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P01 - ARTHUR Eunice

DOSIMETRIC PROPERTIES OF COBALT 60 TOMOTHERAPY SYSTEM AT KOMFO ANOKYE TEACHING HOSPITAL, GHANA

P02 - DESTRI Sara

Commissioning of HDR Prostate Brachytherapy: Challenges in the implementation of the technique in Argentina

P03 - EL GHAZI Yassir

Optimization of 6 MV photon beam characteristics in a clinical accelerator using BEAMnrc and DOSXYZnrc MC Simulation

P04 - GÓMEZ VILLEGAS Sharon Leandra

Quality control of measuring instruments in teletherapy

P05 - INIPPULLY SOMASUNDARAN Rohit

DEVELOPMENT OF A DEEP INHALE BREATH HOLD TRAINER USING ARDUINO, ToF SENSOR AND NEXTION DISPLAY

P06 - JOVCHEVSKI Martin

Radiotherapy Treatment with Small Fields

P07 - KARIMI Amir Hossein

On the mystery behind the lower percentage depth dose in grid radiotherapy

P08 - MURKOVIĆ Andrea

VMAT planning in Eclipse for Halcyon compared to our current Monaco VMAT planning technique for head and neck cancer patients with simultaneous integrated boost - a case study

P09 - RAOUI Yasser

Pre-treatment Verification of Carcinoma Breast VMAT plan based on Mono-isocentric technique : Assessment of the combined fields feature of new 2D MatriXX arrays Resolution

P10 - SOL ZAMORA Wilfredo

RELATIVE DOSIMETRIC VERIFICATION IN IMAGE-GUIDED HDR BRACHYTHERAPY USING A PTW2D-ARRAYseven29 DETECTOR.

P01

DOSIMETRIC PROPERTIES OF COBALT 60 TOMOTHERAPY SYSTEM AT KOMFO ANOKYE TEACHING HOSPITAL, GHANA

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ABSTRACT

The study has evaluated the feasibility of performing tomotherapy using fabricated turn table capable of performing rotational and translational motion using cirus cobalt 60 machine at komfo Anokye based on phantom studies. The Co-60 beam dosimetric characteristics such as beam flatness beam, symmetry beam profile, tissue air ratio, output factors and percentage depth dose were determined with tomotherapy procedure. Measurements were done at source -to -surface distance of 80cm for tomotherapy beam using a Farmer type ionization chamber connected to a UNIDOS electrometer and 30 x 30cm^2 water phantom. Measurements were carried out using various field sizes ranged from 4x4 to 30x 30 cm^{2}at depths of 0.5cm, 5cm, 15cm and 20cm. The percentage depth dose increased from the surface to a depth of maximum dose which is 0.5cm for cobalt and decreased as the depth increased it was found that as field size increased the output factor and tissues air ratio increased due to an increased in scatter which increased the dose and decreased as depth increased. The beam flatness and beam symmetry were found to be 0.60 %, and 1.19% (at depth 10cm and width of 3cm from the central axis; and 0.74% at depth 5cm and width of 2 cm from the central axis) which agreed with the International Electrotechnical commission range of 3% and 2% respectively**.** The fabricated turn table needs refinement in term of high rpm rotational motor to rotate fully-filled 30x30cm^2 water phantom and potentiometer to regulate the speed of the rotational motor.

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P02

Commissioning of HDR Prostate Brachytherapy: Challenges in the implementation of the technique in Argentina

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HDR Prostate Brachytherapy is a highly effective treatment modality for prostate cancer. However, successful implementation presents unique challenges, particularly in centers lacking prior experience or immediate access to the necessary equipment. This abstract highlights the commissioning process of HDR Prostate Brachytherapy in Bariloche (Argentina), using Elekta equipment. It focuses on the technical approach, specific challenges encountered, and strategies employed to overcome them.

The commissioning process involved overcoming hurdles related to the afterloader, ultrasound (US) equipment, Oncentra Prostate TPS, and needles. Despite the lack of prior expertise, our team managed to establish parameters and indexes to develop an acceptability criterion for treatment quality [1]. Mechanical, imaging, and dosimetry tests were performed to validate the system [2]. The mechanical tests encompassed several system calibrations and the study of their impact on treatment delivery. Additionally, we defined acceptability criteria for US image quality [3]. Dosimetry tests included source positioning, TPS comparison with Oncentra Brachy, and an algorithm for independent calculation.

The workflow development of our prostate brachytherapy procedure involved the active participation of various professionals at each step, highlighting the integral role of the radiotherapy medical physicist beyond QA and treatment planning. This work aims to serve as a valuable reference for other centers facing similar socioeconomic challenges during the commissioning of the technique.

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P03

Optimization of 6 MV photon beam characteristics in a clinical accelerator using BEAMnrc and DOSXYZnrc MC Simulation

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In radiotherapy, the main reason behind a successful clinical treatment implementation related to the accuracy of transporting and generating treatment beams. In the context of radiation transport, a Monte Carlo technique based on random processes is widely used to simulate the random trajectories of individual particles. This technique was originally developed because of the complexity of electron-photon transport in materials.

This work aims to develop and optimize the computational model of an incident 6 MV photon beam generated by an Elekta Synergy Linear accelerator available at the regional oncology center of Oujda. The simulation has been performed to irradiate 3x3 cm2, 5x5 cm2 and 10 x 10 cm2 field sizes with a source-surface distance of 90 cm, in order to determine the dose deposited in a 3D water phantom and to provide valuable information on the distribution and intensity of the photon beam. For this, the study was carried out in two stages. Firstly, all the elements that have the impact on photon beam quality, such as materials, geometry and dimensions, were accurately implemented in the Monte Carlo code EGSnrc (BEAMnrc and DOSXYZnrc). Then, the Gaussian characteristics of the primary electron beam were tuned and optimized by comparing the distributions obtained from the Monte Carlo simulations with those measured experimentally. A good agreement was obtained between the simulation and experimental results in terms of percentage depth dose (PDD) and dose profiles, with average dose deviations of approximately 0.25% for PDDs and 1.03% for dose profiles.

Keywords: Radiotherapy, Linear accelerator, Photon beam, BEAMnrc, DOSXYZnrc, Monte Carlo.

P04

Quality control of measuring instruments in teletherapy

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Aim:
Consolidate a quality control program (QC) of measuring instruments used in absolute and relative dosimetry in teletherapy at the Javeriano Oncology Center

Methodology:
Following the recommendations of the IAEA TECDOC-1151 and the IEC-60731:19972 standard, stability and comparison tests are carried out for the different cables used with the PTW TANDEM and UNIDOS-E-T10010 electrometers with a beta emission reference source of 90Sr and the geometry of four ionization chambers is verified using a digital radiograph.

Results:
The dimensions of the 2 farmer ionization chambers and 2 electron chambers (roos-markus) in the images are less than 0.10±0.05mm with respect to the technical specifications. The repeatability test of 10 PTW-FREIBURG 172012 cables with lengths [6-20]m are less than 0.5%, managing to define the specific use of each of the cables. The comparison of the electrometer charge measurements allowed us to analyze the linearity tests (united: R2:0.999 and tandem: R2:0.999 field, R2:0.998 reference), repeatability (UNIDOS-E: CV=0.09%, TANDEM: CV =0.04% span, 0.10% reference) and the zero and drift offset current are on the order of pC. The ignition stability depends on the voltage and the polarity, therefore, the warm-up time established by the manufacturer (15 min.) is recommended and even if there is a higher leakage current in one of the electrometers (If=12.0±0.3fA), the independence of the two dosimetric systems can be trusted. Traceability of instrument calibration factors is recorded along with a digital reminder alert system to ensure calibration control, including thermometer and barometer.

Conclusions.
A CC program was established for measuring instruments, such as: cables, electrometers, radiation detectors, ionization chambers, thermometer and barometer; with their respective frequency and tolerance of tests, as well as their traceability over time.

Keywords: quality control, measuring instruments, traceability, calibration

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P05

DEVELOPMENT OF A DEEP INHALE BREATH HOLD TRAINER USING ARDUINO, ToF SENSOR AND NEXTION DISPLAY

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Radiation therapy requires accurate treatment of thoracic and upper abdominal regions, making Deep Inhale Breath Hold (DIBH) techniques essential. However, training patients to consistently perform DIBH poses challenges, especially for those unable to attend frequent hospital visits.

This study introduces an innovative solution: an affordable and portable Arduino-based distance sensor system designed to facilitate remote DIBH training from home. The system utilizes the VL53L0X Time-of-Flight (ToF) laser-ranging module connected to an Arduino microcontroller, which interfaces with a custom graphical user interface (GUI) displayed on the Nextion screen, providing real-time feedback. To position the device correctly, it is mounted on a phone holder above the patient's head. The GUI displays the chest's vertical position during breath holds, enabling patients to visualize and maintain the desired depth.

Preliminary testing with DIBH patients demonstrated the reliability and usability of this sensor system. Further optimization and validation studies are required to assess its effectiveness in a larger patient population and its impact on treatment outcomes. If successful, this cost-effective and portable solution could significantly enhance DIBH training and prove highly beneficial for patients undergoing radiation therapy in the thoracic and upper abdominal regions.

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P06

Radiotherapy Treatment with Small Fields

P07

On the mystery behind the lower percentage depth dose in grid radiotherapy

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The advent of megavolt linear accelerators, the use of grid therapy was temporarily stopped because megavoltage photons became the gold standard for radiotherapy of deep structures with skin-sparing advantage. Grid therapy with megavoltage photons was point of interest again for the treatment of bulky tumors larger than 8 cm, which did not respond well to conventional doses [1]. The achievement is the ability to deliver a single high fraction of the dose (10-20 Gy) without significant complications to the normal tissue surrounding the tumor. Despite the well-done research on the clinical achievements of grid therapy [1,2,3], the dosimetric evaluation of this modality has not yet been investigated completely. Given that no scientific evidence is available in the literature to explore the mystery behind the lower PDDs in grid fields, this study was specifically devoted to making a full analysis of photon spectra (also electron spectra) in grid fields. To this end, using MC simulation, spectra of electrons and photons at dmax, 5, and 10 cm depths inside the water phantom were compared between open and grid fields. The evidence showed that the grid genus is affectless on the spectra and consequently on change in PDDs. Calculated electron spectra did not show significant changes between grid and open fields to guide us in the explanation of lower PDDs in grid therapy. Nevertheless, photon spectra in grid fields were found up to 550 keV (at 10 cm depth) harder than in open fields which in turn could potentially lead to increasing the PDDs. On the opposite, the percentage depth fluence in grid fields can be even up to 20% lower than in open fields which can result in lower PDDs. Totally, the 20% reduction in percentage depth fluence overcomes the beam hardening (550 keV), so it is reasonable that PDDs in grid therapy be 10% lower than in open fields.

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P08

VMAT planning in Eclipse for Halcyon compared to our current Monaco VMAT planning technique for head and neck cancer patients with simultaneous integrated boost - a case study

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A case study was done to investigate the effectiveness of both currently available multivendor planning techniques for volumetric arc therapy in our hospital. A sample of five patients with higher staging head and neck cancer, who were treated in our hospital on Elekta Synergy linear acceleration last year, were retrospectively selected for this study. Computer tomography scan, proper structure set, and dose distributions obtained with Monte Carlo based algorithm, were exported from Monaco 5.11 treatment planning system. New plans for Varian Halcyon 3.0 were optimized using PO_HAL_16.1.0: Photon Optimizer and calculated with Acuros algorithm in Eclipse 16.1. Eclipse was further used for analysis and comparison. The aim of this study was to test our planning technique for two different types of optimization and dose calculation algorithms while using the same clinical protocol. In both plans, the same contours for planning target volumes and dose prescribed to them, as well as the contours for organs at risk with proper constraints were used. Comparable and clinically acceptable plans were achieved, with mostly shorter treatment time on Halcyon.

P09

Pre-treatment Verification of Carcinoma Breast VMAT plan based on Mono-isocentric technique : Assessment of the combined fields feature of new 2D MatriXX arrays Resolution

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Objective :
The aim of our work is to verify Mono-Isocentric technique based volumetric modulated arc therapy (VMAT) plan for carcinoma breast and regional nodes employing the new 2D arrays MatriXX Resolution from IBA dosimetry systems, Schwarzenbruck, Germany loaded with the combined field feature.
Materials and Methods:
This study included 12 Mono Iso-centric VMAT plans for breast cancer with supraclavicular and axillary nodes. The radiotherapy planning was performed by the Monaco TPS (5.51 Elekta Limited, Crawley, UK) following the departmental planning protocols employing 6 MV photons using XVMC algorithm for Dose calculation.
The plans were optimized using an arc geometry with 25 increments in gantry angle spacing between control points with a 3 mm resolution dose grid size and 1% per calculation dose to medium, minimum segment width 0.5 cm and high fluence smoothing.
These plans were delivered clinically by an Elekta Infinity linear accelerator equipped with Agility 160- leaf MLC (Elekta Limited, Crawley, UK). Two CT scans of the MatriXX resolution inserted in the Mini Phantom R were acquired using CT simulator (GE discovery (General Electricals, USA). Out of these two scans, the first one taken as the default CT and the second one as the extended CT, in order to use it for large fields combination.
In this study, normal and combined fields were compared using myQA patients' software (IBA Dosimetry, Germany) based on the gamma index analysis and point dose measurements with the ion chamber cc04 according to IAEA Protocol TRS398.

Results:
The new 2D array detector provided good agreement for dose maps without combined field feature over the field lengths ranging from 22 cm to 24 cm and excellent agreement for maps with combined fields for lengths ranging from 24 cm to 28 cm. VMAT Clinical cases passed with more than 95% for the set criteria of 3% DD & 3 mm. The absolute point dose measurement agreement was found to be more than 98%.
Conclusion:
The MatriXX Resolution is a convenient, fast, robust, and practical tool for routine large-field pre-treatment verification in IMRT, VMAT and other advanced techniques.
Keywords: Patient Specific Quality Assurance, Combined Field, My QA Software, 2D Array detector.

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P10

Summary Template for:

RELATIVE DOSIMETRIC VERIFICATION IN IMAGE-GUIDED HDR BRACHYTHERAPY USING A PTW2D-ARRAYseven29 DETECTOR.

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Introduction: Brachytherapy plays an important role in the treatment of cancer patients. Image-guided brachytherapy requires specific patient quality controls to ensure that the planning and delivery of doses in the treatments are correct. **Material and Methods:** CT images were obtained on a SHIMADZU Tomograph of an intrauterine tube inserted into a solid PMMA phantom. A user factor of the PTW2D-Array seven 29 array system is determined by comparing the calculated dose and experimentally determined by the array system in a MultiSource® HDR unit, using the PTW-Verisoft 7.0 application. 4 test cases with uniform and non-uniform dose distributions were planned at the depths of 2.0 cm and 5.0 cm respectively. The comparison of the dose distributions is made by the following methods: 'Difference in % of Normalization Value of Reference Matrix with acceptability criteria between -2% and +2% and the 2D Gamma index method ($\gamma \leq 1$) , with the following acceptance criteria of dose difference at a point and acceptance distance, in tolerance ΔDm/DTA 3%/2mm, in tolerance with action level ΔDm/DTA 5%/2mm. **Results:** When comparing the calculated distributions with the one determined experimentally, using the 'Difference in % of Normalization Value of Reference Matrix' method, 91% (663) of the points pass the criterion of +/- 2% of the 729. For the evaluation ROI that includes the 10% isodose, 100% of the points within that region pass the criteria. The 2D Gamma index method ($\gamma \leq 1$), for the ΔDm/DTA (3%/2mm) criterion, the number of points that meet this criterion is above 97%, and 99% of the points meet the ΔDm/DTA (5%/2mm) criterion. **Conclusions:** The use of the 2DArray device allows specific patient quality control to be carried out, in the performance of brachytherapy of complex locations in 3D and it contributes to the performance of end-to-end dosimetry audits for HDR brachytherapy, to others radiotherapy services in our region.

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