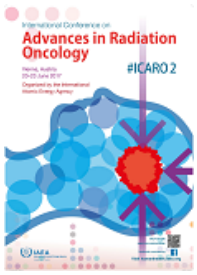

Contribution ID: **17** Type: **Poster**

Patient-specific quality assurance evaluation for stereotactic volumetric modulated arc delivery using 6FFF beams

Thursday, June 22, 2017 3:30 PM (5 minutes)

The patient-specific QA have been performed to verify accuracy of MLC movement of IMRT/VMAT technique prior to first day of treatment delivery. Nowadays, the SBRT in lung region is normally performed with VMAT plans especially with flattening filter free option to reduce beam-on time. The purpose of this study was to compare the dosimetric evaluation of lung SBRT plans in patient-specific QA using various detector types.
The 15 lung SBRT plans with PTV volume ranging from 7.5 to 318.4 cm3 were optimized and calculated for VMAT technique by Eclipse TPS version 11.0.31. The dose calculation was obtained with Acuros algorithm by 6 MV FFF beams. The maximum dose rate at 1400 MU/min was selected before inverse planning optimization. The dose prescription was in the range of 4-30 Gy/F and the several fraction schemes were used depending on indication. After these plans were approved by radiation oncologist according to RTOG dose limitation protocol, the plans were transferred and recalculated in ArcCHECK and Lucy phantoms. The ArcCHECK phantom contains 1,386 diode array in helical grid geometry around the phantom with 1 cm. detector spacing and it is possible to measure the dose in solid center plug using CC13 ionization chamber, while the Lucy 3D QA phantom for sterotactic QA was designed to place the Gafchromic EBT3 film and to insert the IBA CC01 and CC13 ion chambers for patient-specific QA. The plans were exported to TrueBeam linear accelerator for dose measurement. The irradiated films were scanned with Epson Perfection V700. The percentage of point dose differences between measurement and calculation were analyzed using absolute dose from ion chamber position, while the fluence map differences can be analyzed by gamma passing rate from film and ArcCHECK diode array. The gamma pass criteria was set at 3% global dose difference and 3 mm. distance to agreement with 10% dose threshold. The measurement was selected as a reference, so the percentage of point dose differences were calculated from the following equation.
%Dose difference=(Calculated dose-Measured dose)/(Measured dose) × 100
The PTV from these 15 cases can be catagorized into 6 small (7.5 to 22.4 cm3), 4 medium (65.5 to 86.1 cm3), and 5 large (145.3 to 318.4 cm3) volumes. The ArcCHECK presented very good agreement between dose measurement and calculation in both chamber detectors and diode array. The average point dose difference from CC13 chamber was -1.24±2.55% (-7.61 to 1.72%), while gamma passing rate from ArcCHECK diode array was 94.89±1.88% (91.7 to 98.4%). There was a case that presented high dose difference between CC13 point dose chamber in ArcCHECK and dose calculation of -7.61% due to the high dose gradient position in very small PTV volume. If this case was excluded, the error was only -0.79±1.46% (-3.41 to 1.58%). In Lucy phantom, the average dose differences from CC01 and CC13 chambers were -1.37±1.74% (-3.73% to 1.95%) and -0.67±2.27% (-4.41% to 4.62%), respectively. The error from CC13 chamber was wider variation than from CC01 because CC13 is larger volume that may present the volume averaing effect in the case of chamber located in high dose gradient area. The EBT3 film showed the average of gamma passing rate of 92.18±6.99% (80.7 to 99.1%) which the lower passing rates were detected in large PTV size with complicated plans.
For all point dose evaluation, the percent dose difference was dose per fraction and PTV volume independence but position of chamber is an important factor. For the film and diode array comparison, although EBT film is the excellent spatial resoluion detector, it showed the lower passing rate and larger variation than diode array from ArcCHECK because the accuracy of film dosimetry is according to various factors, especially in film calibration.

In conclusion, the Lucy phantom is special designed for sterotactic patient-specific QA with possible option to select detectors for point dose measurement, that both CC01 and CC13 chamers are the option to use in this purpose with the average accuracy within 1.5% and average gamma passing rate from EBT3 film is higher than 90%. The ArcCHECK that is more convenient to perform is originally designed for conventional VMAT plan QA but it is possible to apply for dose verification in SBRT case for various dose per fraction and different PTV size with the average absolute deviation for a single point chamber measurement around 1% and gamma passing rate of 95%.

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Country

Thailand

Institution

aDepartment of Radiology, Faculty of Medicine, Chulalongkorn University, Bangkok. bDepartment of Radiation Oncology,King Chulalongkorn Momorial Hospital, Bangkok

Primary author: SANGHANGTHUM, Taweap (Department of Radiology, Faculty of Medicine, Chulalongkorn University, Bangkok, THAILAND)

Co-authors: OONSIRI, Puntiwa (Department of Radiation Oncology,King Chulalongkorn Momorial Hospital, Bangkok, Thailand); MAKNITIKUL, Sitanan (Department of Radiology, Faculty of Medicine, Chulalongkorn University, Bangkok, Thailand); SURIYAPEE, Sivalee (Department of Radiology, Faculty of Medicine, Chulalongkorn University, Bangkok, Thailand); OONSIRI, Sornjarod (Department of Radiation Oncology,King Chulalongkorn Momorial Hospital, Bangkok, Thailand)

Presenter: SANGHANGTHUM, Taweap (Department of Radiology, Faculty of Medicine, Chulalongkorn University, Bangkok, THAILAND)

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