

GRADING OSTEOARTHRITIC CHANGES OF THE ZYGAPOPHYSEAL JOINTS FROM RADIOGRAPHS: A RELIABILITY STUDY

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ABSTRACT

Objective: This study tested the reliability of a 5-point ordinal scale used to grade the severity of degenerative changes of zygapophyseal (Z) joints on standard radiographs.

Methods: Modifications were made to a Kellgren grading system to improve agreement for grading the severity of osteoarthritic changes in lumbar Z joints. These included adding 1 grade of no degeneration, multiple radiographic views, and structured examiner training. Thirty packets of radiographic files were obtained, which included representation of all 5 grades including no degeneration (0) and Kellgren's 4-point (1-4) joint degeneration classification criteria. Radiographs were digitized to create a radiographic atlas that was given to examiners for individual study and blinded evaluation sessions. Intrarater and interrater agreement was determined by weighted κ (κ_w) from the examination of 79 Z joints (25 packets).

Results: Using the modified scale and after training, examiners demonstrated a moderate-to-substantial level of interrater agreement ($\kappa_w = 0.57, 0.60, \text{ and } 0.68$). Intrarater agreement was moderate ($\kappa_w = 0.42 \text{ and } 0.54$).

Conclusions: The modified Kellgren 5-point grading system provides acceptable intrarater and interrater reliability when examiners are adequately trained. This grading system may be a useful method for future investigations assessing radiographic osteoarthritis of the Z joints. (*J Manipulative Physiol Ther* 2015;38:344-351)

Key indexing terms: *Lumbar Vertebrae; Osteoarthritis; Spine; Zygapophyseal Joint; Diagnostic Imaging; Reliability*

Low back pain is a substantial contributor to global disability.¹ One key source of low back pain is the lumbar zygapophyseal (Z) joint (facet joint).²⁻⁹ Several etiologies have been hypothesized for Z joint mediated pain, including osteoarthritis.⁹⁻¹⁴ Induction of degenerative changes in the nociceptor innervated Z joint (eg, via inflammation) enhances the transmission of pain-related information¹⁵ and nociceptive behaviors as

shown in preclinical osteoarthritis pain models.¹⁶⁻¹⁹ Although recent clinical studies suggest that older patients with severe Z joint degeneration more frequently report low back pain,²⁰ the relationship between Z joint osteoarthritis and low back pain remains unclear,^{21,22} possibly due to confounding patient subpopulations.²⁰ Thus, further work in both preclinical models and clinical subjects is needed to better understand this complex relationship. To begin to

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address this relationship, we wanted to first determine if we could reliably grade the severity of degenerative changes of Z joints observed on radiographs of human subjects using a modified grading system. To date, there are no grading scales using radiographs of the lumbar spine Z joint to assess the severity of osteoarthritis that are considered reliable for outcome-based research.²³ If reliable, this scale could be a useful method to help determine the relationship between Z joint osteoarthritic changes and low back pain.

Degenerative changes in Z joints observed with radiographs are consistent with those found in other synovial joints. These changes include apophysial hypertrophy, subchondral sclerosis, osteophytosis, joint space narrowing, and joint surface irregularity.²⁴⁻³⁰ Evidence of Z joint degeneration can be visualized on standard radiographs,²⁷⁻³⁰ and grading systems that include many of these changes have been described.^{23,31,32} The current recommendations for the development of grading scales to assess lumbar Z joint degeneration on radiographs before implementing them into outcomes research are that the potential scales have 3 to 5 grades (starting with 0 for no degeneration) and demonstrate a reliability coefficient (unweighted κ , weighted κ [κ_w], or interclass) more than 0.40.²³ Grading degenerative changes are inherently difficult for many reasons, and, to date, no grading system for assessing the lumbar Z joints with standard radiographs has been found to reach this level of reliability.²³ Kellgren and Lawrence³¹ and Kellgren³² created radiographic grading classification systems for degenerative changes of many synovial joints, including the Z joints. These Kellgren systems could be advantageous over other radiographic grading scales assessing Z joint degeneration, which have fewer grades, lack categories that clearly describe the degenerative changes, and have levels of agreement below the threshold of acceptability.^{23,33} Previous reliability studies showed that when used with only a lateral (LAT) lumbar radiographic view, the 5-point scale of Kellgren and Lawrence³¹ was not reliable for assessing lumbar Z joint degenerative changes. Kellgren³² later developed a more detailed 4-point classification scale (removing no degeneration as grade 0) for the grading of Z joints in the cervical spine. Modifications of this scale to a 5-point classification by including a grade of no degeneration using only a LAT view of the cervical spine was at the threshold of acceptable reliability for outcomes research^{23,34}; however, the authors suggested that additional views may improve agreement when assessing degenerative changes of the Z joint.³⁴ This is in agreement with previous studies, wherein investigators who performed radiographic studies of Z joints emphasized the need for multiple views of the assessed region.^{21,26,29,33,35}

The most useful radiographic view for the visualization of the lumbar Z joints is the oblique (OBL) due to the joint orientation.^{29,30,33} Lumbar OBL views improve visualization of the joint space and assessment of osteoarthritic

changes.^{29,30,33} Herein, we evaluated the reliability of a modified version of Kellgren's detailed 4-grade system of cervical Z joint degenerative changes by using anterior-posterior (AP), LAT, and OBL lumbar radiographs. Because most of the radiologic findings associated with degeneration of the cervical Z joints also apply to the lumbar region,³⁰ we hypothesized that modification of Kellgren methods by adding a grade of no degeneration (0) to create 5 grades, plus the addition of multiple views, and trained examiners would result in acceptable reliability when applied to the lumbar spine.

The purpose of this study was to test the reliability of a 5-point ordinal scale that grades the severity of degenerative changes of Z joints on standard radiographs. If reliable, these methods could be used to assess Z joint degeneration for research and clinical purposes.

METHODS

The National University of Health Sciences Institutional Review Board approved this project. Packets of radiographs were obtained from a review of the file database from the Department of Diagnostic Imaging over the previous 4 years. Selection of the radiographs was carried out by the primary investigator (JL) and the Director of Diagnostic Imaging (DDI) (JR); neither were examiners in the reliability studies. Attempts were made to include all degenerative grade classifications of Kellgren's criteria (Figure 1 and Table 1). Radiographs were excluded based on poor technical factors, anatomic anomalies, and overlying pathology that hindered visualization of the articular processes or Z joints. Each radiograph could contain up to 4 Z joints to grade (left and right, L4-L5 and left and right, L5-S1), and different grades could exist at different Z joints. To ensure patient privacy and blinded evaluation, the identification plates were covered, and the radiographs were housed in blank jacket covers. In compliance with HIPAA (Health Insurance Portability and Accountability Act) and to prevent examiner bias, the patient's clinical condition was withheld.

Using these selection criteria, evaluation packets were compiled for the reliability study. Each packet contained 3 to 5 radiographic views from the same patient: AP (including AP lumbosacral angulated spot for L5-S1 vertebral levels), LAT, and 1 OBL for each side being assessed. For example, if the left L4-L5 Z joint only was assessed, the packet would include 3 views: AP, LAT, and left OBL. If the left L4-L5 and right L5-S1 Z joints were assessed on the same patient, then the following 5 views would be included in the packet: AP, AP spot (for L5-S1), LAT, left OBL, and right OBL. Twenty-five packets with 79 Z joints were used for the examination portion of the study. The mean age of the patients was 56.2 years (18 males and 7 females). An additional 5 packets were used for training the examiners. A radiographic atlas was compiled from the training packets with representation of every

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