

Bone metastases

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RBWH



Bone metastases

- Incidence and natural history
- Molecular biology
- Potential complications
- Workup and referral
- Treatment options
- Case studies

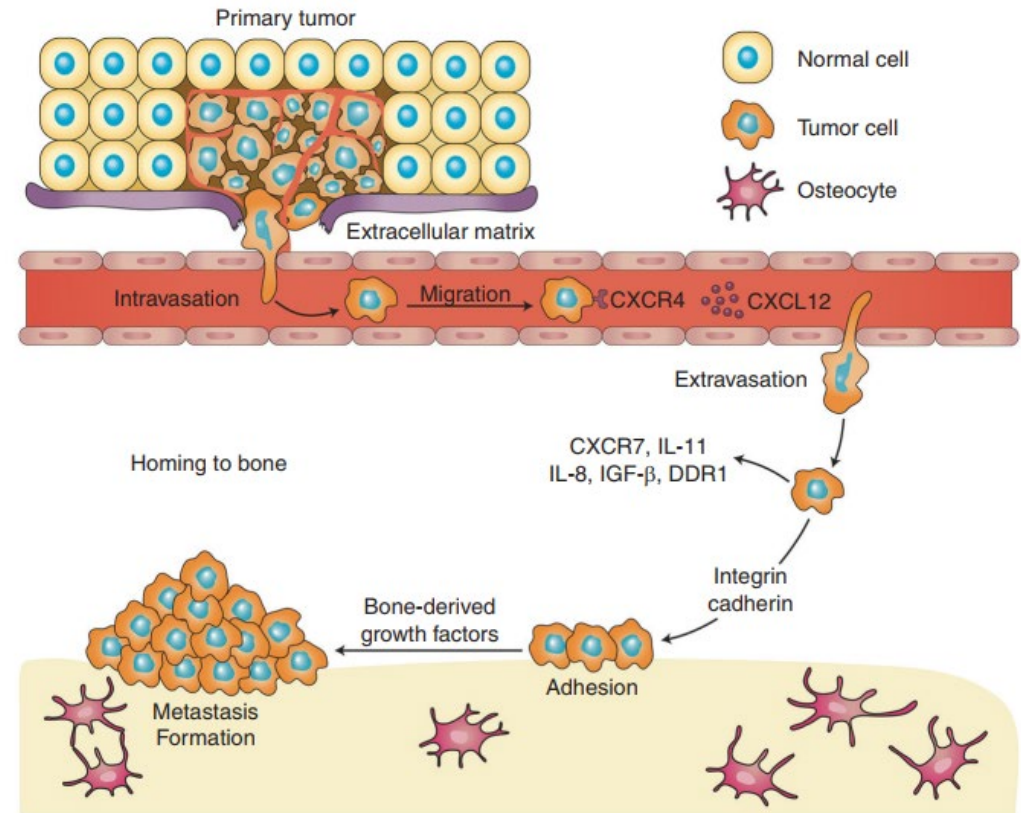
Incidence and natural history

- For all solid tumours – 3-5% of patients
- For prostate, breast and lung – up to 20%

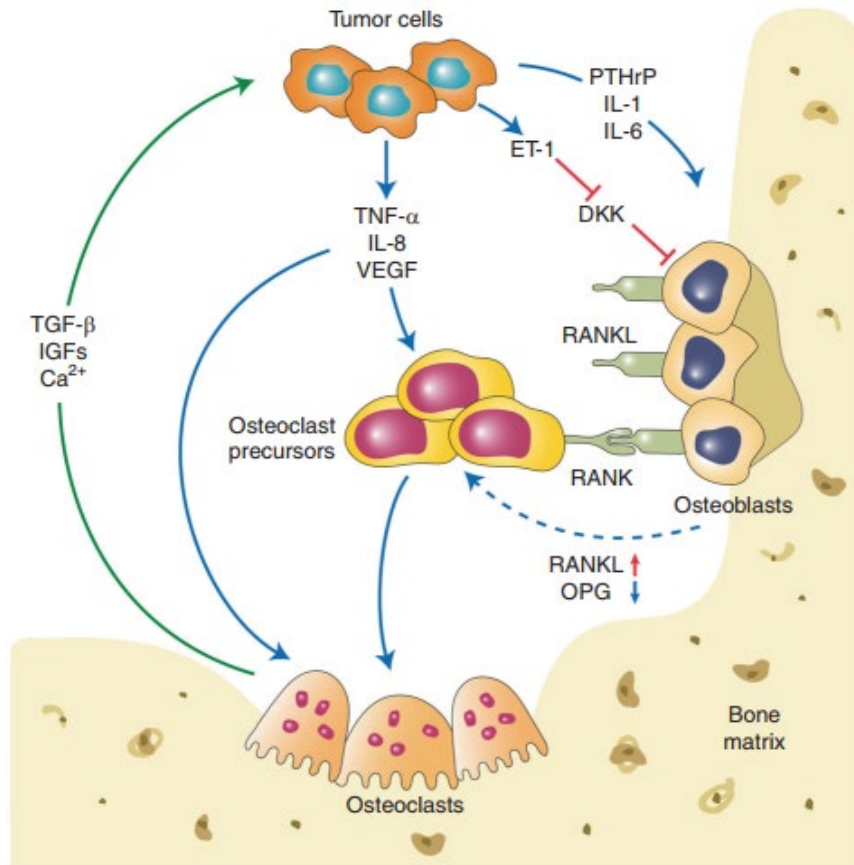
- Occur in variety of disease settings
 - Solitary metastasis
 - Oligometastatic
 - Polymetastatic
 - *De novo* at diagnosis
 - *Metachronous* after treatment

Biology

- ‘Seed and soil’ hypothesis → cancer-host ecosystem
- Epithelial-mesenchymal transition
- ‘Pre-conditioning’ of metastatic niche
- Cancer cell migration, immune evasion, extravasation, growth
- Diagnostics - Liquid biomarkers
- Therapeutics - Interrupting the metastatic cascade



Biology



- Lytic (osteoclastic), sclerotic (osteoblastic) or mixed
- Key role of osteocytes in production of local humoral factors
- Pro-inflammatory cytokines

Workup - History

- Pain
- Function
- Malignancy
- Medication – Analgesia

Workup - Examination

- Gait
- Tenderness
- Potential primary sites
- Neurologic if appropriate

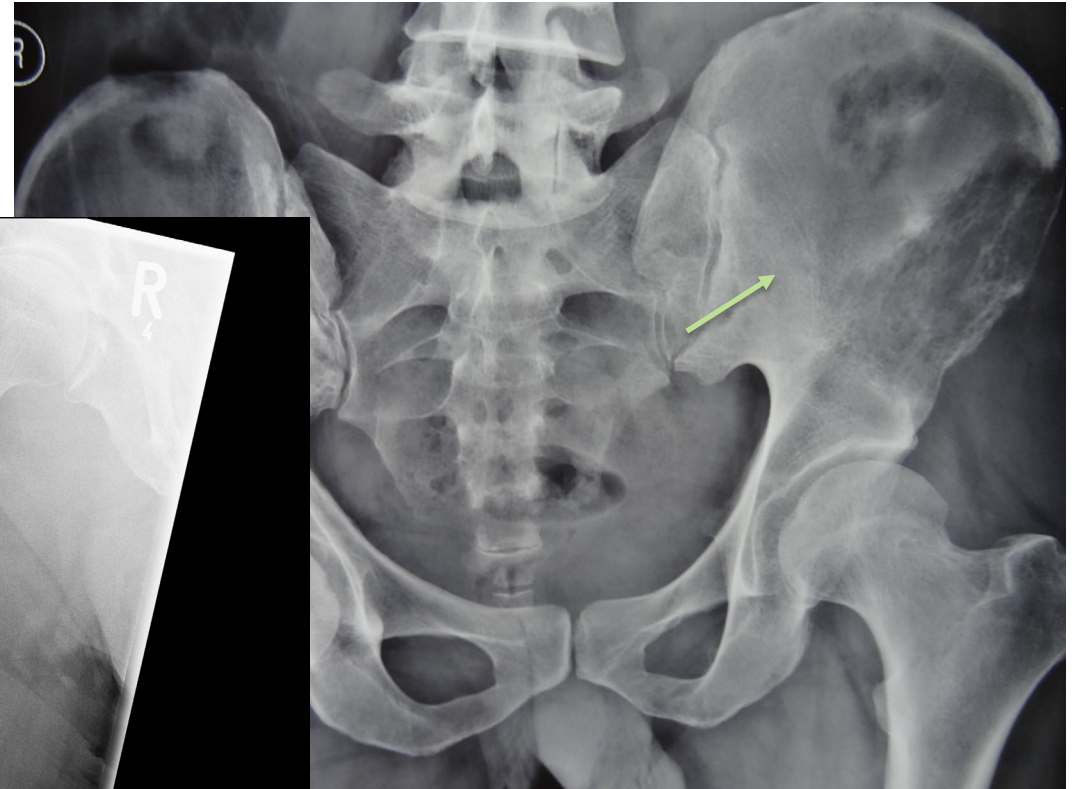
Workup - Investigations

- Targeted workup for primary if none known (consider biopsy)
- Plain Xray especially pelvis and long bones
- CT especially spine
- Bone scan – highly sensitive
- MRI, PET generally reserved for specialist settings

Metastasis related pain

- Pressure effect on periosteum
- Pro-inflammatory cytokines
- Pathologic fracture*
- Instability*

- Likely to require stabilisation for
- symptom control



Metastasis related pain

- Overlap with other painful conditions (inflammatory, degenerative)
- Constant, aching
 - Some have neuropathic component
- Rest and night-time pain common
- Incident pain



Threatened long bone fracture – Mirel score

| SCORE | SITE OF LESION | SIZE OF LESION | NATURE OF LESION | PAIN |
|-------|---------------------|-------------------|------------------|------------|
| 1 | Upper limb | < 1/3 of cortex | Blastic | Mild |
| 2 | Lower limb | 1/3-2/3 of cortex | Mixed | Moderate |
| 3 | Trochanteric region | > 2/3 of cortex | Lytic | Functional |

- Consider prophylactic fixation if 8 or greater (>15% risk of fracture)
- Limited validation studies



Threatened spinal instability – SIN score

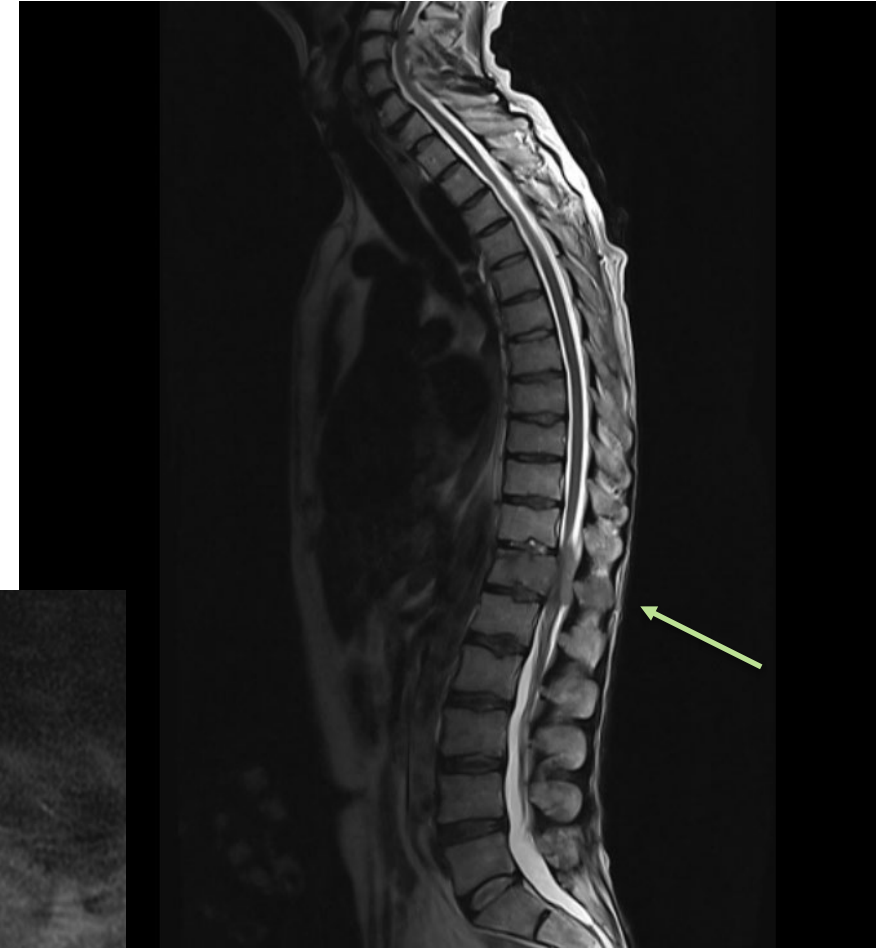
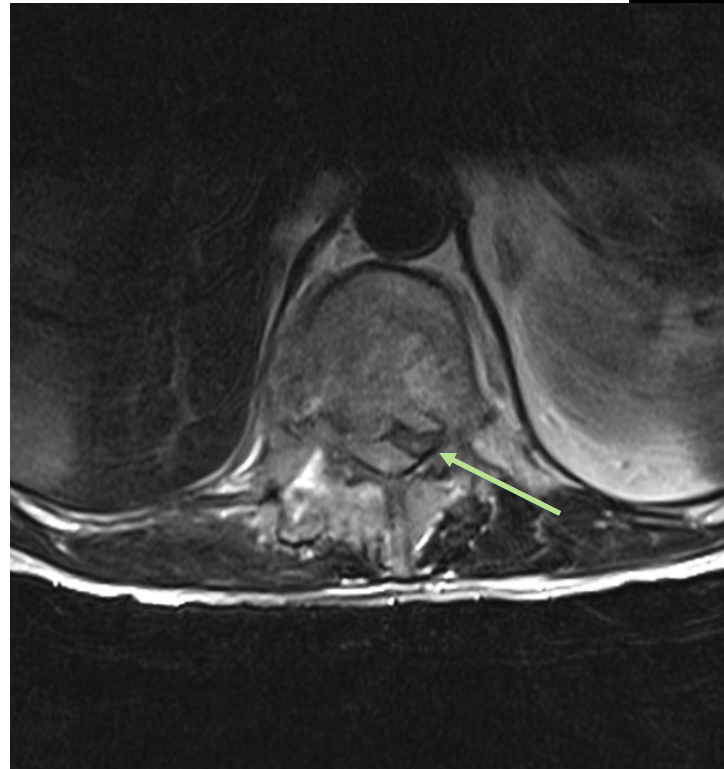
- 7-12 = potentially unstable, consider surgery
- 13-18 = unstable
- Consider benefit of surgery vs extensive rehabilitation
- Valid when interpreted by spine surgeons and radiation oncologists

| SINS component | Score |
|--|-------|
| Location | |
| Junctional (occiput-C2, C7-T2, T11-L1, L5-S1) | 3 |
| Mobile spine (C3-6, L2-4) | 2 |
| Semirigid (T3-10) | 1 |
| Rigid (S2-5) | 0 |
| Pain* | |
| Yes | 3 |
| Occasional pain but not mechanical | 2 |
| Pain-free lesion | 0 |
| Bone lesion | |
| Lytic | 2 |
| Mixed (lytic/blastic) | 1 |
| Blastic | 0 |
| Spinal alignment | |
| Subluxation/translation present | 4 |
| <i>De novo</i> 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[†] | |
| Bilateral | 3 |
| Unilateral | 1 |
| None of the above | 0 |

Criteria of instability. Total score (TS) 0–6 : stable spine, TS 7–12 : potential unstable spine, TS 13–18 : unstable spine. Recommendation : TS \geq 7, consider surgical intervention. *Pain improvement with recumbency and/or pain with movement/loading of the spine, [†]Facet, pedicle, or costovertebral joint fracture or replacement with tumor

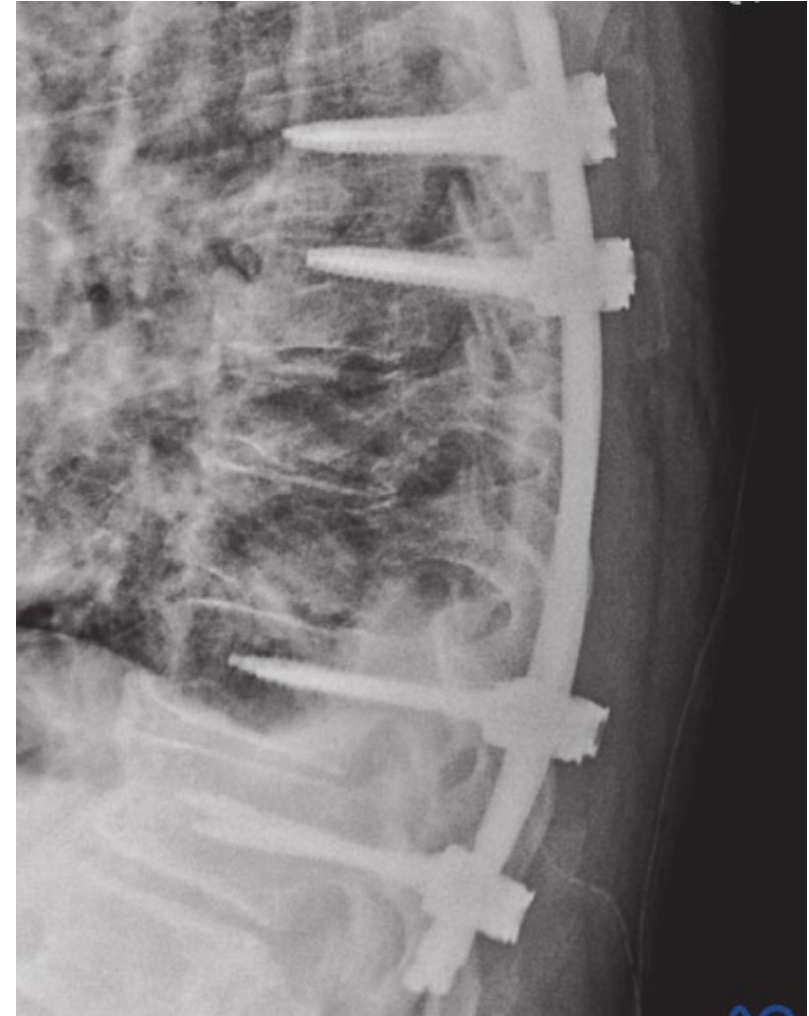
Spinal cord compression

- Severe and progressive pain
- May be associated with functional decline, hypercalcaemia
- Neurologic deficits depending on level of compression
 - Limb weakness
 - Bladder/bowel disturbance
- Thoracolumbar and lumbar sites
- Early recognition – oncologic emergency



Spinal cord compression

- Minimum = urgent CT
- MRI to evaluate extent and for treatment planning
- Early surgery key in
 - Early presentation
 - Isolated disease
 - Good prognosis
 - Good functional status
- Otherwise – palliative RT, best supportive care



Hypercalcaemia

- Incidence 20-30% in patients with metastatic solid organ cancer
- Possibly an oncologic emergency
- Usually a late complication
- Early recognition of symptoms based on affected organ systems
 - Neuropsychiatric
 - GI
 - Renal
 - Cardiac
 - Musculoskeletal
- Osteolytic disease – breast, lung ca, myeloma
- Paraneoplastic effects – PTHrP and Vit-D secretion

Treatment of hypercalcaemia

- Medication review (thiazides, lithium)
- Volume expansion
- Bisphosphonates
- Calcitonin
- Management of underlying malignancy

Treatment - Medical

- Analgesia
- Bisphosphonates
- Osteoclast inhibitors (denosumab)
- Chemotherapy
- Immunotherapy

Treatment - Surgery

- Reduction and stabilisation → analgesia
- Durable fixation → avoid further surgery in future
- Restore function after period of rehabilitation
- Stabilise entire bone or vertebral levels above/below
- Articular surfaces (joint replacement)
- Obtain histology

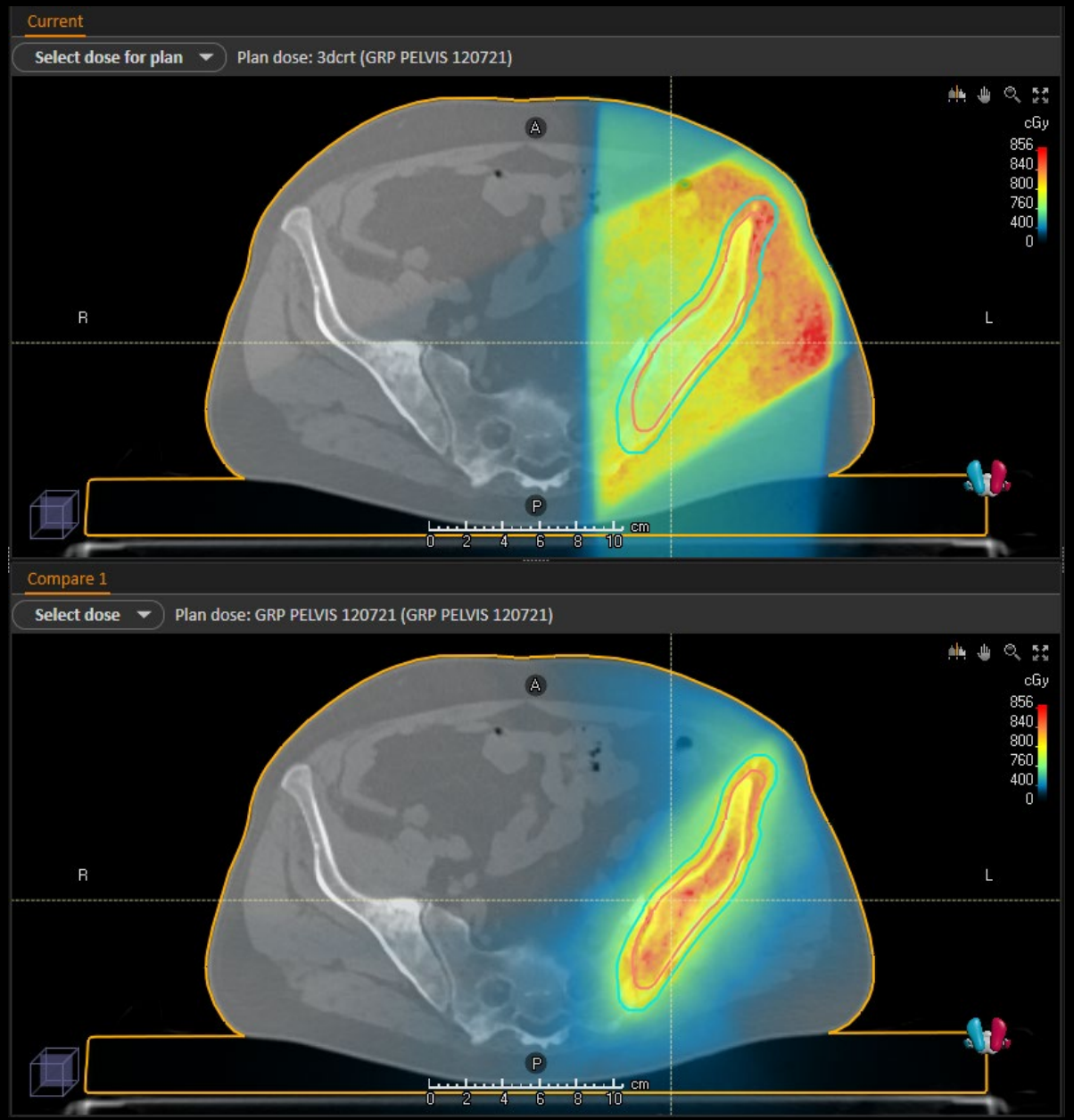
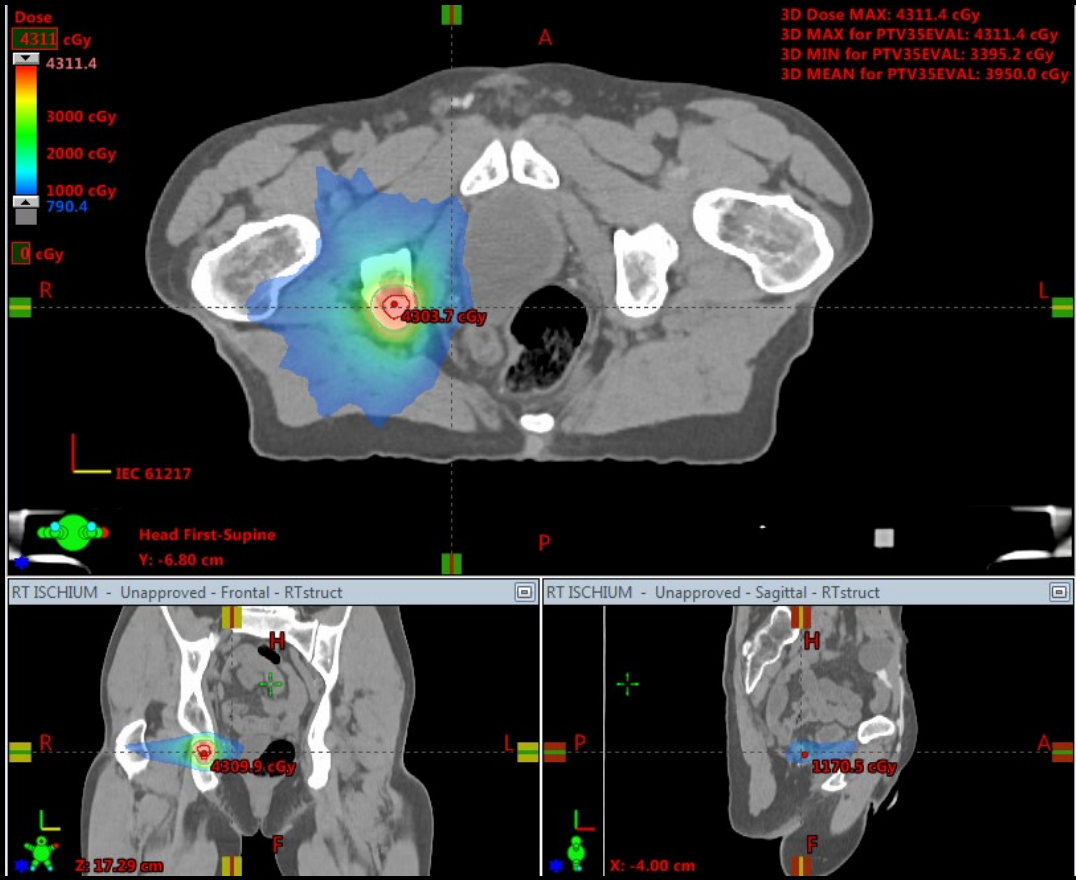
- General ortho usually suitable for lower limb (fixation / joint replacement)
- Dedicated surgical units may be needed for complicated upper limb and spine mets

Treatment - Radiotherapy

- Effective local treatment
- Palliation of symptoms
- Delay progression
- Cure

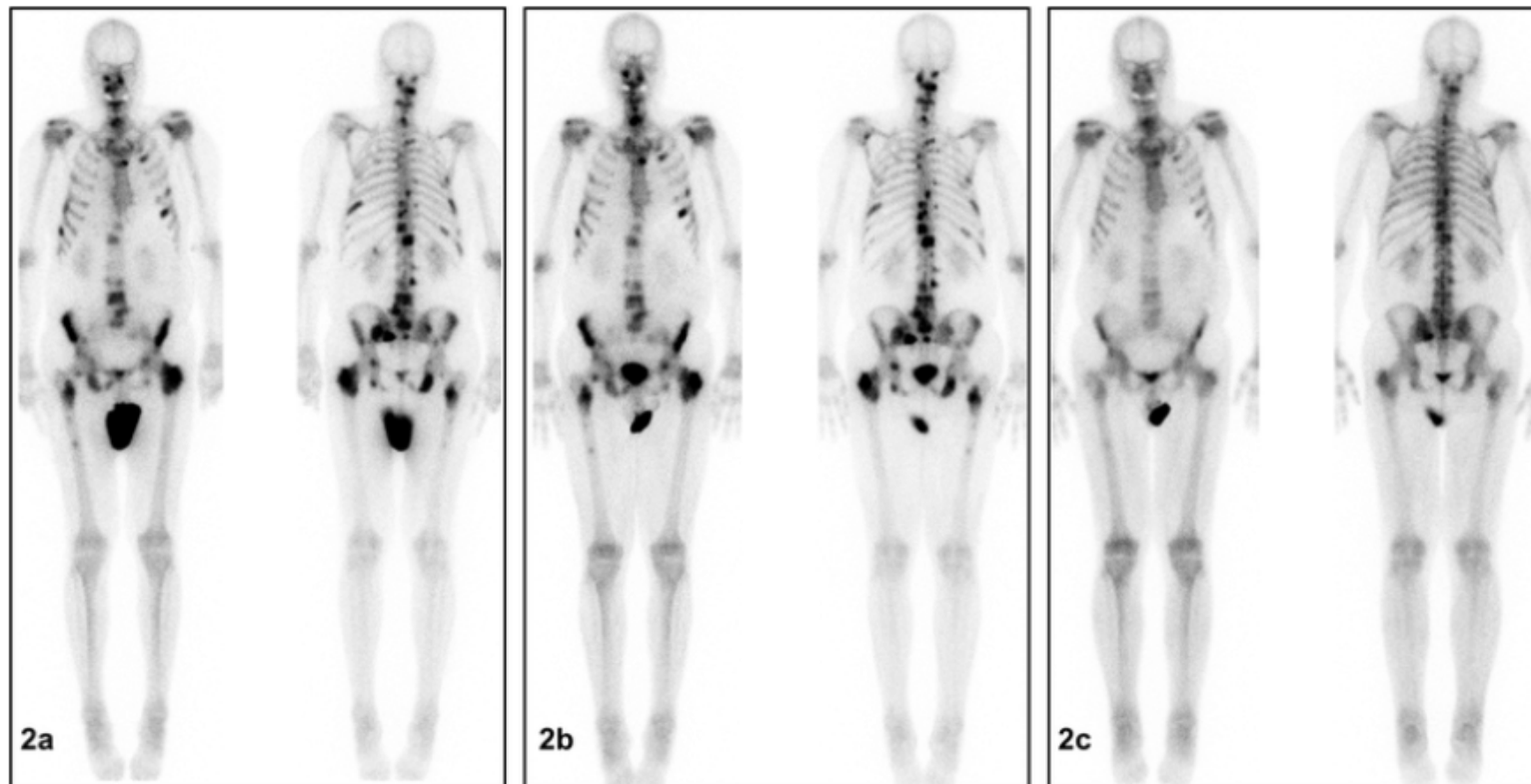
- Widely available and affordable
- Technique, dose and fractionation tailored to clinical scenario
- Minimal side-effects





Treatment - Targeted radionuclide therapy

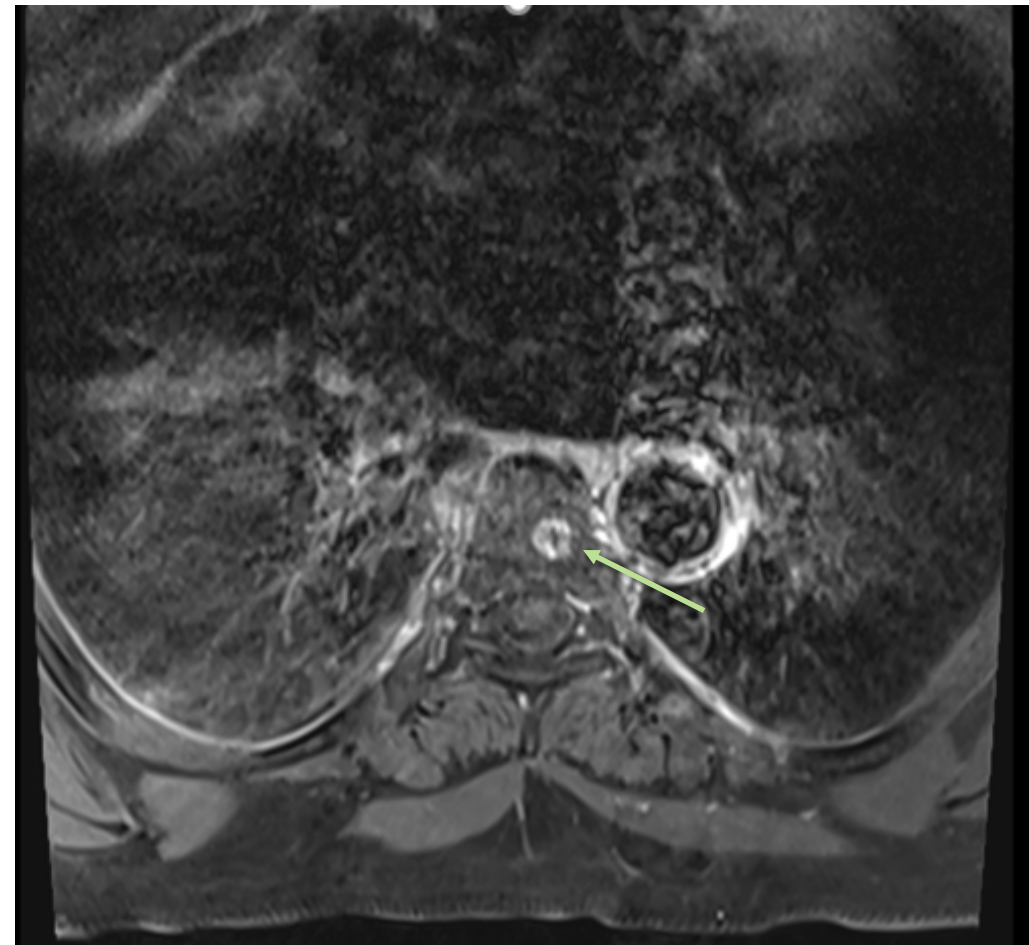
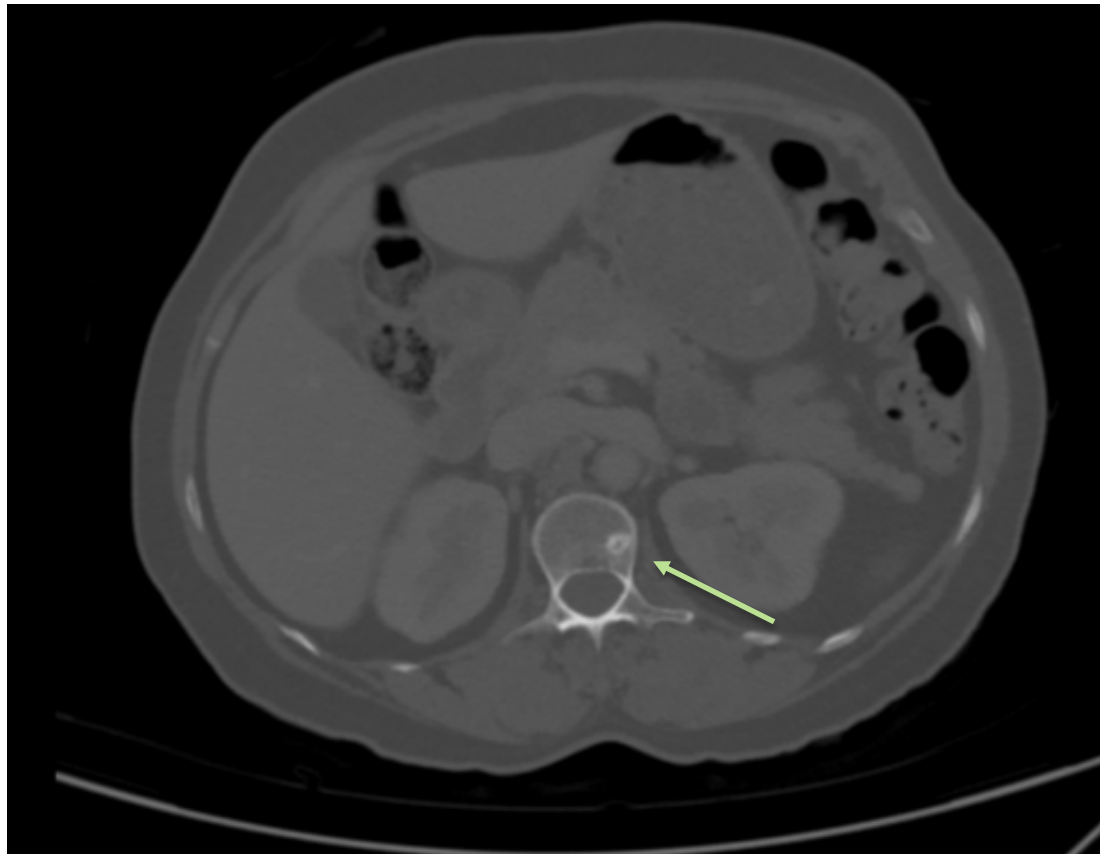
- Short-range emission radioisotopes targeted to bone
- Most evidence in prostate and breast cancer
- Limited by access and cost



Case study 1 – AM

- 76 year old female
- 5 year history of metastatic hormone-receptor positive breast cancer
- Widespread bone-only disease followed up by medical oncology
- Slowly progressing – not keen on intensive chemotherapy
- Persistent low back pain despite moderate opiate analgesia

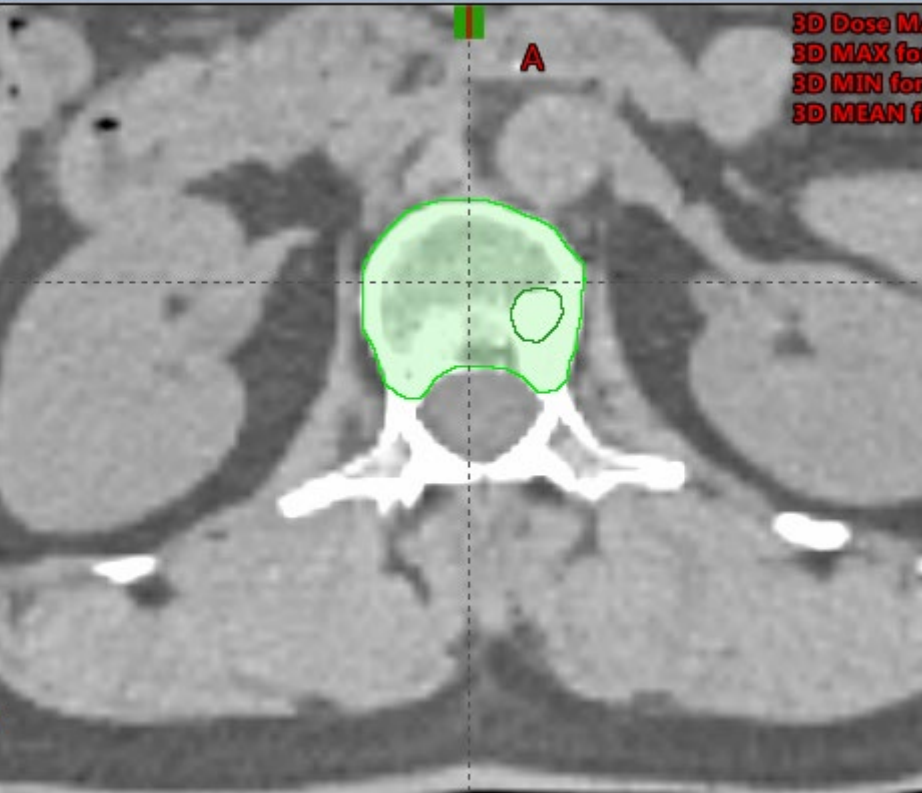
- L1 lesion likely cause of pain
- Other bony sites active on bone scan



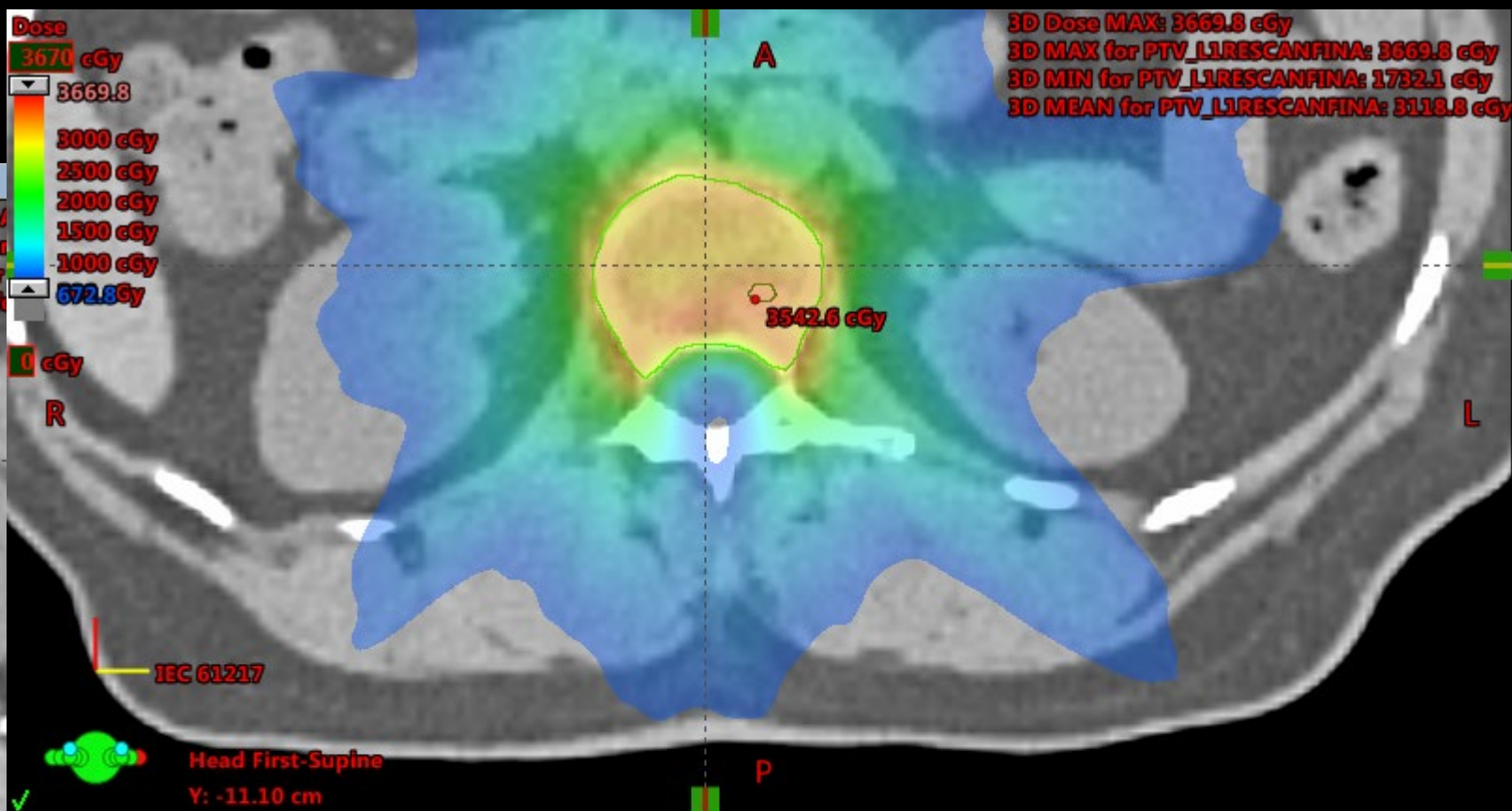
Case study 1 - AM

- Referred to radiation oncology
- Technique, dose and fractionation considered
- Stereotactic body radiotherapy offers better analgesic response, convenience
 - At 3 mths: complete pain response 35%, partial response 18%
- Trade-offs
 - Imaging burden (MRI)
 - Higher risk of vertebral compression fracture
 - Inability to retreat
 - Slightly longer planning delay and treatment time

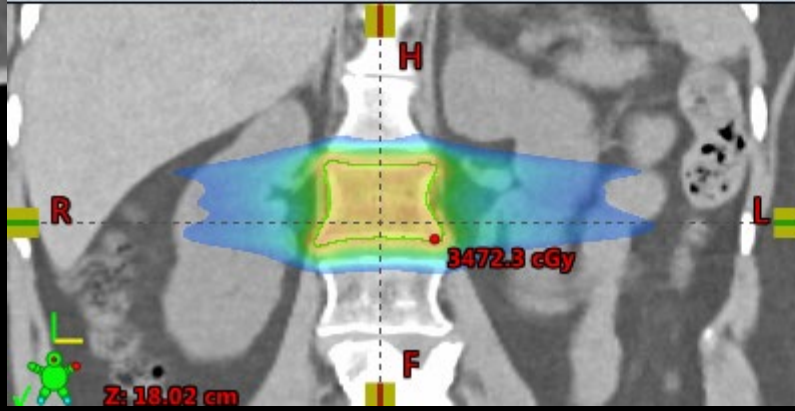
Approved - Transversal - RTstruct



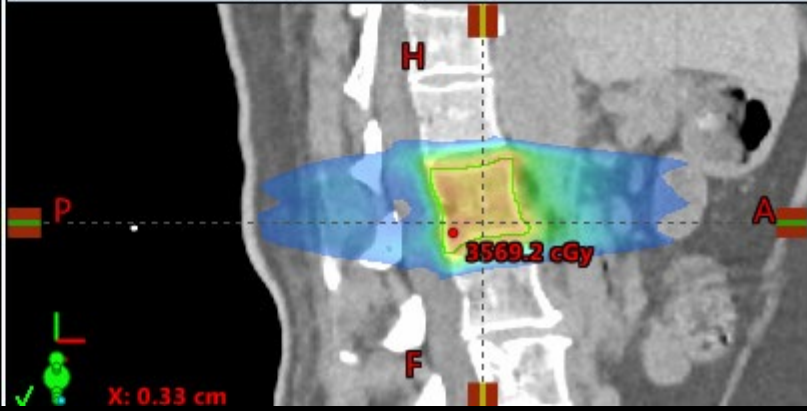
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RP L1 SBRT - Planning Approved - Frontal - RTstruct



RP L1 SBRT - Planning Approved - Sagittal - RTstruct



Case study 1 - AM

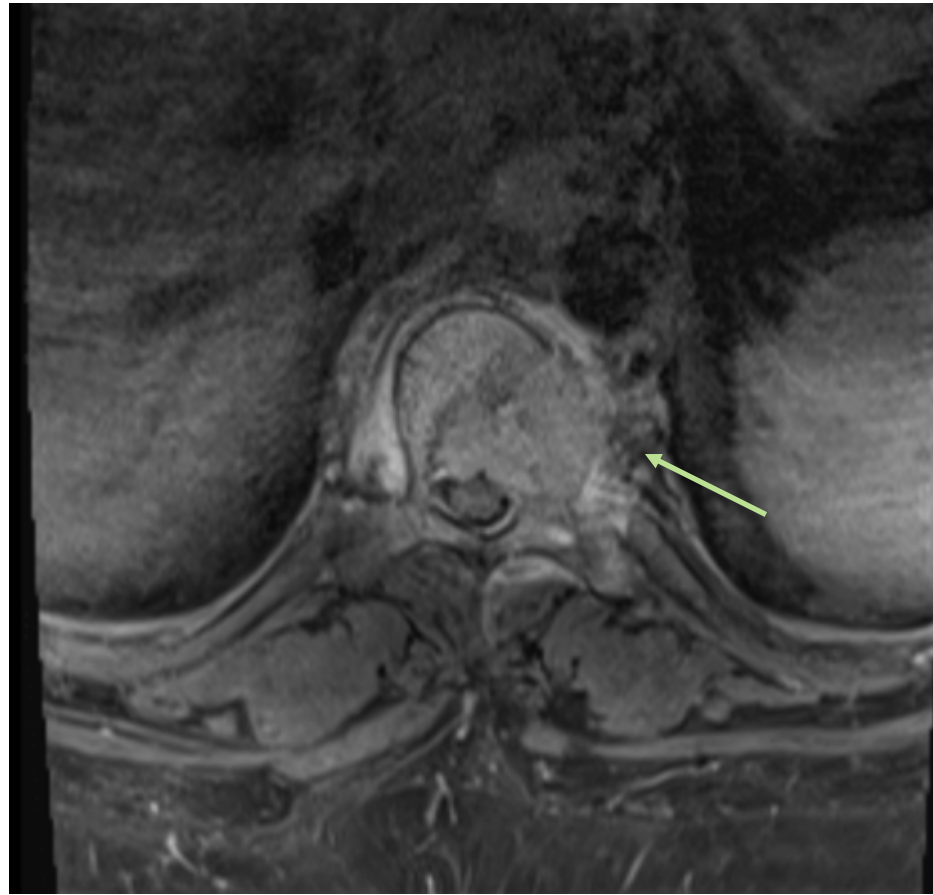
- 2 fractions of SBRT to L1 metastasis
- 45 min per session
- Well tolerated with no acute side-effects
- Excellent pain response at 3 mths
- Ongoing follow-up with medical oncology

Case 1 – Practice points

- RT is effective for metastasis-related pain
- Newer techniques offer better symptom response, local control and greater convenience
- Local therapies may help avoid / delay systemic therapy
- Very rare late side-effects

Case study 2 - CH

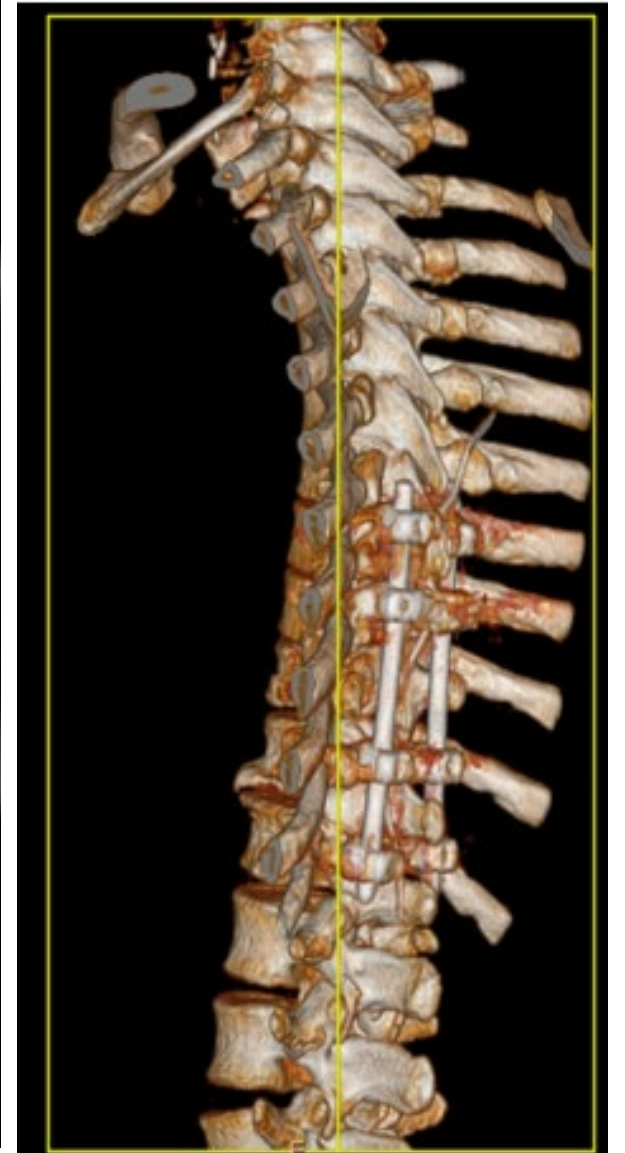
- 48 year old female
- Presented to GP with rapidly progressing back pain, no history of malignancy
- Worked up with CT
- Imaging concerning for metastatic deposit at T10 with other bony sites of disease, lung and liver metastases
- Referred urgently to medical oncology – reported urinary incontinence and found to have saddle distribution sensory disturbance

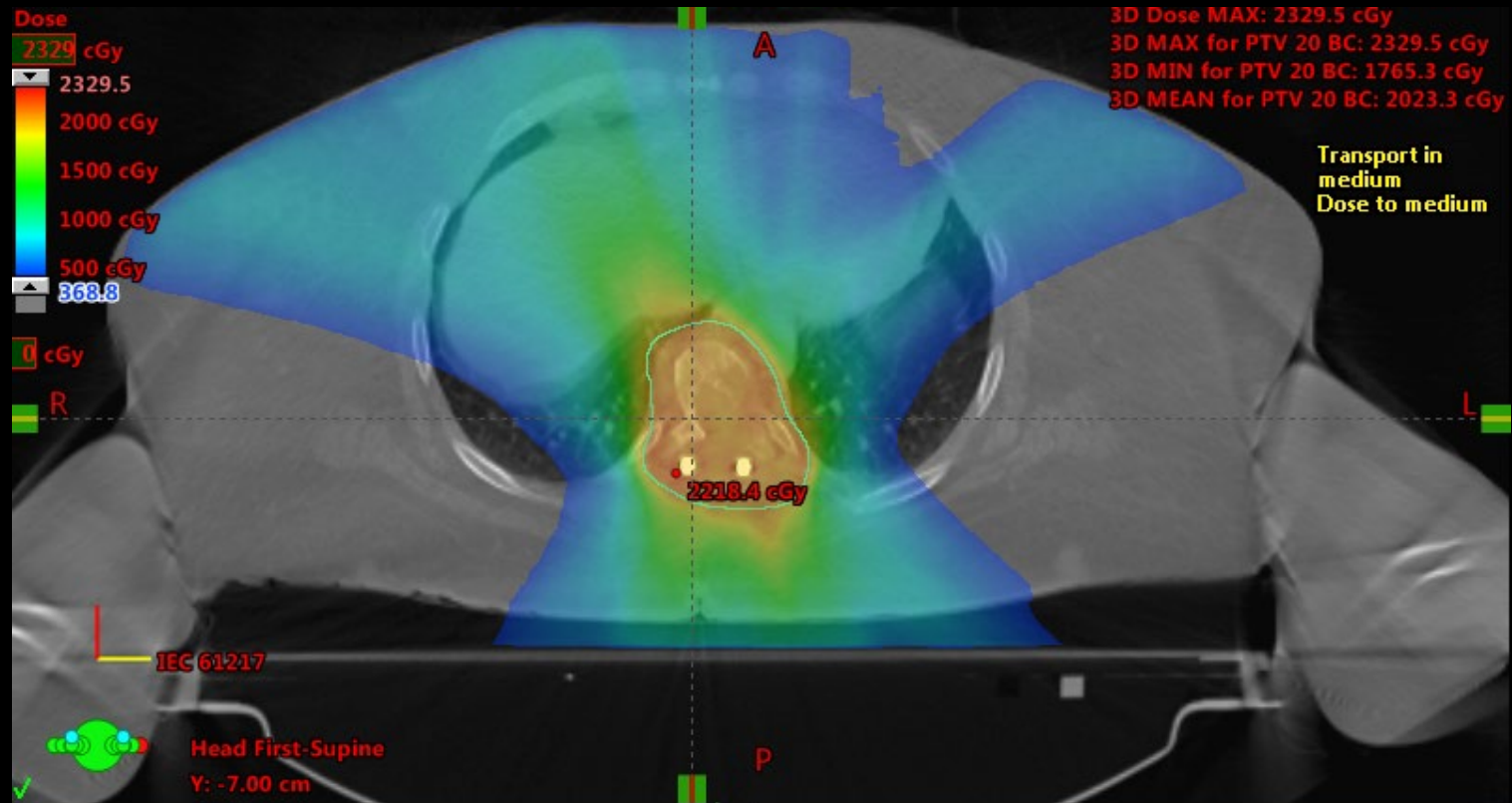


- Metastatic spinal cord compression = oncologic emergency
- Surgery vs RT vs systemic therapy

- Neurosurgery and rad onc discussion
- L10 laminectomy and posterior stabilisation
- Histo – metastatic hormone receptor positive breast cancer

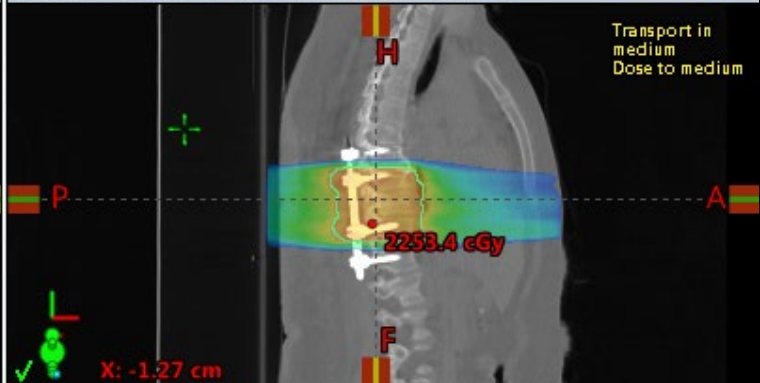
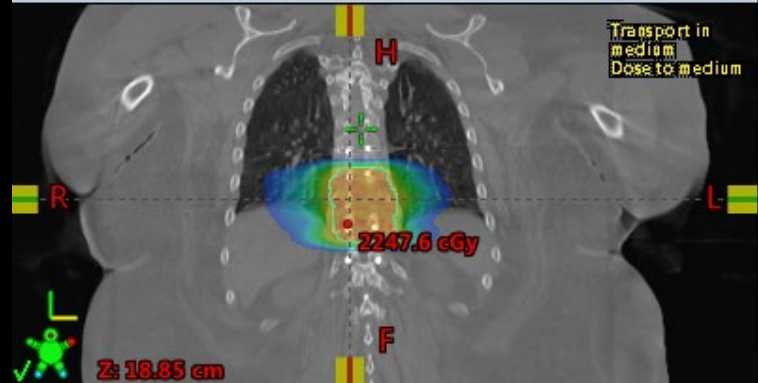
- Partial resolution of neurologic symptoms
- Prolonged rehabilitation
- Started hormonal therapy – chemotherapy in future
- Postoperative radiotherapy 30Gy/10fx





T SPINE - Planning Approved - Frontal - RTstruct

T SPINE - Planning Approved - Sagittal - RTstruct



Case 2 - Practice points

- Role of primary care - recognition of metastatic spinal cord compression
- Early surgery to decompress cord - maximise chance of neurologic recovery
- Potential for prolonged rehabilitation
- Delays to systemic therapy

Summary

- Bone metastases are a common complication of solid organ cancer
- Prognosis highly variable
- Effective treatments are available – with different endpoints
- Treatment is highly individualised

- Be aware of common complications
 - Pain
 - Fracture or impending fracture
 - Hypercalcaemia
 - Spinal cord compression

Thank you

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