

Dosimetric Comparison among Different Head and Neck Radiotherapy Techniques Using PRESAGE™ Dosimeter

Authors : Jalil ur Rehman, Ramesh C. Tailor, Muhammad Isa Khan, Jahnzeeb Ashraf, Muhammad Afzal, Geoffery S. Ibbott

Abstract : Purpose: The purpose of this analysis was to investigate dose distribution of different techniques (3D-CRT, IMRT and VMAT) of head and neck cancer using 3-dimensional dosimeter called PRESAGETM Dosimeter. Materials and Methods: Computer tomography (CT) scans of radiological physics center (RPC) head and neck anthropomorphic phantom with both RPC standard insert and PRESAGETM insert were acquired separated with Philipp's CT scanner and both CT scans were exported via DICOM to the Pinnacle version 9.4 treatment planning system (TPS). Each plan was delivered twice to the RPC phantom first containing the RPC standard insert having TLD and film dosimeters and then again containing the Presage insert having 3-D dosimeter (PRESAGETM) by using a Varian True Beam linear accelerator. After irradiation, the standard insert including point dose measurements (TLD) and planar Gafchromic® EBT film measurement were read using RPC standard procedure. The 3D dose distribution from PRESAGETM was read out with the Duke Midsized optical scanner dedicated to RPC (DMOS-RPC). Dose volume histogram (DVH), mean and maximal doses for organs at risk were calculated and compared among each head and neck technique. The prescription dose was same for all head and neck radiotherapy techniques which was 6.60 Gy/friction. Beam profile comparison and gamma analysis were used to quantify agreements among film measurement, PRESAGETM measurement and calculated dose distribution. Quality assurances of all plans were performed by using ArcCHECK method. Results: VMAT delivered the lowest mean and maximum doses to organ at risk (spinal cord, parotid) than IMRT and 3DCRT. Such dose distribution was verified by absolute dose distribution using thermoluminescent dosimeter (TLD) system. The central axial, sagittal and coronal planes were evaluated using 2D gamma map criteria ($\pm 5\%/3\text{ mm}$) and results were 99.82% (axial), 99.78% (sagittal), 98.38% (coronal) for VMAT plan and found the agreement between PRESAGE and pinnacle was better than IMRT and 3D-CRT plan excludes a 7 mm rim at the edge of the dosimeter. Profile showed good agreement for all plans between film, PRESAGE and pinnacle and 3D gamma was performed for PTV and OARs, VMAT and 3DCRT endow with better agreement than IMRT. Conclusion: VMAT delivered lowered mean and maximal doses to organs at risk and better PTV coverage during head and neck radiotherapy. TLD, EBT film and PRESAGETM dosimeters suggest that VMAT was better for the treatment of head and neck cancer than IMRT and 3D-CRT.

Keywords : RPC, 3DCRT, IMRT, VMAT, EBT2 film, TLD, PRESAGETM

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