

RADIOTHERAPY & ONCOLOGY

Vol. 76 (Supplement 2)

ESTRO 24

Lisbon, Portugal, September 24-29, 2005

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24 Clinical Implementation of IGRT

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Improved geometric accuracy through image guided therapy in radiation treatment delivery can reduce the volume of normal tissue irradiated. This may lead to a possible escalation of dose. We have been analyzing methods to quantitatively assess the geometric gains from IGRT. One application of IGRT at MGH involves improving partial breast irradiation setup. A three dimensional video surface imaging method is used to bring the treatment day breast surface into alignment with a reference surface. This method assumes a high degree of correlation between the breast surface and subsurface target location. Surface matching alignment is critically compared with other methods such as conventional laser based setup or alignment of chest wall from orthogonal radiographs. Using radio-opaque clips around the seroma as ground truth, we apply target registration error (TRE) analysis to quantify the relative accuracy of the different methods. Preliminary analysis shows a TRE of ~ 6-8mm for laser or chest wall based alignment vs. 2-3 mm TRE for surface matching. A statistical analysis shows the differences are meaningful. In the second approach to IGRT, we describe an image guided / gated treatment method for moving organs such as liver tumors. Patients are 4D CT scanned and target motion is quantified. Gated treatment is indicated when large excursions are observed under normal breathing, in order to reduce normal tissue irradiation. In the case study presented, gating reduces tumor motion from 2 cm to ~5mm using a 30% respiratory window. This reduction in target motion permits the use of smaller apertures, which in turn reduce dose to normal tissues. The gain in IGRT is realized by acquiring gated setup images on a daily basis to ensure appropriate field placement. Gated treatment is then typically delivered at exhale respiration phase. An approach to validate accurate delivery of gated treatment has been developed.