DICHIARAZIONE

Relatore: Antonio PONTORIERO

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)**
- Titolarietà 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)**

XXVI CONGRESSO NAZIONALE AIRO
XXX CONGRESSO NAZIONALE AIRB
IX CONGRESSO NAZIONALE AIRO GIOVANI

Farmaci innovativi e ipofrazionamento
PALACONGRESSI DI RIMINI - 30 settembre, 1 - 2 ottobre 2016

UNIVERSITA' DEGLI STUDI DI MESSINA
Facoltà di Medicina e Chirurgia
Dipartimento di Scienze Biomediche, Odontoiatriche, Morfologiche delle Immagini Funzionali
Sezione di Scienze Radiologiche
Scuola di Specializzazione in Radioterapia
Dir. Prof. S. Pergolizzi

Radioterapia locale e sistemica nel trattamento delle metastasi ossee.

A. Pontoriero

Local and systemic radiotherapy in the treatment of bone metastases.

- S. Hellman and ***R. R.Weichselbaum***, “Oligometastases,” Journal of Clinical Oncology, vol. 13, no. 1, pp. 8–10, 1995.
- ***Rubin P***, Brasacchio R, Katz A: Solitary metastases: illusion versus reality. *Semin Radiat Oncol 2006, 16:120–130.*
- ***Niibe Y***, Hayakawa K: Oligometastases and oligo-recurrence: the new era of cancer therapy. *Jpn J Clin Oncol 2010, 40:107–111*.
- **Niibe Y**, Chang JY, Onishi H, Salama J, Hiraki T, Yamashita H: Oligometastases/Oligo-Recurrence of Lung Cancer. *Pulm Med 2013.*

R. R.Weichselbaum 1995

- *Oligometastases are defined as 1–5 distant metastases that can be treated by local therapy to achieve long-term survival or cure.*

Rubin P, 2006: Restaging stage IV cancer.

Rubin' s TNM staging system

- **M:** → "M1" Solitary metastasis.
  "M2" Oligometastases .
  "M3" Multiple metastases.

- **S** → Presence and levels of any serological markers.
- **H** → Karnofsky scale *(condition of the patient)*.
- **A or B** → Patient is symptomatic or not.

JJCO Japanese Journal of Clinical Oncology

Jpn J Clin Oncol 2010;40(2)107–111
doi:10.1093/jjco/hyp167
Advance Access Publication 4 January 2010

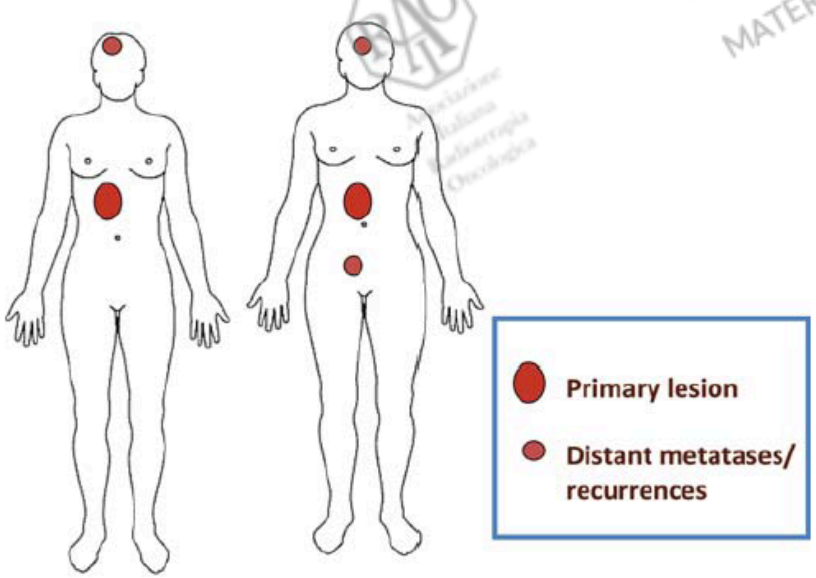
Review Article

Oligometastases and Oligo-recurrence: The New Era of Cancer Therapy

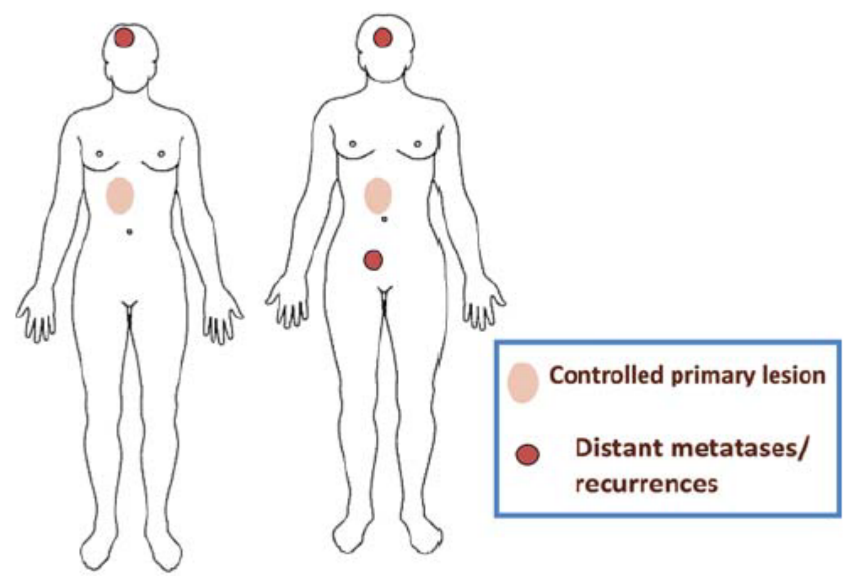
Yuzuru Niibe* **and Kazushige Hayakawa**

Department of Radiation Oncology, Kitasato University School of Medicine, Sagamihara, Kanagawa, Japan

Schema of oligometastases



Schema of oligo-recurrence



Editorial

Oligometastases/Oligo-Recurrence of Lung Cancer

Hindawi Publishing Corporation
Pulmonary Medicine
Volume 2013, Article ID 438236, 3 pages
http://dx.doi.org/10.1155/2013/438236

Yuzuru Niibe,[1] Joe Y. Chang,[2] Hiroshi Onishi,[3] Joseph Salama,[4] Takao Hiraki,[5] and Hideomi Yamashita[6]

[1] *Department of Radiology and Radiation Oncology, Kitasato University School of Medicine, 1-15-1 Kitasato, Minami-ku, Kanagawa, Sagamihara 252-0374, Japan*
[2] *Department of Radiation Oncology, Yamanashi University School of Medicine, Yamanashi, Japan*
[3] *Department of Radiation Oncology, Duke University, Durham, NC, USA*
[4] *Department of Radiation Oncology, Yamanashi University School of Medicine, Yamanashi, Japan*
[5] *Department of Radiology, Okayama University Medical School, Okayama, Japan*
[6] *Department of Radiology, The University of Tokyo Hospital, Tokyo, Japan*

Favorable	Intermediate Relatively favorable	 Relatively unfavorable	Unfavorable
Oligorecurrence Site no. 1-2 NSCLC (brain and adrenal gland) Colon and rectum cancer (lung and liver) Renal cell cancer	*oligo-recurrence* site no. 1-2 breast cancer (bone, lung, and liver) SCLC (brain) site no. 3–5 NSCLC (brain and adrenal gland) colon and rectum cancer (lung and liver) renal cell cancer	*oligo-recurrence* site no. 3–5 breast cancer (bone, lung, and liver) SCLC (brain)	*Oligometastases* and *oligo-recurrence* pancreatic cancer (any site) melanoma (any site) sarcoma (any site)
	sync-oligometastases site no. 1-2 NSCLC (brain and adrenal gland) colon and rectum cancer (lung and liver) renal cell cancer	*sync-oligometastases* site no. 3–5 NSCLC (brain and adrenal gland) colon and rectum cancer (lung and liver) breast cancer (bone, lung, and liver)	*polymetastases*

Niibe-Onishi-Chang classification 2013

- Oligometastases and oligo-recurrence are cancer and organ-specific.
- Sync-oligometastases and oligo-recurrences. Sync-oligometastasis indicates a state of oligometastases with active but controllable primary lesions.
- Polymetastases: worse prognosis.
- Oligorecurrence of breast cancer, patients are reported to achieve relatively favorable survival; patients with bone-only oligorecurrence were still alive at the last followup (median followup, 40 months).

Niibe I, Hayakawa K. 2010

Patients with Stage IV of Cancer:

•Oligometastatic disease at diagnosis.

•Oligoprogressive disease after cytoreductive therapy.

•Oligorecurrent disease after curative locoregional therapy.

Radiotherapy and Bone Metastases

❖ **Prognosis**
- Favorable
- Intermediate
- Unfavorable

✓ **Site**
- Appendicular
- Spinal
- Pelvis

✧ **Type**
- Osteolytic
- Osteoblastic
- Mixed

Bone metastases

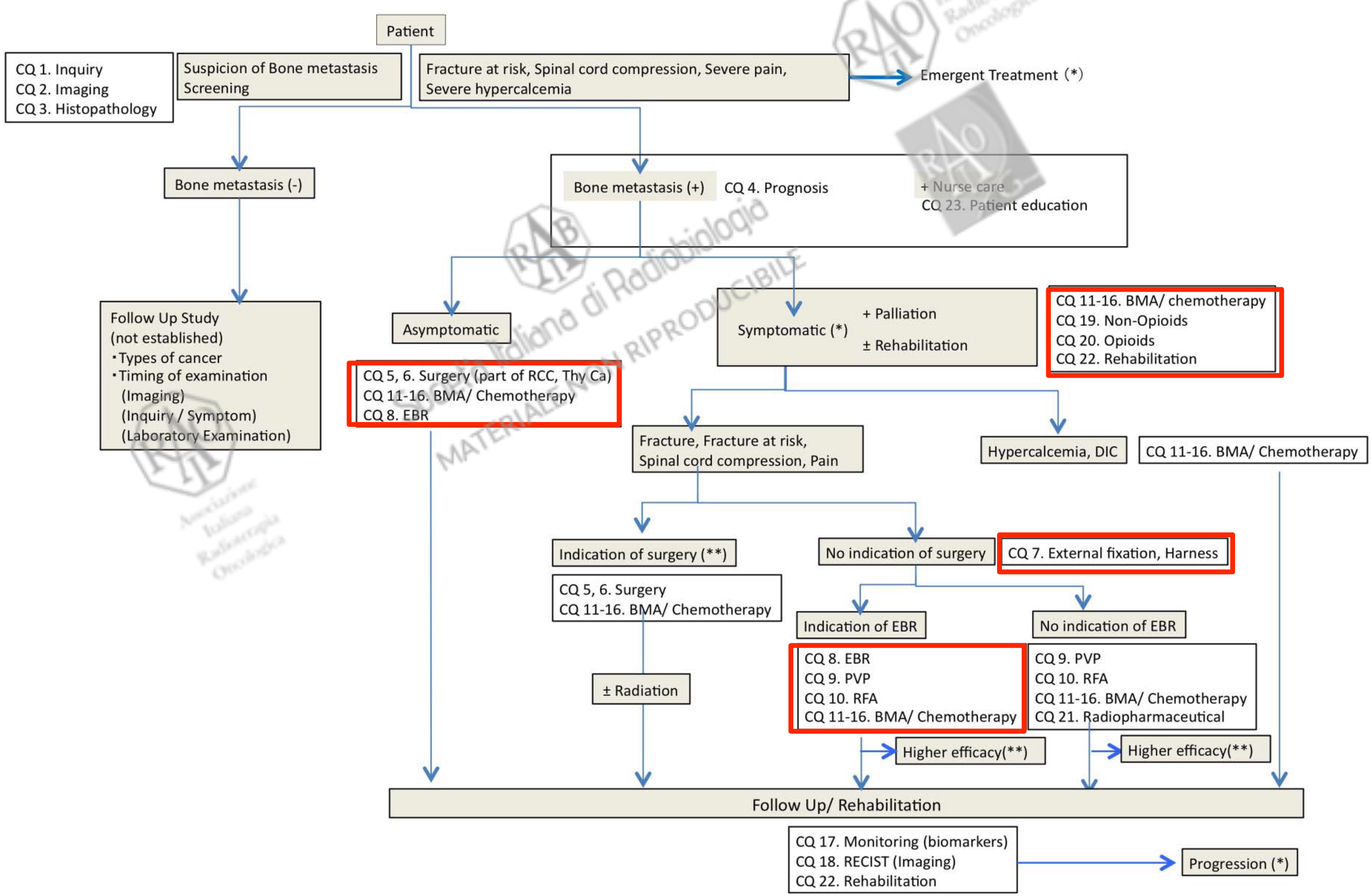
- ***"Uncomplicated":*** bone metastases can be defined as: presence of painful bone metastases unassociated with impending or existing pathologic fracture or existing spinal cord or cauda equina compression.

- ***"Complicated":*** Approximately one-third of bone metastatses.

Tiwana MS, Barnes M, Yurkowski E, Roden K, Olson RA. Incidence and treatment patterns of complicated bone metastases in a population-based radiotherapy program. **Radiother Oncol 2016 Mar;118(3):552-556.**

ESMO Open
Cancer Horizons

Diagnosis and treatment of bone metastasis: comprehensive guideline of the Japanese Society of Medical Oncology, Japanese Orthopedic Association, Japanese Urological Association, and Japanese Society for Radiation Oncology



Radiotherapy and Bone Metastases

- **Objectives:**

✓ Palliation of symptoms

✓ Pain control (within 24-48 hours)

✓ Bone lesion stabilization

✓ Delay pathological fracture, spinal cord compression

Patients with Bone Metastases

- **Prognosis**
  - **Favorable**
  - **Intermediate**
  - Unfavorable
- **Site**
  - **Appendicular**
  - **Spinal**
  - **Pelvis**
- **Type**
  - **Osteolytic**
  - **Osteoblastic**
  - **Mixed**

Dose Fractionation Schedule

8Gy in one fraction is recommended for the treatment of uncomplicated bone metastases. Numerous randomized controlled trials have consistently demonstrated the equivalence of single and multiple fraction schedules for the palliation of pain. Meta-analyses of these trials have repeatedly shown no significant differences between single fraction and multi-fraction RT regimens with regards to rates of pathological fractures, spinal cord compression, QOL, acute toxicity, time to first improvement in pain, time to complete pain relief, time to pain progression, or opioid use. There is insufficient evidence to recommend a specific dose fractionation schedule for oligometastatic disease although effectiveness of single fraction EBRT in patients with a life expectancy of >12 months has been established.

•***Nguyen J, Chow E, Zeng L, Zhang L, Culleton S, Holden L, et al.*** Palliative response and functional interference outcomes using the Brief Pain Inventory for spinal bony metastases treated with conventional radiotherapy. **Clin Oncol (R Coll Radiol) 2011 Sep;23(7):485-491.**

•***Lutz S, Berk L, Chang E, Chow E, Hahn C, Hoskin P, et al.*** Palliative radiotherapy for bone metastases: an ASTRO evidence-based guideline. **Int J Radiat Oncol Biol Phys 2011 Mar 15;79(4):965-976.**

•***Lutz S, Chow E.*** A review of recently published radiotherapy treatment guidelines for bone metastases: contrasts or convergence? **J Bone Oncol 2012;1(1): 18-23.**

•***Souchon R, Feyer P, Thomssen C, Fehm T, Diel I, Nitz U, et al.*** Clinical Recommendations of DEGRO and AGO on Preferred Standard Palliative Radiotherapy of Bone and Cerebral Metastases, Metastatic Spinal Cord Compression, and Leptomeningeal Carcinomatosis in Breast Cancer. **Breast Care (Basel) 2010 Dec;5(6):401-407.**

•***Coleman R, Body JJ, Aapro M, Hadji P, Herrstedt J***, on be half of the ESMO Guidelines Working Group. Bone health in cancer patients: **ESMO Clinical Practice Guidelines. Ann Oncol 2014 Apr 29.**

•***Lutz S, Lo SS, Chow E, Sahgal A, Hoskin P.*** Radiotherapy for metastatic bone disease: current standards and future prospectus**. Expert Rev Anticancer Ther 2010 May;10(5):683-695.**

•***Chow E, Harris K, Fan G, Tsao M, Sze WM.*** Palliative radiotherapy trials for bone metastases: a systematic review. **J Clin Oncol 2007 Apr 10;25(11): 1423-1436.**

•***Wu JS, Wong RK, Lloyd NS, Johnston M, Bezjak A, Whelan T, et al.*** Radiotherapy fractionation for the palliation of uncomplicated painful bone metastases - an evidence-based practice guideline. **BMC Cancer 2004 Oct 4;4:71.**

•***Sze WM, Shelley MD, Held I, Wilt TJ, Mason MD***. Palliation of metastatic bone pain: single fraction versus multifraction radiotherapy--a systematic review of randomised trials. **Clin Oncol (R Coll Radiol) 2003 Sep;15(6):345- 352.**

REPORTS OF PRACTICAL ONCOLOGY AND RADIOTHERAPY 19 (2014) 405–411

Available online at www.sciencedirect.com

ScienceDirect

journal homepage: http://www.elsevier.com/locate/rpor

Original research article

Radiation therapy for the management of painful bone metastases: Results from a randomized trial

Lucia Gutiérrez Bayard[a,*], *María del Carmen Salas Buzón*[a], *Esther Angulo Paín*[b], *Lourdes de Ingunza Barón*[a]

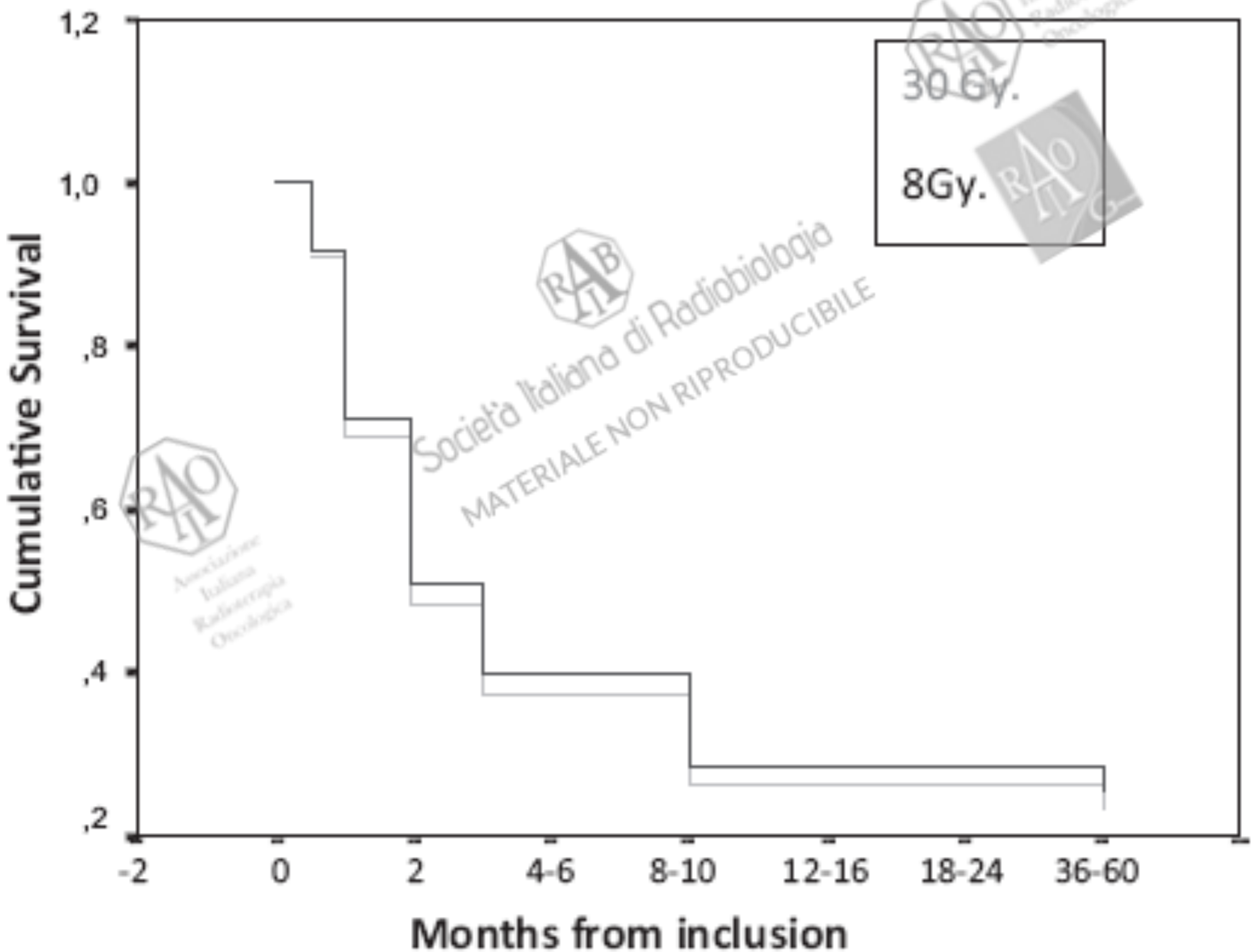
[a] *RadiotherapyOncology Department, UCG Atención Integral al Cáncer, H.U.Puerta del Mar, Cádiz, Spain*
[b] *Radiophysics and Radioprotection Department, Spain*

Table 2 – Pathological fractures and re-irradiations according to primary treatment regimen (*n* = 90).

	8 Gy	30 Gy	*p*-value	Total
Pathological fracture	7 (15%[a])	2 (4.4%)	0.099	9 (10%[b])
Re-irradiation	6 (13.3%)	4 (8.8%)	0.043	12 (13.3%)
Skeletal-related events[c]	13 (28.8%)	6 (13.3%)		21 (23.3%)
Total	45 (100%)	45 (100%)		90 (100%)

[a] Percent within treatment arms.
[b] Percent within the total number of patients.
[c] Includes at least one event of re-irradiation or pathological fracture following irradiation for bone metastases.

Survival functions and total reduction of analgesic treatment.

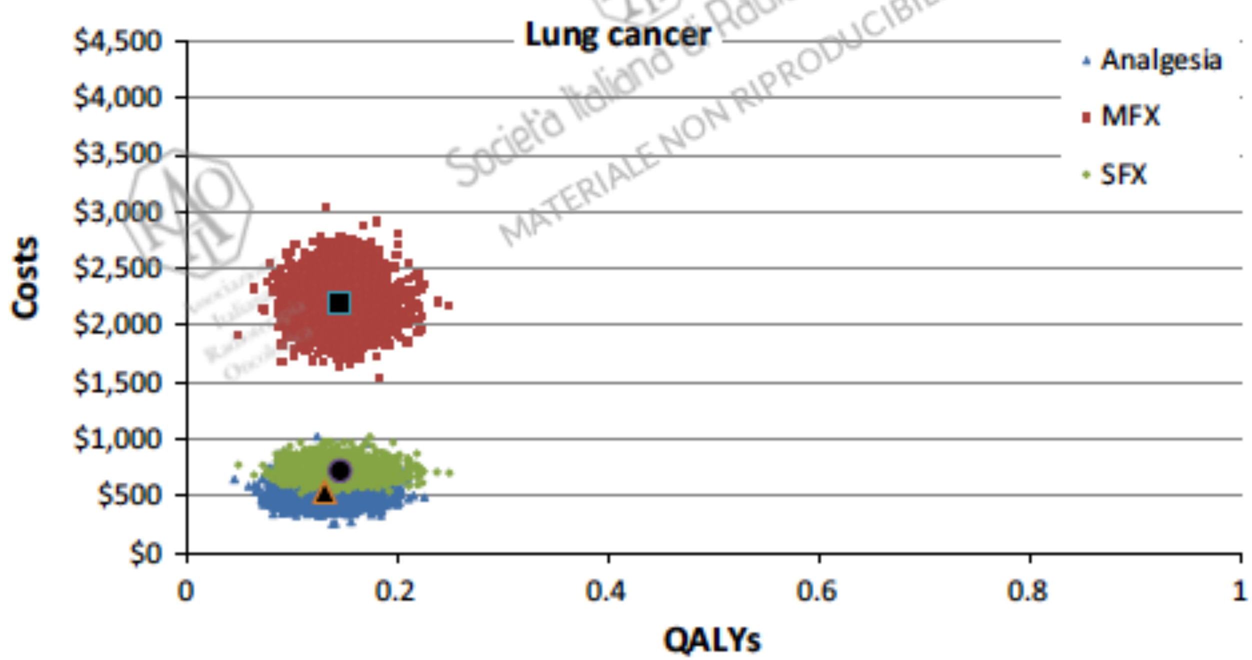


RADIATION ONCOLOGY—ORIGINAL ARTICLE

Economic evaluation of single-fraction versus multiple-fraction palliative radiotherapy for painful bone metastases in breast, lung and prostate cancer

Lucie Collinson,† Giorgi Kvizhinadze, Nisha Nair, Melissa McLeod and Tony Blakely

Burden of Disease, Epidemiology, Equity and Cost Effectiveness Programme (BODE[3]), Department of Public Health, University of Otago, Wellington, New Zealand



Clinical Oncology 27 (2015) 472–478

Contents lists available at ScienceDirect

Clinical Oncology

journal homepage: www.clinicaloncologyonline.net

Original Article

Effectiveness of Repeat Radiotherapy for Painful Bone Metastases in Clinical Practice: A 10 Year Historical Cohort Study

M. Huisman *, H.M. Verkooijen *, Y.M. van der Linden †, M.A.A.J. van den Bosch *, M. van Vulpen ‡

Multivariate analysis results for pain response

Variables	No. responders/No. total	Odds ratio (95% confidence interval)	*P* value
Localisation			
No limb	80/119	Reference	
Limb	27/43	0.82 (0.38–1.77)	0.613
Tumour type			
Other	78/117	Reference	
Breast	29/45	1.10 (0.56–1.02)	0.597
Performance status			
WHO ≤ 1	57/80	Reference	
WHO > 2	41/68	0.59 (0.29–0.89)	0.152
Response to initial radiation*			
No/insufficient response	20/38	Reference	
Response	86/123	2.16 (1.01–4.63)	0.049
Systemic therapy*			
No	31/39	Reference	
Yes	76/123	0.39 (0.16–0.94)	0.037

Clinical Oncology 27 (2015) 472–478

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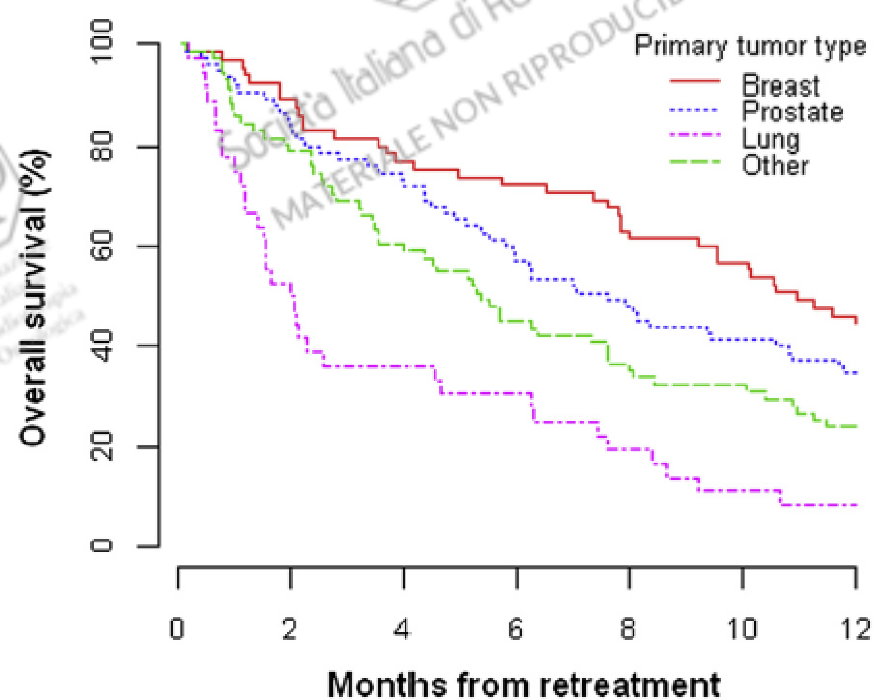
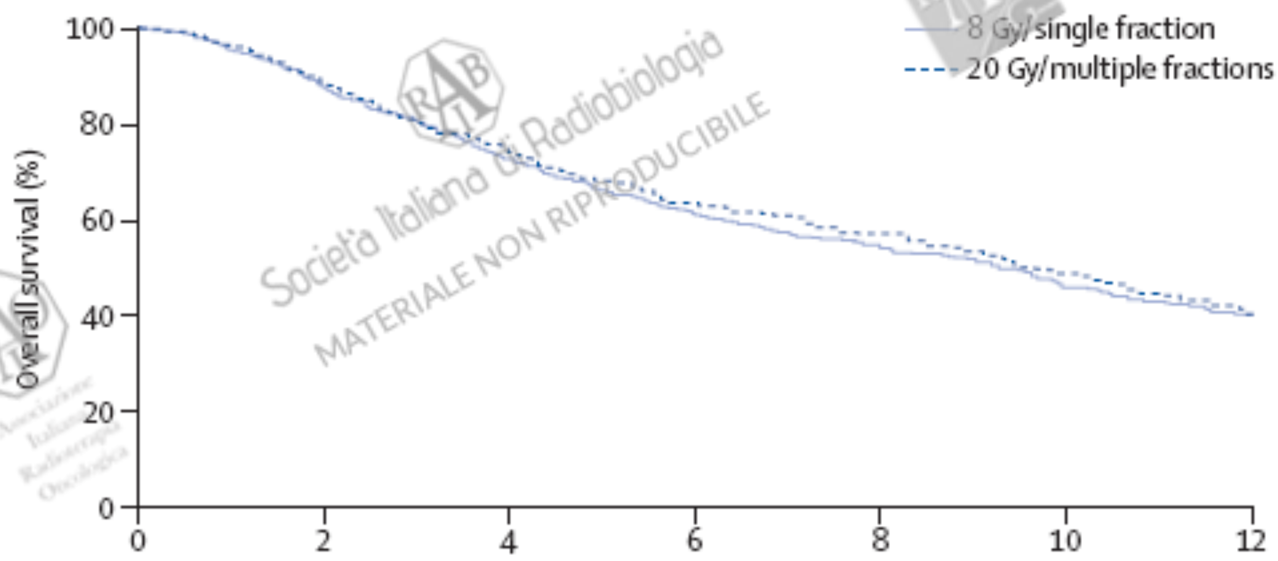


Lancet Oncol 2014; 15: 164–71

Single versus multiple fractions of repeat radiation for painful bone metastases: a randomised, controlled, non-inferiority trial

Edward Chow, Yvette M van der Linden, Daniel Roos, William F Hartsell, Peter Hoskin, Jackson S Y Wu, Michael D Brundage, Abdenour Nabid, Caroline J A Tissing-Tan, Bing Oei, Scott Babington, William F Demas, Carolyn F Wilson, Ralph M Meyer, Bingshu E Chen, Rebecca K S Wong



Number at risk	0	2	4	6	8	10	12
8 Gy/single fraction	425	356	282	226	193	158	106
20 Gy/multiple fractions	425	359	287	228	195	162	116

Kaplan-Meier curves of overall survival in the intention-to-treat population

Radiotherapy and Bone Metastases

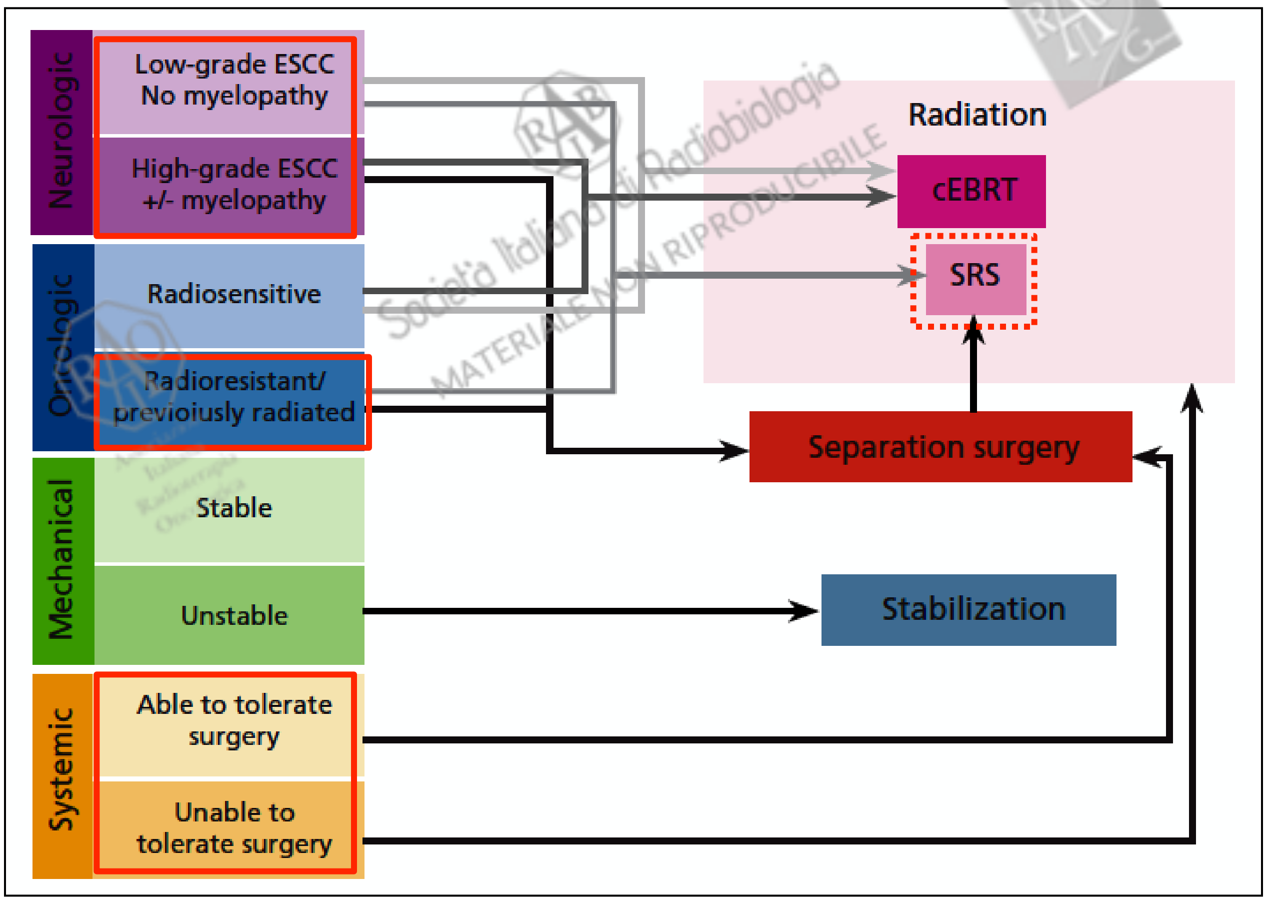
- ❖ **Prognosis**
  - **Favorable**
  - **Intermediate**
  - Unfavorable
- ✓ **Site**
  - Appendicular
  - **Spinal**
  - Pelvis
- ✧ **Type**
  - Osteolytic
  - **Osteoblastic**
  - **Mixed**

© JNCCN—Journal of the National Comprehensive Cancer Network | Volume 13 Number 6 | June 2015

Review

Spine Radiosurgery in the Management of Renal Cell Carcinoma Metastases

Neil K. Taunk, MD, MS[a]; Daniel E. Spratt, MD[a]; Mark Bilsky, MD[b]; and Yoshiya Yamada, MD[a]



The Tokuhashi Score:

Parameters	Scoring Points
General conditions (performance status)*	
Poor (PS 10%–40%)	0
Moderate (PS 50%–70%)	1
Good (PS 80%–100%)	2
No. extraspinal bone metastases foci	
≥3	0
1–2	1
0	2
No. metastases in the vertebral bodies	
≥3	0
2	1
1	2
Metastases to the major internal organs	
Unremovable	0
Removable	1
No metastases	2
Primary site of the cancer†	
Lung, stomach	0
Kidney, liver, uterus, unidentified, other	1
Thyroid, prostate, breast, rectum	2
Primary site of the cancer‡	
Pancreas, esophagus, stomach, bladder, osteosarcoma, lung	0
Liver, gallbladder, unidentified	1
Others	2
Uterus, kidney	3
Rectum	4
Thyroid, prostate, breast	5
Spinal cord palsy	
Complete	0
Incomplete	1
None	2

Tokuhashi Y, Matsuzaki H, Toriyama S, et al. Scoring system for the preoperative evaluation of metastatic spine tumor prognosis. Spine 1990;15: 1110–3.

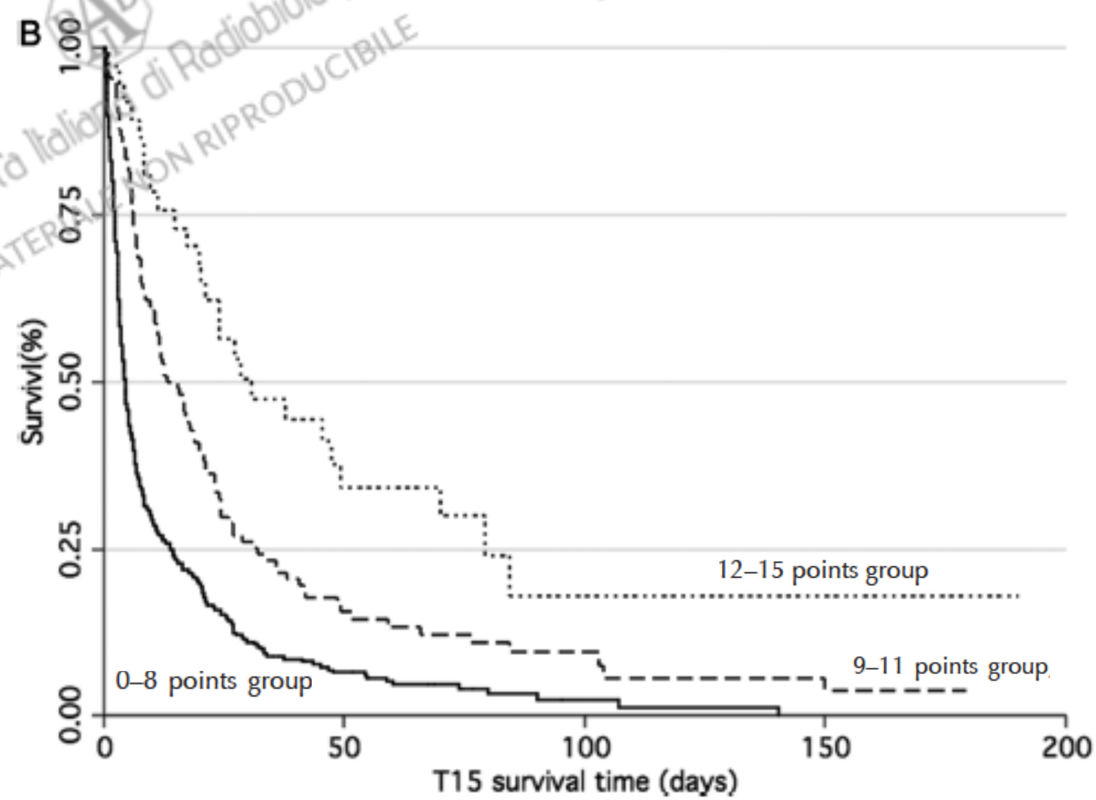
Spine

SPINE Volume 37, Number 7, pp 573–582

CLINICAL CASE SERIES

Predictive Value of Tokuhashi Scoring Systems in Spinal Metastases, Focusing on Various Primary Tumor Groups

Aarhus Algorithm		
Tokuhashi	**Tomita**	**Surgical Treatment Strategy**
0–4		Postdecompression
5–8	1–6	Postdecompression + instrumentation with pedicle screw system
9–11	7	Postdecompression and posterior reconstruction
12–15	1–3	En bloc resection with total vertebrectomy
	4–6	Intralesional total vertebrectomy + reconstruction
	7	Postdecompression, reconstruction with titanium PSS, alt. spacer from behind



Review Article

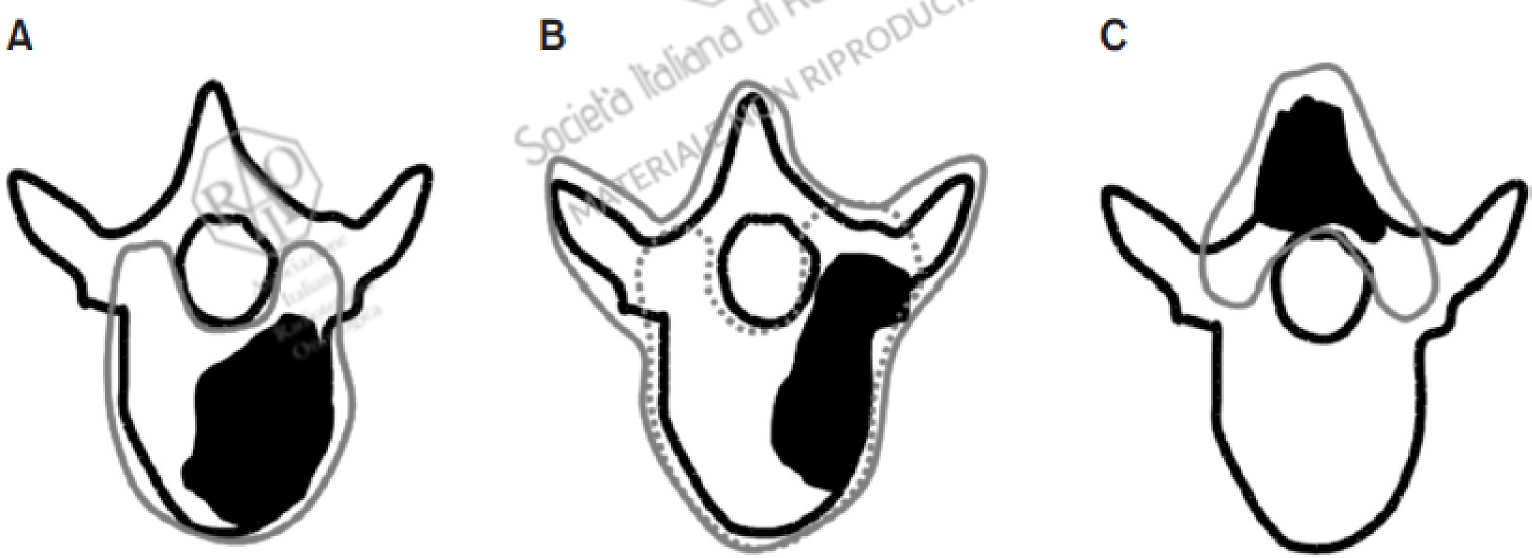
Radiat Oncol J 2015;33(1):1-11
http://dx.doi.org/10.3857/roj.2015.33.1.1
pISSN 2234-1900 · eISSN 2234-3156

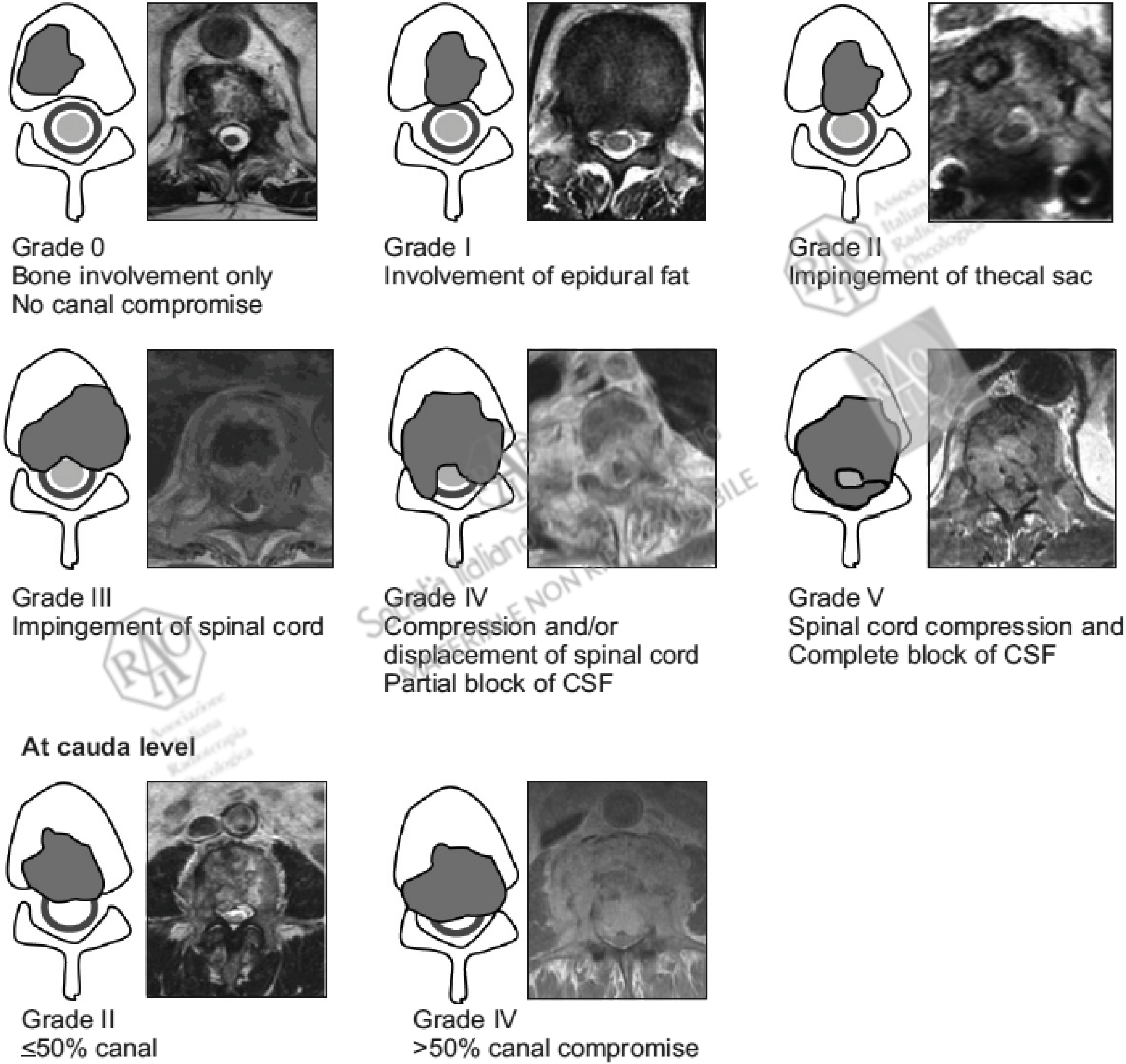
ROJ Radiation Oncology Journal

Contemporary treatment with radiosurgery for spine metastasis and spinal cord compression in 2015

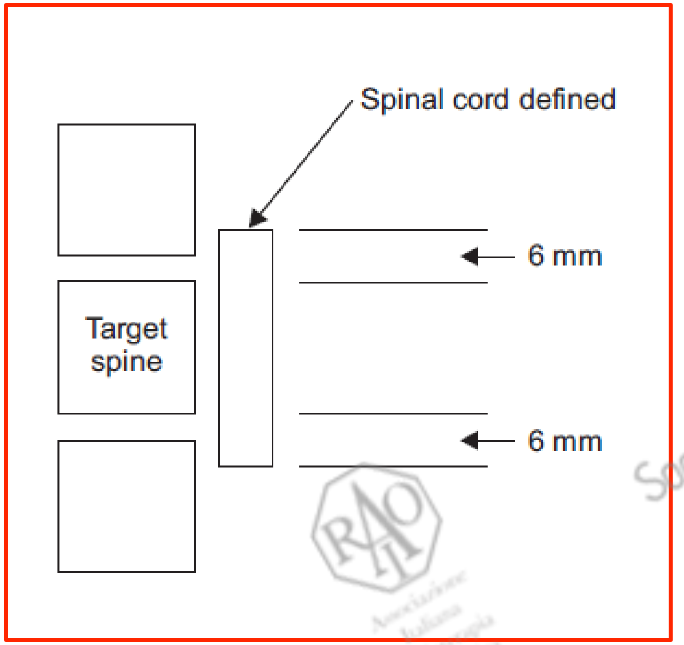
Samuel Ryu, MD[1,2], Hannah Yoon, MD[1], Alexander Stessin, MD, PhD[1], Fred Gutman, MD[2], Arthur Rosiello, MD[2], Raphael Davis, MD[2]

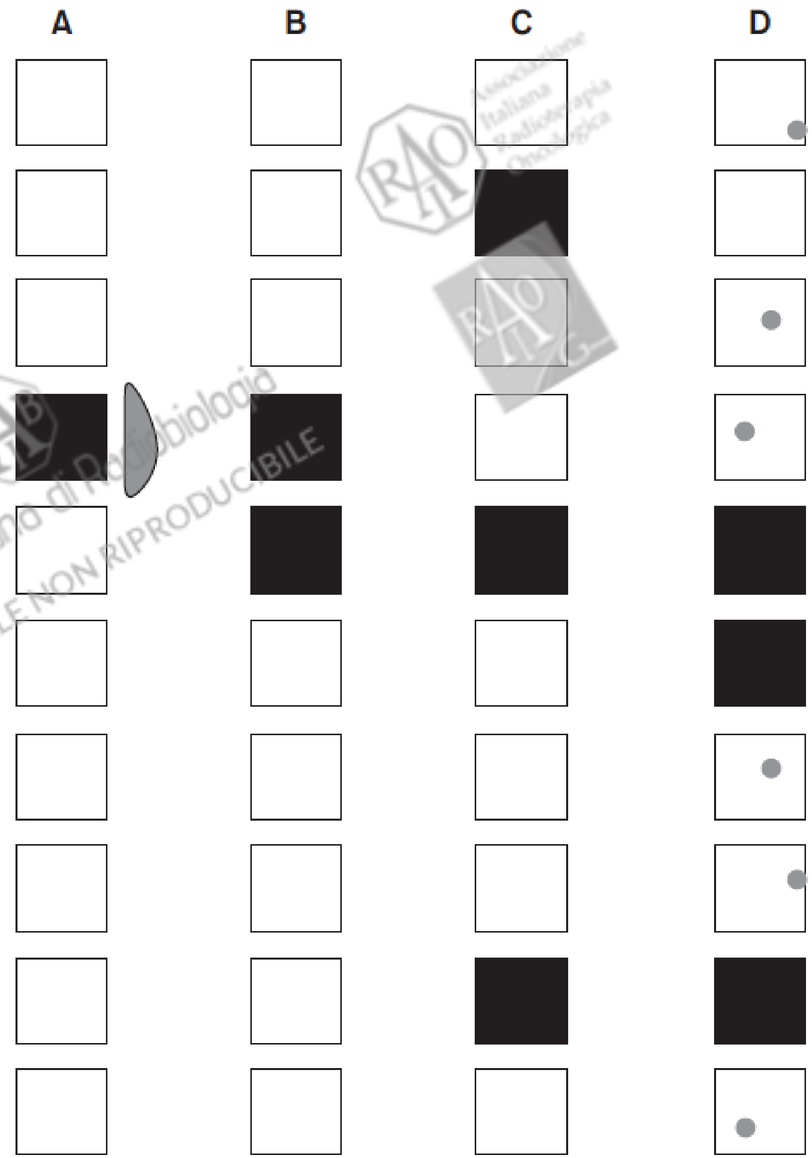
Departments of [1]Radiation Oncology and [2]Neurological Surgery, Stony Brook University, Stony Brook, NY, USA




Grade 0
Bone involvement only
No canal compromise
Grade I
Involvement of epidural fat
Grade II
Impingement of thecal sac
Grade III
Impingement of spinal cord
Grade IV
Compression and/or displacement of spinal cord
Partial block of CSF
Grade V
Spinal cord compression and Complete block of CSF
At cauda level
Grade II
≤50% canal
Grade IV
>50% canal compromise

Algorithm of radiosurgery for spine metastasis





Cancer/Radiothérapie xxx (2016) xxx–xxx

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Mise au point

Radiothérapie stéréotaxique des métastases osseuses vertébrales

Stereotactic body radiation therapy for spinal metastases

D. Pasquier[a,*,b], G. Martinage[a], X. Mirabel[a], T. Lacornerie[a], S. Makhloufi[a], J.-C. Faivre[c], S. Thureau[d], É. Lartigau[a,b]

Recommandations de l'International Spine Radiosurgery Consortium pour la délinéation du volume cible anatomoclinique en radiothérapie stéréotaxique vertébrale.

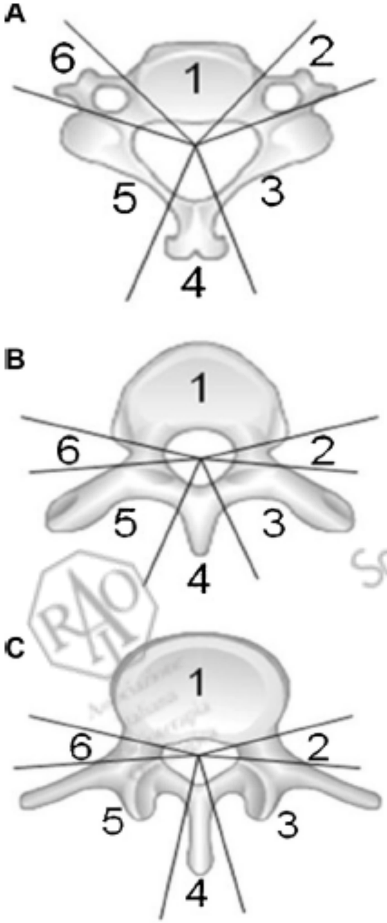
Description du volume tumoral macroscopique	Site du volume tumoral macroscopique	Recommandations de délinéation du volume cible anatomoclinique	Description du volume cible anatomoclinique
Atteinte partielle du corps vertébral	1	1	Corps vertébral dans son ensemble
Atteinte latéralisée au sein du corps vertébral	1	1,2	Corps vertébral dans son ensemble, pédicule homolatéral ± apophyse transverse
Atteinte de l'ensemble du corps vertébral	1	1,2,6	Corps vertébral dans son ensemble, pédicules bilatéraux ± apophyses transverses
Corps vertébral et pédicule	1,2	1,2,3	Corps vertébral dans son ensemble, pédicule, apophyse transverse et lame homolatérales
Corps vertébral, pédicules bilatéraux ou apophyses transverses	1,2,6	1,2,3,5,6	Corps vertébral dans son ensemble, pédicules, apophyses transverses et lames bilatérales
Pédicule unilatéral	2	2,3 ± 1	Pédicule, apophyse transverse et lame homolatérale ± corps vertébral
Lame vertébrale	3	2,3,4	Lame, pédicule et apophyse transverse homolatéraux, apophyse épineuse
Apophyse épineuse	4	3,4,5	Apophyse épineuse et lames bilatérales

- **Sector 1 :** *vertebral body;*
- **Sectors 2 and 6:** *pedicle;*
- **Sectors 3 and 5:** *transverse processes and vertebral lamina;*
- **Sector 4 :** *spinous proces.*

Cervical vertebra A

Thoracic vertebra B

Lumbar vertebra C

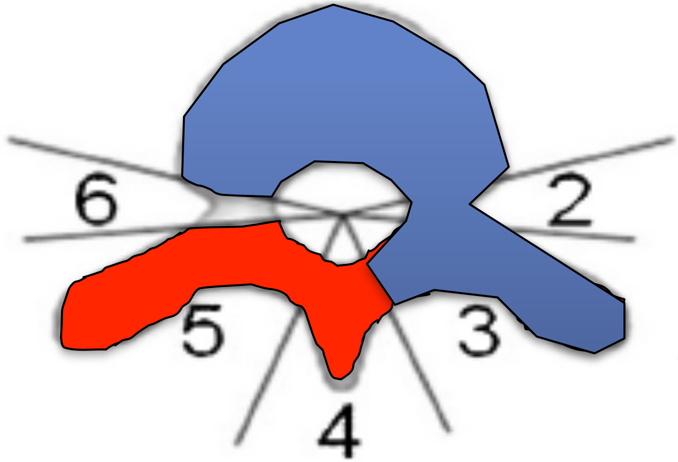


Cox BW, Spratt DE, Lovelock M, Bilsky MH, Lis E, Ryu S, et al. International SpineRadiosurgery Consortium consensus guidelines for target volume definition inspinal stereotactic radiosurgery. ***Int J Radiat Oncol Biol Phys 2012;83:e597–605.***

Contraintes aux organes à risque pour une radiothérapie stéréotaxique vertébrale non- ou hypofractionnée.

	Une séance	Trois fractions	Cinq fractions
Moelle épinière	Dose maximale 14 Gy V10 < 0,25 cm^3 V7 < 1,2 cm^3	Dose maximale 22 Gy V18 < 0,25 cm^3 V11 < 1,2 cm^3	Dose maximale 30 Gy V22,5 < 0,25 cm^3 V13,5 < 1,2 cm^3
Queue de cheval	Dose maximale 16 Gy V14 < 5 cm^3	Dose maximale 24 Gy V22 < 5 cm^3	Dose maximale 34 Gy V30 < 5 cm^3
Plexus sacré	Dose maximale 16 Gy V14 < 5 cm^3	Dose maximale 24 Gy V22 < 5 cm^3	Dose maximale 34 Gy V30 < 5 cm^3
Cœur	Dose maximale 22 Gy V16 < 15 cm^3	Dose maximale 30 Gy V24 < 15 cm^3	Dose maximale 38 Gy V32 < 15 cm^3
Œsophage	Dose maximale 19 Gy V14,5 < 5 cm^3	Dose maximale 25 Gy V21 < 5 cm^3	Dose maximale 35 Gy V27,5 < 5 cm^3
Estomac	Dose maximale 16 Gy V13 < 10 cm^3	Dose maximale 24 Gy V21 < 5 cm^3	Dose maximale 32 Gy V28 < 10 cm^3
Poumons (droit + gauche – volume cible prévisionnel)	V5 < 50 % V7 < 1500 cm^3	V10 < 30 % V5 < 50 %	V12,5 < 1500 cm^3 V13,5 < 1000 cm^3
Trachée	Dose maximale 22 Gy V10 < 4 cm^3	Dose maximale 30 Gy V20 < 1 cm^3 V15 < 4 cm^3	Dose maximale 38 Gy V18 < 4 cm^3
Peau	Dose maximale 16 Gy V14 < 10 cm^3	Dose maximale 24 Gy V22 < 10 cm^3	Dose maximale 32 Gy V30 < 10 cm^3
Intestin grêle	Dose maximale 19 Gy V10 < 5 cm^3	Dose maximale 27 Gy V16 < 5 cm^3	Dose maximale 35 Gy V19,5 < 5 cm^3
Rectum	Dose maximale 22 Gy V11 < 20 cm^3	Dose maximale 30 Gy V20 < 20 cm^3	Dose maximale 38 Gy V25 < 20 cm^3
Reins bilatéraux	V8 < 200 cm^3	V10 < 50 % V15 < 200 cm^3	V17,5 < 200 cm^3

Timmerman RD**. An overview of hypofractionation and introduction tothis issue of seminars in radiation oncology.* ***Semin Radiat Oncol 2008;18:215–22.



Description du volume tumoral macroscopique	Site du volume tumoral macroscopique	Recommandations de délinéation du volume cible anatomoclinique
Atteinte partielle du corps vertébral	1	1
Atteinte latéralisée au sein du corps vertébral	1	1,2
Atteinte de l'ensemble du corps vertébral	1	1,2,6
Corps vertébral et pédicule	1,2	1,2,3
Corps vertébral, pédicules bilatéraux ou apophyses transverses	1,2,6	1,2,3,5,6
Pédicule unilatéral	2	2,3 ± 1
Lame vertébrale	3	2,3,4
Apophyse épineuse	4	3,4,5

Principales études de radiothérapie stéréotaxique prospectives (plus de 50 patients) et rétrospectives (plus de 100 patients) pour la prise en charge de métastases vertébrales.

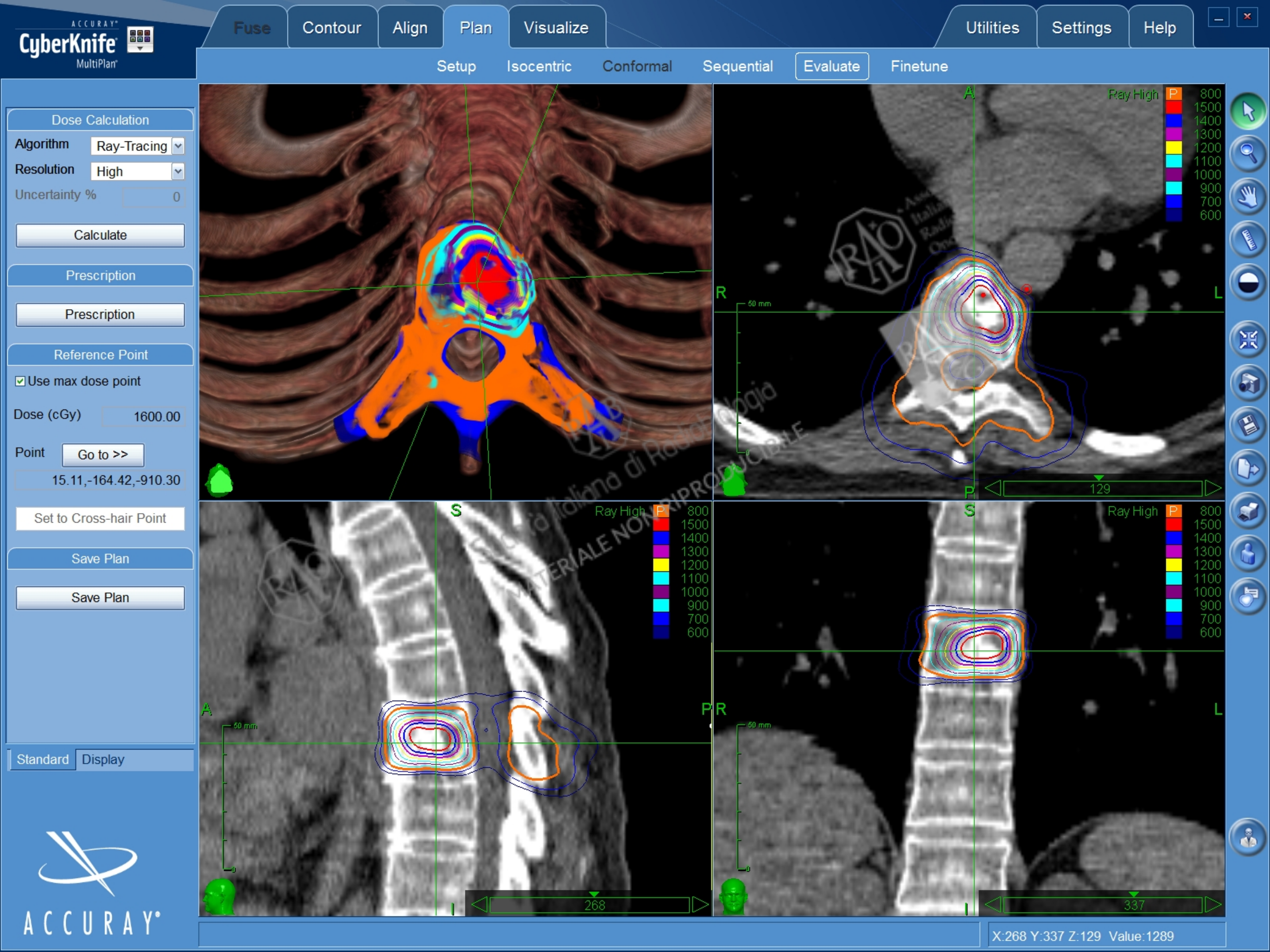
Étude	Type d'étude	Nombre de patients	Nombre de lésions traitées	Irradiation de novo/ Réirradiation (nombre de patients)	Schéma	Suivi médian (mois)	Contrôle local	Contrôle de la douleur	Survie globale médiane	Toxicité (nombre de patients)
Chang et al. [29]	Phase I/II	63	74 51 opérées	53/10	27 Gy/3 fractions 30 Gy/5 fractions	21,3	84 % à 1 an	NR	NR	Toxicité aiguë de grade 3 : nausées – vomissements : 2 ; diarrhée : 1 ; dysphagie : 1 ; douleur thoracique : 1 Pas de toxicité tardive de grade 3–4
Klish et al. [30]	Phase I/II	58	65	58/0	18 Gy/1 séance	18 (6–66)	86,2 %	NR	30 mois	NR
Garg et al. [31]	Phase I/II	61	63 18 opérées	63/0	Primitif rénal : 24 Gy/1 séance Autre : 18 Gy/1 séance	20	88 % à 18 mois	NR	30 mois	Aucune toxicité aiguë de grade 3–4 Toxicités tardives neurologiques : 2 (1 de grade 3, 1 de grade 4)
Wang et al. [32]	Phase I/II	149	166	70/79	27–30 Gy 3 fractions	15,9 (9,5–30,3)	80,5 % à 1 an 72,4 % à 2 ans	72,2 % à 6 mois	23 mois	Toxicités aiguës de grade 3 : nausées – vomissements : 2 ; diarrhée : 1 ; dysphagie : 1 ; douleur thoracique : 1 ; douleur cervicale : 1 ; asthénie : 1 ; pas de toxicité tardive de grade 3–4
Yamada et al. [33]	Prospective	93	103	93/0	18–24 Gy 1 séance	15 (2–45)	90 % à 15 mois	NR	NR	Aucune toxicité de grade 3–4
Gagnon et al. [34]	Prospective	200	274	82/118	21–37,5 Gy 3–5 fractions	12 (1–51)	NR	Amélioration du score moyen	NR	Aucune toxicité de grade 3–4
Gerszten et al. [35]	Prospective	393	500	156/344	12,5–25 Gy 1 séance	21 (3–53)	88 %	86 %	NR	NR
Guckenberger et al. [36]	Rétrospective multicentrique	301	387	301/0	10–60 Gy 1–20 fractions	11,8 (0–105)	89,9 % à 1 an 83,9 % à 2 ans	NR	19,5 mois	Toxicité aiguë de grade 3 : 2
Heron et al. [37]	Rétrospective	228	348	246/102	16,3 Gy/1 séance 20,6 Gy/3 fractions 23,8 Gy/4 fractions 24,5 Gy/5 fractions	12	96 % à 2 ans si hypofractionné 70 % à 2 ans si non fractionné	NR	13 mois 63 % à 1 an si hypofractionné 43 % à 1 an si non fractionné	Toxicité aiguë de grade 3 : 1 Toxicité identique quel que soit le fractionnement
Chang et al. [38]	Rétrospective	142	185	131/54	24 Gy/1 séance 24–30 Gy 3 fractions 18–30 Gy 5–6 fractions	21,8	Global : 87,9 % à 1 an 96 % à 6 mois réirradiation 95 % à 6 mois irradiation de novo 79 % à 2 ans réirradiation 90 % à 2 ans irradiation de novo	86 % à 6 mois réirradiation 93 % à 6 mois irradiation de novo 81 % à 1 an réirradiation 89 % à 1 an irradiation de novo 86 % à 2 ans réirradiation 90 % à 2 ans irradiation de novo	Globale : 29,6 20,7 si réirradiation 32,4 si irradiation de novo	Aucune toxicité de grade 3–4
Chang et al. [39]	Rétrospective	129	167	76/53	16–39 Gy 1–5 fractions	6	90,3 %	91 %	NR	Aucune toxicité de grade 3–4
Schipani et al. [40]	Rétrospective	124	165	165/0	8 Gy/1 séance	7	92 %	92 %	8	Aucune toxicité de grade 3–4
Zelefsky et al. [41]	Rétrospective	105 (primitif rénal)	105	105/0	18–24 Gy 1 séance	12	44 % à 3 ans 88 % si D > 24 Gy 21 % si D < 24 Gy	NR	48,9 % à 1 an	Toxicité aiguë Nausées – vomissements de grade 3 : 1 Érythème de grade 4 : 1

NR : non rapporté.

Principales études de radiothérapie stéréotaxique postopératoires prospectives et rétrospectives (plus de 20 patients) pour la prise en charge de métastases vertébrales.

Auteurs	Type d'étude	Nombre de patients	Schéma (extrêmes) (Gy)	Fractions	Suivi médian (mois)	Contrôle de la douleur à long terme	Contrôle local	Taux de patients ambulatoire	Toxicité (nombre de patients)
Tao et al. [48] issue des études [29] et [31]	Phase I/II (issue de 2 phases I/II) 33 patients ayant reçu une radiothérapie préalable	66 dont 35 tumeurs rénales, 13 sarcomes	16–24 Gy 27 Gy 30 Gy	1 séance 3 fractions 5 fractions	30 mois (1–145)	NR	85 % à 1 an 79 % à 2 ans 74 % à 3 ans	NR	Aucune
Al-Omair et al. [49]	Prospective	80	18–40	1–5	8,3	NR	74 %	NR	Aucune
Gerszten et al. [50]	Prospective	26	16–20 Gy	1 séance	16 (11–24)	92 %	92 %	100 %	Aucune
Harel et al. [51]	Prospective	22	14,58 (12–16)	1 séance	12,59 (3–36)	NR	88,3 %	NR	Aucune
Laufer et al. [52]	Rétrospective	186	24 Gy 24–30 Gy 18–36 Gy	1 séance 3 fractions 5–6 fractions	7,6 (1–66)	NR	81 %	NR	Aucune
Bate et al. [53]	Rétrospective	21	16 (16–22)	1 (1–5)	21,3	100 %	87 %	82,5 %	Toxicité aiguë de grade 3 : douleur thoracique : 1 ; nausées–vomissements : 1 ; dysphagie : 1

NR : non rapporté.



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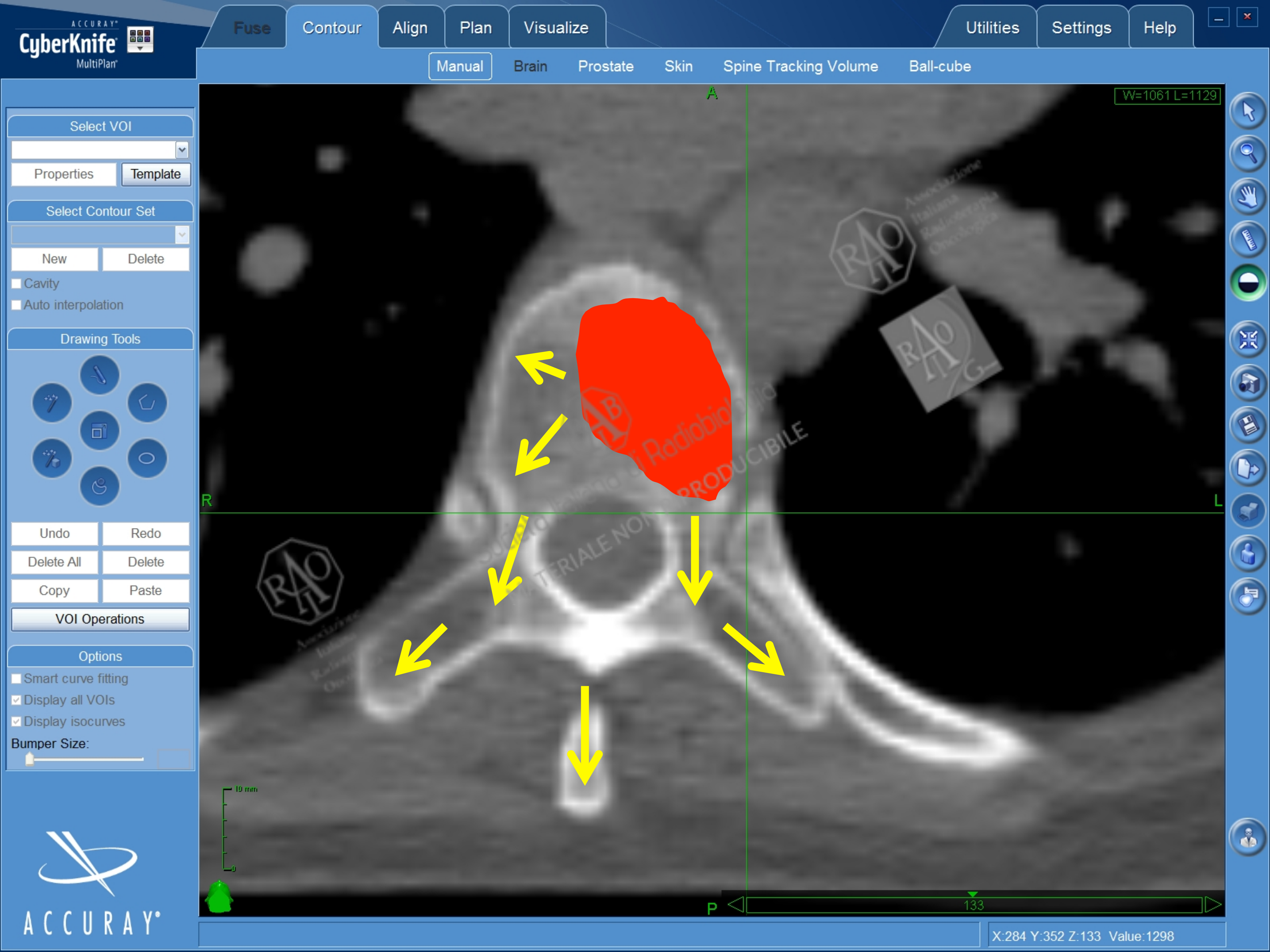
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ACCURAY
W=1061 L=1129
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133
X:284 Y:352 Z:133 Value:1298

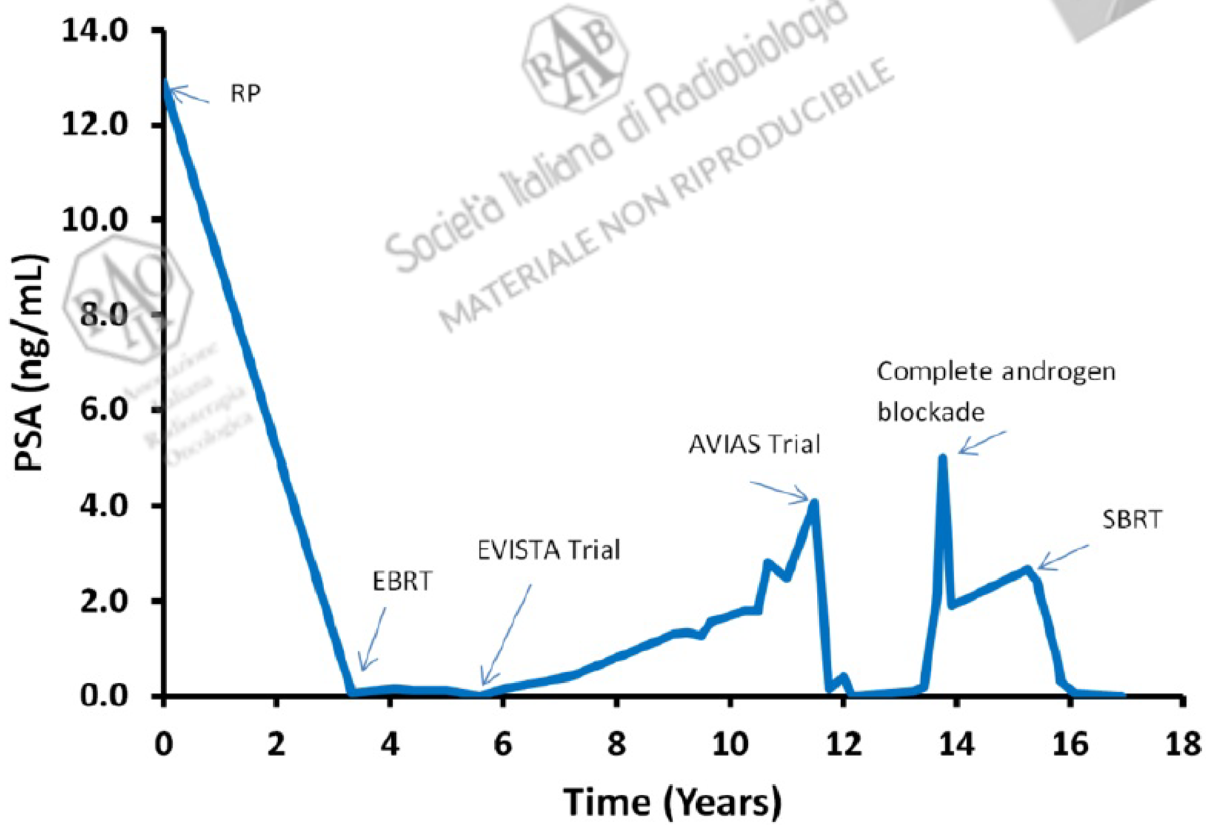
Cureus

Open Access Case Report

DOI: 10.7759/cureus.365

Complete PSA Response Following Stereotactic Ablative Radiotherapy for a Bony Metastasis in the Setting of Castrate-Resistant Prostate Cancer

Jelena Lukovic [1] , George Rodrigues [2]



Radiotherapy and Bone Metastases

- ❖ **Prognosis**
  - Favorable
  - Intermediate
  - **Unfavorable**
- ✓ **Site**
  - Appendicular
  - **Spinal**
  - Pelvis
- ✧ **Type**
  - **Osteolytic**
  - Osteoblastic
  - **Mixed**

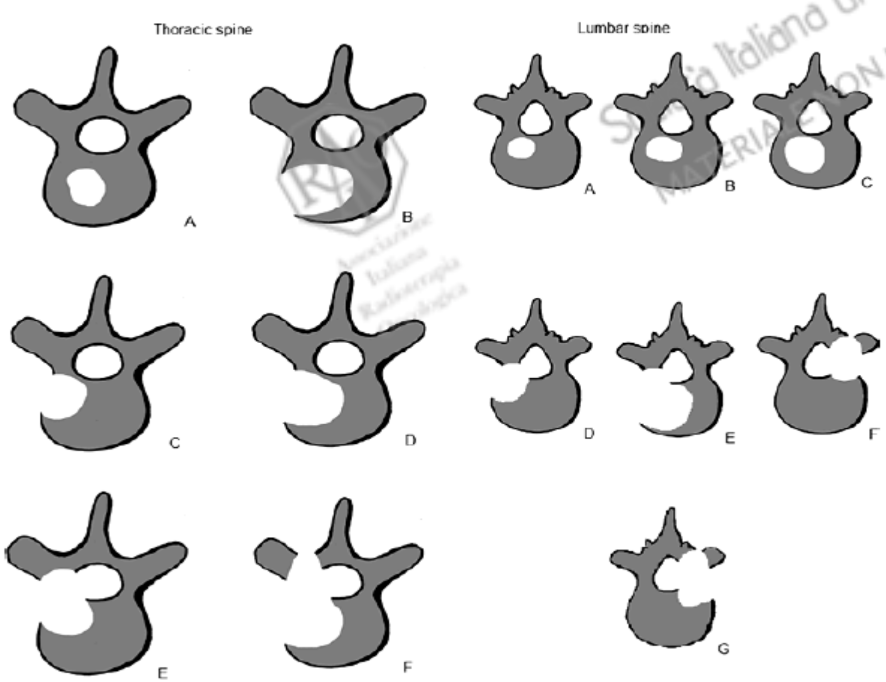
TJ
ISSN 0300-8916
Tumori 2015; 101(6): 614-620
DOI: 10.5301/tj.5000370
ORIGINAL RESEARCH ARTICLE

Stability of spinal bone metastases and survival analysis in renal cancer after radiotherapy

Ingmar Schlampp[1], Helge Lang[1], Robert Förster[1], Robert Wolf[1], Tilman Bostel[1], Thomas Bruckner[2], Jürgen Debus[1], Harald Rief[1]

[1] Department of Radiation Oncology, University Hospital of Heidelberg, Heidelberg - Germany
[2] Department of Medical Biometry, University Hospital of Heidelberg, Heidelberg - Germany

Taneichi Score



Radiotherapy		n	%
	10 × 3 Gy	75	49
	14 × 2.5 Gy	22	14
	20 × 2 Gy	50	32
	Others	8	5
Irradiated vertebral bodies			
	3	72	47
	4-6	59	38
	>6	24	15
Therapy after RT			
	Chemotherapy	55	35
	Bisphosphonates	12	8
Stability (of 28 evaluable patients)			
	Stable prior to RT	14	50
	Stable 3 months after RT	14	50
	Stable 6 months after RT	14	50
Location			
	Thoracic	89	57
	Lumbar	66	43
Patients with fractured vertebral bodies prior to RT			
	Patients with fractures	30	19

Bowker test		6 months after RT						
Prior to RT		A	B	C	D	E	F	G
	A	8	1	0	0	0	0	0
	B	0	4	0	0	0	0	0
	C	0	0	1	0	0	0	0
	D	0	0	0	5	0	0	0
	E	0	0	0	1	5	0	0
	F	0	0	0	0	0	2	0
	G	0	0	0	0	0	0	1

Results of Taneichi score evaluation.
RT = radiotherapy.

<u>Conclusion:</u> *The evaluated patients showed unchanged stability of involved vertebral bodies after 6 months. RT seems to be effective in terms of pain reduction and improvement of neurological deficits. Regarding the short survival after bone metastases, shortened fractionation schedules may be preferred in patients with exhausted systemic therapy options.*

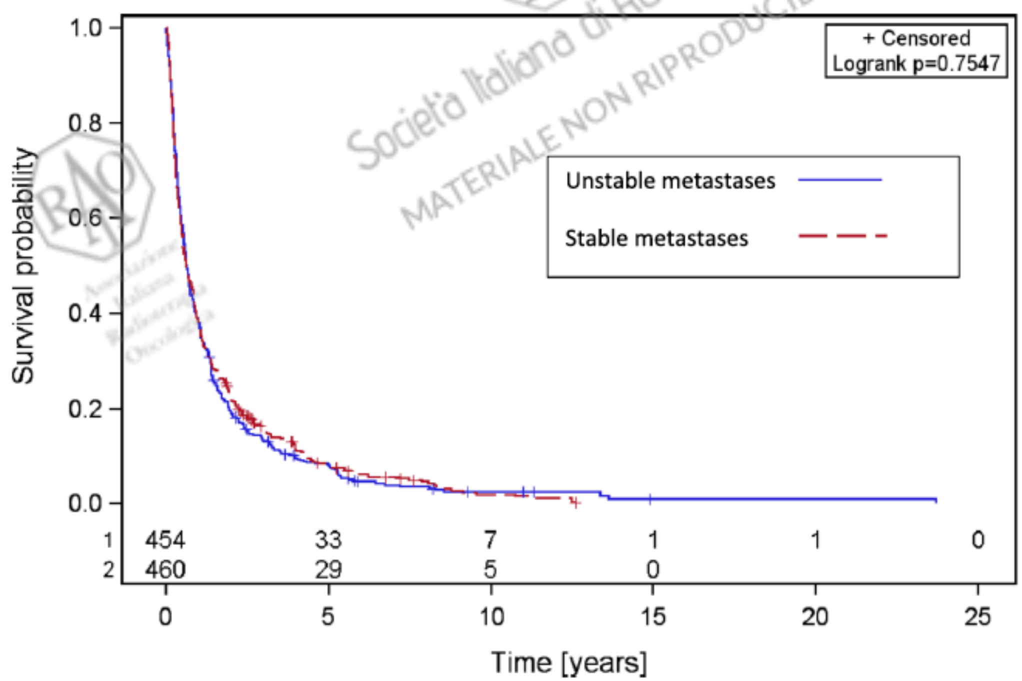
Wolf *et al. BMC Cancer* (2016) 16:528
DOI 10.1186/s12885-016-2571-z

BMC Cancer

RESEARCH ARTICLE Open Access

Survival and prognostic factors in patients with stable and unstable spinal bone metastases from solid tumors: a retrospective analysis of 915 cases

Robert J. Wolf[1†], Robert Foerster[1†], Thomas Bruckner[2], Tilman Bostel[1], Ingmar Schlampp[1], Juergen Debus[1], Harald Rief[1*] and German Bone Research Group



Radiotherapy and Bone Metastases

❖ **Prognosis**
- Favorable
- Intermediate
- **Unfavorable**

✓ **Site**
- **Appendicular**
- **Spinal**
- **Pelvis**

✧ **Type**
- **Osteolytic**
- **Osteoblastic**
- **Mixed**

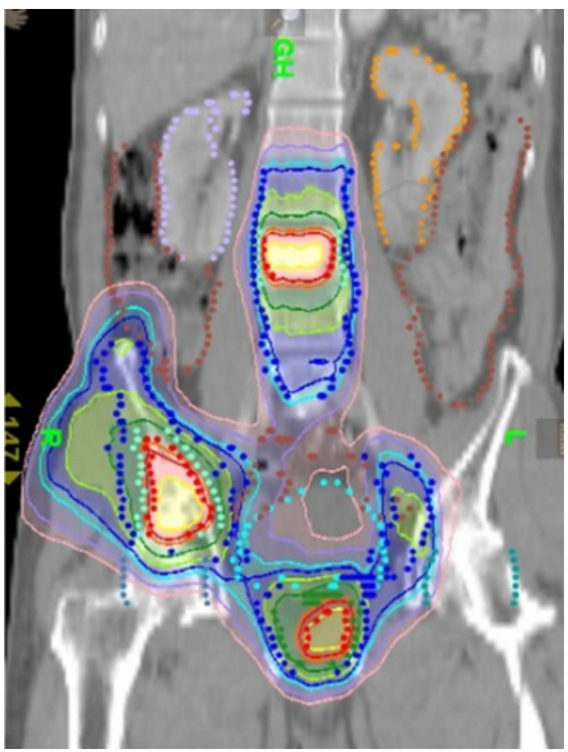
PLOS ONE 2016

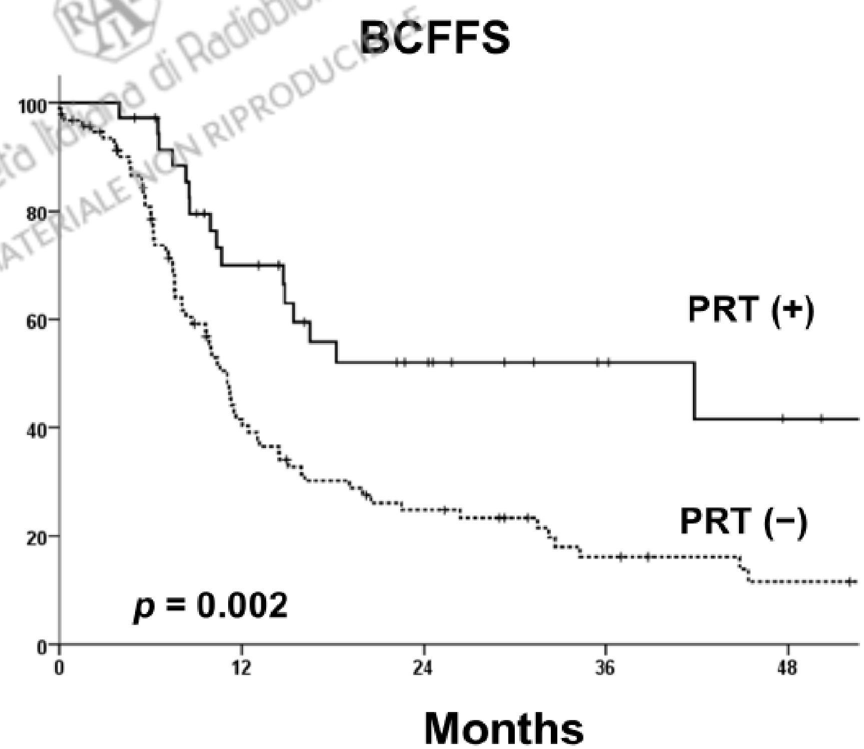
140 Pz

RESEARCH ARTICLE

Does Radiotherapy for the Primary Tumor Benefit Prostate Cancer Patients with Distant Metastasis at Initial Diagnosis?

Yeona Cho[1], Jee Suk Chang[1], Koon Ho Rha[2], Sung Joon Hong[2], Young Deuk Choi[2], Won Sik Ham[2], Jun Won Kim[1], Jaeho Cho[1]*



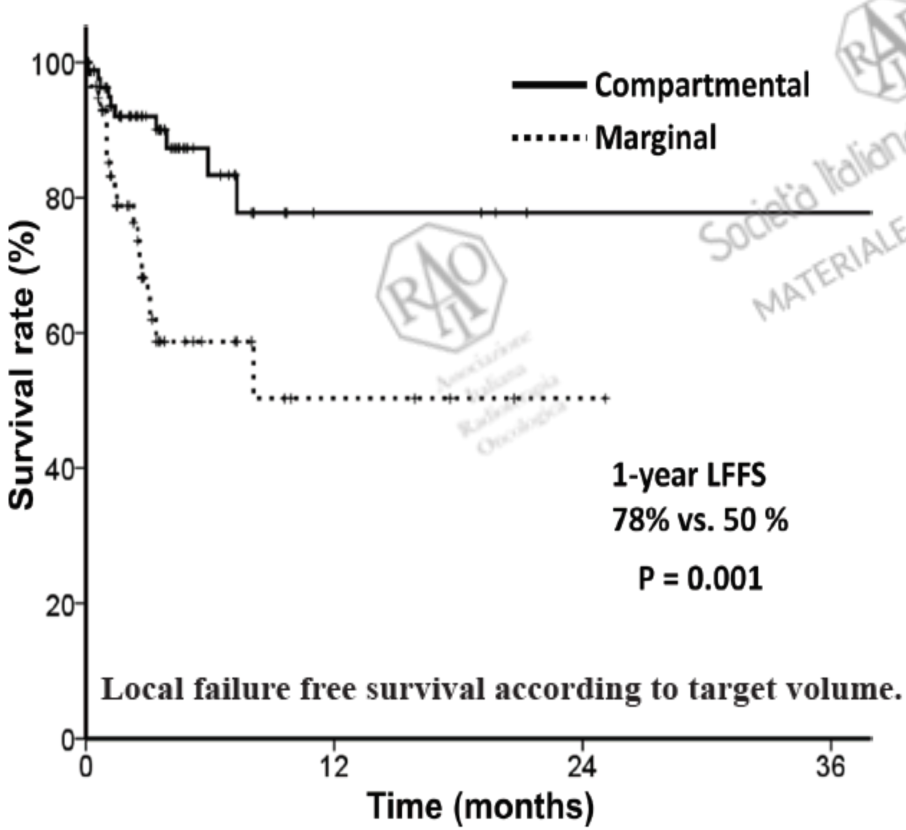


High dose and compartmental target volume may improve patient outcome after radiotherapy for pelvic bone metastases from hepatocellular carcinoma

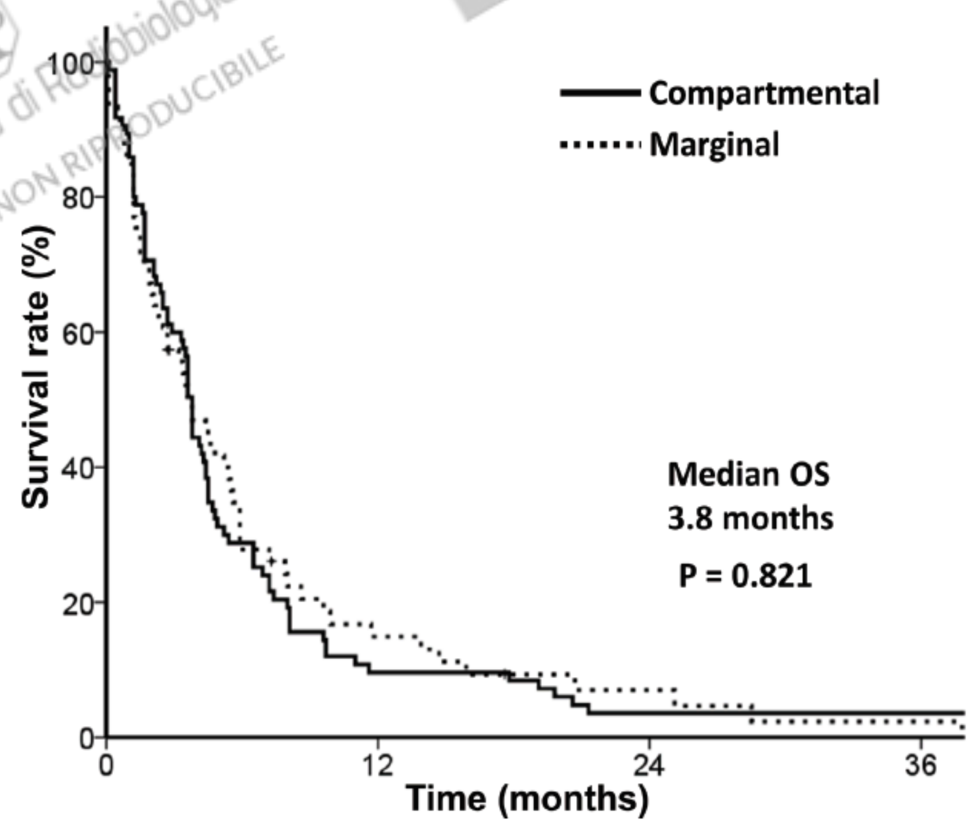
Taehyung Kim[1], **Hye Jung Cha**[1], **Jun Won Kim**[2], **Jinsil Seong**[1], **Ik Jae Lee**[2]

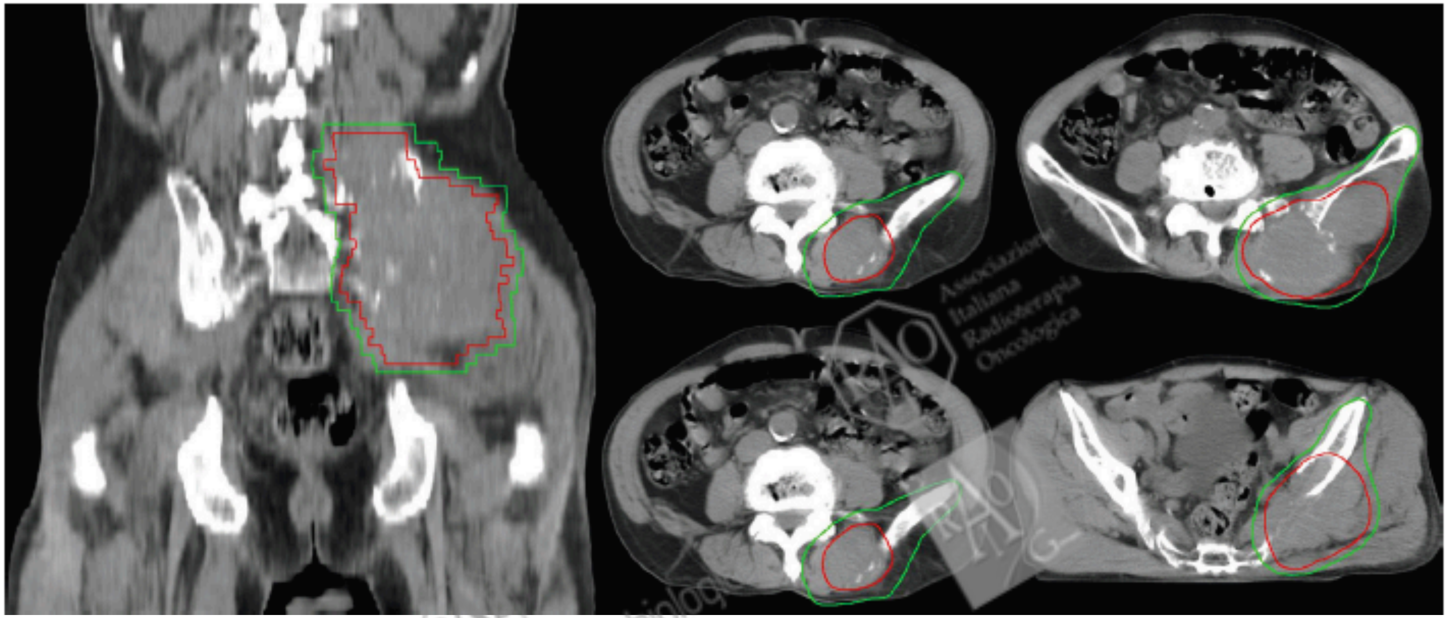
[1]Department of Radiation Oncology, Yonsei University College of Medicine, Yonsei University Health System, Seoul, Korea

[2]Department of Radiation Oncology, Gangnam Severance Hospital, Yonsei University College of Medicine, Seoul, Korea

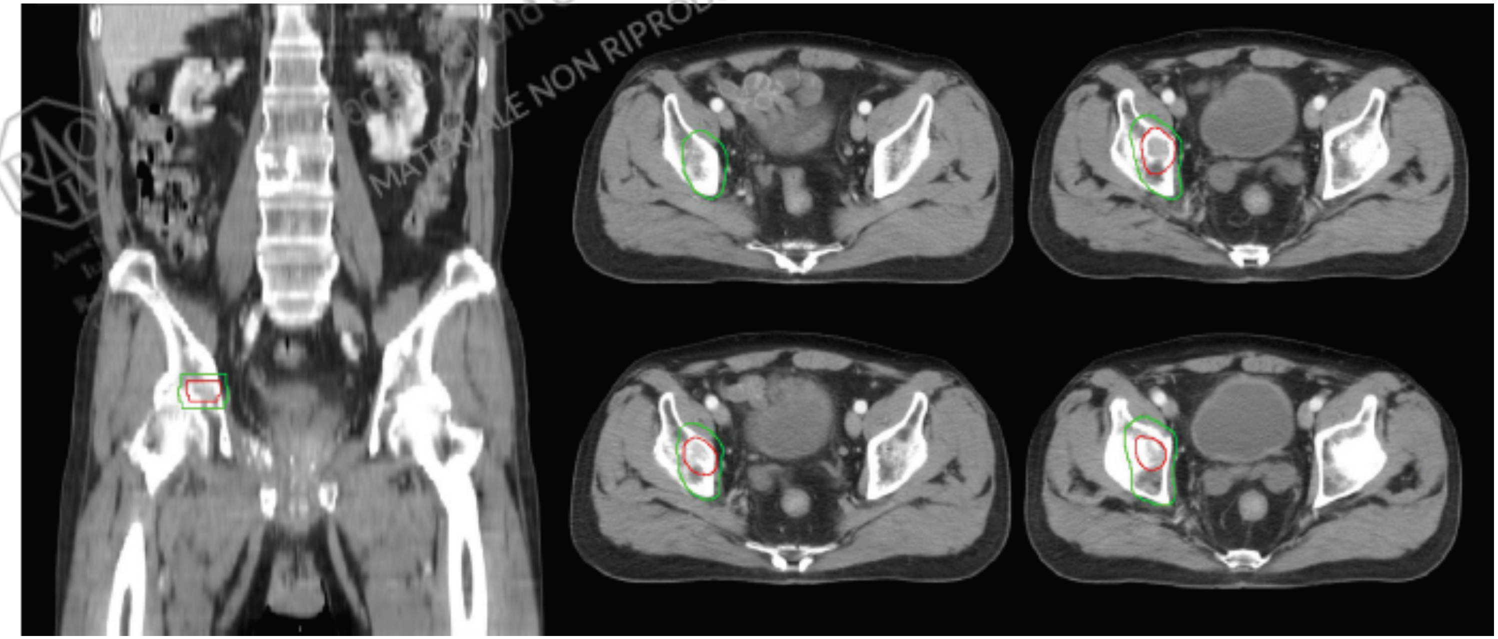


Local failure free survival according to target volume.





Compartmental target volume

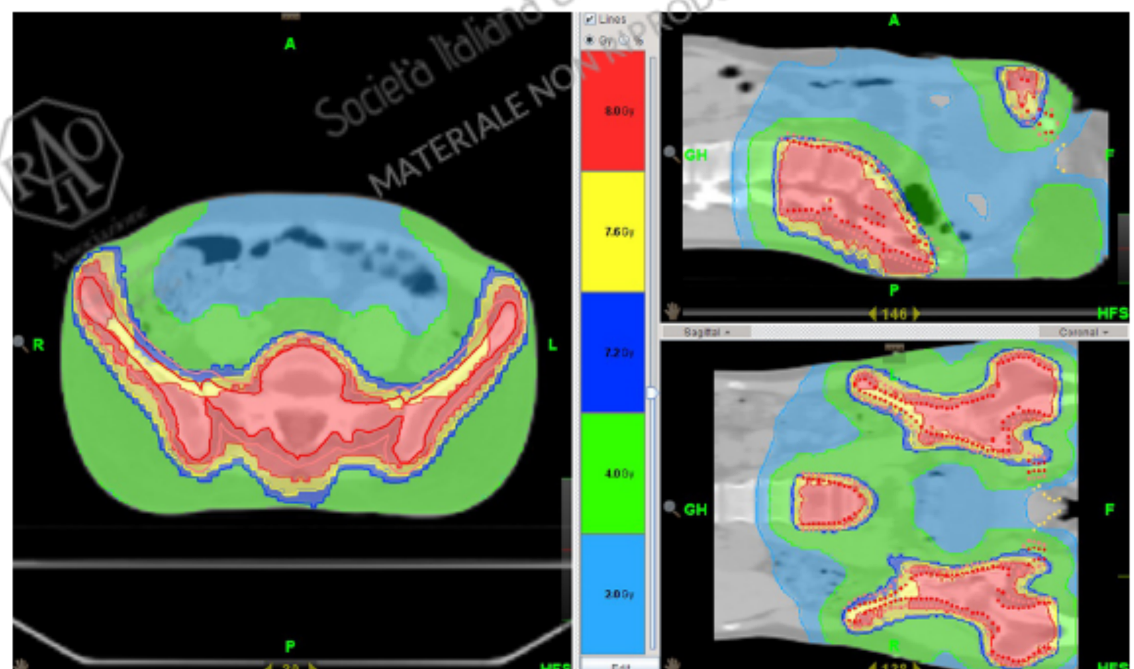


marginal target volume.

Brief Report

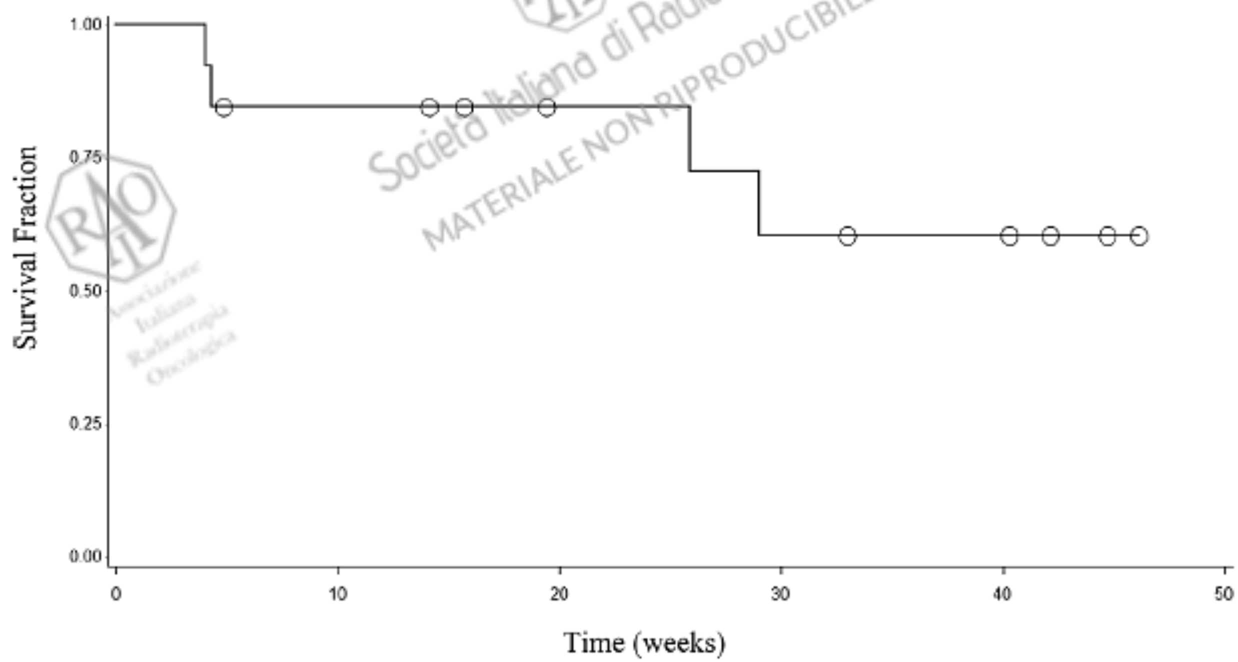
Half-Body Irradiation With Tomotherapy for Pain Palliation in Metastatic Breast Cancer

Carlo Furlan, MD, Marco Trovo, MD, Annalisa Drigo, ScD, MPh,
Elvira Capra, ScD, MPh, and Mauro Gaetano Trovo, MD
Department of Radiation Oncology (C.F., M.T., M.G.T.) and Department of Medical Physics (A.D., E.C.), Centro di Riferimento Oncologico (CRO), National Cancer Institute, Aviano, Italy



Toxicity After HBI

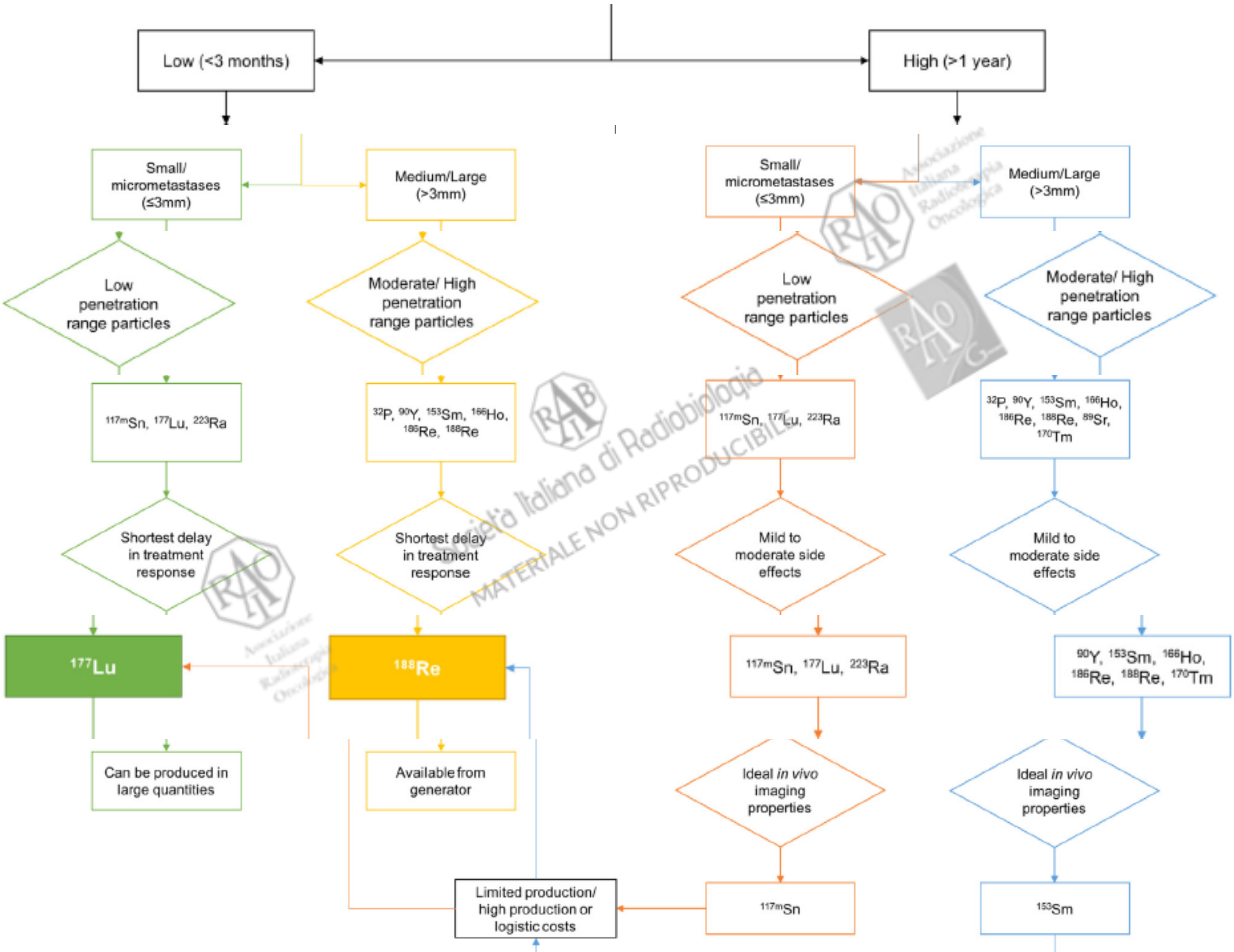
Toxicity	Grade 1	Grade 2	Grade 3	*n* (%) of Cases
Fatigue[a]	0	2	0	2 (15)
Nausea and/or vomiting[a]	2	1	0	3 (23)
Fever[a]	2	1	0	3 (23)
Diarrhea[a]	0	1	0	1 (7)
Leukopenia[a]	3	3	1	7 (53)
Anemia[a]	3	4	2	9 (69)
Thrombocytopenia	0	0	1	1 (7)



Pain-free survival with half-body irradiation for entire series (13 patients).

Radionuclide	Emission type	E_{mean} (MeV) (%)	E_γ (keV) (%)	$T_{1/2}$ (days)	Tissue penetration max. (mm)	Main production mode (impurities)	Production and logistics cost	References
^{32}P	β^-	0.6955 (100)	–	14.3	8.0	$^{31}P(n,\gamma)$ ^{32}P (None) $^{32}S(n,p)$ ^{32}P (^{33}P, ^{35}S) $^{34}S(d,\alpha)$ ^{32}P (None)	High Cost-effective High	Bé et al. (2008), Lewington (2005), Vimalnath et al. (2013) and Volkert and Hoffman (1999)
^{89}Sr	β^-	0.5846 (99.99)	909 (0.1)	50.5	6.7	$^{88}Sr(n,\gamma)$ ^{89}Sr (^{85}Sr, ^{90}Sr) Fission Product (^{90}Sr) $^{87}Sr(t,p)$ ^{89}Sr (None) $^{86}Kr(\alpha,n\gamma)$ ^{89}Sr (None)	High High High High	Bé et al. (2008), Lewington (2005) and Volkert and Hoffman (1999)
^{90}Y	β^-	0.927 (99.98)	–	2.67	11	$^{90}Sr(\beta)$ ^{90}Y (None) $^{89}Y(n,\gamma)$ ^{90}Y (^{91}Y)	High Cost-effective	Bé et al. (2008) and Volkert and Hoffman (1999)
^{117m}Sn	Auger	0.1268 (64.8)	159 (86)	13.6	0.3	$^{116}Sn(n,\gamma)$ ^{117m}Sn (None) $^{117}Sn(n,n')$ ^{117m}Sn (None)	High High	Bé et al. (2008), Lewington (2005), Maslov et al. (2011) and Volkert and Hoffman (1999)
^{153}Sm	β^-	0.2253 (48.2)	103 (28)	1.93	3.4	$^{152}Sm(n,\gamma)$ ^{152}Sm (None) $^{150}Nd(n,\alpha)$ ^{153}Sm (None)	High High	Bé et al. (2008), Lewington (2005) and Volkert and Hoffman (1999)
^{166}Ho	β^-	0.6511 (50.5)	81 (6.4)	1.12	8.6	$^{165}Ho(d,p)$ ^{166}Ho (^{166m}Ho) $^{165}Ho(n,\gamma)(E=thermal)$ ^{166}Ho (None) ^{166}Dy - decay chain (None)	High Cost-effective High	Bé et al. (2008), Knapp (2001) and Volkert and Hoffman (1999)
^{170}Tm	β^-	0.3231 (81.6)	84 (3.3)	128.4	5	$^{169}Tm(n,\gamma)$ ^{170}Tm (None) $^{170}Er(p,n)$ ^{170}Tm (^{168}Tm)	Cost-effective High	Bé et al. (2008) and Das et al. (2009)
^{177}Lu	β^-	0.1494 (79.3)	208 (10.4)	6.2	1.8	$^{176}Lu(n,\gamma)$ ^{177}Lu (^{176m}Lu) $^{176}Yb(n,\gamma)$ $^{177}Yb \rightarrow {}^{177}Lu$	High Cost-effective	Bé et al. (2008), Knapp (2001), Pillai et al. (2003) and Volkert and Hoffman (1999)
^{186}Re	β^-	0.3596 (70.9)	137 (9)	3.8	4.7	$^{185}Re(n,\gamma)$ ^{186}Re (^{186m}Re, ^{188}Re) $^{186}W(n,p)$ ^{186}Re (None)	Cost-effective Cost-effective	Bé et al. (2008), Lewington (2005) and Volkert and Hoffman (1999)
^{188}Re	β^-	0.7304 (71.1)	155 (15)	0.7	10.4	$^{188}We(n,n)$ ^{188}Re (None)	Cost-effective	Argyrou et al. (2013a, 2013b), Bé et al. (2008) and Lewington (2005)
^{223}Ra	α	5.71581 (45.6)	154 (5.6)	11.4	0.1	^{235}U - decay chain (None) $^{227}Ac/^{227}Th$ Generator (None)	High Cost-effective	Bé et al. (2008), Henriksen et al. (2003) and Lewington (2005)

Legend: $T_{1/2}$ (days) – radioisotope half-life in days; E (MeV) (%) – particle energy and respective decay abundance shown in parentheses; E_γ (keV) (%) – gamma ray energy and respective abundance in total energy emission shown in parentheses; Tissue penetration range (mm) – maximum tissue penetration in soft tissue shown in millimeters.

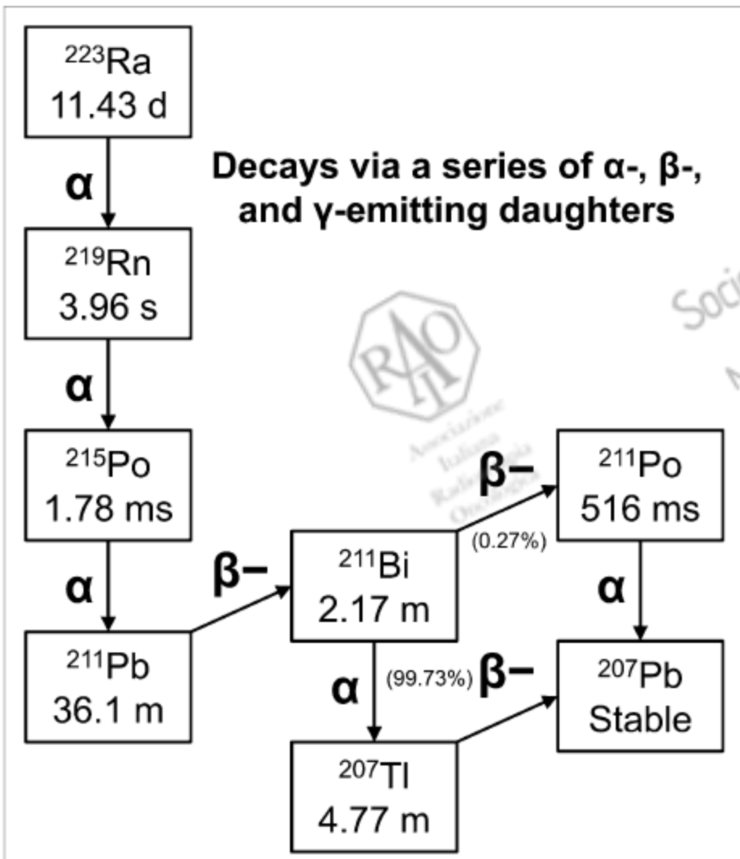


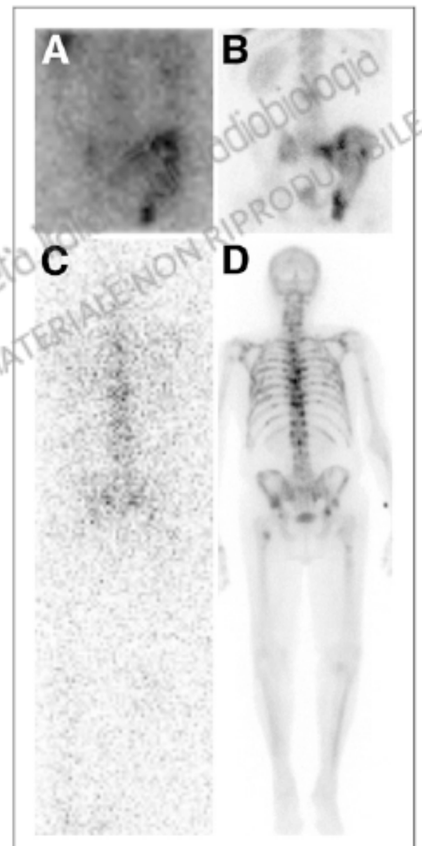
Low (<3 months)
High (>1 year)
Small/ micrometastases (≤3mm)
Medium/Large (>3mm)
Small/ micrometastases (≤3mm)
Medium/Large (>3mm)
Low penetration range particles
Moderate/ High penetration range particles
Low penetration range particles
Moderate/ High penetration range particles
117mSn, 177Lu, 223Ra
32P, 90Y, 153Sm, 166Ho, 186Re, 188Re
117mSn, 177Lu, 223Ra
32P, 90Y, 153Sm, 166Ho, 186Re, 188Re, 89Sr, 170Tm
Shortest delay in treatment response
Shortest delay in treatment response
Mild to moderate side effects
Mild to moderate side effects
177Lu
188Re
117mSn, 177Lu, 223Ra
90Y, 153Sm, 166Ho, 186Re, 188Re, 170Tm
Can be produced in large quantities
Available from generator
Ideal in vivo imaging properties
Ideal in vivo imaging properties
Limited production/ high production or logistic costs
117mSn
153Sm

Bone-Seeking Radiopharmaceuticals for Treatment of Osseous Metastases, Part 1: α Therapy with ^{223}Ra-Dichloride

Neeta Pandit-Taskar, Steven M. Larson, and Jorge A. Carrasquillo

Molecular Imaging and Therapy Service, Memorial Sloan-Kettering Cancer Center, New York, New York





Organ	cGy/37 MBq
Bone surface	4,262.60
Red bone marrow	513.51
Lower bowel wall	171.88
Urinary bladder wall	14.9
Testes	0.31
Ovaries	1.8
Uterine wall	0.94
Kidney	11.86

Radium is very similar to calcium. And like calcium, active bone cells take up the radium. This makes it a good way of specifically targeting bone cancer cells. Cancer cells are more active than normal bone cells and so are more likely to pick up the radium 223.

Category	Description
Indications	Skeletal metastasis in castration-resistant prostate cancer, symptomatic bone metastases, and no known visceral metastatic disease
Contraindications	Pregnancy, breast-feeding, and women of child-bearing age
Prerequisites	
First dose	ANC ≥ 1.5 × 10^9/L, platelet count ≥ 100 × 10^9/L, and hemoglobin ≥ 10 g/dL
Subsequent doses	ANC ≥ 1 × 10^9/L and platelet count ≥ 50 × 10^9/L (discontinue if hematologic values do not recover within 6–8 wk after last administration despite supportive care)

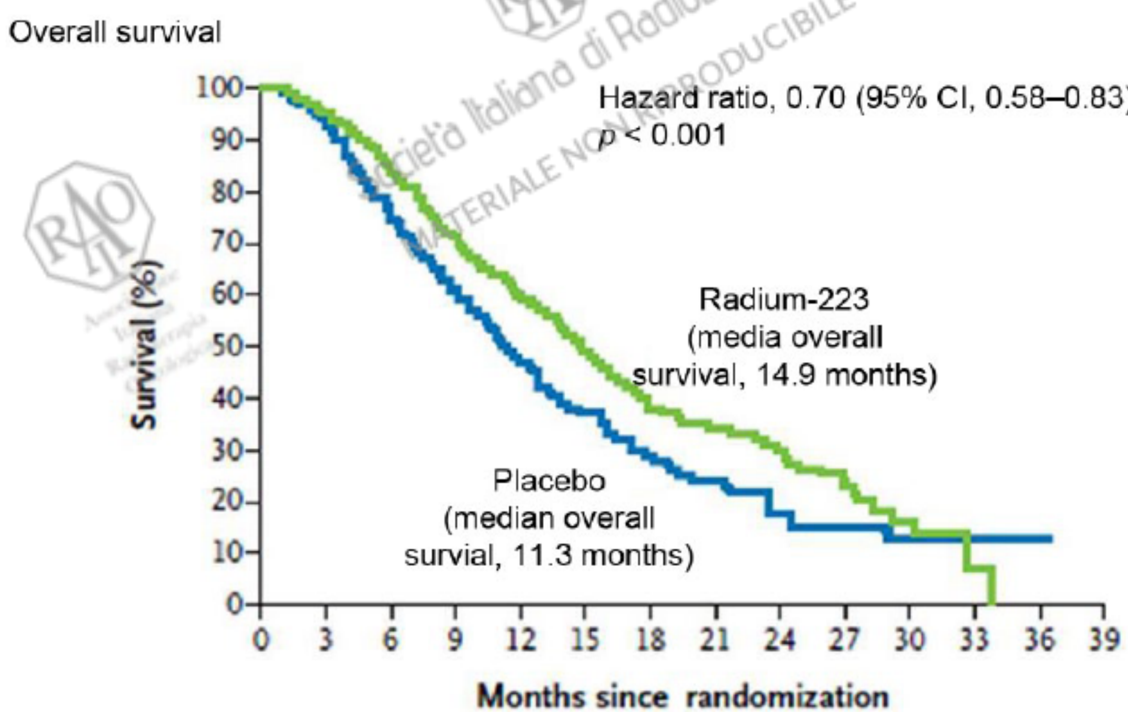
ANC = absolute neutrophil count.

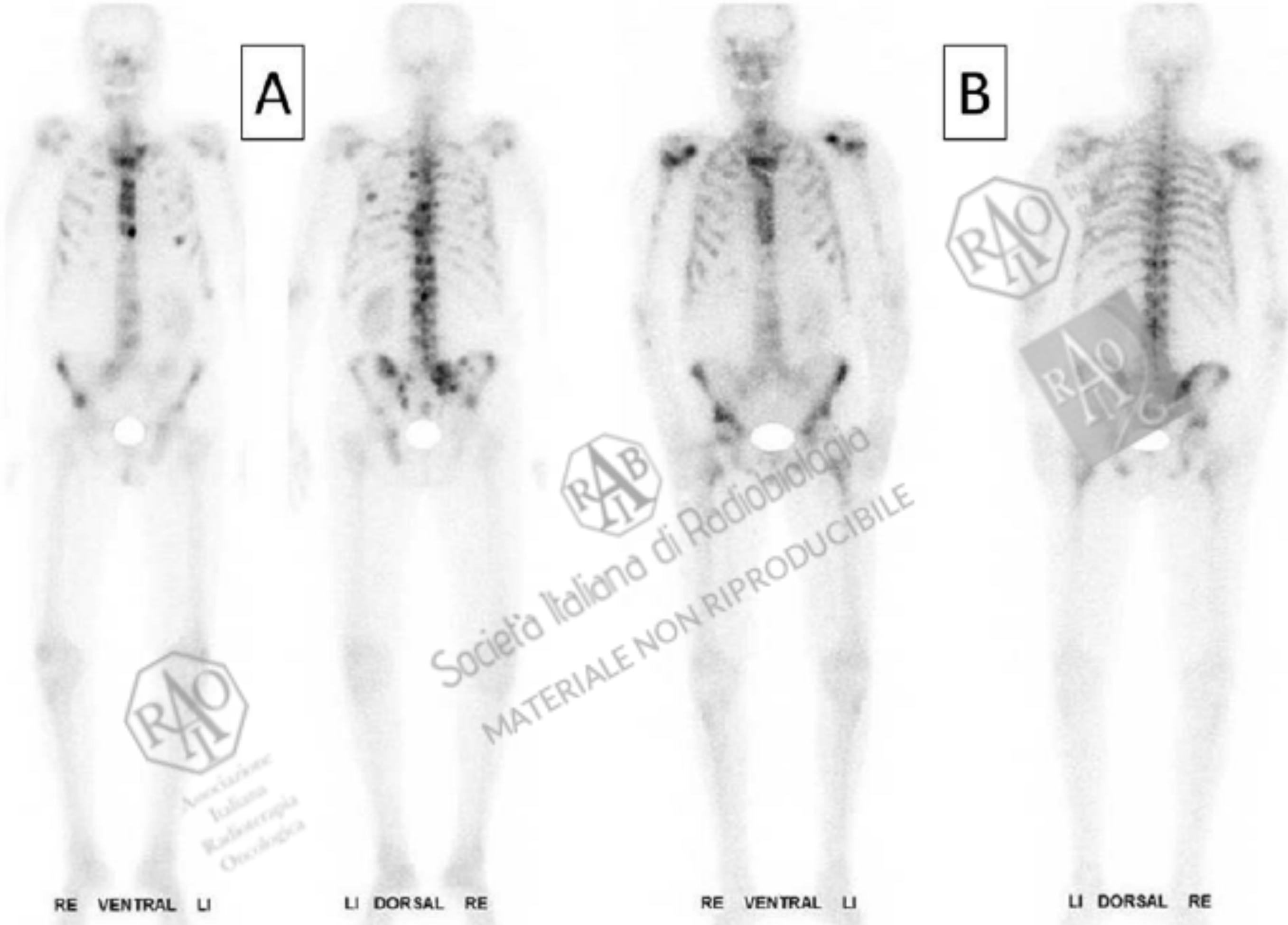
Dosage and Administration of ^{223}Ra-Dichloride

Amount of dose	Route	No of doses	Dose calculation*
50 kBq/kg, or 1.3514 μCi/kg	Intravenous slow injection	6 doses every 4 wk	Volume to be administered(mL) = $\frac{\text{Body weight in kg} \times 50\ \text{kBq/kg}}{\text{Decay factor} \times 1{,}000\ \text{kBq/mL}}$

*Decay table can be found in Xofigo product information (*29*).

From palliative therapy to prolongation of survival: $^{223}RaCl_2$ in the treatment of bone metastases





(A) Pretherapeutic

(B) 3 months after four times 223Ra

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Platinum Priority – Review – Prostate Cancer

Editorial by Oliver Sartor on pp. 427–428 of this issue

Radiopharmaceuticals for Palliation of Bone Pain in Patients with Castration-resistant Prostate Cancer Metastatic to Bone: A Systematic Review

Joyce M. van Dodewaard-de Jong [a], Daniela E. Oprea-Lager [b], Lotty Hooft [c], John M.H. de Klerk [d], Haiko J. Bloemendal [e], Henk M.W. Verheul [a], Otto S. Hoekstra [b,†], Alfons J.M. van den Eertwegh [a,,†]*

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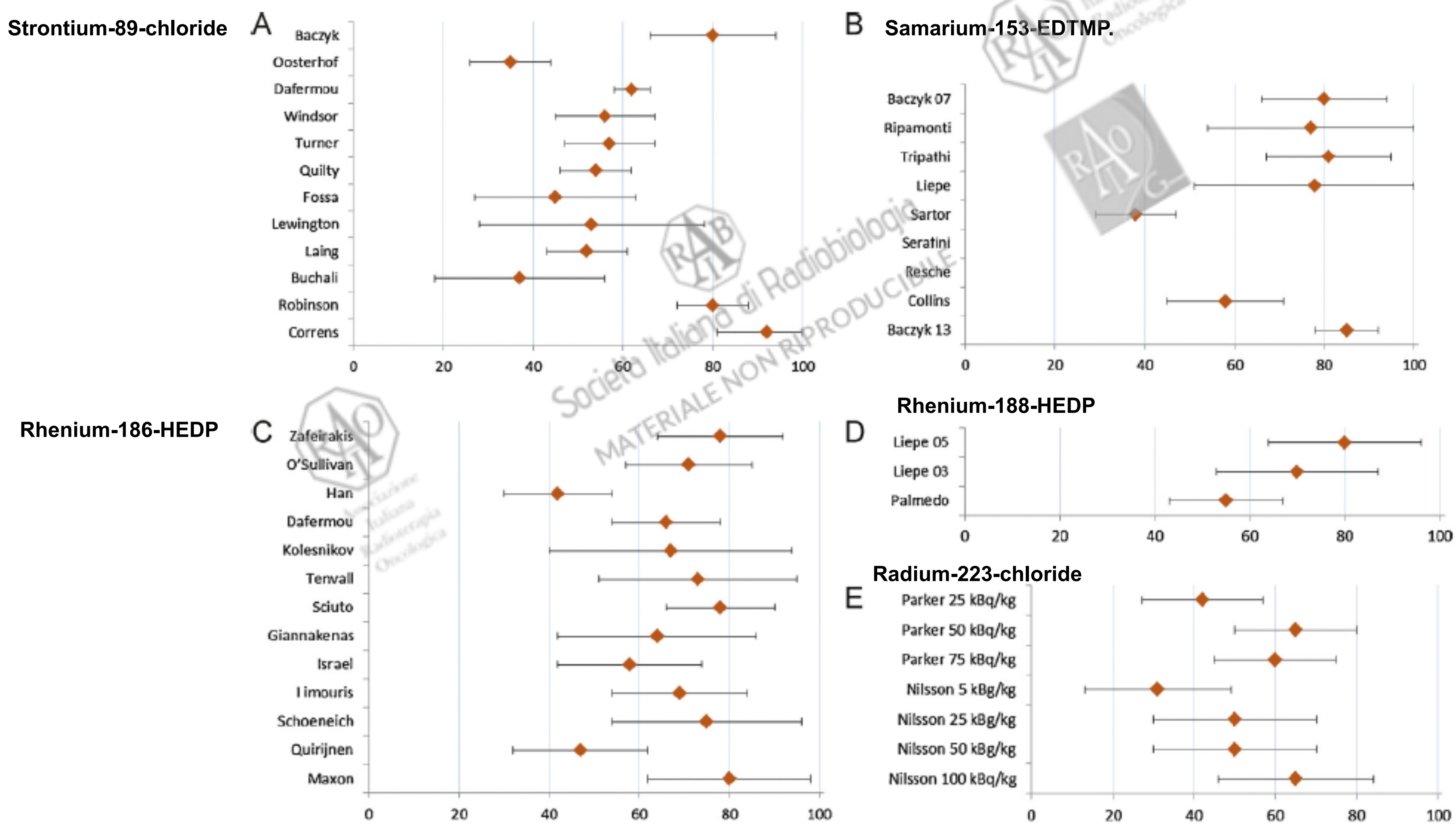
Radio-pharmaceutical	Half-life (d)	Type of radiation	Maximum energy (MeV)	γ-emission MeV (%)	Maximum range (mm)
^{89}Sr	50.5	β	1.46	Nihil (0.01%)	7
^{153}Sm	1.9	β	0.81	0.103 (29%)	2.5
^{186}Re	3.7	β	1.07	0.137 (9%)	5
^{188}Re	0.7	β	2.12	0.155 (15%)	10
^{223}Ra	11.4	α	5.78 average	0.154 (1.1%)	<0.01



Conclusions

"The new restaging of disease, in cancer patients with stage IV, has allowed to improve the quality of life and, in some cases the survival, through a local and systemic radiotherapy applied respecting the characteristics of the disease."