**Title:** Comparison of ORL and prostate VMAT treatment plans verifications by ArcCheck® Sun Nuclear ™ 3D detector and Varian ™ PDIP® module: Assessment of the errors detection sensitivity and the capability of each process

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**Introduction:** The complexity of intensity modulation radiation requires a planned dose distribution verification prior treatment. Delivery a patient treatment plan quality assurance can be carried out by EPID, 2D/3D detector or by ionization chamber. In our department, VMAT treatment plans are checked by ArcCheck® Sun Nuclear™ 3D detector and Varian™ PDIP® module.  
In order to assess the feasibility of reducing the number of verification processes, we studied the detection sensitivity of different errors[1] and the capability of each process.

**Methods:** Treatment plans are checked by ArcCheck® Sun Nuclear™ 3D detector + SNC patient™ v6.7.1 software (AC) and Varian™ As 1000 EPID + Varian™ PDIP® v13.0 module (PDIP). For 5 ORL and prostate treatment plans, errors of collimator angulation (1-5°), dose rate (2-3%) and multi-leaf collimator (opening leaves banks from 0.5-1-2 mm) are simulated. Treatment plans are assessed by γ index (3%/3 mm, 2%/2 mm) with a respective passage criteria of 95% and 90% of the total pixels in global and local mode. A database of 80 ORL treatment plans and 30 prostate treatment plans is analyzed in order to check the capability of each process according to the differents γ index analysis criterias used.

**Results:** As regards the detection sensitivity of errors, according to the analysis criterias of the γ index, the AC and the PDIP respectively make it possible to detect on average: collimator errors from 2° and 3° for the ORL plans and 4° and above 5° for prostate plans; Dose rate errors of 2% for ORL plans and 3% for prostate plans; MLC banks opening errors of 0.5 mm for ORL plans and 0.5 mm and 1 mm for prostate plans. With a fixed analysis criteria, the error detection sensitivity of the AC appears higher than the PDIP.

Concerning the database analysis, for the AC, the mean γ indexes with 3%/3 mm global/local mode, and 2%/2 mm global mode are respectively 99,7 [96,3-100]; 95.8 [83.0-100]; 96.8 [81.0-100] for ORL treatment plans and 99.8 [98.8-100]; 98.2 [93.9-100]; 97.6 [90.0-99.8] for prostate treatment plans. The respective CPM capability indices are 5.2; 0.1; 0.9 for ORL treatment plans and 9.2; 1.0; 1.5 for prostate treatment plans. For the PDIP, the mean γ indexes with 3%/3 mm global/local mode and 2%/2 mm global mode are respectively 99.9 [98.8-100]; 97.6 [92.1-100]; 99.0 [93.6-100] for ORL treatment plans and 99.8 [99.0-100]; 99.0 [93.6-99.9]; 98.6 [95.8-100] for prostate treatment plans. The respective CPM capability indices are 17.4; 0.6; 1.5 for ORL treatment plans and 9.8; 1.6; 3.1 for prostate treatment plans. **Conclusion:** The detection sensitivity of the errors appears equivalent between the two processes AC and PDIP by selecting a suited γ index analysis criteria. Analysis with 3%/3 mm local mode appears the most efficient in the detection of error but also leads to a risk of false positive. On a case by case basis, none of the processes can systematically detect the simulated errors.

**References:**

[1] L. Vieillevigne, J. Molinier, T. Brun, and R. Ferrand, “Gamma index comparison of three VMAT QA systems and evaluation of their sensitivity to delivery errors,” *Phys. Medica*, vol. 31, no. 7, pp. 720–725, 2015.