Pre-treatment quality assurance (QA) with flattening filter free (FFF) beams is challenging because of the high dose rate and the required spatial resolution as small fields are usually used. Our current clinical practice is to perform pre-treatment QA with a chamber array in a rotational phantom. This study investigates the replacement of this process by an electronic portal imager (EPI) measurement without a phantom in place in order to shorten the QA time on the machine.

**Materials and Methods**

- **Varian Truebeam linear accelerator** delivering 10 MV FFF photon beams (Fig. 1a).
- **Varian As1000 EPID** at 150 cm source detector distance (fig. 1a). 0.39x0.29 mm² resolution. 
  => Analysis with Dosisoft EPibeam software version 1.0.2.2alpha (fig. 1b).
- **PTW Octavius 4D rotational phantom** with PTW SRS1000 liquid ionisation chamber array (fig. 2a). 2.5 mm diameter detector resolution. 
  => Analysis with PTW Verisoft version 7.0 (fig. 2b).
- **Varian Eclipse** 13.7 treatment planning system (0.125 cm calculation grid).

**EPID measurements**

- EPID image is converted into dose at 5 cm depth in water and compared with EPibeam dose calculation computed from Eclipse RT plan.

**Octavius 4D measurements**

- Dose measured by chamber array in rotational phantom is converted into 3D dose distribution and compared with Eclipse phantom dose calculation.

**Clinical plans**

- 10 patients treated by stereotactic radiotherapy for hepatic lesions.
- Representative of our clinical activity in terms of dose and beam size.
- Treatment plans are made of a 180 to 200° conformal arc.
- Dose prescription on 80% isodose.

**Error detection**

- Introduced errors: leaf position (leaf bank opening, B30 central leaf shift and blockage), collimator rotation and isocentre dose.
- Applied to the smallest and largest lesions in clinical plans. (patients 7 and 2).
- Dose at the isocentre set to 11 Gy in Octavius in order to avoid dose bias in comparison (only lesion size varies between the two patients).
- Assessment of error effect clinical impact on dose distribution in Eclipse with Verisoft software.

**Results**

**Clinical plans** (Table 1) covered a wide range of PTV size (average = 129.5 cm³, minimum = 9.8 cm³, maximum = 327.5 cm³) and dose prescription (average = 11.8 Gy, minimum = 6 Gy, maximum = 18 Gy) resulting in 1866 MU on average (minimum = 806 MU, maximum = 3072).

**Error detection**

- Results for plans with errors are summarized in Table 2 with 2%-2 mm gamma index criteria (10% threshold).

<table>
<thead>
<tr>
<th>Patient</th>
<th>PTV volume (cm³)</th>
<th>Isocentre position</th>
<th>Rotation</th>
<th>MU</th>
<th>Eclipse</th>
<th>Dose (Eclipse)</th>
<th>Dose (EPibeam)</th>
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</table>

Table 1: clinical plan results (* field not entirely covered by array)

Chamber array and portal imager QA process gave both gamma values higher than 97% for 2%-2 mm criteria (10% threshold).

**Error detection**

- Results for plans with errors are summarized in Table 2 with 2%-2 mm gamma index criteria (10% threshold).
- For the largest volume (patient 2), Octavius was more sensitive to collimator rotation and dose errors. Nevertheless, plan comparison in Eclipse shows that EPID control results are closer to those on dose distribution.
- The smallest volume (patient 7) is more sensitive to leaf position errors and less on collimator rotation (due to the rounded shape of the lesion). With Octavius, as the lesion is small, the number of tested points is small and gamma index values decreases quickly when errors are present. Both detectors gave similar results to Eclipse calculation, except for the 1 mm leaf opening in both direction that was not seen by EPibeam.

A 97% gamma index acceptance criteria can be used for both detectors with 2%-2 mm criteria and 10% threshold.

**Conclusion**

EPI QA process for FFF beams is achievable. It is much faster than chamber array process as there is no need for a phantom setup and it provides similar results. Nevertheless regular QA on collimator and gantry position should be performed on the machine as an error on these parameters is not always if not all detected with EPID. A similar study will have to be performed on 6 MV FFF beams before using EPID images for routine stereotactic plan QA in our institution.