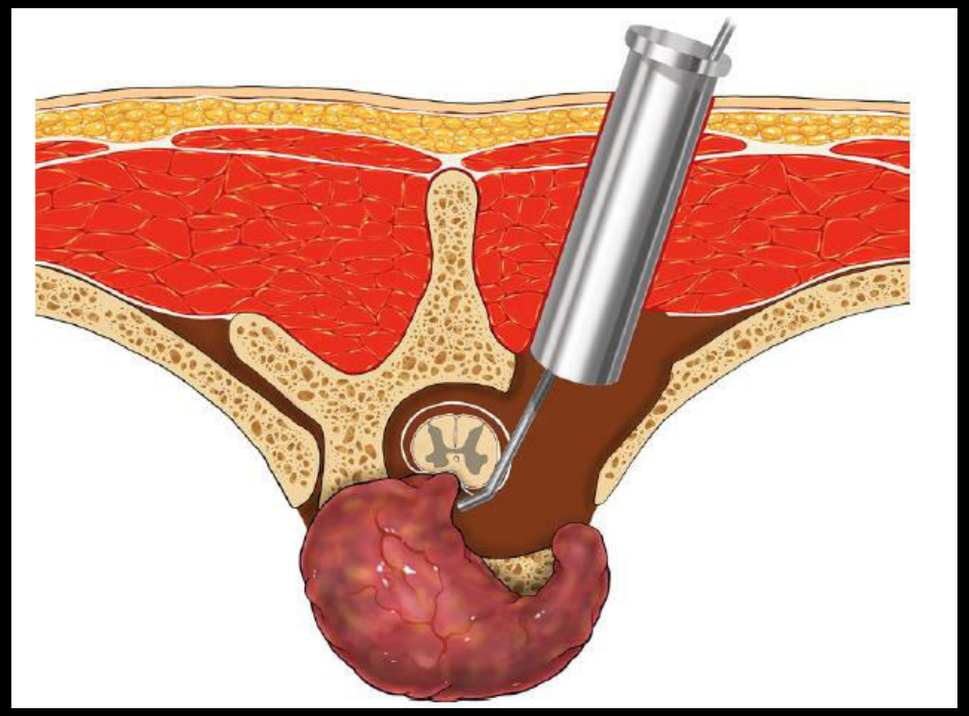
Metastatic disease of the Spine



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The Royal Orthopaedic Hospital

Birmingham Children's Hospital

MSCC

Metastatic Spinal Cord Compression

Prevalence

- Bone metastasis seen in 150,000 patients with solid tumours in England and Wales
- Common sites of metastasis: Lung; Liver; Bone

Aaron AD JAMA 1994; 272: 1208 - 9

Prevalence

- Spine is the commonest site of bone metastasis
- 30 - 70% Cancer patients have spine mets on autopsy
- 5 - 10% patients with cancer develop spinal cord compression

Jacobs, Perin Neurosurg Focus 2001

‘ As survival rates for primary cancers improve, the prevalence of spinal metastasis will rise.’

Common sites of primaries

- Adults: Breast, Lung, Prostate, Renal, Melanoma, Thyroid, Colorectal, Haematologic (MM; Lymphoma)

Constans J Neurosurg 1983; 59: 111 - 118

- Children: Neuroblastomas, Sarcomas

Choi ESJ 2010 19: 215 - 222

Pathology

- Reaching the spine:

Haematogenous spread

Direct extension / invasion

Seeding of CSF

- Thoracic Spine 70%
- Lumbar spine 20%
- Cervical and Sacrum 10%

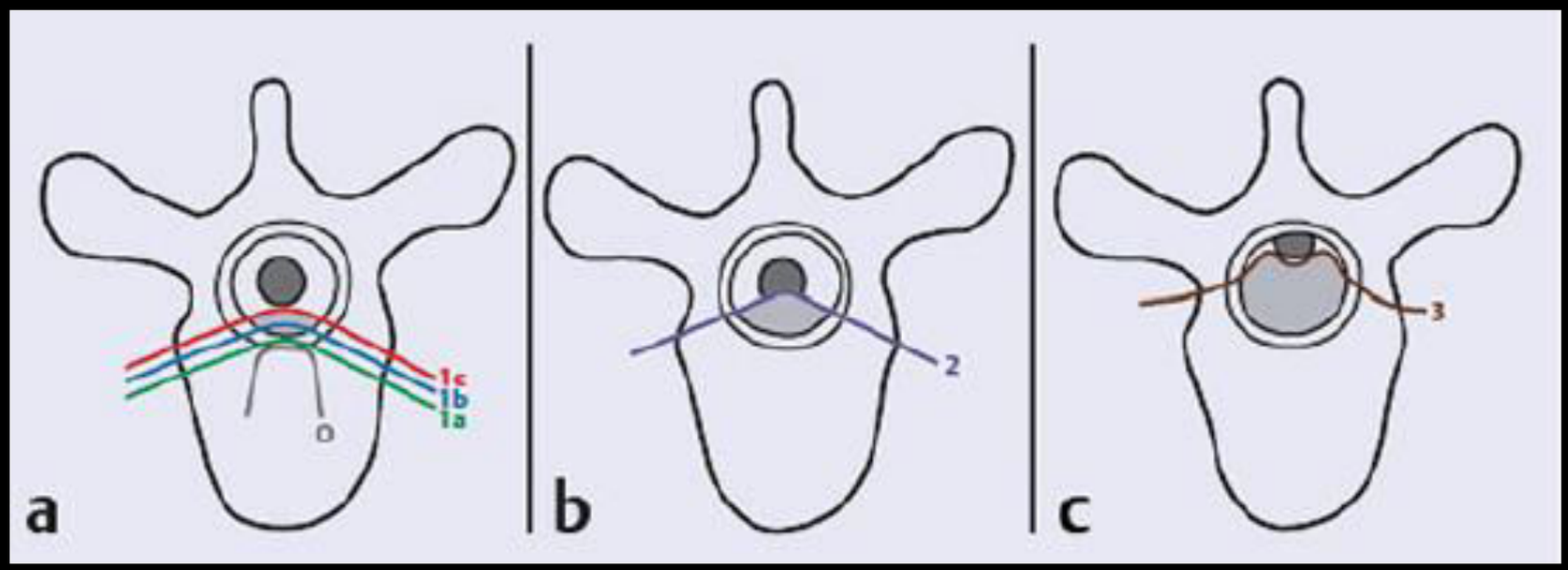
Pathology

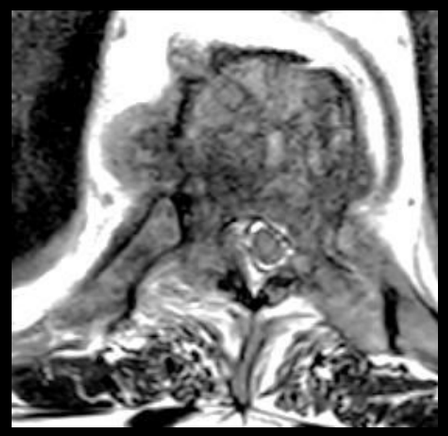
- Vertebral body 80%
- Posterior elements 20%
- Most are osteolytic 95%
- Breast and Prostate are osteoblatic
- Usually do not cross dural barrier

exc sarcomas, recurrence, post radiotherapy

Grades of MSCC

Grade	Bone	Epidural	Theca	Cord deformation	Cord compression
0	+	-	-	-	-
1a	+	+	-	-	-
1b	+	+	+	-	-
1c	+	+	+	+	-
2	+	+	+	+	+ CSF seen
3	+	+	+	+	+ No CSF





instability. Grades 2 and 3 define high-grade ESCC. Note: Used with permission from Bilsky MH, Laufer I, Fourney DR, et al. Reliability analysis of the epidural spinal cord compression scale. J Neurosurg Spine 2010;13(3):324–328.

Patient evaluation

1. Medical condition
2. Clinical presentation:

Neurology, Pain, Instability

3. Oncologic status

Patient evaluation:
Medical condition

- Overall health; previous treatment with chemo / radio, steroids; Nutritional status
- Poor outcome factors: age, obesity, malnutrition, Diabetes, low bone density, chronic steroid use, bone marrow suppression
- Haematologic staus: Leukopenia, thrombocytopaenia, coagulopathy

Patient evaluation

1. Medical condition
2. Clinical presentation:

Neurology, Pain, Instability

3. Oncologic status

Patient evaluation:
Neurology

- Sensory (including fine touch, pin prick, vibration, temperature)
- Motor
- Reflexes (including pathologic reflexes)
- Autonomic

Patient evaluation:
Neurology

- Cord v nerve root
- Myelopathy v radiculopathy
- Ambulation status (important predictor)
- Degree of cord compression
- 5-10% of all MSCC

Patient evaluation:

Pain

- 83 - 95% pain precedes neurology

Sciubba J Neurol Spine 2010; 13: 94 - 108

Types of pain patterns:

- Local
- Radicular
- Mechanical

Patient evaluation:

Local Pain

- Causes: Periosteal strech, endosteal pressure, inflammation by tumour growth

Gokaslan Curr Opin Oncol 1996

- Localised, constant, not related to activities, ‘deep ache’
- Responds to: NSIAD’s, Steroids, radiotherapy

Patient evaluation:
Radicular Pain

- Root compression alongs its course (Dermatomal pattern)
- Sharp, shooting, stabbing
- Constant, not related to activity
- Response to NSAID's, steroids, chemo and radiotherapy (tumour shrinkage)

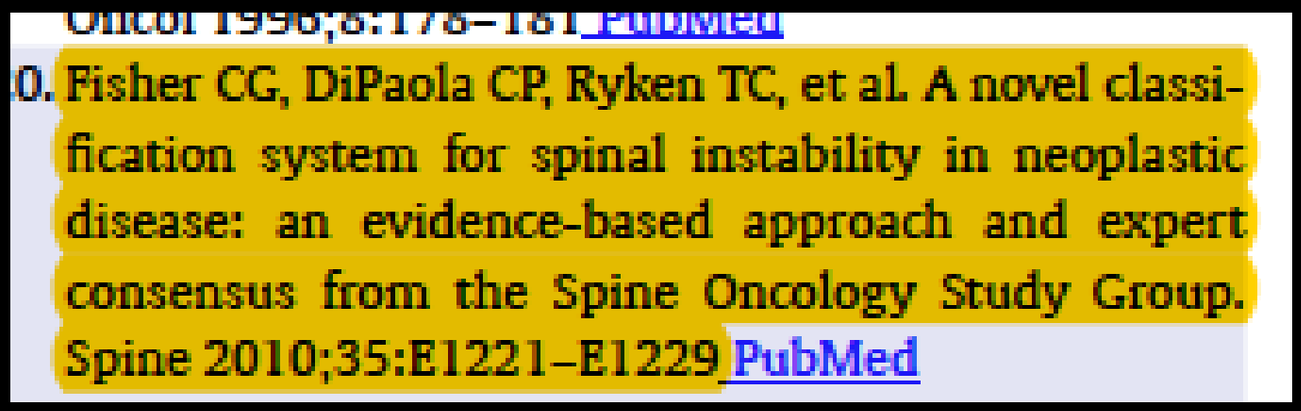
Patient evaluation:
Mechanical Pain

- Severe, movement related
- Worse with loading the spinal column
- Improves with lying down
- Refractory to medications, chemo or radiotherapy
- ‘Instability’

Patient evaluation:

Instability

‘ loss of spinal integrity as a result of a neoplastic process that is associated with movement related pain, symptomatic or progressive deformity and / or neural compromise under **physiologic loads**’


Oncol 1996;8:178–181 PubMed

10. Fisher CG, DiPaola CP, Ryken TC, et al. A novel classification system for spinal instability in neoplastic disease: an evidence-based approach and expert consensus from the Spine Oncology Study Group. Spine 2010;35:E1221–E1229 PubMed

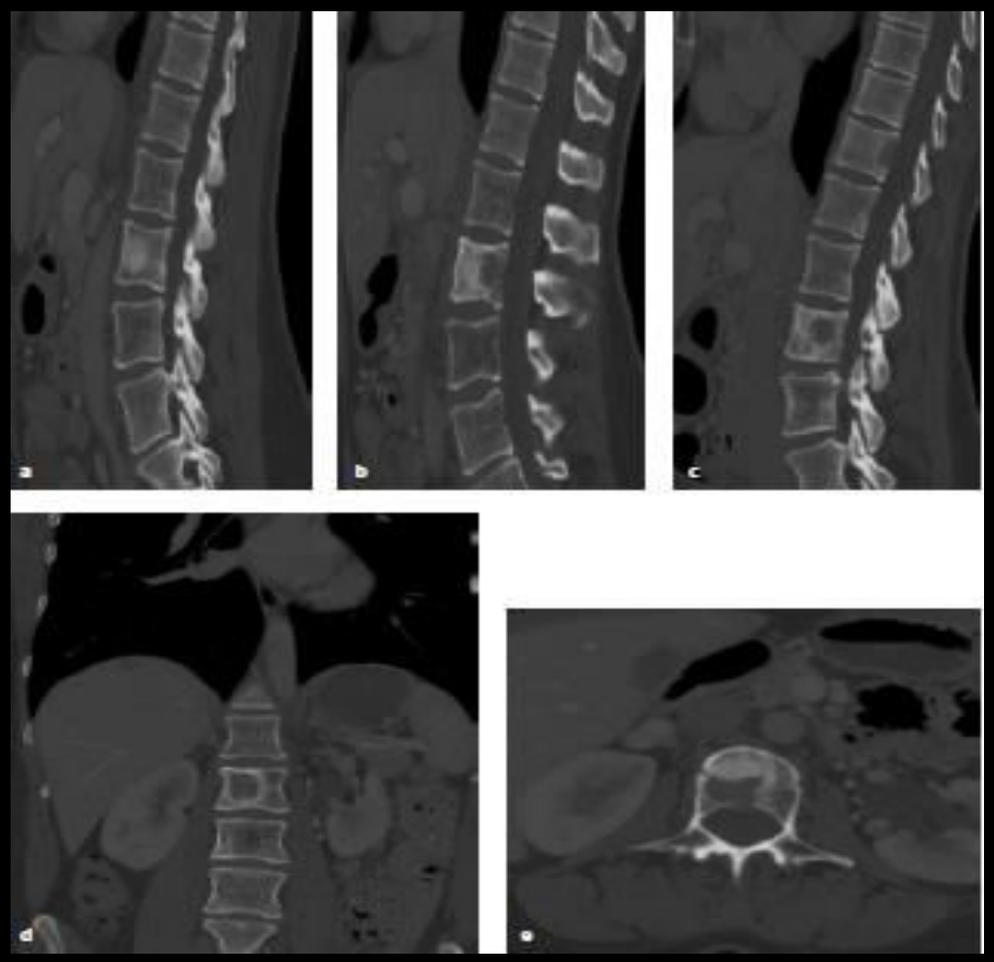
Spinal Instability Neoplastic Score (SINS)

SINS Component	Description	Score
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[a]	Yes	3
	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 spinal elements[b]	Bilateral	3
	Unilateral	1
	None of the above	0

[a] Pain improvement with recumbency and/or pain with movement/loading of the spine.
[b] Facet, pedicle or costovertebral joint fracture or replacement with tumor.
Source: From Fisher CG, DiPaola CP, Ryken TC, et al. A novel classification system for spinal instability in neoplastic disease: an evidence-based approach and expert consensus from the Spine Oncology Study Group. Spine 2010;35:E1221–E1229. Reproduced with permission.

0 - 6 Stable 7 - 12 Intermediate 13 - 18 Unstable

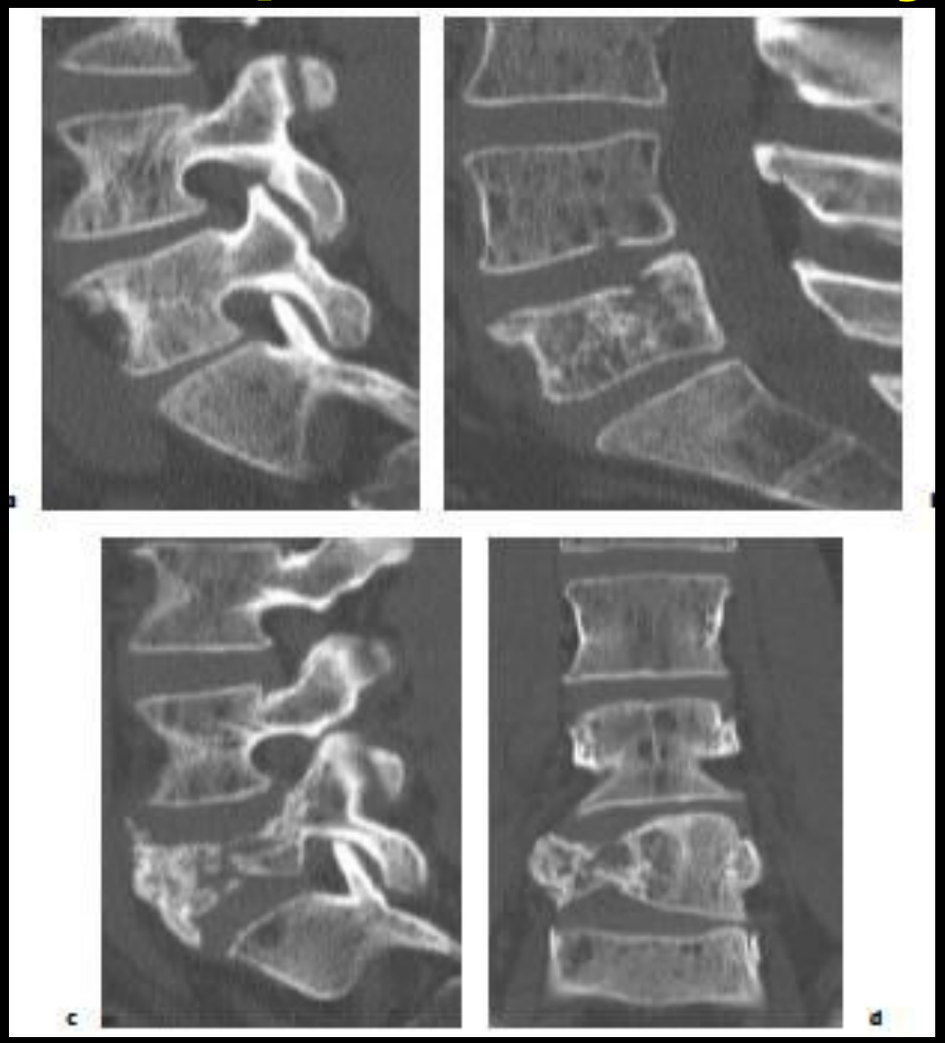
Spinal Instability Neoplastic Score (SINS)

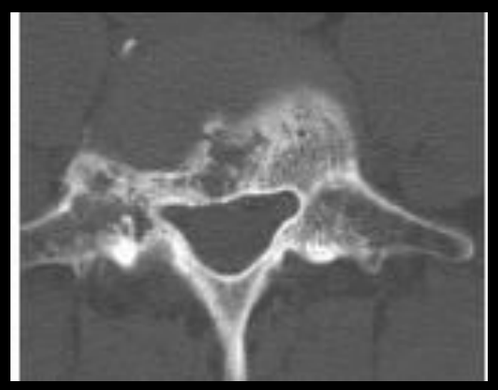


• Mobile	2
• No pain	0
• Mixed	1
• Normal alignment	0
• No collapse	1
• No PL involvement	0
	4

0 - 6 Stable 7 - 12 Intermediate 13 - 18 Unstable

Spinal Instability Neoplastic Score (SINS)





• Junctional	3
• Pain (not mech)	1
• Lytic	2
• Normal alignment	0
• < 50% collapse	2
• Right pedicle	1
	9

0 - 6 Stable **7 - 12 Intermediate** **13 - 18 Unstable**

Spinal Instability Neoplastic Score (SINS)

• Mobile	2
• Mech pain	3
• Lytic	2
• Kyphotic	2
• > 50% collapse	3
• Bil PL involced	3
	15

0 - 6 Stable 7 - 12 Intermediate 13 - 18 Unstable

Biomechanics of collapse

- Cancellous involvement with intact cortical shell may not lead to instability

- Taneichi Risk factors:

Taneichi H, Kaneda K, Takeda N, Abumi K, Satoh S. Risk factors and probability of vertebral body collapse in metastases of the thoracic and lumbar spine. Spine 1997;22:239–245 PubMed

  - Multivariate logistic regression model

  - Thoracic: Costo-vertebral joint destruction v size of lesion

  - TL / L: Size of lesion and pedicle involvement

  - Bone mineral density v size of lesion

Patient evaluation

1. Medical condition
2. Clinical presentation:

Neurology, Pain, Instability

3. Oncologic status

Patient evaluation

Oncologic status

- Tumour histology
- Single strongest predictor of survival
- Vascularity: Renal, Thyroid, Hepato-cellular, Melanoma, GCT (hypervascular; prep embolisation)
- Tomita stratification of tumour histology

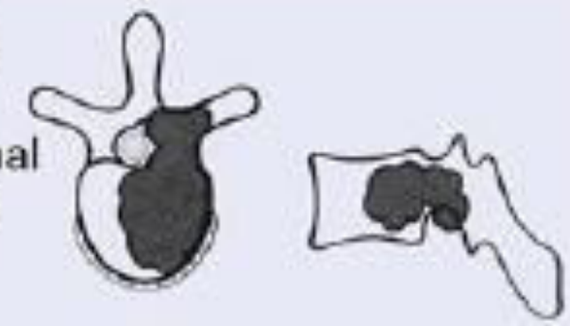
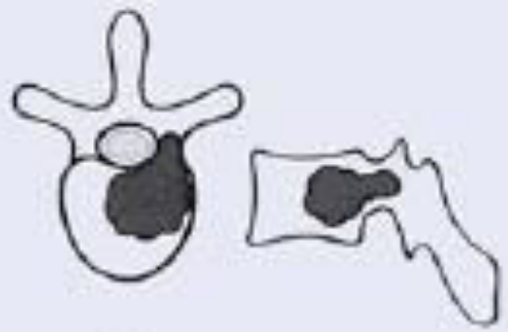
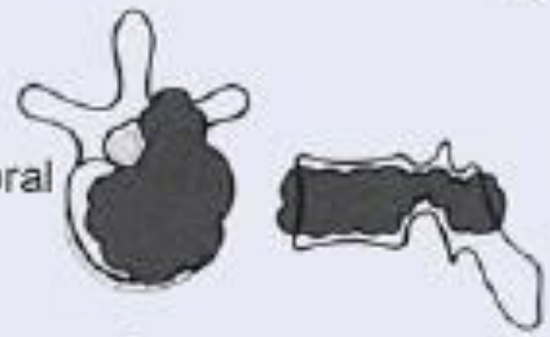
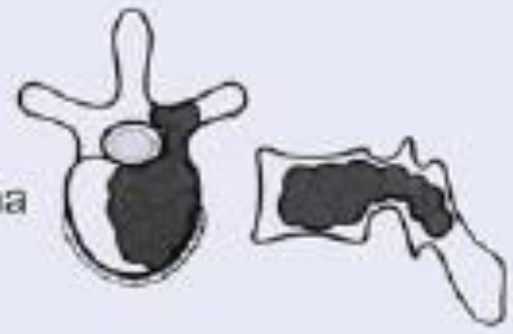
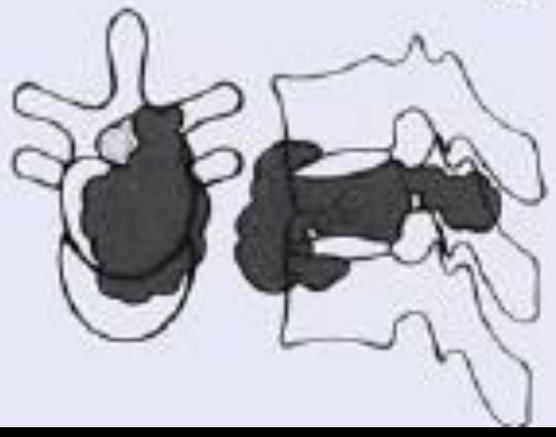
Systemic staging

- Tomita score
- Tokuhashi score

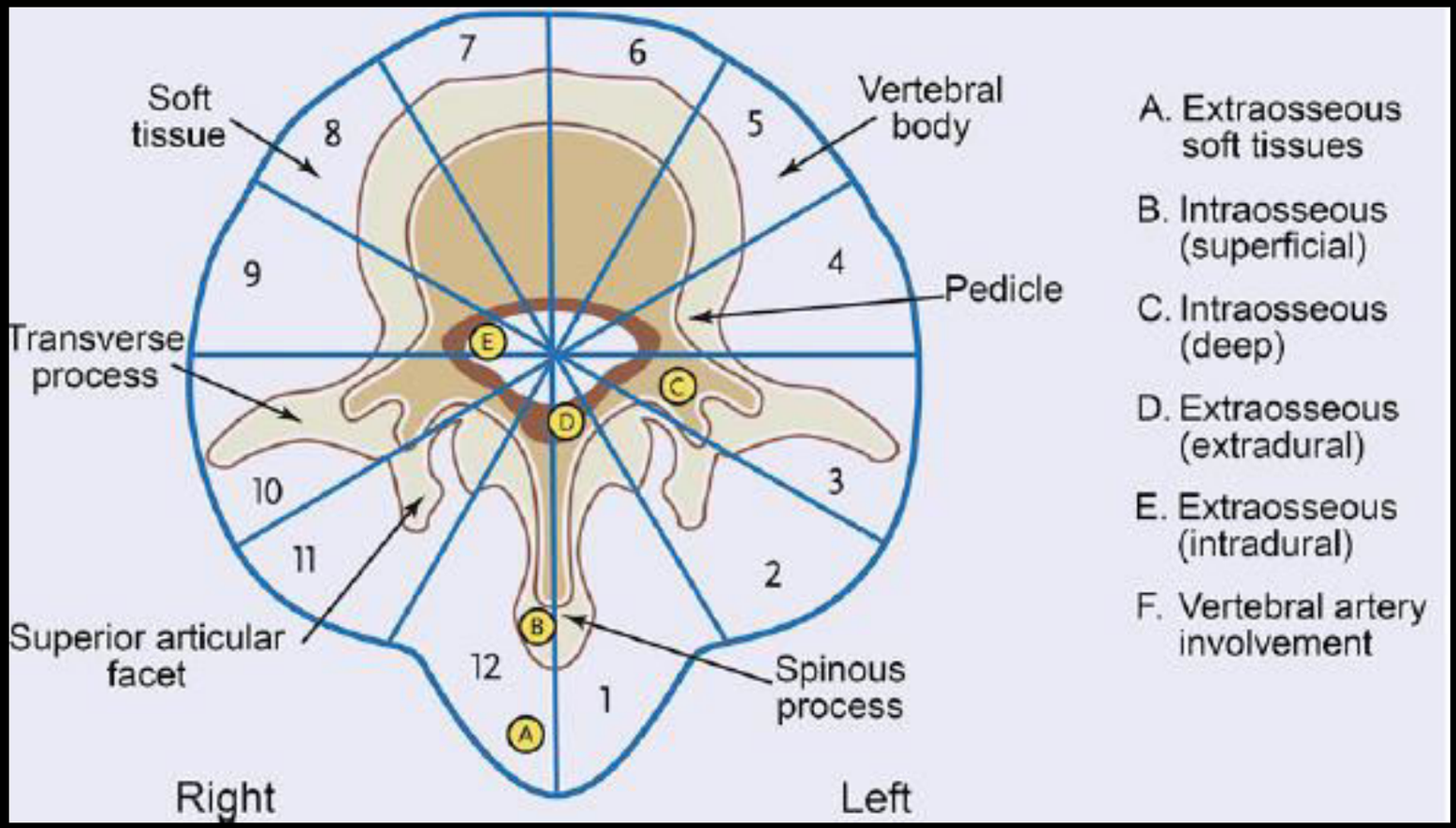
Tomita stratification of tumour histology

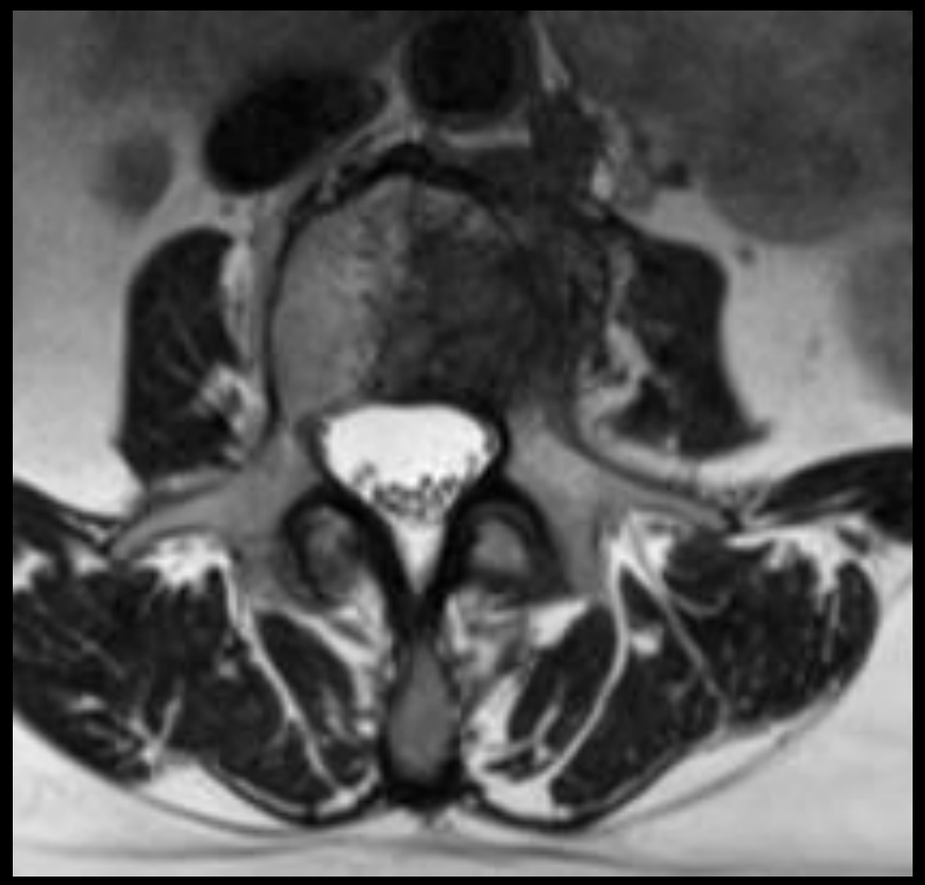
- Slow growing: Breast, Prostate, Thyroid, Carcinoid
- Moderately growing: Kidney, Uterus
- Rapidly growing: Lung, Liver, Stomach, Sarcoma, Pancreas, Bladder, Oesophagus, Unknown

Tomita surgical classification

Intra-compartmental	Extra-compartmental	Multiple
Type 1 Vertebral body 	**Type 4** Spinal canal extension 	**Type 7** 
Type 2 Pedicle extension 	**Type 5** Paravertebral extension 	
Type 3 Body - lamina extension 	**Type 6** Adjacent vertebral extension 	

Weinstein - Boriani - Biagini surgical staging



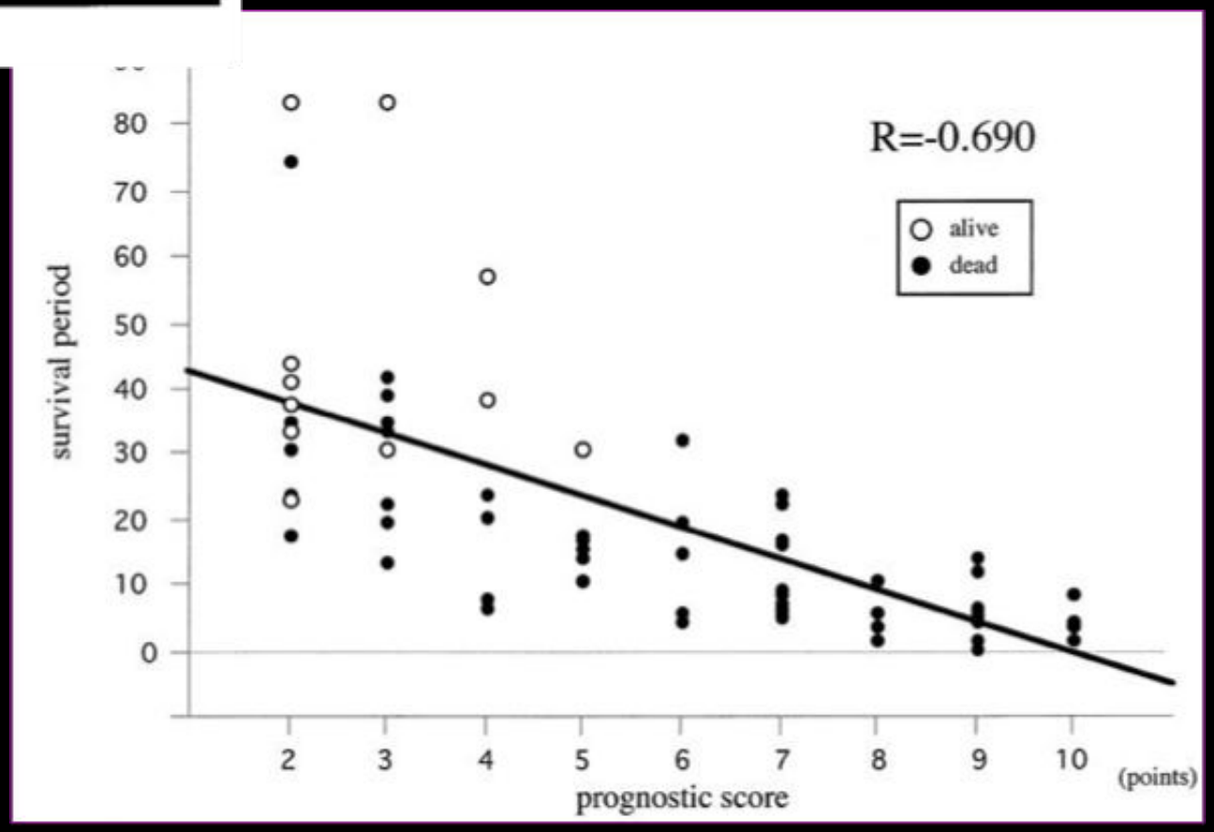


Systemic staging: Tomita

Scoring System			
Point	Prognostic factors		
	Primary tumor	Visceral mets.*	Bone mets.**
1	slow growth (breast, thyroid, etc.)		solitary or isolated
2	moderate growth (kidney, uterus, etc.)	treatable	multiple
4	rapid growth (lung, stomach, etc.)	un-treatable	

Prognostic Score	Treatment Goal	Surgical Strategy
2, 3	Long-term local control	Wide or Marginal excision
4, 5	Middle-term local control	Marginal or Intralesional excision
6, 7	Short-term palliation	Palliative surgery
8, 9, 10	Terminal care	Supportive care

* No visceral mets. = 0 point. ** Bone mets. including spinal mets.



Systemic staging: Tokuhashi

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

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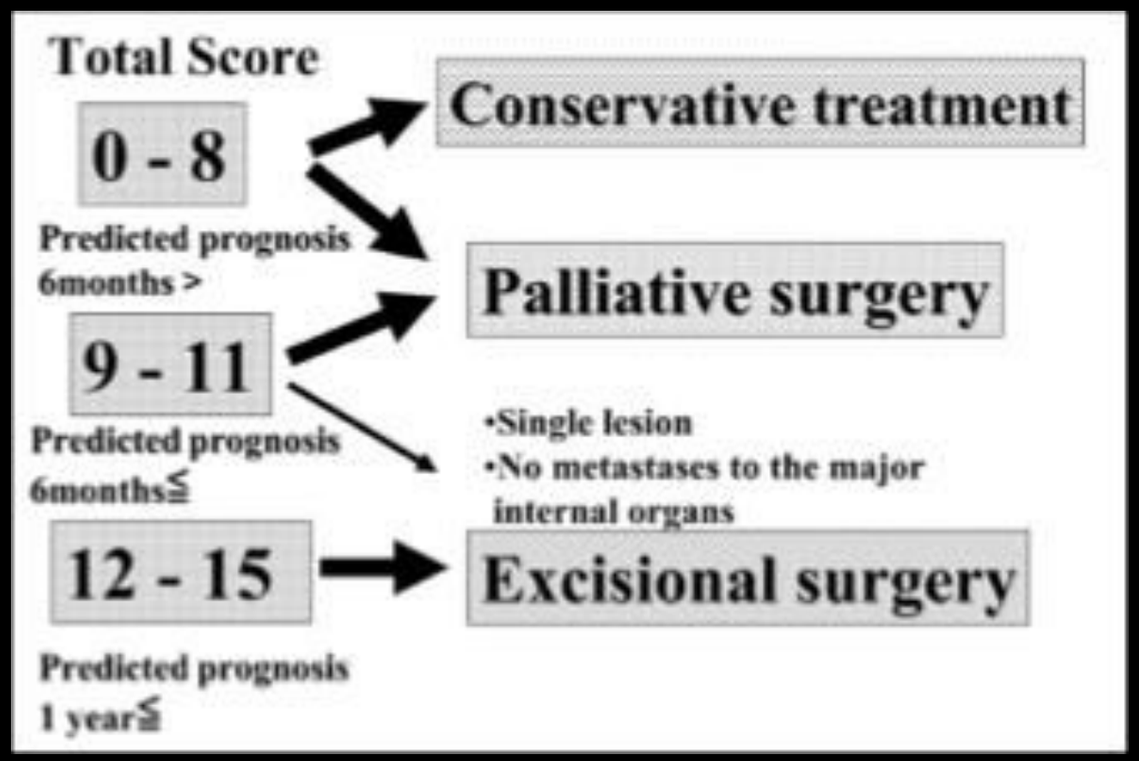
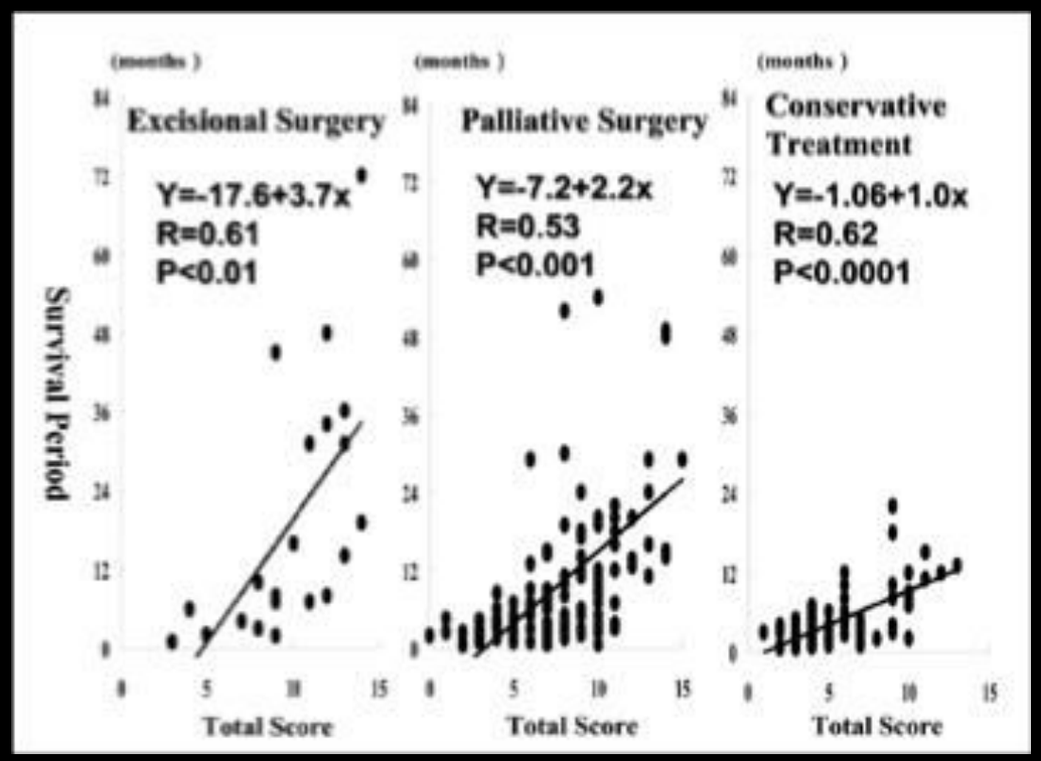
A Revised Scoring System for Preoperative Evaluation of Metastatic Spine Tumor Prognosis

Yasuaki Tokuhashi, MD,* Hiromi Matsuzaki, MD,† Hiroshi Oda, MD,* Masashi Oshima, MD,* and Junnosuke Ryu, MD*

Parameters	0	1	2
General condition	Poor	Moderate	Good
Extra-spinal skeletal metastasis	> 3	1 to 2	0
Metastasis to internal organs	Un-removable	Removable	None
Number of spinal metastasis	> 3	2	1
Spinal cord palsy	Complete	Incomplete	None

Systemic staging: Tokuhashi





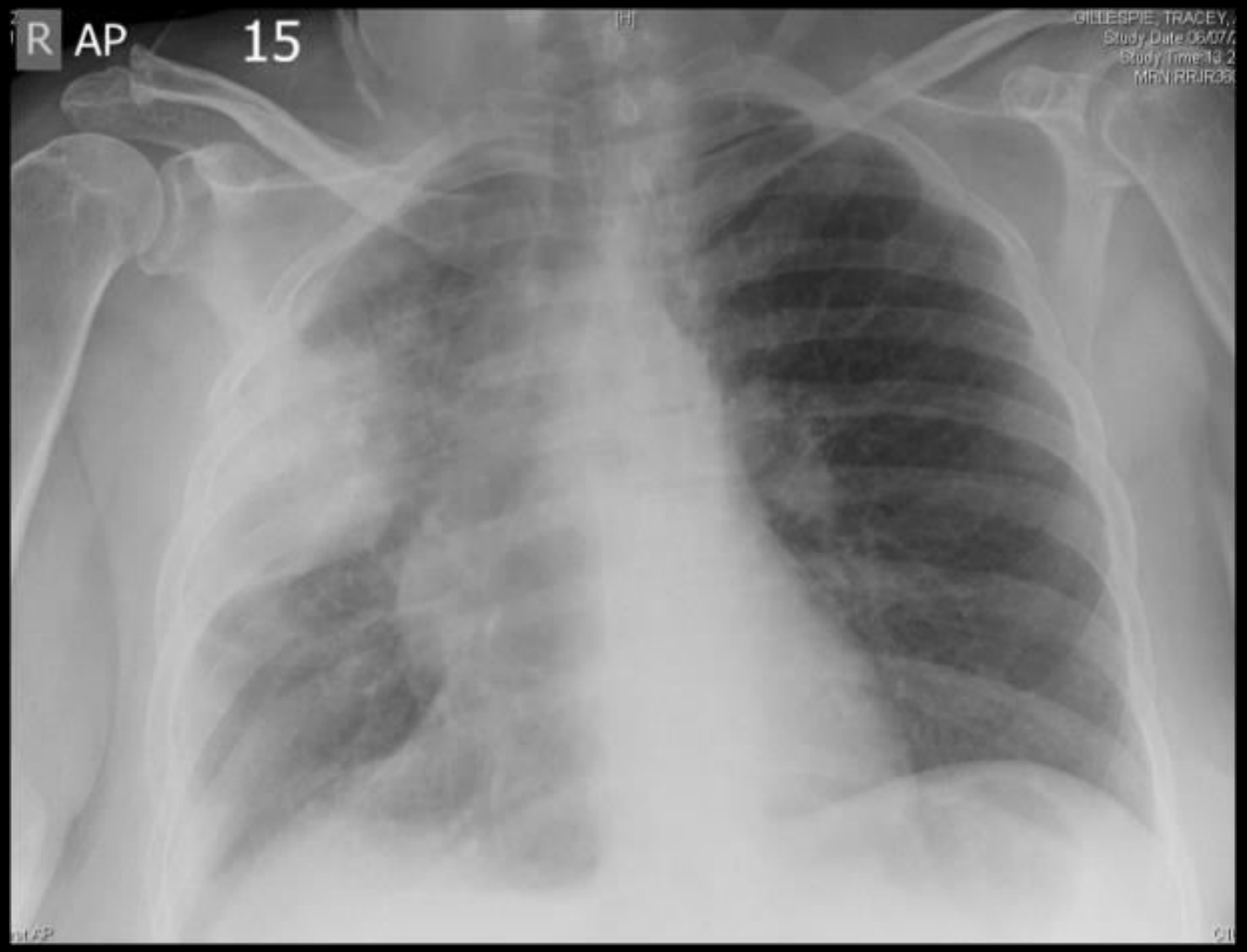
Treatment options

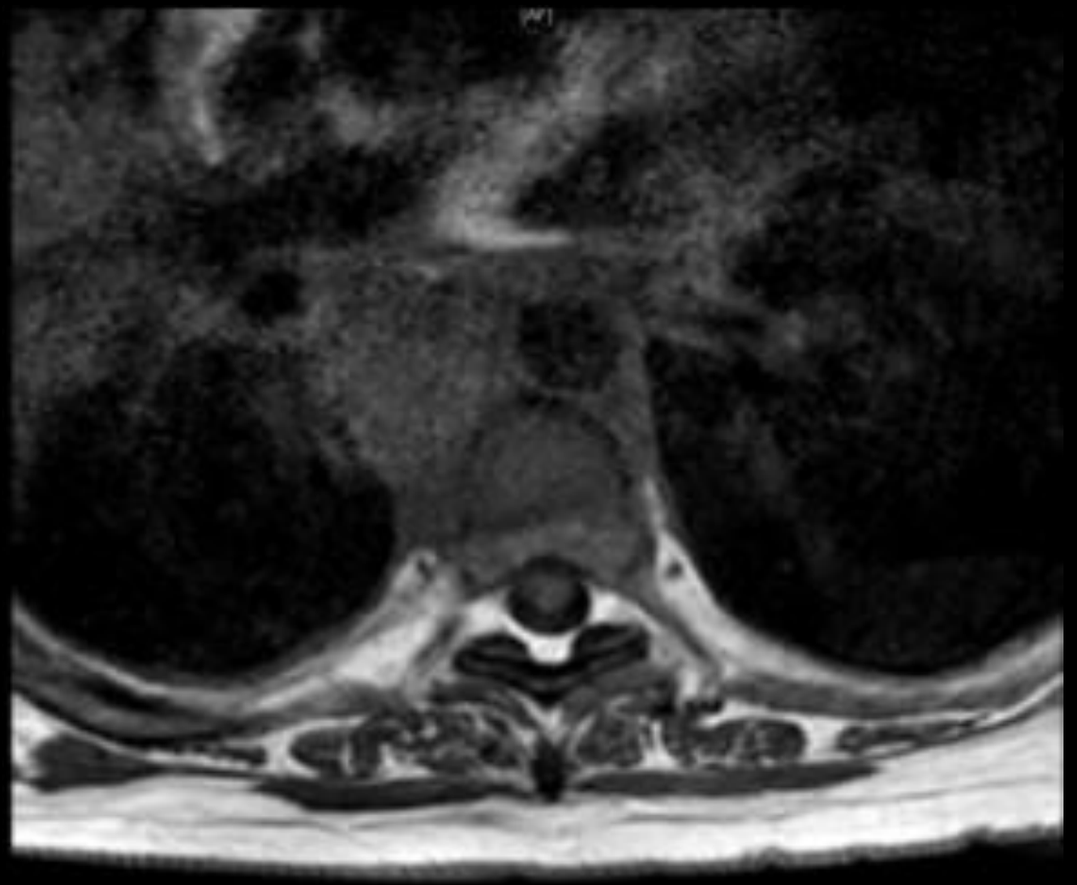
- Chemotherapy
- Radiotherapy (CXT, IMRT)
- Surgery (en bloc, palliative)
- End of life pathway

Treatment options:
Chemotherapy

- Asymptomatic / minimal symptoms
- Haematologic malignancies
- Hormone sensitive tumours (if no surgical indication)
- Newer drugs (named clinical oncologist)

- 51 F
- B cell lymphoma
- Large right lung upper lobe mass
- Chemotherapy
- Chest pain, SOB CTPA r/o PE (T3 lesion identified)





- T3, 4, 5 lesion
- No cord compression
- Encasing thoracic aorta

Treatment options:
Radiotherapy

- Conventional (CRT)
- CRT limited by cord tolerance
- Radio-sensitive: Response to doses within the cord tolerance
- Radio-resistant: Requires higher doses than cord tolerance

Treatment options:
Radiotherapy

- Intensity-modulated radiation therapy
- Higher dose of conformal radiation
- Easing of distinction between sensitive and resistant tumours

Sensitive: Breast, prostate, ovarian, neuro-endocrine cancers

Resistant: Renal, Thyroid, Hepato-cellular, Non Small cell, Colon, Melanoma, Sarcomas

Treatment options:
Radiotherapy

Problems:

- Compression fractures
- Pain flare: Transient increase after CRT
- Visceral (esophagus), plexus / root susceptible to ‘collateral damage’

- 55 M
- Recent diagnosis of Lung Ca
- Pre-morbid normal mobility
- Neurology:

Right L2 - S1 4/5

Left L2 - S1 3/5

Normal PR, Sensory level ill defined

Palliation	Radiotherapy
IV Steroids	Pain management

Treatment options:
Surgery

- En-bloc
- Stabilisation / decompression
- Goals and timing of surgery
- Role of fusion
- Complications

Treatment options:
Goals of Surgery

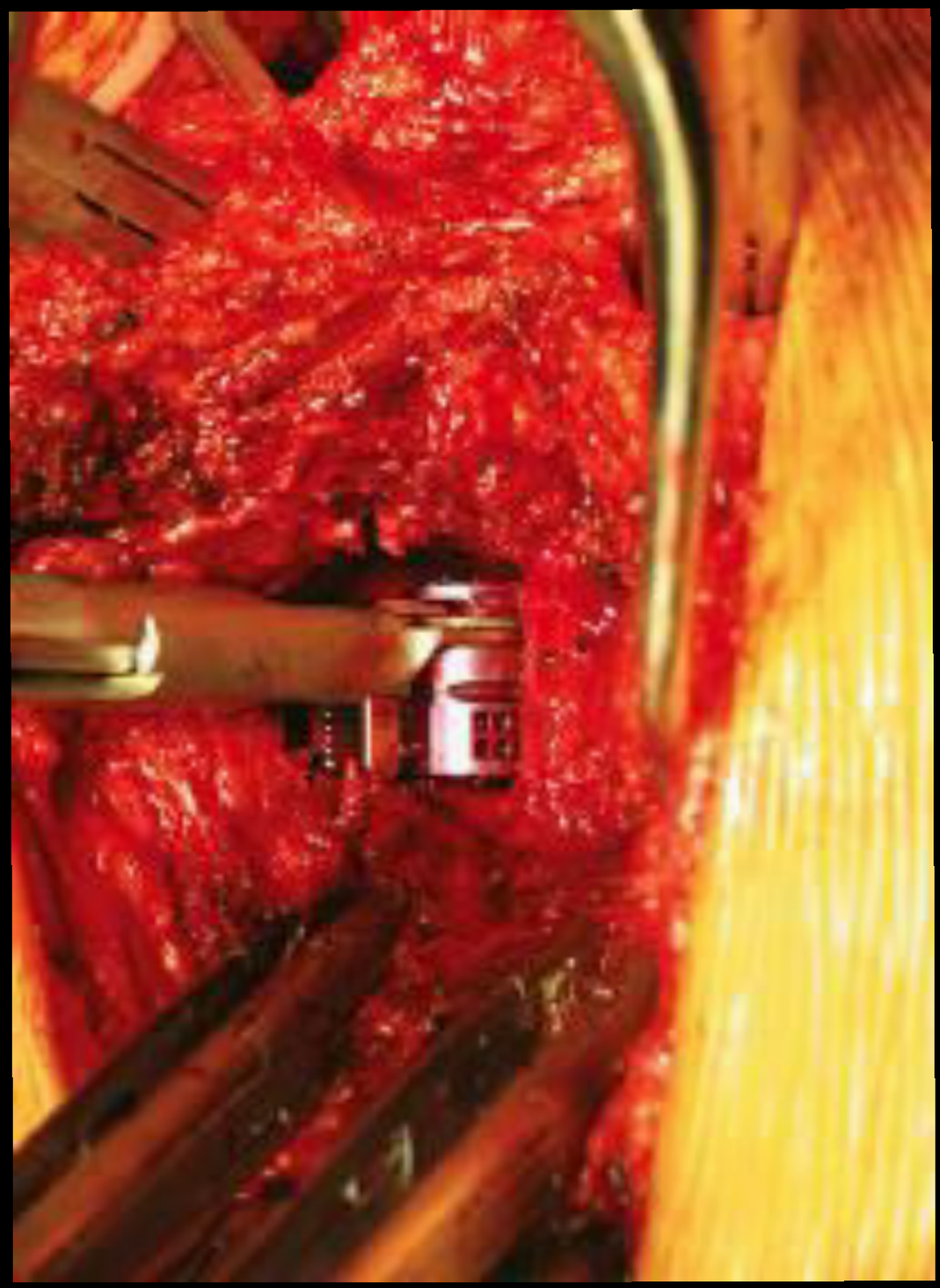
- Manage expectations
- Discuss with patient and family
- Discuss with oncologist
- Reduce pain
- Protect, restore neurology
- Maintain stability for ‘rest of the life’ (QoL)

Treatment options:
En Bloc Resection

- Single level lesion (look for skip lesions)
- Vertebrectomy, sagittal resection, posterior arch resection, spondylectomy
- Pre-operative embolisation
- Assess epidural spread
- Ligate Hoffmann’s ligaments

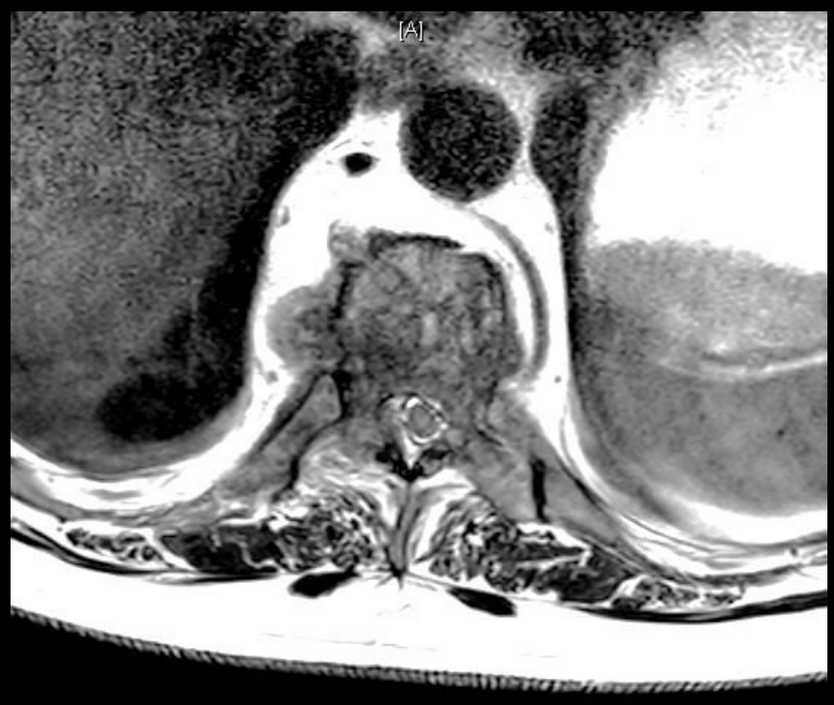
Treatment options:
Palliative Surgery

- Stabilisation, Decompression
- Anaesthetic assessments
- Surgical risk stratifications
- Anterior column reconstruction
- Minimally invasive options




IN STI

- 58 M
- Ca Prostate
- Acute (< 24 h) drop in neurology
- Previously ambulant
- 3 weeks of back pain



- 3 contiguous levels
- Epidural spread
- ‘Cord saving’

New lesions within 3 months

Treatment options:
Surgery: Role of fusion

- Life expectancy
- Adjuvant therapies
- Quality of host bone, nutritional status
- Allografts
- Avoid autografts: may be involved in pathology

Patchell Study

- RCT 101 patients with MSCC
- Surgery (stabilisation, decompression and radiotherapy) v Radiotherapy
- Did not include ‘radio / chemo’ sensitive tumours ie myeloma, lymphoma, small cell lung

Patchell RA, Tibbs PA, Regine WF, et al. Direct decompressive surgical resection in the treatment of spinal cord compression caused by metastatic cancer: a randomised trial. Lancet 2005;366:643–648 PubMed

Patchell Study

- Ambulation better in surgery group (84%) than in radiotherapy group (57%) OR 6.2 p = 0.001
- Maintained ambulation for longer in surgery group (122 d) v radiotherapy (13d) p = 0.003

Patchell RA, Tibbs PA, Regine WF, et al. Direct decompressive surgical resection in the treatment of spinal cord compression caused by metastatic cancer: a randomised trial. Lancet 2005;366:643–648 PubMed

Patchell Study

- Highly sensitive radio / chemo sensitive tumours may respond to cord compression without surgery

- Solid tumours with cord compression (grade 2, 3) require surgery and radiotherapy

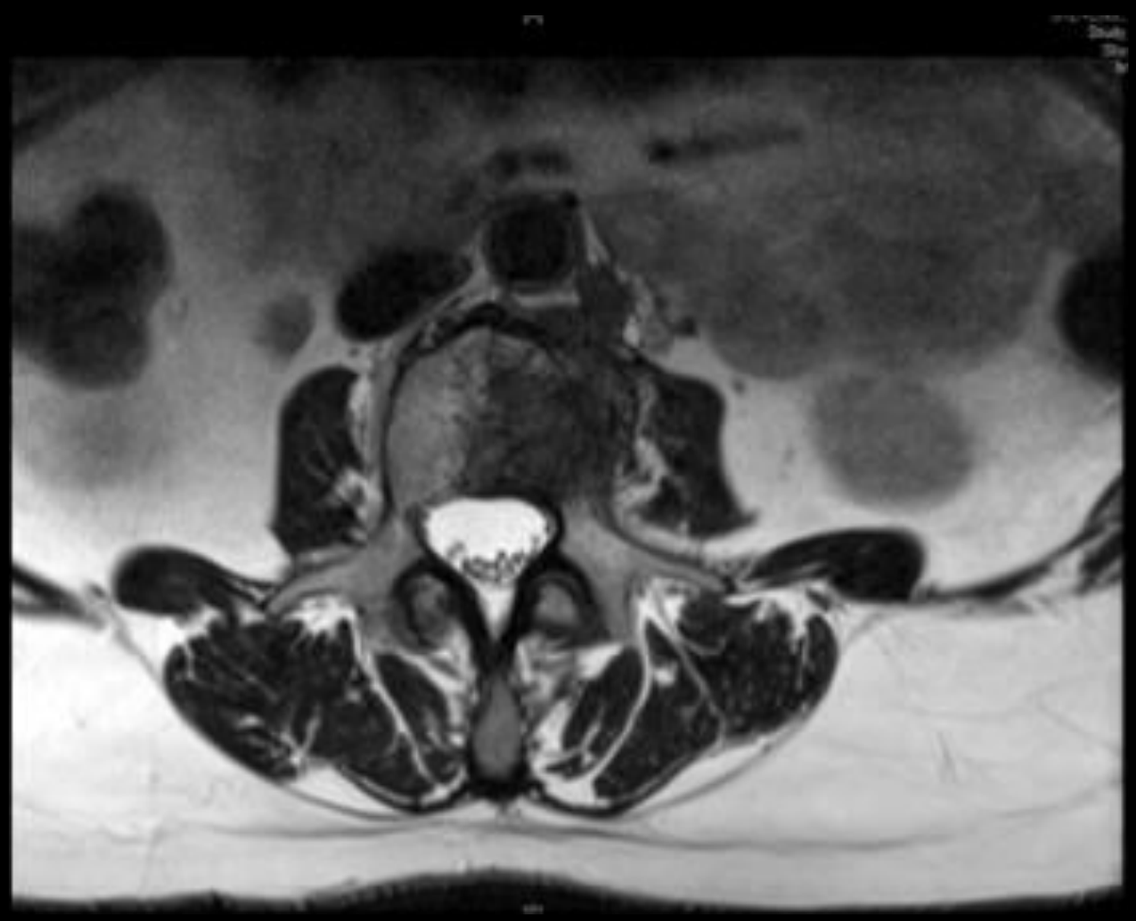
- Grade 1 MSCC may not require surgery (unless unstable)

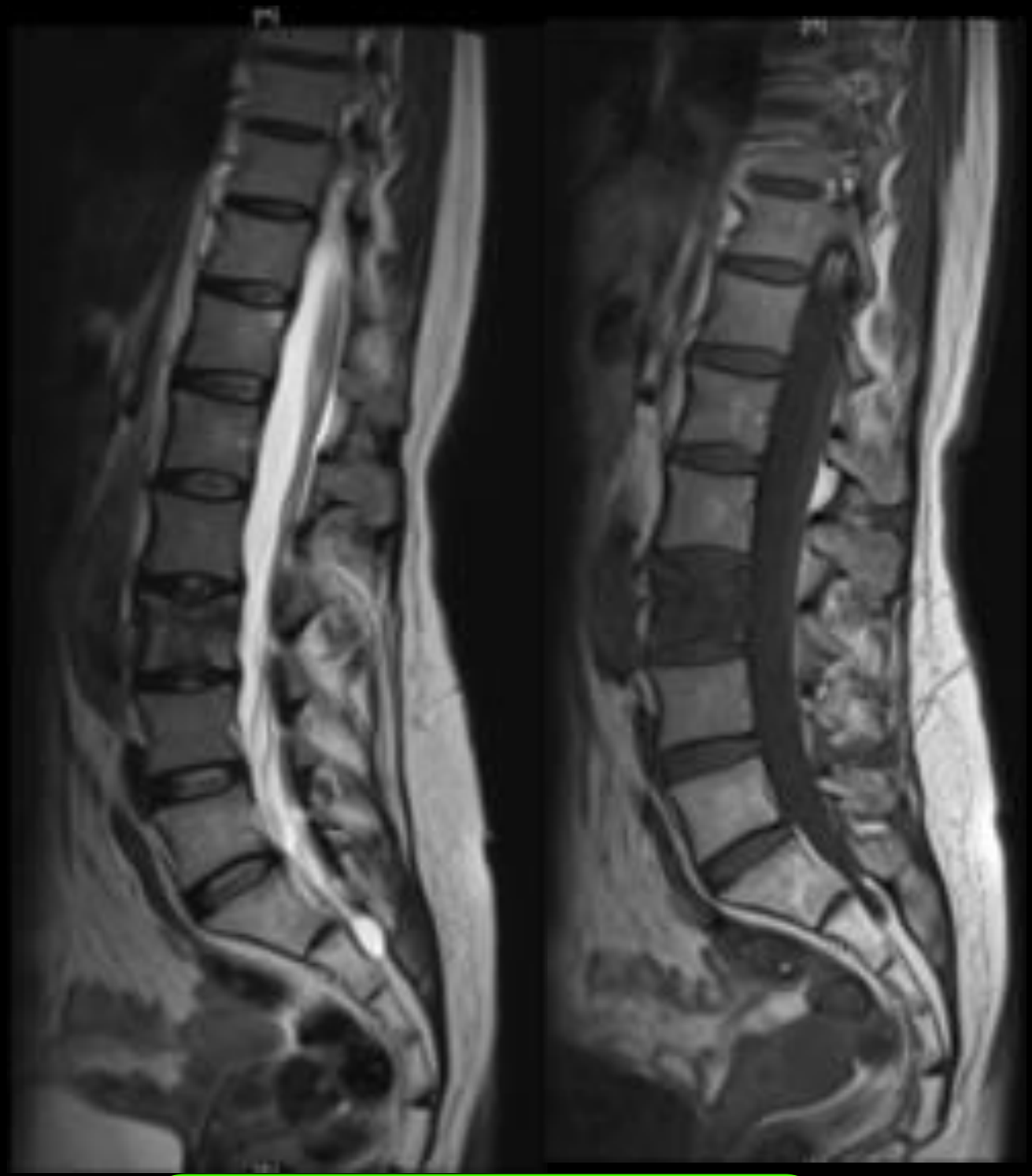
Patchell RA, Tibbs PA, Regine WF, et al. Direct decompressive surgical resection in the treatment of spinal cord compression caused by metastatic cancer: a randomised trial. Lancet 2005;366:643–648 PubMed

Treatment options:
Vertebral augmentation

- Reduce instability pain
- Image guidance; Minimally invasive
- Local control of pain

- 59, F
- Ca Cervix Feb 2016
- 4 cycles of chemo, local recurrence
- Chest pain, SOB, CTPA to r/o PE
- L3 lesion (incidental finding)
- Normal neurology





Biopsy,
Vertebroplasty

- 67 M
- Ca Prostate mets
- Presented with acute neurology and 1 week history of back pain
- Posterior stabilisation, decompression
- Post-op improved neurology (ambulant)
- 5 mo later new neurologic deficit
- New lesions

Treatment options:
Complications of Surgery

- Haemorrhage
- Neurologic injury
- Visceral / Vascular injury
- Wound healing

Medical and Haematologic optimisation pre-operatively

Initial management

- Pain, Neurology, Suspected MSCC: Nurse flat
- TEDS, Flowtrons, Steroids, Bloods
- Maintain and update neurologic assessments
- Discuss with Family, Oncologists, Spinal Surgeon and Anaesthetists
- Identify imaging requirements and related logistics

Imaging and Transfer

- Imaging:
  - MRI Full Spine:
    - T1, STIR: Other lesions
    - T2: Destruction, compression
    - Axials: CSF at site of compression
  - CT scan:
    - Staging Thorax, Abdomen, Pelvis (TAP)
    - Reformat the lesion: size and type
- Plain Xrays not recommended

Imaging and Transfer

- Discuss urgency of transfer / MDT (MSCC) co-ordinator
- Transfer images
- Clearly documented ‘current’ neurology
- Medical and Oncologic information

Selected references

Fischer CG et al Spine 2010; 35: E1221 – 1229

Tomita K et al Spine 2001; 26: 298 – 306

Tokuhashi Y et al Spine 2005; 30: 2186 – 2191

Fourney DR, et al J Clin Ocol 2011; 29: 3072 – 3077

Enneking Clin Orth Rel Res 1986; 204: 9 – 24

Boriani S et al Spine 1997; 22: 1036 – 1044

Patchell RA et al Lancet 2005; 366: 643 – 648

Gokaslan ZL, et al J Neurosurg 1998; 89: 599 - 609