



Clinical evaluation, diagnosis, and decision-making for metastatic spine tumors: WFNS spine committee recommendations

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Abstract

Introduction Spinal metastases are a significant concern for patients with advanced cancer, leading to pain, neurological deficits, and reduced quality of life. They occur in up to 70% of cancer patients, with the vertebral column being the most common osseous site for metastatic disease¹⁻³. An approximate 10% of patients with vertebral body metastases eventually develop spinal cord compression, which can potentially cause severe and permanent disability⁴⁻⁶. This article aims to summarize the consensus statements developed by the World Federation of Neurosurgical Societies (WFNS) Spine Committee on the clinical evaluation, diagnosis, and decision-making for metastatic spine tumors.

Methods A systematic literature search was conducted in PubMed and Google Scholar from 2014 to 2023 using the search terms “clinical evaluation” + “spine metastases,” “spine metastases” + “diagnosis,” and “spine metastases” + “decision making” + “treatment.” Based on the review of this literature, six members of the WFNS Spine Committee developed five consensus statements using the Delphi method, which were voted on during two rounds of voting at two international meetings.

Results We agree that a high index of suspicion is required for early detection and diagnosis of spinal metastasis in cancer patients and adult patients more than 60 years presenting with new onset fractures / neurological deficits. Pain is the most common symptom followed by motor deficit. Bowel and bladder dysfunction is noted in nearly half of patients with metastatic spinal cord compression. An effective treatment for spinal metastases should be able to achieve pain relief, tumor control, prevention of neurological compromise and treat instability. Separation surgery combined with SRS is an effective treatment for spinal metastases.

Conclusion These consensus statements provide evidence-based guidelines for clinical evaluation, diagnosis, and decision-making in patients with metastatic spine tumors.

Keywords Spinal metastasis · WFNS consensus · SRS · SBRT · Separation surgery · Bladder dysfunction · Bowel dysfunction

Abbreviations

SRS Stereotactic Radiosurgery
SBRT Stereotactic Body Radiotherapy
NOMS Neurologic, Oncologic, Mechanical and

Systemic

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Introduction

Spinal metastases are a significant concern for patients with advanced cancer, leading to pain, neurological deficits, and reduced quality of life. They occur in up to 70% of cancer patients, with the vertebral column being the most common osseous site for metastatic disease [1–3]. Spine metastases can lead to significant morbidity owing to pathological vertebral body fractures, and radiculopathy and/or myelopathy from spinal cord or nerve root compression. An approximate 10% of patients with vertebral body metastases eventually develop spinal cord compression, which can potentially cause severe and permanent disability [4–6].

It is estimated that, up to 50% of diagnosed spinal metastases will require some form of management, and 5–10% require surgical treatment [7, 8]. Traditionally, treatment has involved a combination of surgery, radiation therapy, and systemic therapy, each tailored to the individual patient's disease burden, general health, and life expectancy. Newer concepts such as Stereotactic Body Radiotherapy (SBRT) [9] and Stereotactic Radiosurgery (SRS) [10] have further strengthened the treatment armamentarium for these entities. However, despite advances in these therapies, there remains considerable variation in how spinal metastases are managed worldwide. The need for a standardized approach has led to the development of consensus guidelines, informed

by the latest evidence and expert opinion, to guide clinicians in the decision-making process.

This article aims to summarize the consensus statements developed by the World Federation of Neurosurgical Societies (WFNS) Spine Committee on the clinical evaluation, diagnosis, and decision-making for metastatic spine tumors. These statements were formulated during two international consensus meetings held in 2023, utilizing a Delphi method to reach agreement among experts in the field.

Materials and methods

A systematic literature search was conducted in PubMed and Google Scholar from 2014 to 2023 using the search terms “clinical evaluation” + “spine metastases,” “spine metastases” + “diagnosis,” and “spine metastases” + “decision making” + “treatment.” The screening criteria yielded 1653 papers. A total of 13, 35, and 32 studies, respectively, were selected after exclusion of repeat articles, case reports, unavailable full text articles, non-English language papers and single center studies. These were subsequently analyzed (Fig. 1). Studies included randomized controlled trials, meta-analyses, and review articles, while case reports and case series were excluded to maintain high-level evidence.

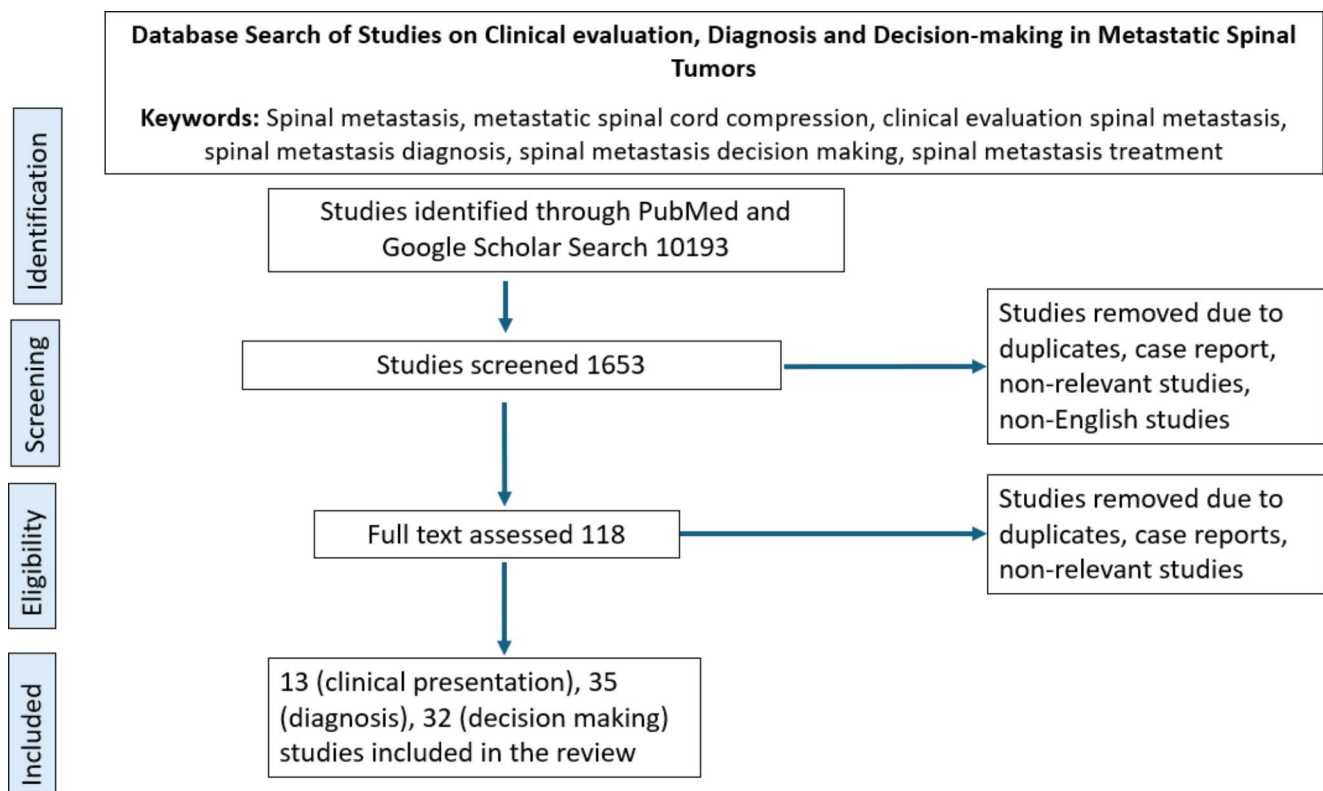


Fig. 1 PRISMA flowchart for identification and analysis of studies pertaining to clinical evaluation, diagnosis and decision-making in spinal metastasis

Based on this review, presentations and discussions were done in two consensus meetings.

Consensus meetings

An international committee of spinal surgeons, specifically members of the World Federation of Neurosurgical Societies (WFNS) Spine Committee, organized two consensus meetings on spinal metastases. The first was conducted in Karad, India, in January 2023, and the second in Belgrade, Serbia, in October 2023. Each participant provided a set of statements on spinal metastases, which were discussed and revised at the initial meeting. After a preliminary voting session, some statements were excluded due to the low evidence of existing literature. Five revised statements were voted on at the second meeting.

Six committee members were given a set of questions on which they anonymously voted. We utilized the Delphi method to generate our consensus statements. The level of agreement or disagreement on each item was voted on independently in a blind fashion through a Likert-type scale from 1 to 5 (1 = strongly agree, 2 = agree, 3 = somewhat agree, 4 = disagree, 5 = strongly disagree). Results were presented as a percentage of respondents who scored each item as 1, 2, or 3 (agreement) or as 4 or 5 (disagreement). Consensus was achieved when the sum for agreement on a question was $\geq 66\%$.

This systematic review tried to answer the questions below:

- 1- What are the initial symptoms and clinical signs of spinal metastasis?.
- 2- What are the most common symptoms of spinal metastasis?.
- 3- How often are the bladder and bowel symptoms in spinal metastasis patients?.
- 4- What are the goals of treatment in spinal metastasis patients?.
- 5- Which surgical and adjunctive techniques are commonly used for spinal metastasis patients?.

Table 1 Clinical presentation in patients with spinal metastasis. Taken from Sutcliffe et al. [15]

Symptom	% of patients
1. Pain	80–95%
2. Neurological deficit	35–75%
3. Mass	10–20%
4. Constitutional symptoms	30–40%

Results and discussion

Early detection and diagnosis

The question to be addressed was “What are the initial symptoms and clinical signs of spinal metastasis?”.

Early detection of spinal metastases is crucial for improving patient outcomes. Studies indicate that timely diagnosis significantly impacts treatment options and survival rates [11]. In patients with cancer, new-onset back pain, especially in those over 60 years, should prompt further investigation due to the high risk of spinal metastasis [12].

Metastatic spinal disease may present with a wide variety of symptoms including pain, motor sensory or autonomic dysfunction [13](Table 1). Additionally sudden onset back pain may suggest pathological fractures due to lytic lesions in the spine [14].

Constitutional signs of systemic disease including weight loss, anorexia, or organ dysfunction can predominate before symptom onset due to spinal metastasis or due to the primary disease [12]. Physical examination may reveal local spine tenderness and rectal masses in case of sacral metastases [16].

Diagnostic imaging, particularly MRI, is essential for detecting spinal metastases and assessing tumor extent. Advanced imaging techniques such as PET-CT also play a critical role in evaluating disease spread and guiding treatment [2].

Symptomatology

The question to be addressed was “What are the most common symptoms of spinal metastasis?”

Pain is the most common symptom seen in patients with metastatic spine disease with an occurrence of 80–95%¹⁷. However, pain as the presenting feature of spinal metastasis is seen in only 10% of patients [12]. In these patients, it may precede the development of other neurological symptoms by weeks or months [16–18].

Pain in spinal metastasis can be due to one of three causes or a combination: local pain, mechanical pain and radicular pain [19](Fig. 2).

Local pain can be attributed to periosteal stretching due to tumor growth and invasion. This can also occur because of enlargement of the venous plexus due to outflow compression [12, 19]. Local pain is more evident in the night and patient feels better with activity as venous pressure decreases [19]. Pain is described as “gnawing” or “aching” pain, which may improve with activity, and may respond to anti-inflammatory agents or corticosteroids [17].

Mechanical pain may occur due to involvement of the weight bearing and mobile units of the spine and may signal

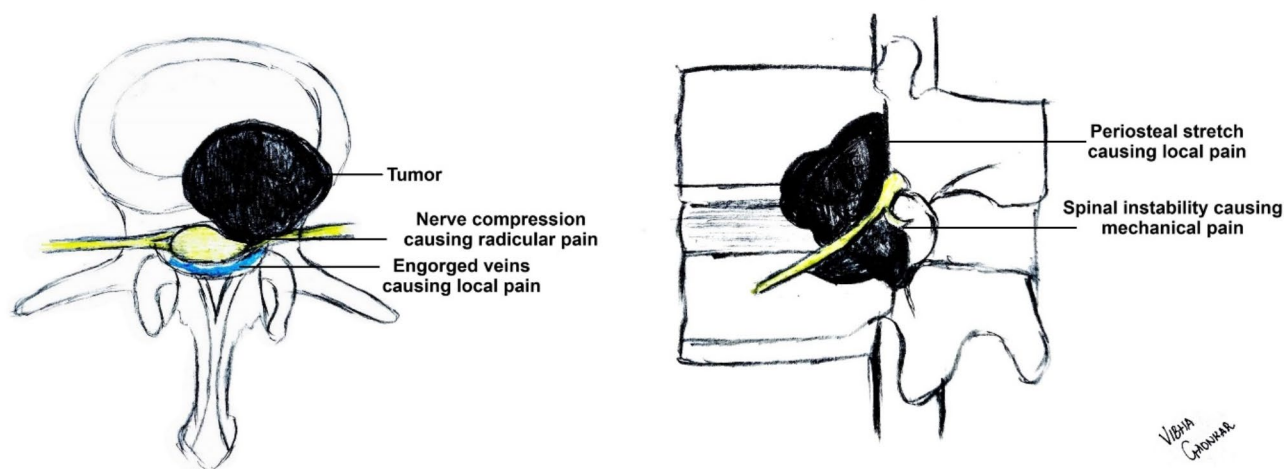


Fig. 2 Diagrammatic representation of pathogenesis of pain in spinal metastasis

an impending instability. In these conditions, there is a strain on the muscles and tendons and therefore mechanical pain is usually aggravated upon weight bearing and axial loading and reduces or abates upon lying supine. Stabilization of the spine improves the pain when it is purely mechanical [12].

Radicular pain may occur due to the involvement or compression of the nerve roots, and this can also occur due to pathological fractures. The pain is sharp and shooting in character with associated paresthesia and dysesthesia. Intradural extramedullary metastases may cause irritation or impingement of nerve roots within the dura mater and may lead to dysesthesias or neuropathic pain [18, 20].

Bladder and bowel symptoms

The question to be addressed was “How often are the bladder and bowel symptoms in spinal metastasis patients?”

Bladder and bowel involvement in patients with spinal metastasis typically results from significant compression of the spinal cord or cauda equina and so this clinical presentation should be considered critical.

Bladder and bowel dysfunction occurs in nearly 50% of patients with extradural spinal metastasis [21]. Helweg et al. reported the need for a urinary catheter in 37% of patients with metastatic spinal cord compression [22]. Bladder and bowel involvement is also seen in patients with intrathecal compressive lesions and leptomeningeal carcinomatosis with drop metastasis. These reflect the severe cases where the spinal cord or nerve roots are significantly compressed.

Patients may experience symptoms such as urinary incontinence, difficulty urinating, or bowel incontinence. Onset of sphincter disturbance is attributed to the involvement of the autonomic nerves by the infiltrating tumor [23].

The development of bladder and bowel symptoms is a serious clinical finding that often necessitates urgent intervention. It may prompt immediate imaging and treatment to relieve pressure and prevent permanent damage [24].

Managing these symptoms involves a multidisciplinary approach, including neurosurgical intervention, radiotherapy, and supportive care. Early intervention is crucial to prevent further deterioration and improve quality of life [25].

Treatment goals

The question to be addressed was “What are the goals of treatment in spinal metastasis patients?”

The management of spinal metastasis is most often palliative with the primary aim being preservation or improvement in quality of life. This aim addresses pain management, relief of neurological deficits and regaining ambulatory status [26].

Due to the variable presentation and treatment response, a multidisciplinary approach involving chemotherapy, radiotherapy, surgical management, and palliative care becomes necessary [27]. This team is required to address pain relief, tumor control, neurological preservation, and spinal stabilization. The establishment of a multi-disciplinary team assists the treating physician in optimal management of the case [28].

Decision making in patients with spinal metastasis has been made using classification- based and principle-based prognostic models.

Tomita, Tokuhashi, Bauer and Katagiri scoring systems are some examples of classification- based scoring systems and these help in estimating the survival of patients diagnosed with spinal metastasis. The life expectancy of the patient is predicted based on scores assigned to each

prognostic factor. Based on these scores, the surgeons select patients with sufficient life expectancy to undergo surgical treatment if needed [29].

The principle-based decision-making systems like the NOMS framework provide specific suggestions on management strategy based on individual oncologic, functional, and systemic status. They also reflect advances in cancer management including molecular target therapy, separation surgery and systemic radiation therapy [30].

Surgical options, such as decompression and stabilization, are critical for relieving spinal cord pressure and preventing neurological deficits [30, 31]. Radiotherapy, including SRS, provides effective tumor control while minimizing surrounding tissue damage [32]. Systemic therapies are tailored based on tumor type and metastasis extent [33].

Separation surgery combined with SRS

The question to be addressed was “Which surgical and adjunctive techniques are commonly used for spinal metastasis patients?”

The combination of separation surgery and SRS is an effective treatment for spinal metastases, addressing both local tumor control and spinal stability.

Separation surgery is a surgical technique used in the management of spinal metastasis particularly used when the cancer has led to significant instability or compression of the spinal cord or nerve roots.

With the advent of ablative radiation (SRS and SBRT), surgical management for spinal metastasis has evolved from the aggressive cytoreduction surgery aimed at maximal excision of tumor mass for better local control to the modern idea of separation surgery [4].

Separation surgery is an innovative technique which aims at circumferential decompression of the spinal cord and nerve roots to preserve nerve function while also restoring lost function (Fig. 3). In addition, it creates an ablative

target for radiation by providing a safe distance between the nervous tissue and tumor [34–37]. The achievement of a 360-degree decompression with either MIS or open technique allows delivery of high dose of radiation via SRS or SBRT and this combined with systemic therapy where applicable, results in better tumor control while reducing morbidity [4, 35, 36, 38].

The procedure of separation surgery involves: (1) Debulking: The procedure begins with the removal of tumor which is causing compression of the spinal cord or nerve roots. (2) Decompression: This is followed by decompression of the spinal cord by removing or reducing the pressure exerted by the tumor or surrounding structures. (3) Stabilization: After decompression, the spine is stabilized using instrumentation to prevent instability and ensure proper alignment.

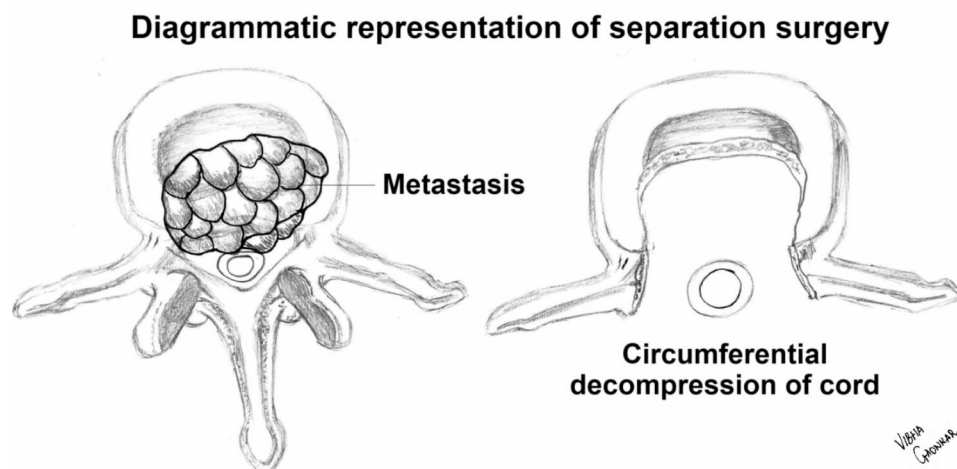
This procedure can be done by an anterior, posterior, or combined approach. It can be done by open surgery or minimally invasive technique [39].

The surgical procedure is followed by stereotactic radiotherapy after 2–4 weeks duration. The combined procedure achieves good local control, relieves pain, and improves neurological function. The outcome depends on the radiation dose and the distance between the cord and the residual tumor. Due to high dose of radiation used in SRS and SBRT, the histology and sensitivity of the tumor to radiation is no longer considered [40].

Factors influencing outcome following separation surgery + SRS are functional status of the patient, pre-operative neuro-deficit, pre-operative embolization, complications following surgery, progressive local or systemic disease following SRS and interval between radiation courses [30, 41–43].

This combined approach has shown improved functional outcomes and survival rates in recent studies. However, treatment must be individualized based on tumor type, location, and patient health.

Fig. 3 Diagrammatic representation of separation surgery



Recommendations

1 A high index of suspicion for early detection and diagnosis of spinal metastasis in cancer patients and adult patients more than 60 years presenting with new onset fractures / neurological deficits is recommended. (6/6 agreement 100%)

2 Pain is the most common symptom in patients with spinal metastasis closely followed by motor radiculopathy. The origin of pain can be multifactorial, owing to local tumor related pain, nerve root irritation or pain due to spinal instability. (6/6 agreement 100%)

3 Bladder and bowel symptoms are present in more than half of the patients with spinal cord compression at the time of diagnosis. (6/6 agreement 100%)

4 An effective treatment for spinal metastases should be able to achieve pain relief, tumor control, prevention of neurological compromise and treat instability. (6/6 agreement 100%)

5 Separation surgery combined with SRS is an effective treatment for spinal metastases. (5/6 agreement 83.3%)

Conclusions

Spinal metastasis is a concern in patients with cancer and in elderly patients presenting with back pain and new onset neurological deficit. A high degree of suspicion is mandatory in these patients. The most common presentation is pain followed by neurological deficit. Bladder and bowel involvement is seen in nearly half of the patients with cord compression. Treatment in patients with spinal metastasis should be planned with a multi-disciplinary committee. Advances in management like separation surgery, stereotactic radiosurgery and systemic therapy should be put to optimal use.

Author contributions All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by [SV, VG, MSB]. The first draft of the manuscript was written by [VG, MSB] and the revisions were done by all other authors [SV, VG, MSB, OY, MZ, SS]. The illustrations (Figs. 2 and 3) were created by [VG]. All authors read and approved the final manuscript.

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Data availability No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate The study was conducted in accordance with the Declaration of Helsinki. Due to the nature of the study, no approval by the institutional review board was necessary.

Competing interests The authors declare no competing interests.

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