Comparison of mini-open anterior corpectomy and posterior total en bloc spondylectomy for solitary metastases of the thoracolumbar spine

Clinical article

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Object. The object of this study was to compare the mini-open anterior corpectomy procedure with posterior total en bloc spondylectomy (TES) in treating patients with solitary metastases of the thoracolumbar spine.

Methods. From 2004 to 2010, 41 patients with solitary metastases of the thoracolumbar spine were treated in our hospital using either a mini-open anterior corpectomy or posterior TES. Intraoperative and diagnostic data, including perioperative complications, were collected using retrospective chart review. The surgical outcomes were assessed according to survival status, neurological function, local recurrence, and pain before and after surgery.

Results. Seventeen patients underwent posterior TES and 24 underwent mini-open anterior corpectomy. Mean blood loss (TES, 1721 ± 293 ml; mini-open corpectomy, 1058 ± 263 ml; p < 0.05), and mean operative time (TES, 403 ± 55 minutes; mini-open corpectomy, 175 ± 38 minutes; p < 0.05) were recorded and calculated. Neurological improvement by at least 1 American Spinal Injury Association Impairment Scale grade was noted in 35 (97.2%) of the 36 cases with preoperative deficits. After the operation, 68.4% of nonambulatory patients became ambulatory again, including 84.6% after mini-open corpectomy and 33.3% after posterior TES (p > 0.05). The visual analog scale scores of the patients were significantly reduced after both procedures, with no difference between the procedures (p > 0.05). The local tumor recurrence rate of the TES group was significantly lower than that of the mini-open corpectomy group (p < 0.05), while the postoperative survival rates within 2 years after surgery were similar. The complication rate in the mini-open corpectomy group (29.2%) was higher than that in the TES group (11.8%), but this difference was not statistically significant (p = 0.185). There was no hardware failure and no loss of the sagittal Cobb angle in either group. Slight subsidence (< 3 mm) of the mesh cage was observed with a successful fusion in 3 (17.6%) of 17 patients in the TES group. No subsidence of polymethylmethacrylate block/autograft was recorded in the mini-open group.

Conclusions. Mini-open anterior corpectomy can be accomplished with less blood loss, fewer fixation instruments, and shorter surgical time than that required for TES, but patients who undergo a mini-open corpectomy might have a greater tendency to experience local recurrence. A mini-open anterior corpectomy has a relatively mild learning curve and involves fewer technical difficulties. With smaller incisions, mini-open anterior corpectomy is an option in treating solitary metastases of the thoracolumbar spine.

Key Words • minimally invasive surgery • posterior total en bloc spondylectomy • anterior mini-open corpectomy • metastatic spinal tumor • oncology

Abbreviations used in this paper: ASIA = American Spinal Injury Association; PMMA = polymethylmethacrylate; TES = total en bloc spondylectomy; VAS = visual analog scale.

This article contains some figures that are displayed in color online but in black-and-white in the print edition.
applied more frequently in the setting of metastatic spinal cancer surgery, although this traditional wide-open anterior approach may cause significant complications, such as intercostal neuralgia and postthoracotomy pain.29 The thoracoscopic and laparoscopic anterior approaches can reduce perioperative complications,5,14,23 but involve a steep learning curve with prolonged surgical duration and costly equipment. Using a mini-open approach to perform the corpectomy on the anterior thoracolumbar spine was introduced at the beginning of the last decade (2000s).2,16,18 With the use of a specific SynFrame retractor system (Synthes Spine), this approach can avoid a large wound field and is relative easy to learn.

Posterior laminectomy without reconstruction and stabilization was applied in the early days (1980s),4 but because the anterior column destruction was untreated, progressive kyphotic deformity was frequent with this method.30 Many authors then reported the use of posterior spondylectomy with good clinical results.11,22,33 Conventionally, curettage or piecemeal excision of vertebral tumors has been commonly practiced, with clear disadvantages such as tumor cell contamination and residual tumor tissue.31 In the 1990s, Tomita et al.29 developed a local curative surgery, the total en bloc spondylectomy (TES), through a single posterior approach and applied it to cases with a solitary or localized metastasis in the thoracic or lumbar vertebrae. Single posterior-approach TES significantly decreases the rate of local recurrence and can provide long-term survival in a selected subset of patients with metastatic spinal disease,1,29 but it is a significant operation associated with many considerable risks such as excessive bleeding, injury of the major vessels, and spinal cord injury.

Currently, in patients with metastatic spinal tumors, the true difference between anterior corpectomy surgery and TES for outcomes such as pain relief, neurological improvement, and recurrence rate, is unknown.7 Which procedure is better for patients with spinal metastases? Is it necessary or possible to remove all the metastases in that late stage? Surgeons have been faced with the dilemma as to whether to only salvage spinal cord function at the cost of possibly leaving residual tumor behind or to radically remove the tumor.31

The aim of this study was to compare the outcomes of mini-open anterior corpectomy with posterior TES in treating solitary thoracolumbar spinal metastases. This study compared the outcomes of the 2 tactics (debulking and en bloc excision) with 2 different surgical approaches (mini-open anterior approach and posterior approach).

**Methods**

From 2004 to 2010, 41 patients underwent a surgical procedure for solitary metastases of the thoracolumbar spine and were included in this retrospective study. This group included 22 women and 19 men, ranging in age from 23 to 77 years (mean 54.0 years). The primary malignancies included gastric cancers (n = 3), lung cancer (n = 10), rectal cancer (n = 1), thyroid cancer (n = 5), prostate cancer (n = 3), lymphoma (n = 1), liver carcinoma (n = 4), colon cancer (n = 1), breast cancer (n = 8), and unidentified origin (n = 5; Table 1). All cases involved isolated solitary spinal metastases. Patients with another concomitant spinal metastatic disease or visceral metastases were excluded from the study.

**Surgical Classification of Spinal Tumors**

The extent of the spinal lesion was assessed with CT scans and MRI for all patients. Bone scans demonstrated a solitary hot spot (single lesion of the spine without other metastasis sites) in all patients. The classification of the tumors was based on the extent of the lesion, such as intracompartmental, extracompartmental, and multiple extent, and subdivided into Types 1–7.28 The tumor classifications in these patients are shown in Table 1.

**Indications for Surgical Treatment**

Indications for surgical treatment of spinal metastases included acute progressive neurological deficits, intractable pain, and an impending fracture of the vertebral body.

**Surgical Procedures**

**Mini-Open Anterior Corpectomy.** For mini-open anterior corpectomy, after appropriate venous line access was obtained, routine induction of anesthesia and nonselective intubation were performed. All patients underwent a left-sided approach and a 6–9 cm skin incision was made in line with the rib that would be removed. To extend the surgical bed effectively when undertaking this minimally invasive approach, a self-retaining retractor system was applied. The corpectomy was then conducted by piecemeal removal of the tumorous vertebral body. The dorsal cortical wall of the vertebral body was removed using a high-speed drill. To perform spinal reconstruction, PMMA secured with Steinman pins or autograft was positioned between the end plates of the adjacent vertebrae. The MACS-TL plate system (Aesculap) was used for anterior fixation (Fig. 1).

**Total En Bloc Spondylectomy.** Total en bloc spondylectomy via a single anterior approach was performed according to the procedure of Tomita et al.28,29 The TES procedure consisted of en bloc laminectomy and en bloc corpectomy, followed by anterior instrumentation with spacer grafting and posterior spinal instrumentation. The posterior fixation was performed at 2 or 3 levels above and below the resected vertebra. A titanium mesh cage (MOSS-Miami, Depuy Spine) with autogenous bone inside was used for the anterior column reconstruction (Fig. 2).

**Chemotherapy**

During surgery, chemotherapy was applied using distilled water and highly concentrated cisplatin. Other details such as resected levels, estimated blood loss, operative time, and intraoperative and postoperative complications were also recorded.

Adjuvant chemotherapy was administered to the patients with breast cancer before and after surgery. Patients with thyroid cancer received radioiodine therapy after

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<table>
<thead>
<tr>
<th>Variable</th>
<th>Posterior TES</th>
<th>Mini-Open Corpectomy</th>
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<td>7</td>
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</table>

Follow-Up

Each patient was evaluated with a Tomita prognostic score before surgery using 3 parameters: primary tumor, the presence or absence of visceral metastases, and the number of bone lesions (Table 1). Follow-up evaluations were conducted at 3-month intervals for the first year, and half-year intervals thereafter, for the remainder of the patient’s life.

Survival Status. Overall patient survival was examined according to the type of surgery. Cumulative survival plots were used to construct Kaplan-Meier survival curves.

Assessment of Neurological Function. The ASIA Impairment Scale was used to assess the neurological function of each patient. Briefly, the patients were segregated into 5 categories: ASIA Grade A, complete spinal cord injury, no motor or sensory function preserved in the sacral segments S4–S5; ASIA Grade B, incomplete spinal cord injury, sensory but not motor function preserved below the neurological level and including the sacral segments S4–S5; ASIA Grade C, incomplete spinal cord injury, motor function preserved below the neurological level, and more than half of key muscles below the neurological level with a muscle grade < 3; ASIA Grade D, incomplete spinal cord injury, motor function preserved below the neurological level, and at least half of key muscles below the neurological level with a muscle grade of 3 or more; and ASIA Grade E, motor and sensory function were normal.

Evaluation of Pain Relief. Pain before and after surgery was measured using the VAS. Briefly, a VAS is usually a horizontal line, with “no pain” written at one end and “unbearable pain” written at the other. Between the two options are a series of numbers from 0 (no pain) to 10 (unbearable pain). The patient marks the point that they believe represents their perception of their current pain state on the 0–10 scale.

Radiographic Follow-Up. All patients were followed
up with radiographic testing and CT scanning of the thoracic or lumbar spine. Radiological assessment of the hardware and sagittal spinal alignment were conducted after each follow-up evaluation. Any changes on radiographs suggesting local recurrence were investigated using MRI to confirm local recurrence. In addition, the difference in the local recurrence rate between the 2 procedures was compared.

**Statistical Analysis**

Statistical analysis was performed using STATA (version 10.0, StataCorp). All values are described as mean ± SD unless stated otherwise. An unpaired Student t-test was used for comparison of parametric data, and the Fisher exact test was used in the analysis of neurological function improvement because of the small sample sizes. Cumulative survival plots were constructed using the Kaplan-Meier method, and the log-rank test was used for statistical comparison. All tests were 2-sided. A p value < 0.05 was considered statistically significant.

**Results**

From May 2004 to September 2008, mini-open anterior corpectomy was performed in 24 cases, and from October 2008 to September 2010, TES was performed in 17 cases (Table 2). The mean age of the patients who underwent mini-open corpectomy was 56.6 years old and that of TES patients was 51.0 years old; the difference between the mean ages of the 2 groups was not statistically significant (p = 0.169). Total en bloc spondylectomy was performed on patients with tumor Types 2–6, and mini-open corpectomy was performed on patients with tumor Types 1–4 (Table 1). The operative duration of the mini-open procedure ranged from 140 to 240 minutes (mean 175 ± 38 minutes). Estimated intraoperative blood loss varied from 800 to 2100 ml (mean 1058 ± 263 ml). The operative duration of TES ranged from 290 to 480 minutes (mean 403 ± 55 minutes). Estimated intraoperative blood loss in the TES group varied from 1300 to 1960 ml (mean 1721 ± 293 ml). The mini-open corpectomy could be accomplished with less blood loss within a shorter...
operative duration than TES, and both of the differences in these variables between the groups were statistically significant (p = 0.0001). Baseline characteristics of the 2 groups are represented in Table 2.

Survival Status

In the mini-open corpectomy group, the follow-up period of the 9 surviving patients ranged from 14 to 35 months (average 24.8 ± 7.7 months). The remaining 15 patients died with a mean survival of 16.8 ± 8.2 months (range 6–35 months) after surgery. In the TES group, the follow-up period for the 7 surviving patients ranged from 12 to 24 months (average 17.0 ± 3.7 months). The remaining 10 patients died of disseminated metastatic disease, with an average survival of 12.6 ± 4.1 months after surgery. The average follow-up of the entire mini-open group was 19.8 ± 8.8 months (range 6–36 months), and 15.3 ± 3.9 months (range 8–24 months) in the TES group. There was no statistically significant difference between the follow-up duration in the 2 groups (p = 0.056; Table 2).

The Kaplan-Meier curve showed that 97.5% ± 2.4% of the patients survived for more than 6 months, 75.6% ± 6.7% for more than 1 year, and 47.3% ± 8.7% for more than 2 years overall (Fig. 3). After TES, no patients died during the first 6 months, 64.7% ± 11.5% of the patients survived for more than 1 year, and 22.6% ± 17.1% survived for more than 2 years. After mini-open corpectomy, 1 patient died on the sixth postoperative month; thus the 6-month expected survival rate was 95.8% ± 4.1%, and the 1-year and 2-year expected survival rates were 75.0% ± 8.8% and 51.5% ± 10.6%, respectively. A log-rank test showed there was no statistically significant difference in survival between the 2 groups (χ² = 1.36, p = 0.244).

TABLE 2: Characteristics of patients who underwent mini-open anterior corpectomy or posterior TES for solitary metastases of the thoracolumbar spine

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mini-Open Corpectomy</th>
<th>Posterior TES</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>no. of patients</td>
<td>24</td>
<td>17</td>
<td>none</td>
</tr>
<tr>
<td>female:male ratio</td>
<td>15.9</td>
<td>7.10</td>
<td>0.177</td>
</tr>
<tr>
<td>mean age (yrs) ± SD</td>
<td>56.6 ± 10.3</td>
<td>51.0 ± 15.47</td>
<td>0.169</td>
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<tr>
<td>mean operative duration (min)</td>
<td>175 ± 38</td>
<td>403 ± 55</td>
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<tr>
<td>± SD</td>
<td></td>
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<tr>
<td>mean estimated blood loss (ml)</td>
<td>1058 ± 263</td>
<td>1721 ± 293</td>
<td>0.0001</td>
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<tr>
<td>± SD</td>
<td></td>
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<tr>
<td>mean last follow-up (mos)</td>
<td>19.8 ± 8.8</td>
<td>15.3 ± 3.9</td>
<td>0.056</td>
</tr>
<tr>
<td>± SD</td>
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</table>

Pain Relief

Pain assessment scores and neurological deficits improved in all patients. Spinal pain (back pain and/or radicular pain) was present in all 41 patients before surgery. All patients with pain reported significant alleviation; VAS scores of patients were significantly reduced after the operation by a mean of 6.5 ± 1.3 points (p < 0.05), and 6 (35.3%) of 17 patients became pain free after TES surgery but none after mini-open corpectomy. However, no improvement of neurological deficits is shown in Table 4. Six months after the operation, neurological improvement by at least 1 ASIA grade was noted in 35 (85.4%) of the 41 cases with preoperative deficits, including 22 (91.7%) of 24 cases after mini-open corpectomy, and 13 (76.5%) of 17 cases after TES. In the mini-open group, 4 patients improved from Grade C to Grade E, and 3 improved from Grade B to Grade D, whereas 1 patient with incomplete paralysis showed no recovery after surgery. In the TES group, 7 patients improved postoperatively from Grade D to Grade E, and 2 improved from Grade C to Grade D. Overall, 13 (68.4%) of 19 nonambulatory patients (ASIA Grade B or C) became ambulatory again (ASIA Grade D or E), including 11 (84.6%) of 13 cases after the anterior surgery, and 2 (33.3%) of 6 after the dorsal surgery. There was 1 case of postoperative transient neurological worsening, and this patient recovered 1 month later. There was no statistically significant difference in neurological function improvement between the 2 procedures (χ² = 11.9493, p = 0.063).

TABLE 3: Results of the Cox proportional hazards analysis

<table>
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<tr>
<th>Covariate</th>
<th>Parameter Estimate</th>
<th>Standard Error</th>
<th>χ²</th>
<th>p Value</th>
<th>Hazard Ratio</th>
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<td>0.4496</td>
<td>2.13515</td>
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<td>0.51842</td>
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<td>age</td>
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<td>0.01725</td>
<td>2.74703</td>
<td>0.09744</td>
<td>1.02901</td>
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</table>
significant difference in VAS score was shown between the 2 procedures (Fig. 4).

Perioperative Complications

The complication rate in the mini-open corpectomy group (29.2%) was higher than that in the TES group (11.8%), although this was not a significant difference ($p = 0.185$). There were 7 recorded cases of perioperative complications in the mini-open corpectomy group. One patient experienced a pleural effusion that was fully absorbed 4 weeks postoperatively. Transient intercostal neuralgia appeared in 4 patients, which resolved spontaneously within 2 weeks. One patient with tumors on T-7 suffered from pulmonary atelectasis postoperatively. None of our patients complained about long-lasting pain at the access site, which was the same as that described in other studies using minimally invasive techniques, although 1 patient had a superficial wound infection. Two cases of complications were recorded in the posterior TES group. One case suffered from CSF leakage, and the other from transient neurological worsening caused by excessive interruption to the spinal cord (retraction of the spinal cord exceeding a normal range and limit). Three months later, both patients had recovered and had attained 1 ASIA grade higher than before surgery.

Local Recurrence

Local recurrence was observed in 5 cases (20.8%) in the mini-open group during follow-up, but no recurrence was observed in the TES group, a significantly lower local recurrence rate in the TES group ($p = 0.045$). Most of the recurrences emerged during the first follow-up year (4 of 5 cases) in the mini-open corpectomy group, although the difference between the groups was not significant ($p = 0.076$).

Radiographic Outcomes

Postoperative radiographic analysis revealed that the internal fixation had been performed properly and there was no hardware failure in either group. No loss of sagittal Cobb angle was observed in either group. Slight subsidence ($< 3$ mm) of the mesh cage was observed with a successful fusion in 3 (17.6%) of 17 patients in the TES group, and no subsidence of PMMA block/autograft was recorded in the mini-open group.

Discussion

Both mini-open corpectomy and posterior TES have their advantages and drawbacks. Posterior TES is a technically demanding procedure with significant perioperative risks; thus most studies have limited their surgical approaches to intralesional curettage or debulking procedures to minimize morbidity. According to the classification of surgical strategies adopted by the Global Spine Tumour Study Group (GSTSG), a corpectomy procedure is one of the tumor debulking procedures. Reliable results for tumor resection and spinal decompression could be obtained through a mini-open anterior approach for corpectomy, but this surgical technique will lead to a higher rate of local tumor recurrence because it is an intralesional resection and carries a high risk of incomplete tumor resection, tumor contamination, and difficulty of resecting the invaded lamina and posterior elements. The posterior TES allows for complete removal of the diseased vertebrae followed by circumferential spinal reconstruction in a single-stage procedure that can achieve excellent local control. Accordingly, since October 2008, we have started to perform the TES procedure on patients with a Tomita prognostic score lower than 6 points (Table 1). Posterior decompression with spinal stabilization was performed on patients with a Tomita prognostic score of 6 or 7 points for short-term palliation. Nevertheless, one potential criticism of such approaches is that the spine is severely destabilized from such procedures. Specifically, as the normal posterior elements are generously resected to remove the diseased anterior elements, there is potentially increased surgical morbidity and a lower chance of successful biological osseous fusion due to the large gap created between neighboring bone surfaces. The metastatic lesions sometimes only involve the vertebral body (Type 1 and 2) and cause spinal cord compression by extending dorsally; thus tumor resection often only requires a corpectomy to salvage the spinal cord, although ventral corpectomy to decompress the spinal cord is just a palliative procedure.

Spinal metastasis is not necessarily an end-stage condition, even if the patient is already paraplegic. Of all the potentially curative strategies available, excision...
of the metastatic focus remains the only proven method of obtaining long-term palliation or cure for a variety of sites, including the lungs, liver, and brain. The value of TES for spinal sites is becoming increasingly important. Although surgical treatment of spinal metastases is a significant procedure with associated morbidity that may negatively affect other areas of quality of life, it is not questioned that, in the appropriately selected patient, it can improve specific domains of quality of life such as back pain, radicular pain, ambulatory status, and bladder function. The mechanism of pain relief is not clearly understood but is most likely affected after removal of the offending lesion, in addition to the increase in mechanical stability. Indications for surgery in patients with metastatic spinal tumors are intractable pain, progressive neurological deficit, or an unknown histological diagnosis. Treatment can effectively relieve pain and improve neurological function in patients with canal compromise. Candidates for surgery should have a life expectancy of at least 3 months. Operative choices include anterior, posterior, and combined approaches, each with its advantages and disadvantages. Maximum tumor resection with a minimum number of complications is one of the goals of surgery. Surgical approaches, including type of reconstruction and extent of resection (including TES), need to be addressed for optimal outcomes. The main advantage of TES is that the spinal cord can be observed carefully throughout the procedure, especially during anterior spinal column osteotomy, corpectomy, and spinal reconstruction via posterior instrumentation. Although some differences between the 2 procedures were found regarding blood loss, operative duration, and local recurrence rate, it remains difficult to discern which procedure is better for the treatment of spinal metastases.

The primary purpose of surgery is to relieve a patient’s pain, and the current study demonstrated satisfying pain relief after both procedures. This finding is not surprising and is in agreement with findings in other studies. Although no differences in the patient-reported outcomes were noted, the estimated blood loss was less for the anterior (mini-open) group (p < 0.05). Operative duration was significantly shorter by 3 hours and 40 minutes (p < 0.05) in the mini-open group than in the TES group. This difference might have occurred because the mini-open corpectomy requires a smaller incision (shorter than 10 cm) to remove the vertebral body and only 1 segment to be fixed. While completing posterior TES, spine surgeons had to make an incision of approximately 30 cm, a surgical field big enough to insert 4–6 pairs of pedicle screws and perform a pediculotomy cautiously as well. It was these conditions that made the mini-open corpectomy procedure less complicated and less time-consuming.

In this study, the local tumor recurrence rate of TES was lower than that of mini-open corpectomy, which would be the biggest advantage of TES, while Kaplan-Meier curves showed that there was no significant difference in expected survival rate after mini-open corpectomy and posterior TES. Tomita et al. suggested basing the surgical strategy for spinal metastases on 3 parameters: primary tumor, the presence or absence of visceral metastases, and the number of bone lesions. On the basis of the prognostic scoring system, they recommended that all patients with solitary metastases should undergo wide or marginal resection of their tumor. Their study demonstrated that the extent of surgery correlated well with survival and local control. The findings of their study also confirmed the current data showing that all patients with solitary spinal tumors have the potential for long-term survival, thus justifying a more aggressive strategy. They recommended that patients with very good prognostic scores (scores 2–3) should undergo wide excision, whereas patients with intermediate scores should undergo marginal or intraleisional excision (scores 4–5) and palliative surgery (scores 6–7), while nonsurgical supportive care should be performed for the worst prognostic group (scores 8–10). In our results, the mean Tomita prognostic score was 3.8 ± 1.6 in the mini-open corpectomy group and 4.6 ± 1.3 in the TES group (p = 0.084). These patients belonged to the same Tomita score class (4–5), which should undergo either marginal or intraleisional excision accordingly.

The results above depended on the appropriate selection of patients. We only selected solitary metastases of the vertebral body without or with limited involvement of the posterior elements to undergo mini-open corpectomy. Debulking or curettage could remove almost all of the tumor tissues and minimize tumor contamination, which may effectively hinder recurrence. Another possible reason why there was no difference observed between the expected survival rate of the 2 procedures might be selection of the TES patients: to achieve TES with wide or marginal resection, the tumor should be contained within the vertebral body, with minimal to no paraspinous extension. Moreover, at least 1 pedicle must be free of tumor, and there should be no significant epidural disease. Unfortunately, for metastases of the spine, this is a very strict requirement; consequently very few patients with metastases could undergo a strictly wide marginal TES, but instead underwent intraleisional TES. Despite the meticulous effort to keep the resection extralesional, there remained an inherent risk of tumor contamination of the field during tumor dissection or pediculotomy.

One point we would like to mention is that in patients with lymphoma, radiotherapy continues to be the first-line treatment, although in our series, 1 patient with B-cell lymphoma, who presented with paraparesis during radiation therapy, was treated using TES. For those patients with smaller lesions with no symptoms or signs, radiotherapy or interventional treatment will assume a main role as a local treatment. For “seed sized disseminated foci or occult microscopic foci,” more effective systemic treatment such as chemotherapy, hormonal therapy, immunotherapy, or gene therapy must play a major role.

Limitations of this study are the small number of patients and the relatively short follow-up period. However, unlike clinical drug trials, it is impossible and unethical to blind surgeons and patients in a study of surgical treatments. A large prospectively designed study in a larger series of patients is required to confirm the results of this study.
Conclusions
The current study demonstrated that (mini-open) spinal metastases, surgical management (mini-open corpectomy or posterior TES) can significantly palliate these metastases. The outcomes of these 2 surgical interventions are similar, especially pain relief and the survival rates within 2 years. With smaller incisions, mini-open anterior corpectomy is an optional procedure with a relatively mild learning curve and fewer technical difficulties in treating solitary metastases of the thoracolumbar spine. This technique can be accomplished with less blood loss, fewer fixation instrumentations, and shorter surgical duration than that required for TES, but patients who undergo mini-open corpectomy might have a greater tendency to suffer local tumor recurrence. The decision of which procedure to perform might depend on the experience of the surgeons and the conditions of the patients. The long-term outcome of each procedure remains to be further investigated using larger sample sizes.

Disclosure
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