



Tianyou Xue, PhD., St. Lukes Hospital & Health Network, Bethlehem, PA

## INTRODUCTION

Traditionally, 3D dose verification is performed by inserting multiple films in a phantom. This method is very time consuming. 2D arrays have been used to verify planar dose on beam cross section at certain depth, and the results could be available immediately after the measurement. Recently, a 3D diode array is available commercially. We have been using it to verify IMRT plans, and SRS plans using conical arcs or dynamical arcs. We also plan to study the possibility of using this diode array for routine QA of the treatment machine and the treatment planning system.

## METHOD AND MATERIALS

IMRT plans are developed on Varian Eclipse, and delivered on a Varian Trilogy treatment unit by using sliding window technique. The SRS plans are developed on a BrainLab IPlan

Dose, and delivered on the Trilogy. The 3D diode array is the Delta4 system from Scandidos. Delta4 has 1069 P type Si diodes on two planes in a cylindrical PMMA phantom. In the treatment planning systems, a patient plan is copied to the phantom, and recalculated. The plan and dose distribution are transferred to the Delta4 system by using DICOM RT. In the Delta4 software, the planned dose and measured dose are compared by using 2D isodose display, profile comparisons, percentage dose deviation, and DTA and Gamma index.

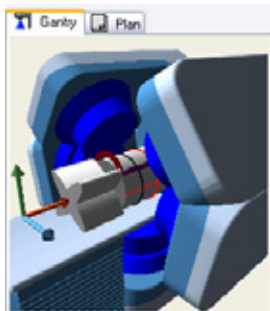


Figure 1. The phantom and measurement setup.

Table 1. Isocenter dose comparison of SRS plans using one 180 degree arc and cone sizes from 7.5 mm to 30 mm.

Cone size (mm)	7.5	10	12.5	15	17.5	20	25	30	Ave.
Plan dose	200	200	200	200	200	200	200	200	200
measured dose	189	196	199	201	201	202	203	204	199.4
% difference	5.50	2.00	0.50	-0.50	-0.50	-1.00	-1.50	-2.00	1.8

## RESULTS

We have used this method to verify 61 IMRT plans. The average percent diodes with deviation of 5% or less is 84.5%; the average distance to agreement (DTA) of 3mm or less is 86.7%. The average Gamma Index (5% and 3mm) of 1.0 or less is 91.8%. We have also used this system to verify the isocenter dose of BrainLab SRS plans, each using a cone from 7.5 mm to 30 mm with 180 degree arc. The average absolute difference between measurement and plan isocenter dose is 1.8%.

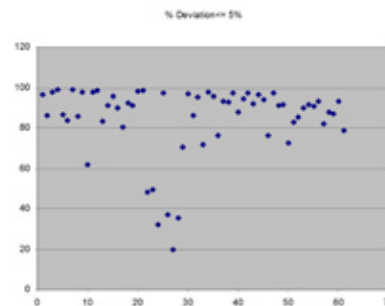


Figure 2. Percent of diodes with deviation of 5% or less.

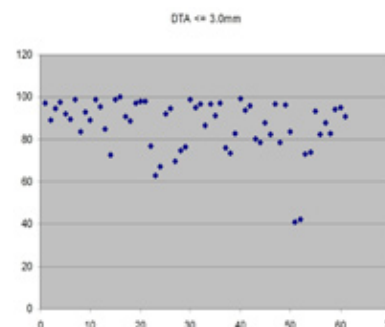


Figure 3. Percent of diodes with DTA of 3 mm or less.

## DISCUSSION

- 1) Table 1 shows that the results are not very good for 6 plans between number 20 and 30. It may be due to the inaccurate temperature measurements, or the machine delivery of the plans. More work needs to be done.
- 2) The system can also compare two sets of measured data. We plan to study the reproducibility of the system with certain gantry and field size configurations, and study the possibility of using this system in place of water tank scanning system for annual QA.
- 3) The large difference (5.5%) of the 7.5 mm cone may be due to the isocenter setup error.

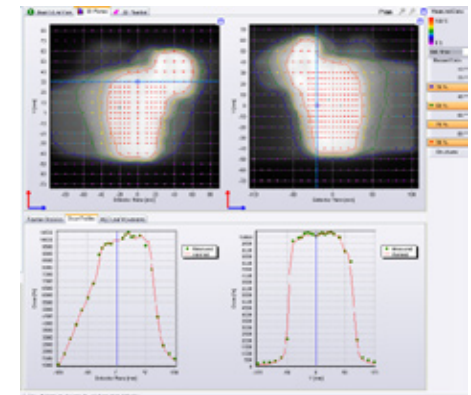


Figure 4. The isodose and profiles comparison of one plan.

## CONCLUSION

The 3D diode system is a good tool to verify 3D dose distribution.