Spinopelvic Tumor Resection and Reconstruction

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How are spinopelvic tumor resections classified?

The type of pelvic resection depends on the area involved and the extent of the tumor. Problems arise when the tumor involves the sacrum and the lower lumbar spine. To obtain acceptable surgical margins in these cases, skeletal resection should extend beyond the standard hemipelvectomy (ie, the sacroiliac joint) and may include the ilium, part of or the entire sacrum, and part of the lower spine.

Major spinopelvic resections have been classified into 4 types: type 1, total sacrectomy with or without lumbar vertebra resection and bilateral iliac wing resection; type 2, total hemisacrectomy with or without lumbar hemivertebrectomy and unilateral ilium resection; type 3, hemisacrectomy, lumbar hemivertebrectomy with or without lumbar hemivertebrectomy, and external hemipelvectomy; and type 4, total sacrectomy with or without lumbar vertebrectomy, medial ilium resection on retained side, and external hemipelvectomy.¹

What are the indications for spinopelvic tumor resection and reconstruction?

The goals of spinopelvic tumor resection and reconstruction are to achieve negative-margin tumor resection and pelvic reconstruction with maximum postoperative stability. Surgical goals include stabilization of the pelvis and improved function. The functional results depend on the mechanical stability of the construct.² ³

The most common indication for spinopelvic tumor resection and reconstruction is primary pelvic, sacral, or spinopelvic malignancy requiring resection. Such tumors include chordoma, chondrosarcoma, osteosarcoma, and Ewing’s sarcoma. Spinopelvic resection, which is more rare, is indicated for patients with primary or recurrent pelvic visceral tumors and no evidence of metastatic or nodal disease. En bloc resections may be considered for giant recurrent benign aggressive tumors of the pelvis and sacrum. The presence of disseminated malignancy is a strong relative contraindication for spinopelvic resection. However, aggressive en bloc resections encompass the pelvis, lumbar spine, rectum, and urogenital and vascular structures to obtain en bloc tumor resection.

Considering the high failure rate and increased morbidity, this type of operation is not indicated for patients with meta-


static disease at onset or if inability to obtain negative-margin resection exists. Spinepelvic tumor resection and reconstruction in a patient who had prior resections at the same site carries an increased risk for complications and local recurrence and should be considered a relative contraindication. Finally, the medical fitness of the patient for surgery also frequently enters into the decision for surgery, especially in patients who may receive adjuvant chemotherapy.

What types of surgical techniques are available for spinepelvic reconstruction after tumor resection?

With the evolution of surgical techniques and neoadjuvant treatments, the ability to resect tumors of the posterior pelvis with adequate margins has advanced. However, reconstruction of the large resultant defects remains in evolution. Generally, resections that require sacrectomy above the S1 foramen require spinepelvic reconstruction. Reconstruction varies according to the type of resection. Spinal fixation using hooks, Luque wires, pedicle screws, and the Luque-Galveston iliac fixation have fueled the evolution of reconstruction techniques. The current generation of instrumentation used in spinepelvic reconstruction is the pedicle screw-rod construct. The fixation is more rigid than that of previous constructs.

How do you determine which surgical technique to use for spinepelvic reconstruction after tumor resection?

In type 1 resections, a combined anterior and posterior approach is required. Posterior instrumented spinoliliac reconstruction is done using pedicle and iliac screws. Dual rods are used bilaterally to decrease the risk of instrumentation failure. The instrumentation is reinforced by 2 fibula grafts bridging the last remaining lumbar vertebral segment to the supra-acetabular region of the pelvis. In type 2 resections, posterior fixation of the lumbar spine to the pelvis with a unilateral bone strut bridging the lumbar spine to the pelvis can be performed. In type 3 resections, either no reconstruction or posterior spine fixation of the remaining lumbar spine to the remaining hemipelvis can be performed. In type 4 resections, spinepelvic arthrodesis can be performed using the femur of the amputated leg to bridge the lumbar spine to the remaining hemipelvis.

What role does imaging play in diagnosing patients with spinepelvic tumors?

Staging and accurate diagnosis are key in the evaluation and preoperative planning of patients with spinepelvic tumors. Systemic staging includes bone scanning and computed tomography of the chest, abdomen, and pelvis; the role of positron emission tomography–computed tomography in staging is currently evolving. Local staging is best provided by contrast-enhanced magnetic resonance imaging, which is key to localizing tumor extent and adjacent structure involvement. Selected patients benefit from computed tomography angiography to evaluate the pelvic vasculature. Computed tomography–guided trocar biopsy is performed in all patients as a last step of staging.

What complications can arise after spinepelvic tumor resection and reconstructions?

Spinepelvic tumor resection and reconstruction is technically demanding and fraught with potential complications. A 75% overall morbidity and high mortality has been reported after hemipelvectomy. More recently, the overall morbidity reduced to 54% and the perioperative mortality to 5%. Wound complications, such as infection and flap necrosis, are most common; longer operative time and increased complexity are associated with higher wound infection and flap necrosis rates. Other reported complications include intraoperative hemorrhage; nerve and visceral injuries of the ureter, bladder and bowel; lower-quadrant hernia and resection of an ischemic terminal ileum; late venous thrombosis that typically involves the common iliac vein; and psychological effects and depression. Reconstructive procedures aim to decrease rate of infections, flap necroses, and skeletal instability.

Describe the postoperative care of patients with spinepelvic tumor resection and reconstruction.

Postoperatively, these patients are maintained on a suspension air mattress for approximately 5 to 10 days. Mobilization then proceeds with the use of a tilt table and progresses to standing. Once patients can be out of bed for up to 3 hours a day, they are transferred to the inpatient rehabilitation service for further aggressive rehabilitation. In patients undergoing type 4 resections, the magnitude of the surgical insult usually prohibits aggressive postoperative mobilization for approximately 2 weeks after the reconstructive procedure. In patients undergoing a unilateral reconstruction, weight bearing is limited on the affected side until evidence of bony healing is seen on radiographs (6 to 8 weeks for patients not on chemotherapy and 12 weeks for patient on chemotherapy or requiring radiotherapy to the area). Pharmacologic deep venous thrombosis prophylaxis is instituted as soon as medically prudent. An inferior vena cava filter minimizes the risk of symptomatic thromboembolic disease to the lungs. In patients who have undergone high resections into the lumbar spine at the level of L3 or higher, a significant risk of lymphatic leak exists postoperatively. In these patients, total parenteral nutrition is started postoperatively, followed by a low-fat diet for the first 2 weeks postoperatively to minimize the risk of symptomatic lymphatic leak. Patients with spinepelvic resection may require colostomy care, chronic pain management, physiotherapy, occupational therapy, psychological support, and use of an artificial limb.
begins at 4 months with axial imaging studies of the chest and operative site. Wound complications, if any, require aggressive debridement and sometimes flap reconstruction.

**How has the technology used for spinopelvic reconstruction after tumor resection changed in the past 2 decades?**

Significant advances have been made in the management of spinopelvic tumors in the past 2 decades. These include more complex surgical approaches for tumor resection with clear surgical margins and improvements in reconstruction using plastic and microsurgical techniques, structural bone grafting, and spinopelvic stabilization using new segmental instrumentation techniques such as the pedicle screw-rod construct for more rigid fixation.4,6

**What does the future hold for the surgical treatment of patients with spinopelvic tumors?**

The use of paired-point imaging with image fusion has made approaching tumors through an accurate and minimally invasive technique a viable option for the treatment of a subset of spinopelvic tumors. Using intraoperative stealth navigation, surgeons are able to accurately localize the tumor site and excise the tumor, avoiding conventional wide exposures and approaches and sacrifice of soft tissues, such as sacrospinous and sacrotuberous ligaments. In addition, advances in spinopelvic fixation instrumentation will decrease the risk of catastrophic fixation failure after wide tumor resections, and improved microsurgical techniques will enable durable wound flap closure.

**REFERENCES**