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Clinical Study

The incidence and patterns of hardware failure after separation surgery in patients with spinal metastatic tumors

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Abstract

BACKGROUND CONTEXT: Spine metastases occur frequently in patients with cancer. A variety of surgical approaches, including anterior transcavitary, lateral extracavitary, posterolateral, and/or combined techniques are used for spinal cord decompression and restoration of spinal stability. The incidence of symptomatic hardware failure is unknown for the majority of these approaches.

PURPOSE: The purpose of this study was to determine the incidence of symptomatic hardware failure and the associated risk factors in patients with metastatic epidural spinal cord compression (MESCC).

STUDY DESIGN/SETTING: This was a retrospective study.

PATIENT SAMPLE: The current series analyzes a cohort of 318 patients who underwent separation surgery, which involves single-stage posterolateral decompression and posterior segmental instrumentation for MESCC.

OUTCOME MEASURES: The event of interest was hardware failure; the competing event was death resulting from any cause. All patients were monitored for survival analysis. A competing risk analysis was conducted to examine univariately a number of potential risk factors associated with hardware failure, including junctional level, gender, construct length, and the presence or absence of prior chest wall resection.

METHODS: A retrospective analysis and chart review were performed for 318 consecutive patients who underwent posterolateral decompression and posterior screw-rod fixation without supplemental anterior fixation from March 2004 to June 2011 at our institution. The median follow-up time for survivors without hardware failure was 399 days (range, 9–2,828), with a mean operative time of 3 hours. A total of 78% of patients died during the 7-year study period.

RESULTS: Of the 318 patients, nine (2.8%) exhibited signs and symptoms of hardware failure and required revision of the instrumentation. Patients with chest wall resection and those with initial construct length greater than six contiguous spinal levels exhibited a statistically significantly

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The disclosure key can be found on the Table of Contents and at www.TheSpineJournalOnline.com.

NMA and RX contributed equally to this work.

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this article.

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higher risk of symptomatic hardware failure than their counterparts. We observed a trend toward an increased risk of failure in women compared with men (p=.09).

CONCLUSIONS: The incidence of hardware failure is low in patients with MESCC who undergo posterolateral decompression and posterior screw-rod instrumentation. Moreover, the short operative time and low morbidity profile associated with this approach make it a reliable and acceptable method for the surgical treatment of MESCC. Patients with constructs spanning six or more levels or those with prior chest wall resection are at higher risk for instrumentation failure.

Keywords: Hardware failure; Spine metastasis; Epidural decompression; Instrumentation; Separation surgery; Posterolateral approach

Introduction

Spinal column metastases are frequent events in malignancy and may result in pain, instability, and neurologic deficits [1–4]. The surgical management of metastatic epidural spinal cord compression (MESCC) varies by institution and surgeon [5–7]. Although anterior transcavitary, posterior, and combined approaches may be used effectively for stabilization of the spinal column after tumor resection, the incidence of hardware failure associated with each of these approaches has not been examined systematically [8]. Knowledge regarding the incidence of morbid postoperative events such as hardware failure is important in clinical decision making for patients with MESCC, for whom palliation of symptoms is the primary goal.

New adjuvant spine radiotherapy protocols developed at our institution and others have improved local disease control markedly following surgical decompression in patients with MESCC [9,10]. These improvements in local control rates are largely a result of the increased availability and use of stereotactic radiosurgery (SRS) for the spine [11–14]. Our recent analysis of local control rates in MESCC following image-guided, intensity-modulated therapy given as a single fraction (24 Gy) or hypofractionated (three to six fractions, 18–36 Gy) revealed a cumulative 1-year local control rate of 84%. These results compare quite favorably with conventional external beam radiotherapy (cEBRT), with which 1-year local control rates as low as 30% have been observed [15–17]. In our judgment, the use of postoperative adjuvant SRS obviates the need for aggressive surgical resection, including extensive removal of tumor from the anterior spinal column in most cases. Our surgical goals have shifted from maximal tumor resection for local tumor control to a more limited tumor resection with the aim of achieving circumferential epidural decompression. We then rely on postoperative SRS to provide durable tumor control [18]. This circumferential decompression of the thecal sac, or ‘‘separation surgery,’’ can be accomplished entirely through the posterolateral approach and spares the patient from anterior exposures or lengthy combined anterior-posterior approaches, regardless of the status of disease in the vertebral body [19,20]. Separation surgery represents a change in our approach from our previously reported technique of a posterolateral transpedicular approach with circumferential decompression and fixation, in which the anterior column was resected and reconstructed using polymethylmethacrylate (PMMA) and Steinman pins [20,21]. Separation surgery provides the same extent of epidural spinal cord decompression, but relies solely on posterior instrumentation to provide spinal stability. Separation surgery via a posterolateral decompression and instrumentation has the advantage of decreased operative time and blood loss compared with surgical approaches that aim to reconstruct the anterior column [22]. However, the absence of anterior column reconstruction could result theoretically in a high incidence of hardware failure from compression fractures and hardware stress. This concern is especially relevant in the setting of SRS, for which fracture rates from 11% to 39% have been reported following SRS [23–25]. Given these concerns, we sought to address the incidence of symptomatic hardware failure in our cohort of patients and to define risk factors associated with such events.

Materials and methods

Study design

The study population included patients who underwent surgery to treat spinal metastases at the Memorial Sloan-Kettering Cancer Center (MSKCC) between March 2004 and June 2011. This study was approved by MSKCC’s institutional review board. Anterior reconstruction performed as a stand-alone construct or in combination with posterior stabilization was an exclusion criterion, leaving only patients with posterolateral decompression and posterior screw-rod instrumentation. Sixty-seven patients were excluded as a result of the presence of anterior instrumentation, resulting in 318 patients meeting the inclusion criteria for our analysis. The majority of the excluded patients underwent surgery at the beginning of the study period, during a time when the surgical approach was undergoing evolution, and anterior reconstruction was used intermittently. During the later portion of the study period, stand-alone posterior reconstruction was used nearly exclusively for patients with MESCC. The primary end point of the study was return to