Decision Making Flowchart for Metastatic Spinal Cord Compression and Pathological Spinal Fractures

All Referrals (see notes): Spinal Surgeons Locally
Spinal Fellow / Trauma SpR at UHW
Oncology SpR at Velindre / Singleton Hospital

ALL PATIENTS WITH SUSPECTED MSCC MUST BE INVESTIGATED, DISCUSSED AND TREATED AS AN EMERGENCY

Suspected spinal metastases or MSCC with prior diagnosis of cancer — See symptoms / signs sheet

Neurological Symptoms / Signs of Cauda Equina or MSCC

⊖ Admit for pain control?
In-pt daily neuro exam
Out-pt give MSCC info letter

⊕ Admit, analgesia, spinal precautions
Dexamethasone 16mg + PPI
Thromboprophylaxis assessment

⊕ Complete sensory and motor paraplegia ≥ 24 hours

"Acute" instability pain / pathological fracture

Incomplete neurological deficit or complete paraplegia ≤ 24 hours

Neurological deterioration

⊖ MRI ≤ 1 week

⊕ Admit MRI

Spinal precautions

MRI ASAP ≤ 24 hours

MRI on next list

*Path fracture
Deformity
SINS score ≥ 7
Good surgical candidate?
CT / XR

Instability*

Confirmed MSCC

Confirmed MSCC

⊕ Surgery
then other therapies ‡
Analgesia, Oncology, Radiology, Palliative

⊖ Radiosensitive
chemo / immuno

Good surgical candidate?
Life expectancy > 3 months
ASA 1-3, Other scores†
Is surgery technically possible / safe?
Does the patient want surgery?

†rev.Tokuhashi
Tomita
Karnofsky
modified Bauer
Van der Linden
Oswestry
Rades

Possibility of recovery?
Instability pain / fracture?
Good surgical candidate?
Yes - Surgery then other therapies ‡
No - Analgesia, Oncology, Radiology, Palliative

⊕ Radiotherapy
Emergency if MSCC
chemo / immuno

⊖ Vertebroplasty
Kyphoplasty
?Surgery

⊕ **Urgent** Surgery
then other therapies ‡
Analgesia, Oncology, Radiology, Palliative

Oncological / Surgical work up – Think / Consider:
CT CAP for staging, primary, bone quality, SINS and identify if epidural mass is soft tissue or bony
STOP / REVERSE ALL ANTICOAGULANTS IF FOR SURGERY
Analgesia / Fluids / DVT / Steroids / PPI / Glu
ASIA chart / Spinal precautions line flat (supine) / ?Collar
Bloods incl G+S, coag, CRP, Ca^{++} electrophoresis etc.
ECG / ECHO / aBG
XR / Bone scan / PET
Biopsy / Embolisation
Bladder / Bowel Care

‡ please discuss timing of post operative radiotherapy with surgeon

NOTE: In the absence of neurological deficits consideration should be given to out of hours referrals
Primary tumour or solitary metastasis with possibility of "cure"- discuss with Oncology and Spinal Team
Some haematological malignancies (e.g. myeloma) with MSCC can be treated non-operatively even in the presence of instability – discussion between surgeon, oncologist and haematologist is advised

Modified from Quraishi et al. JBJS(Br) 2010, Gasbarrini et al. Spine 2010 and NICE Guidelines

Symptoms suggestive of spinal metastases

- pain in the thoracic or cervical spine
- progressive lumbar spinal pain
- severe unremitting lumbar spinal pain
- spinal pain aggravated by straining
- localised spinal tenderness
- nocturnal spinal pain preventing sleep.

In pt with known cancer MRI < 1/52

Neurological symptoms or signs suggestive of MSCC

- radicular pain
- limb weakness
- difficulty walking
- sensory loss
- bladder or bowel dysfunction
- signs of spinal cord or cauda equina compression.

MRI < 24hrs

Surgical Candidates

Any of the following:		**And ALL of the following:**
Progressive / impending neurological deficit		
Spinal instability / collapse / deformity		Prognosis >3-4 months (Pref > 6 months)
Paralysed <24hours	+	Patient willing to have surgery
Intractable pain (including paralysed >24 hours)		Mets affecting ***single area*** of spine
Need histological confirmation		Surgery technically possible (d/w surgeon)
Growing tumour resistant to non-operative measures		
Relapse after / deterioration during radiotherapy		
Reached spinal cord radiotherapy tolerance		*Complete SINS and revised Tokuhashi score for guidance*

Minimum Information Required for Spinal Oncology Referral

Patient name / Date of birth / Your name / Referring specialty / Patients Consultant / Patients Hospital
Past medical history / Diagnosis / Primary tumour / Extent of disease (metastases)
Previous radiotherapy / chemotherapy
Current symptoms / Duration / Walking ability / Continence
Neurological examination (see ASIA chart)
Quality of the skin over the spine
Laboratory / Radiological investigation results
Life expectancy (if known)? Is the patient fit for transfer? Is the patient aware of the diagnosis?
Is the patient willing to undergo surgery? Is the patient a surgical candidate?
Complete a revised Tokuhashi and SINS score for guidance

Spinal Oncology Scoring Systems 1

Karnofsky Performance Status (KPS)

100%	Normal, no complaints, no disease
90%	Capable normal activity, few symptoms or signs disease
80%	Normal activity some difficulty, some symptoms signs
70%	Caring for self, not capable normal activity or work
60%	Requiring some help, able most personal tasks
50%	Requires help often, requires frequent medical care
40%	Disabled, requires special care and help
30%	Severely disabled, requires hospital admission, no risk death
20%	Very ill, urgent admission, supportive measures or treatment
10%	Moribund
0%	Death

Van der Linden Score

Symptomatic spinal mets, no neurological deficit,
no fracture / instability, renal and melanoma excluded,
treated with radiotherapy alone – PROGNOSIS:

Karnofsky score: 80-100 (2 points)
50-70 (1 point)
20-40 (0 points)

Primary Tumour: Breast (3 points)
Prostate (2 points)
Lung (1 point)
Other (0 points)

Visceral Metastases: No (1 point)
Yes (0 points)

Score:

0-3 Mean survival 4.8 months (3.8-5.7) median 3
4-5 Mean survival 13.1 months (11.3-14.8) median 9
6 Mean survival 18.3 (15.2-21.4) median 18.7

Modified Bauer Score

Spinal mets, no fracture

Score 1 for each of following:

No visceral metastases
No lung cancer
Primary tumour breast, kidney (lymphoma, myeloma)
Solitary skeletal metastasis

Score:

0-1 Supportive care, no surgery
median survival 4.8 months

2 Short term palliation, dorsal surgery
median survival 18.2 months

3-4 Middle term local control, ventral-dorsal surgery
median survival 28.4 months

Tomita Score

Scoring System			
	Prognostic factors		
Point	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.

Revised Tokuhashi Score

General condition:	**Points:**
Poor (KPS 10-40%)	0
Moderate (50-70%)	1
Good (80-100%)	2
No. extra-spinal bone mets:	
≥3	0
1-2	1
0	2
No. mets in vertebral body:	
≥3	0
1-2	1
0	2
Mets to major internal organs:	
Unremovable	0
Removable	1
None	2
Primary site of cancer:	
Lung, osteosarcoma, stomach, bladder, oesophagus, pancreas	0
Liver, gallbladder, unidentified	1
Others	2
Kidney, uterus	3
Rectum	4
Thyroid, breast, prostate, carcinoid	5
Palsy:	
Complete (Frankel A or B)	0
Incomplete (Frankel C or D)	1
Normal (Frankel E)	2

Score:

0-8 Prognosis < 6 months
Conservative treatment
? Palliative surgery

9-11 Prognosis > 6 months
Palliative surgery
? Excisional surgery - single lesion, no mets major organs

12-15 Prognosis > 1 year
Excisional surgery

Spinal Instability Neoplastic Score (SINS)

Location:	**Points:**
Junctional (Occiput-C2, C7-T2, T11-L1, L5-S1)	3
Mobile spine (C3-6, L2-4)	2
Semi-rigid (T3-10)	1
Rigid (S2-5)	0
Pain relief with recumbency and /or pain with movement / loading spine:	
Yes	3
No (occasional pain, not mechanical)	1
Pain free lesion	0
Bone lesion – (CT or XR required):	
Lytic	2
Mixed (lytic / blastic)	1
Blastic	0
Radiographic spinal alignment:	
Subluxation / translation	4
De novo deformity (kyphosis / scoliosis)	2
Normal alignment	0
Vertebral body collapse:	
> 50%	3
<50%	2
No collapse > 50% body involved	1
None of above	0
Posterolateral spine involvement: (facet, pedicle or costovertebral joint fracture or Replacement by tumour)	
Bilateral	3
Unilateral	1
None	0

Total Score:
<7 = stable
7-12 = potentially unstable
>12 = unstable

Spinal Oncology Scoring Systems 2

Table IV. Oswestry Spinal Metastasis Risk Index (OSRI)

Characteristic	Description	Score*
Primary tumour		
Slow growth	Breast, thyroid, prostate, myeloma, haemangioma, endothelioma, non-Hodgkins lymphoma	1
Moderate growth	Kidney, uterus, tonsils, epipharynx, synovial cell sarcoma, metastatic thymoma	2
Rapid growth	Stomach, colon, liver, melanoma, teratoma, sigmoid colon, pancreas, rectum, unknown origin	4
Very rapid growth	Lung	5
General condition (KPS†)		
Good	KPS 80% to 100%	0
Moderate	KPS 50% to 70%	1
Poor	KPS 10% to 40%	2

* total score is sum of the two sub-scores. Scoring for general condition has been reversed compared with the revised Tokuhashi scoring system to obtain an index of risk
† KPS, Karnofsky Performance Status

Table V. Median survival time in each risk category. The calculation of the Brookmeyer-Crowley 95% confidence interval (CI) was based on log-transformed interval

Risk index	n	Median survival time (95% CI) (mths)	85th centile of survival time (mths)
1	47	23 (12 to 36)	69
2 or 3	82	6 (4 to 9)	30
4 or 5	43	4 (3 to 5)	12
6	16	2 (1 to 3)	6
7	11	1 (1 to 2)	2

Rades Score

Prognostic Factor	Category	Score
Type of tumour	Myeloma/lymphoma Breast cancer Prostate cancer Other tumours Lung cancer	9 8 7 4 3
Other Bone Metastases*	No Yes	8 2
Visceral Metastases*	No Yes	8 2
Tumour diagnosis to MESCC	>15 months ≤15 months	7 4
Ambulatory status pre-treatment	Ambulatory Non-ambulatory	7 3
Time to develop motor deficits before treatment	>14 days 8–14 days 1–7 days	8 6 3
* At time of radiotherapy		

Score	6 month OS	1 year OS	Median OS (months)*
21–25	4%	0%	2
26–30	11%	6%	5
31–35	48%	23%	7
36–40	87%	70%	25
41–45	99%	89%	62

* Estimated; OS: overall survival

Spinal Bracing

Bracing is used in patients with either metastatic spinal cord compression or instability pain from metastatic spinal disease or for pathological spinal fractures. It is used in patients who are poor surgical candidates in order to control pain and / or to prevent progressive neurological deficit and / or to prevent progressive deformity. The following points need to be considered:

1. Is the patient a surgical candidate?	Yes – refer to surgeon No – go to 2
2. Is the patient in pain?	Yes – go to 3 No – go to 4
3. Will the pain respond to radiotherapy / chemotherapy / Immunotherapy / vertebroplasty etc.?	Yes – proceed and then go back to 2 No – go to 4
4. Is the patient paralyzed?	Yes – ask what is the purpose of the brace? The patient has no pain and is paralyzed Are they at risk of progressive deformity and complications from this? No – go to 5
5. Is the spine unstable (SINS score ≥ 7)?	Yes – consider brace for pain relief and / or to prevent / delay onset of possible neurological deterioration / progressive deformity / pain No – ask what is the purpose of the brace? The patient has no pain and the spine is not unstable

Bracing – Will the patient be compliant with the brace? Can they fit it themselves? Is the patients skin suitable for a brace? Can the spinal level be braced and controlled (mid and upper thoracic lesions)? Does a trial of the brace improve any symptoms the patient has? Can the patient self care in the brace?

Spinal Precautions

Spinal precautions are basic measures designed to protect the spinal cord. They are used in patients with symptoms and signs of either metastatic spinal cord or cauda equina compression or those with acute instability pain or pathological fractures, in order to minimize the risk of neurological deterioration. Instability of the spine is defined as the loss of the ability of the spine under physiological loads to maintain its pattern of displacement so that there is no initial or additional neurological deficit, no major deformity and no incapacitating pain. A SINS score of ≥ 7 indicates possible impending instability and ≥ 13 indicates instability. SINS scores of 7 to 18 warrant surgical consultation in patients who are surgical candidates.

Precautions consist of flat bed rest and 2 hourly log rolls for thoracolumbar lesions plus semi-rigid cervical collar application for cervical lesions. However a patient must not be put into a position that causes more pain, discomfort or neurological deterioration. Spinal precautions should be removed as soon as a decision regarding the stability of the spine has been made. Prolonged bed rest and cervical collar use are not without complications. Once a decision has been made to use a collar / brace or not, a graduated assessment of sitting is performed once any spinal shock has settled or neurological deficits have stabilized. If there are any significant increases in pain or neurological symptoms when the patient is sat up or mobilized then the patient needs to be laid down and reassessed.

INTERNATIONAL STANDARDS FOR NEUROLOGICAL CLASSIFICATION OF SPINAL CORD INJURY (ISNCSCI)

ASIA American Spinal Injury Association — ISCOS International Spinal Cord Society

Patient Name _____ Date/Time of Exam _____

Examiner Name _____ Signature _____

RIGHT

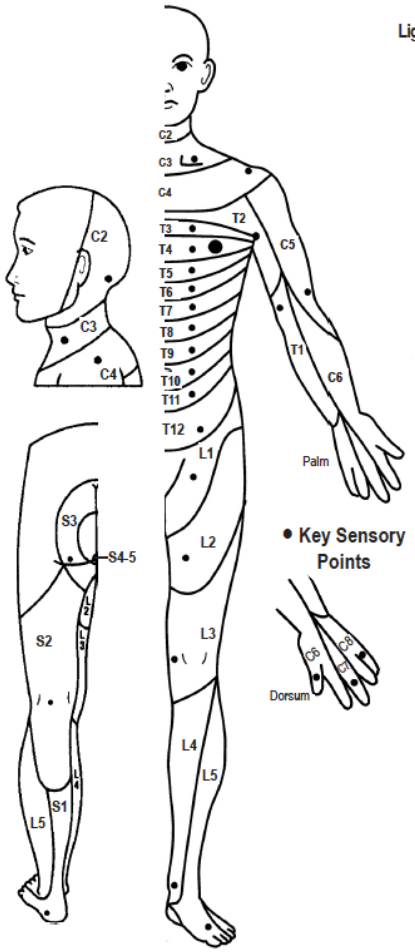
MOTOR KEY MUSCLES		SENSORY KEY SENSORY POINTS Light Touch (LTR)	Pin Prick (PPR)
	C2		
	C3		
	C4		
Elbow flexors	C5		
Wrist extensors	C6		
Elbow extensors	C7		
Finger flexors	C8		
Finger abductors (little finger)	T1		
	T2		
	T3		
	T4		
	T5		
	T6		
	T7		
	T8		
	T9		
	T10		
	T11		
	T12		
	L1		
Hip flexors	L2		
Knee extensors	L3		
Ankle dorsiflexors	L4		
Long toe extensors	L5		
Ankle plantar flexors	S1		
	S2		
	S3		
	S4-5		
RIGHT TOTALS (MAXIMUM)		(50)	(56) (56)

UER (Upper Extremity Right)

LER (Lower Extremity Right)

Comments (Non-key Muscle? Reason for NT? Pain?):

(VAC) Voluntary anal contraction (Yes/No) ☐



LEFT

SENSORY KEY SENSORY POINTS Light Touch (LTL)	Pin Prick (PPL)	MOTOR KEY MUSCLES	
		C2	
		C3	
		C4	
		C5	Elbow flexors
		C6	Wrist extensors
		C7	Elbow extensors
		C8	Finger flexors
		T1	Finger abductors (little finger)
		T2	
		T3	
		T4	
		T5	
		T6	
		T7	
		T8	
		T9	
		T10	
		T11	
		T12	
		L1	
		L2	Hip flexors
		L3	Knee extensors
		L4	Ankle dorsiflexors
		L5	Long toe extensors
		S1	Ankle plantar flexors
		S2	
		S3	
		S4-5	
(56)	(56)	(50)	LEFT TOTALS (MAXIMUM)

UEL (Upper Extremity Left)

LEL (Lower Extremity Left)

MOTOR (SCORING ON REVERSE SIDE)

0 = total paralysis
1 = palpable or visible contraction
2 = active movement, gravity eliminated
3 = active movement, against gravity
4 = active movement, against some resistance
5 = active movement, against full resistance
5* = normal corrected for pain/disuse
NT = not testable

SENSORY (SCORING ON REVERSE SIDE)

0 = absent
1 = altered
2 = normal
NT = not testable

☐ (DAP) Deep anal pressure (Yes/No)

MOTOR SUBSCORES

UER ☐ + UEL ☐ = UEMS TOTAL ☐ (MAX (25) (25) (50))

LER ☐ + LEL ☐ = LEMS TOTAL ☐ (MAX (25) (25) (50))

SENSORY SUBSCORES

LTR ☐ + LTL ☐ = LT TOTAL ☐ (MAX (56) (56) (112))

PPR ☐ + PPL ☐ = PP TOTAL ☐ (MAX (56) (56) (112))

NEUROLOGICAL LEVELS

Steps 1-5 for classification as on reverse

	R	L
1. SENSORY	☐	☐
2. MOTOR	☐	☐

3. NEUROLOGICAL LEVEL OF INJURY (NLI) ☐

4. COMPLETE OR INCOMPLETE? ☐
Incomplete = Any sensory or motor function in S4-5

5. ASIA IMPAIRMENT SCALE (AIS) ☐

(In complete injuries only) ZONE OF PARTIAL PRESERVATION
Most caudal level with any innervation

	R	L
SENSORY	☐	☐
MOTOR	☐	☐

REV 02/13

Muscle Function Grading

0 = total paralysis

1 = palpable or visible contraction

2 = active movement, full range of motion (ROM) with gravity eliminated

3 = active movement, full ROM against gravity

4 = active movement, full ROM against gravity and moderate resistance in a muscle specific position

5 = (normal) active movement, full ROM against gravity and full resistance in a functional muscle position expected from an otherwise unimpaired person

5* = (normal) active movement, full ROM against gravity and sufficient resistance to be considered normal if identified inhibiting factors (i.e. pain, disuse) were not present

NT = not testable (i.e. due to immobilization, severe pain such that the patient cannot be graded, amputation of limb, or contracture of > 50% of the normal range of motion)

Sensory Grading

0 = Absent

1 = Altered, either decreased/impaired sensation or hypersensitivity

2 = Normal

NT = Not testable

Non Key Muscle Functions (optional)

May be used to assign a motor level to differentiate AIS B vs. C

Movement	Root level
Shoulder: Flexion, extension, abduction, adduction, internal and external rotation **Elbow:** Supination	**C5**
Elbow: Pronation **Wrist:** Flexion	**C6**
Finger: Flexion at proximal joint, extension. **Thumb:** Flexion, extension and abduction in plane of thumb	**C7**
Finger: Flexion at MCP joint **Thumb:** Opposition, adduction and abduction perpendicular to palm	**C8**
Finger: Abduction of the index finger	**T1**
Hip: Adduction	**L2**
Hip: External rotation	**L3**
Hip: Extension, abduction, internal rotation **Knee:** Flexion **Ankle:** Inversion and eversion **Toe:** MP and IP extension	**L4**
Hallux and Toe: DIP and PIP flexion and abduction	**L5**
Hallux: Adduction	**S1**

ASIA Impairment Scale (AIS)

A = Complete. No sensory or motor function is preserved in the sacral segments S4-5.

B = Sensory Incomplete. Sensory but not motor function is preserved below the neurological level and includes the sacral segments S4-5 (light touch or pin prick at S4-5 or deep anal pressure) AND no motor function is preserved more than three levels below the motor level on either side of the body.

C = Motor Incomplete. Motor function is preserved below the neurological level**, and more than half of key muscle functions below the neurological level of injury (NLI) have a muscle grade less than 3 (Grades 0-2).

D = Motor Incomplete. Motor function is preserved below the neurological level**, and at least half (half or more) of key muscle functions below the NLI have a muscle grade $\geq$ 3.

E = Normal. If sensation and motor function as tested with the ISNCSCI are graded as normal in all segments, and the patient had prior deficits, then the AIS grade is E. Someone without an initial SCI does not receive an AIS grade.

** For an individual to receive a grade of C or D, i.e. motor incomplete status, they must have either (1) voluntary anal sphincter contraction or (2) sacral sensory sparing with sparing of motor function more than three levels below the motor level for that side of the body. The International Standards at this time allows even non-key muscle function more than 3 levels below the motor level to be used in determining motor incomplete status (AIS B versus C).

NOTE: When assessing the extent of motor sparing below the level for distinguishing between AIS B and C, the ***motor level*** on each side is used; whereas to differentiate between AIS C and D (based on proportion of key muscle functions with strength grade 3 or greater) the ***neurological level of injury*** is used.

AMERICAN SPINAL INJURY ASSOCIATION

INTERNATIONAL STANDARDS FOR NEUROLOGICAL CLASSIFICATION OF SPINAL CORD INJURY

INTERNATIONAL SPINAL CORD SOCIETY

Steps in Classification

The following order is recommended for determining the classification of individuals with SCI.

1. Determine sensory levels for right and left sides.
The sensory level is the most caudal, intact dermatome for both pin prick and light touch sensation.

2. Determine motor levels for right and left sides.
Defined by the lowest key muscle function that has a grade of at least 3 (on supine testing), providing the key muscle functions represented by segments above that level are judged to be intact (graded as a 5).
Note: in regions where there is no myotome to test, the motor level is presumed to be the same as the sensory level, if testable motor function above that level is also normal.

3. Determine the neurological level of injury (NLI)
This refers to the most caudal segment of the cord with intact sensation and antigravity (3 or more) muscle function strength, provided that there is normal (intact) sensory and motor function rostrally respectively.
The NLI is the most cephalad of the sensory and motor levels determined in steps 1 and 2.

4. Determine whether the injury is Complete or Incomplete.
(i.e. absence or presence of sacral sparing)
*If voluntary anal contraction = **No** AND all S4-5 sensory scores = **0** AND deep anal pressure = **No,** then injury is **Complete.** Otherwise, injury is **Incomplete.***

5. Determine ASIA Impairment Scale (AIS) Grade:

Is injury Complete? **If YES, AIS=A** and can record ZPP (lowest dermatome or myotome on each side with some preservation)

NO ↓

Is injury Motor Complete? **If YES, AIS=B**

NO ↓ (No=voluntary anal contraction OR motor function more than three levels below the motor level on a given side, if the patient has sensory incomplete classification)

Are at least half (half or more) of the key muscles below the neurological level of injury graded 3 or better?

NO ↓ **AIS=C** **YES** ↓ **AIS=D**

If sensation and motor function is normal in all segments, AIS=E
Note: AIS E is used in follow-up testing when an individual with a documented SCI has recovered normal function. If at initial testing no deficits are found, the individual is neurologically intact; the ASIA Impairment Scale does not apply.