Juniper publishers
key to the Researchers

Orthopedics and Rheumatology
Open Access Journal

Research Article
Volume 1 Issue 1 - August 2015

Orthop Rheumatol Open Access J

Evaluation of Spinal Ligamentous Injuries using Computerized X-ray Interpretation

Steven P Brownstein MD*, Jeffrey Cronk DC JD and Joseph Cioffi BA

Spinal Kinetics and Dynamic Medical Imaging, USA

Submission: August 19, 2015; Published: August 27, 2015

***Corresponding author:** Steven P Brownstein, Spinal Kinetics, Dynamic Medical Imaging, 950 West Chestnut Street Union, New Jersey 07083, USA, Tel: 908-687-2552; Email: spinalkineticsllc@yahoo.com; Website: www.thespinalkinetics.com

Abstract

Introduction: Spinal Ligament injury is well documented to be one the most common injuries in a trauma. It is also well documented that, depending upon the grade (seriousness) of the injury, they can take up to 2 years to heal and have different treatment protocols. Yet it seems few doctors attempt to accurately grade the injury according to medical guidelines even where specific guidelines exist. The crude and varying methods to assess the injury provided little consensus. This study shows that precise accurate grading of spinal ligament injury can be best obtained by advanced computerized methods for measuring x-rays, while conforming to current AMA injury guidelines. One Hundred random cases of spinal injury were assessed by usual visual inspection of stress x-rays by radiologists, then re-assessed by computer measurement.

Results: Significant spinal ligament injury was accurately revealed by computer measurement that was missed by the standard radiological reads.

Conclusion: Assessing spinal ligament injury by computer measurement significantly improves diagnosis and grading of ligament injury.

Keywords: Spinal Ligament Injury; Intersegmental Motion Spinal insstability; Alteration of motion segment integrity (AOMSI)

Abbreviations: AMA: American Medical Association; AOMSI: Alteration of Motion Segment Integrity; CRMA: Computerized Radiographic Mensuration Analysis

Introduction

While some patients recover uneventfully from a spine injury, a significant number will have pain which may last indefinitely [1,2]. The risk of developing chronic pain will be increased if a physician is unable to find a physical cause of pain in these patients [3,4]. X-ray, CT, and MRI scans are routinely ordered to aid physicians in evaluating a patient, but these imaging techniques are often unable to clearly show the real source of pain adding uncertainty to what the correct diagnosis and ultimately the proper course of treatment is [2].

After spinal trauma, the ligaments in the spine may be damaged causing ligamentous instability resulting in abnormal intersegmental motion. Excessive joint motion caused by spinal ligament sprains is a cause of acute spine pain and is a significant risk factor for developing chronic pain [5,6]. Serious intersegmental motion problems are routinely missed in standard X-ray and CT interpretations by board-certified radiologists. In a related study showing the need to improve accuracy in current radiologist's reads, Taylor et al. [7] concluded that there is a need to reduce the subjectivity of reading medical images and improve agreement of the diagnosis between physicians [7]. They state, "The study reinforces the need for radiologic specialists to reduce missed diagnoses, misdiagnoses, and medico-legal complications" [7]. Spinal ligament injuries will remain problematic unless findings can both be systemized and quantified in a consistent, logical, and accurate manner.

The American Medical Association's (AMA) *Guides to the Evaluation of Permanent Impairment* [8] can be used as a reference by providing a standardized, objective approach when evaluating disability and impairment [8]. The "Spinal Injury Model" includes a diagnosable condition of "joint laxity" called alteration of motion segment integrity (AOMSI) where exact spinal radiographic mensuration is used to identify the severity of joint instability. This spinal impairment caused by spinal ligament injuries is identified not through physical examination but by measuring stress X-ray images (flexion and extension). Since this evaluation uses standardized, objective radiographic mensuration criteria and precisely measured stress X-rays, it produces an opportunity to minimize the adversarial nature of the injury tort arena when attempting to rule in or rule out AOMSI. When the provider feels that there may have been a spinal ligament injury, AOMSI criteria are used to rule in or out any spinal ligament injury by measuring spinal radiographic hypermobility and are critical findings on all spinal impairment examinations. Thus, the most precise image measurement procedure is required to enable physicians to most accurately diagnose and effectively treat patients with pain from spinal ligament injuries.

Computerized Radiographic Mensuration Analysis (CRMA) is an accepted procedure in the National Guidelines Clearinghouse that can provide the most useful clinical information and can be easily utilized to more accurately identify clinically significant ligament instabilities. Information provided by CRMA can assist doctors in determining more focused and effective treatment plans by improving the understanding of the pain source in the patient being treated and can significantly reduce the missed diagnosis, misdiagnoses, and medico-legal complications associated with this injury. In the study conducted by Taylor et al. [9] they showed the effectiveness and reliability of an intersegmental motion exam using plain radiographs when combined with CRMA technology [9]. The physicians' level of agreement on the presence of spinal instability increased from 17% to 77% following minimal training with CRMA because it dramatically increased their ability to locate abnormal spinal motion [9].

The focus of the current experiment was to test a board-certified radiologist's ability to identify the most serious levels of ligament instability (joint laxity) in standard cervical and lumber weight-bearing stress X-ray studies without the use of CRMA.

Case Selection

The purpose of this case selection process was to provide trauma cases that would normally be read by a radiologist. The cases of 100 patients who were previously sent to an outpatient imaging center for a requested CRMA intersegmental motion study were randomly selected from two outpatient medical imaging centers. In this experiment, 53 cervical and 47 lumbar cases were used. Besides having spine pain associated with a car accident, there was no other criteria required for a patient to be included in this study. There was no circumstance where a patient was ruled ineligible to be in this experiment.

Experimental Methods

To assess a physician's ability to identify ratable amounts of intersegmental motion in X-ray studies, the cases of trauma patients were reviewed by a board-certified radiologist. The X-ray studies provided contained the analysis of five view cervical series or five view lumbar X-rays, which included both flexion and extension films. The involvement in a motor vehicle accident and associated pain was the only history supplied to the radiologist. With this history, the radiologist was asked to use all normally used methods to help determine abnormal spine movements.

The measurements obtained by CRMA determined the severity of the spinal unit's motion according to the impairment criteria established in the AMA 5th Edition guidelines. According to the AMA 5th Edition guidelines, spinal instability is ratable in the cervical spine when translation in one vertebra is larger than 3.5mm or has angular motion greater than 11°. Ratable impairment of the lumbar spine occurs when there is a translation greater than 4.5mm in one vertebra on another or when angular motion exceeds 15° at L1-2, L23, or L3-4 levels, is greater than 20° at the L4-5 level, or is greater than 25° at the L5-S1 level. The findings determined by CRMA would eventually be used to determine the accuracy of the physician's ability to diagnose spinal ligament injuries in stress X-rays.

Results

The board-certified radiologist's reports of the selected X-ray studies showed no studies having significant amounts of spinal instability indicative of spinal ligament injuries. No findings of abnormal joint play were found and no units of qualified AOMSI integrity were reported.

However, CRMA determined from the same X-ray series that there were a combined 199 motion units that showed abnormal joint laxity in all 100 patients. In 24 patients, there was a total of 29 findings, 22 cervical and 7 lumbar, of ratable spinal motion abnormalities that exceeded the mensuration threshold for AOMSI according to the widely accepted AMA 5th Edition guidelines. Of the ratable cervical spine findings, 12 resulted from excessive translation and 10 were due to angulation. There was 1 patient with 2 ratable cervical spine translation findings. There were 2 patients with abnormal angular motion and translation in the cervical spine. There were 2 ratable lumbar findings due to translation and the other 5 were from excessive angulation. There was 1 patient that had excessive lumbar translation and angular motion present.

Discussion

This study was designed to test a radiologist's ability to locate spinal ligament injuries in trauma cases. Spinal ligament injuries are an often overlooked physical cause of today's well publicized chronic spinal pain and impairment problem. According to research, many patients with chronic spinal pain do not have a pathoanatomic diagnosis, but rather have a diagnosis of non-specific mechanical neck or back pain [10].

Even with advanced and improved imaging technology, the most problematic area in diagnosing ligamentous injuries is the subjectivity of the imaging study professional read. Taylor et al.'s [9] study showed that the subjectivity is so large that one professional radiologist frequently says there is significant pathology on the study while another report suggests that there is nothing of any significance at all [9]. Without a separate specialty analysis performed through CRNIA technology, these conditions would have gone misdiagnosed or undiscovered.

All the different types of medical imaging techniques are commonly accepted diagnostic procedures that have been utilized for decades. Some have claimed that X-ray, CT, and MRI scans are generally not useful in the evaluation of chronic low back pain [2,11]. But this is because spinal ligament injuries are mostly missed due to inadequate radiographic interpretation [12,13]. When evaluating conditions causing spine pain, their effectiveness is limited by how the image is assessed. These imaging techniques often fail to identify any potential source of pain or cause some gross abnormality, which is not actually the cause of the patient's pain, to be confused with the real source of pain [14]. Intersegmental motion problems are missed by radiologists because there is no way to accurately quantify abnormal spinal motion in these cases by simply looking at films

How to cite this article: Brownstein SP, Jefferey Cronk DC, Joseph Cioffi BA. Evaluation of Spinal Ligamentous Injuries using Computerized X-ray Interpretation. Orthop Rheumatol Open Access J. 2015;1(1): 555551. DOI: 10.19080/OROAJ.2015.01.555551

with the human eye which is a common practice today. Without an intersegmental motion study via CRMA, plain radiographs aren't being used to their fullest potential when diagnosing spine injuries.

Based on the current level of knowledge used in diagnosing spinal ligament injuries today, there are no indications that any other radiologist would have gotten any significantly different results than the physician that was a part of this study. In agreement with the results of Taylor et al.'s [9] study, there is no evidence supporting that more or different radiologists would have been able to accurately and consistently identify spinal ligament injuries. The accuracy in diagnosing spinal ligament injuries is just not feasible without the level of precision computers can obtain in its measurements. Taylor et al. [9] showed in their study that intersegmental joint laxity is most accurately measured with the use of computer assisted technology [9]. However, most radiologists do not have access to CRMA technology that can assist them in diagnose severe levels of joint laxity most accurately and consistently.

Conclusion

Even with guidelines already established, there is still no resolution of determining who is injured and to what level of severity. The obvious path to more effective treatment of spinal pain lies with improving the accuracy of diagnostic techniques. The understanding of AOMSI is of little value if the findings are inherently being missed in most if not all radiographic reads. The CRMA procedure offers a standardized spinal misalignment and intersegmental motion criteria for reporting AOMSI and other abnormal states of the spinal motion unit. CRMA also enables spinal ligament injuries to be reported in a manner that all professions can utilize for more accurate diagnosis and better treatment rationales. The margin of error in intersegmental motion measurement and the wide range of disagreement would be significantly reduced, allowing for a much more accurate assessment of the degree of spinal ligament injuries. Therefore, CRMA should be a critical tool used to rule in or rule out any patient suspected of having a spinal ligament injury that is causing impairment and either acute or chronic pain. This study shows the incredible need for a separate and distinct intersegmental motion study to be performed by an educated and trained board-certified radiologist using CRMA technology. A logical and systematic approach to a standardized spinal ligament evaluation procedure should include a separate CRMA procedure. No provider should be without this assessment. This line of study will require more research in the future, but CRMA technology can be used to reduce the number of patients with spinal ligament injuries that are undiagnosed or misdiagnosed.

References

1. Schofferman J, Bogduk N, Slosar P (2007) Chronic Whiplash and Whiplash-Associated Disorders: An Evidence-Based Approach. J Am Acad Orthop Surg 15(10): 596-606.
2. Cowan P, Kelly N, Chou R (2008) Consumer's Guide Practice Guidelines for Low Back Pain. American Chronic Pain Association, California, USA, p: 5-7.
3. Chou R, Huffman LH (2009) Clinical Guideline for the Evaluation and Management of Low Back Pain. American Pain Society, Glenview, Illinois, USA.
4. Jarvik JG, Deyo RA (2002) Diagnostic evaluation of low back pain with emphasis on imaging. Ann Intern Med 137(7): 586-597.
5. Panjabi MM (2006) A hypothesis of chronic back pain: Ligament subfailure injuries lead to muscle control dysfunction. Eur Spine J 15(5): 668-676.
6. Giles LGF, Muller R, Winter GJ (2006) Lumbosacral disc bulge or protrusion suggested by lateral lumbosacral plain x-ray film-preliminary results. J Bone Joint Surg Br 88-B: 450.
7. Taylor JA, Clopton P, Bosch E, Miller KA, Marcelis S (1995) Interpretation of abnormal lumbosacral spine radiographs. A test comparing students, clinicians, radiology residents, and radiologists in medicine and chiropractic. Spine (Phila Pa 1976) 20(10): 1147-1153.
8. American Medical Association (2000) Guides to the Evaluation of Permanent Impairment (6th edn), pg. 379.
9. Taylor M, Hipp JA, Gertsbein SD, Gopinath S, Reitman C (2007) Observer agreement in assessing flexion-extension x-rays of the cervical spinal with and without the use of quantitative measurements of intervertebral motion. Spine J 7(6): 654-658.
10. Marras WS (2007) The Working Back: A Systems View. Kindle Edition. Wiley-Interscience 18(4): 401.
11. Rockey PH, Tompkins RK, Wood RW, Wolcott BW (1978) The usefulness of x-ray examinations in the evaluation of patients with back pain. J Fam Pract 7(3): 455-465.
12. Torretti JA, Sengupta DK (2007) Cervical Spine Trauma. Indian J Orthop 41(4): 255-267.
13. Reid DC, Henderson R, Saboe L, Miller JD (1987) Etiology and clinical course of missed spine fractures. J Trauma 27(9): 980-986.
14. Deyo RA, Mirza SK, Turner JA, Martin BI (2009) Overtreating Chronic Back Pain: Time to Back off? J Am Board Fam Med 22(1): 62-68.

How to cite this article: Brownstein SP, Jefferey Cronk DC, Joseph Cioffi BA. Evaluation of Spinal Ligamentous Injuries using Computerized X-ray Interpretation. Orthop Rheumatol Open Access J. 2015;1(1): 555551. DOI: 10.19080/OROAJ.2015.01.555551