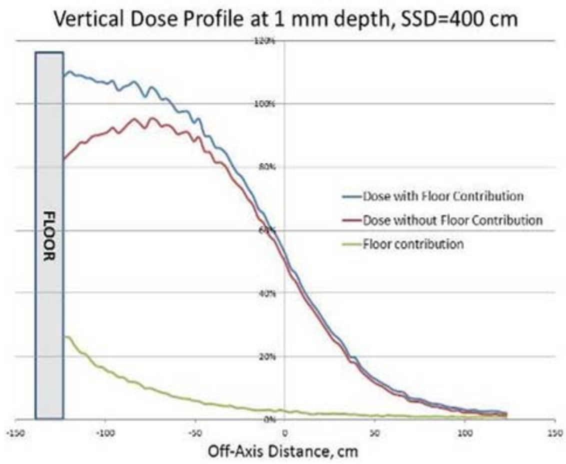
Figure 1. Vertical dose profiles



Conclusion: For the TSEI technique, dose contribution due to the electrons scattered from the treatment room floor and ceiling may be clinically significant and should be taken into account during treatment design and commissioning phases. MC calculations can be used for this task.

EP-1580

CyberKnife multi-site small beam dosimetry with a new plastic scintillator detector

S. Russo[1], L. Masi[2], A. Bergantin[3], E. De Martin[4], R. Doro[2], C. Frassanito[5], M.L. Fumagalli[4], A.S. Martinotti[3], E. Rondi[6], S. Vigorito[6], P. Mancosu[7]

[1]Azienda Sanitaria Firenze, S.C. Fisica Sanitaria, Firenze, Italy

[2]IFCA, Radiotherapy, Firenze, Italy

[3]C.D.I., Radiotherapy, Milano, Italy

[4]Istituto Besta, Radiotherapy, Milano, Italy

[5]C.B.H. Città di Bari Hospital, Radiotherapy, Bari, Italy

[6]I. E. O., Radiotherapy, Milano, Italy

[7]Humanitas Research Hospital, Medical Physics Unit of Radiation Oncology Dept, Milano, Italy

Purpose or Objective: Accurate dosimetry of small photon fields is clinically crucial, yet remains difficult to achieve. Water-equivalent detectors with small dimension compared to the beam size can be considered ideal. The aim of this work was to evaluate the suitability of a plastic scintillator detector (PSD) (Exradin W1, Standard Imaging SI) for relative small beams dosimetry over different CyberKnife systems.

Material and Methods: Five CyberKnife centers were involved in the study. Small beam dosimetry was performed with W1 PSD oriented vertically (parallel to the beam axis) within a water tank. Cerenkov Light Ratio (CLR) according to the method of Morin (Med. Phys 2013) using the two-channel SuperMax electrometer (Standard Imaging) was calculated to take into account the Cerenkov effect. Since this electrometer has not been integrated with the scanning water-tank, separate positioning and dosimetric systems were used. Output factors (OF) for cones diameters ranging from 5 to 60 mm were measured. Setup conditions were: 80 cm source to detector distance and 1.5 cm depth in water (SSD=78.5cm). Inline and crossline profiles for 5 mm circular field were also acquired at 10 cm depth in water and 80 cm source to detector distance. Same measurements were repeated by each center with the PTW60017 silicon diode. Monte Carlo correction factors reported in literature for PTW-60017 silicon diode (Francescon et al. PMB 2012, Francecon ed al. Med. Phys. 2014) were applied to detector readings for OF and dose profile evaluation.

Results: W1 PSD OF measurements averaged over all centers were lower than silicon diode MC corrected values for all field sizes, with differences within 1.7% (see table 1). Comparing OF measured by W1 PSD to MC corrected PTW-60017 diode data for each center, relative differences <2% for 60-12.5 mm fixed cones were obtained. Differences < 3.2% for 10 mm and 7.5 mm cones, and up to 4.6% for 5 mm cones in one center were detected.

Field Size (mm)	5	7.5	10	12.5	15	20	30	40	60
W1 PSD	0.665 (0.014)	0.816 (0.007)	0.870 (0.005)	0.913 (0.005)	0.939 (0.004)	0.965 (0.003)	0.982 (0.003)	0.987 (0.003)	1.000
MC corrected PTW 60017	0.675 (0.014)	0.830 (0.008)	0.880 (0.007)	0.919 (0.004)	0.943 (0.002)	0.966 (0.003)	0.982 (0.002)	0.988 (0.004)	1.000

Table 1. OF mean values and SD over the five CyberKnife centers for W1 scintillator and MC corrected diode measurements.

Dose profile measured by W1 resulted wider than MC corrected silicon diode ones for each center: (see figure 1 for 5 mm collimator of CyberKnife Unit n°1). W1 PSD profile tails were always above diode corrected values for each center.

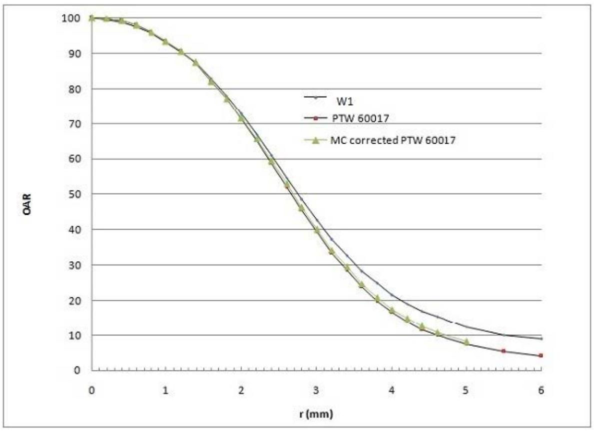


Figure 1. CyberKnife Unit n°1 mean profile measured by W1 PSD and silicon diode for 5 mm field size.

Conclusion: The agreement between Exradin W1 PSD and MC corrected silicon diode results is promising for the use of W1 PSD in small field dosimetry. However, the application of CLR correction remains a critical point in the measurement procedure and further research is needed to determine the most accurate method for CLR determination.

EP-1581

PTW Starcheck 2D array for Quality Control in IOERT: an evaluation of accuracy and dose consumption

M. Severgnini[1], H. Aslian[2], M. De Denaro[1]

[1]AOU "Ospedali Riuniti di Trieste", Medical Physics, Trieste, Italy

[2]International Center for Theoretical Physics and Trieste University, Medical Physics, Trieste, Italy

Purpose or Objective: In this study, a PTW Starcheck device, which is an easy handle measurement equipment, is used to check the possibility of executing periodical QC in IOERT.

Material and Methods: The dosimetric properties of the new Starcheck device (T10043, PTW) have been studied for 6, 9 and 12 MeV electron beams by IOERT accelerator, the MOBETRON (IntraOp, Inc. Santa, CA.). The Starcheck, consists of 527 vented ionization chambers with small volume (0.053cc) along the principal and diagonal axes. The matrix cover an area of 26 x 26 cm with the spatial resolution of 3mm. The main beam parameters are measured at the depth of maximum dose at mentioned energies and different flat base collimator sizes (4, 5, 6, 7 and 10cm) in comparison with measures conducted with ionization chamber (Advanced Markus, PTW TW34045) and electron diode (PTW TW60012) in water phantom (PTW MP3-S) and also with EBT3 gafchromic film (International Speciality Products, Wayne NJ) in water equivalent slab phantom (PTW RW3). The Starcheck data acquisitions were done with the Multicheck software with only 100-200 MU and data analysis was handled by the MEPHYSTO software. Reference profiles measured in water were compared with profiles obtained with 2D array and Gafchromic films using the 2%/2mm gamma-index criterion. Output factor measurements were carried out for the central chamber of the array using its absolute dose value, and the results compared with the reference values.

Results: Comparison between dose profiles obtained with Starcheck 2-Array, chamber, diode and Gafchromic film showed a good agreement and they satisfied gamma analysis (2%/2mm) for almost all the nominal energies and collimators. The high spatial resolution of Starcheck allows accurate evaluation of penumbra, symmetry, flatness and field size and the results showed dosimetric differences less than 1%, 1mm for all the energies in the reference collimator (10 cm). The absolute dose difference at the Zref (IAEA398) between central chamber of 2D-array and Advanced Markus was in the order of 1% for 6 and 9 MeV and was almost 1.5% for 9 MeV. Furthermore, the difference between output factor obtained with the 2D-array and other dosimeters was in the order of 2% for all collimators in different energies except for the smallest collimator (4cm) where the output factor deviated more than 3% from the other results. However, the results for beveled collimators were not acceptable due to angular response variation of chambers.

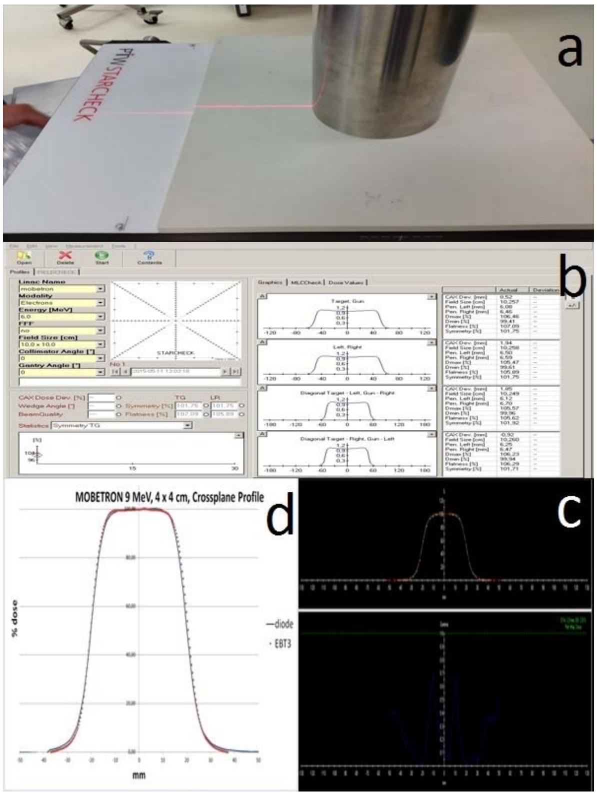


Fig.1. Starcheck 2D array (a), data analyze with Multicheck software (b), crossplane profiles comparison: Starcheck and diode (c), Starcheck and EBT3 (d)

Conclusion: The high spatial resolution, very small detector size and specific arrangement of this 2D array can be really suitable for dosimetry in IOERT. Additionally, it can reduce setup time and dose consumption more than 30% for frequently QC procedure.

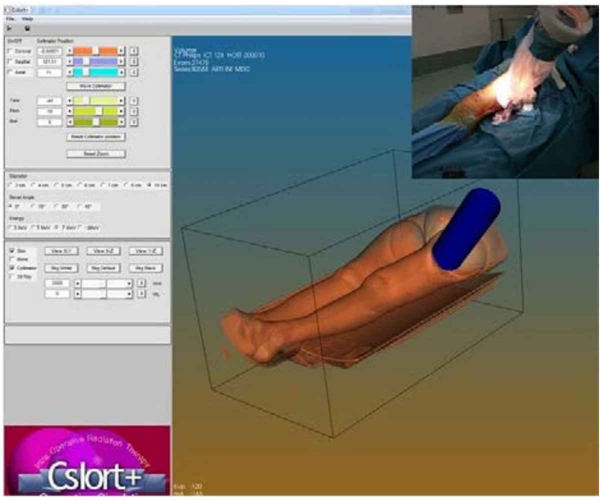
EP-1582
Retrospective study of IORT sarcoma treatment using an innovative dedicated TPS

A. Soriani[1], A. Ciccotelli[2], S. Carpino[1], M. Petrongari[3], M. D'Andrea[1], G. Iaccarino[1], G. Felici[2], M. Benassi[4], P. Pinnarò[3], C. Giordano[3], G. Sanguineti[3], R. Biagini[5], L. Strigari[1]
[1]*Regina Elena Cancer Institute, Laboratory of Medical Physics and Expert Systems, Roma, Italy*
[2]*S.I.T.–Sordina IORT Technologies S.p.A., R&D Dept, Aprilia LT, Italy*
[3]*Regina Elena Cancer Institute, Radiation Oncology Dept., Roma, Italy*
[4]*Istituto Scientifico Romagnolo per lo Studio e la Cura dei Tumori IRST, Medical Physics Dept, Meldola FC, Italy*
[5]*Regina Elena Cancer Institute, Orthopaedic Surgery Dept., Roma, Italy*

Purpose or Objective: The IORT dedicated Treatment planning system (CSRAD+), already validated on simple geometries, has been used to perform calculation on patient-like geometries and to compare the measured and the calculated dose distribution in a clinical configuration. In this study, sarcoma cancer patients have been considered. In sarcoma IORT treatments, the air gap between target and applicator and the extended dimensions are critical parameters that must be fully taken into account. The TPS and MC calculations are mandatory for documenting the dose delivery in order to potentially improve the treatment technique and to better evaluate dose effect correlation.

Material and Methods: Twenty six patients with sarcoma cancer have been treated using NOVAC 7 with an energy from 7 to 9 MeV, an applicator diameter from 40 to 100 mm, delivering a dose from 10 to 16 Gy. In vivo dosimetric data collected during IORT using Gaf films, have been used as the gold standard for testing the accuracy of the algorithms implemented in the TPS. CT images of five representative patients have been used to reproduce the surgery room scenario, using the collected data and taking into account tissue removal during the surgery procedure. Then, the CT images were imported in the TPS and used in order to perform an accurate dose calculation. The dose distribution have been compared with the in vivo dosimetry in order to perform a sensitivity analysis.

Results: The TPS algorithms including the inhomogeneity correction have been investigated considering the clinical scenarios. The algorithm including the inhomogeneity correction allows the best agreement between the in-vivo dosimetry results and calculated dose, for mobile IORT accelerator. CSRAD+ permits to make a virtual docking, to delineate the target ROI, and to evaluate the dose distribution and the dose volume histogram. The sensitivity analysis revealed potential setup uncertainties (up to 80%) due to the manually performed alignment procedure in the surgical room and inaccuracy on target thickness when blood and air are present during the docking.



Conclusion: The developed CSRAD+ shows a good agreement with experimental data and could replace the time consuming MC absolute dose calculation, becoming a potential on-line aid for physician and physicist in the surgical room. The CSRAD+ could represent a training tool for