gantry speed GS) and T3 (variation of MLC Speed MLCS) were updated. Even so, we decided to redraw completely T2 and T3, in the respect of the effective main concept. A family of new plans was generated to guarantee flexibility in the QA procedure and to support the user in a possible troubleshooting.

Material and Methods: Firstly, a historical review of commissioning tests results on 3 different Varian linacs (Clinac iX, Unique, TrueBeam) was collected, for both old (2008: vs1) and new (2015: vs2) Varian test versions; original tests were extended to 10MV, 6FFF and 10FFF beams for TrueBeam. Data were collected monthly through portal vision (PV) images , for respectively 81, 21, and 42 entries for vs1. At the same, delivery parameters were extracted from actual patients plans (3911plans, 6833arcs) and stratified according to the types of treatment. From our experience, we felt the needs to have a more flexible instrument tuned on our clinical practice, able to support us in a possible troubleshooting. A family of new T2 and T3 plans was generated. In addition to the traditional analysis of the images, a direct comparison with the open reference field is proposed to define a more reliable baseline for the monitoring of each strip trend.

Results: First version of the test T2 and T3, have presented during time differences respect reference value>2% (always<3%), for Clinac iX and Unique, while TrueBeam data were always <2%. The first T2 band presents a systematically higher value respect the others, explainable with some weakness in the test itself. Vs2 of T2 and T3, showed an agreement well below 2% for all the three linacs, but still with a systematic higher value for the T2 first delivered strip. The delineation of the new package of RT-plans started from the tune of number and width of the strips; the best compromise was found with 5 strip of 2.8 cm. Now T2 and T3 are fully compatible and can be superimposed, running also a T3 with the same DR-GS variation presents in T2. From this main plan version of T2 and T3, the new family of rt-plans allows to perform tests changing arc direction or/and MLC direction, while an additional basic editing of the dicom files allows to vary the main delivery parameters, in addition to order of the delivered combinations, arc range, MU/deg, etc, as independently as possible.

Conclusion: The new package of RT-plans is proposed in the fully respect of the original idea by Ling, with the intent to offer a more effective tool adjustable to single centre characters. Of particular interested is the extension to FFF beams, which are widely used in stereotactic regimes.

EP-1556

VMAT in nasopharyngeal tumor: clinical implications after a change in the dose calculation algorithm

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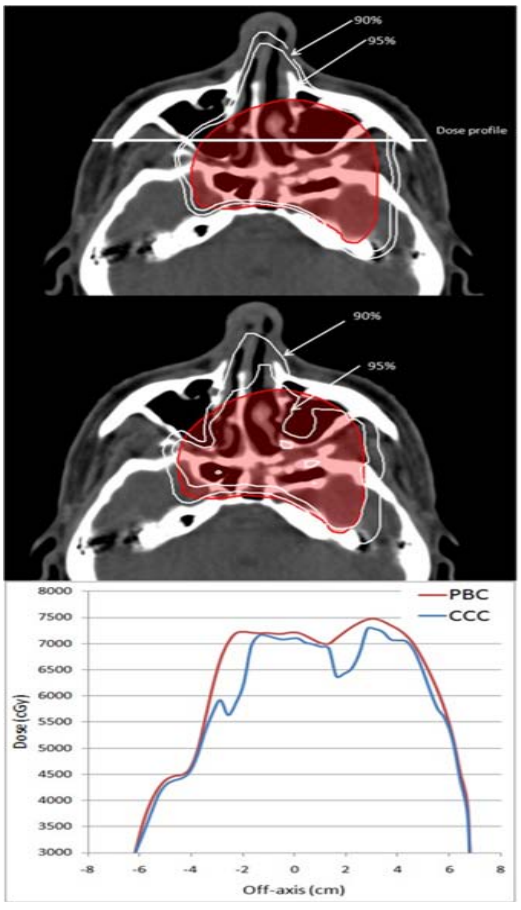
Purpose or Objective: To assess the clinical implications of the Collapsed Cone algorithm implemented in the Masterplan Oncentra treatment-planning system in VMAT treatments of nasopharyngeal tumors (NPC).

Material and Methods: Ten plans initially produced for patients with nasopharyngeal tumors with Pencil Beam Convolution (PBC) algorithm were retrospectively recalculated using the Collapsed Cone Convolution (CCC) algorithm. Clinical target volumes were considered as primary tumor, lymph nodes with high-risk of occult metastases and low-risk nodal regions. Corresponding planning target volumes (PTVs) were obtained by adding a 4-mm margin. Radiotherapy was prescribed according to SIB technique with all PTVs irradiated simultaneously over 30 daily fractions. Doses of 70.5 Gy (2.35 Gy/fraction), 60.0 Gy (2.0 Gy/fraction) and 55.5 Gy (1.85 Gy/fraction) were prescribed to the PTV70.5, PTV60.0, and PTV55.5,respectively. All SIB-VMAT plans were optimized using the "dual-arc" feature with 6MV photon energy. The differences in dose distribution for all PTVs and organ-at-risk were assessed using different metrics (D95%=dose to 95% of PTV, D98%=near-minimum, Dmean=mean dose, V95%=volume receiving al least 95% of prescribed dose, D2%=near-maximum dose). The PTV70.5 was also separated into components in tissue (PTVtiss) and air (PTVair). Collapsed Cone plans were also renormalized (CCCr) in order to obtain the same target coverage in terms of D95% of PBC calculation.

Results: PBC algorithm overestimated dose to PTVs for all considered metrics. The averaged Dmean and D95% to PTV70.5 calculated by CCC decreased by 1.8% (range:0.9%-2.8%) and 3.1% (range:1.5%-5.3%), respectively (1.5% and 2.8% lower for PTVtiss, and 5.5% and 8.6% lower for PTVair). Averaged D98% to PTV70.5 decreased by 3.4% (2.4% in tissue and 9.4% in air). Averaged V95% decreased from 96.0% to 90.2% (from 96.1% to 91.2% for PTVtiss, and from 96.0% to 70.9% for PTVair). The magnitude of dose differences are strongly correlated with the amount of air cavities in PTV70.5. A similar trend was observed for PTV60 and PTV55.5. Maximum doses to spine and brainstem PRVs were found to be approximately 1 Gy lower with CCC. The Dmean to pharyngeal constrictors muscles was found 4.7% higher with PBC. No differences were observed for parotids and mandible. PBC slightly underestimated the doses to eyes and lens (but≤ 0.5 Gy). When the dose calculation were performed in water, the two algorithms provided differences in dose distributions <0.5%.



Conclusion: The CCC algorithm should be used in preference to PBC in VMAT treatments of nasopharyngeal tumors. A key question remains open: should the prescription dose be adjusted to the actually delivered dose, more accurately predicted by CCC algorithm? If radiation oncologists wanted to keep the PBC original dose prescription and the same accepting criteria for target coverage when switching from PBC to CCC, up to 5% more radiation doses would be given.

EP-1557

Development of dose calculation algorithm in homogeneous phantom through the transit dose

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Purpose or Objective: To verify the accuracy of planned dose distribution for patient treatment, patient dose quality assurance using the solid water equivalent phantom is usually performed. This method, however, is not the method of verifying the absorbed dose in real patient. In this study, as a previous process of developing dose calculation algorithm in human, we measured the transit dose using the radio-photoluminescence glass rod detector to develop dose calculation algorithm in homogeneous phantom.

Material and Methods: We measured the trasit dose at 150cm from source of linear accelerator to calculate the dose in the homogeneous phantom. The homogeneous phantom (10cm, 20cm, 30cm thickness) was located nearby the isocenter. We can calculate the dose at the bottom of phantom using the measured transit dose, inverse square law value and scatter factor. Scatter factor in this algorithm is ratio of scatter at the bottom of phantom and scatter at the measurement point of transit dose. To develop dose calculation algorithm in homogeneous phantom, we measured the field size dependence of transit dose and bottom dose to calculate the scatter factor, the relative dose response to correct the change of field size and location of isocenter. We evaluated the algorithm of 6MV X-ray beam in 10cm x 10cm field, 200MU.

Results: The measurement results of the relative dose response for isocenter location change are increased when the SSD decreases. The measured scatter factor was about 1.35 in all cases. We could calculate the dose in the phantom using the transit dose, inverse square law, scatter factor and percentage depth dose data. We evaluated the accuracy of developed phantom-dose calculation algorithm. The accuracies of 10cm, 20cm and 30cm phantom were 0.54%, 1.03% and -1.65%, respectively.

Conclusion: We developed the phantom-dose calculation algorithm using the transit dose, inverse square law, scatter factor and PDD data. This result would be used in the development of dose calculation algorithm in the inhomogeneous phantom and real patient.

EP-1558

Comparison between softwares employed in analysis of star shot patterns

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Purpose or Objective: In linacs QA there are several tests that produce a star shot pattern by exposing a radiographic or radiochromic film. Isocenter size and distance from lasers or crosshair projection to radiation isocenter are some of the parameters obtained by exposing a radiochromic film with a star shot pattern of the rotation of the gantry, table or collimator. The "Twinkle" test was proposed to verify the correct deliveryng of dose during gantry rotation and it is a common QA test for linacs that deliver VMAT treatments and that also produces a star shot pattern. In this study we compare two in-house software to analyze the parameters of the star shot patterns.

Material and Methods: Digital images of star shot patterns of table, collimator and gantry rotation and Twinkle tests were obtained exposing several radiochromic films EBT3 and RT-QA. In all cases a external reference was marked onto the films. Throughout the whole process -irradiation, scanning and analysis- a reference direction was held. The digital images were analized with two different sofwares. The STAR ANALYZE software (SA), implemented with MATLAB, applies Canny algorithm to find the edges of the arms and then, the Hough transform is used to locate these edges and its equations. The second in-house software, FILM CHECK (FC) traces concentric search on the image of the star shot pattern to locate the center axes of the beams. From the characterization of these central axes, by minimax procedure position and radiation isocenter size are obtained.

Results: In the star shot patterns of gantry, table and collimator rotations, the maximum deviation between both algorithms in the isocenter size was lower than 0.5mm, and the maximum deviation in the distance between radiation isocenter and the external reference was lower than 1mm. In the Twinkle tests, the maximum deviation in the thickness of the arms of the star shot was lower than 0.3mm and the maximum deviation in the radii angle was lower than 1°.

Conclusion: The two algorithms shows a very good agreement for the analyzed parameters, despite uncertainty in the localization of the external reference system located in the radiochromic films that affects the parameters related with this external reference system. The Hough transform and the Canny edge detection algorithm are a valid tool for quality control of the linac, although, for the correct determination of sizes and distances we recommend depth knowledge and careful use of the particular parameters involved in both algorithms.

EP-1559

The Australian Clinical Dosimetry Service: The findings from a national auditing service

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Purpose or Objective: The Australian Clinical Dosimetry Service, (ACDS) was initially funded as a pilot program operating over 2011-2014 to enable the Australian Government to determine whether this design of an independent audit program was suitable for Australia. The pilot program was independently reviewed and interim funding was provided for a further two years. During this time the ACDS would increase the frequency of the developed suite of audits and develop a business plan, encompassing a user-paying structure, which would guarantee longevity for the dosimetry program. A summary of the audit outcomes and key findings to date will be presented along with a discussion about why the ACDS has been successful.

Material and Methods: The ACDS, recognised existing auditing practices, dovetailed the Level I Ionizing Radiation Oncology Centre: Houston audits with the International Atomic Energy Agency, IAEA, publications. The resulting three level audit structure resulted in a mutually supportive audit suite in which successive audits focussed on a more complex part of the clinical planning procedure. The ACDS has developed internal quality control procedures for all measurements to ensure the rigor of all audit outcomes. Critically, the ACDS has actively engaged with the professions, public and jurisdictions which has generated a positive response to the on-going success of the program.