



Review

Evolution in treatment strategy for metastatic spine disease: Presently evolving modalities

N. Kumar ^{a,*}, R. Malhotra ^a, A.S. Zaw ^a, K. Maharajan ^a,
N. Naresh ^b, A. Kumar ^c, B. Vellayappan ^d

^a Department of Orthopaedic Surgery, University Spine Centre, National University Health System, 1 E Kent Ridge Road, Singapore

^b School of Dental Sciences, Newcastle University, Framlington Place, Newcastle upon Tyne NE2 4BW, United Kingdom

^c Department of Orthopaedic Surgery, Khoo Teck Puat Hospital, Singapore

^d Department of Radiation Oncology, National University Cancer Institute of Singapore, National University Health System, Singapore

Accepted 5 May 2017

Available online ■ ■ ■

Abstract

The advent of minimally invasive surgery (MIS) in the surgical management armamentarium and stereotactic radiosurgery in the domain of radiotherapy, has led to a major evolution in treatment of metastatic spine disease (MSD). We reviewed the recent literature to discuss evolution from open to MIS approaches in MSD and the concurrent evolution in radiotherapy. This will provide a sound base for further development and understanding of treatment paradigms in MSD. Literature review showed that evolution of surgery can be traced from inappropriate open surgery (i.e. laminectomy) to appropriate open (i.e. posterior instrumentation and decompression) and further to minimally invasive surgery. This transition was concurrent with the introduction of radiotherapy and its evolution in management of MSD. Evidence shows that presently, the best clinical outcomes are achieved by surgery with timely postoperative radiotherapy. To make surgery an appealing choice in MSD, surgical morbidity needs to be minimized when planning postoperative oncological treatment. MIS approaches have advantages such as early wound healing enabling early introduction of radiotherapy, reduced intraoperative blood loss and shortened hospital stay. Pain reduction and neurological improvement are comparable to open surgery. A multidisciplinary team approach including spinal surgeons, medical & radiation oncologists is mandatory, as the treatment options are constantly evolving. Advancement in radiotherapy with introduction of MIS can be a game-changer in MSD due to reduced peri-operative morbidity, allowing earlier postoperative radiotherapy/chemotherapy. We also provide our treatment algorithm which relies on clinical presentation and radiological appearance of spinal cord compression, providing an overview of treatment strategy.

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Keywords: Spinal metastasis; Open surgery; Minimally invasive surgery; Radiotherapy; Chemotherapy

Introduction

The spine is the most common site for osseous metastasis from systemic neoplasia.^{1,2} Metastatic Spine Disease (MSD) can be regarded as a new ‘epidemic’. It can lead

to significant morbidities – namely pain and/or neurological deficits. Traditionally, surgery has been indicated in conjunction with medical treatment in specific situations or when radiotherapy (RTx) and/or chemotherapy (CTx) have failed. It is also commonly employed in emergent situations such as rapid neurological deterioration or pathological fracture. Measures to reduce surgical morbidity in these high-risk patients should be taken. Minimally invasive surgery (MIS) seems to be a logical solution to reduce

* Corresponding author. Department of Orthopaedic Surgery, National University Health System, 1 E Kent Ridge Road, 119228, Singapore. Fax: +65 67780720.

E-mail address: dosksn@nus.edu.sg (N. Kumar).

<http://dx.doi.org/10.1016/j.ejsso.2017.05.006>

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Abbreviations

MIS	minimally invasive surgery
MSD	metastatic spine disease
RTx	radiotherapy
CTx	chemotherapy
MASS	minimal access spinal surgery
VATS	video assisted thoracoscopic surgery
PLIF	posterior lumbar interbody fusion
TLIF	transforaminal lumbar interbody fusion
SRS	stereotactic radiosurgery
cEBRT	conventional external beam radiotherapy

surgical morbidity in such patients. The use of MIS in MSD is relatively new and revolutionary.³ Its indications are still being defined and are constantly evolving.^{3–5}

This review highlights the evolution of surgery and RTx in the management of MSD over the years including recent advances such as MIS and stereotactic radiosurgery with reference to MSD. An algorithm for the management of MSD is also proposed in light of the newer advances.

Search strategy and selection criteria

We searched Medline, Pubmed, Scopus and Google Scholar for the relevant publications from the past 50 years (January 1966 to September 2016) in order to cover the periods of major advancements in surgery and RTx. We also supplemented the results by searching related key articles from before this period to trace the evolution of surgery and RTx from their inception. Relevant articles were selected using search terms: “minimally invasive surgery”, “surgery”, “metastatic spine disease”, and any of these terms with “radiotherapy” and “chemotherapy”. We also identified additional articles through manual searches of references in the key articles selected using the above method. Only the articles relevant to the scope of this review and articles published in English were included in the final reference list.

Epidemiology and incidence

The incidence of cancer is on the rise with approximately 1.6 million new cancer cases diagnosed in the US in 2013.⁶ The World Health Organization estimates that there were 10 million people who were diagnosed with cancer worldwide in 2000 and the incidence of cancer is likely to increase 1.5 times by 2020.⁷ In essence, the burden of cancer related complications and presentation of metastatic disease are inevitably going to rise.⁷ The spine as part of the skeletal system is the third most common system after lung and liver to which metastases take place.² Symptomatic spinal metastases are identified in about 10% of cancer patients.⁸ Spinal metastases can be categorized into two types: extradural (intravertebral lesion with or without epidural spread) and intradural.¹

Extradural lesions comprises 90%–95% of metastatic spinal lesions.⁹ The highest incidence of spinal metastases occurs between 40 and 70 years of age, which may be related to an increased risk of cancer during this period.⁷ The most common primary cancers that metastasize to the spine are of epithelial origin, which include breast (21%), lung (14%), prostate (8%), kidney (5%), and thyroid (3%).¹⁰ Symptomatic spinal metastases are mostly found in the thoracic region (60–80%) followed by lumbosacral region (15–30%) and the least in cervical region (10–15%).^{1,7}

Clinical presentation

Pain, the most common symptom (95%) in MSD patients, occurs from periosteal stretching, instability pain, neurogenic/radicular pain from direct compression from tumour or vertebral body collapse.^{7,8,11} Neurological symptoms comprise the second commonest modality of presentation (75–80%) and occur due to compression of neural structures leading to sensory, motor, and/or sphincter dysfunction.^{7,8,11} Motor and sensory deficits may progress slowly, and if mild, can be managed non-operatively. However, acute and severe motor or sphincter dysfunction necessitates early surgical intervention.^{8,11}

‘Spinal instability’ as a consequence of MSD is still poorly understood but is gaining recognition.^{12,13} It can be successfully managed surgically. The most common symptom of instability is pain on movement, which can render a patient bed-ridden when severe, irrespective of neurological function. This pain is aggravated by normal physiological forces such as twisting/bending and loading of the spine and is relieved when the spine is supported and off-loaded, such as when lying down.^{1,8,14} The Spine Instability Neoplastic Score (SINS) was designed based on expert consensus to qualitatively assess spinal instability according to a number of radiological and clinical factors.¹² The SINS system summary is shown in [Table 1](#).

Evolution of traditional treatment paradigm in MSD

The evolution of surgical management of MSD has been highlighted in [Fig. 1](#) and briefly described in [Table 2](#).

Evolution of surgery

In the first half of 20th century, surgical strategies involved posterior decompressive surgery for MSD. In traditional posterior decompressive laminectomy for MSD with neurological deficits, access to the anterior tumour is limited by the inability to retract the spinal cord intra-operatively, thereby compromising the effectiveness of the procedure. Without instrumented stabilization, this resulted in spinal instability. This led to RTx becoming the favoured treatment for MSD in the past, as laminectomy outcomes were not superior in terms of neurological function improvement and pain control.^{1,2,7,8,11,15} Newer

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