Neurosurgical Management of Sacral Tumors: Review of the Literature and Operative Nuances

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Key words
- Sacral lesions
- Sacral tumor
- Sacrectomy
- Sacrum
- Spinopelvic stability

Abbreviations and Acronyms
CT: Computed tomography
SI: Sacroiliac

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BACKGROUND: **Sacral tumors present a significant challenge to the spine surgeon. As new techniques have evolved in recent years, these lesions have become more amenable to aggressive surgical treatment. Although sacral tumors make up only a small minority of spinal tumors, their surgical management warrants special consideration.**

METHODS: **Based on our experience, we highlight 3 important surgical nuances specifically for the treatment of sacral tumors: preservation and maximization of neurologic function, protection of ventral abdominal and pelvic structures, and lumbopelvic fixation.**

RESULTS: **Two cases of patients with sacral tumors treated at our institution are presented to illustrate these points. Both patients had successful postoperative courses, and remained pain free, well-fixated, and neurologically intact at 3–4 month follow-up. They had no evidence of biomechanical instability.**

CONCLUSIONS: **To ensure a successful outcome, a goal-directed, methodical approach is required.**

INTRODUCTION

Sacral tumors account for approximately 1%–7% of all spinal tumors. Most of these tumors are metastatic lesions from carcinoma of the breast, lung, and prostate.[1] Primary tumors of the sacrum, which are rarer still, pose a special challenge given the fact that they are typically resistant to radiotherapy and chemotherapy.[2] An important aspect of surgical treatment is staging. Two widely used staging systems for primary tumors of the spine are the Enneking staging system (Table 1) and Weinstein-Boriani-Biagini classification (Figure 1), both of which aid the surgeon in oncologically appropriate surgical decision making.[3,4] This article addresses 3 important considerations in surgical management of sacral tumors: preservation and maximization of neurologic function, protection of ventral abdominal and pelvic structures, and lumbopelvic fixation. We present 2 cases of patients with sacral tumors treated at our institution to illustrate these points. We also provide a review of the literature.

MATERIALS AND METHODS

Case A

A 73-year-old man was referred to the clinic for evaluation of progressive lumbosacral back pain, anterior thigh pain, and pelvic pain. The pain was aggravated by prolonged periods of sitting and with standing from a seated position. Squatting for prolonged periods and long car rides also exacerbated the pain. The pain and other symptoms (e.g., constipation and urinary urgency) progressively worsened over a 2-year period. There was no history of bloody stools, weight loss, or other constitutional symptoms.

Diagnostic investigations included computed tomography (CT) scan and magnetic resonance imaging of the lumbar spine. CT revealed a large destructive mass with erosion of most of S1 and all of S2 and S3 sacral segments as well as involvement of the lower portions of the sacrum and coccyx with retroperitoneal extension (Figure 2). Magnetic resonance imaging demonstrated a T1 hypointense lesion and a T2 isointense lesion with multiple small cystic areas that were T2 hyperintense (Figures 3 and 4). The mass homogeneously enhanced with gadolinium. This was a G0T1M0 sacral tumor based on the Enneking staging system (Table 1), indicating that a total capsular resection without complete sacrectomy could be performed to achieve gross total resection. A biopsy demonstrated a spindle cell tumor, but a specific pathologic diagnosis could not be made from the biopsy specimen. Therefore, the patient was offered sacrectomy and gross total resection of the lesion and spinopelvic fixation.

In the operating room, the patient was placed prone on a Jackson table. The operative field was prepared and draped in standard sterile fashion. Motor evoked potentials, somatosensory evoked potentials, electromyography, and sphincter electrodes were placed, and baseline neurologic monitoring was obtained. A posterior midline incision was made extending from the spinous process of L3 down to the coccygeal area. A copious

Table 1. Enneking Staging System

Lesion	Grading (G)	Compartmental Confinement (T)	Metastasis (M)	Treatment
Benign lesions				
Benign latent	G0	T0	M0	Intracapsular excision
Benign active	G0	T0	M0	Extracapsular excision
Benign aggressive	G0	T1/2	M0/1	Wide marginal excision/marginal excision and adjuvant
Malignant lesions				
IA (low grade)	G1	T0	M0	Wide marginal excision and limb salvage
IB	G1	T1	M0	Radical amputation vs. limb salvage
IIA	G2	T1	M0	Radical amputation or wide marginal excision and adjuvant
IIB	G2	T2	M0	Same as for IIA
III (metastatic)	G1/2	T0/1/2	M1	Aggressive resection and adjuvant or palliative

amount of tumor extended through the sacral dorsal endplate superiorly. This was carefully followed, and essentially progressive complete sacrectomy was performed. The tumor had clearly involved and surrounded the S1, S2, and S3 nerve roots bilaterally. A progressive intracapsular dissection of the tumor was performed in conjunction with preservation of neural elements as possible. The tumor appeared to arise from the S4 nerve root on the right side. A biopsy specimen obtained for frozen section confirmed a spindle cell neoplasm. Once the perirectal fascia was identified, a plane was able to be identified between the tumor and fascia, and this was carefully followed on either side, being careful to divide any adhesions between the tumor and muscle and off the sacral nerve roots. Great care was taken to ensure that the sacral nerve roots of S1, S2, and S3 were kept intact throughout. As dissection was carried down to the midportion of the sacrum, it became evident that there was significant bony erosion of the dorsal elements of the sacrum. Care was taken to preserve all neural elements. At this point, progressive tumor resection and dissection continued within the sacral canal. The tumor was carefully dissected off the perirectal fascia with assistance from a colorectal surgeon. This was facilitated after a coccygectomy was performed. The sacral roots were kept intact as the tumor was carefully removed from the perirectal fascia. The tumor capsule was circumferentially exposed, and the last remnants of the tumor were removed achieving a gross total resection. The sacrectomy was completed as the final remnants of tumor were removed.

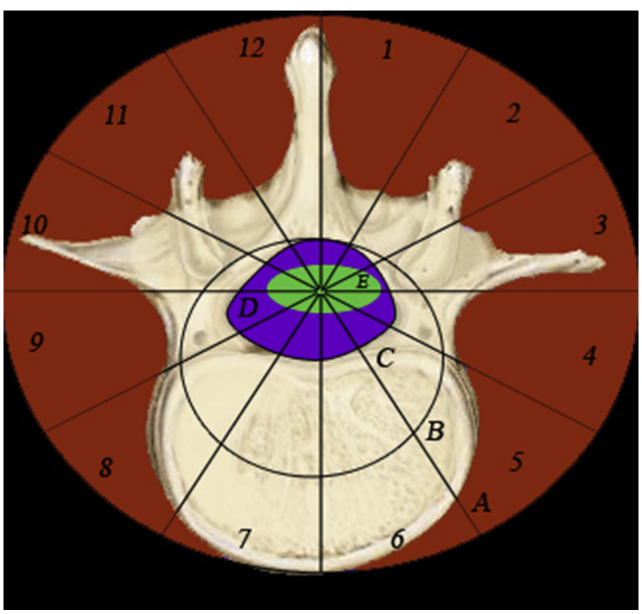

Figure 1. WBB tumor classification schemata; WBB staging system: (**A**) extra-osseous soft tissue; (**B**) intra-osseous soft tissue; (**C**) intra-osseous deep; (**D**) extra-osseous extradural; (**E**) extra-osseous intradural.

When the tumor resection was completed, it was decided that additional spinopelvic stability would be required. This additional lumbopelvic stability was achieved through the creation of a quad-rod construct with 2 rods being placed between L4 and the sacrum. Iliac fixation was achieved with 2 S2-alar-iliac screws on each side for additional stabilization. The additional quad rods were placed parallel to the initial rods, and these were connected to the original rods with lateral connectors to share the stress load on the lumbopelvic construct and to decrease the risk of instrumentation failure through a stress riser leading to a rod fracture