AbstractID: 6702 Title: Novel kyphoplasty/brachytherapy technique for the treatment of vertebral metastases:A Monte Carlo feasibility study

Purpose: Spinal metastases often requires Kyphoplasty (used to stabilize a collapsed vertebral body and relieve pain by injecting a cement mixture into the vertebral body) followed by palliative fractionated external beam radiotherapy. We propose to combine these two treatments into a single procedure (spinal brachytherapy) by adding a β-emitting radionuclide to the kyphoplasty cement, thereby irradiating the bone from within. The potential advantages of this approach include delivery of a higher dose to the vertebral body, limiting the radiation dose to the spinal cord (due to the limited range of β-particles in tissue) and eliminating the need for repeat patient visits for palliative radiotherapy.

Method and Materials: The feasibility of the proposed procedure was studied by creating a CT-based voxelized model of a T6 vertebral body, coupled with radiation transport using Monte Carlo N-Particle code (MCNPX Version 2.5). A cylindrical source representing the injected cement was introduced into the voxelized model. Four β-emitters, Y-90, P-32, Sr-89 and Re-188 were chosen as candidate isotopes for the simulations. Each simulation consisted of thirty million histories. The dose deposited in each voxel was used to generate isodose curves and dose-volume histograms, yielding comparisons of dose to the vertebral body and the spinal cord. The activity of each radionuclide necessary to deliver a dose of 60 Gy to the vertebral body was calculated. The corresponding dose to the spinal cord was also determined.

Results: Dose-volume histograms and isodose line overlays for the different radionuclides indicate activities ranging from 0.5 - 950 mCi, will deliver the target dose to the vertebral body.

Conclusions: Present work indicates that β-emitting radionuclides can be safely used to irradiate the vertebral body while sparing the spinal cord. Future work will involve determining the radionuclide most suitable for this application based on different dosimetric and design considerations.