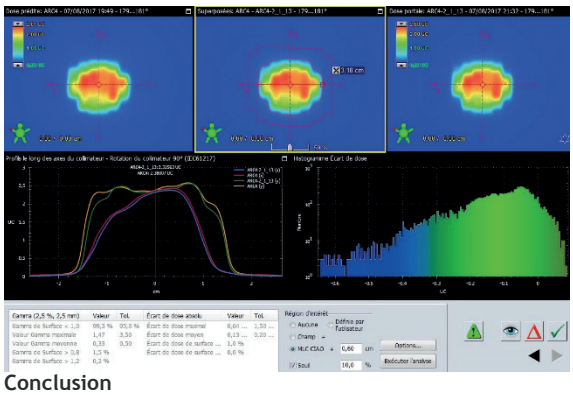

Conclusion

The use of AS1000 and Clinac to measure FFF beams is a success. The locks due to the generation of the system have been lifted. The very complex and high dose field checks in VMAT type stereo allowed to validate the modeling.This solution saves measurement time, facilitates use, and improves spatial resolution which can be better than that in available 3D phantoms. However, it was found that the Portal Dosimetry solution could not be used for large field, which is not problematic for stereotactic therapy.

EP-1770 New RGB algorithm for dose measurements with EBT3 films tested in 6 MV x-ray beams up to 90 Gy doses

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Purpose or Objective

To study the dose response of Gafchromic EBT3 films in a 6 MV x-ray beam up to very high dose levels, 90 Gy, above the recommended 40 Gy value, with a modified function able to provide more accurate dose measurements by weighting the three RGB (Red Green Blue) scanned image colors together. Moreover, a comparison between two different flatbed scanners was performed, showing its influence on the film parameters estimation.

Material and Methods

Gafcromich EBT3 films (lot #03171501) were exposed to the 6 MV Elekta Synergy Agility LINAC x-ray beam. To investigate the film performance at high dose levels, 27 film pieces, each of (4x4)cm^2, were irradiated at different dose values, from 0.5 to 90 Gy.

Films were placed in a RV3 phantom of (30x30x12)cm^3 at 1.7 cm depth, and irradiated perpendicularly to the radiation beam. The distance from the source to the detector surface (SDD) was 100 cm and the field size was (30x30)cm^2 at isocenter.

Each film piece was scanned both with the *Epson 1680Pro* and the *Epson Expression 10000XL* flatbed scanners: RGB-positive images were collected in 48-bit per color channel with a spatial resolution of 72 dpi.

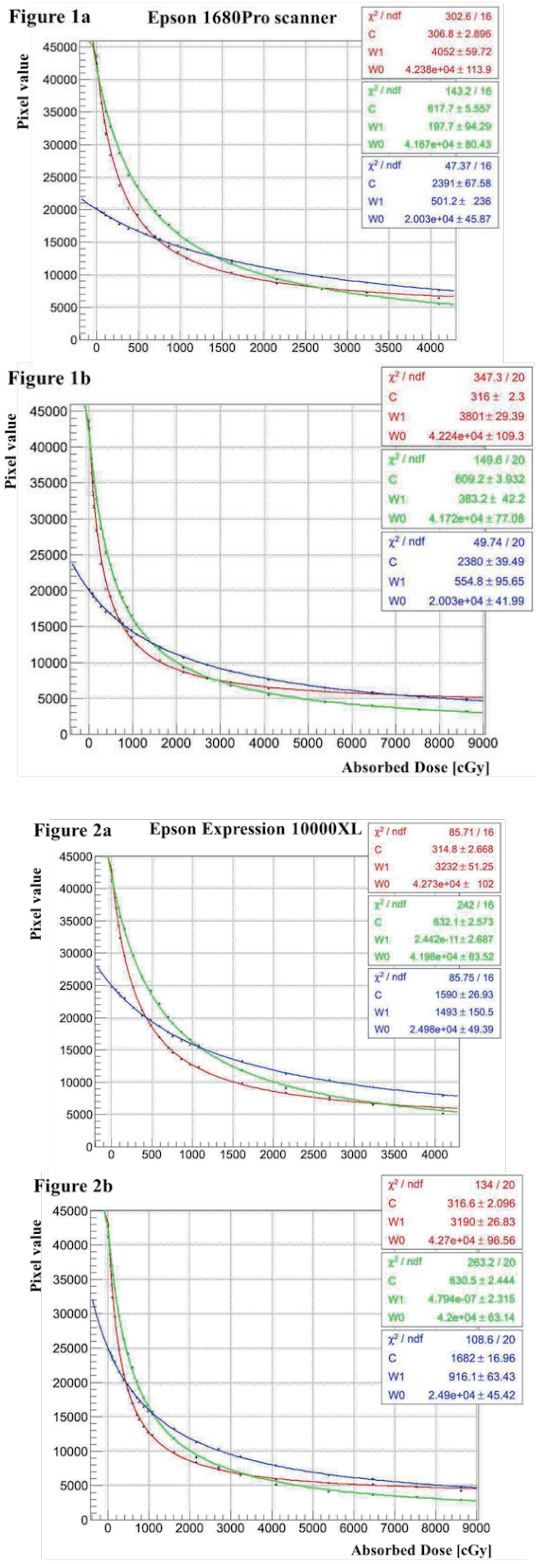
The data were analysed by using *ImageJ* and, for each scanned image, a small region of interest (ROI) at the field center as selected to obtain the mean pixel value and its standard deviation σ. The response curves for each color channel were so plotted and analyzed with *ROOT*, and the following rational function, equivalent to the Gafchromic recommended one V=(a+b)/(D-c), was used to fit them:

$V=[W_0+W_1(D/c)] / [1+(D/c)]$

where V is the pixel value as function of the absorbed dose D; W_0 and W_1 are the pixel values corresponding to D tending to zero and to infinite, respectively; while the parameter c represents the mean pixel value.

Results

The dose response curves are reported with both scanners for dose values up to 4000 cGy (fig 1a,2a) and up to 9000 cGy (fig 1b,2b).



The estimated parameters for the two dose ranges are in agreement within 2σ, except for the parameter W_1 in the green and blue channels in fig 1 and in fig 2, respectively, within 3σ.

The simple parametric dependence has allowed to estimate the dose response error: relative errors range

(0.4-0.8)% for the green and red channels, and (1.0-2.8)% for the blue one. This is due to the blue curve general flatness, giving a higher error value. The rational formula can be inverted for each of the three RGB colors to provide three dose values with their propagated error, that can be used to give a final more accurate dose value in all the full range.

Conclusion

From this work emerges that the rational function fits well at all low, medium and high doses: it's so usable both in the recommended dose range values and at higher ones. A consistent dose response was thus observed in EBT3 films, no deviation from the known response curves is shown. However, some difference in the recorded pixel values was detected using two different scanners, probably due to their dissimilar light source and sensor system.

EP-1771 Evaluation Of Skin Dose Changes Using Tld For Head And Neck Patients Treated With Helicaltomotherapy

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Purpose or Objective

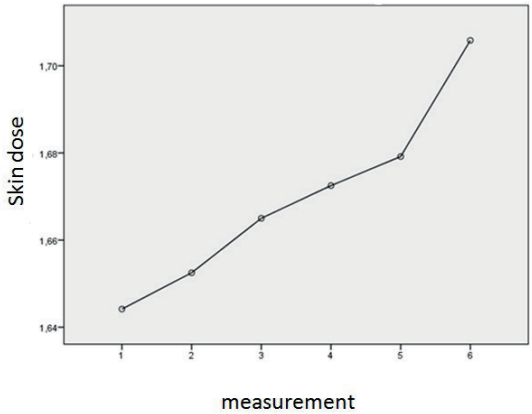
The purpose of this work was to assess skin dose changes for head and neck patients treated with tomotherapy using thermoluminescent dosimeters (TLDs).

Material and Methods

In vivo measurements were performed for 15 head and neck patients treated with tomotherapy. TLDs were placed on the surface of the patients at a number of five positions and to the upper side of thermoplastic mask used for immobilization at a number of four positions. Six measurements were performed for each patient and superficial dose changes were evaluated throughout the treatment. Also, we analyzed the relationship between weight loss and factors of age, gender, stage, diagnosis, treatment regime, respectively and evaluated skin dose changes in terms of weight loss. Statistical analysis was done using Chi-Square test, Nonparametric Related Sample test and General Linear Models Repeated Measures test with SPSS version 23.

Results

In this study, all patients showed a weight change and weight loss ratio of one patient was below 10%, for six patients between 10% and 20%, and for eight patients above 20%. Statistical analysis showed that factors of gender, age, stage, concomitant chemotherapy and surgery did not affect the weight loss ($p>0,05$). However, the influence of diagnosis was statistically meaningful ($p<0,05$). A statistically significant upward change was seen on the skin dose throughout the treatment ($p=0,049<0,05$), this was seen between first and sixth measurement, particularly ($p= 0,034<0,05$). The weight loss affected the increase of skin dose, statistically ($p=0,003<0,05$). We have seen that skin dose has increased after fourth measurement for patients who had lost the greater than 20% weight. The skin dose did not change in relation to the concomitant chemotherapy, surgery and stage of disease ($p>0,05$).



Conclusion

The results of this study showed that the increase of skin dose was observed during helical tomotherapy treatment for head and neck patients. There is direct relationship between weight loss and skin dose changes.

EP-1772 Dose variability with breast tissue assignation for the INTRABEAM device

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Purpose or Objective

Low-energy X-rays intraoperative radiation therapy is often employed for partial breast irradiation after conserving surgery [1]. Breast is composed of glandular and adipose tissues, which are poorly disentangled by means of the CT number, because they have overlapping ranges. However, the variation on chemical compositions of these different tissue types introduces significant differences in the dose received by low-energy photons, due to the dominance of photoelectric effect, highly sensitive to the composition of the tissue at these energies [2]. Given the difficulty of extracting accurate soft tissue composition from CT data, the aim of this work was to study the effect on the estimations of dose deposited in breast with the INTRABEAM device with different soft tissue assignation models.

Material and Methods

Three tissue assignation models were designed and compared to an accurately segmented tissue model following TG-186 recommendations [3] and obtained with the CT stoichiometric calibration model described in [4]. The first model was water-based, following the TG-43 approach [5], with CT-derived electronic densities. The other two models were generated with a majority of breast assigned as adipose tissue or as glandular tissue and densities derived from the CT number. These models have been applied to CT from several patients. Dose was calculated for a 3 cm spherical INTRABEAM applicator with the Monte Carlo (MC) code penEasy [6,7].

Results

Different degrees of variability among models were obtained, with dose differences from about 10% in case of the adipose model up to 45% in the water-based model, with respect to the more accurate soft tissue assignations. In Figure 1 it can be seen a comparison of transverse dose profiles measured in a breast CT with the different tissue assignation models.