

Influence of implanted gold markers on the dose distributions for therapeutic proton beam

PURPOSE: The aim of this work is to examine the influence of implanted gold markers on the dose distributions in proton therapy and to investigate the dependency on the marker position in Spread Out Bragg Peak (SOBP) proton beam.

METHODS AND MATERIALS: The implanted gold marker has a cylindrical shape of 3mm length and 1.2mm diameter. The dose influence of the gold marker was verified in the condition of various locations of the proton beam field, which has 20 cm range in patient and 5cm of SOBP. Spatial dose distributions were measured using 3-Dimensional moving water phantom and a stereotactic diode detector with 0.5 mm of effective diameter. Also, a film dosimetry using EBT film was performed. For Monte Carlo simulation, GEANT4 simulation tool kit was used to confirm the measurement and to simulate the dose influence of multi-implanted condition.

RESULTS: Gold is high-Z material, which is good for CT marker but give more proton beam divergency and more under-dosed volume. The under-dosed volume of cold spots due to the single gold marker is measured to be 0.035 cc which has less than 80% of a prescription dose. The effect on the volume-dose relation has been studied. Monte Carlo simulation made us enable to study the various conditions of marker position.

CONCLUSION: Cold spots inside the target volume affect the probability of the local tumor control. Cold volume due to the gold marker is very small but is not trivial in the view of the local control probability in proton therapy. The position of gold markers and the conditions of the proton beam field give the effect on the dose distribution at the target region implanted gold markers.