CURRENT STANDARDS FOR MEASURING SPINAL RANGE OF MOTION FOR IMPAIRMENT

LEANNE N. CUPON, DC, DABFP^a, AND WARREN T. JAHN, DC, MPS, DABFP^a

^aPrivate Practice of Chiropractic, Roswell, GA. Submit requests for reprints to: Leanne N. Cupon, DC, DABFP, Warren T. Jahn, DC, MPS, DABFP, 1305 Hembree Rd, Suite 203, Roswell, GA 30076. Paper submitted July 29, 2002; in revised form August 21, 2002.

ABSTRACT

Measurement of spinal range of motion (ROM) along with strength, endurance, coordination, and sensation are among the essential determinants of musculoskeletal function. These measurements are important to the chiropractic physician concentrating in the fields of impairment rating, disability evaluation and independent medical examination (forensic examiner). An important initial step toward standardizing measurement of joint motion has been undertaken by the American Medical Association with their publication The Practical Guide to Range of Motion Assessment. Their publication is an attempt to provide a detailed and illustrated description of a standardized approach to ROM measurement and recording. The College on Forensic Sciences (CFS) is spearheading an effort to encourage and provide detailed instruction on measuring range of motion according to this companion book to the AMA Guides. This attempt at providing a systematic format should enable chiropractic (forensic) evaluators to obtain more reliable range of motion measurements/data by using the same standardized protocols, reference tables, and reporting methods. (J Chiropr Med 2003;2:8-12)

Key Words: Range of Motion; Chiropractic; Impairment Rating; Disability Evaluation; Independent Medical Examination

INTRODUCTION

Measurement of spinal range of motion (ROM) along with strength, endurance, coordination, and sensation are among the essential determinants of musculoskeletal function. These measurements are important to the chiropractic physician concentrating in the fields of impairment rating, disability evaluation and independent medical examinations (forensic examiner). Decisions about work capacity and compensation based on physical measurements depend on ascertaining that the measurements are reliable; that is, that the measurements are consistent and have minimal error. (1) There is a convincing necessity for simplification and standardiza-

tion to facilitate communication among researchers, practitioners and triers of fact.

Historically, visual approximation (2) procedures were suggested for the examination of range of motion. The American Academy of Orthopedic Surgeons (AAOS) in 1965 suggested that visual estimation was as good as, or better than, goniometric measurement. (3) This opinion was shared by Rowe (4) and continues in textbooks such as Hoppenfeld's. (5) None of these authors provide any objective data to support their claims.

The description of use of goniometers was apparently contained in the French medical literature (6) and did not appear in the American or British literature until the second decade of the 20th century. (7,8) An increased interest in, and use of, the goniometer accompanied the advent of each of the World Wars. (9) Today's universal goniometer, as described by Clark (10) in 1920, remains little changed.

In the early 1930s, Fox and van Breeman (11) reported measuring range of motion using an instrument called the pendulum goniometer. Leighton (12) in 1955 introduced a similar instrument (Leighton flexometer), consisting of a 360° dial and a weighted pointer mounted in a case. The dial and pointer operated freely, with movement being controlled by gravity. In 1956, Schenkel (13) introduced the fluid goniometer (bubble goniometer). The fluid goniometer contains a 360° scale with a fluid-filled circular tube containing a small air bubble.

The first to use the term inclinometer to describe the wide range of measuring instruments that rely on the principle of gravity was Loeb. (14) These instruments are calibrated or referenced on the basis of gravity, with a starting 0 position that is indicated by a fluid level or weighted needle. The term inclinometer includes devices labeled for how the instrument works (gravity goniometer, bubble goniometer) as well as for the manufacturer that developed the measurement tool (Myrin goniometer, Rangimeter, CROM, BROM). (15)

The gold standard against which all other techniques of measuring joint range of motion are compared is radio-

graphic measurement of joint motion. Radiographic techniques have been used to study the amount and type of motion occurring at various joints and to examine the validity of goniometer. However, the routine use of radiographic techniques for the measurement of joint motion is not recommended because of the health risks of repeated exposure to radiation and because of the high costs involved.

DISCUSSION

The *AMA Guides to the Evaluation of Permanent Impairment* (2nd, 4th and 5th editions) recommends use of different instruments to measure spinal range of movement in order to estimate the level of impairment.

The 2nd edition *AMA Guides* recommended measurement of spine range of motion utilizing a long-arm goniometer (16) but failed to cite any research which investigated the appropriate evidence of its reliability for use in the spine. Additionally, it recommended using a visual estimate (eg, rotation of the thoracolumbar spine) but no research was cited that investigated its reliability either. Visual range of motion estimates have been reported less reliable than those from a goniometer in the cervical spine. (17)

The 4th and current 5th editions of the *AMA Guides* recommend the use of a dual inclinometer to measure spine range of motion. (18,19) The reliability of the dual inclinometer has been extensively investigated in both normal subjects and patients with low back pain but variable results have been obtained. (20–33)

In 1999, Nitchke et al (32) concluded that the spinal motion measurements as suggested by the *AMA Guides* show reliability problems when comparing methods in the 2nd and 4th editions. These problems underscore the *AMA Guides'* insistence on validity checks and clinical judgment in impairment ratings using spinal motion. In the 5th edition, a different (ROM Method) paradigm for impairment rating has been introduced.

The ROM method is used in several situations:

1. When an impairment is not caused by an injury, if the cause of the condition is uncertain and the DRE method does not apply, or an individual cannot be easily categorized in a DRE class. It is acknowledged that the cause of impairment (injury, illness, or aging) cannot always be determined. The reason for using the ROM method under these circumstances must be carefully supported in writing.
Example: Spinal stenosis is not a specific injury but as a result of superimposed trauma the stenosis may become symptomatic. Spinal stenosis does not precisely fit into the DRE categories, thus the ROM method is appropriate. Foraminal stenosis is not a specific injury, but as a result of superimposed trauma the stenosis may result in radiculopathy. A DRE category would be utilized.
2. When there is multilevel involvement in the same spinal region (eg, fractures at multiple levels, disk herniations, or stenosis with radiculopathy at multiple levels or bilaterally).
Example: Imaging reveals severe arthritic changes at L4–5 and L5–S1 and a herniated disk at L5–S1. There is pain and neurological deficit relating to the L4–5 and L5–S1 disk levels. There is multilevel involvement (radiculopathy and disk herniation) in the same spinal region; thus, the ROM method is appropriate.
3. Where there is alteration of motion segment integrity (eg, fusions) at multiple levels in the same spinal region, unless there is involvement of the corticospinal tract (then use the DRE method for corticospinal tract involvement).
Example: There is a previous fusion for spondylolytic spondylolisthesis that is asymptomatic. Seven years later, the patient falls down the stairs and develops back pain. There is significant alteration of motion segment integrity at the level above the previous fusion. A second fusion is accomplished. Development of an additional alteration of motion segment integrity at another level in the same spinal region has now occurred, thus the ROM method applies.
4. Where there is recurrent radiculopathy caused by a new (recurrent) disk herniation or a recurrent injury in the same spinal region.
Example: Condition (neck and arm pain; disc bulging on MRI at C4–5 and C5–6) becomes stabilized and asymptomatic after conservative care but experiences an occasional radicular arm pain when carrying groceries in plastic bags. Is involved in a motor vehicle collision and develops severe radiculopathy into the forearm and hand without additional MRI changes. The ROM method would apply since this is a recurrence of the radiculopathy, with more symptoms and the same imaging findings.
5. Where there are multiple episodes of other pathology producing alteration of motion segment integrity and/or radiculopathy.
Example: Patient has repeated episodes of lower-back pain, varying degrees of spondylosis, foraminal encroachment and radiculopathy that requires symptomatic relief every 2–3 years. Is involved in a water skiing accident and sustains a lumbar injury. Develops an alteration of motion segment integrity

and worsening radiculopathy that is now unresponsive to manipulative therapy. The ROM method is appropriate since there are multiple episodes affecting the same spinal region.

6. The ROM method can also be used if statutorily mandated in a particular jurisdiction. (34)

Example: Several states still use the 3rd edition of *The Guides*, 4th edition (eg, Texas) or have their own rating system utilizing ROM models or methods (eg, Florida). Some states (eg, West Virginia) do not recognize the DRE method.

An important initial step towards standardizing measurement of joint motion has been undertaken by the American Medical Association with their publication of *The Practical Guide to Range of Motion Assessment*. This publication is an attempt to provide a "thoughtful, detailed, and illustrated description of a standardized approach to ROM measurement and recording. This work should serve as a useful companion reference not only to the *AMA Guides*, but for users of other disability systems who seek to improve their measurement accuracy and reliability when evaluating physical impairments of the spine and extremities." (34)

Problems with reproducibility and variability are inevitable due to the fact that there is no agreed upon standardized approach to measurements of range of motion. There are no standardized features of instruments; the variability of instruments and their application does not lend itself to consistent readings or comparability and dynamic nature of the human body and its condition. Thus, "...variability can be greatly reduced with appropriate instrumentation, training of examiners, consistent measurement techniques, suitable warm-up exercises and accurate recording of measurements." (34) This book provides the needed instruction to limit these potential sources of variability and error.

"This manual seeks to decrease variability in range of motion measurements by alerting the evaluator to conditions that lead to variability and by providing a reproducible protocol for the measurement of range of motion. To obtain accurate ROM measurements, the evaluator must adhere to the following procedural principles:" (34)

1. Prepare the examinee psychologically and physically to minimize the examinee's apprehension and anxiety, and reduce possible errors in measurement. Maximal consistency and reproducibility of measurement is the goal to be achieved.

2. Identifying anatomical landmarks is an absolute necessity so subsequent consistent measurements can be obtained.
3. Have the individual perform standardized warm-up exercises to increase accuracy, consistency, and reproducibility of the measurements. If maximum medical improvement (MMI) has not been reached then warm-up exercises should be curtailed.
4. To prevent a significant source of error (instability secondary to positioning) by multiple investigators, properly position and stabilize the body and proximal part of the joint.
5. Appropriately select, apply, and stabilize the instrumentation. Identification of movement within a spinal region necessitates simultaneous measurements (motion is compound and complex) at both ends of the measured segment. Subsequent subtraction provides the result.
6. Introduced in 1935, the Neutral Zero Measuring Method became the method of preference in 1969 for describing range of motion. Utilizing this method and proper measuring techniques is recommended to enhance consistency and reproducibility. The Neutral Zero Method defines the anatomical position of the body (upright position; feet facing forward, arms at the side of the body, palms facing anteriorly as the starting position). If examinee position changes, always relate back to the upright position.
7. Accurately record measurements in the standardized numerical documentation of the SFTR (acronym stands for the basic planes through which motion can occur) system.
8. Recognize and evaluate the importance of the factors affecting range of motion (ie, objective factors, subjective influences and examiner variability).

The Practical Guide to Range of Motion Assessment lists 12 identifiable items on how to avoid common errors.

- "1. Properly prepare the examinee and encourage his or her cooperation.
2. Identify anatomical landmarks correctly.
3. Perform the standardized warm-up exercises with the examinee before taking measurements.
4. Properly calibrate inclinometers that do not indicate gravity to horizontal or vertical gravity-0-position. Make certain that the objects that you are calibrating against have true vertical and horizontal surfaces. Digital displays do not indicate gravity.
5. Choose gravity-related starting positions and measure them with inclinometers. Never use visual assessment or guess by the 'rule of thumb.'

6. Properly position and stabilize the examinee and/or proximal component of the joint.
7. Set the inclinometer to vertical or horizontal gravity -0- position and stabilize it on the body and or distal component of the measured joint. In large joints, properly align the extender arm with the long axes of joint components. Ascertain that the inclinometer is stabilized on a single level on the spine. Avoid concomitant movements in other planes during measurements.
8. Stretch the skin when stabilizing inclinometers on loose skin overlying bone, such as on the scalp or forehead to avoid shifting of the inclinometer with the skin on the underlying bone. In general, do not stabilize the inclinometer on soft tissue.
9. Do not use Velcro to fasten inclinometers to the body except for dynamic measurements.
10. Read degrees indicated by mechanical inclinometers by facing the dial straight to avoid errors caused by parallax and use the upper or lower meniscus for reading fluid-type inclinometers consistently.
11. Record the planes of motion: sagittal (S), frontal (F), transverse (T), and rotation (R).
12. Become familiar with the instrument that you are using and know its technical limitations. (Call the manufacturer as necessary.) Learn correct measuring techniques before attempting measurements for rating purposes." (34)

CONCLUSION

In the United States (ie, *AMA Guides*, Florida Guides; Minnesota Guides) and now with the introduction of the *AMA Guides* abroad, range of motion is mostly used to assess function of the musculoskeletal system. Limited formal instruction on range of motion measurement within chiropractic colleges and/or diplomate programs adds additional variability to these measurements. The College on Forensic Sciences (CFS) is spearheading an effort to encourage and provide detailed instruction on measuring range of motion (objective tool) according to this companion book to the *AMA Guides*. This attempt at providing a systematic format should enable chiropractic (forensic) evaluators to obtain more reliable range of motion measurements by using the same standardized protocols, reference tables, and reporting methods. (35) A forensic evaluation, based on the ROM method, is subject to attack in a Daubert or litigation/administrative hearing if it fails to justify the method utilized, fails to discuss why any portion of the ROM method (fractures, disc lesions, etc.), measurements are variable and not reproducible or inclinometry is not used for spinal regions.

Additionally, it will provide an acceptable degree of professional skill, knowledge and/or training in this forensic sub-specialty - impairment rating.

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