PO-0760

Adjuvant treatment of keloid scars: brachytherapy or electrontherapy?

S. Yossi[1], S. Krhili[1], P. Gustin[1], C. El Alouani[1], D. Rousseau[1], N. Nebout[1], S. Vinchon Petit[1], C. Tuchais[1], P. Cellier[1], A. Paumier[1]
[1]*CRLCC Paul Papin, Radiotherapy, Angers Cedex 01, France*

Purpose/Objective: Evaluation of perioperative treatment of the Keloids scars with electron beam therapy or low dose rate brachytherapy by Iridium 192.

Materials and Methods: From 1994 to 2010, 95 patients with 142 keloids scars have been treated by immediate perioperative radiotherapy and retrospectively reviewed in our Institute: 116 scars were treated by electron therapy (E-) and 26 by brachytherapy (Ir).

Results: In group E-: treated locations were: earlobe n = 88 (76%), thorax n = 14 (12%), neck n = 9 (8%), limbs n = 5 (4%). The median size of lesions was 3 cm (range (R): 0, 5-18 cm). In 95.6% of cases, a dose of 15 Gy was delivered in 5 fractions of 3 Gy. The median follow-up was 70 months (R: 7-161 months). The 2-year and 5-year local control were respectively 69% (95% confidence interval (95% CI): 59-76%) and 55% (95% CI: 45-64%).

In group Ir: treated locations were: neck n = 3 (11%), earlobe n = 8 (32%), abdomen n = 3 (11%), thorax n = 2 (8%), limbs n = 10 (38%). The median size of lesions was 6.6 cm (R: 1, 7-28 cm). The median dose delivered at 5 mm from the source was 20 Gy (R: 15-20, 69). The median follow-up was 113 months (R: 21-219 months). The 2-year and 5-year local control were respectively 84.6% (95% CI: 64-94%) and 73.5% (95% CI: 49-87%). There were no cases of radiation-induced cancer or unexpected local complications. A trend to a better local control with brachytherapy was noted (2-year relative increase of 15.9% compared to group E-) though this difference did not reach the significance (p = 0.099), probably due to the reduced number of patients in brachytherapy group.

Conclusions: Brachytherapy seems to provide better local control compared to electron therapy, and should be proposed as first line treatment. However, electrontherapy is an interesting alternative in case of difficulty to perform brachytherapy. There is probably a dose effect: according to published data, 25 to 30 Gy at least should be proposed.

PO-0761

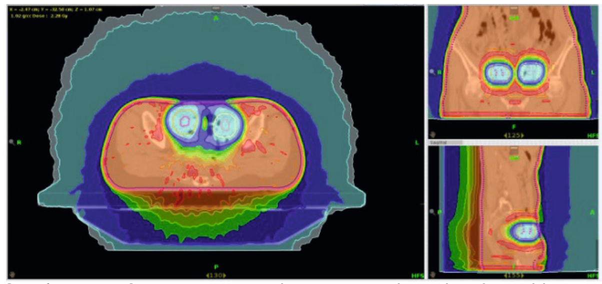
Ovarian conserving at TBI with Tomotherapy planning

M. Omori[1], K. Okuma[1], M. Nakano[1], H. Yamashita[1], K. Nakagawa[1]
[1]*Tokyo Univ. Hosp., Radiology, Tokyo, Japan*

Purpose/Objective: In recent years, the target form of TBI techniques using helical tomotherapy system has been reported from several institutions, and these studies have shown the favorable early clinical results, and the reduction of acute radiation toxicities. One of the radiation sensitive organs is ovary. We experienced the recovery of ovarian function and childbirth after conventional TBI technique using ovary shielding, previously. In that study, the total dose to ovary was estimated about 3.1Gy by the results of measurements for humanoid phantom. The purpose of present study is to develop a TBI technique using Tomotherapy for preservation of ovarian function.

Materials and Methods: We used a female patient's CT image set for TBI planning that was scanned from the top of skull to the mid-thigh. The Tomotherapy TBI plan was generated on the TomoTherapy Planning Station Ver.4.2.0.0, using a 2.5cm jaw width and an average pitch value of 0.43. We set the target which pulled 2.0 mm from a whole body from the head to the upper-femur with the PTV. The organs at risk (OARs) included the lungs and ovaries. Contours for ovaries were drawn by a radiodiagnosis specialist. The plan had 6 fractions defined for a planned delivery of 12 Gy, and that was prescribed to ensure, at a minimum, 95% planning target volume dose coverage with the prescription dose (percentage of PTV receiving dose of 12 Gy was 95%). Additionally, for sparing OARs, we designed the plan such that Dmax and D50 for lungs-1cm were 8Gy and 4Gy, respectively, and Dmax for ovaries was 1.5Gy.

Results: The Dmax, Dmin, and Dmean for the PTV were 14.6 Gy, 1.3 Gy, and 12.4 Gy, respectively. The average organ doses were 12 Gy in general, except for the doses to the OARs. We succeeded to reduce the dose to the OARs. The Dmax, Dmin, and Dmean for the lung was 13.2 Gy, 3.3 Gy, and 9.1 Gy, respectively, and for the ovaries was 2.5 Gy, 2.2 Gy, and 2.3 Gy, respectively.



Conclusions: Our present results suggest that the favorable TBI treatments for conserving ovarian function can be planned using Tomotherapy technique.

POSTER: PHYSICS TRACK: BASIC DOSIMETRY AND PHANTOM AND DETECTOR DEVELOPMENTS/ CHARACTERISATION

PO-0762

Submillimeter dose measurement with EBT2

N. Corradini[1], S. Presilla[1], K. Schombourg[1], G. Ballerini[1], A. Franzetti-Pellanda[1]
[1]*Clinica Luganese, Centro di Radioterapia, Lugano, Switzerland*

Purpose/Objective: To demonstrate that µm-scale signal extraction from EBT2 film can be used for accurate film calibration and point measurement.

Materials and Methods: Measurements were made using Gafchromic EBT2 film in conjunction with the TomoTherapy Hi-Art II system. EBT2 films were cut to rough squares of approx. 1-2mm. The film orientation was demarcated with permanent marker in the corner of each piece to allow correct positioning throughout the procedure. A film calibration was performed using solid water slabs with an ion chamber, and irradiating 6 doses ranging from 15cGy to 400cGy. Each dose level was measured with a 5-film sample. An Epson Expression 10000XL was used for scanning the films. Films were placed within a predefined position on the flatbed scanner surface. Scans were started 30 minutes after irradiation with a 5-minute scanner warmup before each scan session. Images were scanned with a resolution of 12800 dpi. Five sequential scans were done for every measurement and the average of the last three scans was taken as the official reading. A square ROI sample of 200x200 pixels (~400x400µm^2) was used in signal extraction for all film measurements. The mean value measured in each 5-film sample was used as a single data point on the calibration curve. The corrected OD_{red} signal, as originally suggested by the manufacturer[1], was used to correlate to the measured doses. The calibration curve data was fit using the rational function $y(x)=(a+cx)/(1+bx)$. The dosimetry method was verified with a set of 10 absolute dose point measurements using an open-field irradiation on a phantom. The film results were compared to the ion chamber measurements and TPS calculation.

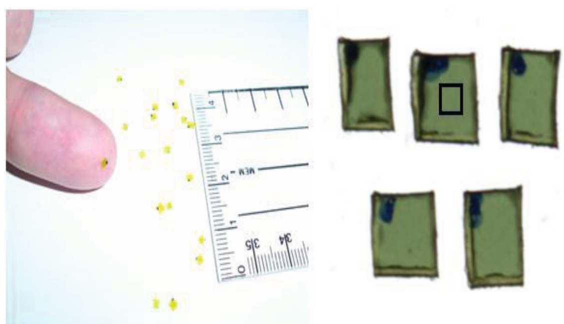


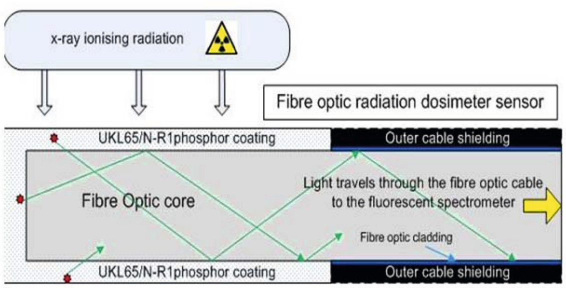
Figure 1. (Left) Film measurement dimensions with respect to the author's small finger and (Right) an example of the scanned image of a 5-film sample. The square ROI used in signal extraction can be seen in the upper central film.

Results: The coefficient of determination, r^2, measured 0.99997 for the calibration curve fit and the local residuals measured less than 0.5% for doses greater than or equal to 1Gy. The largest local residual was 5% (0.7cGy) and was observed at a dose level of 15cGy. The verification set measured a mean dose of 193.4cGy (σ=1.4cGy) while the ion chamber measured an absolute dose of 190.7cGy and the TPS

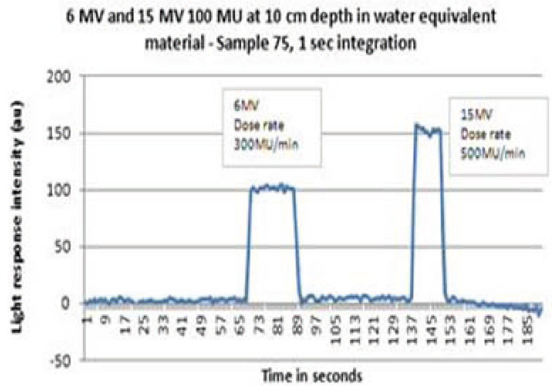
calculated 191.7cGy. The error in film measurement increases from 1.4cGy to 2.2cGy if a single film is used instead of a 5-film sample.
Conclusions: Submillimeter point dose measurement with EBT2 film is shown to be very accurate. Signal extraction from such a small spatial area allows for accurate measurement in small-fields, steep dose gradients, and non-flattened beams.
References:
1. Gafchromic EBT2 Self-Developing Film for Radiotherapy Dosimetry, ISP White Paper, Revision 1, February, 2009.

PO-0763
Optical fibre radiation detector for radiotherapy dosimetry
P. Woulfe[1], D. McCarthy[2], S. O'Keefe[2], E. Lewis[2], J. Cronin[1]
[1]*Galway Clinic, Department of Medical Physics, Galway, Ireland Republic of*
[2]*University of Limerick, Optical Fibre Sensor Research Centre, Limerick, Ireland Republic of*

Purpose/Objective: An optical fibre sensor for use in radiotherapy dosimetry is presented. The sensor is based on a scintillating material coated plastic optical fibre (POF), which emits visible light when exposed to low level ionising radiation. The incident level of ionising radiation can be determined by analysing the observed emission spectra. The work presented reports on the design of the sensor and the stability of the sensor during measurement of incident x-ray energy. Initial testing of the sensor on a Linac is presented, demonstrating the suitability of such a sensor for a range of radiotherapy dosimetry applications, including the area of small field dosimetry.
Materials and Methods: A 1 metre PMMA (Polymethyl Methacrylate) plastic optical fibre of 1mm diameter is prepared.The optical fibre cable end was polished, an epoxy resin and hardener mix,containing the scintillation material, was then encapsulated around the fibre cable end using an injection method and allowed to set. The radiation source used was a Siemens Artiste, with a water equivalent phantom of varying depths. The sensor was connected to a fluorescent spectrometer using a 19 meter long POF cable. The spectrometer and a computer for analysing the resultant optical signal were located at the control console. The optical fibre coated with a scintillation material fluoresces when subjected to ionising radiation. Upon scintillation, the low level light permeates the fibre optic cable end and the spectrometer placed at the distal end of the POF cable measures the received optical signal. The amount of radiation incident on the sensor is directly related to the measured intensity of the received spectrum at the preselected wavelengths. The spectrometer detects and records low level light from the sensor and detects any changes in optical intensity levels that are recorded via LabVIEW software.



Results: The optical fibre sensor was initially tested for its response to 100MU (Monitor Units,where 1MU = 1cGy when SSD (surface to source distance) is 100cm at a depth of Dmax.) at 6MV photon energy using a 1.5cm build-up. The peak intensity of the received fluorescent signal, at 544nm, was monitored. During irradiation the sensor demonstrates a stable response and then returns to its original off state when the radiation stops. The sensor was then tested at repeated radiation doses of 100MU at 15MV to test for the stability of the optical fibre sensor at repeated exposures.



Conclusions: The optical fibre sensor was investigated for its response to known incident radiation exposure patterns, repeatability and stability of measurement. The sensor demonstrated excellent response to a wide range of exposure conditions including different levels of ionising energy, dose rates and exposure duration. The results show that the sensor is capable of realtime, accurate and repeatable radiation dose measurements with a maximum variance of ± 2% from a Linac.

PO-0764
Evaluation of EBT3 films for use in clinical photon and proton beams
S. Reinhardt[1], M. Hillbrand[2], J.J. Wilkens[3], W. Assmann[1]
[1]*Ludwig-Maximilians-University, Physics Department - Medical Physics, Garching, Germany*
[2]*Rinecker Proton Therapy Center, Radiooncology, Munich, Germany*
[3]*Klinikum rechts der Isar TU München, Department of Radiation Oncology, Munich, Germany*

Purpose/Objective: Radiochromic films such as Gafchromic EBT or EBT2 offer an excellent spatial resolution which is beneficial for dose verification in highly conformal radiation therapy such as IMRT or proton therapy. Recently, a new generation of these films, EBT3, has become available. As composition and thickness of the sensitive layer are the same as for the previous EBT2 films, a similar dosimetric performance is expected, in particular with respect to the known energy dependence of the films. The side orientation dependence, which is reported for EBT2 films, has been eliminated in EBT3 films by a symmetric layer configuration.
Materials and Methods: The general EBT3 film characteristics such as read-out orientation dependence and post-exposure darkening growth are evaluated and compared to EBT2 films. Film response has been investigated in clinical photon and proton beams. The energy dependence of both, EBT2 and EBT3 films, has been studied for low proton energies (<=20MeV) as predominating in the vicinity of the Bragg peak but also up to a maximum energy of 200 MeV.
Results: In general, EBT3 show a comparable performance to EBT2 films, moreover, orientation dependence with respect to film side is completely eliminated in EBT3 films. Response differences of EBT2and EBT3 films are of the same order of magnitude as batch-to-batch variations observed for EBT2 films. Photon and proton exposure show similar response for both generations of EBT films. Depth dose measurements show an under-estimation of dose by up to 20 % in the Bragg peak region for both types of film.
Conclusions: EBT3 and its precursor EBT2 have similar dosimetric performance and can, thus, be applied to dose verification in IMRT in the same way. Dose under-response in the Bragg peak region has to be taken into account if films are to be applied for dose verification in proton therapy.

PO-0765
Dosimetry audit of TPS performance
W. Bulski[1], K. Chelminski[1], J. Rostkowska[1]
[1]*The Maria Sklodowska-Curie Memorial Cancer Center, Department of Medical Physics, Warsaw, Poland*

Purpose/Objective: In the radiotherapy Treatment Planning Systems (TPS) various calculation algorithms are used (Pencil Beam Convolution PBC, analytical anisotropic algorithm AAA, Monte-Carlo). The accuracy of dose calculations has to be verified. Numerous phantom types and detectors are proposed to verify the TPS calculations by dosimetric measurements. A heterogeneous cubic-shape phantom has been designed for this purpose within a Coordinated Research Project of the IAEA.