Conclusions: Not negligible differences between detectors were observed. Montecarlo correction factors for diode might explain the OF discrepancy with A26, while the A1SL bigger collecting volume could justify the variation observed in 1x1 cm² field PDD. Due to the lack of a gold standard detector for small field dosimetry, the previous measurements showed the reliability of A26 as detector for small fields.

EP-1379
Characterization of Exradin W1 plastic scintillator for output factors measurements in small field photon beams A. Petrucci1, R. Consorti1, F.P. Mangiacotti1, M.C. Pressello2
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Purpose/Objective: Contemporary radiotherapy approaches widely employ ‘non standard’ photon beams raising unprecedented challenges for absolute dose determination. In particular, standard reference dosimetry for small fields used in stereotactic radiosurgery treatments is substantially unfeasible. The implementation of new technologies for dosimetry is mandatory. The aim of this work is to characterize Exradin W1, a plastic scintillation detector manufactured by Standard Imaging, Inc. that seems to be promising in term of water equivalence, spatial resolution, dose rate and energy dependence for small field dosimetry purpose.

Materials and Methods: Exradin W1 was irradiated in vertical position (axis parallel to beam axis) in a water phantom with 6MV and 10 MV photon beams produced by a Varian Accelerator. Beam stability during irradiation was monitored with a PTW Semiflex Ionization Chamber (IC). W1 dose calibration for both energies was carried on at 10 cm depth in a 10x10cm² field, in two different condition of irradiated optical fiber length. Dose linearity was investigated at a dose rate of 3000MU/min ranging from 4 to 1000 MU in 10x10 cm² field. Dose-rate dependence was also studied varying from 100 to 600 MU/min. The detector response depending on gantry orientation was tested in a 5x5cm² field, at 10° step angles from 340° to 40°. Relative output factors (ROF) were measured at 10cm depth for both energies with W1, PTW PinPoint IC and PTW microdiamond detector up to 0.4x.04cm² field. Results were also compared with Pinnacle and RayStation TPSs calculated values.

Results: Detector dose response showed a optimal linearity both for 6MV and 10MV, less than 0.5% up to 4MU and 1% for MU<4 but due to accelerator behavior. Regarding dose-rate dependence a standard deviation of 0.3% was observed among measurements performed in the range all dose-rates tested. Detector response showed a not negligible dependence on the length of fiber irradiated, observed both in calibration setup and during measurements at different gantry angle. Output factor measured with the 3 detectors showed a maximum difference of 1% for the 1x1cm² field. A poorer agreement was found for smaller field dimension. As expected, the same trend was observed comparing W1 detector measured ROF with calculated values, that is, a difference less than 0.5% up to 1x1cm² and worse beyond.

Conclusions: Exradin W1 is a new detector that seems to introduce a minimum perturbation of the beam fluence. It is fast in data collection and easy to set up and manage. It show a good behavior in term of dose linearity and dose rate independence.

EP-1380
Characteristics and potential clinical use of the chemical dosimeter Methyl Viologen K. Petersson1, M. Jaccard1, C. Bailat1, J.F. Germond1, M.C. Vozenin2, J. Bourhis1, R. Moeckli1, F. Bochud1
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Purpose/Objective: Methyl Viologen (MV) is a chemical dosimeter historically used in pulsed radiolysis studies since it gives a sub-microsecond response to the delivered dose. MV is also reported to be dose-rate independent up to ultra-high (≥ 10⁷ Gy/s) dose-rates. The recent interest into using MV as a clinical dosimeter in radiotherapy is coupled with promising new radiotherapy techniques operating at these dose-rates, e.g. Flash irradiation and synchrotron radiation therapy. The purpose of this study is to characterize MV as a clinical dosimeter and to reveal its potential use in routine measurements at a radiotherapy department.

Materials and Methods: When ionizing radiation interacts with a MV solution it produces radicals, which display a characteristic blue color. This occurs as visible light is strongly absorbed, with absorbance peaks at wavelengths (λ) of around 395 nm and 603 nm. Consequently, the absorbed dose by a MV solution is readily determined by measuring the optical density (absorbance) at those particular wavelengths.
with spectrophotometry. Hence, the absorbed dose \( (D) \) is given by:

\[
D = A_\lambda \cdot c_\lambda
\]

where \( A_\lambda \) is the absorbance \( (\lambda = 395 \text{ or } 603 \text{ nm}) \) and \( c_\lambda \) is a constant which depends on the radiolytic yield (i.e. the amount of radicals created per absorbed joule), the density, and the molar extinction coefficient of the solution, as well as the path length of the light through the solution.

The reproducibility of the MV dose measurements was assessed by irradiating samples of MV solution introduced in optical cuvettes with 1000 monitor units (MU) from a clinical electron beam (4 MeV at an Elekta Synergy) and repeating this process for 20 different solutions. The linearity response was checked by delivering 10 - 10 000 MU to the solution, while the dose-rate dependence was investigated at normal clinical dose-rates by delivering 1 000 MU with varying dose-rate 25 - 430 MU/min.

**Results:** Our MV dose measurements show an acceptable level of reproducibility with a standard deviation for the 20 measurements of 1.8 % for both wavelengths. The dosimeter has a linear dose-response relationship between 500 - 7 000 MU (= 5 - 70 Gy), and is clinically usable (but not linear) down to 100 MU, see Figure 1.

![Figure 1](image)

Our results show a small dose-rate dependence of the MV response, specifically an increase of the response with higher dose-rate. This behavior is most likely due to the fading of the signal that occurs over time and starts to become a considerable factor for long irradiation sessions.

**Conclusions:** The results of our study show that MV is usable as a clinical dosimeter within radiotherapy. Although its characteristics cannot rival those of ion-chambers or diodes at normal dose-rates, its reported dose-rate independence up to high dose-rates makes it of clinical interest. The characteristics of MV can make it a vital component in taking promising experimental radiotherapy techniques like high dose rate irradiation and synchrotron radiation therapy to clinical trials.

**Electronic Poster: Physics track: Dose measurements**

**EP-1381**

**Assessment of the effect of spatial dose delivery inaccuracies on DVHs: a simulation hypophysis study**

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**Purpose/Objective:** To present a simplified methodology for quantitatively assessing the effects of spatial dose delivery inaccuracies on DVHs and to highlight the dependence of the treatment outcome and patient safety on small spatial dose delivery errors in an hypophysis treatment case.

**Materials and Methods:** The planning-CT scans, the RStructure dicom-RT file and the Treatment Planning System (TPS) calculated RDose dicom-RT file of an hypophysis patient treatment were imported to the open source software 3D-slicer. Spatial dose delivery errors, ranging from 1 to 3 mm in all Cartesian directions, were systematically introduced to the TPS calculated dose dataset (RDose). To achieve this, the RDose dataset volume was manually moved along the x, y and z axes (antero-posterior, left-right and cranio-caudal directions respectively) while keeping spatially stationary the planning-CT scans and RStructure datasets. The DVHs, \( D_{mean} \), \( D_{min} \), \( D_{max} \), \( V_{50,4} \) and \( D_{95%} \) for the PTV, brainstem, right optic nerve and left optic nerve were calculated for the nominal dose delivery scenario, as well as for various simulation scenarios representing different spatial dose delivery errors.

**Results:** For the brain tumor radiotherapy case studied (hypophysis), a relatively small spatial dose delivery error of 1 mm in each axis resulted in minor DVH alterations for all structures. Contrarily, the worst case scenario investigated, i.e., 3 mm spatial dose delivery error in each axis, resulted in important DVH alterations for the PTV and the organs at risk.

In the latter scenario, PTV \( D_{95%} \) was reduced by about 18%, while right optic nerve \( D_{95%} \) was increased by over 30%. Acquired results suggest that cranio-caudal spatial errors induce the more intense DVH alterations. The incorporated table presents the calculated values of \( D_{mean} \), \( D_{min} \), \( D_{max} \), \( V_{50,4} \) and \( D_{95%} \) for all studied structures and two of the simulated scenarios with spatial delivery inaccuracies, whilst corresponding PTV DVHs are depicted in the included Figure (solid, dashed and dotted lines represent the scenarios of 0, 1 and 3 mm spatial errors in each axis, respectively).

<table>
<thead>
<tr>
<th>Spatial Error (mm)</th>
<th>PTV</th>
<th>Brainstem</th>
<th>Left Optic Nerve</th>
<th>Right Optic Nerve</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 (nominal delivery)</td>
<td>54.5</td>
<td>45.7</td>
<td>51.9</td>
<td>99.6</td>
</tr>
<tr>
<td>1 (in each axis)</td>
<td>54.3</td>
<td>46.7</td>
<td>53.5</td>
<td>97.2</td>
</tr>
<tr>
<td>2 (in each axis)</td>
<td>52.7</td>
<td>47.8</td>
<td>54.8</td>
<td>85.3</td>
</tr>
<tr>
<td>3 (in each axis)</td>
<td>51.2</td>
<td>48.0</td>
<td>56.4</td>
<td>72.9</td>
</tr>
</tbody>
</table>

**Acquired results suggest that cranio-caudal spatial errors induce the more intense DVH alterations.**