Purpose: To evaluate the accuracy of intensity modulated radiation therapy (IMRT) delivery during real-time tumor tracking using a gimbaled X-ray head of Vero4DRT (MHI-TM2000) (Mitsubishi Heavy Industries, Ltd., Japan).

Methods: We have utilized a QUASAR platform phantom (Modus Medical Devices Inc.) where a Kodak EDR2 X-ray film was placed at 5 cm depth in a solid water phantom. A simple step-and-shoot test field with five segmental fields and a clinical field for a prostate IMRT were used. Films were irradiated in following three setups: (1) stationary phantom and gimbal, (2) moving phantom and stationary gimbal and (3) moving phantom and real-time tracking irradiation. The moving phantom was driven by sine waves at a frequency of 0.25, 0.33 and 0.5 Hz with amplitude of 20 mm along tilt direction. 2D dose distributions and profiles were obtained for each case and analyzed using dose analysis software, DD-IMRT (R-TECH.INC, Japan).

Results: We observed a large dose blurring effect and as large as 40 % dose discrepancies between (1) and (2) for the test field at the high dose gradient. In contrast, the comparison of (1) with (3) shows the differences less than 3 % in the most area except the high dose gradient. We also found the good agreement between (1) and (3) for a clinical field. The percentage of values of discrepancy less than 5 % and 3% were 97.5 % and 82.0 %, respectively.

Conclusions: We demonstrated the significant dose blurring effect with a moving target in step-and-shoot IMRT dose delivery and it was greatly improved by real-time tumor tracking with Vero4DRT. The system showed an excellent accuracy of IMRT dose delivery during tumor tracking as result of the first evaluation.

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