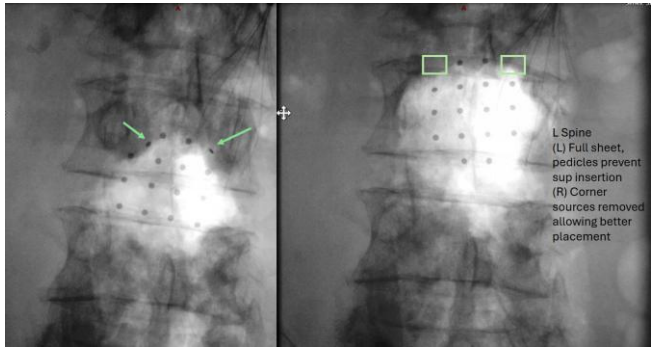
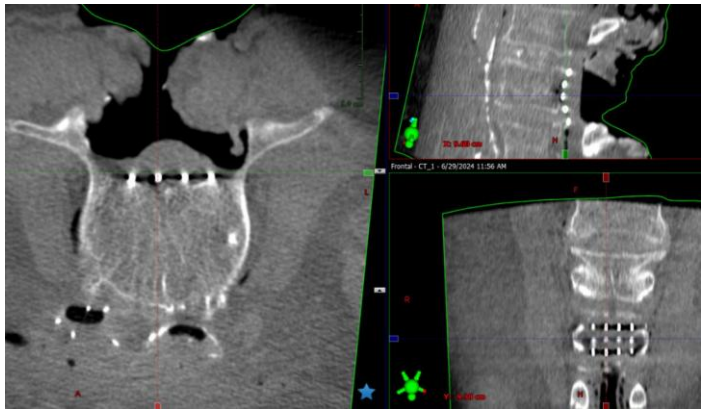
Lumbar Placement of Low-Dose Rate Membrane-Like Brachytherapy: A Cadaveric Study of a Novel Anisotropic Brachytherapy for Metastatic Spine Disease

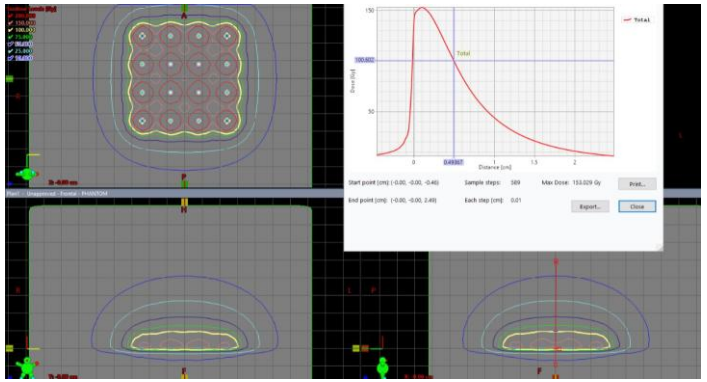
Seth B. Wilson, BS[1]; Nathan Ritchey, BS[1]; Michael Degnan, MS[2] , Anas Bardeesi, MD[3], Joshua Palmer, MD[2], Vikram Chakravarthy, MD[3]
1 – The Ohio State University Wexner College of Medicine, 2 – The Ohio State University, Department of Radiation Oncology, 3 – The Ohio State University, Department of Neurosurgery

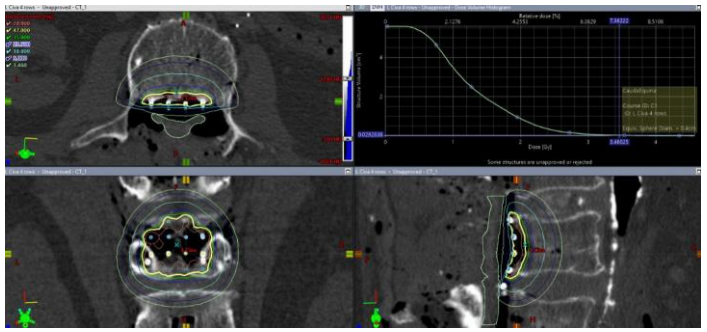
Introduction: Brachytherapy has demonstrated efficacy in treating metastatic disease to the spine.[1] Indications for brachytherapy include inability to tolerate chemotherapy and other forms of radiation including External beam radiotherapy or stereotactic body radiotherapy.[2,3] Tumor recurrence is often seen in the posterior vertebral body and pedicle as this area receives lower doses of radiation in attempt to preserve key neurologic structures. We evaluate the surgical placement of a low-dose rate membrane-like brachytherapy device anterior to the spinal cord to provide adequate radiation to the bony structures while preserving key neurologic structures through anisotropic dose distribution.

Methods: Following surgical exposure, a contoured low-dose rate ^{103}Pallidium(Pd) X-ray emitting membrane-like brachytherapy device were placed in the lumbar and sacral spine anterior to the spinal cord and nerve roots respectively utilizing fluoroscopy to optimize placement. An absorbable hemostatic agent (Surgicel Nu-Knit) was place between the device and the spinal cord. 4mm CMF screws were used to hold the device in place. The cadaver was then sent for XR, CT, and MRI imaging. Radiation planning was performed using Eclipse.









Results: Placement of the low-dose rate ^{103}Pallidium(Pd) X-ray emitting membrane-like brachytherapy device was achieved following exposure of the lumbar spinal cord and nerve roots. An absorbable hemostatic agent was placed on the dorsal aspect of the device to increase the distance between the device and the spinal cord to reduce cord dosing. Before installation, the cranial corner sources were removed from a 4X4 source sheet to yield maximal surface area exposure to the posterior vertebral body and lateral recess after anterior placement to the spinal cord. The low-dose rate membrane-like brachytherapy device demonstrated minimal artifact on CT and MRI. With 14 emitting sources, we observed 6.10mCi per source, yielding a total of 47 Gy at a 5 mm depth with Cauda max voxel (0.03cc) of 3.5Gy.

Conclusion: The uses of low-dose rate ^{103}Pallidium(Pd) X-ray emitting membrane like brachytherapy may demonstrate efficacy in providing appropriate radiotherapy through anisotropic dosing of radiation. Surgical placement of this device is technically feasible and may allow for optimized local control in conjunction with adjuvant SRS. Further evaluation is indicated for this novel treatment to progress to first in human trials.

References:

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