

The quantitative analysis included the MCC, MSCC, and length of lesion (LOL). The qualitative analysis included the presence of cord hemorrhage, edema, swelling, soft-tissue injury, pre-injury stenosis, and disc herniation. Data were analyzed using Fisher exact test, analysis of covariance (ANCOVA) with Tukey's post hoc test, Kaplan-Meier method with log-rank test, multiple logistic regression, and stepwise multiple linear regression.

RESULTS: There were 79 males and 21 females with mean age of 49 years (17-96 years). Incomplete SCI (51%) was more often than complete SCI (26%) and normal neurological assessment (22%) on admission. Mean follow-up was 7 months (1-35 months). Mean MCC, MSCC, and LOL were significantly greater in patients with complete SCI than in individuals with incomplete SCI. Whereas sex was a significant covariate for MCC, age was significantly correlated with MSCC. Neither age nor sex was significantly associated with LOL. The frequency of intramedullary hemorrhage, cord edema, swelling, and soft-tissue injury at injury site (but not canal stenosis and disc herniation) was significantly higher in patients with complete SCI. Using stepwise multivariable regression, all 10 qualitative and quantitative elements were tested for prediction of ASIA motor scores on admission and at last follow-up visit. The best model for prediction of the baseline ASIA motor score has MCC, MSCC, and swelling. The best model for predicting unadjusted follow-up neurological evaluation has MSCC, hemorrhage, and swelling. The best model for prediction of follow-up ASIA motor score adjusted for baseline ASIA motor score includes hemorrhage and swelling.

CONCLUSIONS: MRI is useful in prognosticating the potential for neurological recovery. More significant MSCC, the presence of hemorrhage, or cord swelling, observed at the time of injury, carry a poorer prognosis. The extent of the spinal cord compression (MSCC) is more reliable in predicting the neurological outcome of patients than is the presence of canal stenosis.

FDA DEVICE/DRUG STATUS: This abstract does not discuss or include any applicable devices or drugs.

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119. Clearance of the Asymptomatic Cervical Spine:

A Meta-Analysis

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BACKGROUND CONTEXT: No consensus regarding the indication for radiographic evaluation in blunt trauma patients exists. There are wide practice variations in the utilization of plain radiographs and advanced imaging such as CT or MRI in "clearance" of the cervical spine. The purpose of this study is to perform a meta-analysis to determine the most effective means to clear the cervical spine in alert asymptomatic trauma patients. We will focus on the identification of which patients should have radiographic evaluation of the cervical spine and who can reliably be cleared clinically without radiographs.

PURPOSE: The purpose of this study is to perform a meta-analysis to determine the most effective means to clear the cervical spine in alert asymptomatic trauma patients.

STUDY DESIGN/SETTING: A computerized literature search of the National Library of Medicine from 1966 to December 2004 was performed using keywords "spinal injury" or "spinal fractures" or "spinal injuries". Combination with keyword "cervical", "human studies", and "English language" resulted in 2038 matches. Combination with the keywords "clearance", "diagnosis", or "radiography" yielded 1433 matches which

were reviewed. All papers focusing on the clinical decisions of radiographic use with regard to the diagnosis of cervical spine injury in adult victims of trauma were included. In addition, references were obtained from the bibliographies of the included papers.

PATIENT SAMPLE: 61,989 patients were evaluated in 14 studies.

OUTCOME MEASURES: Fourteen level I or level II studies were identified. Inclusion criteria were: (1) A prospective protocol; (2) Outcomes on all patients; (3) Follow-up to determine status of potential injuries by 2-week telephone call or by CT. Negative predictive value (NPV), positive predictive value (PPV), specificity, and sensitivity were calculated. The Oxman and Guyatt index was employed to score the methodology of the meta-analysis.

METHODS: Negative predictive value (NPV), positive predictive value (PPV), specificity, and sensitivity were calculated. The Oxman and Guyatt index was employed to score the methodology of the meta-analysis.

RESULTS: 61,989 patients were evaluated in 14 studies. The protocols recommended radiographic evaluation in 3.2% of patients with cervical spine injury (PPV 3.1%). The protocols failed to recommend radiographs in 0.2% of patients who had a cervical spine injury (NPV 99.8%). The protocols correctly recommended radiographs in 97.6% of patients with cervical spine injury (sensitivity 97.6%). Overall, 14,953 patients examined (24.1%) were asymptomatic. Twenty-eight "occult" cervical spine injuries were identified in the 14 studies. None resulted in a neurologic deficit. There were two large protocols: The National Emergency X-Radiography Utilization Study (NEXUS) (44,450 patients; NPV 99.7%, sensitivity 99.6%) and Canadian C-spine Rule (8924 patients; NPV 100%, sensitivity 100%). Canadian C-spine Rule included cervical range of motion into their protocol and outperformed NEXUS in a head to head study. Nine institutional protocols were reviewed. In eight of nine protocols, no injuries were missed (sensitivity 100%, NPV 100%). In the remaining protocol, three occult stable injuries occurred. (sensitivity 90.9, NPV 99.8). This protocol did not include associated injuries into their algorithm.

CONCLUSIONS: An alert asymptomatic patient without a distracting injury or neurologic deficit who can perform range of motion of their cervical spine may be cleared clinically without radiographs.

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CONFLICT OF INTEREST: No conflicts.

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120. Pseudarthrosis in the Cervical Spine: What Is the Gold Standard? CT Scan versus Flexion Extension Quantitative Motion Analysis With Intraoperative Correlation

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BACKGROUND CONTEXT: Assessment of postoperative fusion is an important factor in assessing a patient's success after anterior cervical spine fusion. Gross intervertebral motion can be used as a measure; however, the gold standard for determining fusion status is a CT scan to look for bridging bone. Defining the amount of intervertebral motion at the fusion site has been previously addressed and definitions have varied widely.

PURPOSE: Attempt to establish a gold standard for determining pseudoarthrosis in anterior cervical fusion

STUDY DESIGN/SETTING: Compare motion analyzed flexion extension radiographs to CT scan to predict pseudoarthrosis. Define motion thresholds on flexion extension radiographs to define pseudoarthrosis. Correlate these with intraoperative findings.

PATIENT SAMPLE: Patients who underwent anterior cervical discectomy and fusion surgery who had symptoms at 1 year were evaluated

radiographically and underwent a posterior spinal fusion to address the pseudoarthrosis.

OUTCOME MEASURES: Intraoperative findings during posterior cervical fusion to clarify the CT scan and flexion and extension radiographic results.

METHODS: Intervertebral motion at the fusion site was measured from flexion extension (FE) X-rays taken at least 1 year after cervical spine fusion. Motion was quantified from digitized radiographs by an independent researcher (QMA, FDA-approved motion analysis software). CT scans from all patients were analyzed for fusion status by a neuroradiologist. Those patients determined to have pseudoarthrosis were revised and intraoperative motion was documented in the operative record. Correlation between intraoperative findings, CT scan, and motion analysis was then analyzed.

RESULTS: Using greater than 4 degrees of measured motion, Spearman correlation p value was .096 (95% confidence interval -0.06 to 0.66). Using greater than 1 degree of motion, Spearman correlation p value was <.0001 (95% CI 0.54 to 0.90). Positive predictive value using 4 degrees of motion as the criteria was 100%, indicating a high sensitivity. Negative predictive value was 57%, indicating a low specificity. Using greater than 1 degree of motion, PPV was 100% (10/10); NPV was 79% (11/14). CT scan PPV 100% (9/9); NPV 73% (11/15).

CONCLUSIONS: Current accepted angular motion to describe a pseudoarthrosis is currently accepted as 4 degrees of motion. Our study suggests that this value has a high positive predictive value, but a low specificity and would miss many of the pseudoarthroses that have angular motion less than 4 degrees (specificity 57%). By lowering the threshold of angular motion to 1 degree, this sensitivity remains high at 100% and specificity improves to 79%. CT scan is touted as the gold standard. It has a positive predictive value of 100%, but its negative predictive value was slightly lower than using 1 degree of motion. By combining CT scan and 1 degree of motion, the positive predictive value was 100% and negative predictive value was 92%. Combining QMA and CT scan is better than CT alone and can increase the specificity of detecting a pseudoarthrosis dramatically.

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121. Diagnosis of Vertebral Nonunion After Osteoporotic Compression Fractures by Functional Radiography: Clinical Significance of Lateral View in a Supine Position

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BACKGROUND CONTEXT: Patients with pseudarthrosis after osteoporotic vertebral compression fracture (OVCF) often present chronic back pain and good indication for vertebroplasty. Intra-vertebral vacuum cleft or instability on flexion-extension (F-E) radiography are helpful to diagnose the nonunion status of the OVCFs, but are not always positive for all pseudarthrosis cases. MRI has been a gold standard tool to detect such conditions, but old OVCFs, which have already healed with fixed deformity, often show abnormal low intensity on T1- and T2-weighted images and are not a good indication for vertebroplasty. In patients with multiple compression fractures, detection of painful vertebra is difficult and vertebroplasty or kyphoplasty may be overindicated for nonpainful old fractures.

PURPOSE: The purpose of this study was to evaluate the significance of lateral radiography in a supine position as a simple method to detect a pain source of chronic OVCFs.

STUDY DESIGN/SETTING: A retrospective study of 44 consecutive patients with vertebral nonunion after OVCF treated with vertebroplasty.

PATIENT SAMPLE: We treated 44 patients who had a single-level vertebral nonunion with more than 3 months duration of back pain after OVCF with vertebroplasty between 2000 and 2005. The nonunion status was confirmed by MRI and CT findings and continuous clinical symptoms in all cases. Thirty-seven of them completed lateral radiography both in the upright F-E positions and in the supine position, and were enrolled in this study. Average period between onset of back pain and these tests was 7.6 months.

OUTCOME MEASURES: We evaluated the wedge shape of vertebral body in lateral radiograms using a vertebral wedging rate, which was defined as the anterior vertebral height as a percentage of the posterior vertebral height. Visual analog scale was used to rate back pain.

METHODS: We evaluated the vertebral wedging rate in upright flexion and extension positions and in the supine position, and recorded the changes of anterior vertebral height between the upright F-E positions (F-E comparison) and between the upright flexion and supine positions (F-S comparison). We defined intra-vertebral instability as more than 5% anterior vertebral height change in the wedging rate.

RESULTS: Average wedging rate of the nonunion vertebrae was 35.1% in flexion, 39.8% in extension, and 63.9% in the supine position. The intra-vertebral instability was detected in 37.8% (14/37 cases) by F-E comparison and in 97.3% (36/37 cases) by F-S comparison. Intra-vertebral vacuum cleft was observed in 32.4% (12/37 cases) in extension and in 83.8% (31/37 cases) in the supine position. Mean visual analog scale for back pain improved from 77 mm to 14 mm after vertebroplasty.

CONCLUSIONS: The F-E radiography was less sensitive to detect intra-vertebral instability in chronic OVCFs. Patients may not be able to fully extend in the upright posture because of back pain or local severe kyphosis. Lateral radiography in a supine position was simple and sensitive to differentiate a pain-generating nonunion vertebra as a target of vertebroplasty from other nonpainful old fractures.

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122. The Natural History of Lumbar Disc Degeneration and Facet Arthrosis: A Postmortem Specimen Study

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BACKGROUND CONTEXT: The lumbar elements consist of three joint complexes including the intervertebral disc and facet joints. It is believed that lumbar degeneration begins in the disc, where dessiccation and collapse lead to instability and compensatory arthritis in the facet joints.

PURPOSE: To evaluate the above hypothesis, we examined postmortem lumbar spines and studied the relationship between arthritic changes in the discs and facets and specimen age.

STUDY DESIGN/SETTING: An anatomic study of 647 cadaveric lumbar spines was conducted to evaluate the natural history of facet and disc arthrosis.

PATIENT SAMPLE: The study sample consisted of 647 cadaveric lumbar spines.

OUTCOME MEASURES: The spines were examined for evidence of facet arthrosis and disc degeneration in relation to age progression.

METHODS: Information on race, age, and sex was collected. Based on studies by Kettler, we used grading systems for facet arthrosis and disc degeneration from Grade 0 to 4 on a continuum from no arthritis to ankylosis. Each facet and disc at all levels were graded. Fisher exact tests and *t* tests were used to compare the prevalence and degree of disc and facet arthrosis for different age groups to examine patterns of degeneration with age.

RESULTS: In the specimens <30 years of age, we found a significantly higher prevalence of facet arthrosis when compared with disc degeneration