
XXXII CONGRESSO NAZIONALE AIRO
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XII CONGRESSO NAZIONALE AIRO GIOVANI
AIRO2022
Radioterapia di precisione per un'oncologia innovativa e sostenibile
BOLOGNA, 25-27 NOVEMBRE
PALAZZO DEI CONGRESSI
Associazione Italiana
Radioterapia e Oncologia clinica
Società Italiana di Radiobiologia

RUOLO DELLA RADIOTERAPIA STEREOTASSICA?

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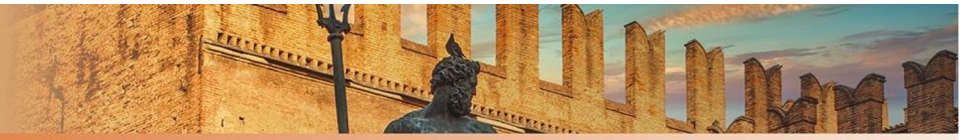


DICHIARAZIONE

Relatore: LUCA DOMINICI

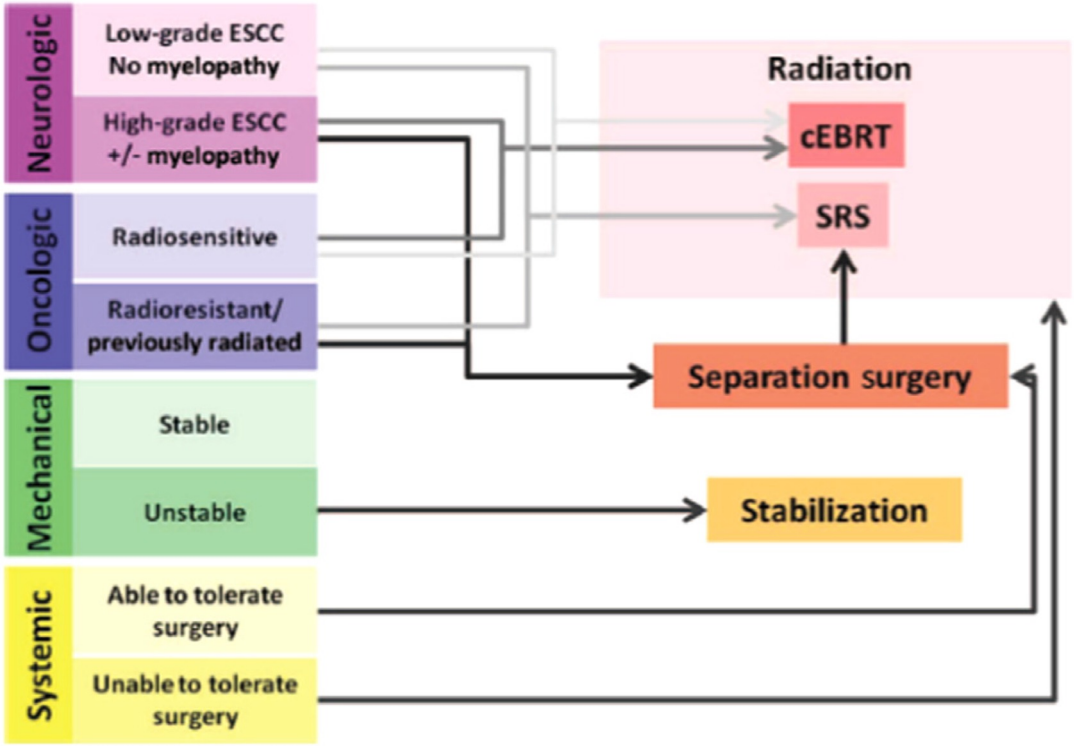
Come da nuova regolamentazione della Commissione Nazionale per la Formazione Continua del Ministero della Salute, è richiesta la trasparenza delle fonti di finanziamento e dei rapporti con soggetti portatori di interessi commerciali in campo sanitario.

- Posizione di dipendente in aziende con interessi commerciali in campo sanitario: NIENTE DA DICHIARARE
- Consulenza ad aziende con interessi commerciali in campo sanitario: NIENTE DA DICHIARARE
- Fondi per la ricerca da aziende con interessi commerciali in campo sanitario : NIENTE DA DICHIARARE
- Partecipazione ad Advisory Board : NIENTE DA DICHIARARE
- Titolarità di brevetti in compartecipazione ad aziende con interessi commerciali in campo sanitario: NIENTE DA DICHIARARE
- Partecipazioni azionarie in aziende con interessi commerciali in campo sanitario : NIENTE DA DICHIARARE
- Altro: NIENTE DA DICHIARARE

SPINE METASTASIS

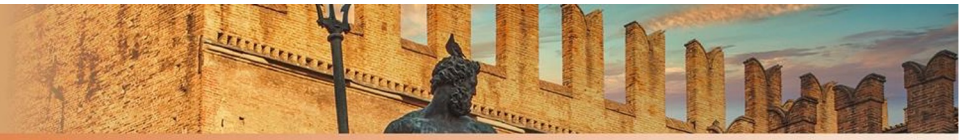
- **Occurrence rate at 40% among patients with bone metastasis**
- **Adverse skeletal-related events: pathological fracture, spinal cord/cauda equina compression, hypercalcemia**
- **Impact on Quality of Life**
- **Aims of RT: pain relief, prevent SRE, preserve QoL and functions, extend survival**

NOMS (NEUROLOGIC, ONCOLOGIC, MECHANICAL AND SYSTEMIC) SINS SCORE



Oncologist 18:744-751, 2013

SINS component	Score
Location	
Junctional (occiput–C2, C7–T2, T11–L1, L5–S1)	3
Mobile spine (C3–6, L2–4)	2
Semirigid (T3–10)	1
Rigid (S2–5)	0
Pain*	
Yes	3
Occasional pain but not mechanical	2
Pain-free lesion	0
Bone lesion	
Lytic	2
Mixed (lytic/blastic)	1
Blastic	0
Spinal alignment	
Subluxation/translation present	4
De novo deformity (kyphosis/scoliosis)	2
Normal alignment	0
Vertebral body collapse	
>50% collapse	3
<50% collapse	2
No collapse with >50% body involved	1
None of the above	0
Posterolateral involvement of the spinal elementsy†	
Bilateral	3
Unilateral	1
None of the above	0



Palliation of Metastatic Bone Pain: Single Fraction versus Multifraction Radiotherapy – A Systematic Review of Randomised Trials

W. M. Sze*, M. D. Shelley†, I. Held§, T. J. Wilt¶, M. D. Mason‡

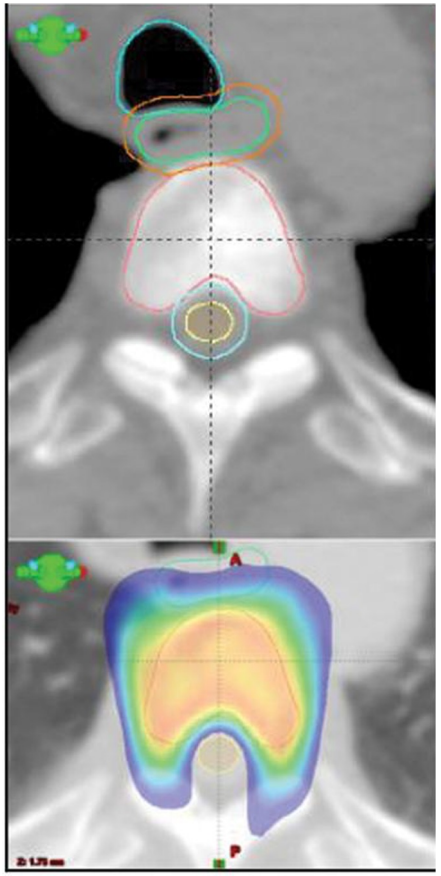
CLINICAL INVESTIGATION **Bone**

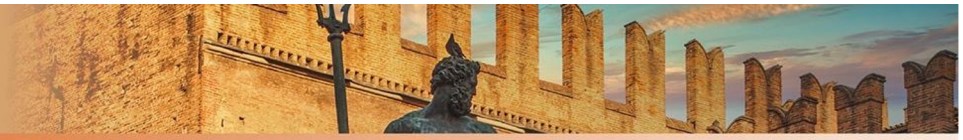
META-ANALYSIS OF DOSE-FRACTIONATION RADIOTHERAPY TRIALS FOR THE PALLIATION OF PAINFUL BONE METASTASES

JACKSON SAI-YIU WU, M.D., F.R.C.P.C.,* REBECCA WONG, M.B.CH.B., M.SC., F.R.C.P.C.,†
MARY JOHNSTON, B.SC.,‡ ANDREA BEZJAK, M.D.C.M., M.SC., F.R.C.P.C.,†
AND TIMOTHY WHELAN, B.M.B.CH., F.R.C.P.C.,*
ON BEHALF OF THE CANCER CARE ONTARIO PRACTICE GUIDELINES INITIATIVE SUPPORTIVE CARE GROUP§

- **Single fraction (SF) and multifractions (MF): same overall pain-response rates (60 % vs 59%)**
- **SF and MF: same complete pain-response rates (34% vs 32%)**
- **SF higher re-treatment rate compared with MF (21% vs 7,4%)**
- **SF higher incidence of pathological fractures (3% vs 1,6%)**
- **Spinal cord compression rates similar**

Stereotactic body radiotherapy (SBRT) is able to create **steep dose gradients** around the spinal cord for the sake of minimizing dose to the spinal cord or other organs at risk, while giving ablative doses of radiation to the tumor-bearing tissues.



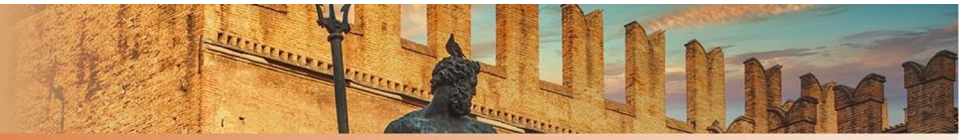


CRITERIA FOR SBRT SPINE

- Inclusion:
  - Spinal or paraspinal metastasis
    - Radioresistant histology
    - Failure of prior EBRT
    - Oligometastatic or bone-only metastatic disease
  - 3 or fewer involved spine segments
  - Stable spinal column
    - Calculate Spinal Instability Neoplastic Score (SINS score)
  - Low grade epidural disease
    - Utilize Bilsky grade
  - Limited extra-spinal systemic disease
  - Life expectancy >3 months
  - KPS > 40-50

- Exclusion:
  - Unstable spine requiring stabilization
  - Previous SBRT to lesion
  - EBRT within 90 days
  - Worsening neurologic deficit
  - Inability to lie flat on table
  - <3-month life expectancy
  - Spinal canal compromise >25%
  - Inability to have MRI
  - Receiving radiosensitizing chemotherapy

Adapted from ASTRO guidelines(3)



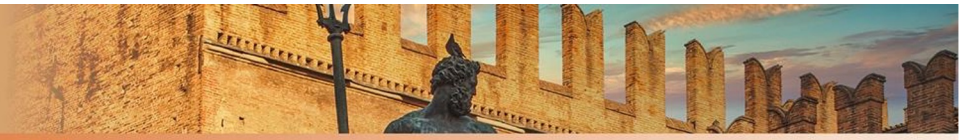
The **ideal candiate** for SBRT (or Radiosurgery) is:

- oncologically radioresistant histology
- with limited metastatic disease
- good prognosis that exceeds at least 6 months
- patient who on neurologic assessment has limited spinal cord compromise
- without mechanical instability

TABLE 4. ISRS-recommended patient selection for consideration of spine SBRT outside a clinical trial*

Criteria	Rationale	Level of Evidence
Inclusion		
Oligometastasis involving the spine	These pts generally have a long expected survival & thus are most likely to benefit from radiosurgery/SBRT	V
Pts w/ radioresistant histology (RCC, melanoma, sarcoma)	Higher doses of radiation might be associated w/ improved local tumor control	IV/V
Patients with paraspinal extension contiguous to the spine	Pts w/ extraosseous extension might experience improved soft-tissue tumor control	IV
Exclusion		
Pts w/ an expected survival time of <3 mos	Pts w/ a shorter expected survival time are less likely to benefit from SBRT	V
Mechanically unstable based on the SINS score	Pts w/ mechanical instability should be treated w/ surgical stabilization before radiotherapy	IV/V
>3 sites to be treated in a single session	For logistical reasons, it is difficult to keep a pt adequately immobilized for long enough to accurately treat more than 3 lesions in a single session	V
Spinal cord compression or cauda equina syndrome	These pts should be preferentially treated w/ up-front decompressive surgery†	I

Husain et al, 2017, j Neurosurg Spine



SBRT FOR DE NOVO SPINE METS

POST-OPERATIVE

REIRRADIATION

Study-Authors & Year	Intervention	Local control rates (%) (time of assessment or median FU)	Pain response rates (%)(time of assessment or median FU)
Sprave et al, 2018	24 Gy in 1 fracions	NR	Complete response: 43,5%
Tseng et al, 2018	24Gy in 2 fractions	90,3% (12 months)	NR
Yamada et al, 2017	16-26 gy in 1 fraction	99,5%	NR
Germano et al, 2016	10-18Gy in 1fraction	94% (16mo)	100% (7days)
Lee et al, 2016	16-27Gy in 1-3 fractions	81% (21mo)	NR
Moussazadeh et al, 2015	24Gy in 1 fraction	90,3% (72 mo)	NR
Sellin et al, 2015	24 Gy in 1 fraction	57% (49 mo)	41% (1,3, or 6 mo)
Bate et al, 2015	16-23Gy in 1 fraction	95,8% (12 mo)	NR
Sohn et al, 2014	38 Gy in 4 fractions (mean)	85,7% (12 mo)	Complete response: 23,1% (1 mo)
Guckenberger et al, 2014	16-60 Hy in 1-20 fractions	90% (12mo)	Complete response: 44-77% (11,5 mo)
Thibault et al, 2014	24 Gy in 2 fractions (median)	83% (12 mo)	NR
Chang et al, 2012	20 Gy in 1 fraction	89,2 % (12 mo)	89,2 (12 mo)

SBRT DE NOVO SPINE METS

HIGH LOCAL CONTROL AND PAIN CONTROL

Randomized phase II trial evaluating pain response in patients with spinal metastases following stereotactic body radiotherapy versus three-dimensional conformal radiotherapy

Tanja Sprave [a,c], Vivek Verma [b], Robert Förster [a,c,d], Ingmar Schlampp [a,c], Thomas Bruckner [e], Tilman Bostel [a], Stefan Ezechiel Welte [a], Eric Tonndorf-Martini [a], Nils Henrik Nicolay [a,c,f], Jürgen Debus [a,c], Harald Rief [a,c,*]

Single-fraction SBRT (24 Gy) vs 3DCRT (30 Gy in 10 fractions)

This trial showed better pain relief at 3 months (primary end point), significantly faster pain relief, and better pain relief at 6 months for SABR compared with cEBRT.

Response according to Brief Pain Inventory score at 3 and 6 months in the per-protocol cohort.

	Intervention group $n = 27$		Control group $n = 28$		
After 3 months	*n*	%	*n*	%	*p*-Value
CR	10	43,5	4	17,4	0,0568
PR	6	26,1	7	30,43	
PP	2	8,7	0	0	
IP	5	21,7	12	52,2	
Responders	16	69,6	11	47,8	0,1343
Non-responders	7	30,4	12	52,2	
After 6 months					
CR	10	52,6	2	10	0,0034
PR	4	21,1	5	25	
PP	2	10,5	0	0	
IP	3	15,8	13	65	
Responders	14	73,7	7	35	0,0154
Non-responders	5	26,3	13	65	

Radiosurgery for Spinal Metastases

Clinical Experience in 500 Cases From a Single Institution

Peter C. Gerszten, MD, MPH, Steven A. Burton, MD, Cihat Ozhasoglu, PhD, and William C. Welch, MD, FACS

SPINE Volume 32, Number 2, pp 193–199

A cohort of **500 cases of spinal metastases** underwent **radiosurgery**. Ages ranged from 18 to 85 years (mean 56).

The maximum intratumoral dose ranged from **12.5 to 25 Gy (mean 20).** Tumor volume ranged from 0.20 to 264 mL (mean 46).

Table 2. Lesion Histopathologies (n = 500)

	No.
Renal cell	93
Breast	83
Lung	80
Melanoma	38
Colon	32
Sarcoma	26
Prostate	24
Multiple myeloma	18
Unknown primary	14
Squamous cell (laryngeal)	12
Thyroid	11
Other	69

Table 3. Summary of Pain and Radiographic Outcome for the 4 Most Common Histopathologies (n = 294)

Long-term pain improvement	
All patients	86%
Renal cell	94%
Breast	96%
Lung	93%
Melanoma	96%
Long-term radiographic control	
All patients	88%
Renal cell	87%
Breast	100%
Lung	100%
Melanoma	75%

The impact of histology and delivered dose on local control of spinal metastases treated with stereotactic radiosurgery

Yoshiya Yamada, MD, FRCPC[1], Evangelia Katsoulakis, MD[1], Ilya Laufer, MD[2], Michael Lovelock, PhD[4], Ori Barzilai, MD[2], Lily A. McLaughlin, BS[2], Zhigang Zhang, PhD[5], Adam M. Schmitt, MD[1], Daniel S. Higginson, MD[1], Eric Lis, MD[3], Michael J. Zelefsky, MD[1], James Mechalakos, PhD[4], and Mark H. Bilsky, MD[2]

Neurosurg Focus. 2017 January ; 42(1): E6.

A total of **811 lesions** were treated in 657 patients between 2003 and 2015 at a single institution.

The mean follow-up and **overall survival** for the entire cohort was **26.9 months** (range 2–141 months).

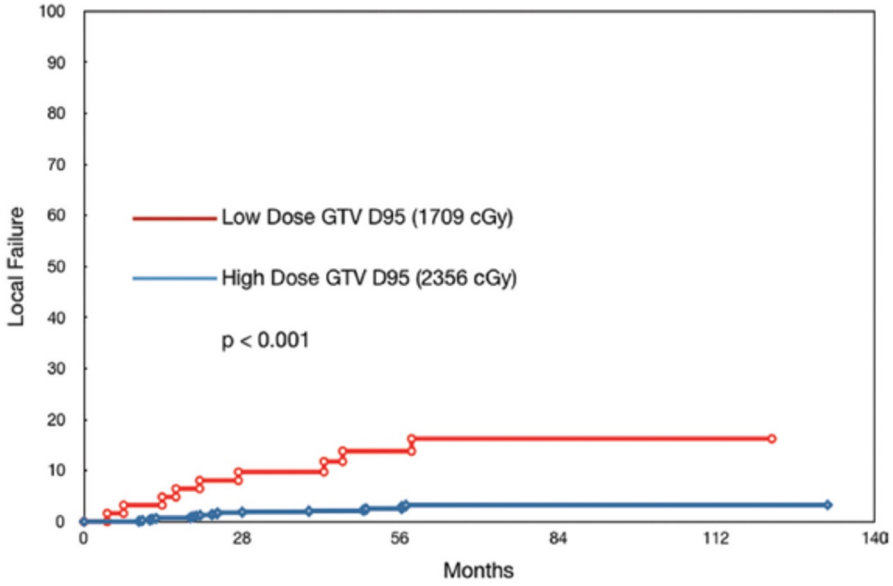
The **median** prescribed dose was **2400 cGy** (range 1600–2600 cGy)

A total of **28 lesions progressed** and the mean time to failure was 26 months (range 9.7–57 months).

Those lesions irradiated to **higher doses** (median GTV D95 2356 cGy, minimum 1830 cGy) had a significantly **higher probability of durable local control** than those treated with lower doses (median PTV D95 2232 cGy, minimum of 1740 cGy) ($p < 0.001$).

Histological findings were **not associated** with local failure, suggesting that radioresistant histological types benefit in particular from radiosurgery.

Vertebral Compression Fracture (VCF) rate of 36% at a median follow-up of 25.7 mo - 12% intervention for symptoms

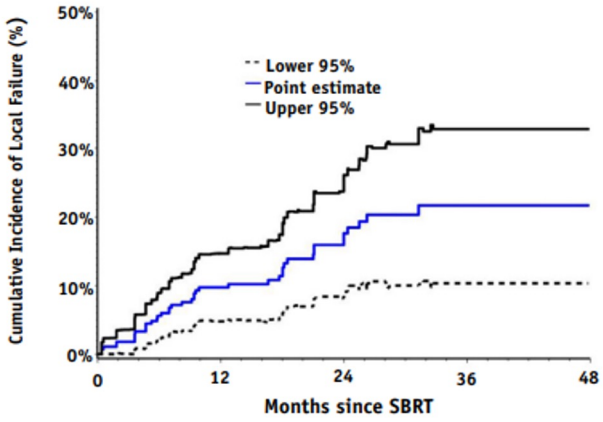


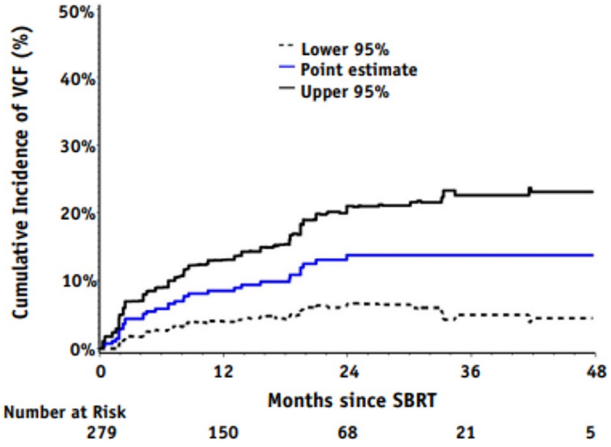
CIF% (95%CI)	12 months	24 months	36 months	48 months
Overall	**0.63%** (0.08-1.2%)	**2.3%** (1.2-3.3%)	**2.6%** (1.2-3.7%)	**3.1%** (1.8-4.4%)
GTV D95 Low Dose	**3.2%** (0-7.7%)	**8.1%** (1.2-15%)	**9.7%** (2.2-17%)	**14%** (4.7-23%)
GTV D95 High Dose	**0.42%** (0-0.9%)	**1.8%** (0.77-2.8%)	**1.9%** (0.89-3%)	**2.1%** (1-3.2%)

Imaging-Based Outcomes for 24 Gy in 2 Daily Fractions for Patients with de Novo Spinal Metastases Treated With Spine Stereotactic Body Radiation Therapy (SBRT)

Tseng et al, 2018 - Odette Cancer centre-Sunnybrook Health Sciences Centre

- 24 Gy in 2 daily fractions
- 145 patients with 279 spinal mets
- Very good cumulative rates of local failure (1- and 2-year local control of 9.7 % and 17.6 % respectively
- Lower comparative rates of VCF (1- and 2- year VCF rates of 8.6% and 17.6% respectively)





SBRT vs CRT - PAIN RELIEF

Stereotactic body radiotherapy for de novo spinal metastases: systematic review

International Stereotactic Radiosurgery Society practice guidelines

Husain et al, 2017, j Neurosurg Spine

14 studies (2 prospective): 1024 lesions treated with SBRT in single o multiple fractions
Overall pain response > 85% with SBRT
Complete pain response from 43.8 to 56.3%

Update on the Systematic Review of Palliative Radiotherapy Trials for Bone Metastases

E. Chow *, L. Zeng *, N. Salvo *, K. Dennis *, M. Tsao *, S. Lutz †

25 randomized trials
Overall pain response from 60% to 70% with CRT
Complete pain response < 20%

Stereotactic body radiotherapy versus conventional external beam radiotherapy in patients with painful spinal metastases: an open-label, multicentre, randomised, controlled, phase 2/3 trial

Sahgal et al, 2021, Lancet oncol

229 patiens enrolled
115 treated with cEBRT 20 Gy in 5 fractions
114 treated with SBRT 24 Gy in 2 fractions

	Conventional external beam radiotherapy group (n=115)			Stereotactic body radiotherapy group (n=110)		
	Grade 2	Grade 3	Grade 4	Grade 2	Grade 3	Grade 4
Dysphagia	0	0	0	1 (1%)	1 (1%)	0
Oesophagitis*	2 (2%)	0	0	2 (2%)	0	0
Nausea	2 (2%)	1 (1%)	0	1 (1%)	0	0
Pain†	4 (3%)	5 (4%)	0	2 (2%)	5 (5%)	0
Fatigue	0	1 (1%)	0	0	0	0
Vertebral compression fracture	0	0	1 (1%)	0	1 (1%)	0

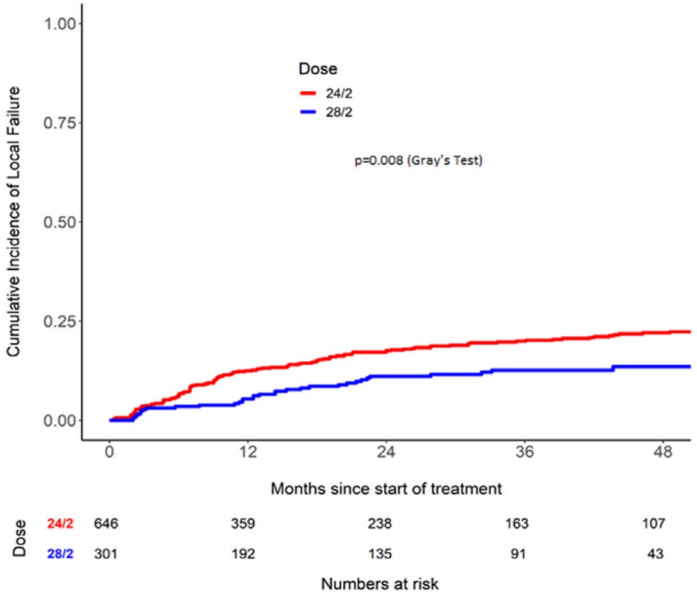
	Conventional external beam radiotherapy group (n=115)	Stereotactic body radiotherapy group (n=114)	p value
1-month assessment			
Complete response	20 (17%)	30 (26%)	0·10*
Partial response	33 (29%)	34 (30%)	..
Stable pain	38 (33%)	26 (23%)	..
Progressive pain	14 (12%)	9 (8%)	..
Indeterminant	10 (9%)	15 (13%)	..
Mean daily OME consumption, mg	44 (122)	27 (95)	0·26
3-month assessment			
Complete response	16 (14%)	40 (35%)	0·0002*
Partial response	29 (25%)	20 (18%)	..
Stable pain	34 (30%)	27 (24%)	..
Progressive pain	14 (12%)	7 (6%)	..
Indeterminant	22 (19%)	20 (18%)	..
Mean daily OME consumption, mg	43 (106)	37 (97)	0·70
Mean change in SINS from baseline	−0·49 (1·61)	−0·94 (1·69)	0·034

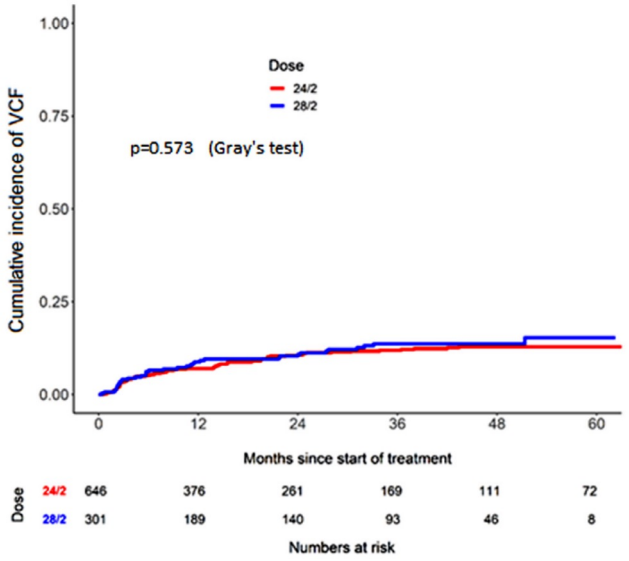
	Conventional external beam radiotherapy group (n=115)	Stereotactic body radiotherapy group (n=114)
Primary tumour classification		
Radioresistant	30 (26%)	30 (26%)
Radiosensitive	85 (74%)	84 (74%)

Dose-Escalated 2-Fraction Spine Stereotactic Body Radiation Therapy: 28 Gy Versus 24 Gy in 2 Daily Fractions

Zeng et al, Int J Radiat Oncol Biol Phys. 2022

- 947 treated vertebral segments in 482 patients
- 28 Gy or 24 Gy in 2 daily fractions
- In the 28 Gy cohort, the 6-, 12-, and 24-month cumulative incidences of local failure were 3.5%, 5.4% and 11.1%, respectively, vs. 6.0%, 12.5% and 17.6% in the 24 Gy cohort, respectively (p=0.008)
- No increase risk of vertebral compression fracture





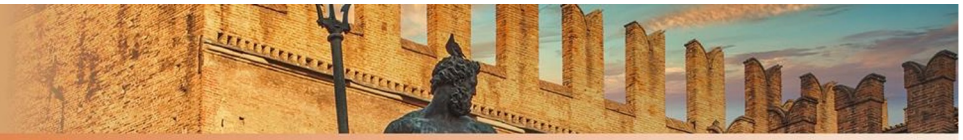
Vertebral Compression Fracture After Spine Stereotactic Body Radiation Therapy: A Review of the Pathophysiology and Risk Factors

Faruqi S, Neurosurgery. 2017 Oct 18

TABLE 2. A Summary of Statistically Significant Predictive Factors Observed on Multivariate Analysis by at Least 2 Studies From Those Described in Table 1 and the Associated Range of HR

Risk factor	Number of studies reporting this risk factor	Range of HR
Lytic disease	6	2.76-12.2
Baseline VCF	6	1.69-9.25
Dose per fraction (dose/fx)	4	5.03-6.82
Spinal deformity	2	2.99-11.1
Age (>55 or ≥65)	2	2.15-5.67
>40%-50% VB involved by tumor	2	3.9-4.46

VCF, vertebral compression fracture; VB, vertebral body



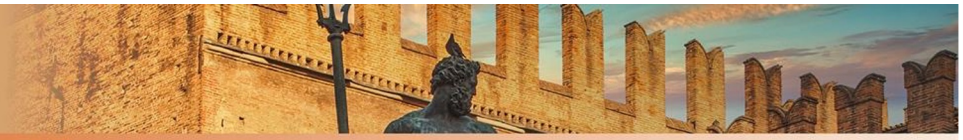
HyTEC Organ-Specific Paper

Spinal Cord Dose Tolerance to Stereotactic Body Radiation Therapy

Arjun Sahgal, MD,* Joe H. Chang, MBChB, PhD,* Lijun Ma, PhD,†
Lawrence B. Marks, MD,‡ Michael T. Milano, MD, PhD,§
Paul Medin, PhD,‖ Andrzej Niemierko, PhD,¶ Scott G. Soltys, MD,#
Wolfgang A. Tomé, PhD,** C. Shun Wong, MD,* Ellen Yorke, PhD,††
Jimm Grimm, PhD,‡‡ and Andrew Jackson, PhD††

For de novo SBRT delivered in 1 to 5 fractions, the following spinal cord point maximum doses (Dmax) are estimated to be associated with a 1% to 5% risk of radiation myelopathy (RM):

- 12.4 Gy to 14.0 Gy in 1 fraction
  - 17.0 Gy in 2 fractions
  - 20.3 Gy in 3 fractions
  - 23.0 Gy in 4 fractions
  - 25.3 Gy in 5 fractions



POSTOPERATIVE RADIOTHERAPY

- In current multimodality treatment paradigms, surgery for metastatic tumors is reserved as initial therapy to treat patients with high-grade spinal cord or cauda equina **compression** with or without myelopathy or in cases of significant spinal **instability**.

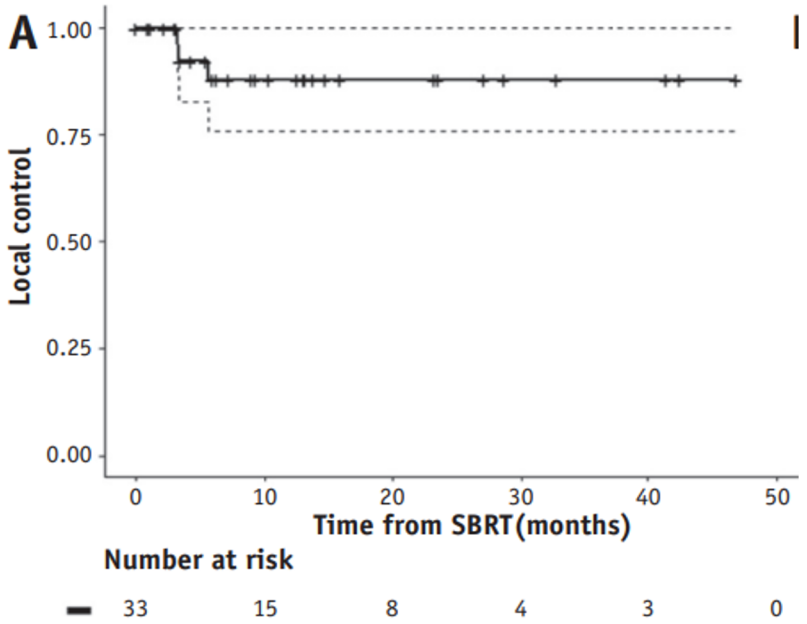
- The majority of solid tumors do not respond rapidly to radiotherapy and may benefit from **surgery to decompress** the neural elements and to stabilize the spinal column.

- The rationale for using radiosurgery as opposed to conventional radiotherapy as an adjuvant to surgical decompression is the predicted improvement in tumor control based on radio-responsiveness.

A Phase 2 Study of Post-Operative Stereotactic Body Radiation Therapy (SBRT) for Solid Tumor Spine Metastases

Redmond et al, Int J Radiat Oncol Biol Phys. 2020 Feb

- 33 patients (35 target volumes)
- SBRT: 30 Gy in 5 fractions
- Local control at 1 year was 90 %
- No grade 3 or more toxicities



Stereotactic Radiosurgery for Postoperative Spine Malignancy: A Systematic Review and International Stereotactic Radiosurgery Society Practice Guidelines

Faruqi S. et al, Pract Radiat Oncol. 2022 Mar-Apr

Table 4 ISRS recommendations for the use of postoperative spine SBRT

Key recommendations

Patient selection
- Patients with oligometastatic disease.
- Patients with radioresistant histologies and/or those with mass-type tumors with paraspinal extension.
- If prior cEBRT or SBRT has been given to the affected spinal segment then salvage postoperative SBRT can be considered.

Treatment planning
- All patients should undergo an axial high-resolution 1.5 Tesla T1/T2 MRI of the affected spinal segment including at least one vertebral segment above and below the target volume for both target and OAR delineation. This MRI is fused to the planning CT scan. Use of gadolinium or CT contrast can assist in delineation of soft tissue tumor extension. A CT-myelogram can be considered, especially for cases where hardware artifact obscures canal on the MRI scan. In this scenario it is best to perform a simulation CT myelogram as opposed to a diagnostic CT myelogram that is then fused to the radiation planning CT.
- A 1.5-2 mm PRV should be applied to the spinal cord. The thecal sac does not need a PRV. Spinal cord and thecal sac dose limits vary based on fractionation. Published guidelines for dose constraints can be consulted as indicated.[34-36]
- The preoperative extent of epidural/paraspinal disease should be included in the postoperative CTV. This often requires the use of a "donut" type CTV.[38] A 5 mm superior/inferior CTV expansion including the spinal canal beyond visible epidural disease should also be considered, in addition to a 5 mm margin surrounding any paraspinal soft tissue disease extension while respecting anatomic boundaries. The surgical scar does not need to be included in the CTV. Contouring recommendations have been published by Chan et al and Redmond et al.[38,39]
- A minimum time interval of 1-week from the time of a minimally invasive spinal surgery, and 8-14 days for more invasive surgeries, should be maintained before simulation for SBRT. Delays longer than 4 weeks postoperatively to the initiation of radiation may result in worse tumor control.

Follow-up
- In addition to history and physical examination, a spine MRI should be considered every 2-3 months post-SBRT for the first year and then every 3-6 months thereafter.

Abbreviations: CT = computed tomography; CTV = clinical target volume; cEBRT = conventional external beam radiation therapy; ISRS = International Stereotactic Radiosurgery Society; MRI = magnetic resonance imaging; OAR = organ at risk; PRV = planning organ-at-risk volume; SBRT = stereotactic body radiation therapy.

Reirradiation spine stereotactic body radiation therapy for spinal metastases: systematic review

International Stereotactic Radiosurgery Society practice guidelines

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SBRT has the potential to substantially reduce the Dmax to the spinal cord, and allow to deliver a comparatively higher dose then cEBRT

SBRT to previously irradiated spinal metastases is safe and effective with respect to both local control and pain relief

Targets treated	Median retreatment total dose/fraction	Local control	Overall survival	Pain response	VCF
22	24 Gy/3	1 year, 83%	1 year, 28%	NR	5%
237	16 Gy/1	1 year, 71%	NR	81%	9.3%
54	20.6 Gy/1	1 year, 81%	Median, 11 months	81%	22%
51	20 Gy/2	1 year, 73%	1 year, 68%	65%	NR
92	30 Gy/5	1 year, 66%	Median, 13.6 months	77%	9.8%
63	27 Gy/3	1 year, 68%	1 year, 76%	Improvement at 6 months	NR
247	16.6 Gy/1 24 Gy/3*	1 year, 83%	1 year, 48%	74.3%	4.5%
81	30 Gy/5	1 year, 93%	Median, 11 months	79%	NR
37	24 Gy/3	1 year, 82%	Median, 21 months	NR	NR
11	24 Gy/2	1 year, 83%	NR	NR	0
56	30 Gy/4	1 year, 81%	Median, 10 months	NR	NR

CLINICAL INVESTIGATION **Central Nervous System Tumor**

REIRRADIATION HUMAN SPINAL CORD TOLERANCE FOR STEREOTACTIC BODY RADIOTHERAPY

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Table 6. Reasonable reirradiation SBRT doses to the thecal sac P_{max} following common initial conventional radiotherapy regimens

Conventional Radiotherapy (nBED)	1 fraction: SBRT dose to thecal sac P_{max}	2 fractions: SBRT dose to thecal sac P_{max}	3 fractions: SBRT dose to thecal sac P_{max}	4 fractions: SBRT dose to thecal sac P_{max}	5 fractions: SBRT dose to thecal sac P_{max}
0*	10 Gy	14.5 Gy	17.5 Gy	20 Gy	22 Gy
20 Gy in 5 fractions ($30\ Gy_{2/2}$)	9 Gy	12.2 Gy	14.5 Gy	16.2 Gy	18 Gy
30 Gy in 10 fractions ($37.5\ Gy_{2/2}$)	9 Gy	12.2 Gy	14.5 Gy	16.2 Gy	18 Gy
37.5 Gy in 15 fractions ($42\ Gy_{2/2}$)	9 Gy	12.2 Gy	14.5 Gy	16.2 Gy	18 Gy
40 Gy in 20 fractions ($40\ Gy_{2/2}$)	N/A	12.2 Gy	14.5 Gy	16.2 Gy	18 Gy
45 Gy in 25 fractions ($43\ Gy_{2/2}$)	N/A	12.2 Gy	14.5 Gy	16.2 Gy	18 Gy
50 Gy in 25 fractions ($50\ Gy_{2/2}$)	N/A	11 Gy	12.5 Gy	14 Gy	15.5 Gy

Reirradiation on spine metastases: an Italian survey on behalf of palliative care and reirradiation study groups of Italian association of radiotherapy and clinical oncology (AIRO)

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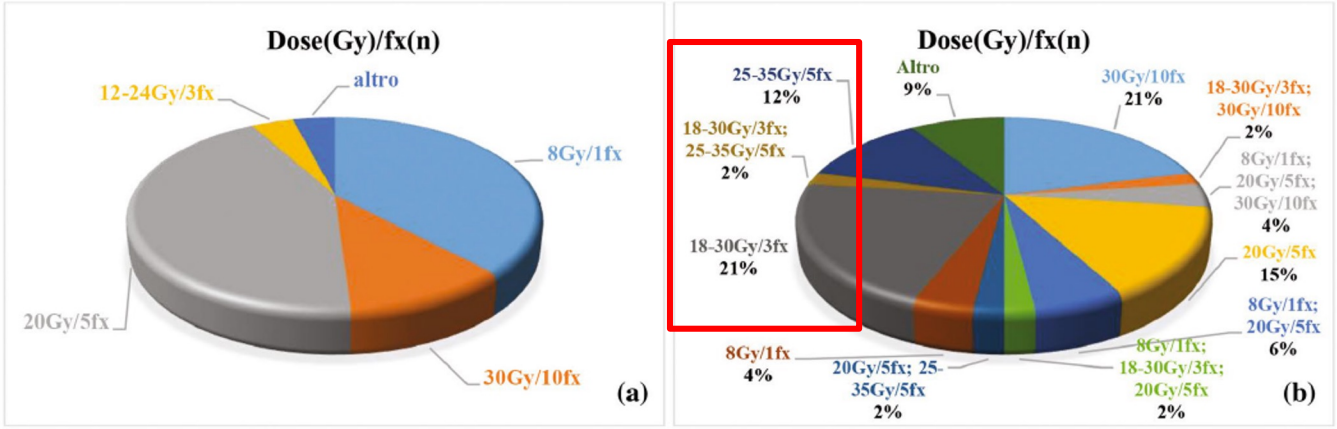

Fig. 1 **a** Prescription dose in the first setting of patients; **b** prescription dose in the second setting of patients

TAKE HOME MESSAGE

- In selected patients, the stereotactic radiotherapy on de novo spinal metastases provides excellent local control and pain relief.

- The possibility to use a fractionated treatment schedule reduces the risk of vertebral fracture, with preservation of therapeutic response.

- The stereotactic radiotherapy plays an important role in patients who have previously had surgery.

- The use of stereotactic radiotherapy in reirradiation is safe and effective.

THANK YOU FOR YOUR ATTENTION

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