

Spine Body Radiosurgery (SBRS): A Multidisciplinary Approach to Treating Tumors of the Spine

Cynthia Anderson, MD
Assistant Professor
Department of Radiation
Oncology

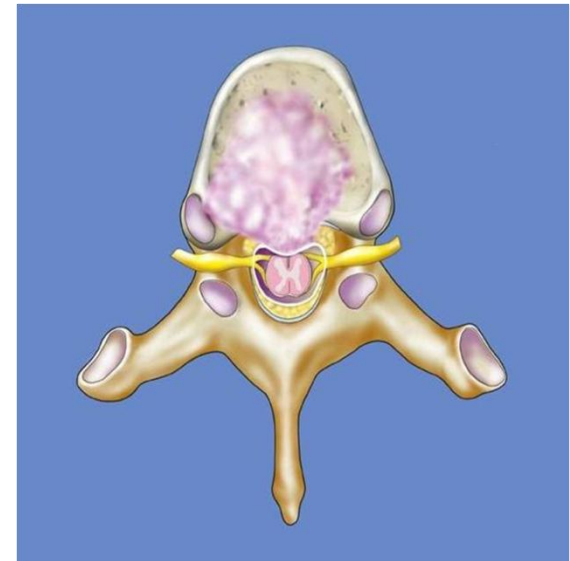


Overview

- Tumors of the Spine: Incidence and why it is a problem
- Historical Radiation Approach to Treatment
- History of Radiosurgery
- Spine Radiosurgery Compared to CNS Radiosurgery
- Advantages of Radiosurgery for Treatment of Spine Tumors
- Indications and Contraindications
- How to Evaluate the Patient
- Treatment Planning and Delivery
- Normal Tissue Tolerances
- Outcomes thus far
- Sequelae to consider
- Future Directions: RTOG 0631

Tumors of the Spine

- 40-70% of cancer patients develop spinal metastases during the course of their disease
- The spine is the most common site of bone metastases for most tumor types
- Metastases can be
 - Well centered in the bone and asymptomatic
 - Eroding significant portion of bone causing pain and/ or mechanical instability
 - Source of life threatening spinal cord compression with loss of neurologic function



Presentation of Spinal Metastases

- 90% of patients present with progressive pain
- 10% have neurologic symptoms:
 - Weakness, paresthesias, bladder or bowel dysfunction
- Up to 50% of presenting patients, the primary tumor is unknown



Multidisciplinary Evaluation of How Best To Manage Spinal Tumors

- Cancer Pain
 - One of the most common presenting symptoms of cancer
 - Chest pain – lung cancer
 - New onset headaches – brain metastases/ tumors
 - Back pain/ bone pain – osseous metastases

Multidisciplinary Evaluation of How Best To Manage Spinal Tumors

Given the likelihood of a patient developing spinal metastases over the course of their diagnosis

Given an evolving paradigm shift in oncology on how to address oligometastatic disease

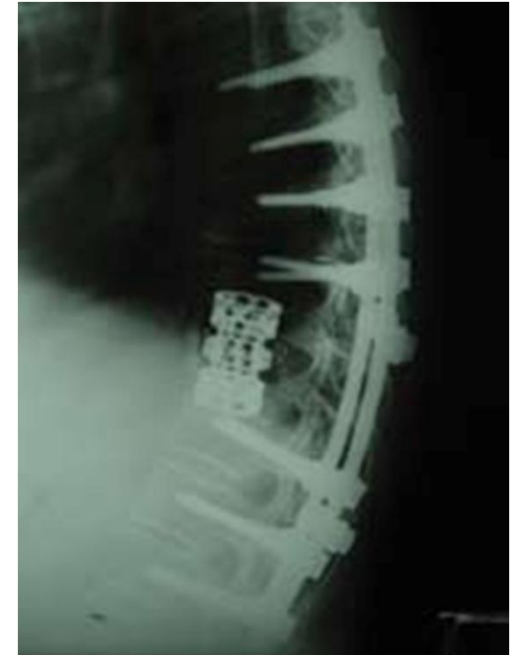
- Multidisciplinary clinics and tumor boards specifically to address spinal disease has been gaining currency as its own discipline, *even in patients with metastatic disease in multiple sites*

Spine Oncology – Multidisciplinary Approach

- Given the spectrum of clinical presentation, initial clinical approach can include
 - Initiating/ changing chemotherapy
 - Fractionated external beam radiation therapy
 - Stereotactic Body Radiosurgery (SBRS)
 - Surgery
 - Bisphosphonates - Zometa
 - Radiopharmaceuticals – Samarium, Strontium

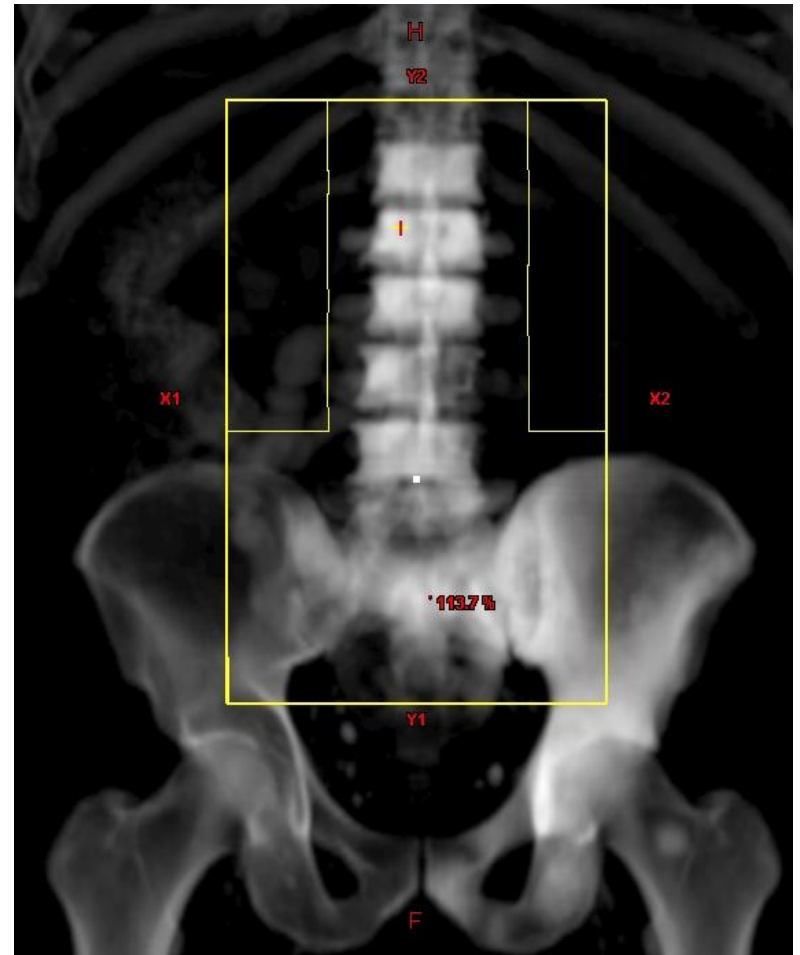
Surgical Spine Oncology

- Predominantly focuses on *mechanical management* and *urgent decompression* for symptomatic relief
- New techniques in spinal reconstruction with a trend toward minimally invasive surgery (vertebral augmentation) when possible
- What about the *oncologic management* of metastases?



Spine Radiation Oncology

- Historical Treatment
 - Treatment to a large field with extra margin above, below and to the sides of the tumor
 - Single fraction or multiple fractions based on size of field, degree of symptoms, patient performance status
 - Still has a valuable role in radiation oncology for patients with extensive amount of spinal disease or when SBRS contra-indicated

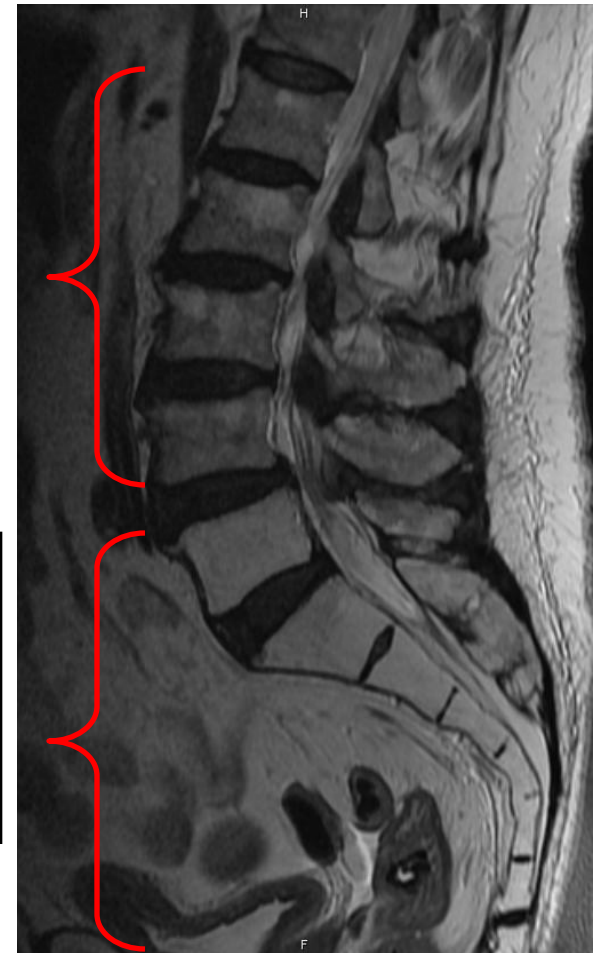


Chronic Sequelae of Radiation Therapy

- 80 year old male diagnosed with prostate cancer in 1984
- Underwent external beam radiation to the prostate and pelvis in 25 treatments w older, historical field sizes and design
- 2007 developed PSA rise without evidence of bone metastases
- 2010 noted mild pain in L spine w MRI showing lesions in L1-4

New prostate cancer mets from L1-L4

Chronic marrow changes from prior radiotherapy



Spine Body Radiosurgery (SBRS)

- A new treatment option for patients that builds on the legacy of success of stereotactic radiosurgery for brain tumor treatment

Definition of Stereotactic Radiosurgery

- Stereotaxy – utilization of an external measuring apparatus to help localize the tumor in relation to the patient's external anatomy
- Radiosurgery – utilization of radiation therapy to treat a patient with the same precision as surgery
 - “Scalpel” without the steel
 - “Surgery” without a trace

Power of Radiosurgery

- Fast
 - Often a single day treatment
 - Less interference with chemotherapy schedule
- Friendly
 - All workup and treatment done as an outpatient
 - Non-invasive
- Focused
 - Rapid, durable pain control with more cytotoxic dose to the tumor and better sparing of surrounding tissue
 - Allows for future surgical intervention if needed with smaller chance for wound complications

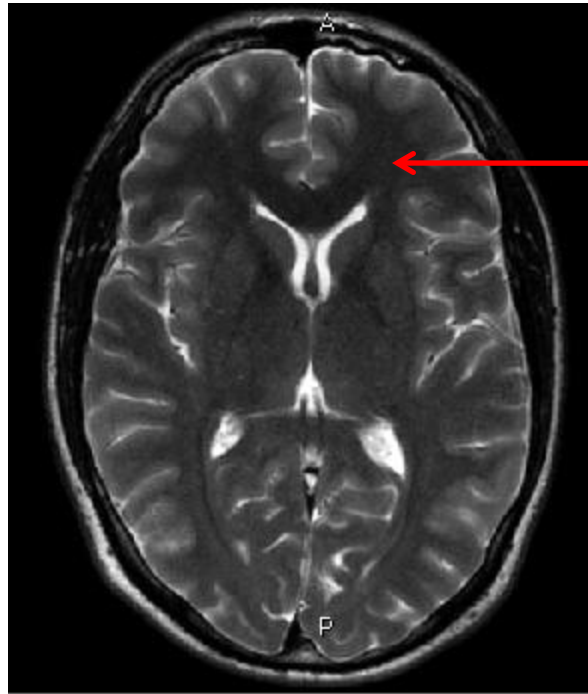
Similarities to Brain Radiosurgery

- Treat a small tissue volume that can be accurately targeted
- Show improved local control rates over conventional EBRT
- Conformal to spare maximally the surrounding tissue
- Can be done after prior radiation therapy

Differences from Brain Radiosurgery

- Brain treatments involve stereotactic guidance with an external measuring device
- Immobilization techniques are different
- Tissue tolerances are different
 - Brain – parallel organ
 - Spinal cord – serial organ
- Different options for beam arrangements

Parallel vs Serial Tissue



- Plasticity of the brain:
Bilateral hemispheres with overlapping function
The other side can compensate if a small area is damaged



- Less room for damage with the spinal cord:
Damage to a small area in the cord can leave a patient functionally debilitated

When to Refer a Patient for Evaluation of Metastatic Spine Disease to Multidisciplinary Clinic

- At initial diagnosis of cancer
 - Patient with pain as presenting symptom of cancer
 - Patient with unstable fracture or spinal cord compression
- No/ minimal response after 1-2 cycles of chemotherapy
- Progression of disease on therapy
- New metastases signaling recurrence

Evaluating the Patient

- Thorough evaluation of pain
 - National Pain Rating Score (NPRS)
 - Brief Pain Inventory (BPI)
- Are there any other neurologic symptoms?
- Is the pain purely mechanical or oncologic?

Evaluating the Patient

- Imaging – MRI, PET/CT
 - How many vertebrae are involved?
 - If >3, not a candidate for SBRS, more likely to use EBRT
 - How many are contiguous?
 - Should not have more than 2 adjacent involved vertebrae
 - MRI is superior to CT to contour the cord and a paraspinal soft tissue mass
- Physical exam
- What chemotherapy is the patient receiving?
 - Do we need to delay one cycle of chemotherapy for it or can we interdigitate?

Mechanical vs Oncologic Pain

Mechanical Pain

- Evidence of a fracture?
- Loss of vertebral body height?

Oncologic Pain

- Sclerosis or lysis of bone matrix?
- Associated soft tissue mass displacing the cord or impinging on nerve roots?



Spectrum of physical exam and imaging findings that help guide how best to approach the patient with initial treatment and whether to combine surgery and radiation

Interdigitating with Chemotherapy

- Potent radiosensitizers – consider suspending chemotherapy
 - “TAG”
 - Taxanes, TKI, Avastin, Gemcitabine
- Most others
 - Can interdigitate between cycles without disrupting systemic therapy

Indications for SBRS

- Solitary or oligometastatic disease in a relatively good performance status patient
- Up to 2 contiguously involved vertebrae
- Up to 3 involved vertebrae total
- Non-myeloma histologies
- Recurrence/ persistence after prior external beam RT
- Patient preference or co-morbidities precluding surgery
- Tumor at least 3-5mm away from the spinal cord
- Gross residual disease after surgery deemed at risk for recurrence

Contraindications for SBRS

- External beam RT within 3 months prior to area
- >25% spinal canal compromise from tumor
- Spinal cord compression/ cauda equina syndrome
- Progressive neurologic deficits
- Spinal instability due to bony destruction
- Inability to lie flat
- Connective tissue disease that contraindicated radiotherapy in general

How many and how much of the bone to treat with SBRS

Figure 1: Diagram of Eligible Metastatic Lesions

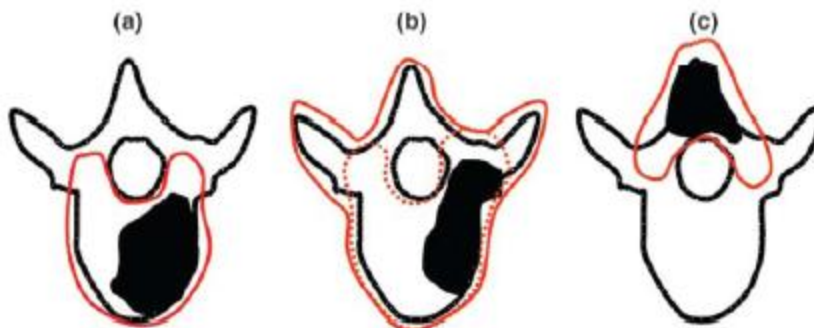
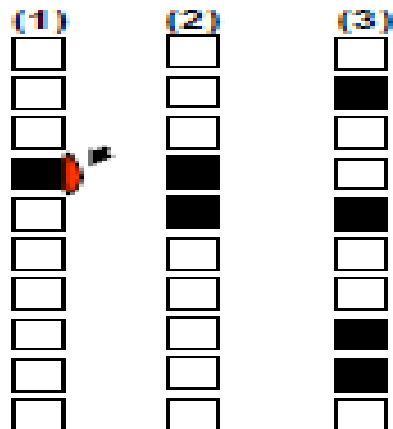


Figure 2: Diagram of Spine Metastasis and Target Volume

RTOG – up to three vertebrae total and up to 2 contiguous vertebrae

If there is a soft tissue mass, it can be up to 5cm in size, at least 3-5mm from the spinal cord

How much of the bone to treat –
a – Well centered in the body
b – Body with extension into the pedicle
c – Spinous process alone

It may not be important to treat the entire bone

Combining SBRS and Surgery

- Bone autograft – need to wait at least 1-2 months to allow for graft vascularization
- Degree of potential “field contamination” with microscopic disease
- Adequate time for dural healing – approx 3-4 weeks

Current and Future Directions

- RTOG 0631 – comparing single dose SBRS 16 Gy to single dose 8 Gy standard field radiation
- Dose escalation – up to 20-24 Gy in some institutions
- Increasing knowledge of tissue tolerances including absolute spinal cord tolerance
- Integrating with surgery when indicated

RTOG 0631

- Phase II/III trial
 - Phase II – determine the feasibility of IGRT/SBRS being delivered by a certain site
 - Required before we proceed to Phase III
 - Emory will enroll 5 patients on this part
- A safety step to ensure we can deliver SBRT safely before moving to the randomized portion of the trial
 - Phase III – Does SBRS of 16 Gy X1 improve pain control compared to 8 Gy X1 using the National Pain Rating Scale (NPRS)
 - Does it increase the duration of pain control
 - Compare side effects to vertebrae and surrounding tissue
 - Compare quality of life

Who is a candidate?

RTOG 0631

- Localized spine mets from C1 to L5 in up to 3 non-adjacent vertebrae
- MRI within 4 weeks of registration
- Numerical Pain Rating Scale (NPRS) ≥ 5
- If epidural compression, there must be a ≥ 3 mm gap between the spinal cord and edge of epidural mass
- Paraspinal mass ≤ 5 cm

Who is ineligible?

- Patients with multiple myeloma, lymphoma, renal cell carcinoma, or melanoma
- Non ambulatory patients
- Spine instability due to compression fracture
- >50% loss of vertebral body height
- Rapid neurologic decline
- Frank spinal cord compression
- Bony retropulsion causing neurologic changes
- Prior RT to spine