

# 4D dosimetry in the RapidArc treatments using Delta<sup>4</sup>


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Conflict of interest: Sponsored by Varian and ScandiDos

**Purpose**

The new RapidArc™ treatment technique, also described as Volumetric Modulated Arc Therapy technique, has the potential to treat patient with improved result in target coverage and normal tissue sparing in much less time than IMRT. One important aspect of this is to ensure the quality in an efficient way, find the cause of any discrepancy and learn how to best use the various TPS parameters.

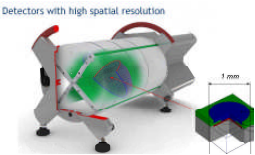
Delta<sup>4</sup>, originally developed to improve IMRT QA, was also designed for RapidArc/VMAT 4DRT and helical tomotherapy. Presented data is from the first test using Delta<sup>4</sup> on RapidArc made in collaboration between ScandiDos and Varian.



**Method and Materials:**

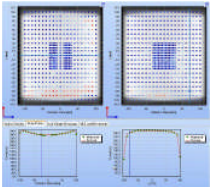
Measurements on a Varian ClinacIX with RapidArc capability, installed in Varian Medical Systems laboratory in Baden, Switzerland, were performed with a Delta<sup>4</sup> QA device of absolute dose distribution in 4-dimensions resolved in time and each dose pulse was tagged with independently measured gantry angle. The measured dose was grouped into the control points (every 2.2 degree) of the delivery sequence planned with Eclipse.

Verification against planned data in 3D using Eclipse TPS were done as well as reproducibility studies.



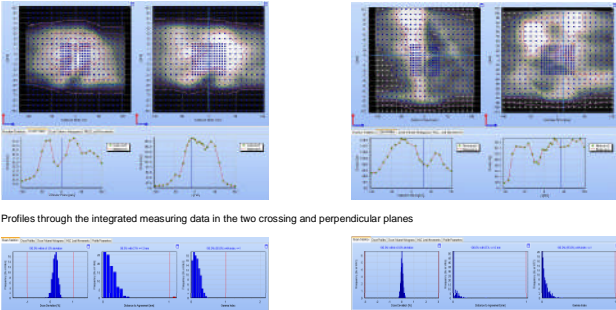
**Measurement using Delta<sup>4</sup> to verify a traditional fixed field ARC delivery**

A simple test on traditional ARC (fixed field sizes) was done to verify that the Delta<sup>4</sup> system correctly measures the dose distribution.




**Short term reproducibility for RapidArc delivery system and dosimetry**

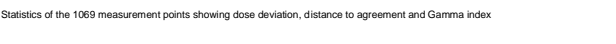
Short term reproducibility was studied for both measurement system and treatment delivery; gamma index 1 was set to 1% and 1mm:



Profiles through the integrated measuring data in the two crossing and perpendicular planes

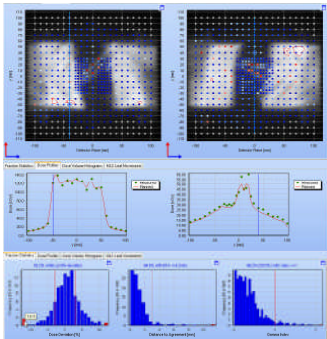


Statistics of the 1069 measurement points showing dose deviation, distance to agreement and Gamma index

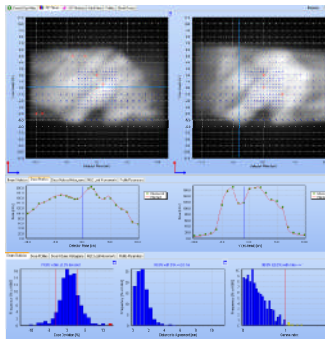


**RapidArc QA and dosimetry using Delta<sup>4</sup>**

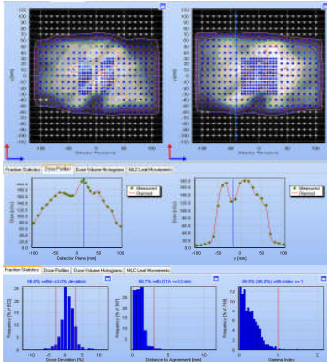
Comparison planned and measured dose distribution in RapidArc treatment delivery in several treatment plans and sites at both 6 and 18MV were made; gamma index 3% and 3mm:



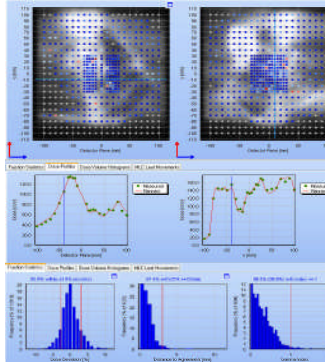
6MV; 358 degree ARC



6MV; 200 degree ARC (no beam through couch). Gamma index >1 high lighted in red



18MV; 200 degree ARC



6MV; 358 degree ARC; Gamma index >1 high lighted in red

## Results

Generally there was a very good agreement between planned data and measurement using Delta<sup>4</sup>. Gamma index (3%, 3mm) was generally better than 98%. For the reproducibility gamma index (0.5%, 0.5mm) nearly all measurement were within 100%. Reproducibility could be verified also individually for each control point.

## Conclusion

It was shown that Delta<sup>4</sup> can be used very efficiently to verify RapidArc delivery; the measurement time is only as long as the delivery time and set-up is very fast, thanks to the 3D measurement array no data is missed. Analysis can be done in a few minutes directly after measurement.

QA must not become the bottle neck in RapidArc clinical implementation!