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Review Article

# Transpedicular Partial Corpectomy and Psf without Anterior Structural Grafting in Debilitated Patients with Vertebral Osteomyelitis or Metastatic Spinal Lesions

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## Abstract

**Study Design:** Retrospective, Level I trauma center, Tertiary referral Cancer Center

**Objective:** To analyze a consecutive series of critically ill patients who underwent limited posterior surgery for vertebral osteomyelitis of metastatic disease.

**Methods:** From 2010-2017, 34 consecutive patients with osteomyelitis or metastatic tumor were treated with transpedicular posterior decompression (TPD) and posterior instrumentation. A retrospective chart review was performed. Demographic information, surgical data (EBL, ASIA Impairment Score (AIS), length of surgery, level of TPD, levels instrumented, histology, post-operative complications) were recorded.

**Results:** 24 male and 10 female patients with an average age of 66 years (46-83) and average of 2.5 major comorbidities (1-7) were identified after approval was obtained from our institutional review board. 14 had osteomyelitis and 20 had metastatic tumors. Mean operative time was 149.8 minutes (60-275), average EBL was 786.8 mL (200-2500). Hospital stay averaged 18.2 days (3-61). AIS was noted to improve or remained constant in all patients. The average number of levels instrumented was 4.9 (2-8). Medical follow up of the patients averaged 437.2 days (13-2080) and radiographic follow up averaged 324.3 days (0-1360). Major medical complications occurred in 9 patients (26.5%) and procedure related complications occurred in 7 patients (20.6%).

**Conclusions:** TPD and PSF without anterior structural grafting demonstrates low operative times, EBL, and instrumentation complications along with improved postop neurologic function. Other complications and patient morbidity remain high in this critically ill subset of patients. This limited procedure should be considered as a treatment option for debilitated patients with spinal disease and neurologic impairment.

**Keywords:** Infection; Partial Corpectomy; Posterior Instrumentation; Transpedicular Approach; Tumor

## Introduction

There has been much written about circumferential reconstruction and stabilization of the spinal column for patients with spinal lesions causing neurologic compression with a recent trend towards less invasive procedures (16,17). There is a lack of literature describing limited procedures without anterior reconstruction of the spinal column in the debilitated patient population with medical comorbidities and uncertain life expectancy. Patients with vertebral osteomyelitis or tumor are at higher risk for complications following extensive surgeries due to comorbidities [1-13].

Almost 70% of patients with cancer will develop metastasis to the spinal column by the time of death making them a significant population treated by the spine surgeon [2-13]. Treatment of metastatic disease is palliative and not intended as a cure. Indications

for surgical treatment include intractable pain, neurologic decline, tumors not sensitive to radiation, and spinal instability or collapse [1-14]. The life expectancy of these patients must be taken into account when planning surgical intervention and goals should include pain relief, neural decompression, and stabilization of the spine to permit return to activity. Cancer patients are at a higher risk of complications due to poor nutrition, blunted immune response due to chemotherapy, radiation, and the disease process itself [3-13]. Due to surgery's effect on quality of life, the patient should have a minimum of 3 to 6 months' life expectancy [1].

Patients with vertebral osteomyelitis and epidural abscess represent another population that may present with instability of the spinal column and need for corpectomy to decompress the neural elements. Although vertebral osteomyelitis due to tuberculosis is on the decline worldwide, rates of pyogenic osteomyelitis are increasing in the elderly population in developed countries and these patients often have higher comorbidity rates due to their advanced age [4]. Pyogenic osteomyelitis in the younger population is increasingly associated with intravenous drug use. The majority of these cases can be treated with a 6-12 week course of organism specific antibiotics and auto fusion of the involved levels is a common sequela [5]. Vertebral body collapse with structural instability, epidural abscess with impending or active neurologic decline, and failure of antibiotic treatment for at least 6 weeks are indications for surgery with the gold standard being anterior column debridement with anterior column reconstruction and support [6]. Mortality rates after a 360-degree reconstruction for pyogenic osteomyelitis range from 8 to 14% in the literature [5-6].

The gold standard of treatment for maximum restoration of sagittal alignment and stability has been a debridement of the anterior column with reconstruction using either static or expandable cages or structural bone graft backed up with posterior instrumentation [14]. This is a major surgical procedure in a debilitated population which has an average surgical time of 4.5-6 hours and complication rates up to 29.6% [7-14]. Anterior column debridement through a posterior-based transpedicular approach combined with longer posterior instrumentation is a relatively limited surgical procedure and may be a safer surgical treatment option for debilitated patients.

| | |
|---|---|
| Total Patients | N=34 |
| Males | N= 24 |
| Females | N= 10 |
| Average age (yrs) | 66 (46-83) |
| Avg Comorbidities | 2.5 (1-7) |
| Avg Length of Follow up (days) | 437 (13-2080) |
| Mean Operative Time (min) | 149.8 (60-275) |
| Average EBL (ml) | 786.8 (200-2500) |
| Average Length of Stay (days) | 18.2 (3-61) |
| Patients admitted to physical rehabilitation | N=15 |
| Average physical rehabilitation admission (days) | 7.5 |

**Table 1:** Patient Information.

## Methods

During the period of 2010-2017, 34 consecutive adult patients with thoracic or lumbar vertebral osteomyelitis or metastatic tumor and epidural compression were treated by the senior author. Each patient was treated surgically with transpedicular partial corpectomy decompression and longer PSF without anterior structural grafting (no anterior cages, autograft or allografts). The surgery was performed from an open posterior approach in all patients and involved initial pedicle screw placement at appropriate levels above and below the lesion. Laminectomy at the level of the lesion followed by bilateral transpedicular partial

corpectomy was performed in the next step using surgical curettes. The initial penetration of the affected vertebral body pedicles was performed by using a small 3mm curette, followed by a 2mm increase in curette size until the largest possible size that safely fit into each pedicle approach hole was achieved. The vertebral body partial corpectomy was performed from a bilateral approach using the sequential curetting etechnique (Figure 3). Angled curettes were then used to remove the portions of posterior vertebral body wall that was involved with the lesion. Intraoperative fluoroscopic imaging was used in the AP and lateral planes to assist with screw placement, lesion and partial corpectomy location. The extent of the partial corpectomy was determined intraoperatively by the size of the lesion and the degree of neurologic compression. Near-complete decompression of the neural canal was achieved in all cases.

All patients had multiple medical comorbidities and neurologic impairment which contributed to the surgical decision-making process. A retrospective evaluation of prospectively collected data was performed. ASIA Impairment score was calculated for all patients both preoperatively and post operatively. Operative times, blood loss, length of hospital stay, major and minor complications were also recorded for all patients.

There were 24 male and 10 female patients with an average age of 66 years (range 46-83). 14 of the patients had osteomyelitis and 20 had metastatic tumor of the spinal column. MSSA was the most common organism isolated from the osteomyelitis population and breast and lung were the most commonly encountered metastatic tumors. All patients with metastatic tumors has epidural compression and some degree of vertebral collapse. Fourteen of the 20 patients with metastatic tumors had postoperative radiation. The patients had an average of 2.5 major comorbidities (range 1-7). Length of follow up ranged from 13-2080 days with an average of 437 days.

Mean operative time was 149.8 minutes (range 60-275 min). The case with the longest surgical time involved osteomyelitis with laminectomy and decompression from T6-9 and posterior fusion from T4-11. EBL for the procedures averaged 786.8 mL (range 200-2500 mL). The patient who experienced the largest blood loss underwent T4-5 partial corpectomies for metastatic endometrial adenocarcinoma. Hospital stay length prior discharge home or a rehabilitation facility averaged 18.2 days (range 3-61 days). Fifteen of the 34 patients were discharged to a rehab facility where they spent an average of 7.5 days. ASIA impairment scores were noted to improve or remained constant in all patients (Table 2). Medical follow up of the patients averaged 437.2 days (range13-2080) and mean radiographic follow averaged 324.3 days (range 0-1360). The 30-day hospital readmission rate was 8.8% (3/34). Two patients were readmitted for wound issues and 1 was readmitted for a clinical trial for their cancer. Five patients died postoperatively from medical complications of their disease. Two patients died in the 90-day post-operative period while three of these patients died greater than 90 days from surgery. The average number of levels instrumented in this study population was calculated to be 4.9 with a range between 2 and 8 levels. The number of levels instrumented correlated with the extensiveness of the debridement. Patients with metastatic disease had an average of 5.3 levels instrumented while patients with osteomyelitis had an average level of 4.3 levels instrumented. (Figures 1-4) show preoperative imaging of osteomyelitis, transpedicular decompression technique, post-operative CT scan, and final x-rays demonstrating the levels instrumented without anterior support in a typical patient.

| Pre Op Deficits (ASIA) | Post op deficit (ASIA) |
|---|---|
| E | E |
| D | D |
| E | E |
| E | E |
| C | D |
| C | D |
| E | E |
| E | E |
| E | E |
| E | E |
| C | C |
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| D | D |
| D | D |
| E | E |
| D | E |
| C | C |
| E | E |
| E | E |
| D | D |
| A | A |
| D | D |
| E | E |

**Table 2:** Patient Asia Scores (N=34).

**Figure 1:** MRI image showing T4-5 osteomyelitis and epidural abscess in 85 you male with ASIA B deficits.

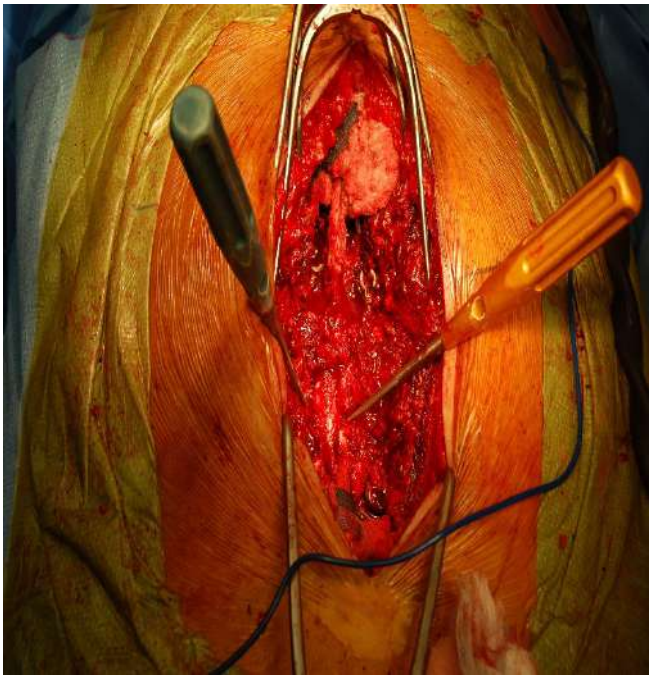

**Figure 2:** Intra Op image showing bilateral transpedicular corpectomy technique.

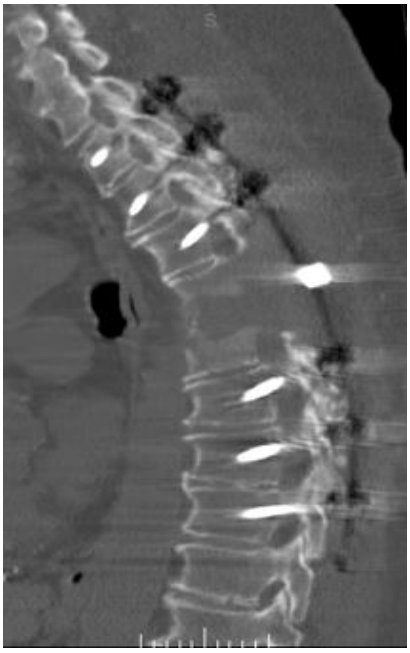

**Figure 3:** Postop CT demonstrating transpedicular partial corpectomy decompression and longer instrumentmented PSF.

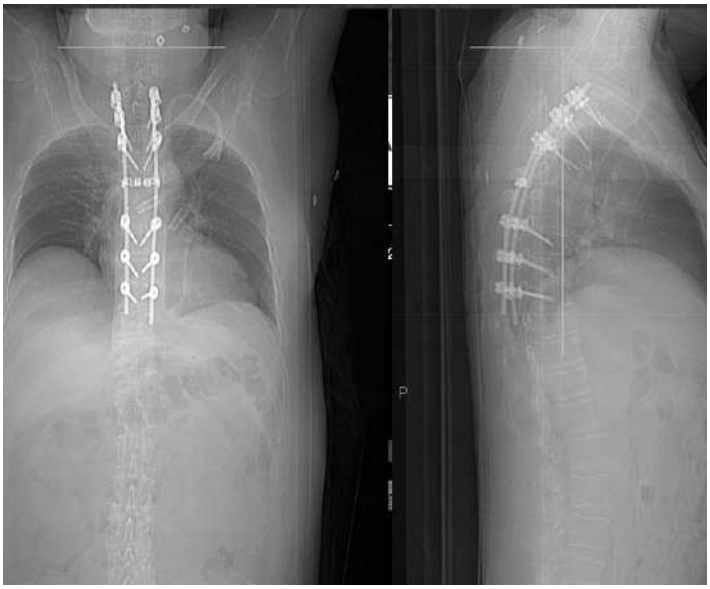

**Figure 4:** F/U CT scout images showing PSF construct with maintained alignment.

Major medical complications occurred in 9 of the 34 patients (26.5%) and there was postoperative procedure related major complications in 7 of 34 patients (20.6%). Five of 34

patients (14.7%) required a return to the OR for procedure-related complication. Three patients had infection requiring wound I&D and 2 patients required revision of loosened posterior instrumentation. Both of the patients developed back pain in the region of their inferior screws which had halo effects from loosening on follow-up radiographs. There were no cases of catastrophic instrumentation failure including breakage of any of the implants. The two patients with loose hardware were from the osteomyelitis cohort. Two of the three patients requiring wound I&D were tumor patients and the third was an osteomyelitis patient.

## Discussion

Vertebral body collapse due to tumor or infection with neurologic compromise in the debilitated patient population is a condition which is commonly encountered by the spine surgeon who regularly performs spine trauma call duty. In addition to vertebral body collapse, all of the patients in our study had epidural compression and intractable back pain as the indication for surgery. The gold standard surgical treatment option in a healthy patient is a thorough debridement of the anterior column with additional anterior column structural support combined with posterior stabilization. This approach provides decompression and thorough stability with reconstruction of the anterior column. We propose that a more limited surgery may be beneficial to patients with multiple medical comorbidities in order to decrease blood loss and surgical time. Prior studies have shown that instrumentation of the acutely infected spine after debridement is a safe practice, and these patients often go on to fusion of the infected levels [8].

Quite often the patients who sustain a vertebral body collapse due to infection or tumor are debilitated before the surgery. Cancer patients with metastatic disease are often malnourished which has been shown to carry an increased risk of wound healing problems [3]. Although there has been an increase in pyogenic vertebral osteomyelitis with the increase in IV drug use, the majority of patients with this condition continue to be the elderly with increased numbers of comorbidities such as diabetes mellitus, renal disease, and urinary tract infections. Both patients with metastatic cancer and multiple medical comorbidities have a decreased reserve to undergo the extensive anterior column debridement, reconstruction, and posterior reinforcement.

We have reported a series of debilitated patients with vertebral osteomyelitis and tumor causing anterior column failure with a posterior based transpedicular decompression extended posterior instrumentation without anterior column reconstruction. This approach has led to decreased average surgical times, 2.5 hours' average for the proposed technique versus 4.5-6 hours' average which has been reported in the literature for the technique with anterior column reconstruction [7-15]. The average blood loss for this technique was 786.8mL which is reasonable when compared to averages of 1965 mL for similar conditions where mesh cage reconstruction was used [10-15].

There has been evidence that although infections have a predilection for the anterior column, posterior decompression and abscess evacuation without anterior column debridement, combined with instrumentation have good results when combined with antibiotic therapy and a posterior only approach leads to earlier mobilization [8,9]. In our patient series anterior column debridement was necessary as there was collapse causing neural element compression. Spontaneous fusion often occurs after vertebral osteomyelitis and discitis. The metastatic tumor group of patients have a limited life expectancy, and we have demonstrated that the longer instrumentation did not significantly fail before the patient's demise due to their cancer burden. Our procedure provided needed neurologic decompression and stability with decreased surgical times and blood loss for these debilitated patients.

Postoperative complication rates were similar in type and frequency to other techniques used to treat compressive spinal lesions. Previous studies have reported major complications rates of approaching 30% [7]. Our patients had an average of 2.5 major medical comorbidities, and were neurologically impaired due to epidural compression. Medical complications occurred in 26.5% of the patients and procedure related complications in 20%, which may be lower than the average of 30% in previous studies but statistical analysis was not performed. In the 90-day post-operative period, acute kidney injury in 4 patients was the most common medical complication, while wound dehiscence in 7 patients was the most common procedural related complication. Five patients, or 14.7% required a return to the operating room. The most common cause for return to the operating room was a superficial wound infection requiring I&D, 3 of the 5. The other 2 patients underwent revision of the instrumentation for loosening which was greater than 90 days from the index procedure. There were no catastrophic hardware failures. In the 90-day post-operative period 2 patients died, 3 more patients in the series dies between 90-days and last medical follow up. All 5 patients died secondary to medical complications from their underlying disease. There were no acute postoperative deaths in the immediate perioperative period.

All patients had an improved or stable ASIA Impairment Scale (AIS) Grade postoperatively. Nineteen patients presented with an ASIA Grade of E and all nineteen of these patients remained at ASIA Grade E showing no decline in neurologic function. Ten patients presented with AIS Grade of D pre-operatively. Following surgery, four of these patients improved to AIS Grade E and the remaining six were stable at AIS Grade D. Four patients presented as AIS Grade C, two remained at Grade C while two improved to a Grade D. One patient presented as AIS Grade A and remained an AIS Grade A post-operatively. No patients experienced neurologic decline, all improved or remained stable See (Table 2) for details.

Our study demonstrates that posterior based transpedicular decompression of the anterior column and extended posterior instrumentation without anterior column support is an effective treatment option in ill patients. This technique results in relatively short surgical times and less blood loss in a patient population with limited physiologic reserves. Minimally invasive surgery for decompression and stabilization may also be an appropriate option for these patients. However, MIS surgeons should be well-trained in order to perform expeditious decompression and instrumentation to reduce operative times. The operative time for our procedure averaged 149.8 minutes (range 60-275 min) and is relatively low.

Two smaller studies involving partial corpectomy without anterior column reconstruction have been previously reported in the literature in patients with metastatic thoracic tumors. Both studies have small numbers of patients and short-term follow-up. Chen et al. published a study which examined 23 consecutive patients with symptomatic spinal cord compression from metastatic disease in the thoracic spine. These patients had a mean survival of 11.3 months with no hardware failure and improved Frankel grade in 83 % [16]. Chang et al. discussed a similar technique in 29 patients with metastatic disease to the thoracic and thoracolumbar spine which showed no evidence of early hardware failure and a median survival time of 7 months with improvement in Frankel grade in 75. % [17]. Both studies also suggest that transpedicular decompression without anterior support is a valid option for debilitated patients with metastatic tumors and short life expectancy. Our study is the largest series reported to date and expands the procedure indications to include debilitated patients with thoracic or lumbar vertebral osteomyelitis and epidural abscess. We have also demonstrated continued durability of the posterior implants with longer follow-up time.

Limitations of the study include the retrospective chart review design and lack of a control group. There is also limited radiographic follow up. There are 34 patients in this case series, a larger patient population would of course provide stronger evidence supporting the utility of limited surgery in critically ill patients.

## Conclusion

Transpedicular partial corpectomy decompression and longer PSF without anterior structural grafting demonstrates low operative times, EBL, and instrumentation complications along with improved postop neurologic function. Other complications and patient morbidity remain high in this critically ill subset of patients. This limited procedure should be considered as a treatment option for debilitated patients with spinal disease and neurologic impairment.

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