lot of time-machine, stealing it from patients' treatments. Moreover, physicist's time is a limited resource.

The innovation proposed within this work is to introduce a new MC software (SciMoCa) in the RT workflow, which can be used as a fast-secondary dose check and an independent plan QA evaluating tool. This method allows to verify only those treatments that do not pass the minimum acceptance criteria.

The aim of the study is to evaluate SciMoCa, testing its performances in term of accuracy, repeatability and calculation time.

Material and Methods

SciMoCa was benchmarked against TPS Monaco (Elekta) and Pinnacle (Philips) in VMAT techniques, they are based on MC and CCC dose calculation algorithm respectively. All three software were commissioned for the same 6MV Elekta accelerator using the same measurement set. Fifty patients of six clinical classes (CNS, H&N, breast, lung, prostate and bone metastasis) were randomly selected from the clinical database and computed with all algorithms using the same calculation parameters. Dose accuracy was studied by assessing the isocenter point dose differences while dose distributions were evaluated with the statistics of 2D-γ analysis (3%3mm-TH10%). Software performances were also verified at the accelerator with measurements relying on ArcCHECK to evaluate the dose differences in a homogeneous phantom. The comparison was performed with the same setting as before.

Results

Results are shown in Table1. On average, the percentage point dose differences between Monaco and Pinnacle compared to SciMoCa are -1.8±1.8% and -0.5±1.1%, respectively; while TPSs to ionization chamber measurements are -0.6±1.7% and 0.4±1.4%, for Monaco and Pinnacle respectively.