**In Vivo Dosimetry of Stereotactic Radiation Therapy Using Integral Quality Monitor (IQM) System**

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**Introduction**

Real-time dosimetry is a challenging problem for high-dose and highly precise stereotactic radiosurgery (SRS) or stereotactic body radiation therapy (SBRT). Integral quality monitor (IQM) is a new in vivo dose monitoring and interlocking system using on-line comparison of checksums calculated from geometric and dosimetric parameters of fields, jaws, MLC and ion chamber.

**Purpose**

- To investigate the feasibility of using IQM for in vivo dosimetry of stereotactic radiation treatment with step-and-shoot intensity modulated radiation therapy (IMRT) or rotational volumetric modulated arc therapy (VMAT).

**Materials/Methods**

- A beta-version IQM system was commissioned initially on an Elekta Infinity Linac equipped with 160-MLCs Agility head, and later on an Elekta Versa HD Linac with Agility head and high dose-rate flattening-filter-free (FFF) energies.
- Prostate and head-and-neck IMRT and VMAT plans were used to assess IQM constancy in stationary and rotational delivering modes, respectively.
- The IQM sensitivity of detecting dosimetric deviations caused by leaf errors in SBRT were evaluated with different plans. Two scenarios of plans were assessed: relatively small and large targets. Single leaf offsets of 2 mm and 5 mm into fields were introduced into the plans. Sensitivity of IQM detecting dosimetric errors in these scenarios were compared with TPS plans and MapCheck2 measurements.

**Results**

IQM constancy measurements across several days showed 0.1-0.2% average standard deviation for cumulative checksum comparison in prostate and H&N IMRT deliveries and 0.7-1.0% (excluding first three control points) in VMAT case.

<table>
<thead>
<tr>
<th>Plan</th>
<th>Stationary PF</th>
<th>Rotational PF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Leaf Offset</td>
<td>2 mm</td>
<td>5 mm</td>
</tr>
<tr>
<td>Checksum Deviation</td>
<td>1.1-2.0%</td>
<td>3.1-5.3%</td>
</tr>
<tr>
<td>p-value</td>
<td>0.0005</td>
<td>0.0005</td>
</tr>
</tbody>
</table>

Table 2: IQM checksum deviation caused by single leaf offset in picket fence tests.

**Premature Conclusions**

- IQM is a stable dosimetric system and can detect dosimetric deviations caused by small leaf errors in stereotactic radiation therapy.
- IQM sensitivity to leaf errors is more pronounced for relatively small fields (i.e., small targets) in SBRT.
- IQM appears to be more sensitive than MapCheck2 to small leaf errors in SBRT of small targets while showing similar sensitivity in SBRT of relatively large targets.
- Given relatively small checksum deviations in response to small or moderate leaf errors, appropriate criteria need be established for proper pass/fail assessment of a SBRT delivery using IQM.