Purpose:

To test the sensitivity of pass rates of Gamma Index to the detector setup errors in six degrees of freedom.

Methods:

VMAT (Volumetric Modulated Arc Therapy) treatment technique is used in our clinic on an Elekta Beam Modulator with a HexaPOD couch. The HexaPOD system is a robotic patient positioning platform with six degrees of freedom. ScandiDos Delta4 system is used for our VMAT patient QAs. Delta4 is a pseudo 3D diode detector array which is capable of calculating 3D Gamma Index.

Seven prostate and four H&N VMAT treatment plans were delivered. The measurements were compared with the Pinnacle TPS calculations and the pass rates of Gamma Index were calculated. Then the HexPod couch was shifted or rotated either by 1 mm or 1 degree in any of the six degrees of freedom to simulate the setup errors, and the pass rates were re-measured and re-calculated. The criterion used for Gamma Index calculation was 3% and 3mm. A detector point is considered pass if the calculated Gamma Index is smaller than 1. Pass rates of Gamma Index with different detector setup errors in the six degrees of freedom were compared.

Results:

Regarding the rotational setup error of different directions, the changes of pass rates of Gamma Index are significantly different (p < 0.001). While one degree change in Roll angle causes the least change of the pass rates of Gamma Index, one degree change in Pitch angle causes the biggest change. Regarding the translational setup error of different directions, the changes of pass rates of Gamma Index are insignificant (p > 0.1).

Conclusions:

Although 1 mm or 1 degree machine-type tolerance was recommended by AAPM TG reports, they don’t translate to the same amount of changes in pass rates of Gamma Index for VMAT QA.

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None