AbstractID: 9326 Title: Dosimetric effect of energy spread of proton beams

Purpose: To investigate how proton beam energy spreads dosimetrically affect proton plans.

Method and Materials: Scanning proton beams were simulated using the Monte Carlo method. A computer program was developed to calculate the weights to produce the SOBP that will be used for treatment planning. The prostate proton plans (PT and IMPT) with different beam orientations were generated with the Monte Carlo simulation. The energy spread ranged from 0 to 20 MeV. The plans were compared to show the effects of energy spread.

Results: For the one-beam (AP) PT plans, the increase of energy spread increased the target heterogeneity by a factor of 4, and the mean doses to the normal tissues by up to 28%, but decreased V_{65} for the rectum by 60%. For the two-beam (lateral) plans, the energy spread increase reduced the target heterogeneity by up to 20%, the mean doses to the bladder and rectum by about 2%, and V_{65} for both the rectum and bladder by up to 4%, while increased the mean doses to the whole body and the femoral heads by up to 8%. For 4-beam (box) plans, all those parameters were increased with the energy spread except that V_{65} and V_{40} for the rectum were reduced by up to 20%. All IMPT plans have consistently reduced the mean doses to the normal tissues by up to 60% and V_{40} and V_{65} except the one-beam plan that increased V_{65} for the rectum.

Conclusion: The dosimetric effect of energy spread could result in either increasing or decreasing normal tissue doses depending on the beam geometry. But almost all IMPT plans reduced the doses to normal tissues compared to IMRT. Therefore, the energy spread of proton beams can be effectively used for proton therapy with the appropriate use of beam orientation and intensity modulation.