AbstractID: 11276 Title: Real time 3D tracking of the HDR source using flat panel detector.

Purpose: This is a proof of concept study with the objective of reconstructing the position of an HDR source in 3D in real-time using a flat panel detector (FPD). It can potentially become the new standard in Quality Assurance (QA) for treatment delivery.

Method and Materials: A matrix of markers (Ball Bearings 4mm in diameter) with precisely known locations was mounted on the cover of a flat panel detector (Acuity, Varian Inc) at variable height. Images acquired with the x-ray source were used to calibrate the system. A plan with three dwell positions, well defined in 3D was created and delivered. Images were acquired with the FPD during the delivery of 'treatment'. In house software was created to automatically segment and label the markers' images. A mathematical solution for the 'near-intersection' of two 3D lines was implemented and used to determine the 'true' 3D source position. Each line was defined by the 3D positions of each marker and its projection on the FPD. A matrix with N markers will produce N*(N-1)/2 points of intersection and their mean will result in a more accurate source position. The HDR source was placed on a 5cm solid water to mimic the patient and the FPD was placed at distances varying from 50 to 70cm.

Results: The best imaging geometry was determined and images of markers obtained with the HDR source (strength of 6.2Ci) were properly segmented at all distances. During delivery, the source was located at [0,0,50], [0.5,0,50] and [2.0, 0, 50]. The reconstructed positions were [0,0,50.130], [0.497,-0.008,50.106] and [1.984, -0.005,50.053] with a standard deviation of [0.027,0.019,0.115]cm. When intersecting lines in 3D, the mean shortest distance between any two lines was 0.025cm with standard deviation 0.016cm.

Conclusion: We proved that the accuracy of source position detection in 3D using a FPD is sub-millimeter.