Complex, highly conform radiation technique IMRT enables sparing of normal surrounding tissues, while steep dose gradients can be also used for dose escalation to the target volume. In comparison to standard conform radiotherapy there is a greater risk of mistake. Because of the fact that eventual mistake can cause a serious complication it is important to verify the whole process of the patient’s dose delivery. One of the necessary parts of QA of the whole treatment planning process is dosimetric verification of IMRT plan before the actual patient treatment. Just this work is dedicated to comparison of three commonly used methods for IMRT verification of delivered fluence. In this work we are trying to compare reliability, accuracy and time demandingness of each method.

DESCRIPTION OF THE EXPERIMENT

For purpose of this work was chosen one field of IMRT plan which passed standard verification procedure at our department (= verification with solid water phantom and EPID) and with which a patient was treated. From this plan were made so called verification plans following demands of each verification method. These plans were used for measurements and for comparison of predicted and measured results. For generation of treatment and verification IMRT plans TPS Eclipse was used and for evaluation of dose distributions OmniPro-I’MRT software from Scanditronix-Wellhofer and Varian’s Varis Vision software were used.

Verification using film dosimetry

To verify the planned dose distribution versus the measured dose distribution a film dosimetry was used. Film was irradiated by the IMRT patient’s field and it was developed in the developing automat together with other films. These were irradiated by known doses ranging from 0.05 to 1 Grey and afterwards they were used for film calibration. Each developed film was scanned in Vidar and then in OmniPro-Accept a known dose was assigned to the measured optical density. The aim of this was to derive absolute dose distribution from the signal of the film which was irradiated by IMRT field. Film dose distribution was subsequently compared and analysed with the predicted one in the OmniPro-I’MRT software using gamma method, while the acceptance gamma criteria were chosen to be 2 % of dose in isocenter and 2 mm DTA (distance to agreement). Priority of this method is an excellent space resolution of film, however verification using film dosimetry is very time-consuming which is the main limitation of this method.

Verification using dose measurement in solid water phantom and portal dosimetry

For this way of verification two verification plans were generated. Firstly, for point dose verification, fluence maps for each treatment field were transferred to the 3D CT image of a cubic solid water phantom and dose distribution in the phantom was predicted. Afterwards partial and total doses in the isocentre in the phantom were measured by small ionization...
chamber (CC01 from Scanditronix Wellhofer). These measured partial doses from single fields and total absorbed dose were then compared with the prediction. Acceptance criteria are 2% difference between measurement and prediction in total point dose and 2% difference in partial point dose.

For portal dosimetry electronic portal imaging device was used. This is an amorphous silicon flat panel array with space resolution of 0.79 mm. Firstly a portal dose prediction for EPID measurement was made which was then in the Varis Vision software compared with the measured dose distribution. Distributions were evaluated by gamma method while the acceptance criteria were chosen to be 2% of dose in isocenter and 2 mm DTA. Whole process from generation of verification plans till final evaluation by gamma analysis takes approximately 1.5 hour.

**Verification using I’mRT MatriXX**

I’mRT MatriXX, a product of Scanditronix Wellhofer, is a modern two dimensional array of 1020 cylindrical ionization chambers uniformly arranged in a field of 24 x 24 cm² with spatial resolution of 0.76 cm. Sensitive volume of each chamber is only 0.07 cm³, which explains the ability of matrix to reliably verify complex IMRT fields for which regions of steep dose gradients are typical.

In order to dosimetrically verify IMRT field, fluence map for this treatment field was transferred to the 3D CT image of the I’mRT MatriXX so that the distribution in the matrix can be predicted. The measured and predicted dose distributions were then compared and evaluated by gamma analysis in OmniPro-I’mRT software. The acceptance gamma criteria were chosen to be 2% of dose in isocenter and 2 mm DTA, just like in film and in portal dosimetry. This process of verification takes in comparison with portal dosimetry about 1.5 hour longer. This is due to the matrix set up and mainly due to the evaluation in OmniPro-I’mRT software. For each field it takes about 3 minutes to convert grid to 0.1 mm, which is recommended, and also the geometric orientation of the compared distributions is not automatic as in Varis Vision is.

**Table 1. Comparison of 3 verification methods**

<table>
<thead>
<tr>
<th>Method</th>
<th>Reliability</th>
<th>Evaluation software</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Film dosimetry</td>
<td>The best space resolution =&gt; allows the most reliable verification of the IMRT field.</td>
<td>OmniPro-I’mRT software was used</td>
<td>4 hours (including generation of verification plans, irradiation, film developing, film calibration, scanning and evaluation of distributions)</td>
</tr>
<tr>
<td>Portal dosimetry</td>
<td>Space resolution = 0.79 mm =&gt; reliable.</td>
<td>Varian’s Varis Vision</td>
<td>1.5 hour (including whole verification process)</td>
</tr>
</tbody>
</table>

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### CONCLUSION

In Faculty hospital At Bulovka, for the dosimetric verification of plans, electronic portal imaging device is preferred. It is a compromise between reliability and time demandingness. It is true that film dosimetry for its excellent space resolution may afford even more reliable dosimetric verification however four hours of verification time for one patient is unacceptable.

I’mRT MatriXX is on the other hand not so time-consuming but on the other hand its space resolution can cause problems in regions of high dose gradients since the interpolated doses in this region may be very different from the real obtained ones. Software used by I’mRT MatriXX is however more user friendly and in performing gamma analysis it allows selection of region of interest in gamma analysis.

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