

Purpose:

To determine the feasibility of combining external beam radiotherapy (EBRT) and brachytherapy (BT) in terms of Biological Effective Dose (BED) using deformable image registration to evaluate treatment.

Methods:

This study analyzed combined EBRT and BT treatments of prostate cancer. Each patient received 45 Gy EBRT IMRT or VMAT technique prescribed to a planning target volume (PTV) followed by a 110 Gy or 100 Gy BT boost using I-125 or Pd-103, respectively. EBRT planning CT and post-implant CT were co-registered using rigid/deformable registration. The BT dose matrix was mapped via deformable transformation component to the EBRT CT study. The seed dose distribution was combined with the EBRT CT by the re-sampling of the dose matrix. BED calculations were performed utilizing the linear quadratic model assuming α/β ratio of 2 to convert EBRT and BT dose distributions. This yields evaluable topographical dose volume histogram (DVH) for evaluation of dosage to the PTV and organs at risk (OAR).

Results:

Twenty seven patient plans were successfully reconstructed to yield combined BED information. The average EBRT BED was found to be 85 Gy and the BT BED average was to be 127 (range 100-155 Gy) for a combined total average dose of 212 (range 185-240 Gy). The combined V0.1cc and V2cc of OAR were evaluated in both conventional and a novel topographical technique.

Conclusions:

We found it feasible to combine EBRT and BT treatment plans for BED analysis of both target and OAR. This allows for a novel and dynamic evaluation of combined therapy. BED distribution can enable clinicians to identify areas where failure can occur and assess areas of potential toxicity, currently not possible using physical dose summation. It can also be used as a tool for physicians to objectively assess the quality of treatment plans and for multi institutional comparisons.