ROOT CAUSE ANALYSIS OF IN VIVO DOSIMETRY CONTROLS FOR DYNAMIC ARC TREATMENTS

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INTRODUCTION:

In-vivo-dosimetry (IVD) is mandatory in France since 2011 for all beams where this control is technically feasible.

most popular method remains the direct dose The measurement by means of diodes or MOSFETs. However, these detectors are of limited use in the case of multiple complex fields. So with the broadening use of modern techniques, such as intensity modulated radiotherapy or dynamic arctherapy, the use of diodes and MOSFETs for

mandatory IVD is rendered obsolete.

As an alternative, a transit IVD system such as EPIgray® (DOSIsoft S.A.) can reconstruct the delivered dose for IMRT and dynamic arctherapy fields from portal images recorded during the treatment.

However, the recorded images of very small, complex, arctherapy fields give little additional information, such as body or bone delineation, for the interpretation of the IVD

results and eventual deviations. In the perspective of developing additional tools for a successful analysis of the results, it is thus important to dig into all technical and clinical parameters influencing the dose outcome.

The observations made during a first analysis of the causes often cited for the failure of Quality Assurance controls, such as modulation and measurement point, are here presented.



Sketch of « cine mode » for a prostate. RapidArc plan

Linac	Energy	kV set up images	Tolerance
Clinac 2300EX, Varian	6MV	S ₀ + weekly	2mm

MATERIALS AND METHODS



arc, total number of control points ${\mathcal Z}$	Per control point CP_i , with \mathcal{N} open leaves at positions pos_n :		
oint position index PI:			
$=\sum_{i=1}^{Z} PI_{CP_{i}} \cdot BM_{CP}$	$PI_{CP} = \begin{cases} 1 & if point in field \\ 0 & if point in field \\ BM_{CP}Bear \end{cases}$		







CONCLUSION:

Several plan parameters were here investigated: the position of the IVD point of measurement in the field/segment (Point Index), the planned variability of the dose rate during the plan delivery (Dose Rate Variation and Standard Deviation), and the complexity of the delivered arc (Modulation Complexity Score, Modulation Factor). Based on the analyzed plans, the following observations could be made:

① The 90 analyzed plans present an average dose deviation of 1.7±7.5 % over a total of 1055 controls.

20%

0%

25%

20%

5%

A small shift in in-vivo-dosimetry results can be observed between primary (largest dose) and secondary (smallest dose) arcs.

REFERENCES:

(%)

0.95

- **1.** Nijsten SM, et al. Routine individualized patient dosimetry using electronic portal imaging devices. Radiother Oncol 2007; 83:65-75.
- 2. Francois P, et al. In vivo dose verification from back projection of a transit dose measurement on the central axis of photon beams. Phys Medica. 2011 Jan; 27(1):1-10.
- Masi L, et al. Impact of plan parameters on the dosimetric accuracy of volumetric modulated arc therapy. Med Phys. 2013 Jul;40(7):071718

2 The dose rate of dynamic arcs can be very variable, with a standard deviation of up to 56 MU/min.

∽ A slight correlation can be observed between the standard deviation of the dose rate and the passing of an in-vivo-dosimetry control. The plans in tolerance limits tend to have a lower dose rate deviation (under 100 MU/min).

③ The point index shows that measurement points spend in the field an average of 45% of the irradiation time.

④ The average modulation complexity score of 0.33 matches the literature.

The wever, no evident correlation can be detected between the position of the point in the field or the modulation complexity of the field and the results of the in-vivo-dosimetry controls.

To polish and refine these results, a second study will be conducted to include the type of treatment site, which may influence the complexity of the plan, the total planned dose, a correlation to clinical parameters, such as weight loss, and phantom studies.

4. Wessels C, et al. Influence of the Modulation Index On Daily Quality Assurance in Rapid Arc Treatments. Poster session presented at: AAPM 56th Annual Meeting & Exhibition; 2014 Jul 20-24; Austin, TX, USA. **Corresponding author:** sofia.celi-sviridiuk@curie.fr sofia.celi@outlook.com This work is supported by: institut**Curie** DOS