Original research article

**Multienergetic verification of dynamic wedge angles in medical accelerators using multichannel linear array**

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**Abstract**

**Background**

The aim of the modern radiotherapy is to get a homogenous dose distribution in PTV, which is obtained by using for example physical or dynamic wedges. The using of a physical wedge has provided such isodose distributions but their use resulted in detrimental dosimetric consequences, for example beam hardening effects and practical consequences of filter handling or possible misalignment. Linear accelerators are now equipped with collimator jaws systems and controlled by modern computers and it is possible to generate wedge shaped isodose distributions dynamically. Because of a more comfortable use of a dynamic wedge, there are alternatives to the standard physical wedge. During the treatment, different segments of the treatment field can be exposed to the primary beam at different intervals of time. This process of shrinking the field while modulating the collimator jaw velocity and dose rate creates the desired wedge-shaped isodose gradient across the treatment field. Dynamic wedges can replace physical wedges but they need more precise dosimetry and quality control procedures.

**Aim**

The aim of this study was to perform a multienergetic verification of dynamic wedge angles using the multichannel detector PTW LA48 linear array.

**Material and methods**

The measurements of angle value of dynamic wedges were performed for Clinac 2300 C/D accelerators (Varian). The accelerator was equipped with the EDW option for 6 MV and 15 MV photon beams. In this case, 7 wedge angle values were used: 10°, 15°, 20°, 25°, 30°, 45° and 60°. The dynamic wedges are realized by continuous movement of one collimator jaw. The field size is gradually reduced until the collimator is almost completely closed or the field increases, while the beam is on. The measurements were divided in two steps: in the first step, the dynamic wedges were verified with the recommended values and in the second step there the planned and measured angles of dynamic wedges were compared. Measurements were made by means of LA48 linear array of ionization chambers (PTW). The results of the measurements were compared with the reference profile produced by the treatment planning system ECLIPSE 8.5 (Varian).

**Results**

The results showed differences between measured and calculated angle of dynamic wedges. The differences were observed for both energies in the case of a small angle value. For
energies 6 MV and 15 MV, almost all percentage difference between the measured and calculated profile was lower than 5%. The biggest difference was observed in the first step of measurements when the angle of Dynamic Wedge was verified. The comparison between the planned and measured angle value of Dynamic Wedge showed the difference between 0.1% and 4.5%.

The difference for 6 MV for the angle value of 10° in orientation IN was 1.1% and for energy 15 MV in the same case the difference was 3.8%. Thinner wedges exhibit less difference.

Conclusion

It is necessary to provide comprehensive quality control procedure for enhanced dynamic wedges. Verification measurements should be an obligatory procedure in the recommendation for the testing of medical accelerators. These results are the preliminary results to provide measurements in other Polish Cancer Centres.

Keywords

Dynamic wedges; Physical wedges; Linear array; Radiotherapy