

# Short-term outcomes of posterior surgery for thoracolumbar spinal metastasis

Belal Elnady, Karim Gamal, Mohamed G. Hassan, Mahmoud F. Ibrahim, Essam Elmorshidy

Department of Orthopedic and Trauma Surgery, Assiut University Hospital, Assiut, Egypt

Correspondence to Essam Elmorshidy, MD, PhD, Department of Orthopedic and Trauma Surgery, Assiut University Hospital, Assiut, Egypt, 71111, Assiut, Egypt  
Tel: 0201119343404; e-mail: esmorshidy@aun.edu.eg

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## Purpose

The purpose of the work is to evaluate the postoperative quality of life, neurological condition, and ambulatory status of patients with spinal metastases treated surgically during the first year after surgery in countries with limited resources.

## Methods

This was a prospective case series study. All patients with spinal metastasis and indicated for surgery, presented to our facility from 2020 to 2021 were included in the study. Clinical evaluation includes visual analog score (VAS) for back pain, the Frankel grading system for neurological assessment, the Tokuhashi severity and survival score for predicting the expected patient survival period, and the 5Q-ED score for assessment of quality of life.

## Results

This study included 30 patients with thoracolumbar spine metastasis who underwent surgery, 21 males and 9 females in the age range of between 18 and 72 years with a median value of  $49.17 \pm 13.272$  years. Five patients died within 6 months postoperatively due to advanced malignancy, while the remaining 25 patients were followed-up for at least 1 year.

## Conclusion

Surgical treatment for metastatic spinal tumor can improve quality of life in a substantially high percentage of patients with acceptable complication rates in a limited resource setting. Spinal surgery for metastatic cancer significantly reduces pain and is effective in preserving neurological function over short-term follow-up with acceptably low morbidity. The Tokuhashi score (especially primary site of malignancy) had a significant effect on overall survival.

## Keywords:

outcomes, spinal metastasis, surgical treatment, thoracolumbar

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## Introduction

The spine is the most common site for skeletal metastasis. About 30% of patients with malignancy will initially present with symptomatic spinal metastasis and about 90% of metastasis occurs in the thoracolumbar spine [1].

Thoracolumbar spinal metastasis can cause instability, severe axial pain, radicular pain, and/or neurological injury up to paralysis, which can significantly impair patients function and quality of life [2].

Surgery for spinal metastasis can restore spinal stability, protect neural elements, and improve pain and function. However, proper selection of patients and optimal choice of surgical approach is crucial to provide the maximal benefits of surgery while minimizing risks and morbidity [3,4].

Most of the previous literature treated spinal metastasis through either posterior, anterior or

combined approach based on the site and extent of spinal metastasis [5].

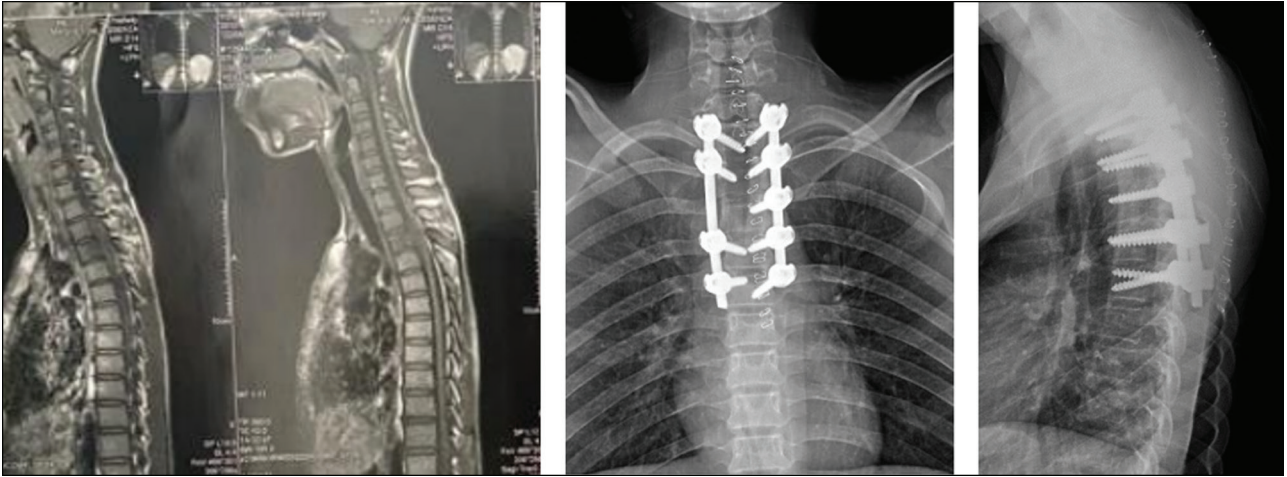
The aim of this study is to document the short-term outcomes and complications of posterior surgery for thoracolumbar metastasis in a limited-resource setting as well as clinical significance of the Tokuhashi score in predicting survival [6].

## Patients and methods

From October 2020 to October 2021, all patients with thoracolumbar spine metastasis presented to our hospital and indicated for surgical intervention were treated by posterior surgery and were prospectively followed-up at least 1 year after surgery. This study

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Figure 1



A male patient of 18 years old, single-level metastasis at D3. The primary tumor is unknown. Posterior spinal fixation and laminectomy.

was ethically approved by our Institutional Review Board and informed consents were obtained from all participants.

Preoperative evaluation started with thorough history and full clinical and neurological examination. Radiological evaluation started with plain radiograph in two standard views followed by whole-body MRI or computed tomography (CT) to detect other visceral or skeletal metastasis and to exclude multiple spinal metastases.

Clinical evaluation includes visual analogue score (VAS) for back pain, Frankel grading system for neurological assessment, revised Tokuhashi severity and survival score for predicting the expected patient survival period, and the 5Q-ED score for assessment of quality of life [7].

The revised Tokuhashi score evaluates the general condition of the patient, number of spinal metastasis, the extent of major internal organ metastasis, degree of neurological deficit, and the primary site of malignancy. Patients with a score less than 8 have a predicted survival period of less than 6 months [6].

The EQ-5D comprises five questions on mobility, self-care, pain, usual activities, and psychological status with three possible answers for each item (1=no problem, 2=moderate problem, 3=severe problem). A summary index with a maximum score of 1 can be derived from these five dimensions. Score analyses were performed to explore the impact of patient and disease characteristics on health-related quality of life [8].

The choice of surgical intervention depends on several factors including age, medical condition, site and extent of spinal metastasis, the presence or absence of

instability or neural compression, and the expected life span according to the revised Tokuhashi score.

All patients were treated by posterior-only surgery. Patients with instability and neural compression were treated with pedicle screw fixation and posterior decompression (Fig. 1), while patients with anterior compression due to retropulsed vertebral body metastasis with good life expectancy and good general condition were treated by posterior corpectomy with a mesh cage to restore stability and remove anterior compression (Fig. 2).

Fragile patients with cord compression without instability were treated by palliative laminectomy, while posterior fixation only was chosen for patients with pathological fractures with no neural compression.

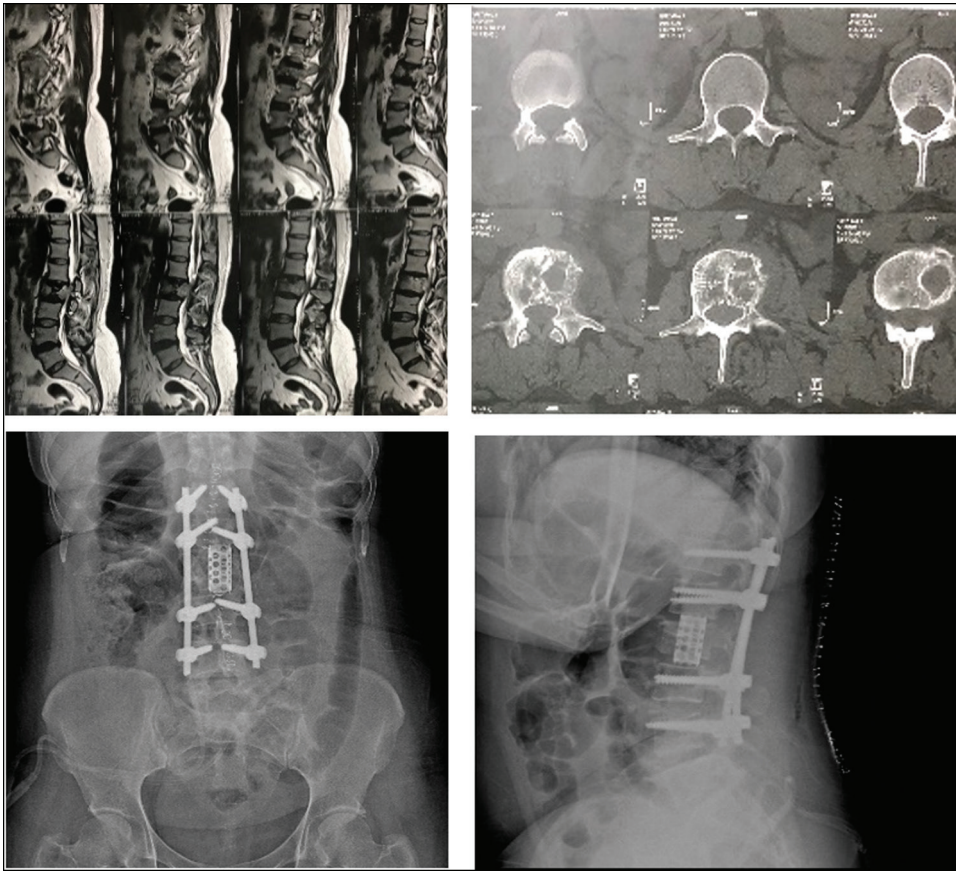
All patients indicated for surgery were operated upon on urgent basis except for one patient whose surgery was scheduled 6 weeks after his last radiotherapy session to avoid potential wound complications.

All patients received postoperative adjuvant chemotherapy and/or radiotherapy according to the multidisciplinary oncology team after complete wound healing.

The follow-up visits were scheduled after 3 weeks for evaluation of the wound and then every 3 months till the end of the first year. Patients were evaluated clinically and radiologically by plain radiographs at each follow-up visit. MRI or CT is ordered if needed during the follow-up period.

Statistical analysis of data was done using the IBM SPSS software package version 20.0. The normality of dispersion was examined using the Kolmogorov-

Figure 2



A female patient 40 years old, single-level metastasis at L2. The primary tumor is cancer breast. Posterior spinal fixation and posterolateral corpectomy with reconstruction using a mesh cage.

Smirnov test.  $\chi^2$  test was used to compare categorical data while Student's *t*-test was used to compare quantitative variables. Mann-Whitney test was used to compare aberrant quantitative variables.

## Results

This study included 30 patients with thoracolumbar metastasis indicated for surgery out of 72 patients with thoracolumbar metastasis who were admitted to our hospital during the study period. The remaining 42 patients were treated with chemotherapy or radiotherapy and were excluded from the study.

Ten patients had single-level metastasis, while 20 patients had multiple-level metastasis. In patients with multiple metastasis, the management was focused on the level that mostly correlated with the patient's symptoms.

Indications for surgery were neurological deficits due to spinal cord compression in 23 patients. The remaining seven patients had intractable back pain with or without pathological fracture.

This study included 21 males and 9 females. The mean age was  $49.17 \pm 13.272$  years (range 18–72 years). Five patients died within 6 months postoperatively due to advanced malignancy, while the remaining 25 patients were followed-up for a mean of  $12.7 \pm 1.89$  months.

The mean preoperative VAS score for back pain was 5.77 and improved to a mean of 3.61 at 1 year. Regarding the Frankel grading system, two patients had complete motor deficits (Frankel A and B), 21 patients had incomplete motor deficits (Frankel C and D), while seven patients were neurologically intact at the time of surgery (Frankel E). Neurological improvement by at least one Frankel grade within 6 months occurred in 20 patients out of 21 with incomplete paraparesis. Patients with complete lesions showed no improvement in neurological deficits.

Regarding the type of surgical intervention, 17 patients had posterior corpectomy and mesh cage due to retracted metastasis of the vertebral body causing anterior compression of the spinal cord. The



mesh cage was filled with polymethyl methacrylate to provide immediate stability. Six patients had posterior fixation and laminectomy, five patients had posterior fixation only. Regarding the number of instrumented vertebrae, two levels above and two levels below were usually done. While palliative posterior laminectomy alone is no longer recommended [9], it was done in only two patients with posterior epidural compression and without pathological fracture. The average hospital stay was 2–3 days. A suction drain was applied in all patients and removed on day 2 postoperatively.

Intraoperative dural tear occurred in two patients, and direct repair was done immediately with no postoperative CSF leakage. Wound dehiscence and infection occurred in three patients and were treated by aggressive debridement, secondary closure, and extended antibiotic regimen.

One patient developed postoperative pulmonary embolism and was treated.

One patient developed postoperative neurological deterioration after an uneventful surgery. The immediate postoperative CT showed a satisfactory position of the hardware; however, the MRI showed a high signal intensity in the T2 sequence. Therefore, high-dose methylprednisolone was rapidly administered intravenously. The patient received methylprednisolone (30 mg/kg) over 15 min, followed by a 45 min rest and a 23 h maintenance infusion (5.4 mg/kg/h), according

to the National Acute Spinal Cord Injury Study II (NASCIS-2) protocol [10]. Also, a proton-pump inhibitor (40 mg) was administered to the patient before each dose of methylprednisolone to prevent gastrointestinal bleeding. Fortunately, the patient improved gradually over the following 3 months after being engaged in an extensive physiotherapy rehabilitation program.

As regards the revised Tokuhashi score, the total score ranged between 5 and 14 with a mean value of  $8.93 \pm 2.876$ . There were highly statistically significant differences between survived and dead patients according to the primary site of malignancy and total score (Table 1).

Five patients died during the first 6 months after surgery. All deceased patients had a Tokuhashi score of less than 8. There were no statistically significant differences between survived and dead patients as regards age and sex.

The most common primary site for malignancy was breast cancer in six patients followed by prostate cancer in five patients (Table 2).

The main EQ-5D score was 0.72, preoperative and improved to a mean of 0.75 postoperative with a mean score at the final follow-up of 0.81. At 1-year follow-up, the detailed analysis of the five EQ-5D dimensions showed that the majority of patients did not have any problems with self-care and better mobility except

**Table 1 Distribution of patients according to the revised Tokuhashi score**

	Mortality		P value
	Survived [n (%)]	Died [n (%)]	
<b>General condition</b>			
Poor (PS 10% to 40%)	1 (4.0)	0	0.101
Moderate (PS 50% to 70%)	12 (48.0)	5 (100)	
Good (PS 80% to 100%)	12 (48.0)	0	
<b>Primary site of malignancy</b>			
Lung, osteosarcoma, stomach, bladder, esophagus, or pancreas	2 (8.0)	2 (40.0)	0.001*
Liver, gallbladder, unidentified	5 (20.0)	2 (40.0)	
Others	4 (16.0)	1 (20.0)	
Kidney, uterus	1 (4.0)	0	
Rectum	0	0	
Thyroid, breast, prostate, carcinoid	13 (52.0)	0	
<b>Palsy</b>			
Complete (Frankel A, B)	1 (4.0)	1 (20.0)	0.214
Incomplete (Frankel C, D)	17 (68.0)	4 (80.0)	
Non (Frankel E)	7 (28.0)	0	
<b>Total Score</b>			
<6 months	11 (44.0)	5 (100.0)	0.072
6–12 months	6 (24.0)	0	
≥1 year	8 (32.0)	0	
Range	5–14	5–6	0.002*
Mean±SD	9.56±2.740	5.80±0.447	

those who were bedridden preoperatively. About half of the patients have better pain control. Patients could perform their usual activities with less anxiety or depression.

The quality of life showed marked improvement in most of the patients. After 6 months postoperatively, most of the patients needed less pain control and showed good ambulation. At 1-year follow-up, 16 patients out of the surviving 25 patients had better walking, self-care with no problems in performing usual activities with less pain and anxiety with a highly significant difference between preoperative and postoperative EQ-5D scores (Table 3).

## Discussion

Management of patients with spinal metastasis has markedly improved during the last few years.

**Table 2 Distribution of patients according to the primary site of malignancy**

Primary site of malignancy	No.
Breast	6
Prostate	5
Unidentified	4
Lung	3
Liver	3
Multiple myeloma	3
Thyroid	2
Kidney	1
Lymphoma	1
Pancreas	1
Parathyroid	1

**Table 3 Distribution of patients according to preoperative and 12-month postoperative EQ-5D score**

	Preoperative (N=30) [n (%)]	Follow-up (N=25) 12 months [n (%)]	P value
<b>Mobility</b>			
No problems in walking	3 (10)	14 (56.7)	<0.001*
Some problems in walking	8 (26.6)	5 (20)	
Confined to bed	19 (63.3)	6 (24)	
<b>Self-care</b>			
No problems with self-care	2 (6.6)	16 (64)	<0.001*
Some problems in washing/dressing	9 (30)	3 (12)	
Unable to wash or dress myself	19 (63.3)	6 (24)	
<b>Usual activities</b>			
No problems with performing my usual activities	3 (10)	15 (60)	<0.001*
Some problems with performing my usual activities	6 (20.0)	4 (16)	
Unable to perform my usual activities	21 (70)	6 (24)	
<b>Pain/discomfort</b>			
No pain or discomfort	0	7 (28)	<0.001*
Moderate pain or discomfort	8 (26)	5 (20)	
Extreme pain or discomfort	22 (73)	13 (52)	
<b>Anxiety/depression</b>			
No anxious or depressed	2 (6.6)	5 (20)	<0.001*
Moderately nxious or depressed	6 (20.0)	6 (24)	
Extremely anxious or depressed	22 (73)	14 (56)	

This resulted in earlier diagnosis of malignancy and increased the potential for survival of patients with multidisciplinary management [1].

Advances in spinal instrumentation, reconstruction of destroyed vertebral bodies and more precise surgical techniques allowed better outcomes after surgical treatment of spinal metastasis with immediate restoration of spinal stability and circumferential decompression of the spinal cord, cauda equina, and nerve roots [3,4].

The goals of surgery in patients with spinal metastasis are essentially palliative to improve pain, mobility, and to prevent or improve neurological deficits. This should be associated with minimal morbidity for this fragile population to allow better quality of life. Finding a balance between the estimated patient survival and the anticipated risks and benefits of surgery is crucial for proper patient selection [11].

The choice of surgical approach for thoracolumbar metastasis is classically dependent on the site of the tumor. For excision and reconstruction of vertebral body tumors, the anterior approach alone or combined with posterior stabilization is used while metastasis of the posterior neural arch is treated with the posterior approach [12].

Recently, the posterior and posterolateral approach can provide a three-column management of the thoracolumbar spine with a more familiar, less morbid single approach alleviating the need for an anterior

or combined approach and their possible related morbidity [13].

In this study, a posterior single approach was used to stabilize the spine, circumferentially decompress the neural element and excise and reconstruct vertebral body lesions if needed. We did not try to accomplish bony fusion by adding bone grafts. Our concept is that radiotherapy and/or chemotherapy along with the patient's catabolic state make the likelihood of fusion small.

Cement augmentation procedures, e.g. vertebroplasty or kyphoplasty were not utilized in our study as the main aim of our surgeries was to decompress the neural elements, an aim which could not be achieved by these procedures. Besides, these procedures are not readily available in our limited resources community.

Patients with neurological deficits presenting to our emergency department were scheduled for surgery in the next morning's operative list. We believe that such surgeries should be done by the most experienced surgeons with the best perioperative resources available.

Regarding demographic data of the studied group, there were no statistically significant differences between survived and dead patients as regards age and sex. Bollen *et al.* [14] identified prognostic factors that are associated with survival in patients with spinal metastasis and reported that the prognostic factors most frequently not associated with survival were age and gender.

However, older age was found to have a significant negative effect on overall survival with higher complication rates with increasing age; however, sex has no influence on survival or complications [15,16].

As regards Tokuhashi score, there were highly statistically significant differences between survived and dead patients according to the primary site of malignancy and total score. This supports the results of Liang *et al.* [17], who revealed that primary tumor type and Tokuhashi score independently predicted survival in patients with spinal metastases.

Neurological integrity was maintained or improved in all patients except one. Patients who were bedridden at admission with complete motor deficits had a lower chance of recovery; however, some of them may still show some neurological improvement at 6 months postoperative. We recommend early surgery for patients with impending or minimal neurology to protect neural elements and to prevent further deterioration [18].

We believe that improvement and preservation of quality of life after surgery are the overall objectives of surgery. The majority of survived patients needed less pain control with better ambulation at 6 months and 1 year after surgery. Choi *et al.* [19] concluded that surgical treatment for spinal metastases produces rapid pain relief, maintains ambulation, and improves good quality of life. Ibrahim *et al.* [4] reported that surgical treatment was effective in improving quality of life by providing better pain control, enabling patients to regain or maintain mobility, and offering improved sphincter control.

One of the main limitations of our study is that we did not use any scoring system to assess neoplasm-related spinal instability, as the majority of our patients (23 out of 30) had neurological deficits related to spinal metastases and this was the main indication of surgery. This might be partly due to inadequate access to medical services, and delays in the diagnosis and management in a limited resources community.

Another limitation of this work is the small number of patients and their further stratification according to the surgical techniques, which makes it difficult to draw comprehensive conclusions regarding the optimum surgical procedure for treating patients with spinal metastasis. Future studies will be more viable if they are multicenter trials to improve patient recruitment.

The posterior approach for the thoracolumbar spine is safe, familiar, and less morbid than the anterior or combined approach. It allows posterior stabilization, decompression of neural elements, and excision of anterior vertebral body metastasis if required without the need for an anterior or combined approach and their related morbidity [20].

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## Conclusion

Posterior surgical treatment for thoracolumbar metastasis can improve quality of life in a substantially high percentage of patients with acceptable complications rate in a limited resource setting. Posterior surgery significantly reduces pain and is efficacious in preserving neurological function over a short-term follow-up with acceptably low morbidity. Anterior or combined approaches are no longer needed for fragile cancer patients.

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Nil.

## Conflicts of interest

There are no conflicts of interest.

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