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Supplemental material

Consensus guidelines for postoperative stereotactic body radiation therapy for spinal metastases: results of an international survey

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Post-operative Spine Stereotactic Body Radiation Therapy (SBRT) Survey:

Are you a surgeon or a radiation oncologist? _____

How many post-operative cases have you performed to date:
- ☐ <30
- ☐ 30-100
- ☐ >100

How many years have you been in practice?_____
In what country do you practice?_____

Please select the answer that best reflects your practice:

1) For which patients do you offer SBRT rather than conventional radiation therapy in the post-operative setting? (check all that apply)

- ☐ Radio-resistant primary
- ☐ Single level of disease
- ☐ Two levels of adjacent disease
- ☐ >2 levels of adjacent disease
- ☐ Oligometastatic spine disease (less than 5 mets in the spine and no more than 2 to 3 contiguous vertebrae)
- ☐ KPS ≥70
- ☐ I offer radiosurgery to most post-operative patients
- ☐ Limited or absent extraspinal metastatic disease
- ☐ Prior external beam radiation therapy to the same site
- ☐ Other (please specify)_____

2) Which of the following do you view as **contraindications** to post-operative spine radiosurgery? (check all that apply)

- ☐ Widely metastatic disease
- ☐ Progressive disease outside of the spine
- ☐ Greater than 3 contiguous vertebral bodies involved
- ☐ Radiosensitive primary (myeloma, chloroma)
- ☐ KPS ≤60
- ☐ ASIA score A (complete spinal cord injury where no motor or sensory function is preserved in sacral segments S4-5)
- ☐ ASIA score B (incomplete spinal cord injury where sensory but not motor function is preserved below the neurologic level and includes sacral segments S4-5)
- ☐ Pre-existing risk factors for radiation toxicity such as connective tissue disease or multiple sclerosis
- ☐ Other (please specify)_____

3) What grade of post-operative residual disease would you consider a contraindication for post-operative spine radiosurgery?

- ☐ Bilsky grade 0 (tumor confined to bone without epidural extension)
- ☐ Bilsky grade 1a (epidural extension without cord abutment, 2 mm distance from cord)
- ☐ Bilsky grade 1b (epidural extension without cord abutment, 1 mm distance from cord)
- ☐ Bilksy grade 1 c (epidural extension with cord abutment but without deformation of CSF around cord)
- ☐ Bilsky grade 2 (cord abutment with deformation of the CSF remaining around the cord)
- ☐ Bilsky grade 3 (cord compression without any fluid around the cord)
- ☐ None of the above

4) Which imaging series do you fuse into your treating planning system? (check all that apply)

- ☐ Pre-operative axial MRI
- ☐ Pre-operative axial CT
- ☐ Post-operative axial T1 pre-gadolinium MRI
- ☐ Post-operative axial T1 post-gadolinium MRI
- ☐ Post-operative axial T2, CISS, FIESTA, or Trufi MRI
- ☐ Post-operative axial CT myelogram
- ☐ Post-operative sagittal T2 MRI or CT myelogram
- ☐ Other (please specify)_____

5) What is your GTV? (check all that apply)

- ☐ Post-operative residual as visualized on MRI
- ☐ Post-operative residual as visualized on CT
- ☐ Other (please specify)_____

6) What is your CTV?

- ☐ Post-operative residual as visualized on MRI or CT
- ☐ Post-operative bed (defined as entire extent of pre-operative tumor) plus any residual disease
- ☐ Post-operative bed plus any residual disease and hardware
- ☐ Post-operative bed plus any residual plus hardware plus scar
- ☐ Other (please specify)_____

7) What is your PTV expansion?

- ☐ None
- ☐ 1 mm
- ☐ 2 mm
- ☐ Other (please specify)_____

8) What is your cord avoidance structure?

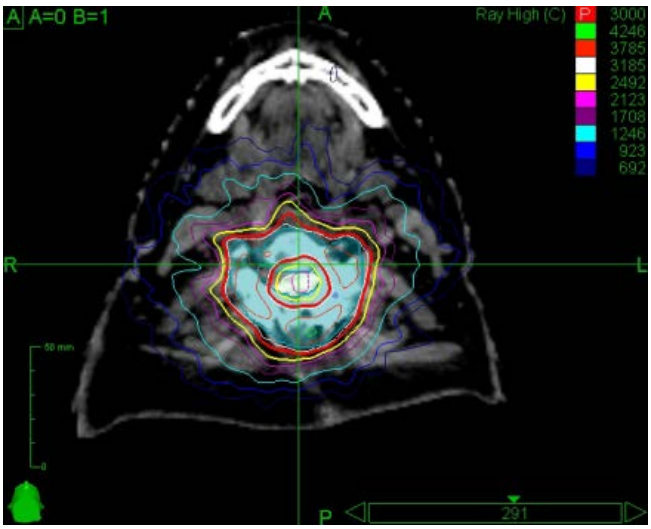
- ☐ True cord as delineated on the imaging series selected above
- ☐ Cord plus 1.5-2 mm
- ☐ Thecal sac
- ☐ Spinal canal as defined by simulation CT
- ☐ Other (please specify)_____

9) Do you subtract out the cord/thecal sac/planning risk volume from your PTV expansion?

- ☐ Yes
- ☐ No

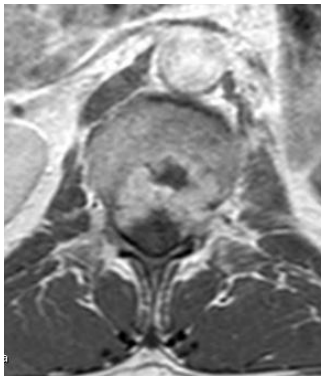
Please describe:_____
_____
_____
_____

10) In which of the following situations would you treat the epidural space circumferentially, as depicted in the image below? (Please select one option below that best fits your practice.)



Example of circumferential treatment

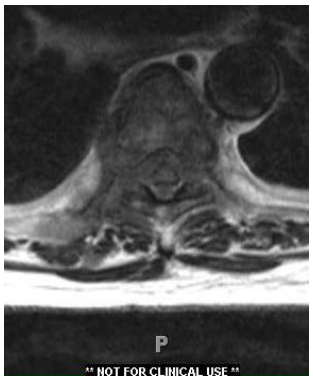
☐ I usually treat circumferentially, even when the disease is localized in the body (as depicted in the images below) since the epidural space is at high risk in all post-operative patients



Pre-op MRI

Simulation myelogram

☐ I treat circumferentially any time that there is circumferential involvement **pre-operatively**, even if the posterior elements have been completely removed (as depicted in the images below)



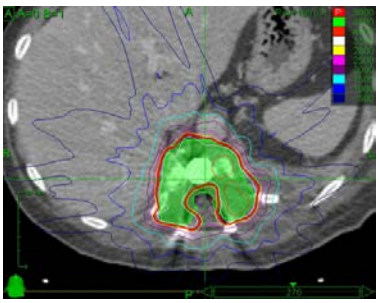
Pre-op MRI

Simulation myelogram

☐ I treat circumferentially only when there is circumferential **gross residual disease** visualized on post-operative imaging (as depicted in image below)

Post-op myelogram

☐ It is too difficult to meet dose constraints when treating a circumferential volume, so I usually leave a gap similar to that shown in the image below, even when there is circumferential disease, as long as it has been resected



☐ Other (please specify)_____

11) How do you manage paraspinal extension?

☐ Include the disease as visualized on MRI/CT with no additional margin
☐ Include the disease as visualized on MRI/CT plus a margin of 5 mm
☐ Other (please specify)_____

12) *What are your most frequent doses and fractionations for the following situations?*

a) No prior radiation therapy, single vertebral body, no epidural disease: _____

b) No prior radiation therapy, multiple vertebral bodies, no epidural disease:_____

c) No prior radiation therapy, epidural disease:_____

d) No prior radiation therapy, cord compression:_____

e) Prior radiation therapy, single vertebral body, no epidural disease :_____

f) Prior radiation therapy, multiple vertebral bodies, no epidural disease:_____

g) Prior radiation therapy, epidural disease:_____

h) Prior radiation therapy, cord compression:_____

13) *What spinal cord constraint (to your cord avoidance structure selected in question 8) do you use in the following situations? Please fill in any that apply and leave blank any with which you are not familiar.*

Prior Conventional RT dose	**1 fraction**	**2 fractions**	**3 fractions**	**4 fractions**	**5 fractions**
No prior RT with no cord compromise					
No prior RT but cord compromise					
800 cGy in 1 fraction					
2000 cGy in 5 fractions					
3000 cGy in 10 fractions					
4000 cGy in 20 fractions					
4500 cGy in 25 fractions					
5000 cGy in 25 fractions					

14) *True or False* : I account for repair and the time interval between prior RT and spinal SBRT in calculating my cord constraint for previously irradiated patients.

☐ True
☐ False
If true, how? _____

15) *True or False:* I use an integrated boost to give higher dose to areas of residual tumor vs the CTV.

☐ True
☐ False

If true:

a) What dose do you give to the GTV for radioresistant histologies?_____

b) What dose do you give to the GTV for non-radioresistant histologies?_____

16) How do you account for dose perturbation from metallic hardware and metallic artifacts?

☐ Treatment plans use a density override for any hardware that is within the beam path
☐ Treatment plans do not take the density of hardware into account
☐ Other (please specify)_____

17) *True or False:* For post-operative spine cases, my department uses a treatment planning algorithm approved by the RTOG for calculation of dose within a medium with heterogeneities.

☐ True
☐ False

<u>RTOG approved treatment planning algorithms:</u>

Brain Lab / Monte Carlo
Eclipse / ACUROS
XiO / Superposition – Fast Superposition
Helax / Collapsed Cone
Corvus / Monte Carlo
In House TPS / Monte Carlo
Eclipse / AAA
Pinnacle / Collapsed Cone Convolution – Adaptive Convolve
Monaco / Monte Carlo
TomoTherapy / Convolution Superposition
CyberKnife Multiplan / Monte Carlo

18) What coverage do you most frequently obtain on your PTV?

☐ 100% prescription dose covering 95%PTV
☐ 95% prescription dose covering 95% PTV
☐ 90% prescription dose covering 90% PTV
☐ 95-100% prescription dose covers at least 80% PTV
☐ 95-100% prescription dose covers at least 70% PTV
☐ 95-100% prescription dose covers at least 60% PTV
☐ Other (please specify)_____

19) What do you do if you are unable to meet target PTV coverage?

☐ Compromise PTV coverage to meet cord constraint
☐ Change fractionation to improve PTV coverage while meeting cord constraint
☐ Treat with conventional fractionation
☐ Other (please specify)_____