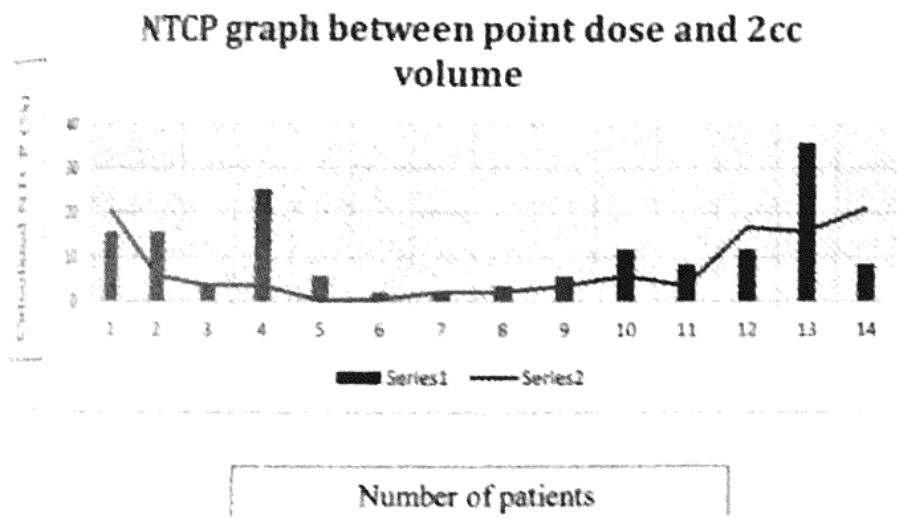
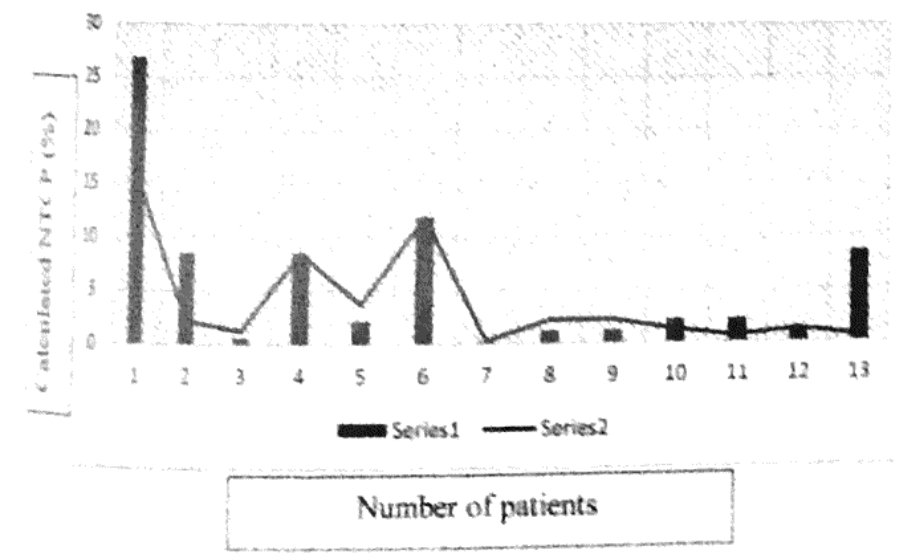
data set the organ at risk (Bladder and rectum) were delineated in the Oncentra Master plan Treatment Planning System. The dose prescription was done at point A in each brachytherapy sessions.

According to the ICRU recommendation the point doses and volumetric doses to the OARs (bladder and rectum) has been obtained from brachytherapy CT data. Normal tissue complication probability has been calculated with the help of TDF PLAN software for both the groups. The grade of toxicity has been evaluated by RTOG guidelines of bladder and rectum toxicity.

Result: Normal tissue complication probability was calculated mathematically for ICRU defined point dose and volumetric dose (2cc volume) of bladder and rectum. The calculated NTCP for bladder was not exceeded the TD5/5 equivalent dose, except in 1 patient of Group (I) regime (0.44) and 2 patients of Group (II) regime (3.06 & 0.22). The clinical study data was compared and it was found to be in conformity with the calculated NTCP of bladder. Correlation between point dose and volumetric dose data of rectum has been plotted for two different regimens.




Graph2: NTCP graph for Rectum between Point dose and volumetric dose for 2 session of 9Gy




Figures 1- NTCP for ICRU defined point doses

Figures 2- NTCP for volumetric (2cc) data

The final result of the study is that for brachytherapy regime with 3 session of 7Gy the calculated NTCP of point and volumetric doses of rectum found significant correlation. For the Group (I) the clinical study shows that the NTCP is more reliable for volumetric data (2cc volume) rather than point dose data.There was not much difference in NTCP between point doses and volumetric doses of rectum for Group (II) with brachytherapy treatment.

Conclusion: Point doses overestimated the NTCP of normal organ due to increased equivalent dose while the volumetric evaluation of 2cc volume gives the better co-relation with the clinical study in both regimes. Statistically significant number of patient data is required for further evaluation and conclusive correlations.

## 4447

## Commissioning of Five Elekta's Linear Accelerators & TPS by Standard Imaging RFA and Delta 4 Patient Specific QA Tools.

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Purpose: Acceptance tests and commissioning constitute a major part in Quality Assurance (QA) program for radiotherapy. The process of purchase, acceptance testing, and commissioning of a computer-controlled Linac is a major undertaking that can take up a considerable amount of time, effort, and expense. Therefore, it is crucial that a great deal of thought and care go into the initial planning. The primary objective is that the accelerator specifications must meet the clearly defined needs of the facility over the projected lifetime of the accelerator. The installation is followed by acceptance testing by the physicist to ensure that the machine meets the product specifications and national/International protocol and the purchase agreement.

The beam data generation for TPS is very crucial, where the specific data requirement for particular TPS, make and model.

Prior to patient treatment, the phantom plan must be executed with patient specific QA tool for overall commissioning process of Linac.

Methods: We have performed our comprehensive QA program over five Elekta Linear Accelerators, with following make and model till our first patient treatment.

Elekta Synergy platform:

Elekta Synergy Platform is a unique multi-functional digital accelerator that is XVI-ready and future-proofed. Elekta Synergy Platform combines all the proven benefits of Elekta digital accelerators with a platform for image guided radiation therapy (IGRT). Elekta Synergy Platform has a full range of treatment capabilities and MV portal imaging to provide improved treatment conformance and accuracy.

TPS: Monaco:

Monaco is a next-generation IMRT planning system, and represents a significant leap forward in IMRT. It features innovative biological cost functions with multi-criterial constrained optimization, a powerful leaf sequence optimizer and a robust Monte Carlo dose calculation algorithm. Fully integrated into the CMS Focal platform, Monaco provides seamless connectivity and integration with the advanced fusion, contouring, simulation and plan review capabilities of Focal and represents state-of-the-art IMRT planning.

BEAM DATA REQUIREMENT: Photon Beam Data Requirement- for Standard Elekta machines, All data collection, collected with Leaves and diaphragms. All measurement divided in to two part- In water measurement and in air measurements. All water measurement performed at 90 cm SSD & all Point Dose measurements performed at 100 cm SDD (Source to Detector Distance) as per guidelines supplied by the vender. Electron Beam Data Requirements- In air measurements-All measurements was at 70 cm and 90 cm SDD (Source to Detector Distance). If 70 cm SDD is not possible for technical reasons, then another SDD may be chosen, as long as the distance of 20 cm between the two SDD planes was maintained. The in-air measurements carried out free in air without any applicator or build-up cap and the detector located in an empty water tank. In water measurement- All measurements performed at 100 cm SSD with and without applicators. For each applicator size, In-plane and Cross-plane Jaw positions were needed.

RFA:

Standard Imaging, USA: The DoseView 3D is a 3-axis water scanning phantom that fuses robust hardware with easy-to-use software for superior beam commissioning and quality assurance measurements. Scanning Dimensions [ length x width x height ]-500 mm x 500 mm x 410 mm. Measurement Speed 25 mm/s, Positioning Accuracy ± 0.1 mm per axis, Positioning Repeatability ± 0.1 mm per axis. Fine rotational adjustment ±1°, Discreet engagement 10°, 45°, and 90° intervals, Channels 2 , Bias Voltage 0, ±150 to 450 (VDC) in 50 volt increments, Range 2 pC - 999, 999 nC Resolution 10 fC.

SCAN PROCESSING AND TREATMENT PLANNING SYSTEM EXPORT: The Scan Processing Module features a comprehensive suite of tools facilitating data manipulation using a wide range of standard protocols. Transition scan data to a variety of treatment planning systems, including: Varian Eclipse, Philips Pinnacle, Elekta XiO, Elekta Monaco, Prowess Panther, & Elekta Oncentra.

Patient Specific QA:

Delta 4. Delta 4 delivers both the machine-specific and the patient-specific Pre Treatment QA. The Delta4PT patent design is based on two crossing arrays in a fixed cylindrical geometry providing full coverage of the cross-section of any beam direction. Thereby the intensity modulation can be verified without missing any data. Delta4PT is the 3D solution that verifies the dose gradients in X, Y and Z directions by real measurement in the target and a necessity if the gradient region is to be verified and the dosimetry task to be completed. The design with two crossing arrays optimizes the use of a fixed number of detectors in Radiation Therapy. Each detector independently measures dose, pulse by pulse, building the 4D dose-picture, pixel by pixel -thus, benefiting the user by enabling full flexibility in adaptation to any possible dynamic treatment.

Analyze clinical significance in full 3D: Overlay of patient structures on the full 3D data is used to determine whether hot and cold spots are of clinical significance. DVH display the discrepancy between planned and measured data in each structure: TPS dose and delivered 3D dose in phantom. Volume of interest based on patient structure and find out if discrepancy is in clinically important region (patient structure). The 3D delivered dose is reconstructed using the measured dose and the TPS calculated dose in a logical and highly accurate way. Gamma index-Absolute dose or deviation, Relative dose or deviation and Distance-to-agreement.

Result: As per national and international protocols, all generated data (beam data) were tested, modeled and quality assured within specific and stipulated parameters.

Conclusions: A great care and deligence should be exercised in selecting, installing, testing, and commissioning a linac till patient treatment. The time commitment and money can be substantial, and errors and oversights can be costly. Therefore, the responsible physicist must act responsibly and not compromise on any aspect of the process.

Keywords : Delta 4, Commissioning

## 4448

## Quality Assurance of Beam Matching after Waveguide & Target Replacement

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