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Clinical Study

The Spine Instability Neoplastic Score: an independent reliability and reproducibility analysis

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Abstract

BACKGROUND: Metastatic vertebral instability has not yet been clearly defined in the literature; there still exists a paucity of reliable criteria to assess the risk of vertebral collapse.
PURPOSE: We performed an independent interobserver and intraobserver agreement evaluation of the Spine Instability Neoplastic Score (SINS) and correlated the score with selected clinical cases and the treatment they received.
STUDY DESIGN: Independent reliability study for the newly created SINS.
PATIENT SAMPLE: Thirty patients who underwent either radiotherapy alone or surgery followed by radiotherapy were randomly selected from the orthopedic surgery and radiotherapy department's databases.
OUTCOME MEASURES: Patients were rated and classified for spinal stability using SINS. Intraclass correlation coefficient (ICC) and Fleiss's kappa measures were occupied for reliability analysis.
METHODS: Patients who underwent either radiotherapy alone or surgery followed by radiotherapy were randomly selected and classified for spinal stability using the SINS by orthopedic surgeons and nonorthopedic oncology specialists. ICC and Fleiss's kappa were calculated for inter- and intraobserver agreement. A comparative analysis of SINS and the actual management was also conducted.
RESULTS: Interobserver ICC reliability for the SINS was 0.79; κ values for location, pain, bone quality, alignment, vertebral body collapse, and posterolateral involvement were 0.81, 0.58, 0.21, 0.45, 0.42, and 0.29 respectively. Intraobserver ICC for the SINS scores was 0.96; ICC values for the same components were 0.98, 0.98, 0.87, 0.88, 0.92, and 0.86, respectively. Potentially unstable lesions (SINS score≥7) were operated on in 62.5%.
CONCLUSIONS: SINS seem to be a reproducible tool that could be used equally by multiple specialists to estimate metastatic vertebral stability; however, prospective clinical validation is still pending.

Keywords: Reliability analysis; Spinal metastasis; Spinal instability; Spinal Instability Neoplastic Score; Observer agreement; Impending fractures

Introduction

Symptomatic spinal metastatic disease has become a prevalent condition because advances in cancer therapy have allowed patients to live longer [1]. Spinal metastases may lead to spinal cord compression, secondary paralysis, and bladder/bowel dysfunction determining a significant negative impact on quality of life and survival [2]. Clinical management in this scenario involves complex decision-making and multidisciplinary team efforts to ponder diverse

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factors such as patient functional status and prognosis, primary tumor histology, neurological status, and mechanical stability of the affected segment [3,4]. Surgical treatment should be considered to treat metastatic spinal instability because radiation therapy will not restore the load bearing capacity of the spine; however, instability produced by tumoral destruction is poorly defined in the literature and there are still no reliable criteria to assess the risk of vertebral collapse in these patients [5–8].

Recently, the Spine Oncology Study Group (SOSG) developed the Spine Instability Neoplastic Score (SINS), a comprehensive classification system to diagnose neoplastic spinal instability that comprises six components (location of the vertebral metastasis, mechanical pain, blastic or lytic bone lesions, subluxation or deformity, vertebral collapse, and posterior element compromise) [5]; an adequate score to determine spinal instability would allow communication and easier consultation among specialists treating patients with spinal metastases. However, this new score has only been evaluated by its authors and still requires independent validation before wide clinical use. The purpose of this study is to perform an independent interobserver and intraobserver agreement study and to correlate the score with selected clinical cases and their treatment.

Materials and methods

Institutional review board approval was obtained to perform this study. Database records of patients treated in our institution for symptomatic spinal metastases between January 2004 and March 2011 were retrospectively collected and analyzed. Inclusion criteria were patients with a metastatic disease of the spine, with confirmation on pathological studies, complete clinical data, including pain description and available imaging studies before treatment. Exclusion criteria were patients nonambulatory at presentation and incomplete clinical data or imaging studies. Complete imaging for SINS scoring had to include axial images, either computed tomography (CT) or magnetic resonance imaging to rate the majority of score components. In the absence of spine CTs, bone quality component was rated through radiographs and/or chest/abdominal CTs whenever the metastatic level was well visualized. Thirty patients who underwent either radiotherapy alone or surgery followed by radiotherapy were randomly selected; 17 patients who received surgical treatment and 13 patients treated with radiotherapy were included (Table 1). Data obtained included demographic characteristics, pathology report, type and length of treatment, complications, and survival as per registered in the last follow-up. To determine sample size, we considered preliminary intraclass correlation coefficient (ICC) values reported for SINS [9] and through the method reported by Walter et al. [10] as follows: assuming six evaluators, defining $\rho 0$ (minimally acceptable level of reliability)=0.5 and $\rho 1$ (expected ICC value)=0.7, resulted in a minimal sample size of 26.5 for $\alpha=0.05$ and $\beta=0.2$. Therefore, we considered 30 cases for the final patient sample.

Table 1
Patient characteristics

Gender (male)	14 (46.7%)
Age (median)	65 yr (29–85)
Years of disease (median)	3 (0–15)
Location (%)	
Cervical	2 (6.7)
Thoracic	15 (50)
Lumbar	3 (10)
Multiple locations	10 (33.3)
Primary tumor (%)	
Renal cell carcinoma	7 (23.3)
Lung cancer	4 (13.3)
Femur osteosarcoma	1 (3.3)
Breast cancer	6 (20)
Lyposarcoma	2 (6.7)
Hepatocellular carcinoma	2 (6.7)
Cervical carcinoma	3 (10)
Unknown origin carcinoma	2 (6.7)
Prostate adenocarcinoma	3 (10)

To perform inter- and intraobserver agreement evaluation of the SINS (Table 2), six physicians representing different levels of expertise and from different specialties involved in spinal metastasis treatment participated in the study. Nonorthopedic specialists included were one radiotherapy oncologist (YB) and one palliative therapy oncologist (AP). The orthopedic surgeons included were three spine surgeons and one general orthopedic surgeon (JR). The evaluators were unaware of the patients' identification, the treatment they received, and their clinical course. Most of the patients were not treated by any of the evaluators. However, in cases where the rater was at some point involved in patient treatment, this occurred in all cases more

Table 2
Spine Instability Neoplastic Score

Location	Points	Vertebral body collapse	Points
Junctional	3	>50% collapse	3
Mobile spine (C3–C6, L2–L4)	2	<50% collapse	2
Semirigid spine (T3–T10)	1	No collapse with >50% body involved	1
Rigid spine (S2–S5)	0	None of the above	0

Pain relief with recumbency/pain with movement or loading	Points	Bone lesion	Points
Yes	3	Lytic	2
No	2	Mixed	1
Pain-free lesion	0	Blastic	0

Radiographic spinal alignment	Points	Posterolateral involvement	Points
Subluxation/translation present	4	Bilateral	3
De novo deformity	2	Unilateral	1
Normal alignment	0	None	0

Note: Total score 0–6 points: stability; 7–12: indeterminate stability; 13–18: instability.