Spine Instability due to Neoplastic Disease

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ABSTRACT

Instability of the spine caused by neoplastic disease differs from instability after spine trauma. Progress is being made in understanding characteristics of these neoplasms and their role in causing spinal instability. This progress will help surgeons decide whether or not to offer a stabilization procedure, and if so, the extent of instrumentation required based on bone quality and the lytic or blastic characteristics of the underlying tumor pathology. Advancing tumor therapies are altering the course of these tumors, and patients are living longer. This may lead to more opportunities to intervene and treat complications from neoplastic spinal instability, either by relieving pain or preventing neurologic compromise. Discussions need to be had with the patient, the oncologist and the surgeon to best determine appropriate procedures based on quality of life and estimated life expectancy. Smaller procedures, such as percutaneous stabilization, could be offered to patients with shorter life expectancies if it could allow them to mobilize and improve quality of life, while a larger procedure, such as an en bloc resection with spinal reconstruction should be reserved for patients with a longer life expectancy as the post-operative recovery may lead to a period of worsened quality of life. The spinal instability neoplastic score (SINS) is being updated to reflect further understanding of the underlying characteristics of neoplastic spinal instability. Ultimately it can be modified into a decision making support tool that a surgeon could use to help guide treatment decisions in complex patients with neoplastic spinal disease.

KEY WORDS: Instability, neoplasm, spine, tumor

INTRODUCTION

The definition of what constitutes spinal instability has been debated, but the core concept revolves around the inability of the spine to maintain normal conformation and prevent neurologic compromise under physiologic loads (12). While this definition applies to trauma, it does not encompass other potential signs or symptoms of instability that may be present in the setting of a neoplastic process. The Spine Oncology Study Group (SOSG) defines neoplastic spinal instability, as “The loss of spinal integrity as a result of a neoplastic process that is associated with movement-related pain, symptomatic or progressive deformity, and/or neurological compromise under physiologic loads” (10).

Determining the presence of instability in the setting of a spinal neoplasm is important as instability can cause mechanical pain which inhibits movement, worsens quality of life, and can lead to a slew of immobilization-related health problems (13,15). Instability can also lead to direct neurologic compromise and subsequent neurologic deficit. Even when neoplastic spinal instability is recognized, it is difficult to determine what needs to be done. Surgical stabilization can be complicated in the presence of altered or obliterated anatomy from the neoplastic process, and an invasive surgery with subsequent recovery and post-operative pain can worsen quality of life in patients who may have a short life expectancy due to their primary disease.

The spinal instability neoplastic score (SINS) was created to be a generalizable scoring system that usable by surgeons and physicians in other specialties, and could reliably predict which patients may be more likely to require surgical stabilization as part of their treatment regimen (10). More specifically, the main purpose of the SINS score is to suggest when referral to a spine surgeon for consideration is appropriate, as unlike other scoring systems, there is no fixed
cut-off highly suggestive of surgical intervention. The scored components include: location, pain with movement, type of bone lesion, spinal alignment, vertebral body collapse and involvement of the posterolateral spinal elements (10). The SINS score has been shown to have a high degree of inter and intra rater reliability as well as validity in both surgeons and non-surgeons (11,12). The SOSG is currently updating the SINS, but the individual characteristics of neoplastic spinal instability will be reviewed here. Understanding the components of neoplastic instability is important as it will allow members of the multidisciplinary team often caring for these patients to identify which cases are potentially unstable and may warrant surgical consultation and ultimate surgical stabilization.

**REVIEW**

**Location of Neoplasm**

Location of the neoplastic process is an important determining factor of spinal stability in similar fashion to location of any traumatic fracture and how it leads to instability. Junctional regions of the spine are at higher risk when involved with a neoplastic process as any potential lytic process or even just weakening of the bony structure at these locations may lead to an inability to avoid deformation of the spine (1,17). Tumor involvement of the cervicothoracic junction can be problematic due to the small canal size and rigidity of the thoracic spine in the setting of a highly mobile cervical spine (1). Decompressions alone in this area are likely to cause a high degree of instability that may manifest as progressive deformity. Fusion following the decompression is usually recommended in this area, and even if an anterior approach is utilized, in most cases a posterior fusion is also required (11,24). Similarly, neoplastic involvement of the thoracolumbar junction can lead to instability and deformity both pre-operatively and post-operatively if a fusion is not performed. Tumors of the mid-thoracic spine are thought less likely to be unstable due to the presence of the rib cage as added support, and similarly, involvement of the rigid sacrum is less likely to demonstrate instability.

**Pain with Movement**

Pain can be an important symptom of potential instability, but the type of pain described can distinguish between pain due to instability and other causes of pain, such as compression of the neural elements. True mechanical back pain potentially due to an unstable spine is thought to be axial in nature, and highly associated with movement, and patients tend to report relief when lying down or ceasing movement (3-6,14,16,19). This is contrasted with worsened pain while lying down, often due to venous congestion and worsening of any previous compression of the neural elements.

**Bone Lesion Quality/Histology**

Bone quality (as best determined by dedicated CT scan) can be an important factor in spine stability, and it is important to determine whether a lesion is a lytic or blastic lesion (10,25). Lytic lesions of the spine are inherently more unstable as they erode bone quality and lead to higher rates of failure under normal physiologic loads (18). Several attempts have been made to characterize the amount of vertebral body involvement with fracture risk, including dividing the individual vertebra into 6 segments and involvement of 4 or more segments (greater than 50% of the vertebral body) is indicative of high fracture risk (14,22,24). Another study took product of remaining intact vertebral body and the bone mineral density to create the vertebral strength index, a scoring system highly correlated with fracture risk (7,26,27). It is thought that burst fracture risk increases with tumor size, but no specific limit has yet been determined (11).

**Spinal Alignment**

Overall or regional deformity may be indicative of instability if there is evidence of progression of the deformity attributable to the neoplastic process (2,9,23). Some regional deformities may be stable and not require surgical stabilization unless they affect the overall spinal balance of the patient leading to symptomatic deformity. Other regional deformities may lead to a focal change in load bearing patterns of the spine leading to exacerbated pain, or in severe cases, catastrophic failure of adjacent spinal elements or the involved segment.

**Involvement of Posterior Elements**

Involvement of the posterior elements of the spinal column may lead to spinal instability in trauma, and it is believed that this may also be true in the setting of neoplastic disease (8,20,21). Violation or disruption of the posterior elements, including the pedicles, facets or ligamentous attachments may lead to deformity or frank instability. It is thought that bilateral pedicle involvement leads to a significant worsening of instability when compared to unilateral pedicle involvement. More work will need to be done to better understand how posterior element...
involvement by a neoplastic process affects overall spinal stability in these patients.

**DISCUSSION**

Instability of the spine caused by neoplastic disease differs from instability after spine trauma. There have been attempts to describe the components of neoplastic spinal instability, most recently the SINS, (10) which is undergoing revision. As more is understood about spinal neoplasms, more progress will be made in understanding their characteristics and role in causing spinal instability. The current update will aim to include specific histologic types and how these types may influence bone architecture and structural integrity. Better understanding of how specific tumor pathologies affect spinal stability will help surgeons decide whether or not to offer a stabilization procedure, and if so, the extent of instrumentation required based on bone quality and the lytic or blastic characteristics of the underlying tumor pathology.

Advancing tumor therapies are drastically altering the course of certain types of neoplastic processes, and the life expectancies of patients are lengthening. This may lead to more opportunities to intervene and treat complications from neoplastic spinal instability, either by relieving movement associated pain or preventing neurologic compromise. There may be a role for palliative stabilization to treat mechanical pain. Discussions need to be had with the patient, the oncologist and the surgeon to best determine appropriate procedures based on quality of life and estimated life expectancy. Smaller procedures, such as an en bloc resection with spinal reconstruction should be reserved for patients with a longer life expectancy as the post-operative recovery may lead to a period of worsened quality of life.

The SINS is being updated to reflect further understanding of the underlying characteristics of neoplastic spinal instability and to better characterize patients based on specific tumor type. Prospective studies are underway to determine the ability of SINS to predict intervention and outcome. These studies should help to further refine this scoring system and define the cutoff levels for questioned instability and frank instability. Ultimately it can be modified into a decision making support tool that a surgeon could use to help guide treatment decisions in complex patients with neoplastic spinal disease.

**CONCLUSIONS**

Neoplastic spinal instability differs from instability caused by spinal trauma. As targeted therapeutics improve and longer life expectancies follow, there will be more of a role for stabilization of patients with instability to relieve pain or prevent neurologic compromise. A thorough understanding of the factors leading to neoplastic spinal instability will be key in determining who will need surgical stabilization and the type of procedure required.

**REFERENCES**


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