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The Reliability and Validity of Radiographic and CT Scan Determination of Posterolateral Spine Fusion
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INTRODUCTION: Little is known regarding the reliability and validity of imaging modalities in determining a successful spine fusion. The purpose of this study was to evaluate the reliability and validity of radiographic and CT scan determination of spine fusion using an established animal model of posterolateral spine fusion.

METHODS: Posterolateral spine fusion was performed in 42 skeletally mature male New Zealand White rabbits. Autogenous iliac crest bone graft was used and spondylodesis performed between lumbar vertebra L5 and L6. The animals were euthanized at 9 weeks and the lumbar spine harvested. The presence of successful bony fusion (solid arthrodesis) was determined by a manual palpation test. The absence of motion between the transverse processes of lumbar vertebra L5 and L6 and at the L5-6 intervertebral disc space constituted a solid arthrodesis. Radiographic tests evaluated were dorsal-ventral fine detail (PA) radiographs and CT scan with axial images (1mm section cuts) with sagittal and coronal reconstructions. Three spine surgeons, blinded to the manual palpation test result, independently graded the radiographs and CT scan images for the presence of successful bony fusion. Sensitivity, specificity, and negative and positive predictive value were determined for each radiographic technique. Interobserver agreements for the techniques were determined using an unweighted Cohen's Kappa statistic. The correlation between each radiographic technique and the manual palpation testing was determined using the Spearman correlation coefficient.

RESULTS: Using the manual palpation testing as the 'gold' standard in this study, the rate of spinal fusion was 14%. However, the rate of successful fusion as determined by the evaluators was 54 plus/minus 2% for PA radiograph and 26 plus/minus 6% for CT scan. For radiographic evaluation, the mean values of the readers for sensitivity, negative predictive value, specificity, and positive predictive value were 100 plus/minus 0%, 100 plus/minus 0%, 52 plus/minus 2%, and 26 plus/minus 1% respectively. For CT scan evaluation, the means values of the readers for sensitivity, negative predictive value, specificity, and positive predictive value were...
100 plus/minus 0%, 100 plus/minus 0%, 86 plus/minus 7%, and 61 plus/minus 14% respectively. Use of CT scan images gave a higher correlation to manual palpation testing when compared with PA radiographs (mean r = 0.72 vs. r = 0.38; p<0.05, Mann-Whitney U Test). There was good interobserver agreement of successful fusion using CT scan images (mean kappa = 0.65) and marginal to good interobserver agreement for PA radiographs (mean kappa = 0.52).

CONCLUSIONS: The results of this study indicate that both fine detail PA radiographs and CT images tended to overestimate the rate of spinal fusion when compared to a manual palpation test. Although both techniques had high sensitivity and negative predictive value, they did not fair as well with regard to specificity and positive predictive value. Nevertheless, CT scan analysis was superior to PA radiographs in identifying nonunions.