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Chapter 2

*A Novel Classification System for Spinal Instability in Neoplastic Disease: An Evidence-Based Approach and Expert Consensus from the Spine Oncology Study Group**

Fisher CG, DiPaola CP, Ryken TC, Bilsky MH, Kuklo TR, Harrop JS, Fehlings MG, Boriana S, Chou D, Schmidt MH, Polly W, Berven SH, Biagini R, Burch S, Dekutoski MB, Ganju A, Okuno SH, Patel SR, Rhines LD, Sciubba D, Shaffrey CI, Sunderesan N, Tomita K, Varga PP, Vialle LR, Vrionis FD, Yamada Y, Fourney DR. Spine 15(35):E1221–E1229, 2010

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Research Question/Objective Although the indications for surgical management of metastatic spinal disease are well understood (metastatic spinal cord compression [SCC], progressive neurological decline), the concept of tumor-related spinal instability was previously difficult to reliably evaluate among surgeons and nonsurgeons alike given the complexity of spinal column biomechanics.[1,2] Given the lack of established guidelines prior to 2010, spinal instability in the setting of neoplastic disease was limited to the individual patient's subjective clinical experience combined with the associated physician's interpretation. Such subjective evaluation may result in inconsistencies in recognizing instability and may prevent clear and consistent communication among the members of the multidisciplinary treatment team, leading possibly to inappropriate or missed referrals for surgical management.[3]

As a result, the Spine Oncology Study Group (SOSG), an internationally recognized group of experts in spinal oncology, developed a classification system based

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on review of available literature and expert consensus opinion to evaluate spine instability in patients diagnosed with neoplastic disease in 2010.[4]

Study Design The SOSG first conducted two preliminary systematic reviews to identify clinical and radiographic factors associated with overt or impending instability involving tumors of the cervical and thoracolumbar spine. A modified Delphi technique was used to integrate the available evidence with expert opinion to develop the classification system. A questionnaire was then administered to the members of the SOSG that collected factors, based on individual clinical experience and review of evidence from the literature that contributed to spinal instability. A preliminary Spine Instability Neoplastic Score (SINS) was created based on the relative ranking of a particular factor's contribution to spinal instability. A second round of questionnaires involved more critical evaluation of instability factors, in an effort to improve reliability among evaluators and to improve validity of the score to predict instability in case examples. The SOSG ultimately defined tumor-related spinal instability as "loss of spinal integrity as a result of a neoplastic process that is associated with movement-related pain, symptomatic or progressive deformity, and/or neural compromise under physical loads."[4] Factors mentioned in the SINS included regional location of tumor, presence of mechanical/postural pain, bone lesion quality, spinal alignment, extent of vertebral body involvement/collapse, and posterolateral involvement of the spinal elements.[4,5]

Sample Size Not applicable. Three representative cases are presented in the text. However, the total series of clinical cases reviewed by the SOSG is not reported.

Follow-Up Not applicable.

Inclusion/Exclusion Criteria Not applicable.

Intervention or Treatment Received Not applicable.

Results The final SINS classification system includes six components, with a weighted value for each component. As such, the clinical presentation and imaging findings can be combined to determine an objective status of instability for a given patient with a neoplastic lesion of the spine. The score for each component is additive to achieve a final SINS. In terms of *location-specific factors*, junctional areas (occiput-C2, C7-T2, T11-L1, and L5-S1) are at the most risk for developing tumor-related spinal instability, with an assigned score of 3; the mobile spine (C3-C6, and L2-L4) is assigned a score of 2; the semirigid spine (T3-T10) is assigned a score of 1, and the rigid sacrum (S2-S5) is assigned a score of 0. With regard to *clinical pain presentation*, mechanical or postural pain is scored based on pain that may be relieved with recumbency (score of 3), while occasional, nonmechanical pain is assigned a score of 1, and a pain-free lesions score of 0. The *quality of the bone lesion* is scored

based on whether the lesion is lytic (score of 2), mixed blastic and lytic (score of 1), or blastic (score of 0). *Deformity* is a major contributing factor and has the highest potential score, with subluxation/translation assigned a score of 4; *de novo* deformity, including kyphosis or scoliosis, assigned a score of 2; and normal spinal alignment assigned a score of 0. *Vertebral body collapse* is a score of 3 if it is greater than 50%, a score of 2 if it is less than 50%, a score of 1 if the lesion includes greater than 50% of the vertebral body but there is no collapse, and a score of 0 if none of the vertebral body criteria are met. *Posterolateral involvement of the spinal elements*, including facet, pedicle, and costovertebral involvement, may exacerbate spinal instability. If posterolateral involvement is present bilaterally in the neoplastic lesion, a score of 3 is assigned, unilateral involvement is given a score of 1, and involvement of the vertebral body without any posterolateral involvement is given a score of 0.

The maximum amount of points that can be earned is 18; a score of 0–6 denotes stability, a score of 7–12 is "indeterminate" and possible impending instability, and a score of 13–18 indicates instability. Surgical consultation is recommended for any patient with a score greater than, or equal to, 7.

Study Limitations Although the study is currently the most comprehensive classification system for spinal instability in the setting of neoplastic disease, several limitations have been highlighted by the authors. Disease that is contiguous or multi-level, previous spine surgery, and previous radiation are relevant factors that can contribute to instability. However, these are not included in this classification system. Although the classification system is relatively straightforward, the study did not grade the representative clinical cases with spine surgeons outside the SOSG for reliability.[4] Although several additional studies have attempted to address these factors, most are retrospective in nature.[6–11] Prospective validation of this study will determine the SINS prognostic value in determining neoplastic spinal instability.[11]

Relevant Studies Previous studies have attempted to quantify instability but have neglected to include key contributing factors or have only focused on instability using the framework created for spine trauma.[11–15] The Neurologic, Oncologic, Mechanical instability, Systemic disease (NOMS) and the Location of disease, Mechanical instability, Neurologic status, Oncological history, and Physical status (LMNOP) have incorporated the SINS criteria into the management paradigms of patients for patients with neoplastic spine lesions.[8,16] The interobserver and intraobserver reliability of the SINS classification system has also been widely demonstrated.[5,6,17,18] Furthermore, it has been determined to be more relevant for very radiosensitive tumors (i.e., multiple myeloma), where instability may be the primary indication for surgical intervention.[19] Additionally, a higher instability score has been demonstrated to increase the risk of radiotherapy