OPERATIVE TECHNIQUE

Surgical Approach To Spine Tumors

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Introduction

Primary tumors of bone are extremely rare, accounting for approximately 0.4% of all tumors. Primary tumors of the spine are likewise rare, accounting for less than 10% of all bone tumors. Primary tumors are far less common than metastatic spine lesions, particularly in adults. Other non-neoplastic conditions producing spinal symptoms are much more common. Nevertheless, primary tumors of the spine represent a diagnostic and therapeutic challenge to the spinal surgeon. One must have a high index of suspicion, if one is to accurately diagnose and successfully treat these lesions, since the most common early complaint is back pain. Although these lesions are often times found in compromising locations; around the spinal cord, nerve roots, major organs, and blood vessels; results of treatment can positively affect survival and quality of life.

Primary Spine Tumors

The clinical presentation can vary considerably from patient to patient, but the primary complaint of most patients is back pain (Tables 1-2). Symptoms of back pain at night, pain at rest, or a neurologic deficit should prompt consideration of a spine tumor. In one series, 84% of patients presented with some complaint of pain, either localized back pain (60%) or radicular pain (24%). There was no symptomatic distinction between those benign tumors compared to those being malignant. The pain is not usually relieved by rest or recumbency. Pain is usually of an insidious onset and is usually progressive over time.

Despite these complaints, diagnosis is often delayed. The delays are usually in terms of years. Unfortunately, delays affect adequate (optimal) treatment and survival. Patients often relate their pain to a fall, or some other mishap, thus providing the unsuspecting physician with a likely explanation of their pain. At the time of the initial neurologic examination, an objective deficit maybe identified in 50% of patients. This is directly related to the loca-

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tion and nature of the tumor mass. Herniated disks and various types of spinal stenosis have been confused with primary tumors. A palpable detectable mass is uncommon.9 The interval from onset of symptoms to diagnosis is often prolonged, particularly in benign lesions. However, most patients having primary spine tumors are diagnosed within the first year of symptom onset.

Judicious use of roentgenographic investigations is essential. Plain radiographs are satisfactory in a majority of spinal tumors, with thoracic spinal lesions being the most difficult to see.1,4,6,7,9,12 Treatment plans, however, must be supplemented with appropriate use of bone scans, CAT scans, MRIs, tomography, and, occasionally, myelography and angiography. With these techniques and appropriate preoperative radiographic staging, a treatment algorithm can be instituted (Fig. 1).9 On plain radiographs, cortical disruptions and/or soft tissue masses are common for both benign and malignant spine tumors. Fluoroscopy using C-arm control, or CT scan guided techniques are useful when closed percutaneous biopsies are indicated. It is strongly recommended that spine tumors should only be biopsied and treated by surgeons experienced in the approach and management of these most difficult problems.9,13 The Technetium 99 bone scan is the most sensitive diagnostic tool for detecting spinal metastases. However, false negatives do occur, if little vascular response has occurred due to the tumor. Primary tumors such as multiple myeloma and some sarcomas, for example, may be negative on bone scan. Also, the extent of 99m Tc uptake does not necessarily correlate with the extent of tumor involvement.14

CT may be the best diagnostic and surgical planning tool. It provides good visualization of even minimal vertebral destruction, a good look at the surrounding soft tissues, and allows surgical decisions to be made based on a clear visualization of the extent of invasion of the spinal
canal. Using a small amount of water-soluble dye in the subarachnoid space, enhanced CT, will aid in distinguishing tumor from the thecal sac. Myelography by itself is rarely indicated, although it can be useful to define extent of involvement or multiple site involvement. Today, however, magnetic resonance imaging has replaced myelography for delineating multiple site involvement and extent of disease. One should remember that myelographic or MRI blocks don’t necessarily correlate with symptoms or outcome. It is the progressive neurologic compromise, rather than the diagnostic studies, that indicates the treatment course to be taken.

The effectiveness of anterior spinal surgery is
sometimes compromised by excessive bleeding. Metastatic renal cell and thyroid carcinomas can be very vascular, increasing the morbidity and mortality in such cases. Aneurysmal bone cyst, hemangiosarcoma, and other primary tumors may also present a vascular challenge to the spinal surgeon. Angiography with selective embolization can be an effective way to deal with such lesions. With the use of this technique, intraoperative blood loss and perioperative morbidity and mortality can be improved.

**Location**

Primary spine tumors involve all spinal segments. Cervical spine tumors are, however, less common than thoracic, lumbar, and sacral lesions (Fig. 2). The vertebral body is three times more likely to be involved with primary tumors than are the posterior elements (Fig. 3).

The surgical approach to spine tumors can affect prognosis. The single most important factor in determining the prognosis of the patient with a primary spinal malignancy is the ability to obtain a complete excision at the initial surgery, particularly with respect to the chordomas and chondrosarcomas. Although some authors have advised that attempts of surgical extirpation are fruitless and should not be made, it is clear from others that the ability to completely remove the primary tumor, plays a significant role in overall patient survival.

As in the extremities, certain high grade tumors necessitate more aggressive surgery when possible. Certain anatomical structures in and around the spine provide for natural planes of dissection. The individual bony vertebral bodies, disk, anterior and posterior longitudinal ligaments, and the dura are often resected to provide adequate tumor margins. Neural, muscular, and vascular structures can also be safely sacrificed in order to achieve adequate surgical margins. Surgical treatment significantly influences outcome in malignant lesions, both in terms of longevity and quality of life. Thus, the basic tenants of tumor surgery apply: extirpation allows the best prognosis for local control and cure of the disease.

**Anatomical Extent Of Spine Tumors**

The anatomical extent of various zones can be seen in Figure 4. Intraosseous lesions confined within the boundaries of the cortical spine are seen in Zones IA to IVA. Zone IA includes spinous process to the pars interarticularis and inferior facets. Zone IIA includes beyond the pars interarticularis, including the transverse process, superior articular facet, and the pedicle to its junction with the vertebral body. Zone IIIA includes the anterior three fourths of the vertebral body. Zone IVA includes the posterior one fourth of the vertebral body. Zones IB to IVB are theextraosseous extensions beyond the boundaries of cortical bone. Zones IC to IV(C) are regional or distant metastatic involvement (more than one zone is frequently involved).

Surgical outcome is ultimately affected by the zones involved, whether the lesion is intra- (Fig. 4A), extraosseous (Fig. 4B), or metastatic (Fig. 4C), and the type of tumor and its grade. Likewise, the ability to extirpate these tumors can directly affect prognosis, depending on tumor type, grade, and location.

**Surgical Procedures**

Isolated lesions in Zones IA through IVA can be completely resected by a wide resection while extraosseous lesions of the spine are extremely difficult to resect with good margins especially in the lumbar-sacral and cervical spine, without neurovascular compromise. Many times surgery is marginal at best and usually intralional. The decision to perform wide or radical resection must be weighed against the risk.
Fig. 6: A CT scan of an L3 (A). Chordoma involving Zones IIIa and IVA&B. MRI of the same patient, T2-weighted image (B). Illustration of reconstruction performed (C-D). AP and lateral radiographs 3 years postoperatively (E). No signs of recurrence to date.

Fig. 6A.

Fig. 6B.

Fig. 6C.

Fig. 6D.

Fig. 6E.

However, using the classification as outlined, wide excision is possible in many cases. 9,19,23

**Surgical Approaches**

The posterior approach can be seen in Figure 5. Zone I (A,B,C) lesions are best approached from posteriorly, the resulting tensile loads are best minimized by posterior fixation of the surgeon's choice (Fig. 4A,B,C). Zone II (A,B,C) lesions are also, in general, best approached posteriorly. Zone II lesions may be stabilized by posterior fixation alone (Fig. 4A,B,C).
Fig. 7: AP radiograph of a giant cell tumor T12 (A). CT scan giant cell tumor T12 (B). AP radiograph following wide resection (C). Lateral radiograph following wide resection (D). Patient is 8 years out without recurrence.
Zone III lesions should be approached anteriorly. Adequate resection and reconstruction with or without internal fixation can usually be performed in this zone throughout the spine (Fig. 4A, B, C).

A combined approach must be used for Zone IV lesions because they present the most difficult area to approach and reconstruct. One must go across Zone I, II, and/or Zone III to get to Zone IV lesions. In some cases of Zone IV lesions (ie, lumbar spine) resection demands anterior and posterior stabilization following extirpation of the lesion (Fig. 6).

This scheme by zone is an important attempt to unify the approach to these difficult problems. It must be critically analyzed and retrospectively reviewed to determine its efficacy.

This type of classification scheme is relevant to both surgical planning and reporting end results of treatment for spine tumors. Depending on the location and extent of the lesion as determined by complete preoperative workups, three types of procedures may be performed: wide excision, marginal excision, or intrale-
Fig. 9: CT scan of L2 chordoma in a 74-year-old woman (A). Postop AP radiograph 2 years following intralesional resection followed by internal fixation plus polymethylmethacrylate (B).

Fig. 9A.

Fig. 9B.

...sional excision. Appropriate reconstruction can and must be accomplished. Once the tumor has been removed, and the spinal cord and nerve roots decompressed, if indicated, stabilization of the spine is performed (Fig. 7). Some surgeons use corticocancellous anterior interbody graft, for Zone III lesions, keyed into the vertebral endplates. The patient is then immobilized in an orthosis until the graft incorporates (Fig. 8). If a patient is chronically debilitated and/or is facing further treatment, such as chemotherapy or irradiation, this may not be a good management plan. Internal fixation with grafting in such a case may be a better approach. Depending on location, age, and tumor type, stabilization augmented with methylmethacrylate cement may be the procedure of choice (Fig. 9).

Summary

The goals of treatment of spine tumors should focus on: obtaining a definitive diagnoses through an appropriate biopsy or primary excision, institution of appropriate surgical or nonsurgical treatment as indicated by tumor type at the time of the initial procedure, preservation or restoration of normal neurologic function, and maintenance of spinal stability.

References


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