



Vertebroplastica- cifoplastica

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Metastasi

Prima Linea

- ✓ *Radioterapia*
- ✓ *Chemioterapia*
- ✓ *Chirurgia*

Seconda linea

(dopo fallimento delle terapie convenzionali)

- ✓ *Gestione del dolore*

- *Vertebroplastica*
- *Termoablazione (RF, MW)*
- *Crioablazione*
- *MRgFUS*
- *Embolizzazione*
- *Trattamento combinato*

MANAGEMENT STRATEGIES FOR SPECIFIC CANCER PAIN SYNDROMES

Moderate to severe cancer pain is treated with opioids as indicated ([PAIN-3](#)); these interventions are meant to complement opioid management. Adjuvant analgesics are used depending on the pain diagnosis, comorbidities, and potential for drug interactions. Integrative interventions should also be optimized. ([See PAIN-J](#))

- Pain associated with inflammation:
 - ▶ Trial of NSAIDs or corticosteroids
- Bone pain without oncologic emergency:
 - ▶ NSAIDs, acetaminophen, or steroids
[See Non-Opioid Analgesic \(Nonsteroidal Anti-Inflammatory Drugs \[NSAIDs\] and Acetaminophen\) Prescribing \(PAIN-K\)](#)
 - ▶ Consider bone-modifying agents (eg, bisphosphonates, denosumab)
 - ▶ Diffuse bone pain: Consider hormonal therapy or chemotherapy, corticosteroids, and/or systemic administration of radioisotopes
 - ▶ Local bone pain:
 - ◊ Consider local RT, nerve block (eg, rib pain), vertebral augmentation, or radiofrequency ablation.
 - ◊ Assess for impending fracture with plain radiographs.
 - ▶ Consider physical medicine evaluation
[See Specialty Consultations for Improved Pain Management \(PAIN-L\)](#)
 - ▶ Consider orthopedic consultation for stabilization, if feasible
 - ▶ Consider referral to a pain specialist for interventional consultation. [See Interventional Strategies \(PAIN-M\)](#)
- Bowel obstruction
 - ▶ Evaluate etiology of bowel obstruction. If resulting from cancer, consider surgical intervention.
 - ▶ For medical management of partial bowel obstruction consider corticosteroids and/or metoclopramide.
 - ▶ Palliative management of bowel obstruction could include bowel rest, nasogastric suction (or percutaneous gastrostomy drainage), corticosteroids, H2 blockers, anticholinergics (ie, scopolamine, hyoscyamine, glycopyrrolate), and/or octreotide
- Nerve pain
 - ▶ Nerve compression or inflammation:
 - ◊ Trial of corticosteroids
 - ▶ Neuropathic pain:
 - ◊ Trial of antidepressant, [see \(PAIN-G\)](#) and/or
 - ◊ Trial of anticonvulsant, [see \(PAIN-G\)](#) and/or
 - ◊ Consider trial of topical agent, [see \(PAIN-G\)](#)
 - ◊ For refractory pain, consider referral to a pain specialist and/or the use of interventional strategies.
[See Interventional Strategies \(PAIN-M\)](#)

Ablative strategies such as radiofrequency (RF) ablation or US ablation may also be performed to reduce pain and prevent SREs. RF ablation of bone lesions has proven successful in pain management, especially for those failing to achieve adequate analgesia without intolerable effects.²²⁷⁻²³⁰ Several small studies have also demonstrated the palliative effects of high-intensity focused US (HIFU) treatment of bone lesions.²³¹⁻²³³

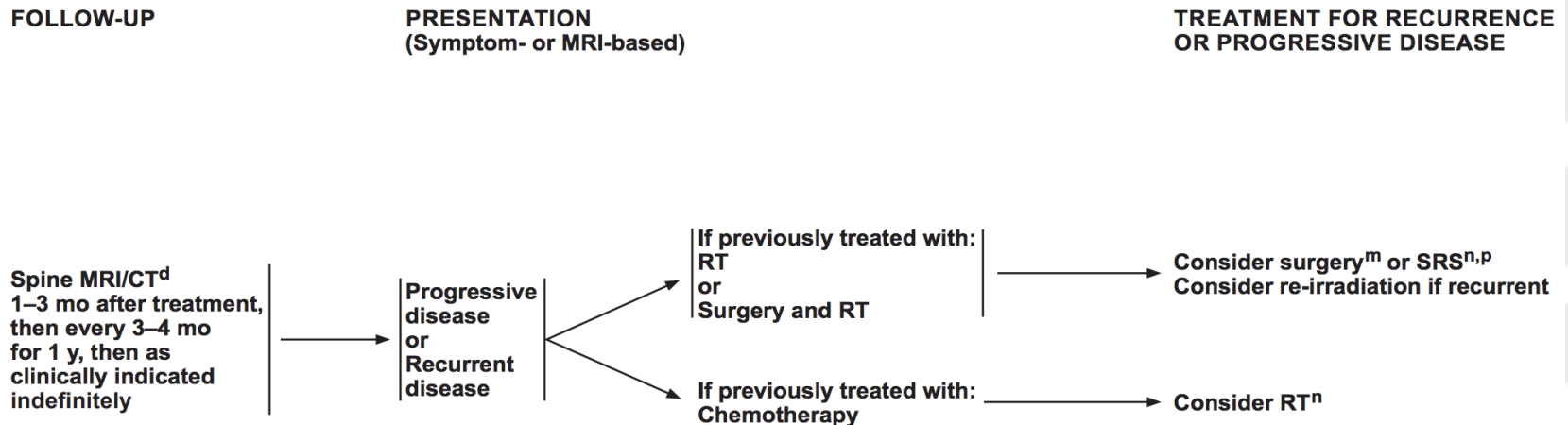
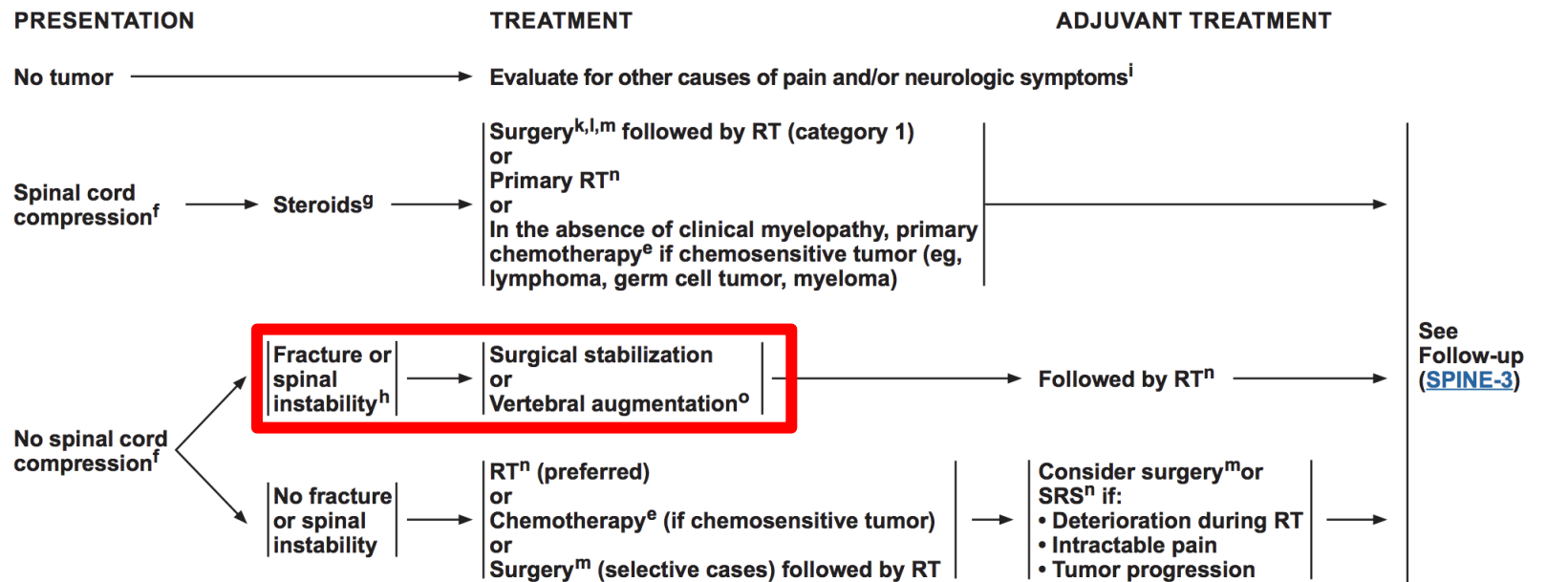
GUIDELINES AND TREATMENT ALGORITHMS



National
Comprehensive
Cancer
Network®

NCCN Guidelines Version 1.2018 Metastatic Spine Tumors

[NCCN Guidelines Index](#)
[Table of Contents](#)
[Discussion](#)



LINEE GUIDA CIRSE 2010

CIRSE GUIDELINES

Quality Improvement Guidelines for Bone Tumour Management

A. Gangi · G. Tsoumakidou · X. Buy ·
E. Quoix

Tumour Management

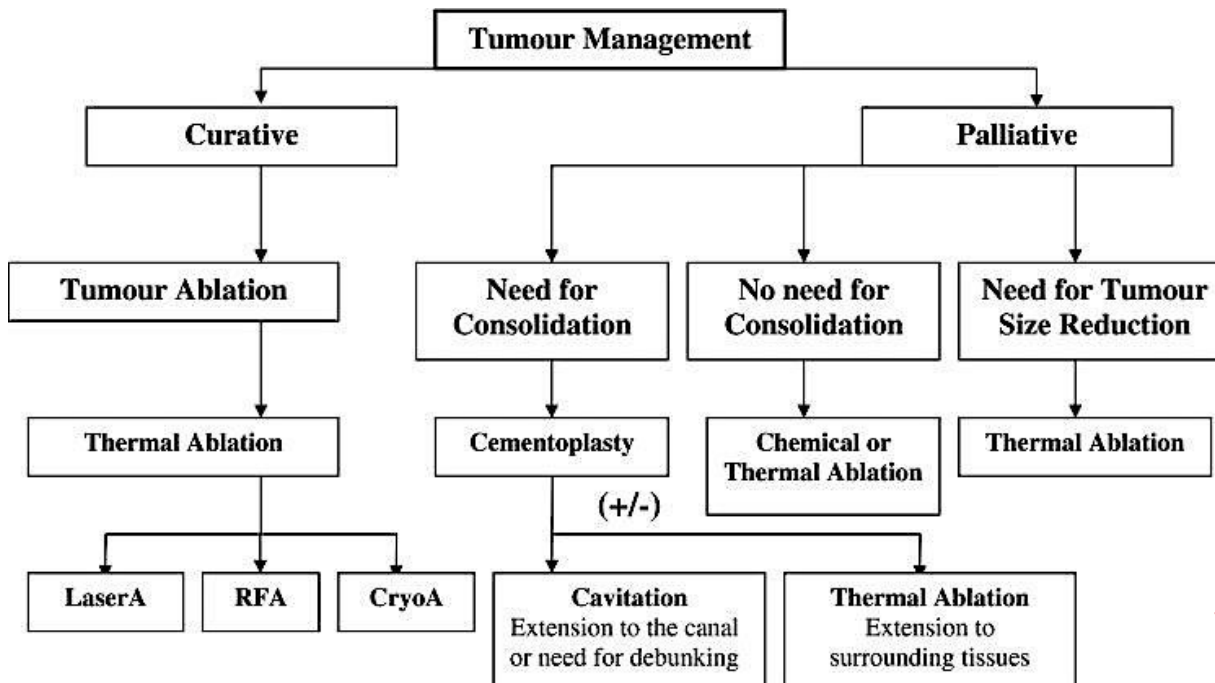
- ✓ *Single Tumor (complete ablation)*
- ✓ *Tumor Reduction*

Palliative treatment: Pain management

- ✓ *Cementoplasty*
- ✓ *RF Ablation*
- ✓ *Cryoablation*
- ✓ *Coblation*

Combined technique

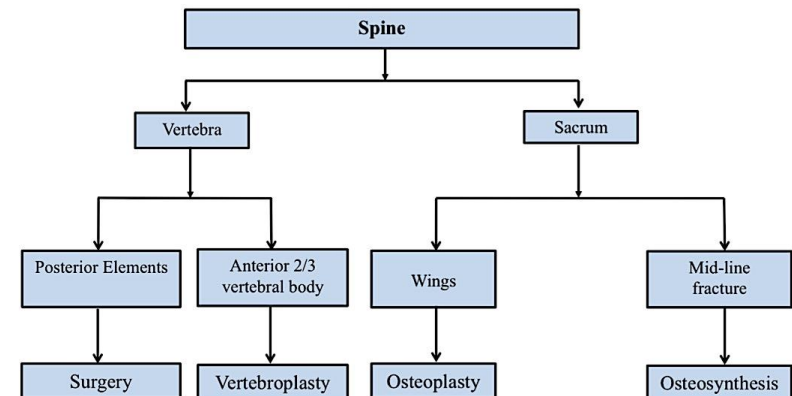
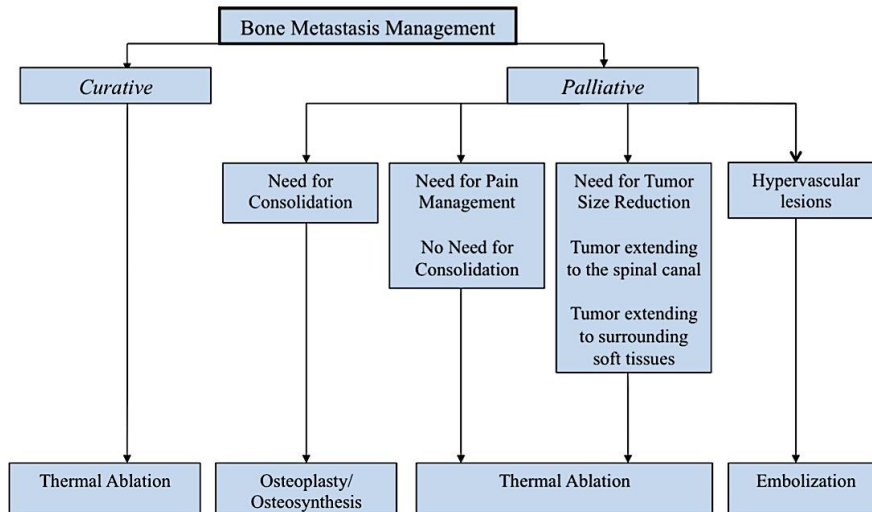
- ✓ *Consolidation and tumor Ablation*
- ✓ *Consolidation and tumor decompression (Coblation)*





Percutaneous management of bone metastases: state of the art, interventional strategies and joint position statement of the Italian College of MSK Radiology (ICoMSKR) and the Italian College of Interventional Radiology (ICIR)

Roberto Luigi Cazzato¹ · Francesco Arrigoni² · Emanuele Boatta¹ · Federico Bruno² · Jean Betsy Chiang³ · Julien Garnon¹ · Luigi Zugaro² · Aldo Victor Giordano² · Sergio Carducci² · Marco Varrassi² · Bruno Beomonte Zobel⁴ · Alberto Bazzocchi⁵ · Alberto Aliprandi⁶ · Antonio Basile⁷ · Stefano Marcia⁸ · Salvatore Masala⁹ · Rosario Francesco Grasso⁴ · Silvia Squarza¹⁰ · Chiara Floridi¹¹ · Anna Maria Ierardi¹² · Nicola Burdi¹³ · Roberto Cioni¹⁴ · Alessandro Napoli¹⁵ · Raffaella Niola¹⁶ · Giuseppe Rossi¹⁷ · Umberto Geremia Rossi¹⁸ · Massimo Venturini¹⁹ · Francesco De Cobelli¹⁹ · Marina Carotti²⁰ · Giovanni Luca Gravina²¹ · Mario Di Staso²² · Carmine Zoccali²³ · Roberto Biagini²³ · Giuseppe Tonini²⁴ · Daniele Santini²⁴ · Gianpaolo Carrafiello¹² · Maurizio Cariatì¹⁰ · Enzo Silvestri²⁵ · Luca Maria Sconfienza^{26,27} · Andrea Giovagnoni²⁰ · Carlo Masciocchi² · Afshin Gangi¹ · Antonio Barile²



Trattamento palliativo delle metastasi ossee

- *Radiofrequency ablation*
- *Microwave ablation*
- *Cryoablation*
- *High Intensity Focused Ultrasound (HIFU)*
- *Vertebral Augmentation*

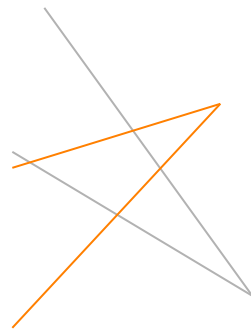
- Trattamento del dolore acuto
- Non interruzione della chemioterapia
- Complementare alla radioterapia
- Sinergia con altre cure

Trattamento palliativo delle metastasi ossee

Stabilizzazione

Analgesia

Antiblastico



- Thermal ablation (RF MW)
- Crioablation
- MRgFUS (focused US)
- Embolization
- Osteoplasty and vertebroplasty

VERTEBROPLASTICA

- Effetto diretto citotossico e termico del PMMA sulle cellule tumorali e sulle terminazioni nervosa
- Va fatta isolate o insieme alla terapia ablativa
- *Il cemento stabilizza e reduce il rischio di fratture*

LESIONE METASTATICA SPINALE



Come gestirla

- a) Chirurgia ?
- b) Radioterapia ?
- c) Chemioterapia ?
- d) Vertebroplastica ?
- e) Radiofrequenza ?
- f) Terapia combinata?

■ A Novel Classification System for Spinal Instability in Neoplastic Disease

An Evidence-Based Approach and Expert Consensus From the Spine Oncology Study Group

Charles G. Fisher, MD, MHSc, FRCSC,* Christian P. DiPaola, MD,*

Location:

- *Junctional* (C0-C2, C7-T2, T11-L1, L5-S1): 3
- *Mobile segment* (C3-C6; L2-L4): 2
- *Semi-rigid* (T3-T10): 1
- *Rigid* (S2-S5): 0

Type of lesion:

- *Lytic*: 2
- *Mixed*: 1
- *Blastic*: 0

Pain :

- *Mechanic*: 3
- *Not mechanic*: 1
- *Absent*: 0

Radiog. Spine Alignment:

- *Subluxation/translation*: 4
- *New deformity*: 2
- *Normal*: 0

Post. Arch involvement:

- *Bilateral*: 3
- *Unilateral*: 1
- *Absent*: 0

Body involvement:

- *>50% collapse*: 3
- *<50% collapse*: 2
- *No collapse with >50% VB invol*: 1
- *None of the above*: 0

0-6= stable

7-12= possible instability

13-18=instability

LESIONE METASTATICA SPINALE SINTOMATICA



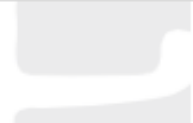
Localizzazione T11	3
Litica	2
Dolore	3
Allineamento	0
Arco Posteriore	1
Estensione sul corpo	3

Total 12 Instabile

LESIONE METASTATICA SPINALE SINTOMATICA



VERTEBROPLASTICA CON CEMENTO AD
ALTA VISCOSITA'

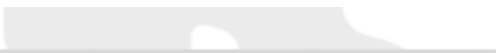


ARTICLE

Open Access

The role of cement augmentation with percutaneous vertebroplasty and balloon kyphoplasty for the treatment of vertebral compression fractures in multiple myeloma: a consensus statement from the International Myeloma Working Group (IMWG)

Charalampia Kyriakou^{1,2}, Sean Molloy², Frank Vrionis³, Ronald Alberico⁴, Leonard Bastian⁵, Jeffrey A. Zonder⁶, Sergio Giralt⁷, Noopur Raje⁸, Robert A. Kyle⁹, David G. D. Roodman¹⁰, Meletios A. Dimopoulos¹¹, S. Vincent Rajkumar¹², Brian B. G. Durie¹³ and Evangelos Terpos¹¹



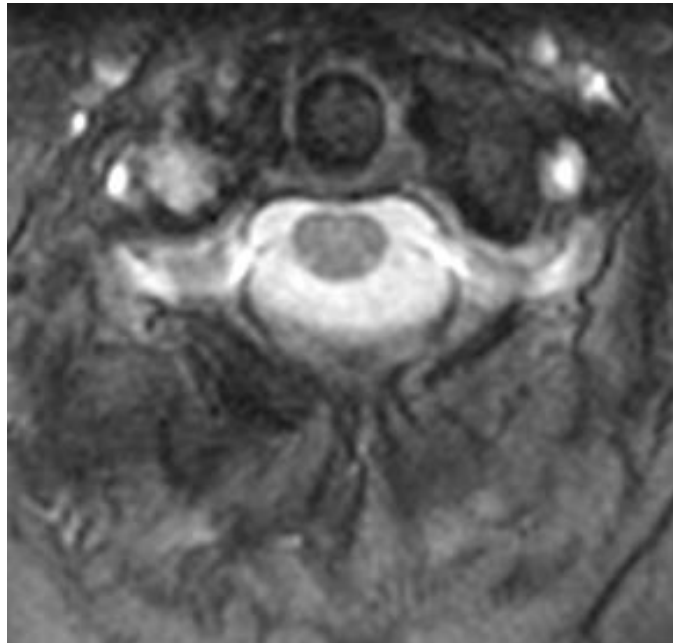
C1-C3 Mieloma Multiplo

Donna 63aa

- *Dolore*
- *VAS 8*
- *Halo Jacket*



Cor T2 STIR



*Ax T2**



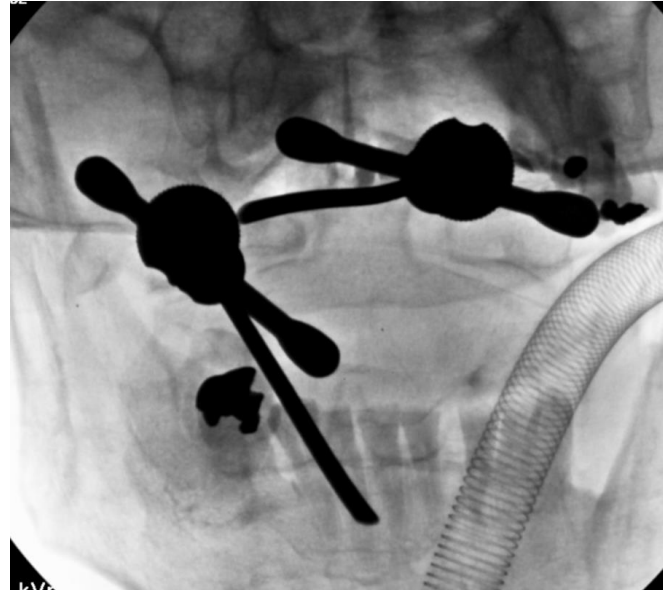
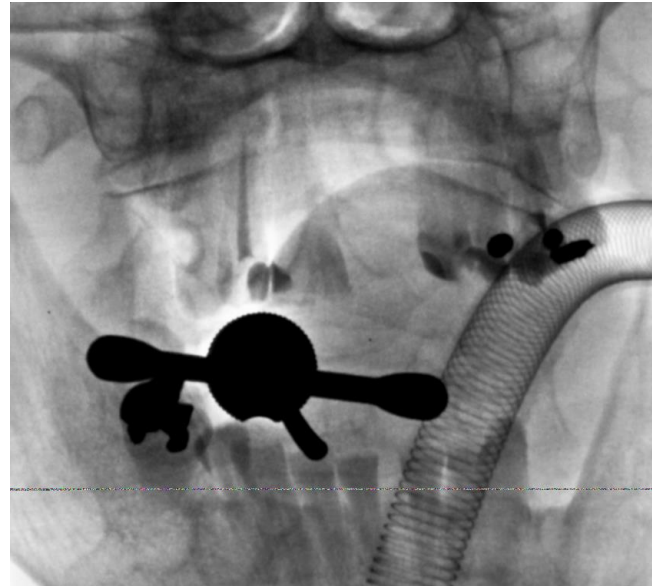
Sag T1



Sag T1 CE

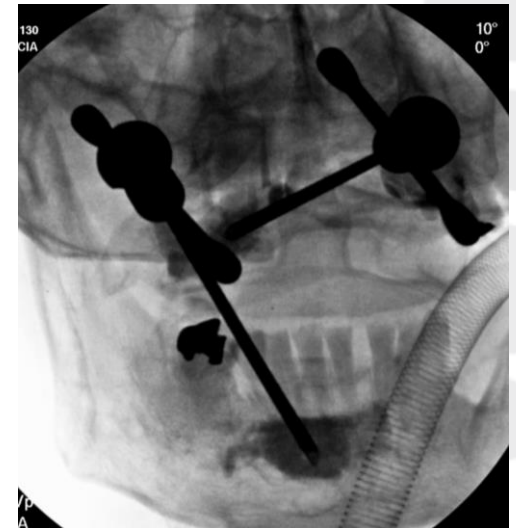
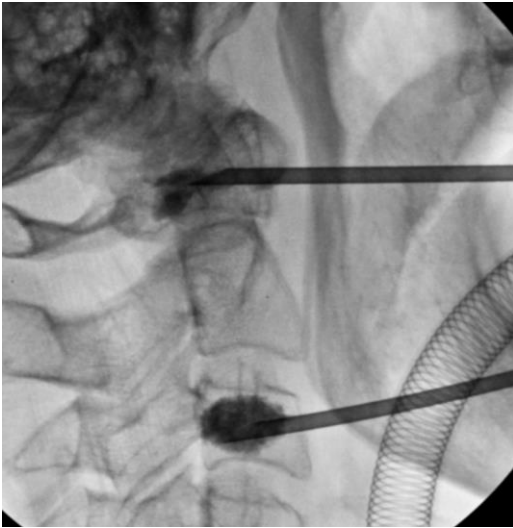
C1-C3 Mieloma Multiplo

Vertebroplastica Percutanea



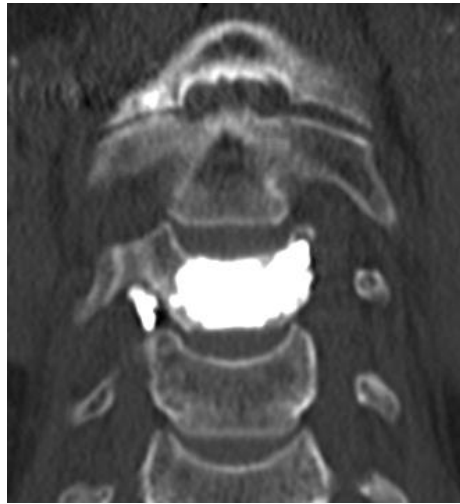
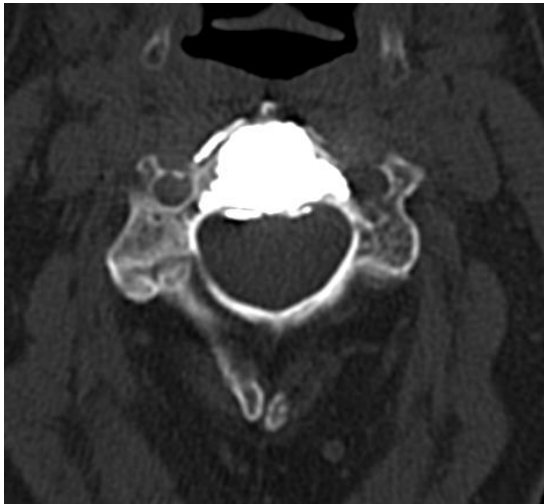
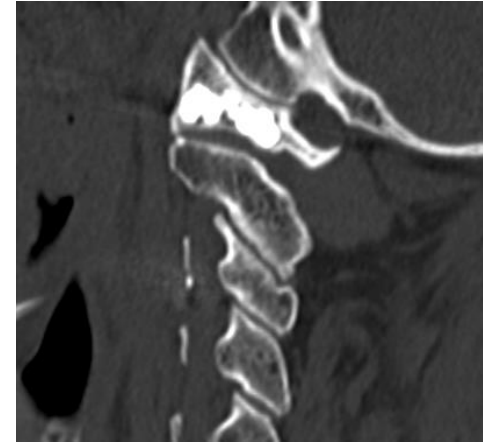
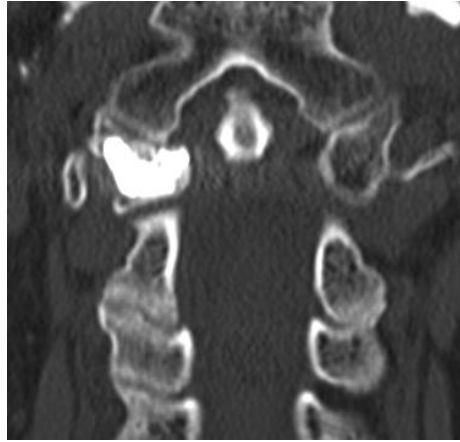
C1-C3 Mieloma Multiplo

Vertebroplastica Percutanea



C1-C3 Mieloma Multiplo

Vertebroplastica Percutanea

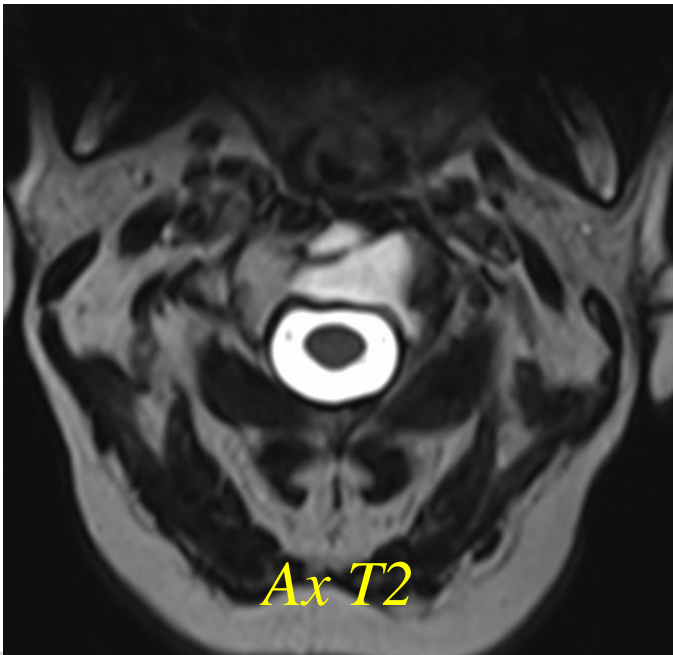
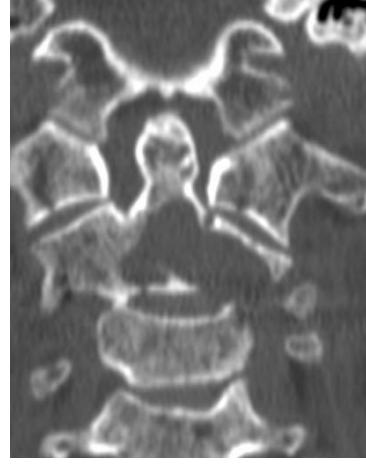


Dopo 1 settimana scomparsa dei sintomi

C2 Mieloma Multiplo

Donna 74 aa

- *Dolore al collo*
- *VAS 7*
- *Halo Jacket*



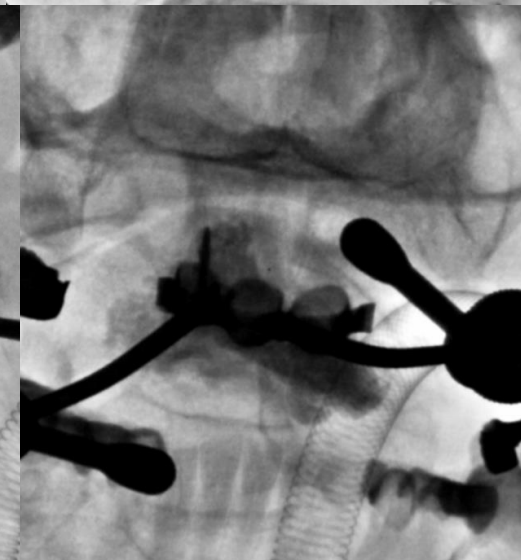
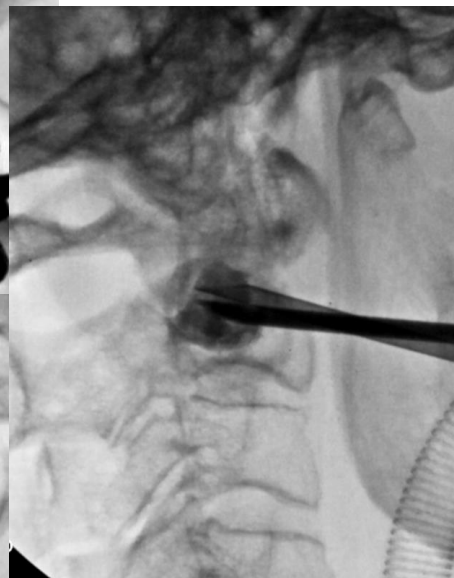
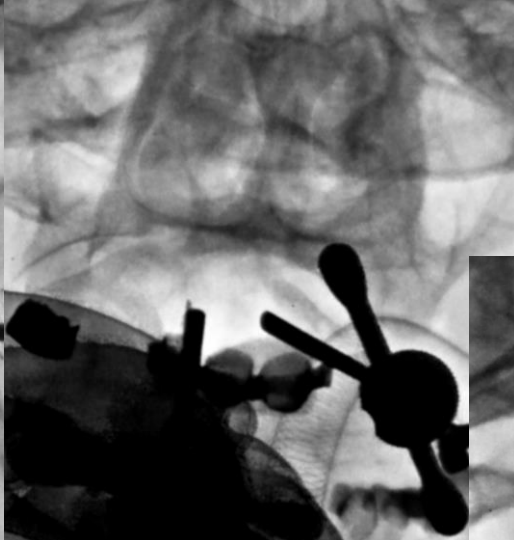
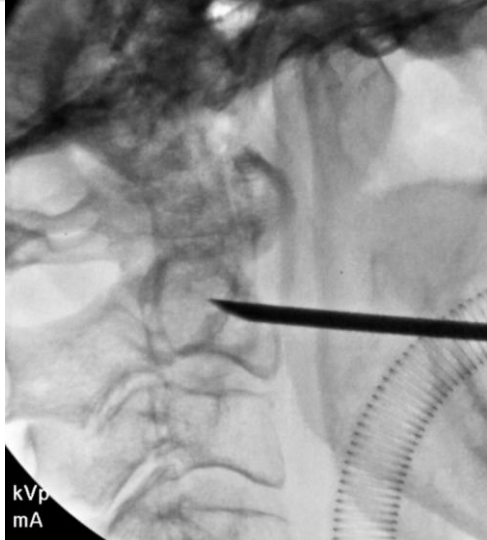
Ax T2

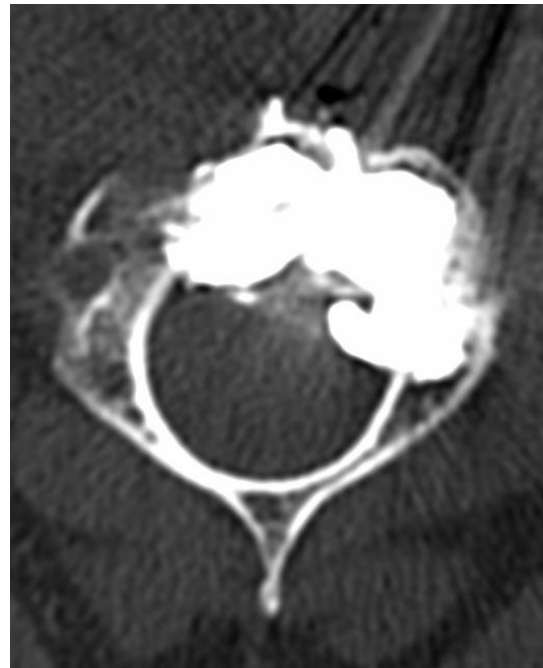
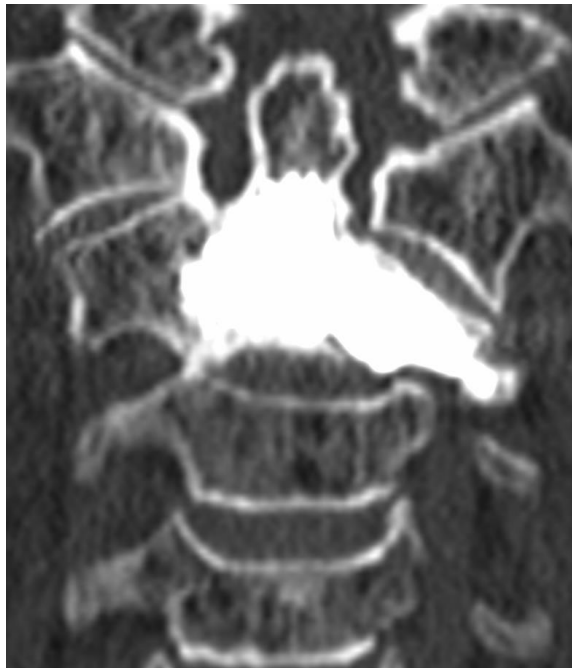


Sag T2



Sag T2 STIR





After 1 week complete disappearance of symptoms

Vertebroplastica

- ✓ *Metastasi sintomatica con rischio di frattura*
- ✓ *Pazienti che non rispondono alla terapia convenzionale*

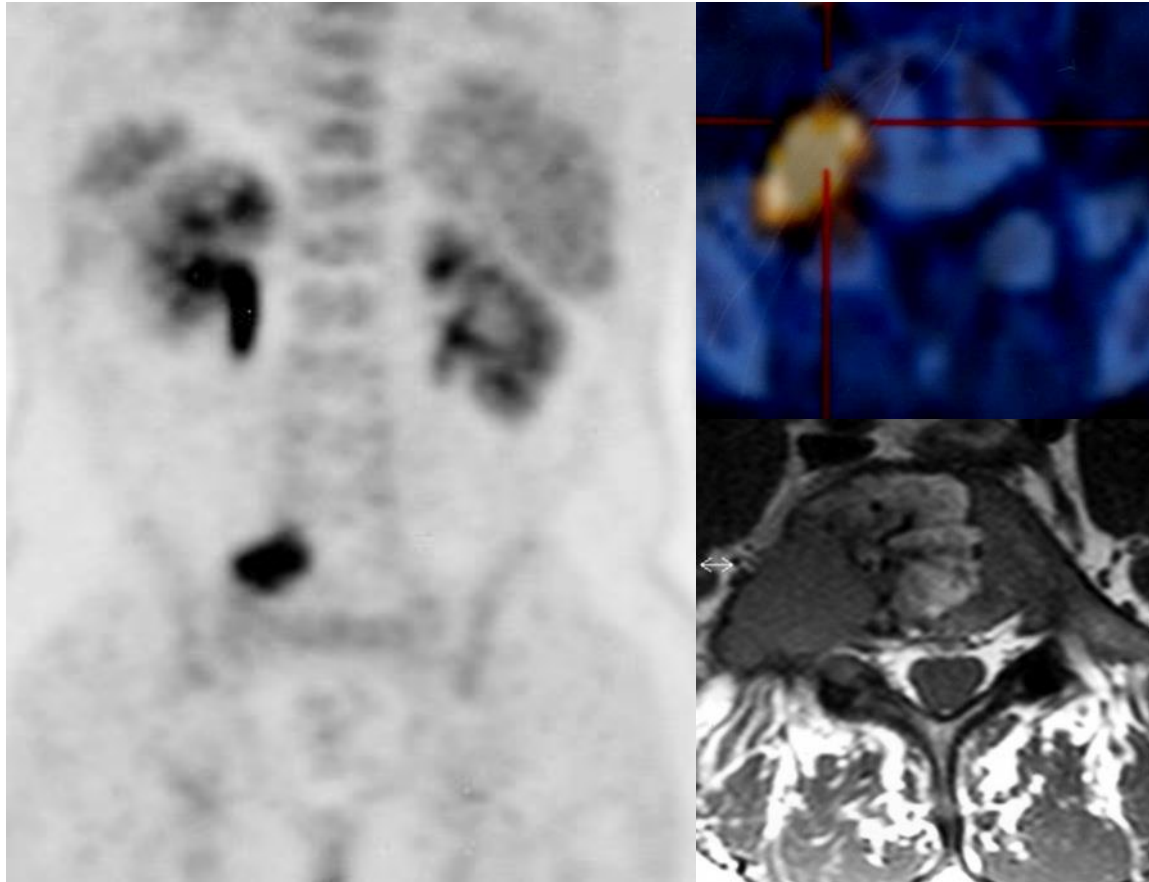
Vertebroplastica + RF

- ✓ *Metastasi sintomatica con rischio di frattura*
- ✓ *Lesioni ampie (per ridurre le dimensioni)*
- ✓ *Lesioni uniche*
- ✓ *Pazienti che non rispondono alla terapia convenzionale*

Indicazione per Ablazione

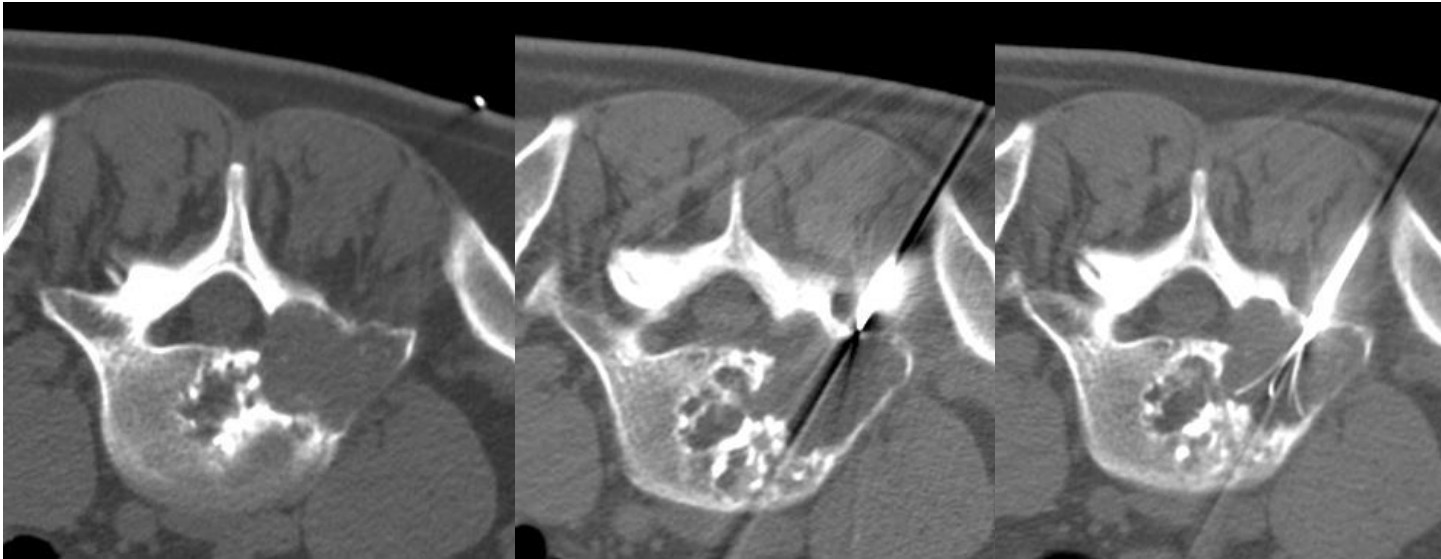
- *Painful lesion with impending fractures*
- *Persistent pain after Radiation therapy*
- *Radio-resistant tumors (RCC, chondrosarcoma, melanoma)*
- *Reached maximal Radiation dose*
- *Development radiotoxicity with ongoing pain*
- *Bone marrow suppression*
- *Refused RT*

VERTEBROPLASTICA E RADIOFREQUENZA

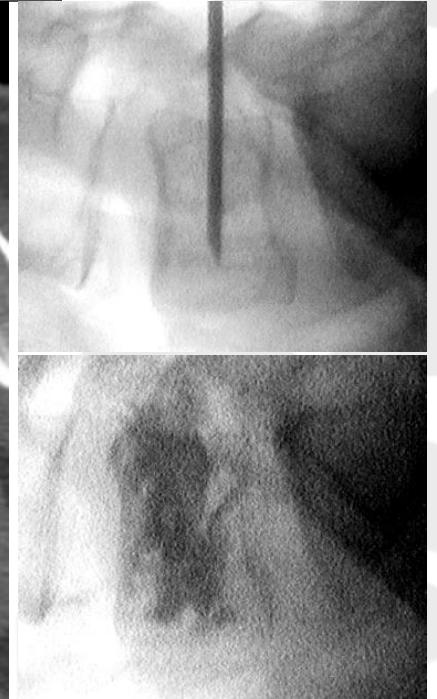


Emnagiopericitoma L5

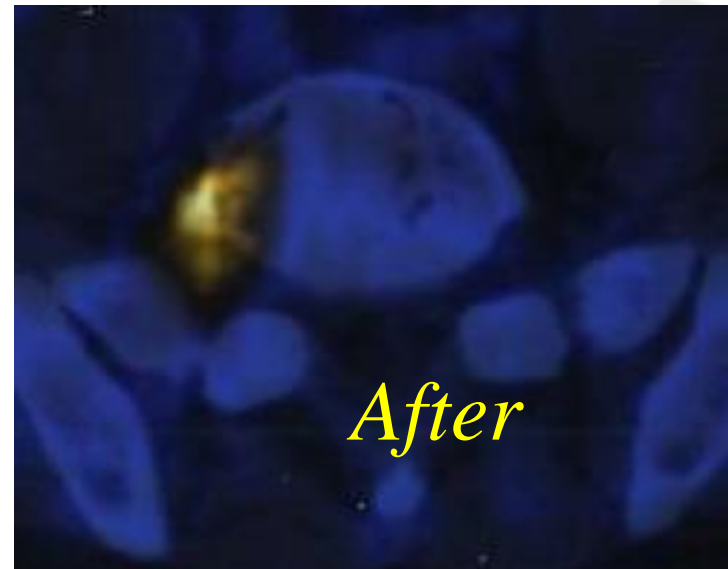
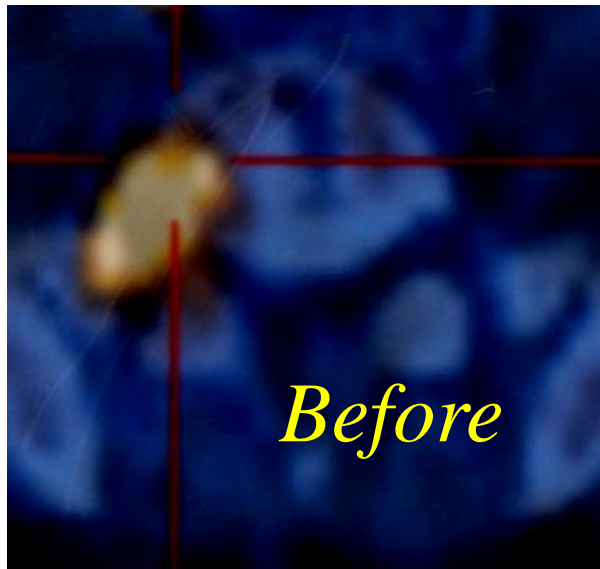
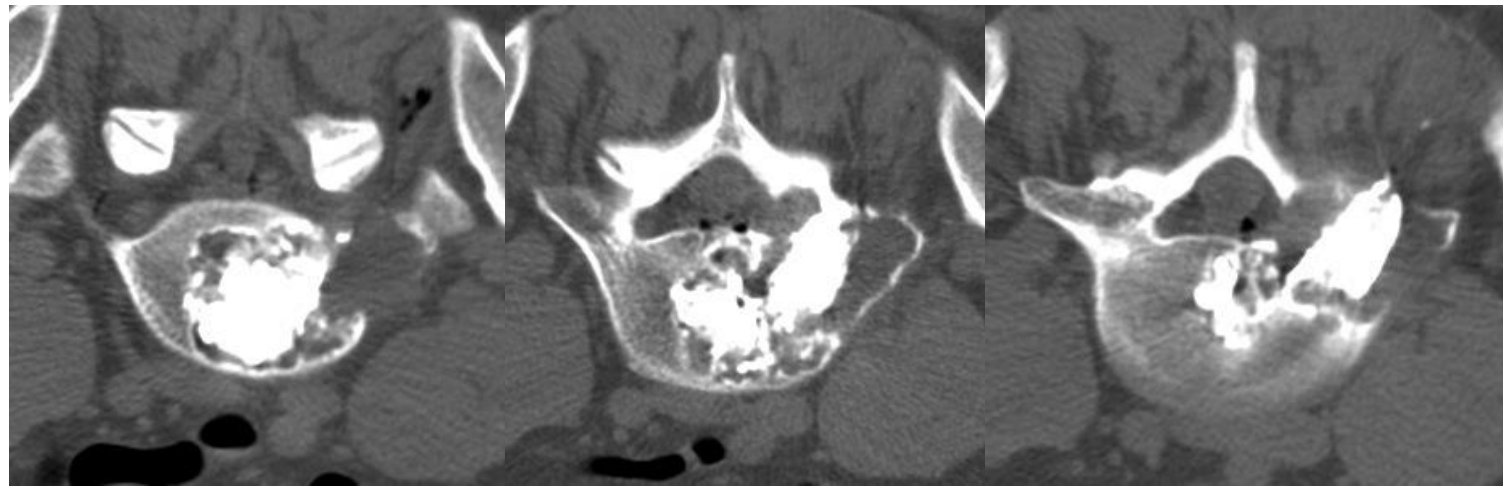
VERTEBROPLASTICA E RADIOFREQUENZA



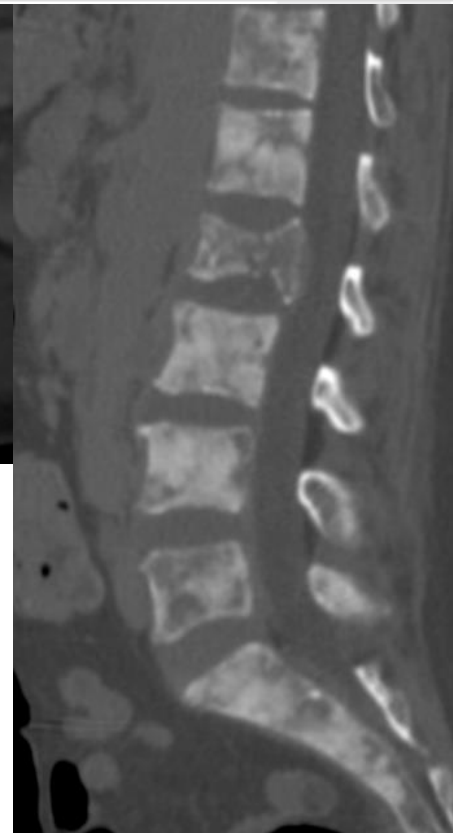
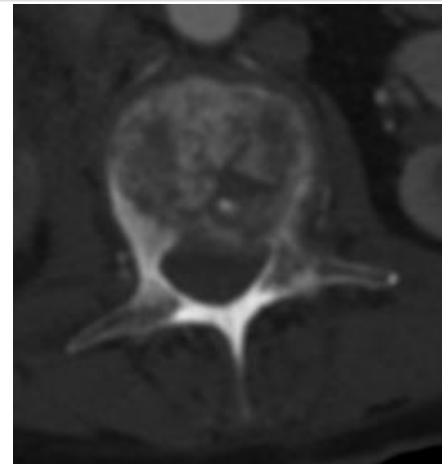
- *Controllo dolore*
- *Riduzione dimensioni*
- *Stabilizzazione*



VERTEBROPLASTICA E RADIOFREQUENZA



- Donna 61 aa
- Carcinoma Uroteliale
- Metastasi vertebrali multiple
- Frattura sintomatica L2

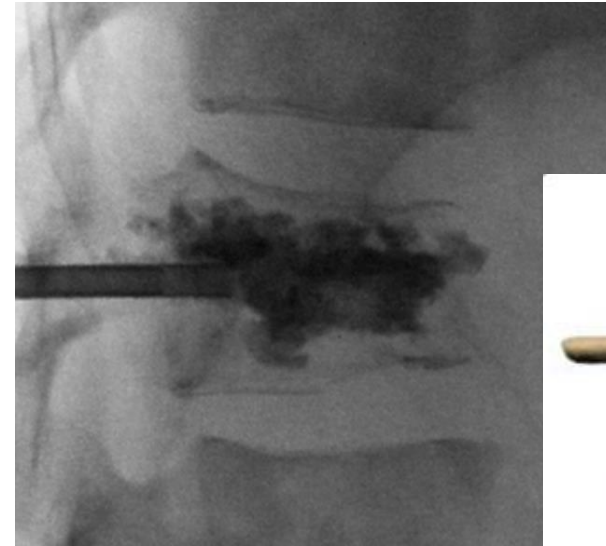
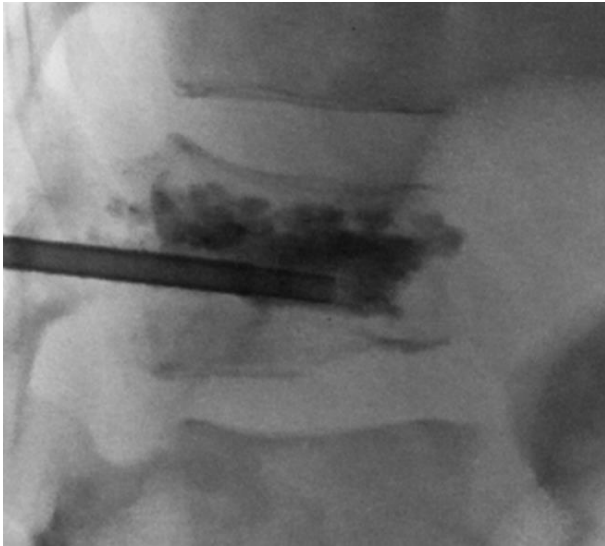
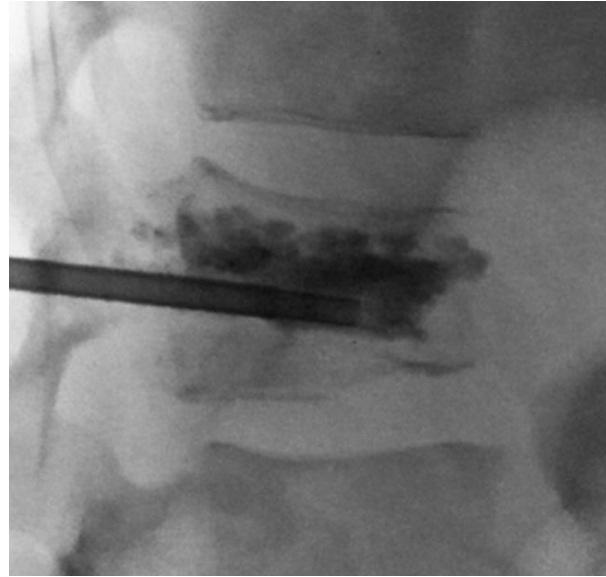


Temperature: 50°

Time of ablation: 6'

RF Cycle	Cycles	RF Total	Reset
03:00	01	02:00	
	Distal TC	Proximal TC	
	50°C	42°C	
		Power	
		Level 1	

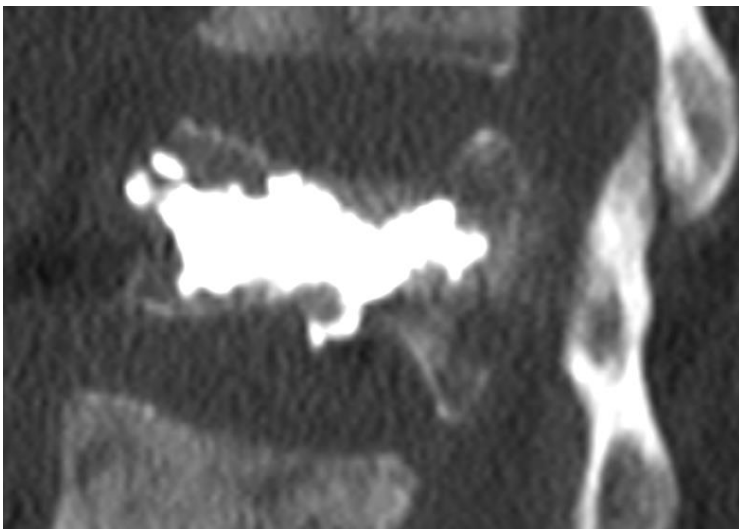
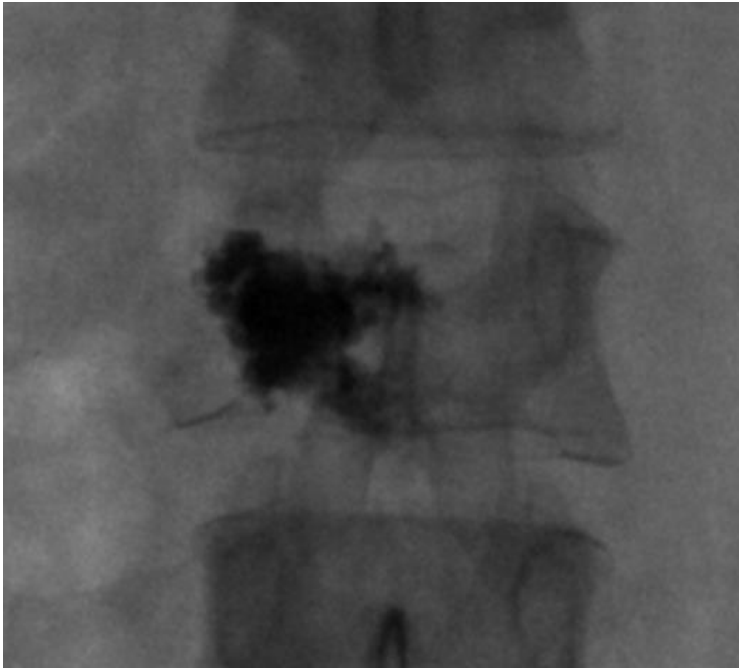
L2 Intra-op



5ml Di cemento



L2 Post-treatment



VAS before: 9

VAS after: 6

ODI before: 39

ODI after: 26

Risultati in Letteratura

Vertebroplastica e radiofrequenza

Authors	Study Design	N° of Pts	N° PVP	Follow-up	Improved Pts (%)	Complications
Gronemeyer et al. 2004	<i>Prospective Not Randomized</i>	4	4	5.8 months	74.4%	No
Goetz et al. 2004	<i>Prospective Not Randomized</i>	43	43	7 months	95%	1 skin-burn; 1 transient bowel and bladder incontinence; 1 fracture of the acetabulum
Nakatsuka et al. 2004	<i>Prospective Not Randomized</i>	17	23	4.9 months	96%	4 neural damages
Toyota et al. 2005	<i>Prospective Not Randomized</i>	17	17	7.3 months	100%	2 nerve root pain
Van der Linden et al. 2007	<i>Prospective Not Randomized</i>	12	12	18 (mean 5.6 months)	81%	1 nerve root pain
Hoffmann et al. 2008	<i>Retrospective Not Randomized</i>	22	27	7.7 months	100%	8 asymptomatic canal leakages
Munk et al. 2009	<i>Retrospective Not Randomized</i>	19	25	3 months	95%	6 limited cement extravasation; 1 nerve thermal nerve injury

Ablazione e Vertebroplastica

J Neurooncol (2015) 124:111–118
DOI 10.1007/s11060-015-1813-2



CLINICAL STUDY

Radiofrequency ablation and vertebral augmentation for palliation of painful spinal metastases

Adam N. Wallace¹ · Taylor J. Greenwood¹ · Jack W. Jennings¹

Table 2 Patient and tumor characteristics

Patient age (years)	68.4 ± 18.8
Men	39 % (28/72)
Women	61 % (44/72)
Primary tumor	
Breast adenocarcinoma	15 % (11/72)
Lung	28 % (20/72)
NSCLC	85 % (17/20)
SCLC	15 % (3/20)
Sarcoma	18 % (13/72)
Renal cell carcinoma	13 % (9/72)
GI adenocarcinoma	5.6 % (4/72)
Multiple myeloma	5.6 % (4/72)
Melanoma	5.6 % (4/72)
Other	9.7 % (7/72)

GI gastrointestinal, NSCLC non-small cell lung cancer, SCLC small cell lung cancer

49% thoracic spine

51 % lumbar spine

retrospectively review the tumor ablation database for 72 patients who underwent RFA of 110 osseous metastases between April 2012 and July 2014

mean number of ablations: 6.4 ± 3.1 (for each vertebra)

mean total ablation time: 8 min and 32 s ± 4 min

Vertebral augmentation was performed after 95 % (105/110) of ablations

At 1 week: 70 % (45/64) of patients reported at least partial and 23 % (15/64) reported complete pain relief

At 4 weeks: 78 % (45/58) of patients reported partial and 45 % (26/58) reported complete pain relief with decreased pain medication usage in 31 % (18/58) and increased activity in 50 % (29/58) of patients

No major complications such as permanent thermal nerve injury; four patients (5.6 %; 4/72) reported post-procedure radicular pain

Risultati in Letteratura

Vertebroplastica e radiofrequenza

J Neurooncol (2015) 124:111–118
DOI 10.1007/s11060-015-1813-2



CLINICAL STUDY

Radiofrequency ablation and vertebral augmentation for palliation of painful spinal metastases

Adam N. Wallace¹ · Taylor J. Greenwood¹ · Jack W. Jennings¹

Combination RFA and vertebral augmentation is a safe and effective therapy for palliation of painful spinal metastases, including tumor involving the posterior vertebral body and/or pedicles

Risultati in Letteratura

Vertebroplastica e radiofrequenza

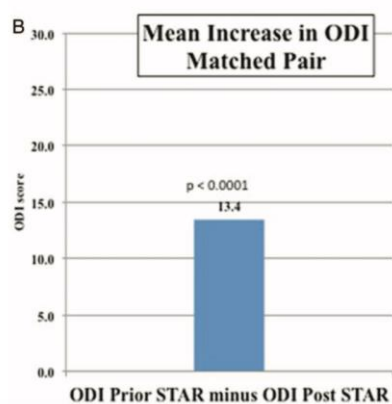
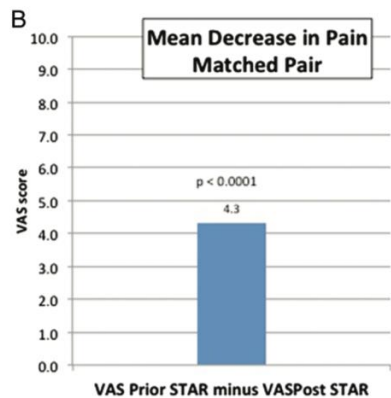
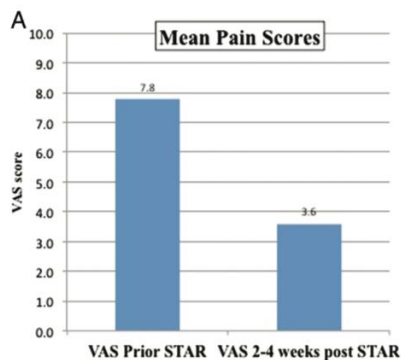
jnis



ORIGINAL RESEARCH

Multicenter clinical and imaging evaluation of targeted radiofrequency ablation (t-RFA) and cement augmentation of neoplastic vertebral lesions

Melinda Reyes,¹ Mark Georgy,² Lorenzo Brook,³ Orlando Ortiz,⁴ Allan Brook,⁵ Vikas Agarwal,⁶ Mario Muto,⁷ Luigi Manfre,⁸ Stefano Marcia,⁹ Bassem A Georgy¹⁰



retrospective multicenter study of 49 patients with 72 painful vertebral lesions treated with t-RFA and cement augmentation

Primary tumor types: breast (n=21, 43%), lung (n=18, 37%), pancreatic, renal and prostate (n=2, 4% each)

average n° vertebrae treated per patient: 1.5 ± 0.7

average n° overlapping ablation zones per patient: 1.8 ± 1.1

average time of ablation per vertebra: 3.7 ± 2.5 min

amount of cement injected: 2.9 ± 1 ml

post- ablation contrast-enhanced MRI consistently demonstrated a decrease in tumor bulk after ablation

FDG PET imaging showed either decreased or absent uptake and metabolic activity in all lesions

Risultati in Letteratura

Vertebroplastica e radiofrequenza

Spine



ORIGINAL RESEARCH

Multicenter clinical and imaging evaluation of targeted radiofrequency ablation (t-RFA) and cement augmentation of neoplastic vertebral lesions

Melinda Reyes,¹ Mark Georgy,² Lorenzo Brook,³ Orlando Ortiz,⁴ Allan Brook,⁵ Vikas Agarwal,⁶ Mario Muto,⁷ Luigi Manfre,⁸ Stefano Marcia,⁹ Bassem A Georgy¹⁰

This study shows that t-RFA of spinal metastases using a navigational device followed by concurrent vertebral augmentation is safe and clinically feasible.

No procedure-related complications were encountered in this series of patients treated at multiple different centers.

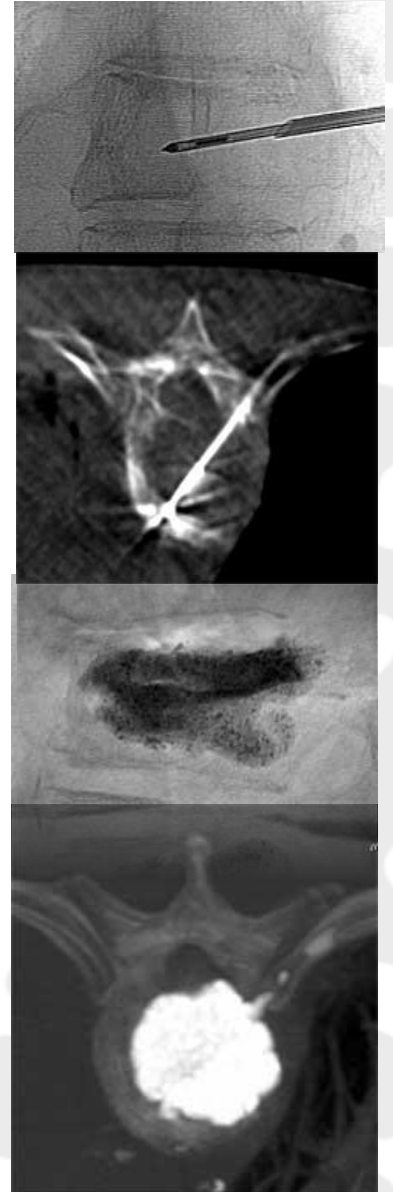
Additionally, no clinically significant cases of cement extravasation, including epidural cement leakage, were observed in this group of patients.

CRYOABLATION

Ago con possibilità di arrivare a temperature di -180°

Va utilizzata nel trattamento di lesioni complesse vicino a strutture critiche.

- Lesioni spinali con tessuto mole
- Intercostale
- PROCEDURE SOTTO GUIDA RM



Crioablazione + Vertebroplastica

Lesione osteolitica L5 già trattata con radioterapia

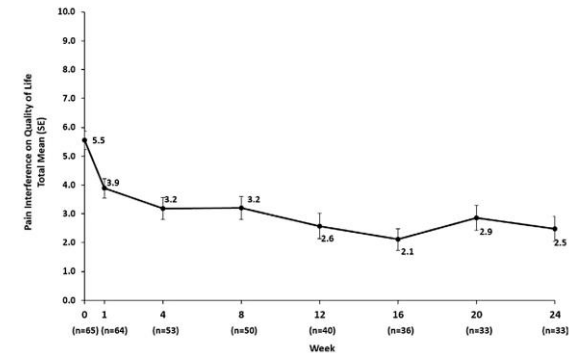
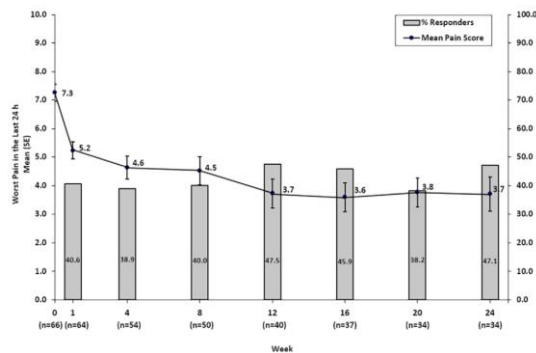


Cryoablation for Palliation of Painful Bone Metastases: The MOTION Multicenter Study

Jack W. Jennings, MD, PhD • J. David Prologo, MD • Julien Garnon, MD • Afshin Gangi, MD, PhD • Xavier Buy, MD • Jean Palussière, MD • A. Nicholas Kurup, MD • Matthew Callstrom, MD, PhD • Scott Genshaft, MD • Fereidoun Abtin, MD • Ambrose J. Huang, MD • Jason Iannuccilli, MD • Frank Pilleul, MD, PhD • Charles Mastier, MD • Peter J. Littrup, MD • Thierry de Baère, MD • Frédéric Deschamps, MD

multicenter, prospective, single-arm study

66 participants with metastatic bone disease who were not candidates for or had not benefited from standard therapy were enrolled



Cryoablation of metastatic bone tumors provided rapid and durable pain palliation, improved quality of life, and offered an alternative to opioids for pain control

TAKE HOME MESSAGES

- *Approccio multidisciplinare*
- *Radioterapia prima opzione*
- *La combinazione di vertebroplastica e ablazione è la migliore opzione nella gestione del dolore*

CONCLUSIONS

Demand for percutaneous treatment of bone and non-visceral soft-tissue tumours is growing

Palliative treatment of painful skeletal metastases is well established by multiple multicentre prospective trials

Application of ablation to spinal metastases is increasing due to improvements in monitoring for potential complications

Emerging clinical indications include treatment of non-painful oligometastatic disease for local tumour control as well as ablation of desmoid tumours

Thank You



Thank You



Thank You



Thank You



Thank You



Thank You



Thank You



Thank You



Plasmocytoma



- *45 years old, male*
- *Level T9*
- *Desease: Plasmocytoma*



Courtesy of Matteo Bellini, Siena, ITALY

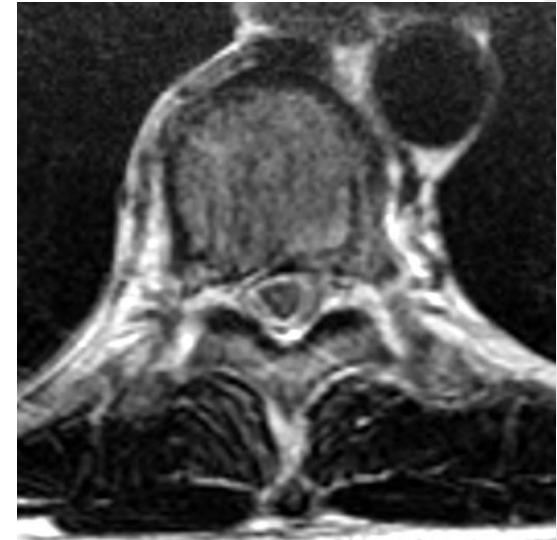
Plasmocytoma



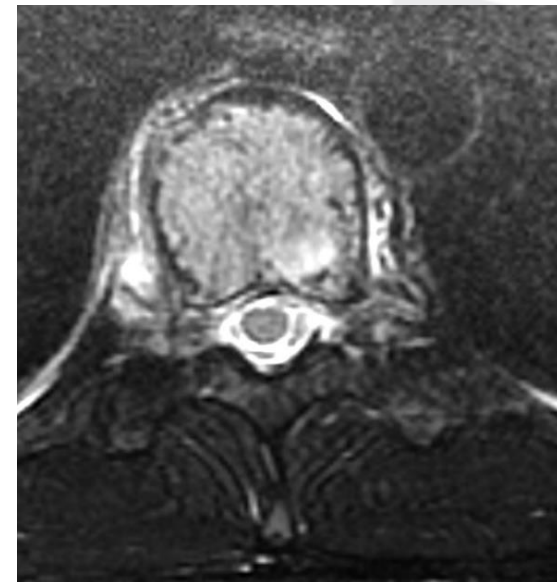
Sag T2



Sag T2 STIR



Ax T2



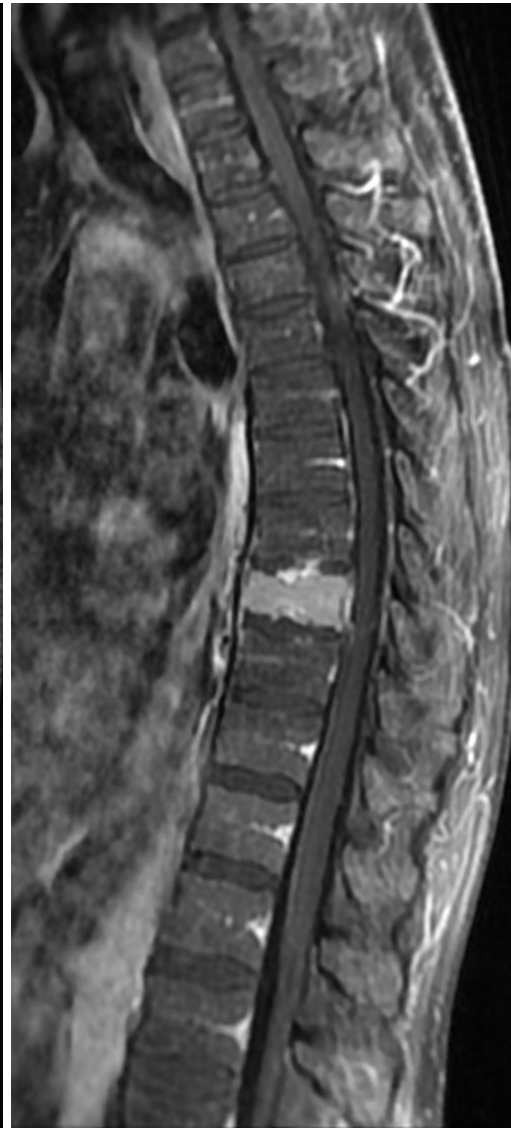
Ax T2 STIR

Plasmocytoma

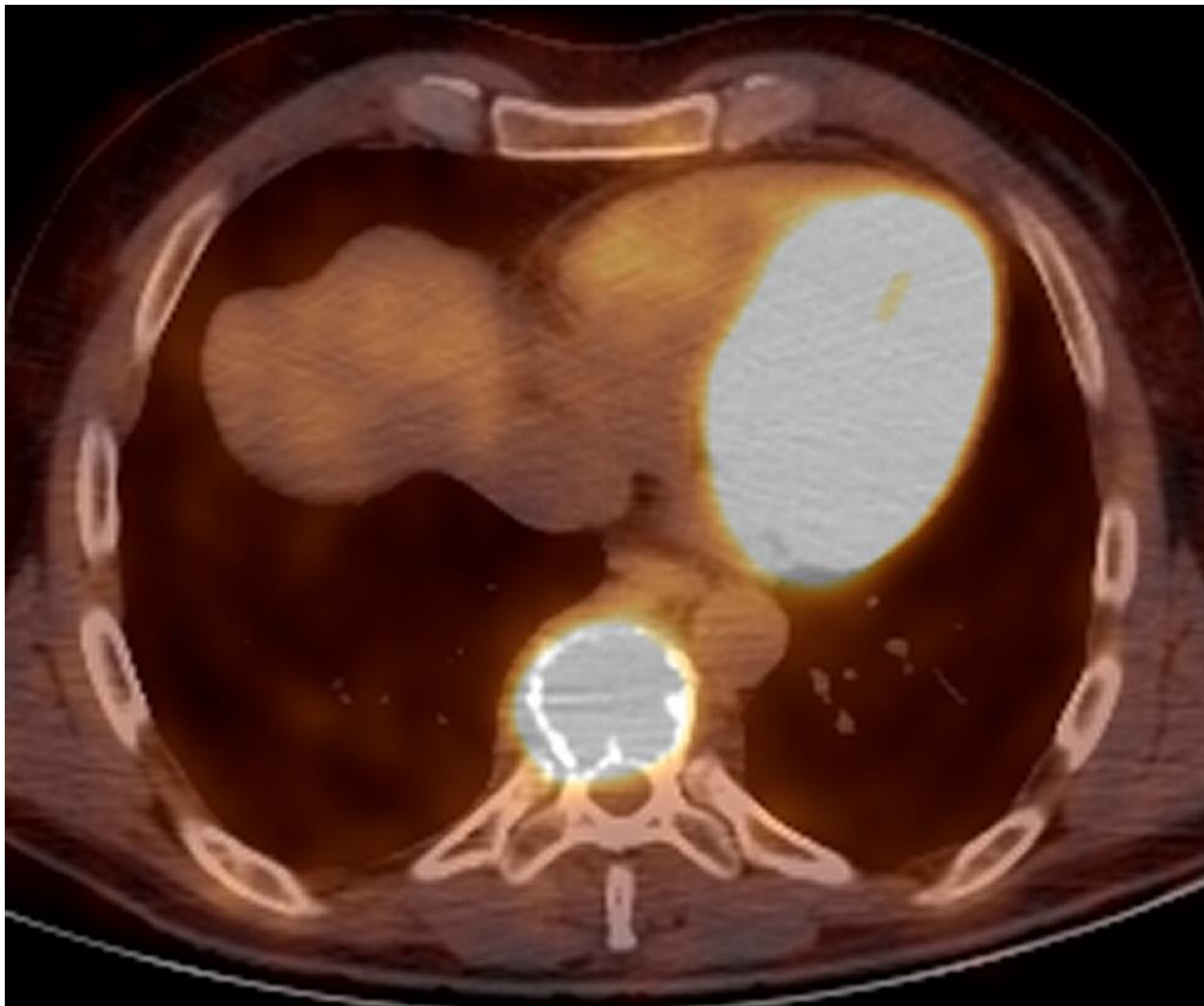
Sag T1



Sag T1 CE FS

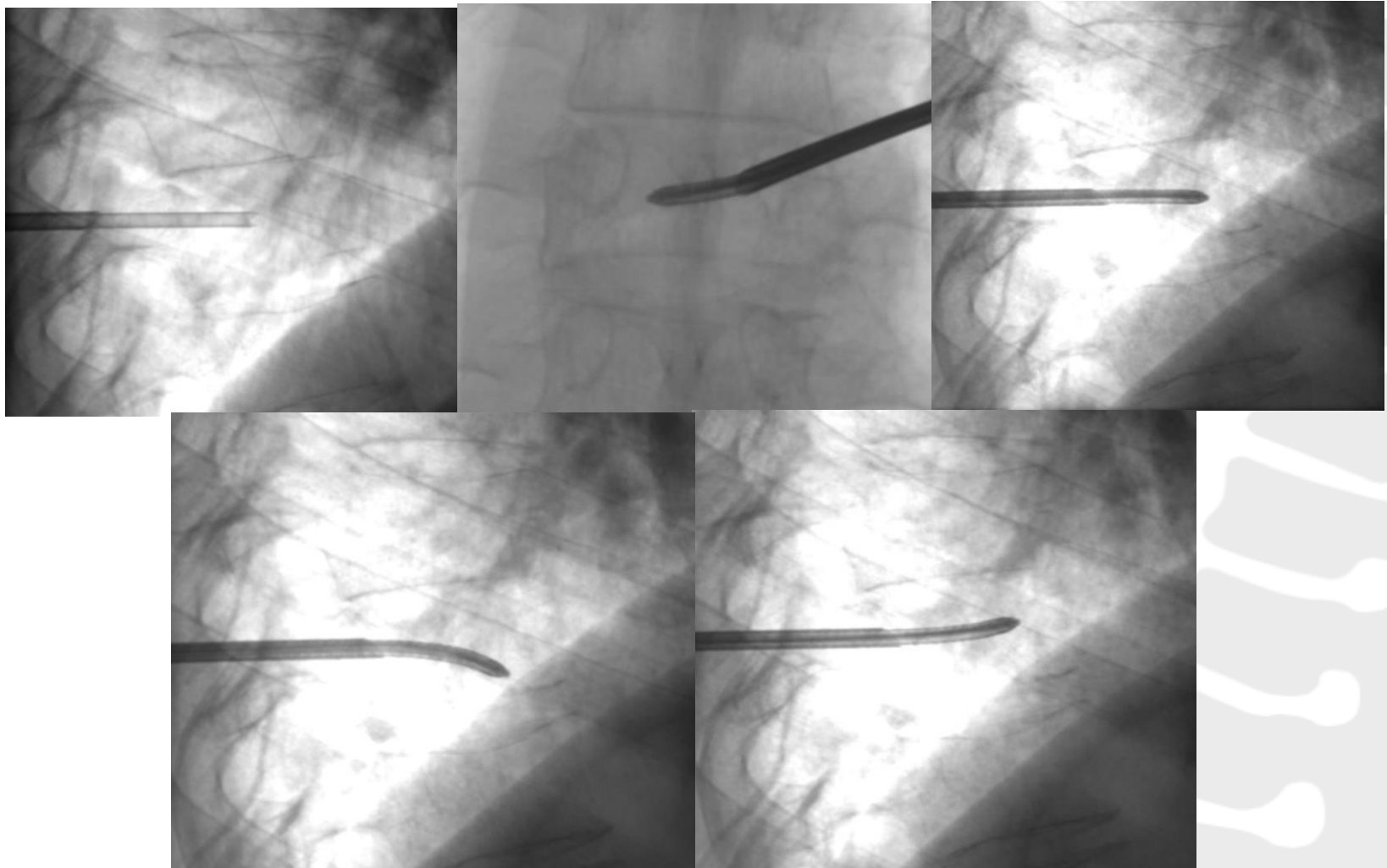


Plasmocytoma



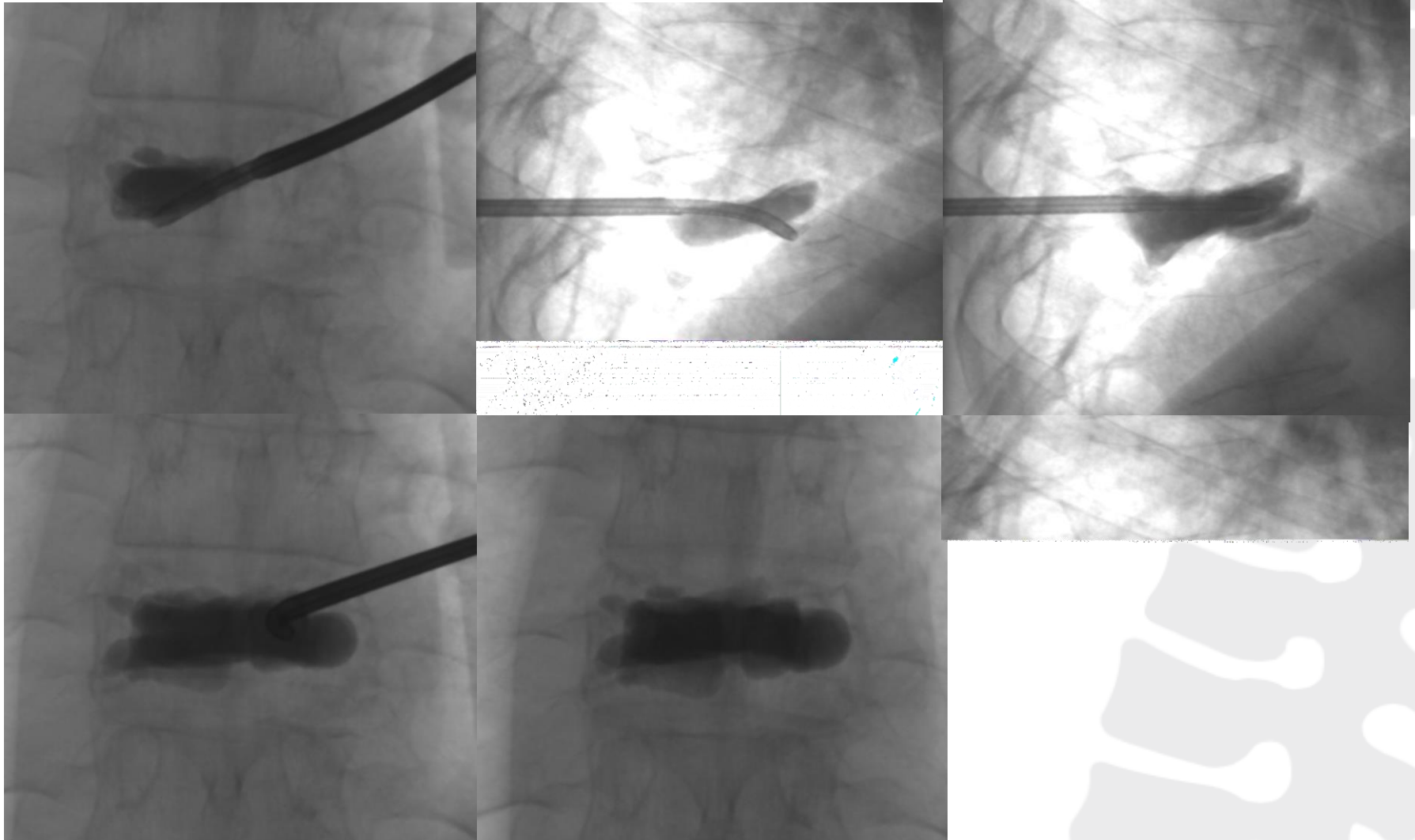
Courtesy of Matteo Bellini, Siena, ITALY

Plasmocytoma

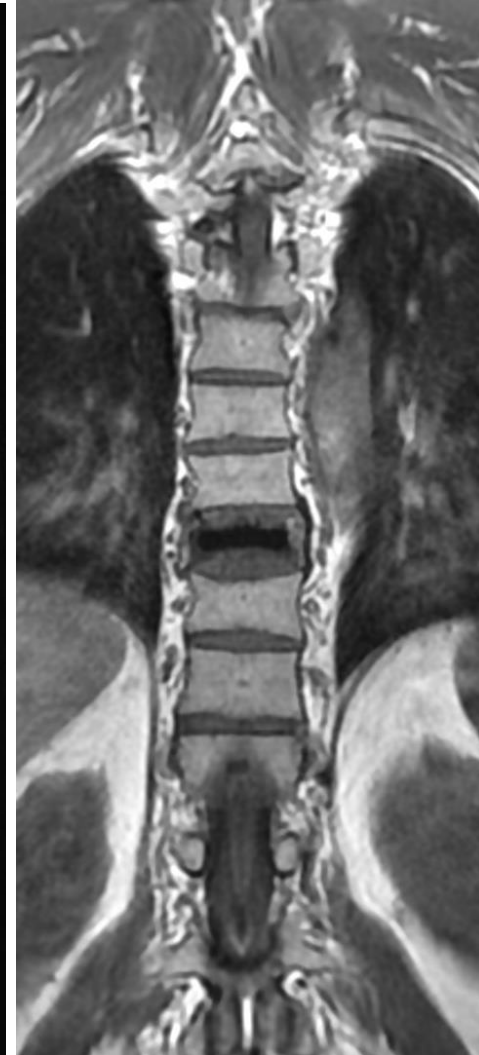


Courtesy of Matteo Bellini, Siena, ITALY

Plasmocytoma



Plasmocytoma



Sag T2

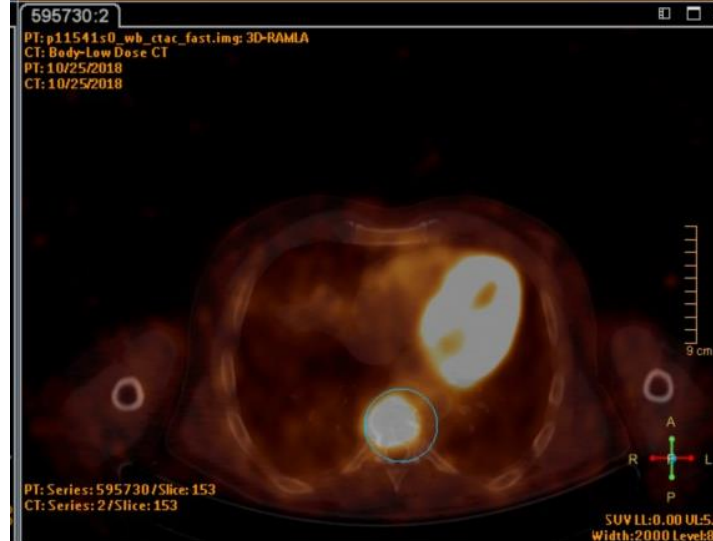
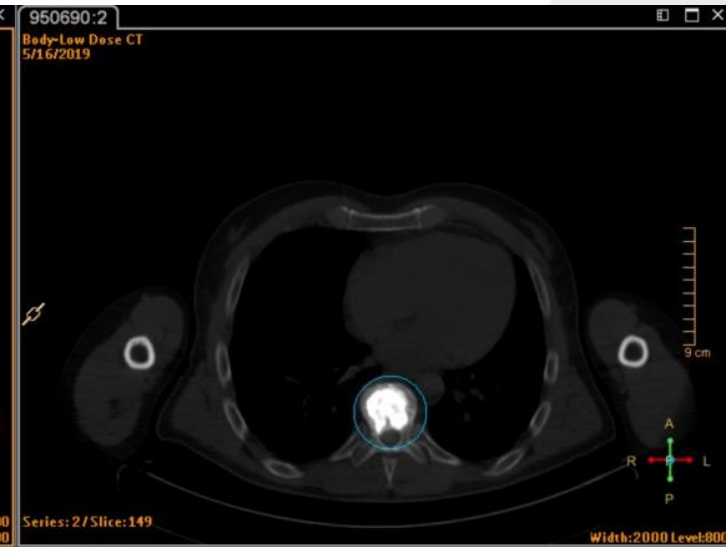
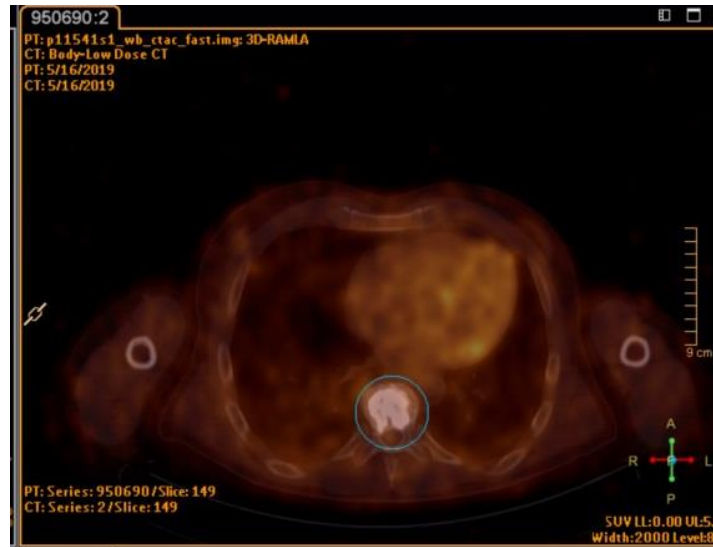
Sag T2 STIR

Sag T1

Cor T1

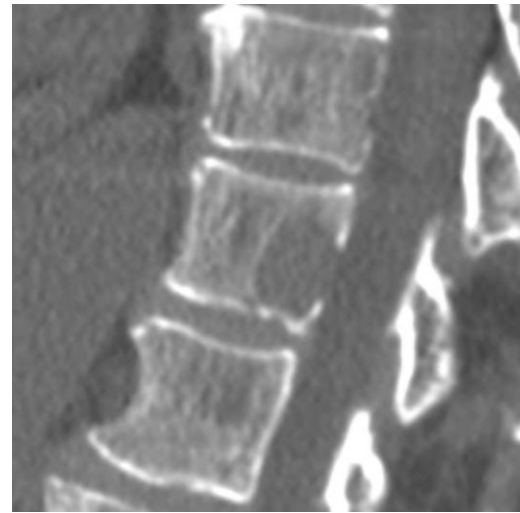
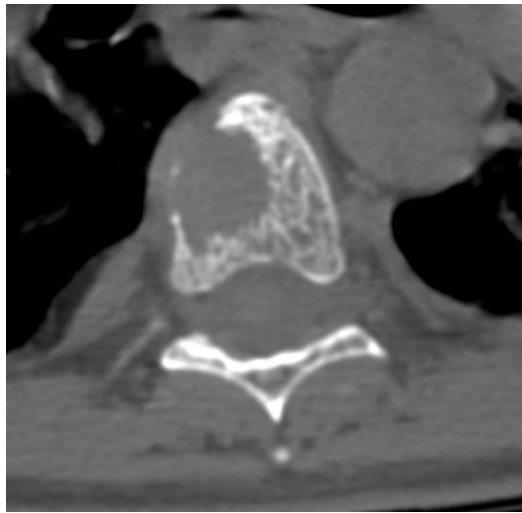
Courtesy of Matteo Bellini, Siena, ITALY

Plasmocytoma

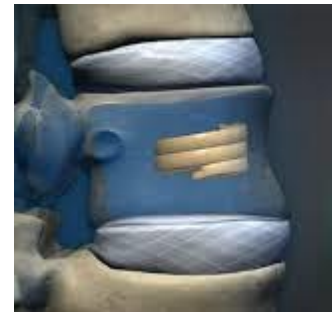


PET-CT after cementoplasty showed good oncological result

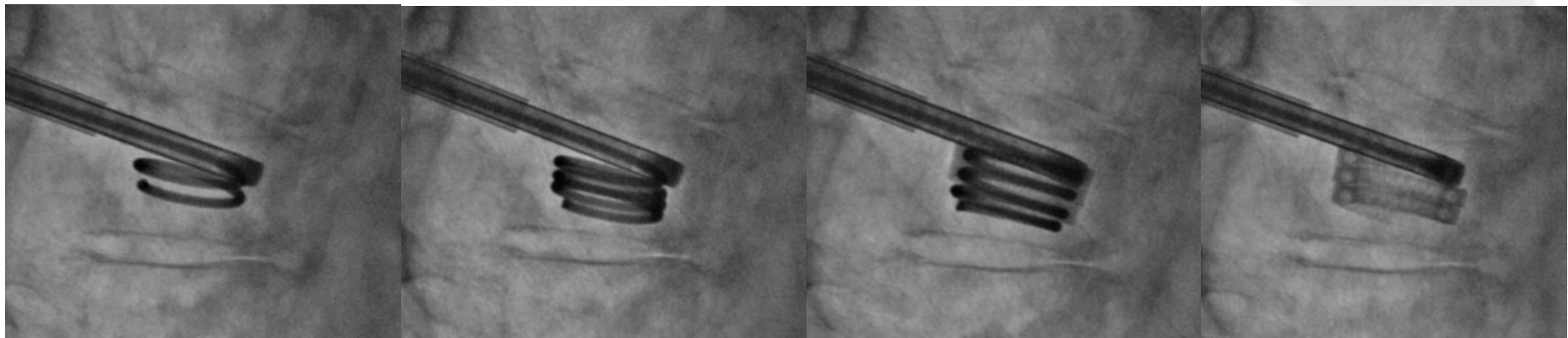
Courtesy of Matteo Bellini, Siena, ITALY

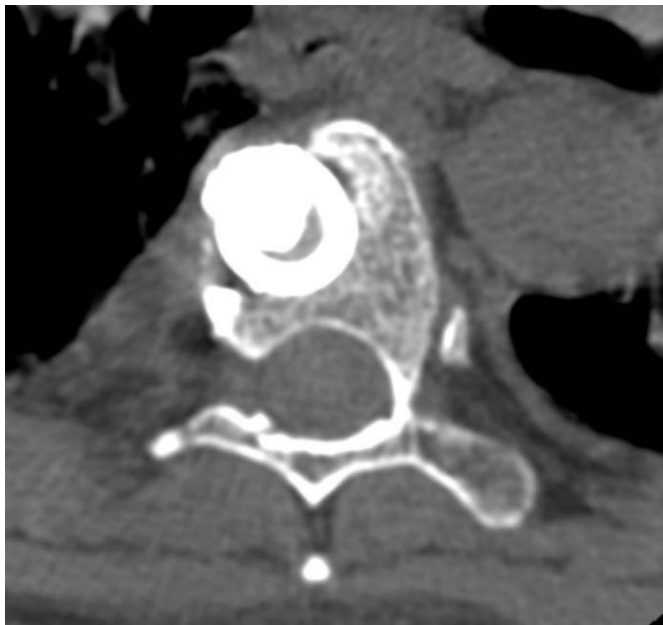


nitinol coil



PEEK polymer Cage

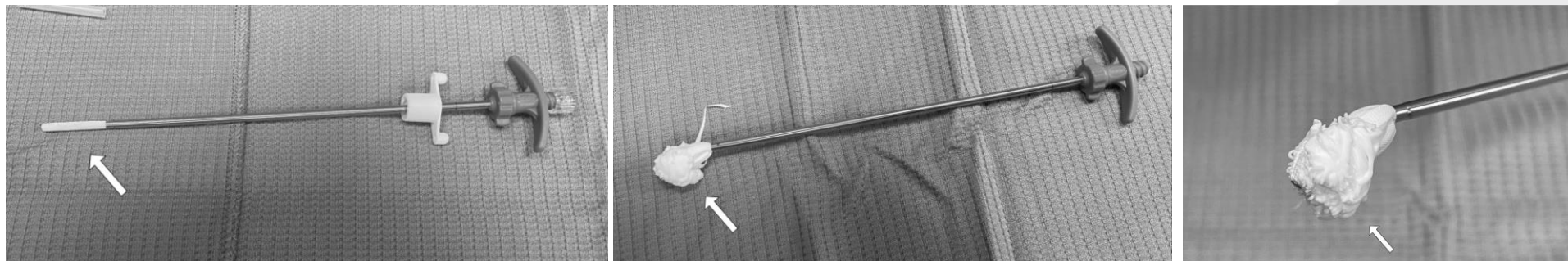




> [Eur J Radiol.](#) 2020 May;126:108962. doi: 10.1016/j.ejrad.2020.108962. Epub 2020 Mar 18.

Vesselplasty using the Mesh-Hold™ bone-filling container for the treatment of pathological vertebral fractures due to osteolytic metastases: A retrospective study

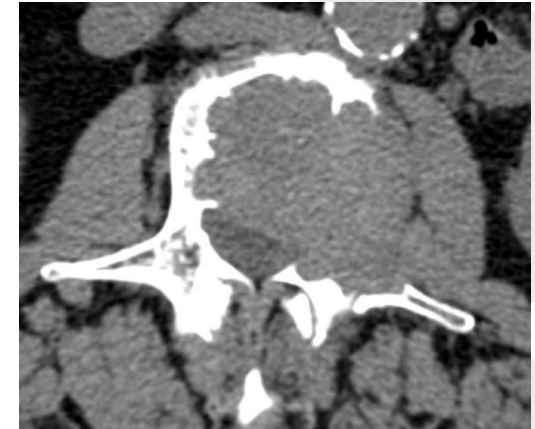
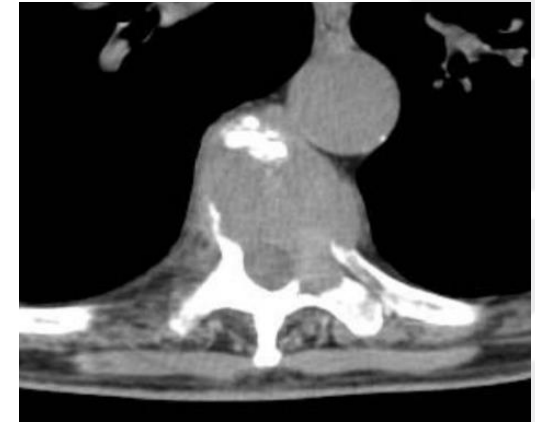
Xue-Gang Yang ¹, Ge Wu ¹, Yan-Yuan Sun ¹, Hua-Rong Pang ¹, Xiao-Qi Huang ², Guo-Hui Xu ³



Conclusions: The Mesh-Hold™ bone-filling container in the treatment of vertebral fractures induced by osteolytic metastases could reduce pain, improve function, and reduce the bone cement leakage rate in the process of vesselplasty.

T9-L2 MM involvement

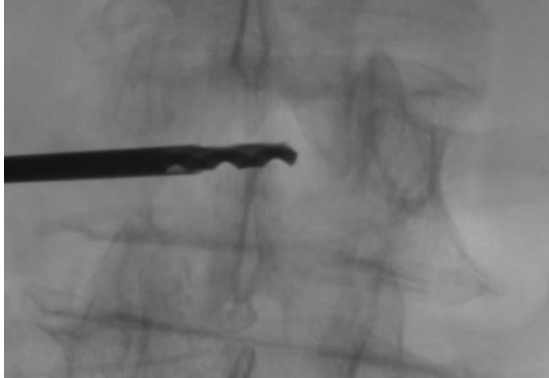
- *Patient 79 years old, male*
- *Level T9, L2*
- *Disease: Multiple myeloma*
- *Treatment in 3 different sessions*



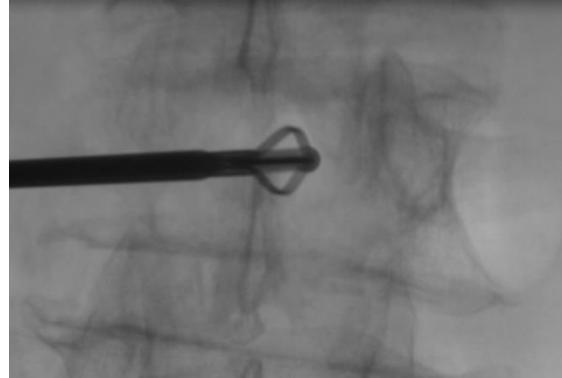
CT demonstrated a large pathologic lytic lesion occupying most of L2 vertebral body with high risk of collapse and large posterior wall invasion

T9-L2 MM involvement

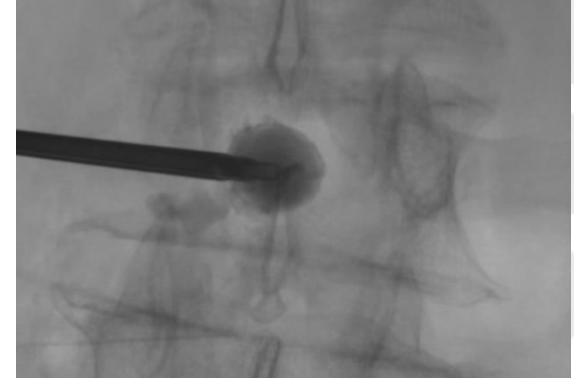
Percutaneous Vertebroplasty



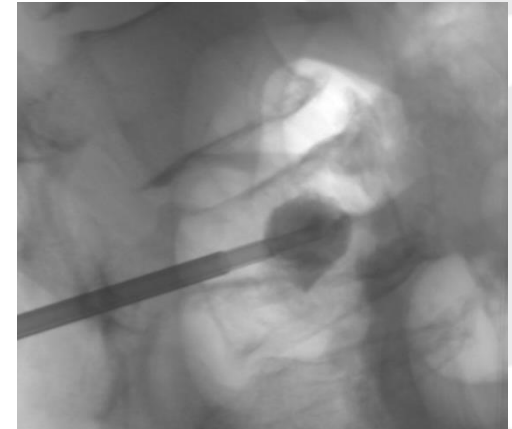
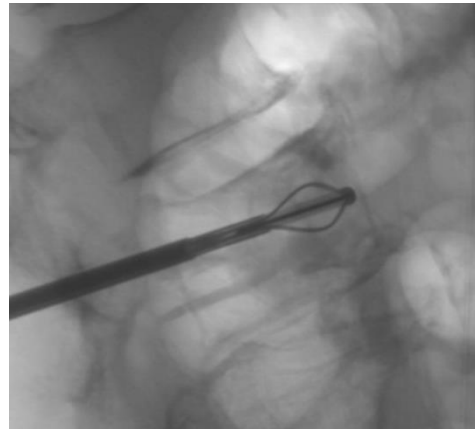
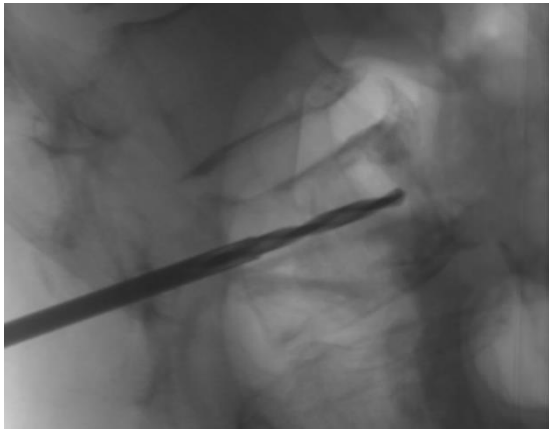
Drill



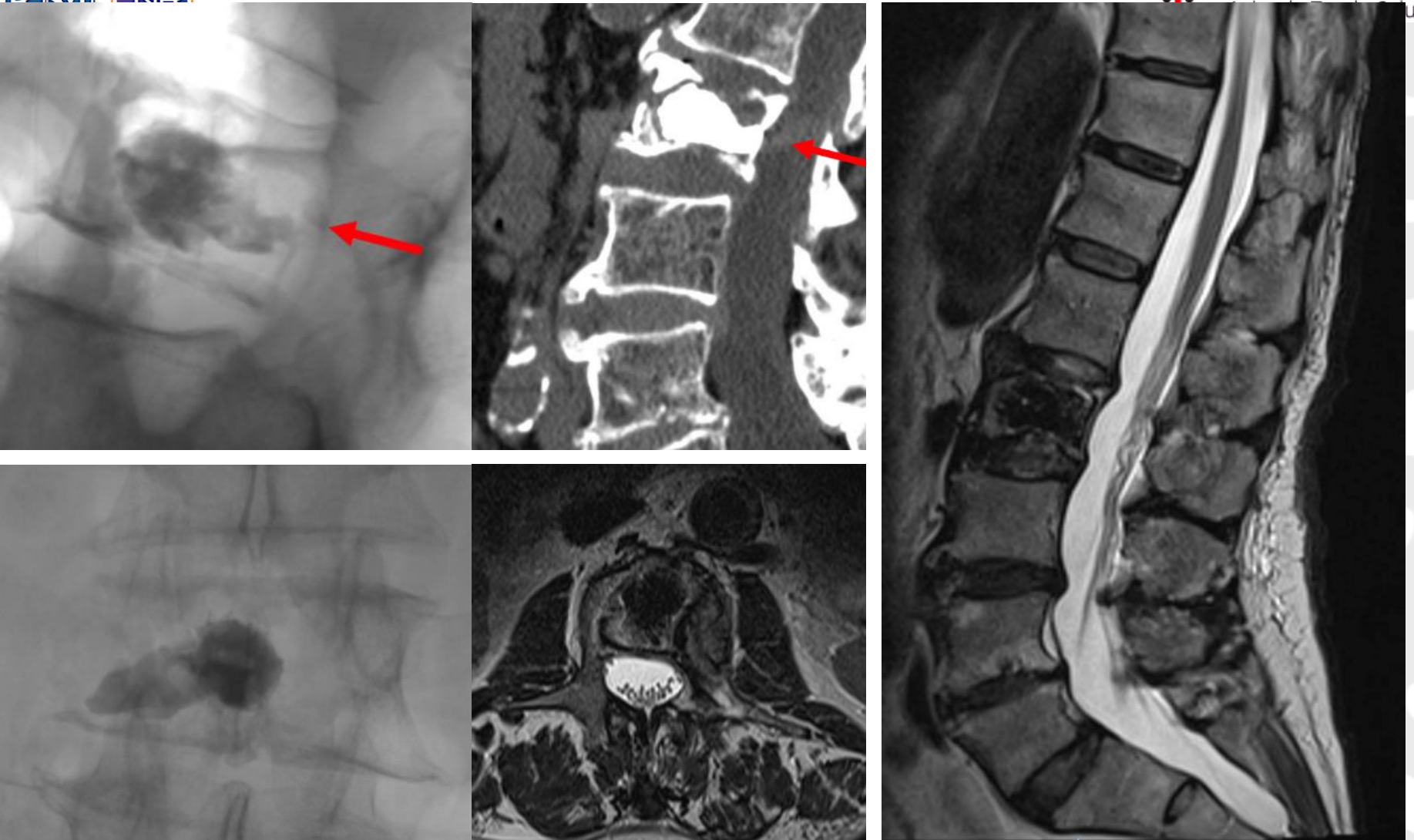
Expander



Vessel Filling Container

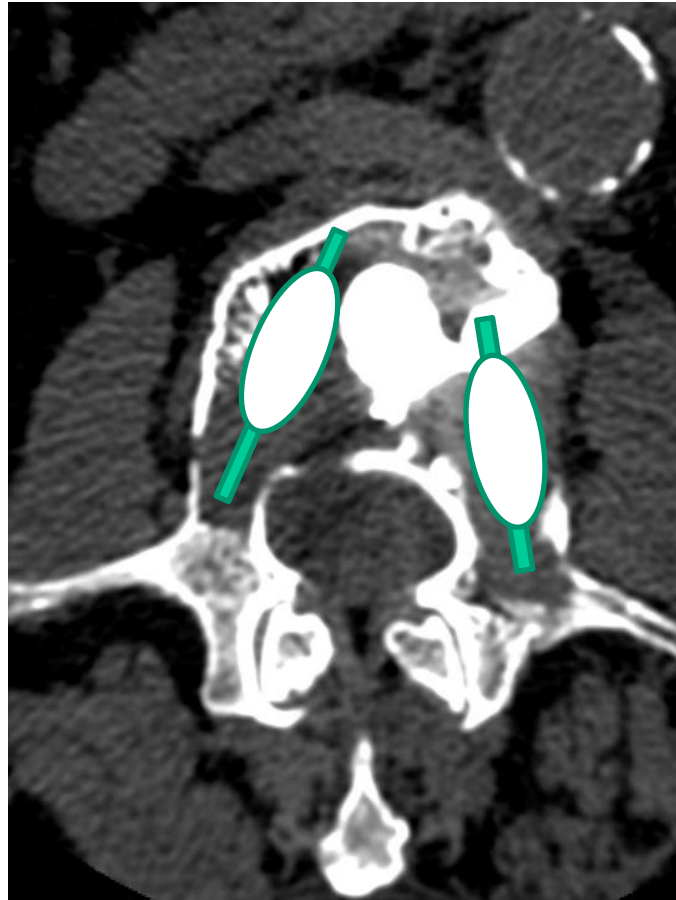


First Treatment: Vesselplasty



First Treatment: Xray and CT/MR final result. No cement leakages

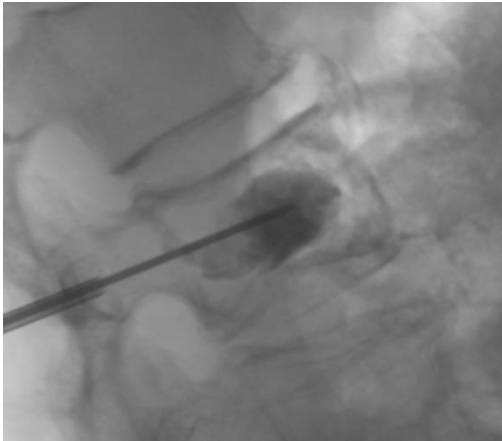
T9-L2 MM involvement



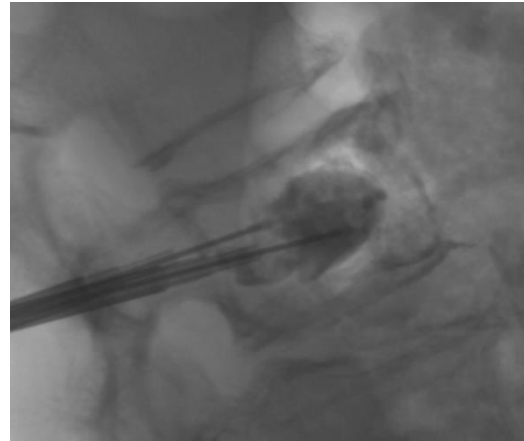
Second Treatment: CT planning, bipedicular approach

T9-L2 MM involvement

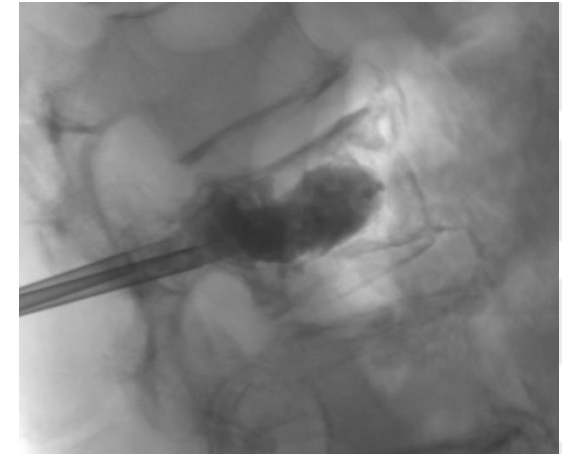
Percutaneous Vertebroplasty



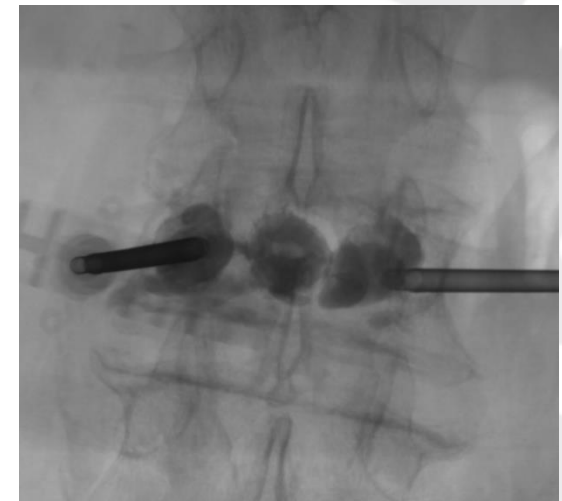
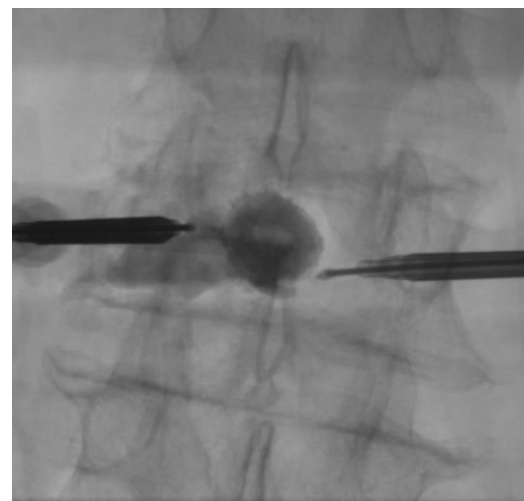
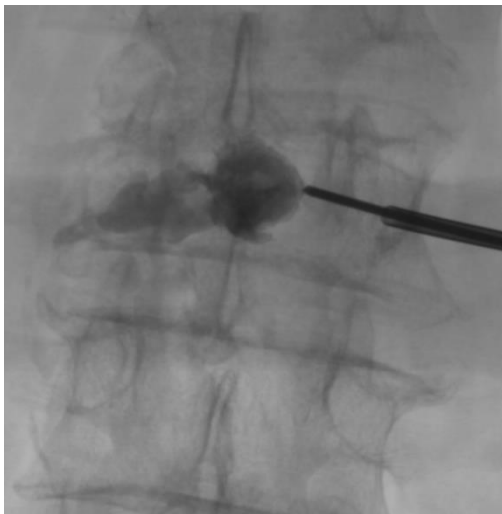
Single tip RF ablation



Vessel Positioning



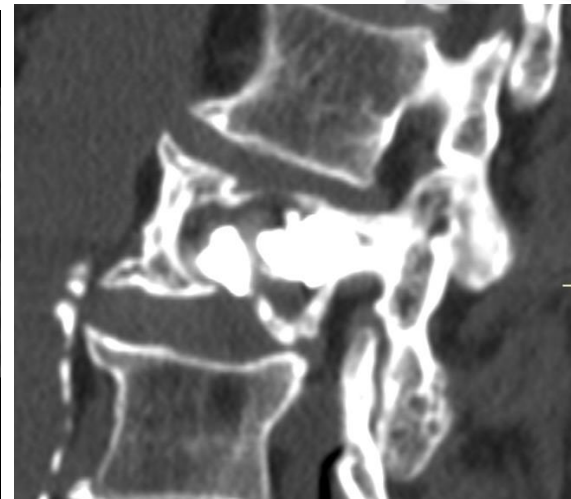
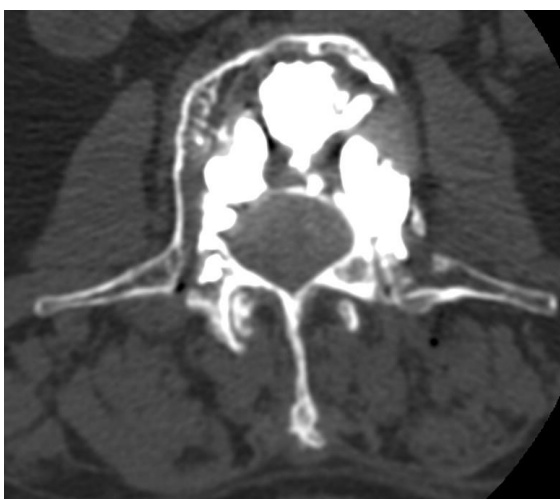
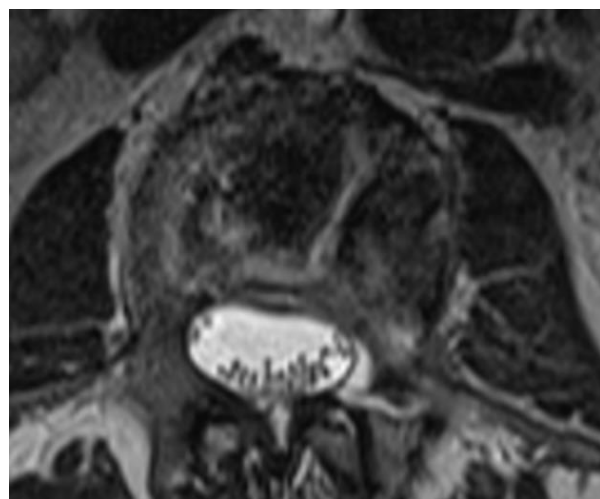
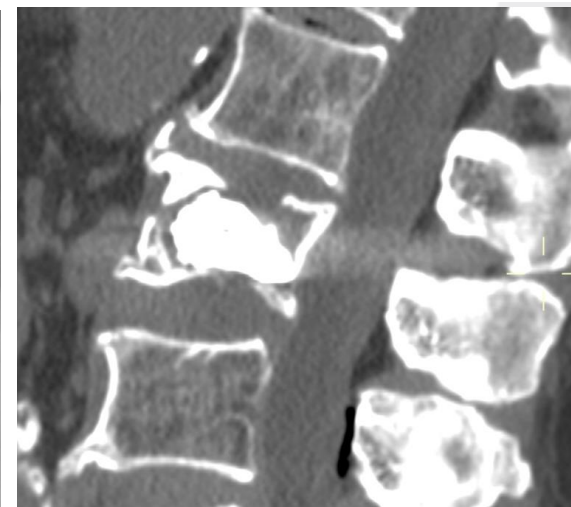
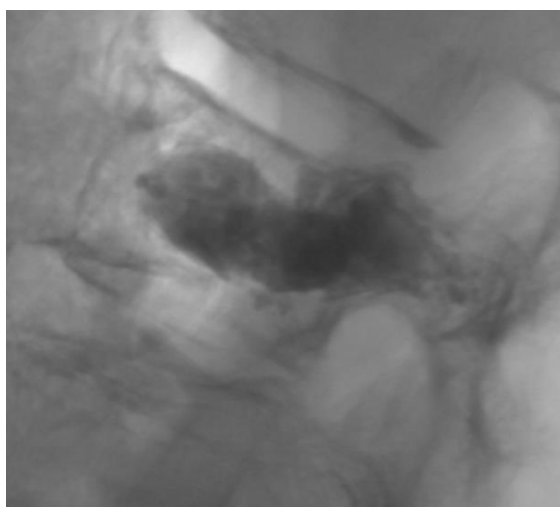
Vessel expansion



Second Treatment, bilateral approach: RF ablation and Vessel expansion sequence

Courtesy of Matteo Bellini, Siena, ITALY

T9-L2 MM involvement



MRI and CT showed reduction of epidural mass

ABLATION+CONSOLIDATION

Indications for ablation of bone and soft-tissue tumours have expanded beyond palliation of painful bone metastases and eradication of osteoid osteomas to the local control of oligometastatic disease from a number of primary tumours and ablation of desmoid tumours

In addition, tools for consolidation of bone tumours at risk of pathological fracture have also expanded and percutaneous methods to consolidate bone at risk of fracture have become more commonplace, aided by techniques using materials beyond typical bone cement

Kurup AN, Callstrom MR. EXPANDING ROLE OF PERCUTANEOUS ABLATIVE AND CONSOLIDATIVE TREATMENTS FOR MUSCULOSKELETAL TUMOURS. Clin. Rad. 2017 Aug;72(8):645-656. doi: 10.1016

Percutaneous Vertebroplasty and RFA

- *RFA is widely used for tumoral tissue ablation, this procedure can be successfully use in bone tumors also achieving tumor necrosis and pain reduction*
- *Vertebroplasty can be successful used to achieve immediate bone tumors consolidation and pain regression*
- *Combining RFA and Vertebroplasty can increase these results*

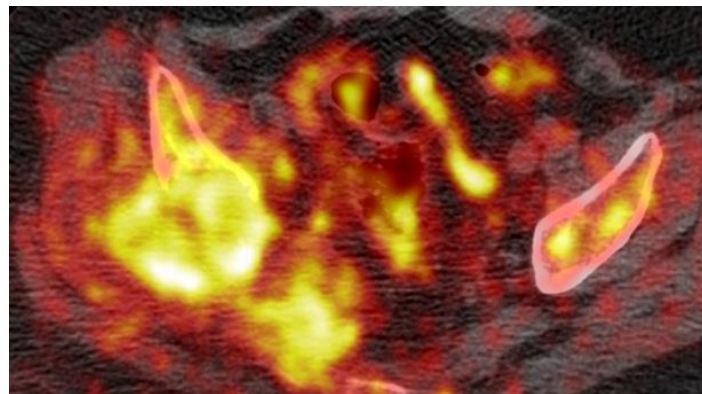
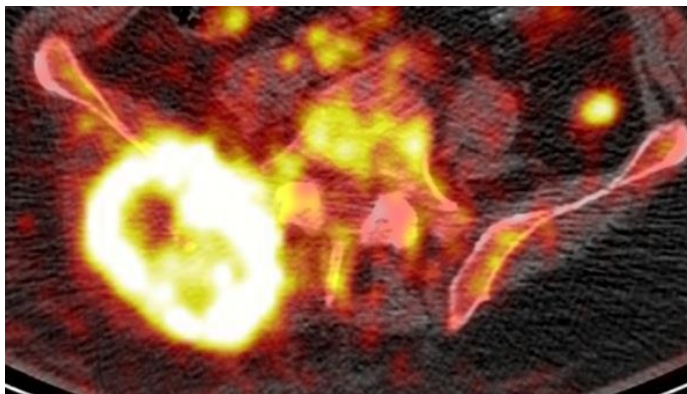
Microwaves refers to the use of all electromagnetic methods for inducing tumor ablation by using devices with frequencies of at least 900MHz

- *Larger and uniform ablation zones with faster ablation times*
- *Consistently higher intra-tumoral temperatures*
- *Ability to use multiple probes*
- *Improved convection profile with less heat-sink effect*
- *Optimal heating of cystic masses*
- *Grounding pads are not necessary*
- *Less influenced by impedance and so better for osteoblastic and mixed lesions*



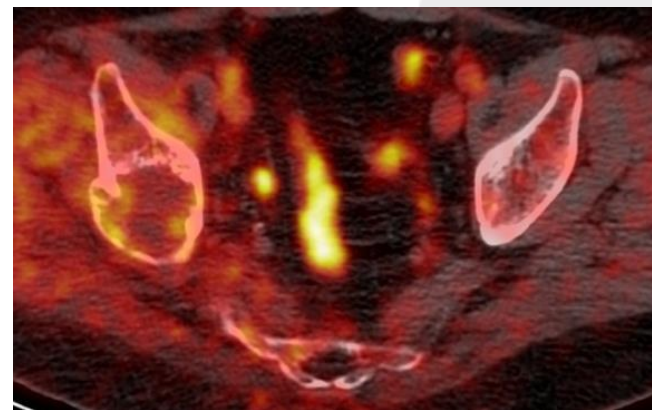
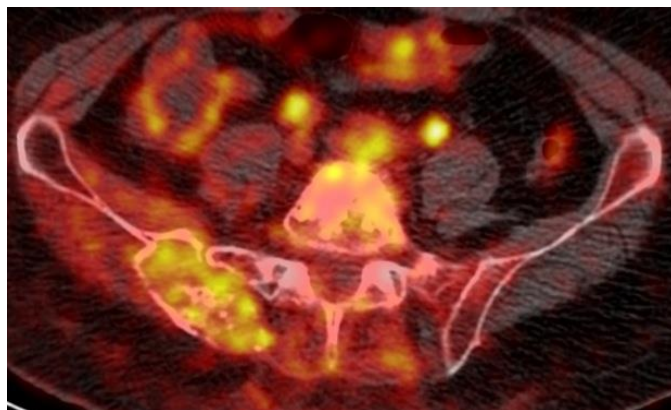
Male 48 years old, with previous (1981) RT in the leg for Ewing's sarcoma

- In 2011 onset of severe pain in the right hip; CT and Pet-CT revealed a bulky lesion of the hip
- Patient underwent to chemo-radio therapy with mass reduction
- vertebroplasty from T12 to L5 for secondary osteoporosis fractures (steroids during chemo)
- Osteoplasty on the acetabular lytic lesion (PET -)
- Mw ablation on iliac bone (PET +)



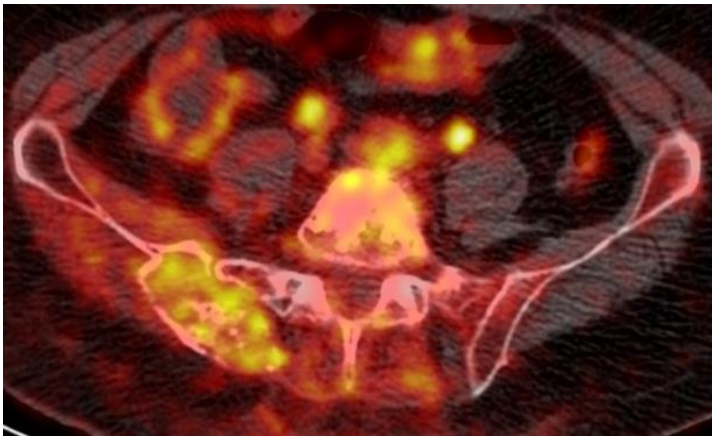
Before

After

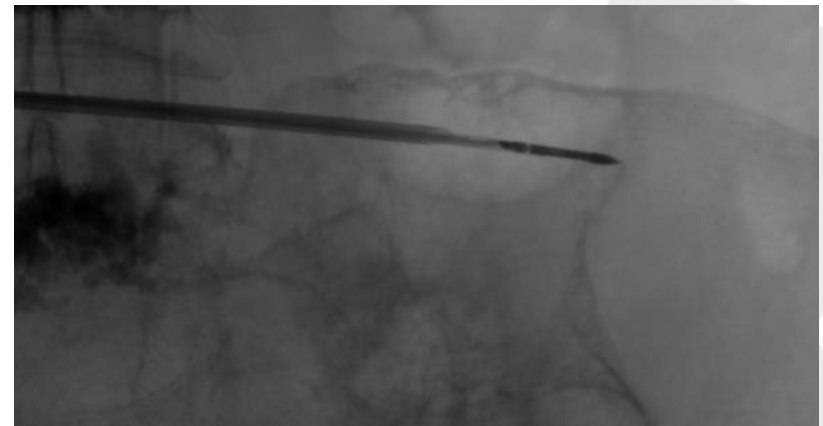
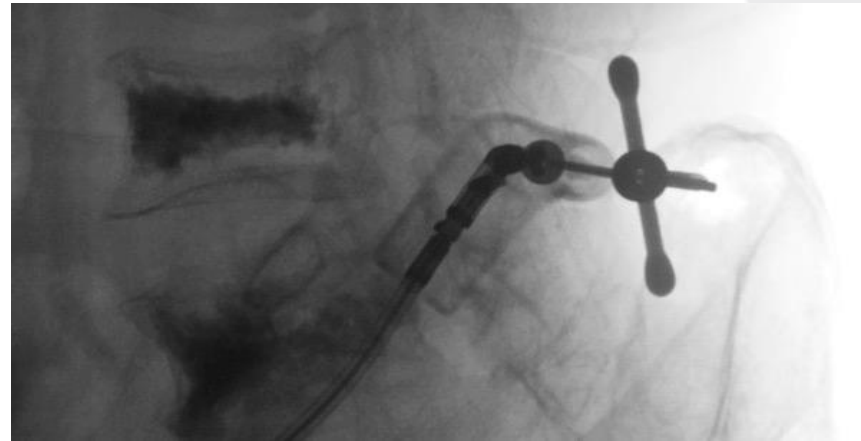


Courtesy of Antonio Manca, Torino, ITALY

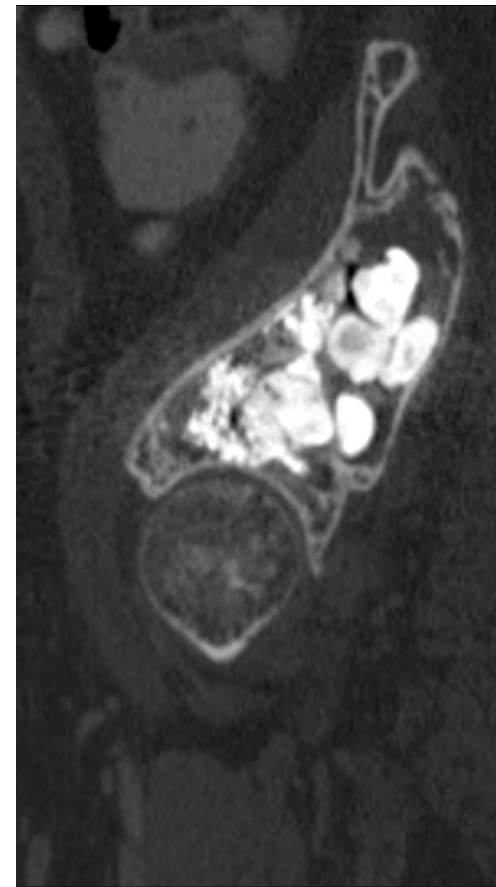
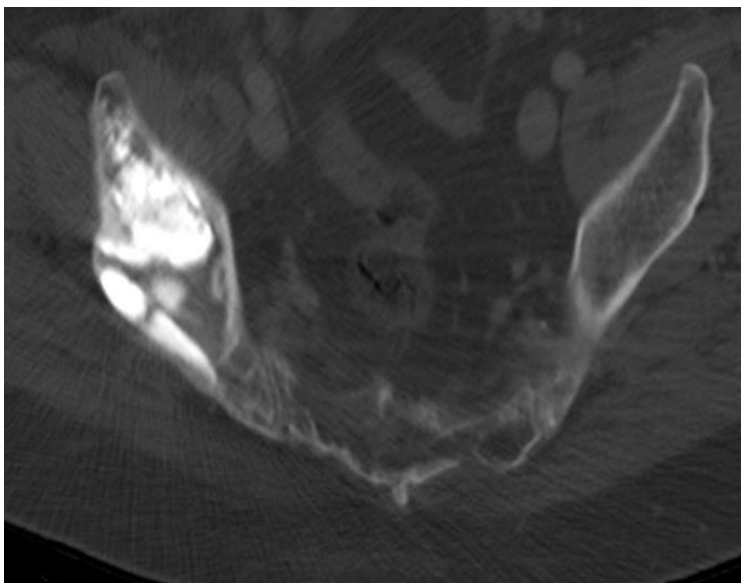
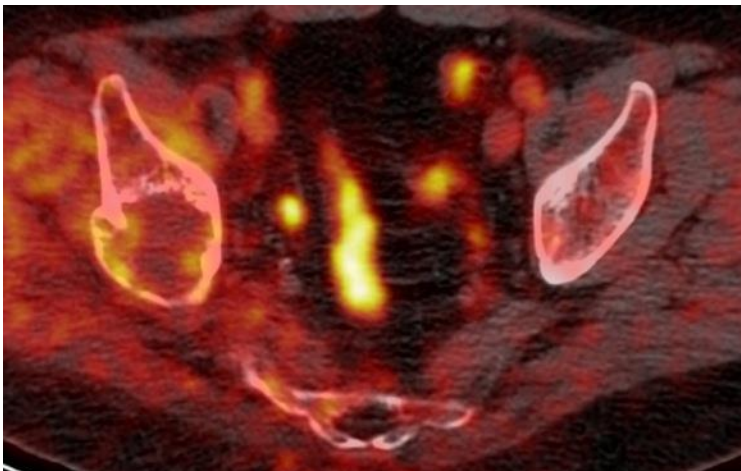
MW ABLATION



- ✓ *Big lesion*
- ✓ *No closer vessels or nerves*
- ✓ *Osteolytic lesion*
- ✓ *Short time ablation*



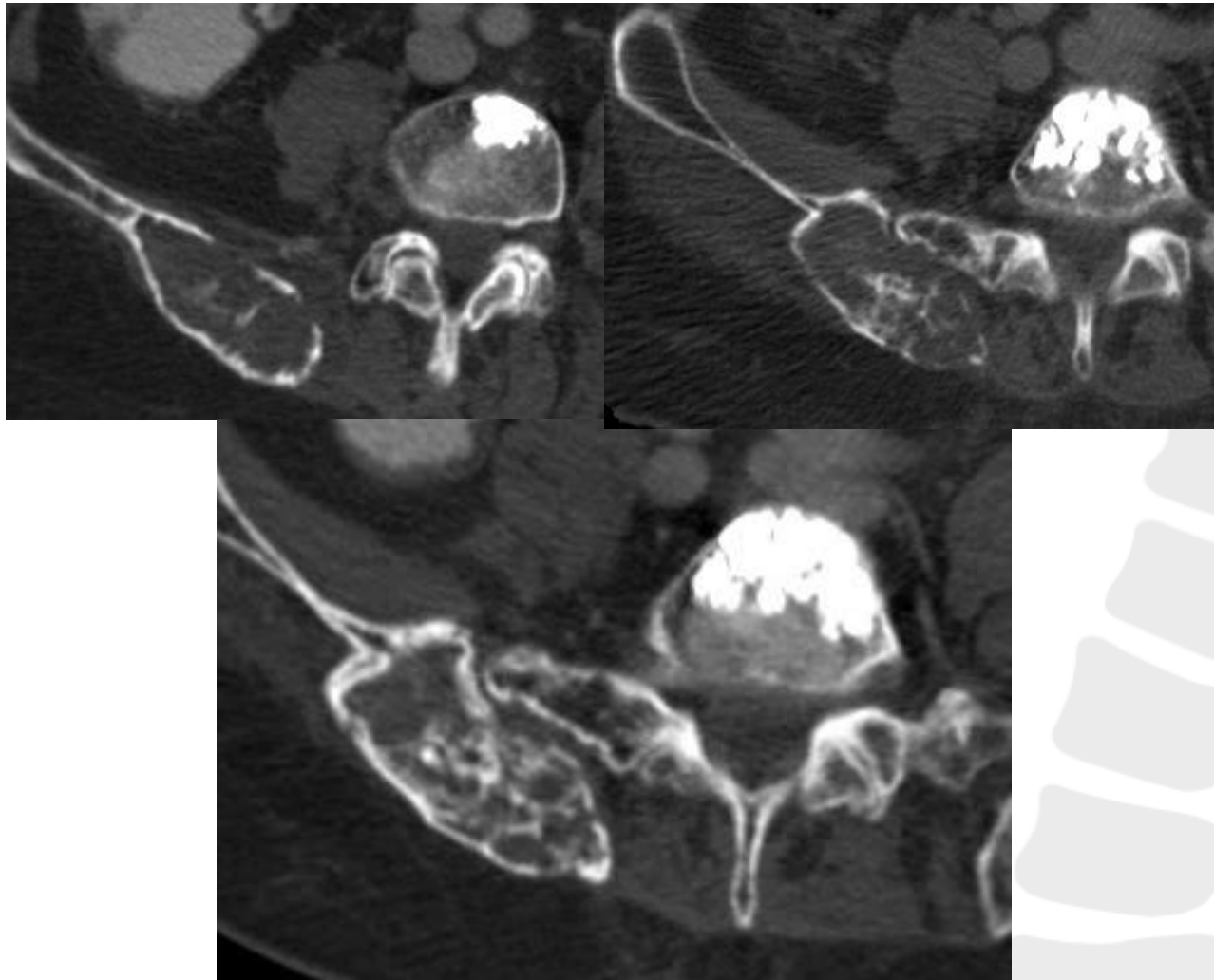
Ewing Sarcoma met: MW and Osteoplasty



No hip fracture @ 7 year
follow up (4/2011 -4/2018)

Courtesy of Antonio Manca, Torino, ITALY

After MW ablation, pain relief and partial bone calcification



Courtesy of Antonio Manca, Torino, ITALY

LASER ABLATION

Laser ablation uses optical fibers to transmit infrared light energy into a tumor to produce heat and coagulative necrosis

- MR imaging compatibility
- Ablation size obtained using laser ablation is relatively small
- Used primarily in the treatment of osteoid osteoma

HIGH INTENSITY FOCUSED ULTRASOUND (HIFU)

- Transcutaneous Coagulative Necrosis
- Totally NON-INVASIVE
- Radioactive Decontamination
- Low complication rates
- Epidural block or deep sedation
- Not on the vertebral body



Magnetic Resonance–Guided Focused Ultrasound for Patients With Painful Bone Metastases: Phase III Trial Results

Mark D. Hurwitz, Pejman Ghanouni, Sergey V. Kanaev, Dmitri Iozeffi, David Gianfelice, Fiona Mary Fennessy, Abraham Kuten, Joshua E. Meyer, Suzanne D. LeBlang, Ann Roberts, Junsung Choi, James M. Larner, Alessandro Napoli, Vladimir G. Turkevich, Yael Inbar, Clare Mary C. Tempary, Raphael M. Pfeffer

F, 67 yo
T: BrCa
Sp: xRTmf

07/12

03/13

VAS:10

VAS: 0

10/2012
Treatment
Time: 45 min

Conclusions

This
viati
JNC

PATHOPHYSIOLOGY OF PAIN REDUCTION POST ABLATION

- *Necrotize tumor-periosteum interface*
- *Decompression of tumor volume*
- *Decrease nerve-stimulating cytokines (tumor release)*
- *Inhibition of osteoclast activity*

Gangi et al Semin Intervent Radiol 2010

Rosenthal et al Radiology 2012

Kurup et al Semin Intervent Radiol 2012

Filippiadis et al Insights Into Imaging 2014

PAIN PALLIATION

PATHOLOGY	AUTHOR/YEAR	TECHNIQUE	INDICATION
OSTEOID OSTEOMA	<u>Gangi et al (2007)</u>	Laser ablation	Curative Treatment
	<u>Mahnken et al (2006)</u>	RFA (Bipolar)	Curative Treatment
	<u>Dasenbrock et al (2012)</u>	<u>Coblation</u>	Curative Treatment
	<u>Mahnken et al (2011)</u>	RFA (Monopolar)	Curative Treatment
	<u>Basile et al (2013)</u>	MWA	Curative Treatment
	<u>Napoli et al (2013)</u>	MR-guided HIFU	Curative Treatment
OTHER PRIMARY BENIGN TUMORS	<u>Tutton et al (2012)</u>	Ethanol and <u>Cryoablation</u>	Curative Treatment
	<u>Becce et al (2012)</u>	RFA	Curative Treatment
	<u>Cable et al (2001)</u>	RFA	Curative Treatment
	<u>Corby et al (2001)</u>	RFA	Curative Treatment
	<u>Ramnath et al (2002)</u>	RFA	Curative Treatment
BONE AND SOFT TISSUE METASTASIS	<u>Callstrom et al (2002)</u>	RFA	Pain reduction and local control
	<u>Carrafiello et al (2002)</u>	RFA	Pain reduction and local control
	<u>Puscedu et al (2013)</u>	MWA	Pain reduction and local control
	<u>Callstrom et al (2013)</u>	<u>Cryoablation</u>	Pain reduction and local control
	<u>Napoli et al (2013)</u>	MR-guided HIFU	Pain reduction and local control
PRIMARY MALIGNANT TUMORS	<u>Li et al (2009)</u>	US-guided HIFU	Curative Treatment
	<u>Rosenthal et al (2001)</u>	<u>RFA+Surgery</u>	Curative Treatment

PAIN PALLIATION

Study	Type/Level of Evidence	Modality	Patients/ lesions	Pain/ Follow-up	ODI/FACT
Anchala et al., Pain Physician 2014	Retrospective/ Multicenter /III	RFA	92/128	Significant/6 mos.	
Kastler et al., JVIR 2014	Retrospective/III	Microwave	17/20	Significant/ 1 mos.	
Hillen et al., Radiology 2015	Retrospective/III	RFA	26/47	Significant/ 1 mos.	
Wallace et. al., J. of Neuro-oncology 2015	Retrospective/III	RFA	72/110	Significant/ 1 mos.	
Tomasian et al., AJNR 2016	Retrospective/III	Cryo	14/31	Significant/3 mos.	
Reyes et al., JNIS 2016	Retrospective/ Multicenter/III	RFA	49/72	Significant/ 1 mos.	Significant
Bagla et al., CVIR 2016	Prospective/ Multicenter/II-3	RFA	50/69	Significant/ 3 mos.	Significant Significant
Jennings et al. SIR 2017 STARRT Interim Analysis	Prospective/ Multicenter/II-3	RFA	34	Significant/6 weeks-3 mos.	Significant/6 weeks-3 mos.

VERTEBRAL AUGMENTATION AND IORT

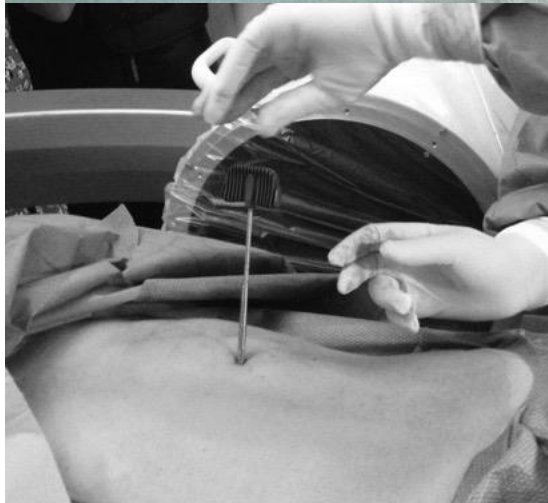
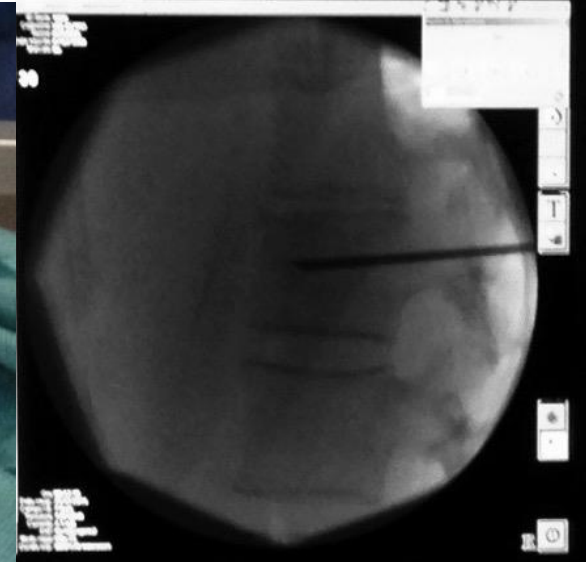
T10 Painful RenalCa Met



*After external beam RT lesion was still active and painful
Due to the previous dose another cycle of external RT was contraindicated*

VERTEBRAL AUGMENTATION AND IORT

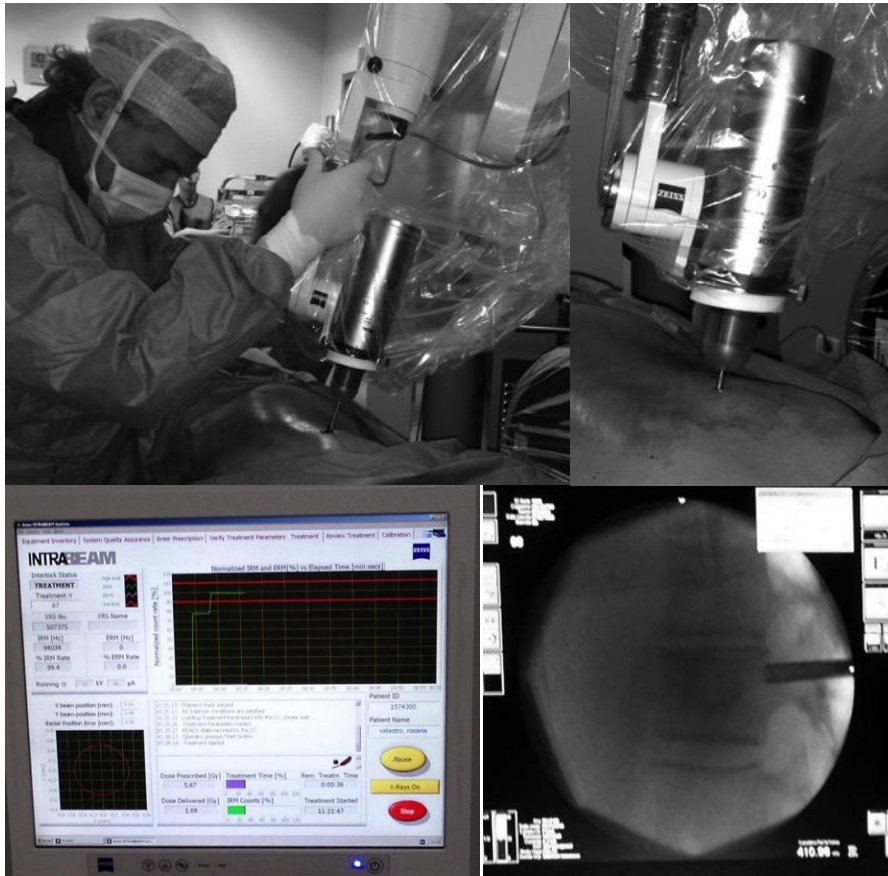
T10 Painful RenalCA Met



*Access 13 gauges
beveled needle and
Kyphon 8 gauges
Osteointroducer to insert
ZEISS proprietary access
cannula*

VERTEBRAL AUGMENTATION AND IORT

T10 Painful RenalCA Met

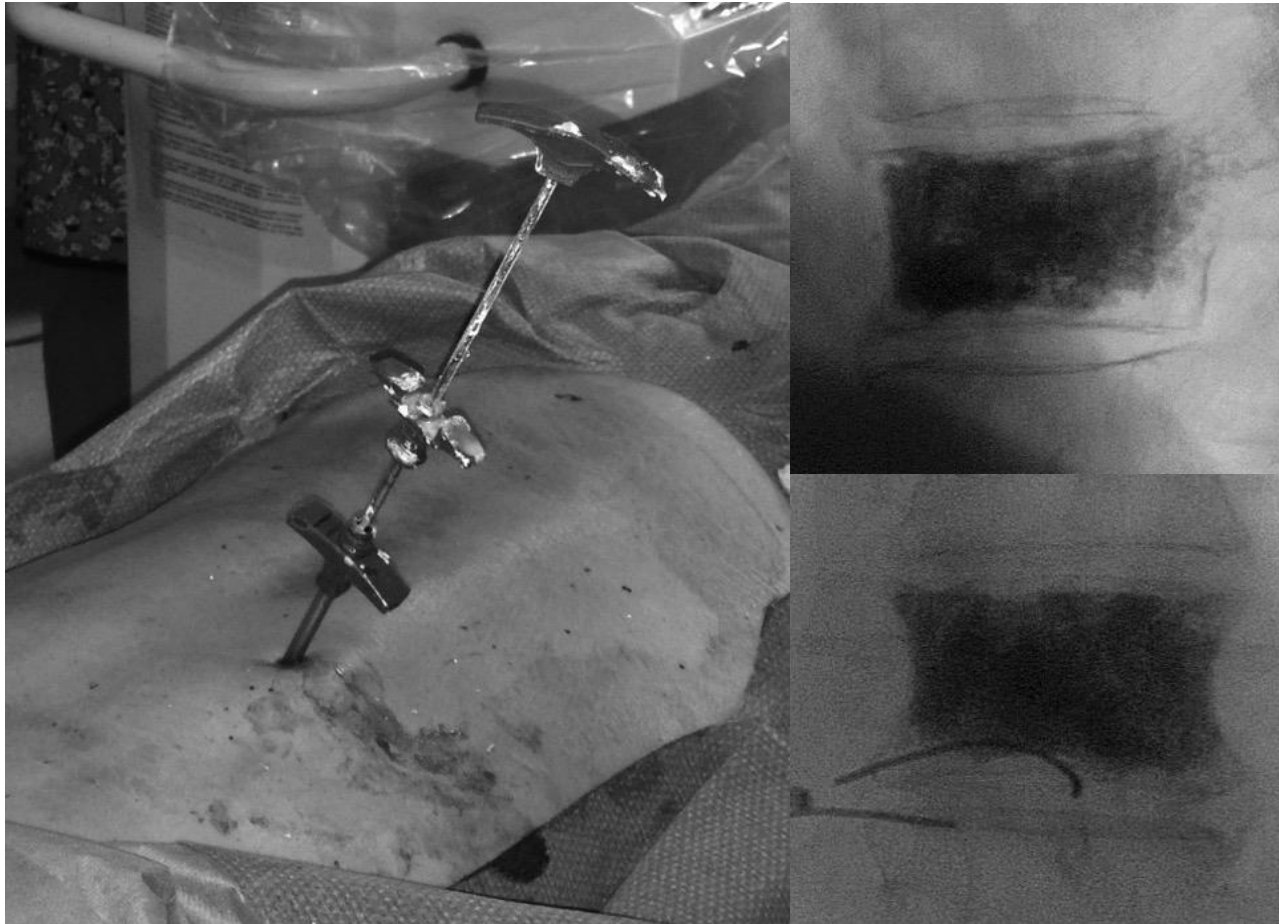


After ZEISS cannula is positioned the Intrabeam arm is inserted

Pre-planned dose and time exposure are monitored automatically

VERTEBRAL AUGMENTATION AND IORT

T10 Painful RenalCA Met

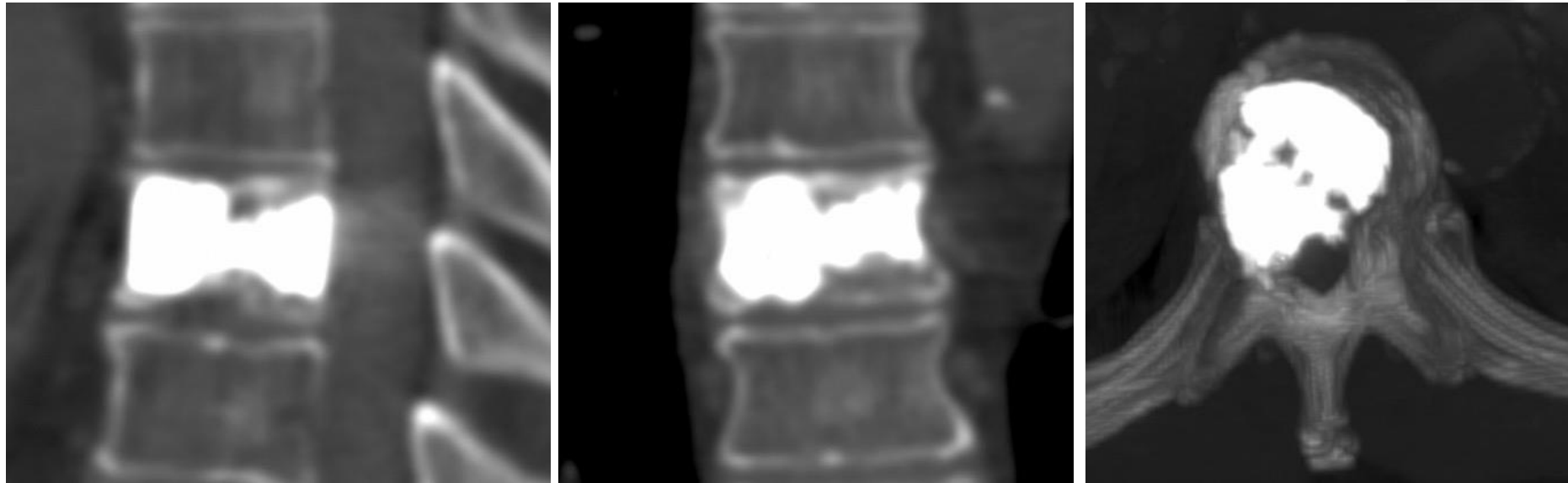


After Vertebro-IORT complete pain relief and optimal PMMA distribution within the lesion

Courtesy of Giovanni Carlo Anselmetti, Torino, ITALY

VERTEBRAL AUGMENTATION AND IORT

T10 Painful RenalCA Met



*CT scan after 2 months confirmed complete filling of the lesion
with no further vertebral collapse*

A feasibility study of percutaneous radiofrequency ablation followed by radiotherapy in the management of painful osteolytic bone metastases

M. Di Staso • L. Zugaro • G. L. Gravina • P. Bonfili • F. Marampon • L. Di Nicola •
A. Conchiglia • L. Ventura • P. Franzese • M. Gallucci • C. Masciocchi • V. Tombolini

- 15 pts RFA + RT (20Gy in 5 fractions)
- 30 pts RT
- 5/15 (33%) vertebrae RFA + RT; 2/30 (6.6%) RT alone
- Pelvis accounted for Majority
- Baseline VAS 6.5 (RT) and 6.3 (RFA + RT)

Results/Conclusion

- **Complete response** (VAS 0) at 12 weeks 16.6% (RT) and 53.3% (RFA+RT)
- **Partial response** (decrease VAS > 2) 43.3% (RT) and 40% (RFA+RT)
- **Overall response rate** at 12 weeks 59.9% (RT) and 93.3% (RFA+RT)
- **Interval to response**: 9 weeks (RT) and 3 weeks (RFA+RT)

Results suggest that RFA-RT is safe and more effective than RT alone. The findings should serve as a framework to design future clinical trials

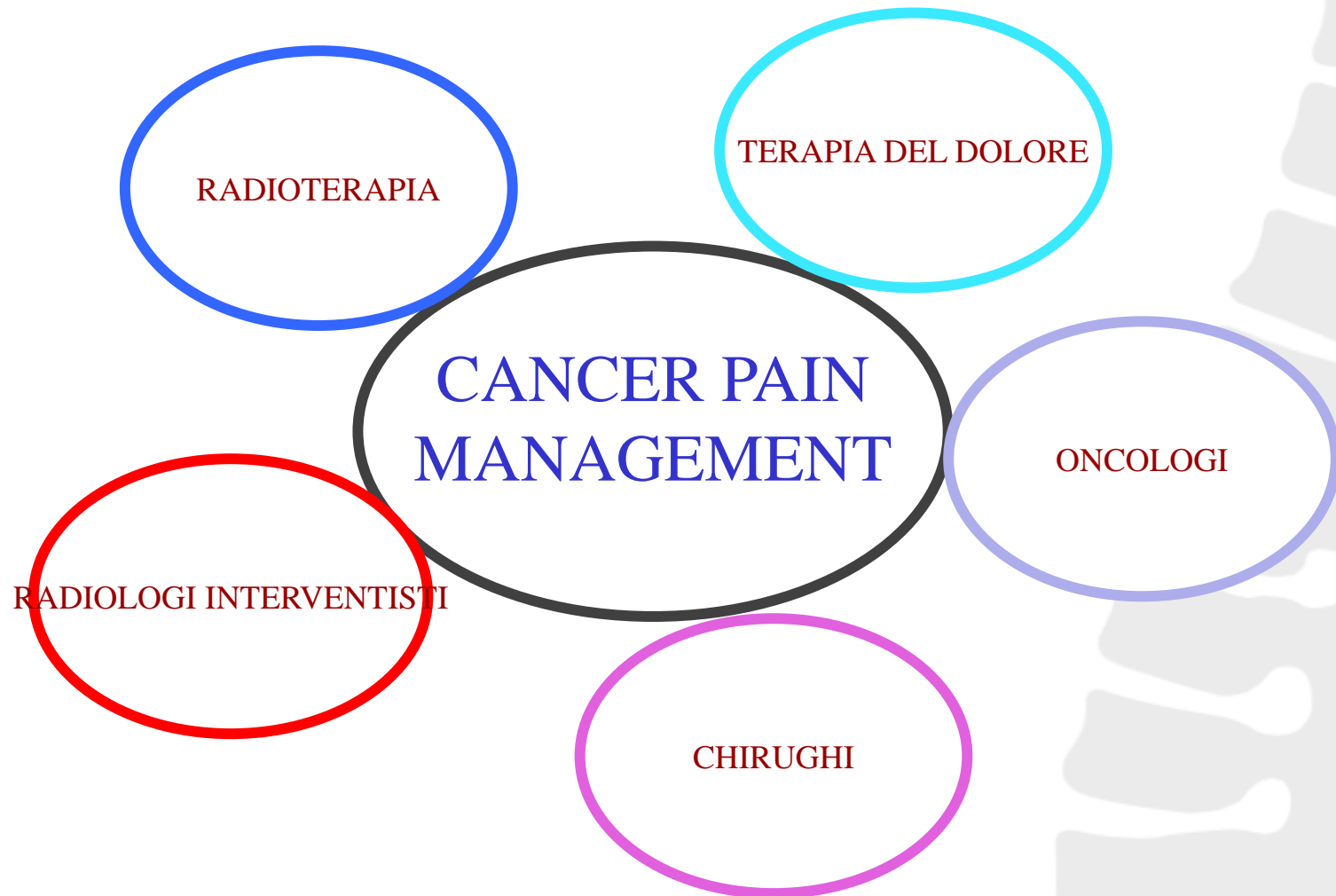
TAKE HOME MESSAGES

- ✓ Ablation: tumor necrosis
- ✓ Osteoplasty: stabilization
- ✓ Choice based on lesion:
 - *Volume*
 - *Location*
 - *Anatomical relationship*

LOCALIZZAZIONI SECONDARIE SCHELETRICHE

- *La terza localizzazione più frequente dopo polmone e fegato*
- *Colonna : la sede più comune di localizzazione metastatica in relazione alla vascolarizzazione del red marrow ed alla comunicazione delle vene toraciche e pelviche con i plessi venosi vertebrali.*
- *La causa della sintomatologia dolorosa è conseguenza di una stimolazione biochimica dei nocicettori dovuti ad infiammazione, striamento e liberazione di citochine a livello del periosto.*

APPROCCIO MULTIDISCIPLINARE



MANAGEMENT OF BONE METASTASES

- *Consultation (physical examination, imaging studies, medical and personal record, informed consent)*
- *Therapeutic algorithm*
- *Life expectancy, performance status and tumor burden*

Multidisciplinary management combined with early start of supportive care leads to improvement of

➤ QoL

➤ survival

MANAGEMENT OF BONE METASTASES



National
Comprehensive
Cancer
Network®

NCCN Guidelines Version 1.2018 Adult Cancer Pain

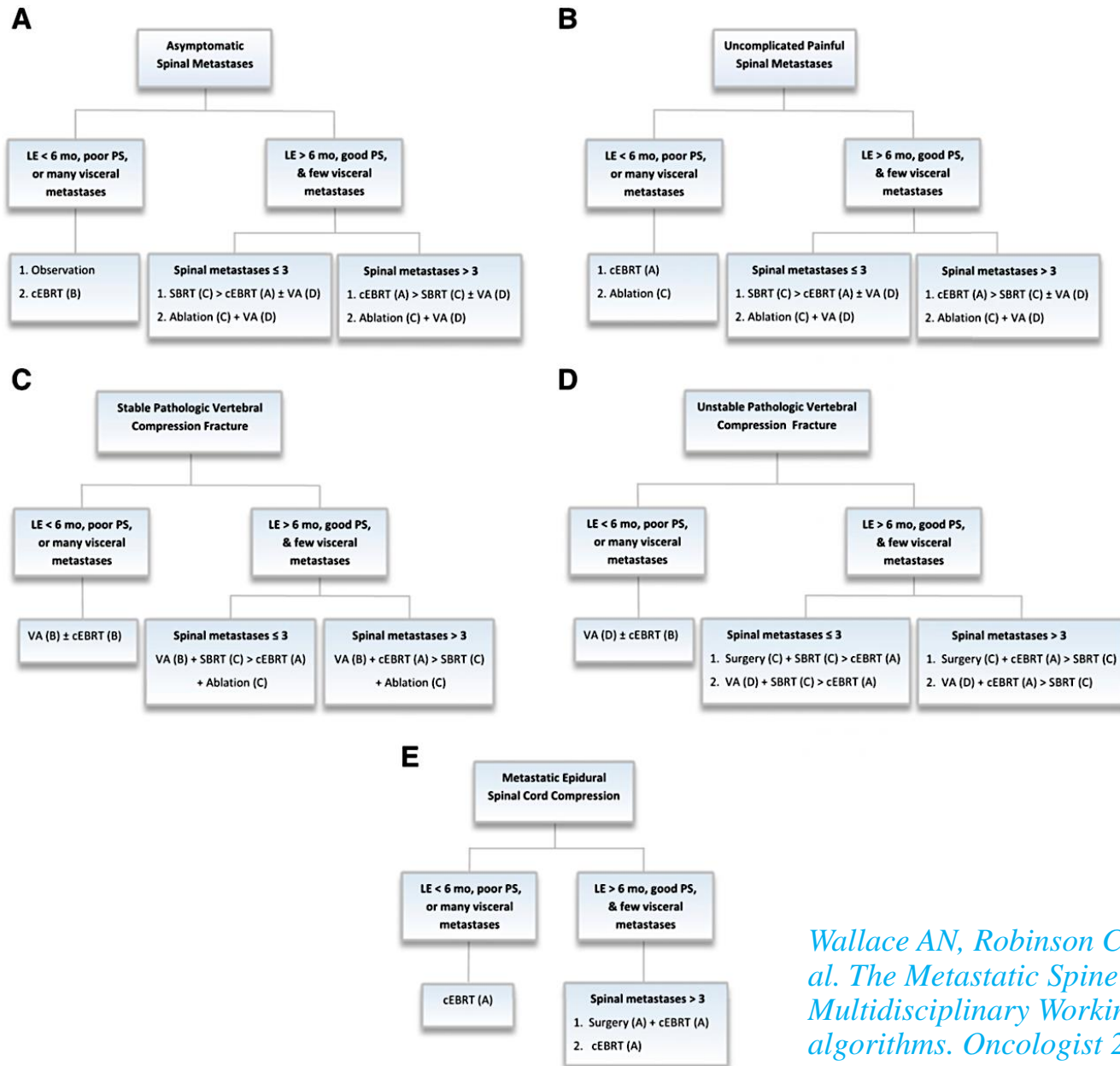
NCCN Principles of Cancer Pain Management ¹

There is increasing evidence in oncology that **survival is linked to symptom reporting and control and that pain management contributes to broad quality-of-life improvement.** To maximize patient outcomes, pain management is an essential part of oncologic management.

Goals of pain management are to meet patient-specific goals for comfort, function, and **safety.**

Prevention of expected analgesic side effects... is key to effective pain treatment.

Algoritmo di trattamento delle metastasi vertebrali



Wallace AN, Robinson CG, Meyer J, et al. The Metastatic Spine Disease Multidisciplinary Working Group algorithms. *Oncologist* 2015;20:1205

Spinal Instability Neoplastic Score: An Analysis of Reliability and Validity From the Spine Oncology Study Group

Daryl R. Fourney, Evan M. Frangou, Timothy C. Ryken, Christian P. DiPaola, Christopher I. Shaffrey, Sigurd H. Berven, Mark H. Bilsky, James S. Harrop, Michael G. Fehlings, Stefano Boriani, Dean Chou, Meic H. Schmidt, David W. Polly, Roberto Biagini, Shane Burch, Mark B. Dekutoski, Aruna Ganju, Peter C. Gerszten, Ziya L. Gokaslan, Michael W. Groff, Norbert J. Liebsch, Ehud Mendel, Scott H. Okuno, Shreyaskumar Patel, Laurence D. Rhines, Peter S. Rose, Daniel M. Sciubba, Narayan Sundaresan, Katsuro Tomita, Peter P. Varga, Luiz R. Vialle, Frank D. Vrionis, Yoshiya Yamada, and Charles G. Fisher

Location	
Junctional (occiput-C2, C7-T2, T11-L1, L5-S1)	3
Mobile spine (C3-C6, L2-L4)	2
Semi-rigid (T3-T10)	1
Rigid (S2-S5)	0
Pain relief with recumbency and/or pain with movement/loading of the spine	
Yes	3
No (occasional pain but not mechanical)	1
Pain free lesion	0
Bone lesion	
Lytic	2
Mixed (lytic/blastic)	1
Blastic	0
Radiographic 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 elements (facet, pedicle or CV joint fracture or replacement with tumor)	
Bilateral	3
Unilateral	1
None of the above	0

Table 2

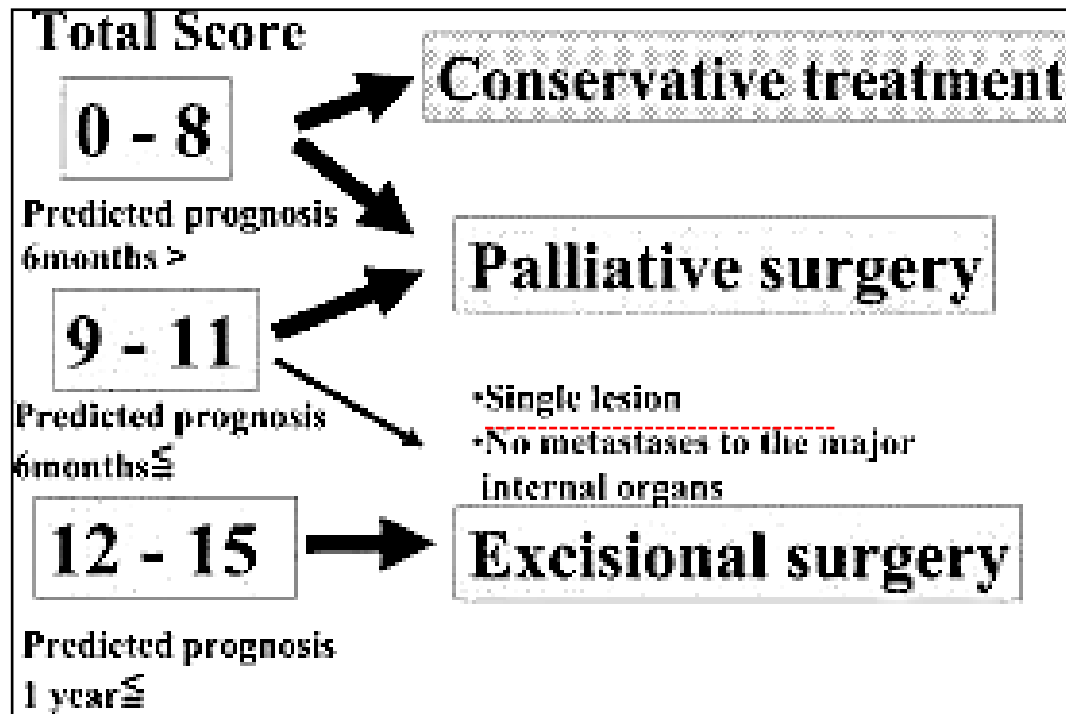
Spine Instability Neoplastic Score

Location	Points	Vertebral body collapse	Points
Junctional	3	>50% collapse	3
Mobile spine (C3-C6, L2-L4)	2	<50% collapse	2
Semirigid spine (T3-T10)	1	No collapse with >50% body involved	1
Rigid spine (S2-S5)	0	None of the above	0
Pain relief with recumbency/pain with movement or loading	Points	Bone lesion	Points
Yes	3	Lytic	2
No	2	Mixed	1
Pain-free lesion	0	Blastic	0
Radiographic spinal alignment	Points	Posterolateral involvement	Points
Subluxation/translation present	4	Bilateral	3
De novo deformity	2	Unilateral	1
Normal alignment	0	None	0

Note: Total score 0-6 points: stability; 7-12: indeterminate stability; 13-18: instability.

PROGNOSIS/TREATMENT

Scoring system for preoperative evaluation of metastatic spine tumor prognosis



Characteristic	Score
General condition (performance status)	
Poor (PS 10%–40%)	0
Moderate (PS 50%–70%)	1
Good (PS 80%–100%)	2
No. of extraspinal bone metastases foci	
≥3	0
1–2	1
0	2
No. of metastases in the vertebral body	
≥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, osteosarcoma, stomach, bladder, esophagus, pancreas	0
Liver, gallbladder, unidentified	1
Others	2
Kidney, uterus	3
Rectum	4
Thyroid, breast, prostate, carcinoid tumor	5
Palsy	
Complete (Frankel A, B)	0
Incomplete (Frankel C, D)	1
None (Frankel E)	2
Criteria of predicted prognosis: Total Score (TS) 0–8 = >6 mo; TS 9–11 = ≤6 mo; TS 12–15 = ≤1 yr.	

TLES Predictive Factor	Range	TLES Points
Karnofsky performance status	Poor	0
	Moderate	1
	Good	2
Extraspinal bone metastases	≥3	0
	1-2	1
	0	2
Vertebral body metastases	≥3	0
	2	1
	1	2
Visceral organ metastases	Unresectable	0
	Resectable	1
	None	2
Cancer histology	Lung, osteosarcoma, gastric, bladder, esophagus, pancreas	0
	Liver, gallbladder, unidentified	1
	Others	2
	Kidney, uterus	3
	Rectum	4
	Thyroid, prostate, breast, carcinoid	5
Frankel neurological function	Complete loss of motor or sensory function	0
	Some motor or sensory neurologic dysfunction	1
	Normal neurologic function	2
Total TLES Points		Estimated Survival
0-8		< 6 months
9-11		≥ 6 months
12-15		≥ 12 months

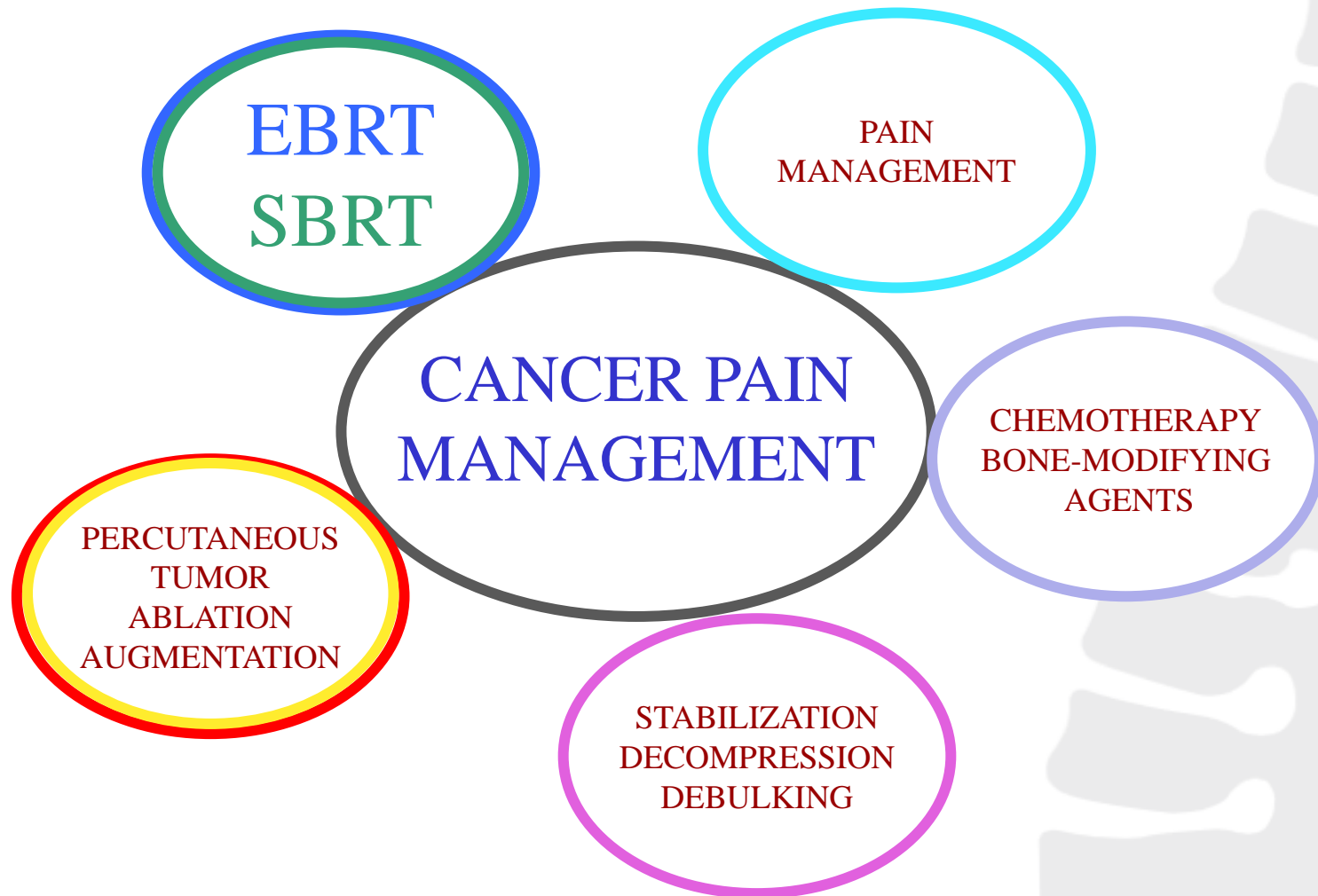
Karnofsky performance index

Definition

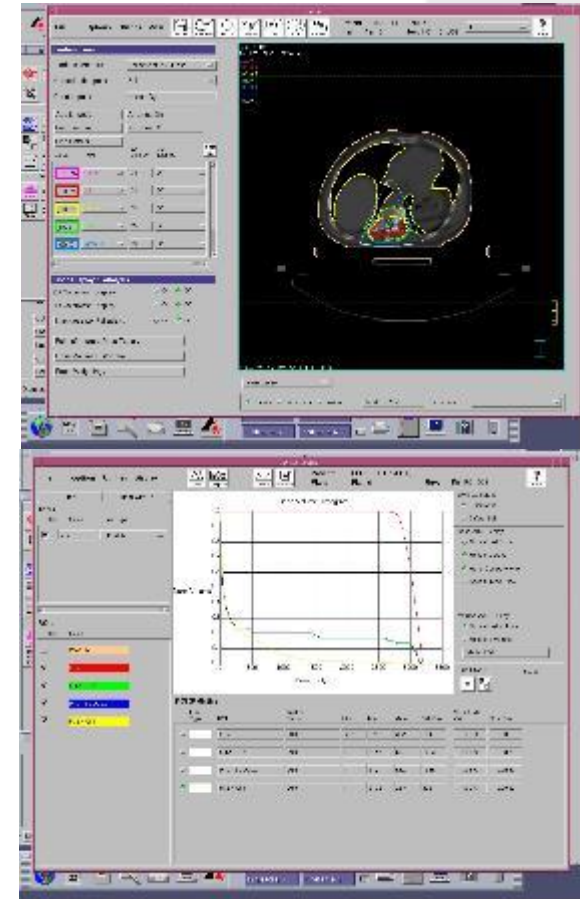
Able to carry on normal activity and to work	100	Normal; no complaints; no evidence of disease
	90	Able to carry on normal activity; minor signs or symptoms of disease
	80	Normal activity with effort; some signs or symptoms of disease
Unable to work; able to live at home, care for most personal needs; a varying amount of assistance is needed	70	Cares for self; unable to carry on normal activity or to do active work
	60	Requires occasional assistance but is able to care for most needs
	50	Requires considerable assistance and frequent medical care
Unable to care for self; requires equivalent of institutional or hospital care; disease may be progressing rapidly	40	Disabled; requires special care and assistance
	30	Severely disabled; hospitalization is indicated, although death is not imminent
	20	Very sick; hospitalization necessary; active supportive treatment necessary
	10	Moribund; fatal processes progressing rapidly
	0	Dead

From Karnofsky DA, Abelmann WH, Craver LF, et al: The use of the nitrogen mustards in the palliative treatment of carcinoma. *Cancer* 1:634-656, 1948.

Approccio Multidisciplinare



- *Conventional external beam radiation therapy (EBRT) is the standard of care for painful spinal metastases that are incompletely palliated with the oral analgesics and biphosphonates*
- *Stereotactic body radiation therapy (SBRT) is recommended for patients with life expectancy greater than 6 months, good performance status, and few visceral metastases, to maximize the likelihood of achieving local tumor control in addition to pain relief*



SBRT uses advances in radiation dose delivery systems to treat spinal tumors with higher doses of radiation while minimizing dose to the spinal cord. As a result, SBRT has the potential to produce more durable pain relief and local control of spinal metastases, including radiation-resistant tumor

Indications

- *Single metastases*
- *Oligometastatic disease: when the treatment aim is not only palliation*
- *Always used in retreatments*

The NOMS evidence based management

CONSIDERS FOUR ASPECTS OF DISEASE STATUS:

- *Neurologic (cord compression, ESCC scale)*
- *Oncologic (radiosensitivity to cEBRT)*
- *Mechanical stability (SINS score)*
- *Systemic status (life expectancy, comorbidities)*

*Integration determines the use of radiation,
surgery/cement augmentation, systemic therapy*

RADIATION THERAPY

The NOMS decision framework

Neurologic	Oncologic	Mechanical	Systemic	Decision
Low-grade ESCC + no myelopathy	Radiosensitive	Stable		cEBRT
	Radiosensitive	Unstable		Stabilization followed by cEBRT
	Radioresistant	Stable		SRS
	Radioresistant	Unstable		Stabilization followed by SRS
High-grade ESCC ± myelopathy	Radiosensitive	Stable		cEBRT
	Radiosensitive	Unstable		Stabilization followed by cEBRT
	Radioresistant	Stable	Able to tolerate surgery	Decompression/stabilization followed by SRS
	Radioresistant	Stable	Unable to tolerate surgery	cEBRT
	Radioresistant	Unstable	Able to tolerate surgery	Decompression/stabilization followed by SRS
	Radioresistant	Unstable	Unable to tolerate surgery	Stabilization followed by cEBRT

Implications for Practice: Treatment of spinal metastatic tumors requires a multidisciplinary approach which integrates radiation and medical oncology, surgery, and interventional radiology. The NOMS framework described in this manuscript incorporates the neurologic, oncologic, mechanical, and systemic considerations to facilitate decision making in the care of patients with spinal metastases. Furthermore, this framework allows dynamic integration of novel systemic and radiation options which is crucial in these rapidly evolving disciplines. The article summarizes the supporting literature for this framework and provides the results of implementation of the NOMS paradigm in the care of cancer patients.

SUMMARY OF EXPECTED RADIATION RESPONSE BASED ON HISTOLOGY

Study	Lymphoma Seminoma Myeloma	Breast	Prostate	Sarcoma	Melanoma	Gastrointestinal	NSCLC	Renal
Gilbert et al	F	F	U	U	U	U	U	U
Maranzano et al	F	F	F	U	U	U	U	U
Rades et al	F	I	I	I	U	I	U	I
Rades et al	F	F	F	U	U	U	U	U
Katagiri et al	F	F	F	U	U	U	U	U
Maranzano et al	F	F	F	U	U	U	U	U
Rades et al	F	I	I	I	U	I	U	I

Abbreviations

F: favorable

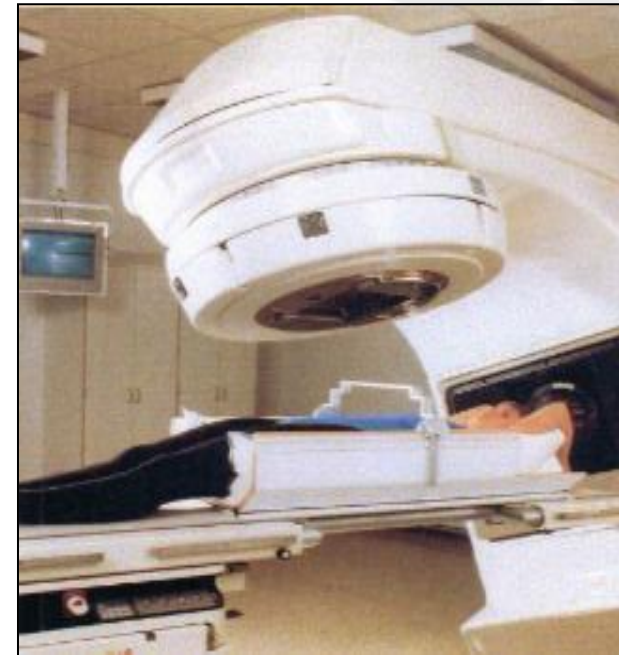
I: intermediate

U: unfavorable

Tumor histology is perhaps the most important factor in determining response to cEBRT

External beam radiation (EBRT), although used frequently

- *provide pain relief only in 70% of the patients treated and that for a limited period of time and complete relief may be seen in up to one-third (30%)*
- *rate and degree of pain relief is weeks to months*
- *requires interruption of chemotherapy*
- *can provoke permanent neural damage*
- *can induce osteonecrosis*



Frassica, D.A., General principles of external beam radiation therapy for skeletal metastases. Clin Orthop Relat Res, 2003(415 Suppl): p. S158-64

gold standard, but.....

External beam radiation therapy is the standard of care treatment for painful bone metastases

Nevertheless, approximately 40% of treated patients do not receive significantly decreased pain

In addition, nearly half of patients develop recurrent pain on average 4 months after radiation therapy

SBRT is showing better results but is also shown to be increasingly associated with development of pathological fractures

Wallace AN et al RADIOFREQUENCY ABLATION AND VERTEBRAL AUGMENTATION FOR PALLIATION OF PAINFUL SPINAL METASTASES . J Neurooncol. (2015)

Chow E, Zeng L, Salvo N, et al. UPDATE ON THE SYSTEMATIC REVIEW OF PALLIATIVE RADIOTHERAPY TRIALS FOR BONE METASTASES. Clin Oncol 2012;24:112e24.

LA CAUSA DEL DOLORO VERTEBRALE

- MECCANICO

- Instabilità da microfratture

- BIOLOGICO

- *Irritazione del periosto da crescita del tumore*
- *Riassorbimento osseo mediato da osteoclasti con rilascio di citochine*

- RADICOLARE

- *Estensione del tumore a livello del neuroforamen*
- *Compressione da frattura*

