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Combination Unidirectional Brachytherapy and SRS in the Treatment of Thoracic Spine Metastasis: A Cadaveric Study and Model

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Abstract

Objectives:

Brachytherapy has become an increasingly important treatment modality for a variety of cancers. However, considerable hesitance is required when implementing near neural structures such as the spinal cord and nerve roots. Tumor recurrence often occurs in the posterior vertebral body and pedicle due to underdosing near these critical structures. Recently there has been development of a brachytherapy device that is anisotropic, beta emitting, planar, palladium-103, low-dose rate, device that utilizes gold shielding to attenuate directional dose. Here, we examine the feasibility of using this device in the thoracic spine.

Methods:

The membrane-like brachytherapy device was placed anterior to the spinal cord following exposure. The device was cut to fit the area and secured using 4mm CMF screws. An absorbable hemostatic agent (Surgicel Nu-Knit) was placed between the spinal cord and the device. The cadaveric specimen was subjected to XR, CT, and MRI imaging. Dosimetry and radiation planning models were created using Eclipse and MIM software.

Results:

Device placement was achieved in the thoracic spine and confirmed through subsequent fluoroscopic imaging. The hemostatic spacer introduced a 1 mm clearance between the cord and device creating a notable drop off in dose delivered to the spinal cord. The device demonstrated a clear anisotropic dose distribution targeting the posterior vertebral body. Further, 12 sources were implanted with an observed 5.95 mCi per source. There was a total of 47 Gy 5 mm into the vertebral body with a cord max voxel (0.03 cc) = 9.2 Gy. Radiation planning contoured the brachytherapy dose distribution in the anterior and middle vertebral body. The combination brachytherapy and SRS approach demonstrated complete coverage of the vertebral body without subtherapeutic doses in the posterior vertebral bodies.

Conclusion(s):

Surgical implementation of this device is feasible. The device demonstrated the ability to provide appropriate therapeutic doses to the vertebral body while sparing the spinal cord. Combined with adjuvant SRS, these techniques demonstrated complete therapeutic dose coverage and may provide improved local control. This novel approach shows promise and merits further evaluation.