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Leakage radiation of ARTISTE LINAC machine

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INTRODUCTION

Leakage radiation evaluation, as a part of acceptance tests during linac commissioning, is of paramount importance regarding patient and staff radiation protection. In this study, leakage tests were performed for a newly installed linac according to IEC 6061.

METHODS

I) Photon beam

a) Photons leakage from head and beam transport system:

In order to measure the potential leakage from the linac waveguide and the source, EDR-2 films were used to wrap around the linac head, covering all the sides of linac head except the collimator. The films should be marked to permit the determination of their position on the machine after they are exposed and processed. Next, a long enough exposure of 1000 MU was delivered using the 15 MV photon beams in a situation that the jaws and MLC leaves were fully closed, Gantry=0, Collimator=0. In the next step, after developing the films, the leakage was measured in any area with density greater than the background or fog using an ionization chamber-style survey meter.

b) Photon leakage from beam limiting system and reaching outside the useful beam:

First, a 0.6 cc Farmer ion chamber (with appropriate buildup caps) was placed at SSD=100 in a 10×10 cm² field size to be exposed 1000 Monitor Unit for three times using the highest available energy. The ion chamber should be positioned along an arc of 1 meter radius circle to repeat delivering the same exposure. Finally, the results compared with the reading collected at the reference condition.

II) Electron beam

Cone leakage:

In order to evaluate the leakage from electron cone, a ROOS ion chamber was positioned in center of radiation field at SSD=100 cm. The gantry, couch and collimator angles were set zero. The position of the ion chamber should be changed in a line 2 cm and 4 cm outside the periphery of the geometrical radiation field. 100 MU was delivered using 18 MeV exposure in each position for each measurement point. This procedure should be performed for all available applicators.

RESULTS

According to the head leakage test, there were no hot spots on films. Dose due to photons leakage outside the useful beam, ranged from 0.01 percent to 0.03 percent of maximum absorbed dose measured at isocentre plane in a 10×10 radiation field. As far as electron beam tests are concerned, the maximum ratio of dose at 2 cm and 4 cm from useful beam edge to dose at isocenter were 5.01% for applicator 20×20 and 2.16% for 15×15 applicator, respectively.

DISCUSSION

From this study, it has been found that:

- 1- Leakage radiation at 1 meter along the path of the electrons between gun and target not exceed 0.1 percent of the maximum dose measured at isocentre of a reference radiation field.
- 2- Leakage radiation at any point outside the maximum useful beam and in a circular plane of radius 1 m from isocenter also not exceed 0.2% of the isocenter.
- 3- Absorbed dose at 2cm outside the 18 MeV useful beam area for all applicators not Exceed 10% max absorbed dose on the reference axis at SSD=100.

CONCLUSION

The newly installed ARTISTE linac was allowed to be used for clinical applications as all the radiation leak-

age parameters were within the tolerance limit specified by the IEC 60-61 requirements. It is suggested that measurement of radiation leakage should be necessary during acceptance testing of a linac machine, especially for new type machines such as the ARTISRE, to ensure patient and staff safety.

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