

Single-stage en bloc resection using a posterior approach for sacral tumors

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Abstract

Objective This study aims to investigate the surgical results of single-stage en bloc resections using a posterior approach for sacral tumors and evaluate its benefit for these tumors.

Methods A total of 32 cases involving patients with sacral tumors who were treated with single-stage en bloc resection by posterior approach from April 2004 to January 2010 were reviewed. The patient cohort included 20 males and 12 females. The average patient age was 49.1 years old (range, 18 to 75 years old). Twenty-seven patients suffered from primary sacral tumors, including 17 patients with chordomas, 5 patients with giant cell tumors of the bone, 3 patients with chondrosarcoma, 1 patient with sarcoma of the nerve fibers, and 1 patient with neurofibromatosis. Five patients were diagnosed with sacral metastatic tumors, including 2 cases of breast cancer, 1 case of renal carcinoma, 1 case of thyroid cancer, and 1 case of lung cancer. According to the Frankel grading system, there were 3 Grade B tumors, 4 Grade C tumors, 10 Grade D tumors, and 15 Grade E tumors.

Results The operation took 265 min on average (range, 130–360 min), and blood loss was 1676 mL on average (range, 800–1800 mL) during the operation. The follow-up period ranged from 6 months to 6.2 years. All patients had pain prior to operation. Twenty-eight patients experienced complete pain-relief, and 4 patients experienced partial pain-relief after their operations. In all patients, neurological function was improved more than one grade using the Frankel grading system. Up to now, 5 patients experienced local recurrence after operation, and 2 patients were deceased. The remaining patients are still alive without recurrence.

Conclusion Single-stage en bloc resection through a posterior approach for sacral tumors is feasible, safe, and effective. It has many advantages, such as controlling local recurrence, thorough decompression of the spinal cord, relieving pain, improving quality of life, and prolonging survival.

Key words: sacrum; tumor; en bloc resection; spinal cord compression; reconstruction

Received: 27 January 2016
Revised: 5 March 2016
Accepted: 25 March 2016

Due to their mild symptoms, sacral tumors are usually not diagnosed early in the disease course. It is a challenge for surgeons to operate on patients with sacral tumors when the diagnosis is finally made. As reported, tumor recurrence is higher than 30% because surgeons are hindered by complicated anatomy, and sacral tumors pose technically challenging surgical problems. Excision of malignant or benign aggressive sacral tumors with intralesional margins is rarely curative because of the high likelihood of increased local recurrence and decreased survival, which reportedly occurs in 30% of patients [1]. Recently, due to better surgical technology and renewed ideology for spinal tumors, total en bloc spondylectomy (TES) has been used to treat thoracic and lumbar tumors [2–3]. TES has been shown to decrease local recurrence and

increase survival in patients with spinal tumors [4–5].

There are few reports about TES in sacral tumor treatment. Here, we report that we have performed total sacrectomy with single-stage en bloc resection of the sacrum and complex iliolumbar reconstruction, stabilization, and fusion using a posterior approach in 32 patients from April 2004 to January 2010. The purpose of this retrospective study was to review the authors' experiences with sacral neoplasms over the last six years.

Materials and methods

Patient population

Between 2004 and 2010, 32 patients (12 female and 20 male patients) with sacral tumors were treated at the

Tongji hospital of HUST, China. The average age of the patients was 49 years old (range, 18–75 years old). We performed total sacrectomies with single-stage en bloc resection of the sacrum and complex iliolumbar reconstruction, stabilization, and fusion using a posterior approach. Patient records were retrospectively reviewed and included age, sex, histological characteristics of the primary tumor, neurological symptoms, and surgical approach. Preoperative evaluation included neurological examination, biopsy sampling, pain assessment, CT scanning, abdominal ultrasonography, and ^{99m}Tc bone scanning. Medical treatments received before surgical consultations were recorded. The 27 primary sacral tumors included chordomas (17), giant cell tumors (5), chondrosarcomas (3), a sarcoma of the nerve fibers (1), and neurofibromatosis (1). Five patients were diagnosed with sacral metastatic tumors, including breast cancer (2), renal carcinoma (1), thyroid cancer (1), and lung cancer (1). According to the Tokunishi evaluation system^[6], the 5 patients with metastatic tumors all had scores under 8 points, and the predicted survival times were greater than 6 months. There were 3 Grade B, 4 Grade C, 10 Grade D, and 15 Grade E tumors using the Frankel grading system^[7]. Selected embolism of internal iliac arteries was performed in 15 patients prior to surgery.

Surgical Procedure

All patients received mechanical purge preparation and oral administration of neomycin and erythromycin three days before the surgery. A clear liquid diet was utilized throughout the three-day preparation. Selected embolizations of internal iliac arteries were performed for some patients 24 h before surgery.

The posterior approach utilizes a midline incision centered over the sacrococcygeal region 3. A retroperitoneal dissection of the lower lumbar and pelvic area was then performed. Both the iliac arteries and veins were dissected, and the internal iliac arteries were ligated. This part of the operation was performed by a general surgeon. Next, pelvic visceral and vascular structures were mobilized away from the tumor. After rectal dissection, sacral nerve roots entering the tumor were sacrificed, followed by an L5–S1 anterior discectomy and partial ventral sacroiliac osteotomies. A piece of sterile gauze was placed in the abdomen dorsal to the rectum to isolate the rectum from the lumbar vertebrae and sacrum, and the abdominal incision was closed. The patient was placed in the prone position, and a vertical midline incision was made. If there was a previous operation, the existing incision lines were resected. After dissecting and retracting the gluteal muscles, the sciatic notch was identified, and posterior osteotomies were performed. An L5 laminectomy was performed, and after identification of the dural sac and the L5 and S1 roots, the dura mater and sacral

roots were ligated distal to the L5 roots. After completion of the osteotomies, the tumor mass was completely removed. Closed suction drainage catheters were placed as needed. Myocutaneous flap closure was used in most cases (Fig. 1 and 2).

Post-operative adjuvant therapy

Chemotherapy was administered as post-operative adjuvant therapy for sarcoma of the nerve fibers (1 case), neurofibromatosis (1 case), and the metastatic tumors (5 cases). Conventional radiation therapy was administered for giant cell tumors of the bone (3 cases) and chordomas (13 cases) after healing of the wound. The other 17 patients with neurology defects were treated with related medical therapy.

Results

The average operation time was 265 min (range, 130–360 min), and average blood loss was 1676 mL (range, 800–1800 mL) during the operation. The follow-up period ranged from 6 months to 6.2 years. All patients had pain before operation. However, 28 patients achieved complete relief, and 4 patients experienced partial pain relief after operation.

In all patients with neurological deficits, all patients improved neurologically by more than one grade using the Frankel grading system. Up to now, 5 patients have experienced local recurrences after operation, and 2 patients died the following year. The other patients remain alive without local recurrences.

Discussion

Hsieh *et al*^[8] reported on 20 patients who underwent en bloc tumor excision of sacral chordomas and chondrosarcomas. The mean disease-free survival time for patients who underwent en bloc tumor excisions was 51 months, but the mean disease-free survival time was only 17.5 months for the patients who had contaminated/intralesional resections. They concluded that en bloc resection was a novel treatment for sacral chordoma and chondrosarcoma. Fournier *et al*^[9] reported on 29 consecutive patients who underwent en bloc resection of primary sacral tumors, and they found a disease-free survival for patients with chordomas of 68 months with little risk of bladder/bowel dysfunction. Hanna *et al*^[10] retrospectively reviewed 18 patients who underwent excisions of the surrounding posterior pelvic musculature (piriformis and gluteus maximus) and found that wide surgical margins resulted in better local disease control. Other authors also found similar results using anterior margin excisions. Fuchs^[11] and his colleague reported that a wide surgical margin is the most important predictor of survival and lo-

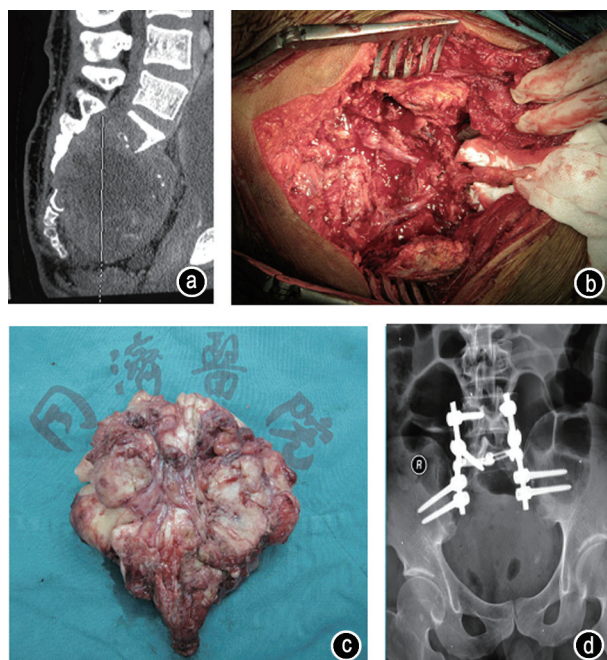


Fig. 1 Male, 32 years old, sacrococcygeal chordoma. (a) CT scan of a large tumor; (b) The dura mater was ligated distal to the L5 roots; (c) The tumor was completely removed; (d) Galveston reconstruction was performed

cal recurrence in patients with sacrococcygeal chordoma. Use of a combined anteroposterior approach increases the likelihood of obtaining wide margins.

In our report, all patients experienced pain before their operation, after which 28 patients achieved complete pain relief and preserved neurological function. For all patients with neurological deficits, patients improved neurologically by more than one grade using the Frankel grading system. To date, 5 patients have experienced local recurrence after their operation, and 2 patients died thereafter. All other patients are alive without recurrence. In our study, 5 patients who had disease with the upper extent at S1 lost bladder and bowel control post-operatively, even after curettage, thus not satisfying one of the primary aims. With training post-operation, 3 pa-

tients recovered, and 2 patients did not progress. There were 12 patients who kept 2 or more roots and lost partial bladder and bowel control post-operatively. After training, 10 patients improved, and 2 did not progress. The 15 patients who kept at least 3 roots maintained bladder and bowel control.

The indications for single-stage en bloc resection by posterior approach for sacral tumors

We treated 32 patients (26 cases under S2 and 6 cases above) with vertebral tumors. For the 5 metastatic patients, the Tokuhashi scores ranged between 2 and 8, and survival was at least 6 months. We conclude that the best candidates for surgery have: (1) a vertebral primary tumor without metastases; (2) a tumor under the S2 and above the S2 should maintain function; and (3) for metastatic tumors, with the sole lesion or with the primary part resection and a Tokuhashi score under 8, survival is at least 6 months. With neurological dysfunction, need demission, and no major organ injuries, the related metastases can be resected.

The challenges for single-stage en bloc resection using a posterior approach for sacral tumors

Blood loss control during the operation

The big challenge for this resection is the blood loss that occurs during the operation. As a preoperative application, selective arterial embolization can reduce intraoperative blood loss for patients with hypervascular primary malignant lesions and metastatic tumors. Because collateral circulation is usually reestablished within 24 h after embolization, tumor resection should be scheduled soon thereafter. During our surgeries, the mean blood loss was 1676 mL, and we observed that blood loss of the en bloc resection is far less than that during traditional surgery.

Making decisions to amputate related roots

Some researchers found that in patients who underwent unilateral sacrectomies and in whom the contralateral sacral nerves were preserved, normal bowel and bladder functions were retained in 87% and 89% of pa-

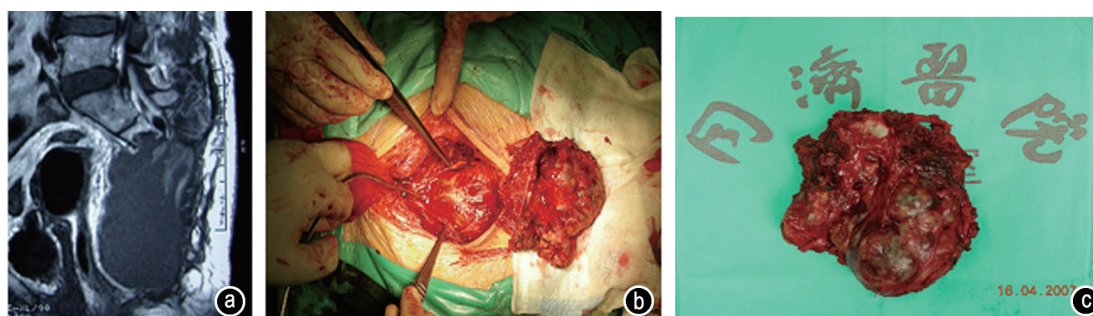


Fig. 2 Female, 56 years old, chordoma. (a) A sagittal MRI scan showing the big sacrococcygeal chordoma; (b) The dura mater was ligated distal to the L5 roots; (c) Complete removal of the tumor

tients, respectively. Of the patients who had bilateral S2–S5 nerve roots sacrificed, all patients had abnormal bowel and bladder function. In patients who had bilateral S3–S5 resections, normal bowel and bladder functions were retained in 40% and 25% of patients, respectively. In patients who had bilateral S4–S5 resections with bilateral preservation of the S3 nerves, normal bowel and bladder functions were retained in 100% and 69% of patients, respectively. In patients who underwent asymmetric sacral resections with preservation of at least one S3 nerve root, normal bowel and bladder function was retained in 67% and 60% of patients, respectively^[12]. These results show that unilateral resection of sacral roots or preservation of at least one S3 root in bilateral resections preserves bowel and bladder function in the majority of patients.

In our study, 5 patients in whom of the majority of their disease was at S1 lost bladder and bowel control post-operatively even after curettage, thus not satisfying one of the primary aims. With training post-operation, 3 patients recovered, and 2 patients did not progress. There were 12 patients in whom at least 2 roots were kept, and those patients exhibited partial bladder and bowel control post-operatively. After training, 10 patients improved, and 2 did not progress. There were 15 patients with at least 3 roots, and those patients maintained bladder and bowel control. Together with the literature, we conclude that root 3 should be the upper extent of resection, and surgeons should try to preserve the bilateral, or at least unilateral, S3 roots to maintain bladder and bowel function, which positively impacts quality of life.

Reconstructive surgery

We performed Galveston reconstruction in 6 patients with good results and no rod fracture. We concluded that reconstruction should be done in the patients who have received total or partial resection of the sacroiliac joint to maintain stability.

Conclusion

Single-stage en bloc resection by posterior approach for sacral tumors is a feasible, safe, and effective method. It has many advantages, such as controlling local recurrence, thorough spinal cord decompression, pain relief, improving the quality of life, and prolonging survival.

Conflicts of interest

The authors indicated no potential conflicts of interest.

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DOI 10.1007/s10330-016-0138-8

Cite this article as: Fang Z, Wu W, Xiong W, *et al*. Single-stage en bloc resection using a posterior approach for sacral tumors. *Oncol Transl Med*, 2016, 2: 65–68.