

Spinal metastases and metastatic spinal cord compression

[H] Evidence reviews for immobilisation

NICE guideline number NG234

*Evidence reviews underpinning recommendations 1.4.1 to 1.4.4
and 1.6.1 to 1.6.6 as well as research recommendations 2 and
3 in the NICE guideline*

September 2023

Final

*These evidence reviews were developed by
NICE*

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Local commissioners and/or providers have a responsibility to enable the guideline to be applied when individual health professionals and their patients or service users wish to use it. They should do so in the context of local and national priorities for funding and developing services, and in light of their duties to have due regard to the need to eliminate unlawful discrimination, to advance equality of opportunity and to reduce health inequalities. Nothing in this guideline should be interpreted in a way that would be inconsistent with compliance with those duties.

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Immobilisation and remobilisation after assessment

Review question

How effective are techniques or methods of immobilisation in managing spinal metastases, direct malignant infiltration or associated spinal cord compression?

Introduction

Patients with suspected metastatic spinal instability may be routinely kept lying flat until a diagnosis is made, to avoid further spinal cord damage. Remobilisation might be started only after radiotherapy, spinal stabilisation or a period of bed rest. However, there is uncertainty about the effectiveness of these positioning approaches and prolonged immobilisation adversely affects quality of life.

Patients with metastatic spinal cord or nerve root compression may experience mechanical pain – where vertebral pain is aggravated by spinal movement or even by standing or sitting in a certain position. This pain may be due to weakening of the bone leading to spinal instability and could be alleviated by immobilising and supporting the spine. External devices such as corsets or braces for the trunk, and collars or halo jackets for the neck can be used, but with uncertainty about relative effectiveness.

Summary of the protocol

See Table 1 for a summary of the Population, Intervention, Comparison and Outcome (PICO) characteristics of this review.

Table 1: Summary of the protocol (PICO table)

Population	Inclusion: <ul style="list-style-type: none">• Adults with confirmed or suspected:<ul style="list-style-type: none">○ metastatic spinal disease○ direct malignant infiltration of the spine• Adults with confirmed or suspected spinal cord or nerve root compression because of<ul style="list-style-type: none">○ metastatic spinal disease○ direct malignant infiltration of the spine
Intervention	<ul style="list-style-type: none">• Spinal bracing, collar, wheelchair• Positioning advice, for example:<ul style="list-style-type: none">○ Lying flat○ Sitting up○ Standing• Combined spinal bracing and positioning advice
Comparison	<ul style="list-style-type: none">• Other intervention• No spinal immobilisation (no spinal bracing and no positioning advice)• Timing, for example 'delayed' mobilisation and/or frequency
Outcome	Critical <ul style="list-style-type: none">• Disease-related morbidity:<ul style="list-style-type: none">○ Pain○ Neurological status○ Deformity

- Health-related quality of life

Important

- Mobility / ambulatory status
- Treatment-related morbidity, for example:
 - VTE
 - Pressure sores
 - Pneumonia
- WHO performance status

VTE: Venous thromboembolism; WHO: World Health Organization

For further details see the review protocol in appendix A.

Methods and process

This evidence review was developed using the methods and process described in [Developing NICE guidelines: the manual](#). Methods specific to this review question are described in the review protocol in appendix A and the methods document (supplementary document 1).

Declarations of interest were recorded according to [NICE's conflicts of interest policy](#).

Effectiveness evidence

Included studies

A systematic review of the literature was conducted but no studies were identified which were applicable to this review question.

See the literature search strategy in appendix B and study selection flow chart in appendix C.

Excluded studies

Studies not included in this review are listed, and reasons for their exclusion are provided in appendix J.

Summary of included studies

No studies were identified which were applicable to this review question (and so there are no evidence tables in Appendix D). No meta-analysis was conducted for this review (and so there are no forest plots in Appendix E).

Summary of the evidence

No studies were identified which were applicable to this review question (and so there are no GRADE tables in Appendix F).

Economic evidence

Included studies

A systematic review of the economic literature was conducted but no economic studies were identified which were applicable to this review question.

A single economic search was undertaken for all topics included in the scope of this guideline. See supplement 2 for details.

Excluded studies

Economic studies not included in this review are listed, and reasons for their exclusion are provided in supplement 2.

Summary of included economic evidence

No economic studies were identified which were applicable to this review question.

Economic model

No economic modelling was undertaken for this review because the committee agreed that other topics were higher priorities for economic evaluation.

Evidence statements

The committee's discussion and interpretation of the evidence

The outcomes that matter most

The committee agreed that critical outcomes were disease related morbidity (pain, neurological status and deformity) and quality of life. This was because movement of an unstable spine can cause pain and even damage to the spinal cord leading to disability with negative impact on quality of life. Immobilisation itself can also negatively affect quality of life – for example by requiring the person to lie flat.

Mobility and WHO performance status were considered important outcomes – as indicators of the longer term consequences of damage to the spinal cord. Treatment related morbidity was also an important outcome because immobility itself can have negative physical consequences such as thrombosis, pressure sores and pneumonia

The quality of the evidence

No evidence was identified and therefore the committee considered recommendations from the previous guideline as well as using their expertise and experience to draft recommendations.

Benefits and harms

Immobilisation

Due to the lack of evidence the committee based all recommendations on experience and expertise. The committee discussed that due to the potentially devastating consequences of spinal collapse it is a matter of safety to immobilise people who present with neurological signs or symptoms of spinal instability (see also evidence review K related to tools to assess spinal stability). Therefore, a strong recommendation is needed despite the lack of evidence. They agreed this should be done without delay and care should be taken during transfer to hospital when the person would need to be moved between environments and vehicles.

The committee agreed that people with moderate to severe pain associated with movement (but in the absence of neurological symptoms or signs of spinal instability) are at lower risk of spinal collapse. In this situation immobilisation might be appropriate but there is a lower level of urgency in comparison to those with neurological symptoms or signs.

It was noted that there are different interpretations of 'immobilisation' and that currently people are left immobilised for too long in a flat position which has a detrimental impact on their physical and mental wellbeing.

To prevent people being immobilised for too long the committee recommended that expert advice should be sought within 24 hours (which currently corresponds to the time it takes to get an MRI) to determine how long immobilisation may be necessary. They did not want to be prescriptive about the type of expert that should be contacted because this could differ by service and by condition, so they decided to give some examples of who may be able to give such advice, such as a specialist physiotherapist, oncologist or spinal surgeon.

The committee noted that the previous guideline recommended log rolling. They noted that this was a technique associated with immobilisation and so they did not recommend against using this. However, the committee decided not to specifically refer to this in a recommendation to avoid blanket use of log rolling which in clinical practice often means that people are immobilised longer.

Commonly immobilisation is interpreted as lying flat but the committee noted that it could involve partial elevation as long as this is perceived as comfortable by the person and weight bearing by the spine is minimised. The committee included 'partial elevation' in the recommendation to clarify this so that this can become an option. The committee discussed that some people find lying down flat painful or that it could affect their breathing. It was noted that positions can be adjusted so that the person is as comfortable as they can be without risking weight bearing onto the spine.

Mobilisation and assessment of spinal stability

As soon as assessment (which would include an MRI but would also include a clinical assessment) show that it is safe to do so, the aim is to gradually increase mobility so that the person has improved ability to engage with the environment and people around them. The committee noted that healthcare professionals need to look out for symptoms, such as hypotension, pain or neurological symptoms and if there is a significant deterioration the person may have to be moved back to a position that was manageable for them. They agreed that graded sitting is the accepted approach to evaluating spinal stability in this context. The committee discussed that a significant increase in symptoms may indicate spinal instability and a reassessment will need to take place.

After treatment the committee agreed that there may still be symptoms but if the treatment outcome was positive then mobilisation should be safe and should be encouraged. However, the committee noted that there are some people for whom treatment may not be appropriate or possible. It was discussed that it should not be assumed a person should remain immobilised because treatment options have been exhausted or are not possible. They therefore recommended that mobilisation should be carried out so that the person can be as comfortable and autonomous as possible.

Using orthoses in mobilisation

Whilst there was no evidence for orthoses, the committee discussed that there are some situations where orthoses are used in clinical practice. For example, drop foot, a weakening of the muscles that allow the ankle and toes to flex, can be caused by nerve damage as a result of MSCC and there are ankle orthoses that can be used to stabilise the muscles around the foot and therefore facilitate mobilisation. However, they noted that there are a range of other orthoses for other body parts that may be relevant on an individual basis and therefore they did not want to be too prescriptive or specific about this. Getting advice from a specialist, usually a physiotherapist, is therefore recommended.

Research recommendations

Given the lack of evidence in this area the committee agreed to make research recommendations about the effectiveness of techniques for immobilisation and remobilisation.

Cost effectiveness and resource use

No economic evidence was identified for this topic from the systematic search of previously published evidence. The committee considered cost effectiveness based on their own experience and knowledge.

The recommendation to seek advice around immobilisation within 24 hours would be a change of practice in some places. Advice around imaging including arranging an MRI and treatment will already be sought for most people at risk of spinal collapse. Therefore, this would not be an additional consultation but may increase the time needed for one. However, the committee from their own experience considered that this increase would be small.

People at risk of spinal collapse will be under regular if not intensive care. Changes in recommendations, such as clarifying that partial elevation is appropriate in some cases, will therefore not lead to any increase in the time needed by health care practitioners.

The consequences of spinal collapse are large including severe pain, deformity and paralysis which are associated with large costs and detriments to quality of life. Appropriate immobilisation could help reduce or prevent these outcomes reducing subsequent resource use. Even small decreases in these events could lead to decreases in cost as well as use of health care practitioners' time across all people in England. This is likely to be significantly greater than the small upfront cost of obtaining advice.

Recommendations supported by this evidence review

This evidence review supports recommendations 1.4.1 to 1.4.4 and 1.6.1 to 1.6.6 as well as research recommendation 2 on effective immobilisation techniques recommendation 3 on safe and effective remobilisation.

References – included studies

No evidence was identified.

Appendices

Appendix A Review protocols

Review protocol for review question: How effective are techniques or methods of immobilisation in managing spinal metastases, direct malignant infiltration or associated spinal cord compression?

Table 2: Review protocol

ID	Field	Content
0.	PROSPERO registration number	CRD42021288029
1.	Review title	Immobilisation in the management of spinal metastases, direct malignant infiltration or associated spinal cord compression
2.	Review question	How effective are techniques or methods of immobilisation in managing spinal metastases, direct malignant infiltration or associated spinal cord compression?
3.	Objective	To establish whether spinal immobilisation is effective in the management of spinal metastases, direct malignant infiltration or associated spinal cord compression. Also to compare the effectiveness of techniques or methods of spinal immobilisation.
4.	Searches	<p>The following databases will be searched:</p> <ul style="list-style-type: none"> • Cochrane Central Register of Controlled Trials (CENTRAL) • Cochrane Database of Systematic Reviews (CDSR) • Cumulative Index to Nursing and Allied Health Literature (CINAHL) • Database of Abstracts of Reviews of Effects (DARE) • Embase • Epistemonikos • International Health Technology Assessment (IHTA) database • MEDLINE & MEDLINE In-Process <p>Searches will be restricted by:</p> <ul style="list-style-type: none"> • Date: 1990 onwards (see rationale under Section 10)

ID	Field	Content
		<ul style="list-style-type: none"> • English language studies • Human studies <p>Other searches: Inclusion lists of systematic reviews.</p> <p>With the agreement of the guideline committee the searches will be re-run between 6-8 weeks before final submission of the review and further studies retrieved for inclusion.</p> <p>The full search strategies for MEDLINE database will be published in the final review.</p>
5.	Condition or domain being studied	Techniques or methods of immobilisation in the management of spinal metastases, direct malignant infiltration of the spine, spinal cord compression.
6.	Population	<p>Inclusion:</p> <ul style="list-style-type: none"> • Adults with confirmed or suspected <ul style="list-style-type: none"> ○ metastatic spinal disease ○ direct malignant infiltration of the spine • Adults with confirmed or suspected spinal cord or nerve root compression because of <ul style="list-style-type: none"> ○ metastatic spinal disease ○ direct malignant infiltration of the spine <p>Exclusion:</p> <ul style="list-style-type: none"> • Adults with spinal cord compression because of primary tumours of the spinal cord, meninges or nerve roots • Adults with spinal cord compression because of non-malignant causes • Adults with primary bone tumours of the spinal column • Children and young people under the age of 18
7.	Intervention	<ul style="list-style-type: none"> • Spinal bracing, collar, wheelchair • Positioning advice, for example: <ul style="list-style-type: none"> ○ Lying flat ○ Sitting up

ID	Field	Content
		<ul style="list-style-type: none"> ○ Standing ● Combined spinal bracing and positioning advice
8.	Comparator	<ul style="list-style-type: none"> ● Other intervention ● No spinal immobilisation (no spinal bracing and no positioning advice) ● Timing, for example 'delayed' mobilisation and/or frequency
9.	Types of study to be included	<p>Experimental studies (where the investigator assigned intervention or control) including:</p> <ul style="list-style-type: none"> ● Randomised controlled trials ● Non-randomised controlled trials ● Systematic reviews/meta-analyses of controlled trials <p>In the absence of controlled trials reporting critical outcomes for each of the interventions and comparators, studies using the following designs will be included:</p> <ul style="list-style-type: none"> ● Observational studies (where neither control nor intervention were assigned by the investigator) including: ● Systematic reviews of observational studies. ● Prospective and retrospective cohort studies ● Case control studies ● Before and after study or interrupted time series
10.	Other exclusion criteria	<p>Inclusion:</p> <ul style="list-style-type: none"> ● Full text papers ● Observational studies should adjust for baseline differences between patients in different intervention groups in their analyses <p>Exclusion:</p> <ul style="list-style-type: none"> ● Conference abstracts ● Articles published before 1990 (the date when MRI use became regular in this population). ● Papers that do not include methodological details will not be included as they do not provide sufficient information to evaluate risk of bias/study quality ● Non-English language articles

ID	Field	Content
11.	Context	Metastatic spinal cord compression in adults: risk assessment, diagnosis and management (2008) NICE guideline will be updated by this review question
12.	Primary outcomes (critical outcomes)	<ul style="list-style-type: none"> • Disease-related morbidity: <ul style="list-style-type: none"> ○ Pain ○ Neurological status ○ Deformity • Health-related quality of life
13.	Secondary outcomes (important outcomes)	<ul style="list-style-type: none"> • Mobility / ambulatory status • Treatment-related morbidity, for example: <ul style="list-style-type: none"> ○ VTE ○ Pressure sores ○ Pneumonia • WHO performance status
14.	Data extraction (selection and coding)	<p>All references identified by the searches and from other sources will be uploaded into EPPI and de-duplicated. Titles and abstracts of the retrieved citations will be screened to identify studies that potentially meet the inclusion criteria outlined in the review protocol.</p> <p>Dual sifting will be performed on at least 10% of records; 90% agreement is required. Disagreements will be resolved via discussion between the two reviewers, and consultation with senior staff if necessary. The full set of records will not be dual screened because the population, interventions and relevant study designs are relatively clear and should be readily identified from titles and abstracts.</p> <p>Full versions of the selected studies will be obtained for assessment. Studies that fail to meet the inclusion criteria once the full version has been checked will be excluded at this stage. Each study excluded after checking the full version will be listed, along with the reason for its exclusion.</p> <p>Draft excluded studies will be circulated to the Topic Group for their comments. Resolution of disputes will be by discussion between the senior reviewer, Topic Advisor and Chair.</p> <p>A standardised form will be used to extract data from studies. The following data will be extracted: study details (reference,</p>

ID	Field	Content
		country where study was carried out, type and dates), participant characteristics, inclusion and exclusion criteria, details of the interventions if relevant, setting and follow-up, relevant outcome data and source of funding. One reviewer will extract relevant data into a standardised form, and this will be quality assessed by a senior reviewer.
15.	Risk of bias (quality) assessment	<p>Risk of bias of individual studies will be assessed using the preferred checklist as described in Developing NICE guidelines: the manual.</p> <p>Quality assessment of individual studies will be performed using the following:</p> <ul style="list-style-type: none"> • ROBIS tool for systematic reviews • Cochrane RoB tool v.2 for RCTs and quasi-RCTs • ROBINS-I for non-randomised studies <p>The quality assessment will be performed by one reviewer and this will be quality assessed by a senior reviewer.</p>
16.	Strategy for data synthesis	<p>Depending on the availability of the evidence, the findings will be summarised narratively or quantitatively.</p> <p>Data Synthesis Where possible, pair wise meta-analyses will be conducted using Cochrane Review Manager software. A fixed effect meta-analysis will be conducted and data will be presented as risk ratios for dichotomous outcomes. Peto odds ratio will be used for outcomes with zero events Mean differences or standardised mean differences will be calculated for continuous outcomes.</p> <p>Heterogeneity Heterogeneity in the effect estimates of the individual studies will be assessed using the I2 statistic. I2 values of greater than 50% and 80% will be considered as significant and very significant heterogeneity, respectively. In the case of serious or very serious unexplained heterogeneity (remaining after pre-specified subgroup and stratified analyses) meta-analysis will be done using a random effects model.</p> <p>Minimal important differences (MIDs) Default MIDs will be used for risk ratios and continuous outcomes only, unless the committee pre-specifies published or other MIDs for specific outcomes.</p> <p>For risk ratios: 0.8 and 1.25.</p>

ID	Field	Content														
		<p>For continuous outcomes: MID is calculated by ranking the studies in order of SD in the control arms. The MID is calculated as +/- 0.5 times median SD.</p> <p>For studies that have been pooled using SMD (meta-analysed): +0.5 and -0.5 in the SMD scale are used as MID boundaries.</p> <p>Validity The confidence in the findings across all available evidence will be evaluated for each outcome using an adaptation of the 'Grading of Recommendations Assessment, Development and Evaluation (GRADE) toolbox' developed by the international GRADE working group: http://www.gradeworkinggroup.org/</p>														
17.	Analysis of sub-groups	<p>Evidence will be stratified by:</p> <ul style="list-style-type: none"> • Ambulant vs non ambulant patients • Neurological deficit versus no deficit • Pain versus no pain • Location of metastasis: cervical versus thoracic vertebrae versus other vertebral locations <p>Where evidence is stratified or sub grouped the committee will consider on a case by case basis if separate recommendations should be made for distinct groups. Separate recommendations may be made where there is evidence of a differential effect of interventions in distinct groups. If there is a lack of evidence in one group, the committee will consider, based on their experience, whether it is reasonable to extrapolate and assume the interventions will have similar effects in that group compared with others.</p>														
18.	Type and method of review	<table border="1"> <tbody> <tr> <td data-bbox="562 983 1541 1027"><input checked="" type="checkbox"/></td> <td data-bbox="1541 983 2056 1027">Intervention</td> </tr> <tr> <td data-bbox="562 1027 1541 1072"><input type="checkbox"/></td> <td data-bbox="1541 1027 2056 1072">Diagnostic</td> </tr> <tr> <td data-bbox="562 1072 1541 1117"><input type="checkbox"/></td> <td data-bbox="1541 1072 2056 1117">Prognostic</td> </tr> <tr> <td data-bbox="562 1117 1541 1161"><input type="checkbox"/></td> <td data-bbox="1541 1117 2056 1161">Qualitative</td> </tr> <tr> <td data-bbox="562 1161 1541 1206"><input type="checkbox"/></td> <td data-bbox="1541 1161 2056 1206">Epidemiologic</td> </tr> <tr> <td data-bbox="562 1206 1541 1251"><input type="checkbox"/></td> <td data-bbox="1541 1206 2056 1251">Service Delivery</td> </tr> <tr> <td data-bbox="562 1251 1541 1327"><input type="checkbox"/></td> <td data-bbox="1541 1251 2056 1327">Other (please specify)</td> </tr> </tbody> </table>	<input checked="" type="checkbox"/>	Intervention	<input type="checkbox"/>	Diagnostic	<input type="checkbox"/>	Prognostic	<input type="checkbox"/>	Qualitative	<input type="checkbox"/>	Epidemiologic	<input type="checkbox"/>	Service Delivery	<input type="checkbox"/>	Other (please specify)
<input checked="" type="checkbox"/>	Intervention															
<input type="checkbox"/>	Diagnostic															
<input type="checkbox"/>	Prognostic															
<input type="checkbox"/>	Qualitative															
<input type="checkbox"/>	Epidemiologic															
<input type="checkbox"/>	Service Delivery															
<input type="checkbox"/>	Other (please specify)															

ID	Field	Content		
19.	Language	English		
20.	Country	England		
21.	Anticipated or actual start date	01 November 2021		
22.	Anticipated completion date	23 August 2023		
23.	Stage of review at time of this submission	Review stage	Started	Completed
		Preliminary searches	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
		Piloting of the study selection process	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
		Formal screening of search results against eligibility criteria	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
		Data extraction	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
		Risk of bias (quality) assessment	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
		Data analysis	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
24.	Named contact	5a. Named contact: National Institute for Health and Care Excellence (NICE)		
		5b Named contact e-mail: metastaticspinal@nice.org.uk		
		5e Organisational affiliation of the review: National Institute for Health and Care Excellence (NICE)		
25.	Review team members	NICE Technical Team		
26.	Funding sources/sponsor	This systematic review is being completed by NICE.		
27.	Conflicts of interest	All guideline committee members and anyone who has direct input into NICE guidelines (including the evidence review team and expert witnesses) must declare any potential conflicts of interest in line with NICE's code of practice for declaring and dealing with conflicts of interest. Any relevant interests, or changes to interests, will also be declared publicly at the start of		

ID	Field	Content	
		each guideline committee meeting. Before each meeting, any potential conflicts of interest will be considered by the guideline committee Chair and a senior member of the development team. Any decisions to exclude a person from all or part of a meeting will be documented. Any changes to a member's declaration of interests will be recorded in the minutes of the meeting. Declarations of interests will be published with the final guideline.	
28.	Collaborators	Development of this systematic review will be overseen by an advisory committee who will use the review to inform the development of evidence-based recommendations in line with section 3 of Developing NICE guidelines: the manual . Members of the guideline committee are available on the NICE website: https://www.nice.org.uk/guidance/CG75	
29.	Other registration details	N/A	
30.	Reference/URL for published protocol	https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42021288029	
31.	Dissemination plans	NICE may use a range of different methods to raise awareness of the guideline. These include standard approaches such as: <ul style="list-style-type: none"> • notifying registered stakeholders of publication • publicising the guideline through NICE's newsletter and alerts • issuing a press release or briefing as appropriate, posting news articles on the NICE website, using social media channels, and publicising the guideline within NICE. 	
32.	Keywords	Humans; Spinal Cord Compression; Spinal Neoplasms	
33.	Details of existing review of same topic by same authors	None	
34.	Current review status	<input type="checkbox"/>	Ongoing
		<input checked="" type="checkbox"/>	Completed but not published
		<input type="checkbox"/>	Completed and published
		<input type="checkbox"/>	Completed, published and being updated
		<input type="checkbox"/>	Discontinued
35..	Additional information	N/A	
36.	Details of final publica-	www.nice.org.uk	

ID	Field	Content
	tion	

CDSR: Cochrane Database of Systematic Reviews; CENTRAL: Cochrane Central Register of Controlled Trials; DARE: Database of Abstracts of Reviews of Effects; GRADE: Grading of Recommendations Assessment, Development and Evaluation; HTA: Health Technology Assessment; MID: minimally important difference; NGA: National Guideline Alliance; NHS: National health service; NICE: National Institute for Health and Care Excellence; RCT: randomised controlled trial; RoB: risk of bias; SD: standard deviation; VTE: venous thromboembolism; WHO: World Health Organization.

Appendix B Search strategy (clinical/economic)

Literature search strategies for review question: How effective are techniques or methods of immobilisation in managing spinal metastases, direct malignant infiltration or associated spinal cord compression?

Database: Medline – OVID interface

#	Searches
1	exp Spinal Cord Neoplasms/ or Spinal Neoplasms/
2	((spine or spinal or vertebr*) adj2 (adeno* or cancer* or carcinoma* or intraepithelial* or intra epithelial* or malignan* or neoplas* or tumo?r*).tw.
3	((spine or spinal or vertebr*) and (metast* or oligometast*).tw.
4	or/1-3
5	Spinal Cord Compression/
6	((cauda equina or cervical* or cervicothoracic or cord* or coccyx or duralsac* or dural sac* or intervertebr* or lumbar or lumbosac* or lumbo sac* or medulla* or orthothoracic or sacral or sacrum or spinal or spine* or thecal sac* or thoracic or vertebr* or epidural or extradural or extra dural or ((axon* or neuron* or nerve*) adj2 root)) and (collaps* or compress* or pinch* or press*) and (adeno* or cancer* or carcinoma* or chordoma* or intraepithelial* or intra epithelial* or malignan* or metast* or neoplas* or oligometast* or tumo?r*).tw.
7	(myelopath* or myeloradiculopath* or radiculopath*).tw,hw. or (radicular adj2 (disorder* or syndrome*).tw.
8	(mescc or msc).tw.
9	or/5-8
10	((adeno* or cancer* or carcinoma* or intraepithelial* or intra epithelial* or malignan* or metast* or neoplas* or tumo?r*) adj3 (escap* or infiltrat* or invasiv* or metast* or spread*) adj5 (cauda equina or cervical* or cervicothoracic or cord* or coccyx or duralsac* or dural sac* or intervertebr* or lumbar or lumbosac* or lumbo sac* or medulla* or orthothoracic or sacral or sacrum or spinal or spine* or thecal sac* or thoracic or vertebr* or epidural or extradural or extra dural or ((axon* or neuron* or nerve*) adj2 root))).tw.
11	or/4,9-10
12	Bed Rest/ or Early Ambulation/ or exp Immobilization/ or exp Orthotic Devices/ or Patient Positioning/ or Sitting Position/ or Standing Position/ or Supine Position/ or Wheelchairs/
13	(bedrail* or bed rail*).tw.
14	(brace or bracing or collar*).tw.
15	(flat adj2 bed*).tw.
16	(foam adj2 mattress*).tw.
17	(headblock* or head block*).tw.
18	immobil*.tw.
19	(bedrest or bed rest or ((lie* or lying or rest* or stay*) adj2 bed*).tw.
20	(legrol* or leg rol* or logrol* or log rol*).tw.
21	((man?euv* or method* or technique*) adj3 (limit* or reduc* or without) adj3 (activit* or motion or move*).tw.
22	((neutral or prone or supine) adj2 (align* or position*).tw.
23	(nurs* adj2 flat*).tw.
24	((one or no*1 or position* or single) adj2 pillow*).tw.
25	((elevat* or pillow* or prop* or rais*) adj2 (calf or calves or feet* or foot or heel* or leg?)).tw.
26	(positioning or reposition* or re position*).tw.
27	rest cure.tw.
28	(sandbag* or sand bag*).tw.
29	(skincheck* or skin check*).tw.
30	sliding sheet*.tw.
31	slipper pan*.tw.
32	((rotat* or turn*) adj2 (bed* or patient*).tw.
33	(chair or reclin* or sit or sits or sitting or wheelchair* or wheel chair*).tw.
34	(ambuli?at* or ambulat* or mobili* or walk*).tw.
35	(stand or standing or ((supine or upright) adj2 position)).tw.
36	(or/12-35) or (backboard* or back board* or spine board* or spine board* or spinal board* or (mechanical adj2 transfer*) or (mechanical adj2 kinetic) or (scoop* adj2 stretch*) or (((compress* and Spinal Neoplasms) or six) adj3 (lift adj2 slid*) or (straddle adj2 (lift adj2 slid*)) or vacuum splint* or strap or straps or strapp* or tapes or tapes or taping).tw.
37	11 and 36
38	(animals not humans).sh. or exp animals, laboratory/ or exp animal experimentation/ or exp models, animal/ or exp rodentia/ or (rat or rats or mouse or mice).ti.
39	37 not 38
40	limit 39 to yr="1990 -Current"
41	(controlled clinical trial or pragmatic clinical trial or randomized controlled trial).pt. or drug therapy.fs. or (groups or placebo or randomi#ed or randomly or trial).ab.
42	(nonrandom* or non random*).tw.
43	41 or 42
44	meta-analysis/ or meta-analysis as topic/ or systematic review/
45	(meta analy* or metanaly* or metaanaly* or ((evidence or systematic*) adj2 (overview* or review*))).ti.ab. or (bibliograph* or data extraction or hand search* or manual search* or reference list* or relevant journals or (search adj (criteria or strategy)) or (search* adj4 literature) or study selection or systematic search or (bids or cancerlit or cinahl or

#	Searches
	cochrane or embase or medline or psychinfo or psychlit or psycinfo or psyclit or pubmed or science citation index)).ab. or cochrane.jw.
46	44 or 45
47	43 or 46
48	40 and 47
49	40 not 48
50	Comparative Studies/ or Follow-Up Studies/ or Time Factors/ or chang*.tw. or evaluat*.tw. or reviewed.tw. or prospective*.tw. or retrospective*.tw. or baseline.tw. or cohort.tw. or case series.tw.
51	49 and 50

Health economics search

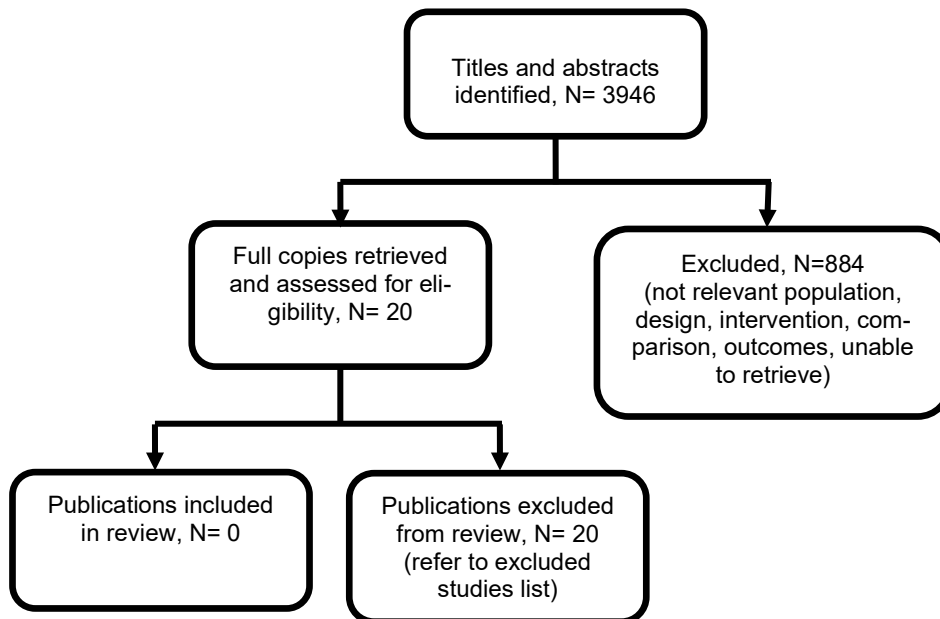
Database: Medline – OVID interface

#	Searches
1	exp Spinal Cord Neoplasms/ or Spinal Neoplasms/
2	((spine or spinal or vertebr*) adj2 (adeno* or cancer* or carcinoma* or intraepithelial* or intra epithelial* or malignan* or neoplas* or tumo?r*)).tw.
3	((spine or spinal or vertebr*) and (metast* or oligometast*)).tw.
4	or/1-3
5	Spinal Cord Compression/
6	((cauda equina or cervical* or cervicothoracic or cord* or coccyx or duralsac* or dural sac* or intervertebr* or lumbar or lumbosac* or lumbo sac* or medulla* or orthothoracic or sacral or sacrum or spinal or spine* or thecal sac* or thoracic or vertebr* or epidural or extradural or extra dural or ((axon* or neuron* or nerve*) adj2 root)) and (collaps* or compress* or pinch* or press*) and (adeno* or cancer* or carcinoma* or chordoma* or intraepithelial* or intra epithelial* or malignan* or metast* or neoplas* or oligometast* or tumo?r*)).tw.
7	(myelopath* or myeloradiculopath* or radiculopath*).tw,hw. or (radicular adj2 (disorder* or syndrome*)).tw.
8	(mescc or msc).tw.
9	or/5-8
10	((adeno* or cancer* or carcinoma* or intraepithelial* or intra epithelial* or malignan* or metast* or neoplas* or tumo?r*) adj3 (escap* or infiltrat* or invasiv* or metast* or spread*) adj5 (cauda equina or cervical* or cervicothoracic or cord* or coccyx or duralsac* or dural sac* or intervertebr* or lumbar or lumbosac* or lumbo sac* or medulla* or orthothoracic or sacral or sacrum or spinal or spine* or thecal sac* or thoracic or vertebr* or epidural or extradural or extra dural or ((axon* or neuron* or nerve*) adj2 root))).tw.
11	or/4,9-10
12	Economics/ or Value of life/ or exp "Costs and Cost Analysis"/ or exp Economics, Hospital/ or exp Economics, Medical/ or Economics, Nursing/ or Economics, Pharmaceutical/ or exp "Fees and Charges"/ or exp Budgets/
13	(cost* or economic* or pharmacoeconomic*).ti.
14	(budget* or financ* or fee or fees or price* or pricing* or (value adj2 (money or monetary))).ti,ab.
15	(cost* adj2 (effective* or utilit* or benefit* or minimi* or unit* or estimat* or variable*)).ab.
16	or/12-15
17	11 and 16
18	limit 17 to english language
19	limit 18 to yr="2005 -Current"

Appendix C Effectiveness evidence study selection

Study selection for: How effective are techniques or methods of immobilisation in managing spinal metastases, direct malignant infiltration or associated spinal cord compression?

Figure 1: Study selection flow chart



Appendix D Evidence tables

Evidence tables for review question: How effective are techniques or methods of immobilisation in managing spinal metastases, direct malignant infiltration or associated spinal cord compression?

No evidence was identified which was applicable to this review question.

Appendix E Forest plots

Forest plots for review question: How effective are techniques or methods of immobilisation in managing spinal metastases, direct malignant infiltration or associated spinal cord compression?

No meta-analysis was conducted for this review question and so there are no forest plots.

Appendix F GRADE and/or GRADE-CERQual tables (or other full modified GRADE tables)

GRADE tables for review question: How effective are techniques or methods of immobilisation in managing spinal metastases, direct malignant infiltration or associated spinal cord compression?

No evidence was identified for this review question and so there are no GRADE tables.

Appendix G Economic evidence study selection

Study selection for: How effective are techniques or methods of immobilisation in managing spinal metastases, direct malignant infiltration or associated spinal cord compression?

No economic evidence was identified which was applicable to this review question.

Appendix H Economic evidence tables

Economic evidence tables for review question: How effective are techniques or methods of immobilisation in managing spinal metastases, direct malignant infiltration or associated spinal cord compression?

No evidence was identified which was applicable to this review question.

Appendix I Economic model

Economic model for review question: How effective are techniques or methods of immobilisation in managing spinal metastases, direct malignant infiltration or associated spinal cord compression?

No economic analysis was conducted for this review question.

Appendix J Excluded studies

Excluded studies for review question: How effective are techniques or methods of immobilisation in managing spinal metastases, direct malignant infiltration or associated spinal cord compression?

Excluded effectiveness studies

Table 3: Excluded studies and reasons for their exclusion

Study	Reason for exclusion
Clauss, Dorothea, Wiskemann, Joachim, Rosenberger, Friederike et al. (2021) Spinal stabilization exercises for cancer patients with spinal metastases of high fracture risk: Feasibility of the DISPO-II training program. <i>Cancers</i> 13: 1-11	Intervention does not match review protocol
Cox, Marie Katherine, Kilbride, Lynn, Grant, Robin et al. (2009) Patient positioning and braces for pain relief and spinal stability in metastatic cord compression in adults. <i>Cochrane Database of Systematic Reviews</i> : cd007609	Other protocol criteria - study protocol (see Lee 2015)
da Silva, G. T.; Bergmann, A.; Thuler, L. C. (2015) Prognostic factors in patients with metastatic spinal cord compression secondary to lung cancer: a systematic review of the literature. <i>European spine journal</i> , 24, 2107-13	Intervention does not match review protocol – systematic review which did not include interventions relevant to this review
Galasko, C. S. (1991) Spinal instability secondary to metastatic cancer. <i>The Journal of bone and joint surgery. British volume</i> 73: 104-8	Intervention does not match review protocol
George, Reena, Jeba, Jenifer, Ramkumar, Govindaraj et al. (2015) Interventions for the treatment of metastatic extradural spinal cord compression in adults. <i>Cochrane Database of Systematic Reviews</i> 2015: cd006716	Study design does not match review protocol - systematic review without pooled results/quantitative data, checked for relevant studies
Heary, R. F. and Bono, C. M. (2001) Metastatic spinal tumors. <i>Neurosurgical focus</i> 11: e1	Study design does not match review protocol - expert review/narrative
Kilbride, Lynn, Cox, Marie, Kennedy, Catriona M. et al. (2010) Metastatic spinal cord compression: a review of practice and care. <i>Journal of clinical nursing</i> 19: 1767-83	Study design does not match review protocol - systematic review without pooled results/quantitative data, checked for relevant studies
Lang, Gernot, Hirschmuller, Anja, Sudkamp, Norbert P. et al. (2018) Efficacy of Thoracolumbar Bracing in Spinal Immobilization: Precise Assessment of Gross, Intersegmental, and Segmental Spinal Motion Restriction by a 3D Kinematic System. <i>World Neurosurgery</i> 116: e128-e146	Population does not match review protocol
Lawton, Andrew J., Lee, Kathleen A., Cheville, Andrea L. et al. (2019) Assessment and Management of Patients With Metastatic Spinal Cord Compression: A Multidisciplinary Review. <i>Journal of clinical oncology : official journal of the American Society of Clinical Oncology</i> 37: 61-71	Study design does not match review protocol - expert review/narrative
Lee, Siew H. W. A., Kennedy, Catriona, Grant, Robin et al. (2015) Positioning and spinal bracing for pain relief in metastatic spinal cord compression	Study design does not match review protocol – systematic review which did not identify any studies for inclusion, checked for relevant studies

Study	Reason for exclusion
sion in adults. Cochrane Database of Systematic Reviews 2015: cd007609	
Liu, Y., Hu, Y., Yang, X. et al. (2018) Prognostic factors of ambulatory status for patients with metastatic spinal cord compression: a systematic review and meta-analysis. World neurosurgery 116: e278-e290	Intervention does not match review protocol
McIlroy, S. and Bell, D. (2017) Change in mobility and survival three months after treatment for metastatic spinal cord compression. Results of a multi-centre prospective audit. Spine journal. Conference: 2017 annual meeting of the british association of spine surgeons, BASS 2017. United kingdom. Conference start: 20170314. Conference end: 20170317 17: 30	Intervention does not match review protocol
Nguyen, Nhu Tram; Hotte, Sebastien; Dayes, Ian (2015) Long-term Survival in a Patient with Metastatic Spinal Cord Compression from a Prostate Cancer with Ultra-high PSA: Case Report and Review of the Literature. Cureus 7: e242	Study design does not match review protocol - systematic review without pooled results/quantitative data, checked for relevant studies
Paniagua-Collado, Maria and Cauli, Omar (2018) Non-pharmacological interventions in patients with spinal cord compression: a systematic review. Journal of neuro-oncology 136: 423-434	Study design does not match review protocol - systematic review without pooled results/quantitative data, checked for relevant studies
Rief, Harald, Omlor, Georg, Akbar, Michael et al. (2014) Feasibility of isometric spinal muscle training in patients with bone metastases under radiation therapy - first results of a randomized pilot trial. BMC cancer 14: 67	Intervention does not match review protocol
Savage, P., Sharkey, R., Kua, T. et al. (2014) Malignant spinal cord compression: NICE guidance, improvements and challenges. QJM : monthly journal of the Association of Physicians 107: 277-82	Intervention does not match review protocol
Schoenfeld, Andrew J., Losina, Elena, Ferrone, Marco L. et al. (2019) Ambulatory status after surgical and nonsurgical treatment for spinal metastasis. Cancer 125: 2631-2637	Intervention does not match review protocol
Sheehan, C. (2016) Defining spinal instability and methods of classification to optimise care for patients with malignant spinal cord compression: A systematic review. Radiography 22: 77-83	Intervention does not match review protocol
White, B. D., Stirling, A. J., Paterson, E. et al. (2008) Diagnosis and management of patients at risk of or with metastatic spinal cord compression: Summary of NICE guidance. BMJ 337: 1349-1351	Other protocol criteria - guidance
Zhu, Mary P., Tetreault, Lindsay A., Sorefan-Mangou, Fatimah et al. (2018) Efficacy, safety, and economics of bracing after spine surgery: a systematic review of the literature. Spine Journal 18: 1513-1525	Population does not match review protocol

Appendix K Research recommendations – full details

Research recommendations for review question: How effective are techniques or methods of immobilisation in managing spinal metastases, direct malignant infiltration or associated spinal cord compression?

K.1.1 Research recommendation

What are the effective forms of immobilisation for people with metastatic spinal cord compression?

K.1.2 Why this is important

Spinal instability caused by metastases can cause pain and lead to spinal collapse and disability. Immobilisation is essential to prevent the spine collapsing but there are different interpretations of ‘immobilisation’ in different services across the UK. People may be immobilised for too long in a flat position which has a detrimental impact on their physical and mental wellbeing. There is an important trade-off between avoidance of disability and the adverse impact on quality of life. However, without evidence it is hard to know the most effective techniques for immobilisation and remobilisation.

K.1.3 Rationale for research recommendation

Table 4: Research recommendation rationale

Importance to ‘patients’ or the population	Spinal collapse can have devastating consequences, however the benefits of immobilising patients at lower risk of spinal collapse are less clear cut and have to be balanced with potential harms
Relevance to NICE guidance	Immobilisation has been considered in this guideline, but there is a lack of comparative evidence on its effectiveness.
Relevance to the NHS	The NHS Long term plan for cancer's main focus is on earlier diagnosis, but it also contains sections on improving quality of life of people with cancer. Having effective ways of immobilisation as well as remobilisation could help improve people’s autonomy and mobility which will improve their quality of life.
National priorities	Improving cancer care is a national priority.
Current evidence base	None
Equality considerations	None known

K.1.4 Modified PICO table

Table 5: Research recommendation modified PICO table

Population	People presenting with spinal metastasis or direct malignant infiltration of the spine and moderate to severe pain associated with movement
Intervention	<ul style="list-style-type: none"> • Immobilisation, for example: <ul style="list-style-type: none"> ○ Lying flat
Comparator	<ul style="list-style-type: none"> • Less restrictive immobilisation, for example <ul style="list-style-type: none"> ○ Sitting up ○ Lying at 30° ○ Orthotics (such as spinal brace) • No immobilisation (for those at lower risk of spinal collapse, for example

	with no neurological symptoms or signs)
Outcome	<ul style="list-style-type: none"> • Disease-related morbidity: <ul style="list-style-type: none"> ○ Pain ○ Neurological status ○ Deformity • Health-related quality of life <p>Important</p> <ul style="list-style-type: none"> • Mobility / ambulatory status • Treatment-related morbidity, for example: <ul style="list-style-type: none"> ○ VTE ○ Pressure sores ○ Pneumonia • WHO performance status
Study design	Randomised controlled trial
Timeframe	2 years
Additional information	None

VTE: venous thromboembolism; WHO: world health organisation

K.1.5 Research recommendation

What are the long-term benefits and risks of early remobilisation (including before surgery or radiotherapy)?

K.1.6 Why this is important

Immobilisation is often necessary for people presenting with suspected spinal instability or cord compression, until MRI and other assessments can be done. If the results of these assessments are reassuring, the aim is to gradually increase the person's mobility to enable them to better engage with the environment and people around them. Prompt remobilisation minimises secondary complications and deterioration in function thus improving quality of life, but it needs to be done safely. Orthotics such as spinal bracing often form part of the remobilisation and rehabilitation process.

K.1.7 Rationale for research recommendation

Table 6: Research recommendation rationale

Importance to 'patients' or the population	Remobilisation after lying flat can be a relief to people once it can be safely achieved because they can again interact with their environment and be more independent. It also prevents secondary complications and deterioration in function thus improving quality of life. Orthotics in particular spinal bracing is something that people commonly report to be helpful. Often they form part of rehabilitation process and usually are readily available.
Relevance to NICE guidance	Remobilisation has been considered in this guideline, but there is a lack of comparative evidence on its effectiveness.
Relevance to the NHS	The NHS Long term plan for cancer's main focus is on earlier diagnosis, but it also contains sections on improving quality of life of people with cancer. Having effective ways of immobilisation as well as remobilisation could help improve people's autonomy and mobility which will improve their quality of life.
National priorities	Improving cancer care is a national priority.
Current evidence base	None

Equality considerations	None known
Feasibility	Due to the nature of the condition, it may not be possible to conduct randomised controlled trial with a no-treatment arm for immobilisation but it may be possible to do a trial using different orthotics when remobilising.

K.1.8 Modified PICO table

Table 7: Research recommendation modified PICO table

Population	People with MSCC or direct malignant infiltration of the spine, with spinal instability who are currently immobilised
Intervention	Early remobilisation (for example before radiotherapy or surgery), with or without orthotics
Comparator	Remobilisation as usual (for example following radiotherapy or surgery)
Outcome	<ul style="list-style-type: none"> • Disease-related morbidity: <ul style="list-style-type: none"> ○ Pain ○ Neurological status ○ Deformity • Health-related quality of life <p>Important</p> <ul style="list-style-type: none"> • Mobility / ambulatory status • Treatment-related morbidity, for example: <ul style="list-style-type: none"> ○ VTE ○ Pressure sores ○ Pneumonia • WHO performance status
Study design	Randomised controlled trial or observational study
Timeframe	2 years
Additional information	None

VTE: venous thromboembolism; WHO: world health organisation