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Abstract

Beam Quality Measurement and Verification in Radiation Therapy

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Abstract:

The aim of all radiotherapy treatment is to precisely deliver a prescribed dose of radiation to a tumour volume while simultaneously sparing the organs at risk (OARs) surrounding this tumour. Radiation therapy has evolved and the method of radiation generation varies, ranging from the controlled emission of gamma rays from a Cobalt 60 source to the production of particles such as; photons, electrons and protons produced in linear accelerators. The high energy photons employed during tumour treatment can interact with components of the gantry such as lead jaws, and produce particles that may contaminate the treatment beam. These contaminants are produced through various interactions with the photons and the absorbing medium such as; Compton Interaction, Photoelectric Effect and Pair Production. Photons have more penetrating power than charged particles of similar energy, and as they traverse a medium there is energy transformation to electron energy(1). The prospect of an interaction per unit distance travelled is denoted by the principle N= N_0 e^(-μx), where μ is dependent on the energy of the photon and the materials through which it travels(2).

The aim of this paper is to conduct beam quality measurements and verification for treatment plan quality assurance in radiation therapy. An IBA Pharma type ion chamber (FC65-G) and electrometer (IBA Dose 2) were used to obtain ionization charges for an 18MV and a 6MV photon beam from a C-Series linear accelerator. These measurements were taken using a 1D water phantom, dimensions 40cm* 35cm*34.5 cm at a source to detector distance (SDD) of 100cm with the chamber 10cm beneath the water surface. The "K" (quality conversion factor) was calculated using the TPR20, 10 method. Two sets of measurements were taken at a depth of 20 cm and 10 cm beneath the water surface at a source to detector distance of 100cm. Three measurements were taken for both photon energies at polarities of +300, -300 and +100 on the electrometer. Ka values were calculated using the TPR20, 10 principles outlined in the TRS 135 protocol. The Ka value for the 6MV photon was determined to be 0.996 Gy while that for the 18MV was 0.973 Gy. These Ka values were then used to determine the tabulated percentage depth dose (PDD) for the photon energies. The tabulated PDD's were 0.665 and 0.788 for the 6MV and 18MV beam respectively. From equation 2, Dw (10cm) for 6MV photon was calculated to be 0.68 Gy and that for the 18 MV photon was 0.81 Gy. The absorbed dose of the treatment unit at Dmax (Eq. 3) was calculated to be; (18MV) 1.03 Gy and (6MV) 1.03 Gy.

Biography:

Barrington Brevitt is a PhD candidate at the University of the West Indies (UWI), Mona Campus, Jamaica doing research in Applied Physics. He is also pursuing a Post Graduate Certificate in University Teaching and Learning. He currently possesses a Diploma in Sports Therapy, BSc in Diagnostic Imaging and an MSc in Medical Physics. Barrington is currently employed as a Senior Medical Physicist at the Kingston Public Hospital and as an adjunct assistant lecturer at UWI. He is actively involved in radiation therapy treatment planning, diagnostic and therapeutic quality assurance and staff training. Barrington has been involved in the medical use of radiation for the past 13 years; he has a passion for radiation protection and has published 4 research papers. He has participated in many local and international conferences as well as technical workshops and training with the IAEA and Varian.

Publication of speakers:

1. Barrington Brevitt, Mitko Voutchkov, Peter Johnson, Lisa Burnett et al, "Beam Quality Measurement and Verification in Radiation Therapy", J Integrative Oncology, 2019 Oct;45(5):391-397.
2. Barrington Brevitt, Mitko Voutchkov, Peter Johnson, Lisa Burnett et al , "_Enhancing_Quality_Management_through_Effective_Quality_Assurance_in_Jamaican_Radiology_Centres" Enhancing Quality Management through Effective Quality Assurance in Jamaican Radiology Centres, 2018 Oct 27 (5):311-326.

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