Purpose: To develop a technique for analyzing the time dependent delivery of VMAT treatment with a 4D diode array.

Method and Materials: VMAT treatment plans with two full arcs for H&N patients were generated with Pinnacle SmartArc. The plan was delivered and measured with a 4D diode array (ArcCHECK). ArcCHECK records data every 50 milliseconds and saves in a movie file for post analysis. Algorithm was designed to derive gantry angle for each signal update based on the intersection of beam edges with the cylindrical ArcCHECK phantom. Angular correction factor for each diode was interpolated and applied, with intrinsic sensitivity correction factor, to the raw data to remove diode response dependence. Based on the derived gantry angles, dose between any two control points can be integrated and written into an ArcCHECK measurement file. Measured dose distribution at any instance or integrated between any two control points can be compared with the Pinnacle calculated control point dose using the MapCHECK software.

Results: Five IMRT beams were used to test the accuracy of the gantry angle derivation algorithm. The maximum mean error was 0.6o. For VMAT delivery, the derived gantry angles showed a smooth 360o clockwise gantry motion starting from 180o. Seven individual control points (#1, #15, #1~3, #1~5, #4~5, #5~15 and #1~90) were selected for dose comparison in relative dose mode. The average passing rates with 3%/3mm and 2%/2mm were 97.1% and 90.5%, respectively.

Conclusion: Control point based dose comparison showed satisfactory results indicating the accurate delivery of VMAT plans. The technique will be valuable in diagnosing VMAT delivery system errors, especially those originating from MLC and gantry motion.