# Documentation and Clinical Outcome Measures in Whiplash Associated Disorders

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# Disclosures

- Private Practice, Boise, ID since 2001
- Certified Instructor, Chiropractic BioPhysics (CBP®)
- CBP® researcher, co-authored Chapters in CBP® Lumbar Rehab book
- Vice President, CBP® NonProfit, Inc
- Immediate Past-President, Idaho Association Chiropractic Physicians
- President, Mountain West Independent Practice Association
- Vice President, Foundation of Chiropractic Tenets and Science
- Board of Directors, International Chiropractors Association
  - Co-Chair, Technique and Posture Committee
  - Chair, Chiropractic Guidelines Committee
- Principle Investigator, PCCRP X-ray Guidelines
- Principle Investigator and Co-Editor, ICA BPPG
- Consultant for ScoliCare (Sydney AU)
- Consultant and Clinical Director, ChiroIC Chiropractic Cooperative, Inc

# Agenda

1. Documentation in the Chiropractic Office for Personal Injury Cases
2. Clinical Assessment
3. “Whiplash” Guidelines for the Practicing Doctor
4. Clinical Prediction Rules for Prognosis

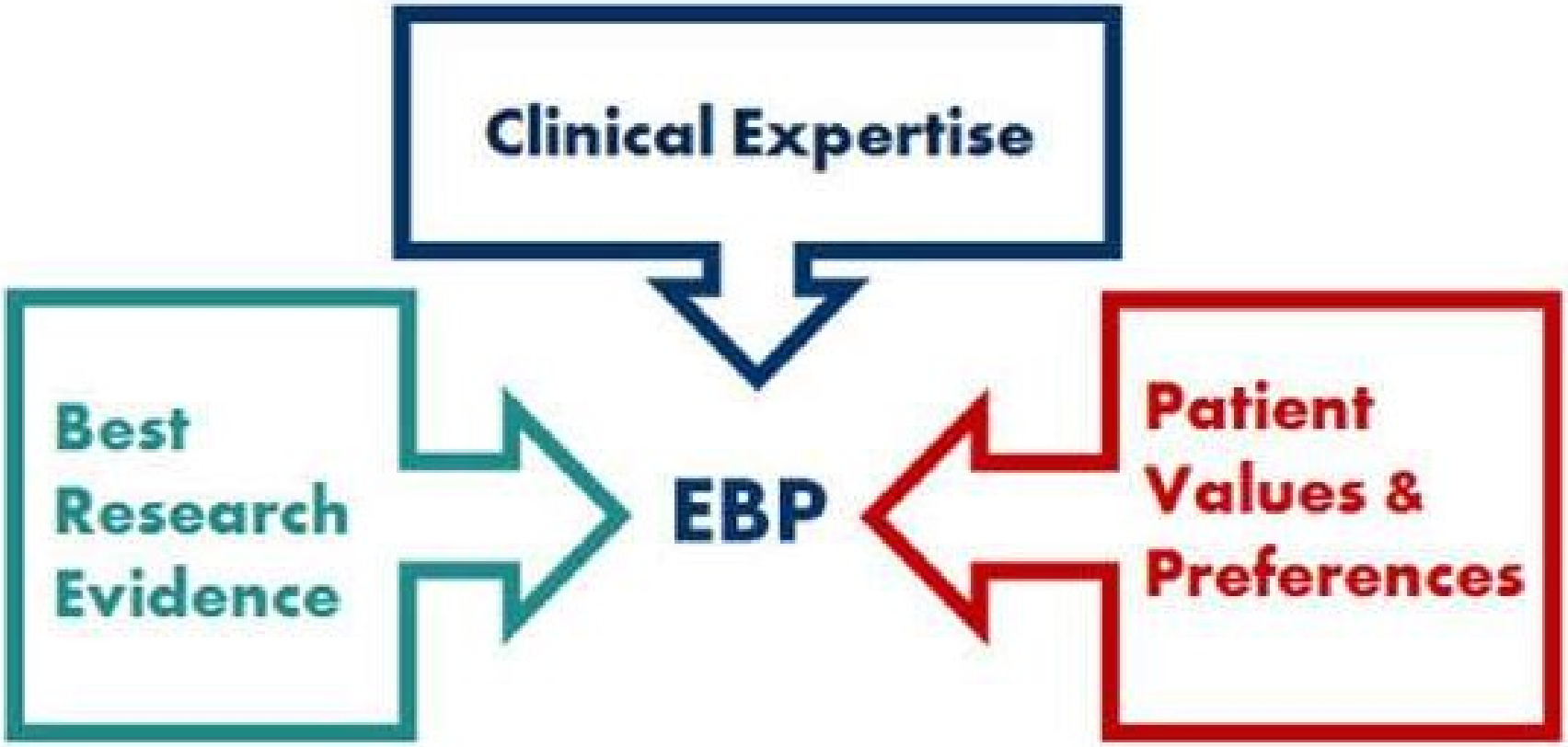
# Documentation…

vs.


Need BOTH

Never sacrifice being the best doctor to your patients at the expense of “proper” documentation (or “accepted” guidelines)

# Evidence Based Practice (EBP)



# Standard of Care

This is a legal term… famously described in *Vaughn v. Menlove* (1837) as whether the individual "proceed[ed] with such reasonable caution as a prudent man would have exercised under such circumstances".

- “Reasonable Standard” vs “Average Standard”

Some states use the "second school of thought" or the "respectable minority" definition

- courts generally refuse to find physicians liable for negligent treatment if, in using their best judgment, the physicians adhered to one of two or more alternative treatments recognized as acceptable in the profession.

# Standard of Care vs “What an Insurance Company Expects”

Unfortunately, the latter drives the former, especially when the insurance industry is “strong” and a particular profession is “weak”

The cart steering the horse

Complying with “What the Insurance Company Expects” is only when reasonable when in the best interest of the patient

Obviously there are times where insurance expectations are not congruent with quality patient care… always side with and fight for quality patient care.

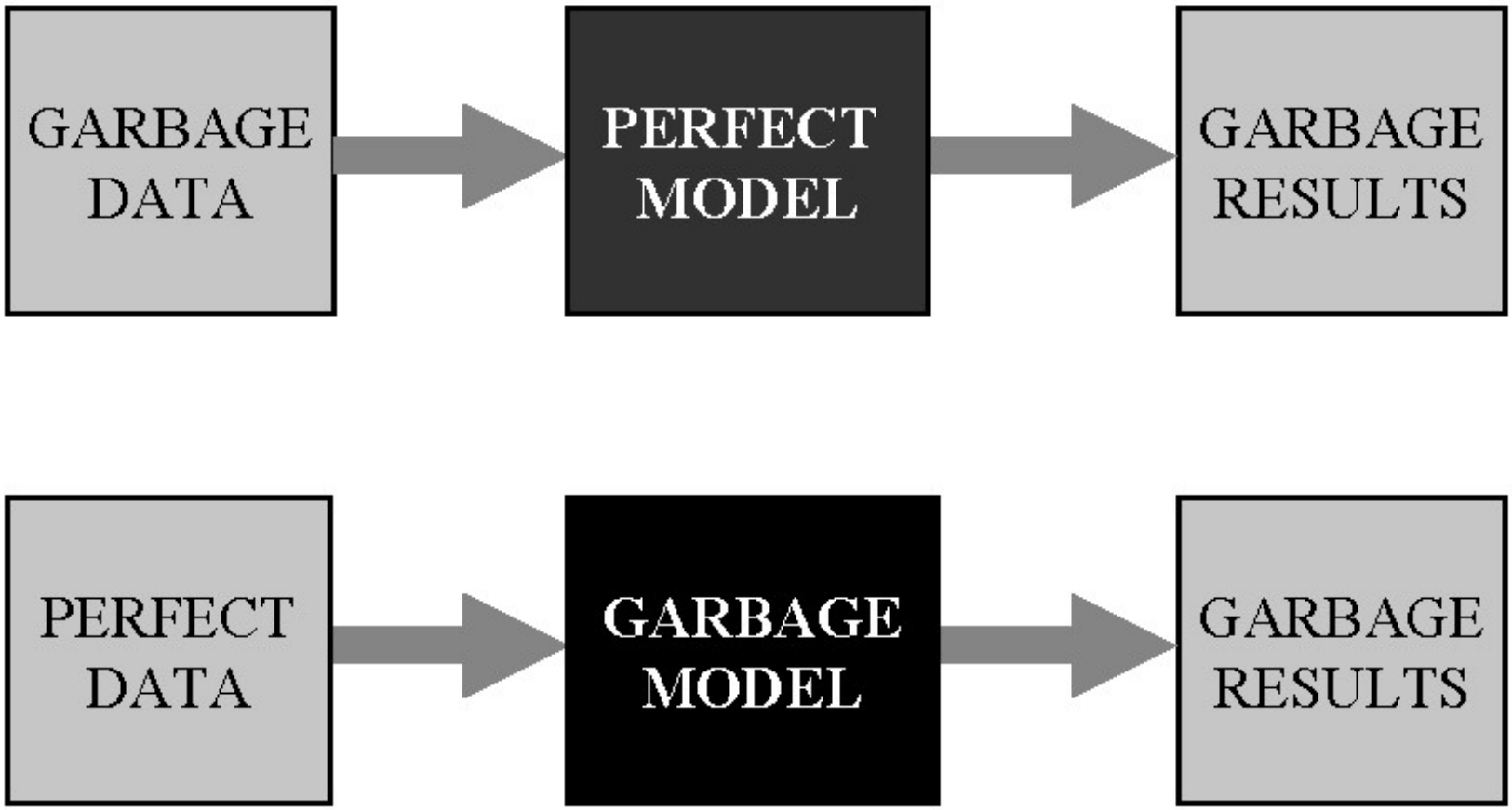
# A “Colossus” Obstacle

- 1990’s in U.S. - Allstate began to rely upon a software program known as “Colossus” which provided adjusters with a tool indicating what a particular case *should be worth.*
- “Colossus” was first developed by the Government Insurance Office (GIO) of Australia (now Suncorp) in the 1980’s.
- Reportedly 60-70% of all 3rd party claims go through Colossus


# Help the Problem…
# Don’t Make it Worse with Your Records!

# MODEL CALCULATIONS

## "Garbage In-garbage Out" Paradigm



# Colossus: garbage in = garbage out

Adjusters in-put info regarding a bodily injury claim:

- Demographic data
- Vehicular damage (<$1000 = SIU)

  * “MIST” case:

***<u>Actual medical records and medical evidence, such as doctor’s notes</u>***

- Over 10,000 factors and diagnoses are taken into consideration by colossus
- Impairment, work/household duty impairment, loss of enjoyment of life, duties under duress, lost wages etc., must be documented in the medical records.

# Reported Value Drivers in Colossus

Type of injury

- Higher values are given to objective, easy-to-verify injuries such as broken bones and herniated discs.
- Soft tissue injuries (sprains and strains) are given lower values.

Medical findings that increase the value of a claim in the Colossus system:

- muscle spasms, dizziness, radiating pain
- headaches, restriction of movement, nausea
- vision impairment, depression, anxiety

# Reported Value Drivers in Colossus

- Proper/thorough testing and diagnosis
  - Demonstrable Injuries: Documented bruises, cuts, abrasions (take photos), disc lesions, loss of cervical curve, segmental instability
  - Non-Demonstrable Injuries: Sprain, segmental dysfunction
- Treatment amount and types
- Referrals (2nd opinions, co-management)
  - Coordination of Care
- Permanent Impairment Ratings (PIR) using AMA Guides 5th Ed.
- Duties Under Duress (DUD)
- Loss of Enjoyment of Life (LEL)

# “MIST” Injury Cases

- Implies a linear correlation between vehicle “Damage” (minor impact) and injury severity

- <$1500 damage
  - Determined by field adjustors and “preferred” garages
  - <1 in. bumper absorber displacement
  - <2 hrs frame repair time

- Insurance companies reference a list of studies refuting injury in cases with “minor” impacts

- These studies are refuted…

# A Review and Methodologic Critique of the Literature Refuting Whiplash Syndrome

Michael D. Freeman, DC, PhD, MPH,* Arthur C. Croft, DC, MS,† Annette M. Rossignol, ScD,‡ David S. Weaver, DC,§ and Mark Reiser, PhD¶

SPINE Volume 24, Number 1, pp 86–98


**REVIEW**

# A review of the literature refuting the concept of minor impact soft tissue injury

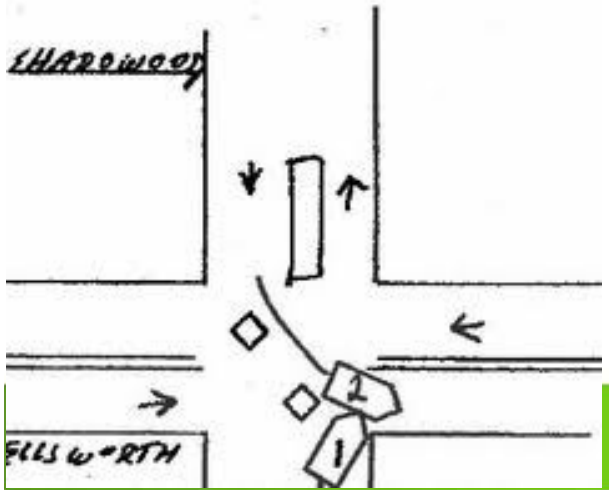
Christopher J Centeno MD[1], Michael Freeman PhD MPH DC[2], Whitney L Elkins MPH[3]

**CJ Centeno, M Freeman, WL Elkins. A review of the literature refuting the concept of minor impact soft tissue injury. Pain Res Manage 2005;10(2):71-74.**

# Case Documentation

# Example of paperwork flow—History, Exam, Assessment

- Intake/History/Outcome Assessment Questionnaires:
  - General History (including past traumas—details)
  - **Detailed** info on Crash (gather risk factors)
  - Pre-exiting injury/conditions—bulging discs, arthritis, etc. They INCREASE the value of the case, but you MUST distinguish between these issues and the current complaints/injuries. (Arthritis may have been asymptomatic prior).
  - Specific effects on ADLs (use proven OA Questionnaires)



# The association between neck pain, the Neck Disability Index and cervical ranges of motion: a narrative review

Emily R. Howell, BPHE (Hons), DC*

Journal of the Canadian Chiropractic Association

J Can Chiropr Assoc 2011; 55(3)

Table 3 *NDI and whiplash*

| Study | Design strength | Design limit | Measure | Results |
|---|---|---|---|---|
| Vernon 2008 | 41 NDI and WAD studies Review | Review done by NDI author himself (could have some bias) | NDI | NDI most widely used and strongly validated self-rated disability measure for neck pain; best outcome predictor (especially of longer term physiological dysfunction and physical impairment) |
| Kaale et al 2005 | N = 92 chronic grade 2 WAD patients & 30 controls | Controls were being treated by physical therapist for other conditions (not specified); controls slightly older than WAD patients. | MRI , NDI | Transverse ligament and posterior atlanto-occipital membrane lesions relate to NDI scores. |
| Pereira et al 2008 | N= 30 WAD and 30 controls Case control study | WAD patients older, had more driving experience, had higher composite driving tasks scores and used more assistance with driving than controls; measures were taken in laboratory and not in real driving context; | NDI, GHQ-28, IES-R, TSK, DHQ, CROM (with Fastrak), cervical joint position sense, smoother pursuit neck torsion test | WAD had CROM deficits (more so in flexion, extension and rotation); moderate correlation between driving task scores and pain and disability levels |
| Stewart et al 2007 | N = 132 chronic WAD patients Cohort study | Baseline and 6 weeks follow-up measurement (after 12 session of exercise program); used diary (not supervised exercise). | NDI, pain intensity, bothersomeness, SF-36, PSFS, FRS, Copenhagen Scale, SF-36 physical summary | NDI and other region-specific measures no more responsive than other general disability measures; region-specific measures are easy to administer and score and are relevant to neck pain population |
| Vernon et al 2009 | N = 107 chronic WAD Cross-sectional correlation design | Pain and disability status of sample higher than previous studies; referral bias of obtaining subjects; no-fault insurance system jurisdiction; | NDI, TSK, pain VAS, pain diagram. | Fear avoidance beliefs and pain amplification have some moderate influence on self-reported disability (and NDI scores) in WAD subjects; Pain diagram correlates with NDI scores |

# Example of “Paperwork” Flow—History, Exam, Assessment

- Exam:
  - **Detailed** Neuromusculoskeletal exam—based on preliminary findings, “order” testing based on exam (computerized ROM, PostureScreen, X-rays, pressure algometry, Computerized MMT, dynamic sEMG–“dynaROM”, DMX, MRI, CT, etc)
  - Take photos of anything visual—bruising, cuts, etc.

# Example of paperwork flow—History, Exam, Assessment

- Assessment of Findings
  - Establish Dx, Prognosis (for complete resolution and for improvement), Coordination of Care (referrals, follow-up with others, etc.)
  - Statement of causation:
    - symptoms are “more likely than not” (>50%) and “to a reasonable degree of certainty” a result of the collision.
    - “in my professional opinion, the mechanism of injury can explain each of the symptoms.”
  - Explain delay in treatment, if appropriate (>5 days, IMO)
  - Establish work AND home activity restrictions
  - Explain any potential relationship to pre-existing conditions
    - Do not “ignore” pre-existing conditions
  - Ascertain patients “expectation of recovery”—VERY important in predicting improvement.

# Qualitative vs. Quantitative Outcome Measures

- ***Qualitative* assessments:** determine the *nature*, as opposed to the *quantity* of the elements comprising a test or measure.
  - Examples: Inspection, palpation, and visual observations of patient structure (posture) or function (visual est. ROM)

- ***Quantitative* assessments:** express a numerical amount relative to the proportionate quantities of a test or measure.
  - Examples: range of motion (degrees), spinal displacements (mm or in). Physiological changes can be expressed, for instance, in units of temperature (degrees) or electrical signals (volts) or other relevant descriptors.

# Outcome Measurements in Chiropractic: Reliability & Validity

| Method | Qualitative or Quantitative | Reliable | Valid |
|---|---|---|---|
| Manual palpation for tenderness | Qualitative | Yes, but not specific | Yes |
| Pressure algometry | Quantitative | Yes | Yes |
| Visual Postural Assessment | Qualitative | Yes | Yes |
| PostureScreen | Quantitative | Yes | Yes |
| X-ray line drawing | Quantitative | Yes | Yes |

**Table 1.**
**Qualitative clinical assessments and their quantitative counterparts**

| Test | Qualitative (Findings) | Quantitative (Units of Measurment |
|---|---|---|
| **Perceived Pain, Disability, and/or Functional Status** | Patients' subjective description (Patient demeanor) | -Outcome Assessment Instruments (numerical score compared to normative values) |
| **Pain threshold or Pain tolerance** | Palpation for pain (tenderness, grading of trigger points) | -Pressure Algometry (psi, kg/cm2, or Pa) |
| **Posture** | Visual postural analysis (i.e. Head tilt, high shoulder, etc.) | -Postural grid photography<br>-Surface topographical measures<br>-Computer assisted digitization<br>-Diagnostic Imaging (x-ray, MRI, CT) (millimeters or degrees) |
| **Range of Motion** | Visual estimation (restricted mobility, pain production or reproduction) | -Inclinometric Measurement<br>-Goniometric Measurement (degrees) |
| **Intersegmental Range of Motion** | Motion palpation (articular fixation, pain) | -Spinal stiffness assessments<br>-Static/Quasi-static (N/m)<br>-Dynamic (Kg-1, Kg, m/Ns, Ns/m, m/N)<br>-Instantaneous axis of rotation (degrees)<br>-Instantaneous helical axis (radians) |
| **Muscle Strength** | Muscle testing (grading 0-5) | -Dynamometric Measurement (kg or lbs.)<br>-Computerized and Digital Equipment (kg or lbs.)<br>-Load cell or Strain gauge types<br>-B200 (kg or lbs.)<br>-EMG (mV) |
| **Muscle Endurance** | Muscle testing (grading 0-5) | - Biering-Sorensen Test (Time duration, sec., of task performance)<br>- EMG (median frequency analysis) (Hz) |
| **Muscle Spasm** | Palpatory myospasm Assessment | -Surface Electromyography (mV) |
| **Nerve Function** | Orthopedic/Neurologic Exam (i.e. mechanical tests, stretch tests, deep tendon reflex, dermatomal sensation) | -Nerve Conduction Velocity (ms)<br>-Needle Electromyography (mV)<br>-H-Reflex (mV)<br>-Somatosensory Evoked Potentials (mV)<br>-Current Perception Threshold (mV)<br>-Thermography (degrees C or F) |
| **Pathology** | History, Inspection, Palpation (mass, rubor, calor, dolar) | -Diagnostic Imaging<br>-Laboratory Analysis<br>-Biopsy |

**** Some Of The Listed Procedures In This Table and in this chpter May Not Be Conducted By Licensed Chiropractors (like needle EMG).*

# Patient Clinical Status and Response to Treatment

4 categories of measurements provide relevant information about patient clinical status and/or response to treatment:

1. ***Structural measurements*** (i.e. X-ray, pathology, or posture),
2. ***Perceptual measurements*** (i.e. self-reported pain quality, location and intensity, as well as health-related quality of life---*questionnaires*),
3. ***Functional measurements*** (i.e. range of motion, strength, stiffness, activities of daily living), and
4. ***Physiological measurements*** (i.e. SEMG, neurologic measures, laboratory examinations)

# Functional and Physiological Outcomes

- ROM
- ROM w/ simultaneous SEMG
- Manual Muscle Testing
- Physical Performance Tests

# ROM in WAD Cases

Evidence shows a correlation between ROM and physical impairment and disability in cases of persistent WAD…

# THE BEHAVIOURAL RESPONSE TO WHIPLASH INJURY

MARTIN GARGAN, GORDON BANNISTER, CHRIS MAIN, SALLY HOLLIS

*From Southmead Hospital, Bristol, England*

THE JOURNAL OF BONE AND JOINT SURGERY

VOL. 79-B, No. 4, JULY 1997

- Found that reduced ROM **3 months** after whiplash injury was a good predictor of persistent pain and disability **2 years** after injury.
- "Our findings suggest that the symptoms of whiplash injury have both physical and psychological components, and that the psychological response develops **after** the physical damage."
- "Both physical and behavioural responses to these injuries are established in most cases within **three months** of injury. This suggests that the greatest potential for influencing the natural history of the syndrome is within this period."

J Manipulative Physiol Ther. 1997 Sep;20(7):468-75.

# A comparison of physical characteristics between patients seeking treatment for neck pain and age-matched healthy people.

Jordan A[1], Mehlsen J, Ostergaard K.

- There is a reduction in primary ROM in persons with WAD, when comparison was made with matched asymptomatic persons.
- “the greatest relative muscular deficiencies seem to be in the extensor muscle group. Additionally, most patients exhibit a significant decrease in active ROM during extension.”

SPINE Volume 26, Number 19, pp 2090–2094


# Cervical Range of Motion Discriminates Between Asymptomatic Persons and Those With Whiplash

Paul T. Dall'Alba, BPhty (Hons), Michele M. Sterling, MPhty, Julia M. Treleaven, BPhty, Sandra L. Edwards, MPhtySt, and Gwendolen A. Jull, PhD

- 89 asymptomatic (41 men, 48 women; mean age 39.2 years)
- 114 patients with persistent whiplash-associated disorders (22 men, 93 women; mean age 37.2 years

- The discriminant analysis resulted in correct categorization of 90.3% of participants (sensitivity 86.2%, specificity 95.3%)

- “The results of the present study indicate that ROM was a significant discriminator between asymptomatic persons and those with persistent WAD. This discriminative ability strengthens the case for using ROM as an indicator of physical impairment.”

RESEARCH ARTICLE

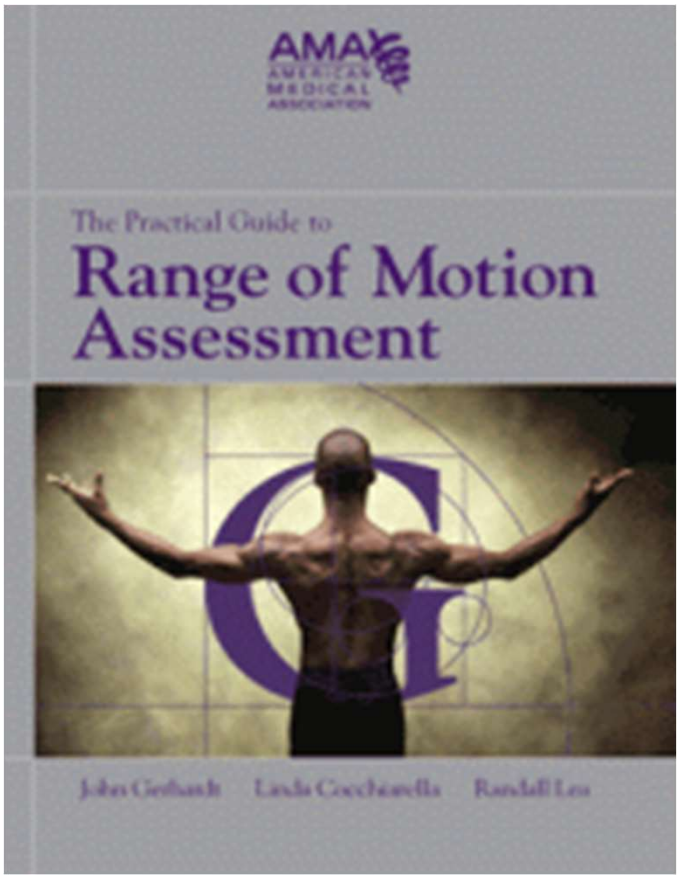
# Reproducibility and Validity of Digital Inclinometry for Measuring Cervical Range of Motion in Normal Subjects

Tamara Prushansky*, Orly Deryi & Bahaa Jabarreen

Physiother. Res. Int. **15** (2010) 42–48 © 2009 John Wiley & Sons, Ltd.

- 15 healthy men and 15 healthy women
- Compared Zebris vs dual digital inclinometry (DI) CROM obtained 2 times, 7 days apart
- No significant differences (Coefficient of Variations) were found between the Zebris- and DI measures
- No significant difference in test-retest values of DI
- ICC's for individual movements ranged from 0.82-0.94

# AMA Guides 5th ed

# AMA Guides 5th ed

- DRE (diagnosis-Related Estimate) vs ROM method
- Only “Rate” an individual when they have reached MMI
- Use ROM method when condition is NOT caused by an injury or when an injury is not well represented by a DRE category

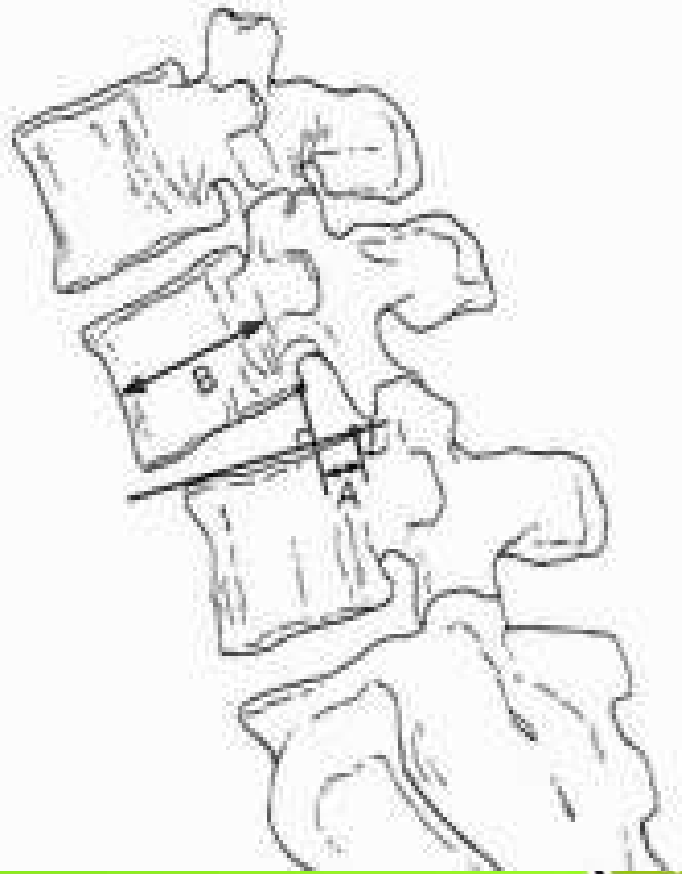
# AMA Guides 5th ed

- Use ROM method for injuries to more than one level in same spinal region and in certain individuals with recurrent pathology
- Use ROM method is cause of condition cannot be determined

# AMA Guides 5th ed

- Loss of Motion Segment Integrity, Translation
- >3.5 mm cervical
  >2.5 mm thor
  >4.5mm lumb
- DRE Category IV (25-28%) or V (35-38%)

**Figure 15-3a** Loss of Motion Segment Integrity, Translation



# AMA Guides 5th ed

- ROM Method—3 Components:

1. Rom of spine region
2. Accompanying Dx (Table 15.7)
3. Any spinal nerve deficit

Whole person impairments obtained by combining all 3 components (p602)

Must have permanent anatomic and/or physiologic residual dysfunction

# AMA Guides 5th ed

- ROM Method—DUAL Inclinometry
  - Mandatory Warm-Up
    - 2x Flex/Ext → 2x Lat Flex → 2x Axial Rot → 1x Flex/Ext
  - 3 Consecutive measurements-take average
  - If avg measure is <50°, all 3 must fall within 5° of the mean
  - If avg measure is >50°, all 3 must fall within 10% of the mean
  - Repeat test until consistency is obtained (max of 6 attempts)

# AMA Guides 5th ed

- ROM Method—DUAL Inclinometry
  - Use maximum motion for each movement from a valid set to use in the AMA Tables
  - Combine ROM, Dx, nerve deficit for EACH region, if applicable and combine using p. 604

# Active Head Re-Positioning

Arch Phys Med Rehabil. 1998 Sep;79(9):1089-94.

**Cervicocephalic kinesthetic sensibility, active range of cervical motion, and oculomotor function in patients with whiplash injury.**

Heikkilä HV[1], Wenngren BI.

- Active head repositioning was significantly less precise in the whiplash subjects than in the control group.
- Failures in oculomotor functions were observed in 62% of subjects.
- Significant correlations occurred between smooth pursuit tests and active cervical range of motion.
- Correlations also were established between the oculomotor test and the kinesthetic sensibility test.

# Measuring Cervical ROM—Age Factor

Spine (Phila Pa 1976). 2009 Aug 15;34(18):1910-6. doi: 10.1097/BRS.0b013e3181afe826.

## Active head and cervical range of motion: effect of age in healthy females.

Tommasi DG[1], Foppiani AC, Galante D, Lovecchio N, Sforza C.

- Three groups of females were compared:
  - 22 aged 15 to 18 years (adolescents),
  - 25 aged 20 to 30 years (young adults), and
  - 16 aged 35 to 45 years (mid-aged women).
- Used Optoelectric Measurement
- **CONCLUSION:** In healthy females, between 15 and 45 years old, cervical ROM in the principal planes decrease (except for rotation), but these variations are NOT statistically significant ($P > 0.05$).

# Cervical ROM in Elderly

Arch Phys Med Rehabil. 1993 Oct;74(10):1071-9.

## Cervical range of motion in the elderly.

Kuhlman KA[1].

Author information

**Abstract**

This study was conducted to establish normative cervical range of motion values for the elderly and to compare those values to standard young adult cervical range of motion values. Differences in range of motion between men and women were also assessed. A gravity goniometer was used to measure six cervical motions in 42 subjects aged 70 to 90 years and 31 subjects aged 20 to 30 years. The elderly group had significantly less motion than the younger group for all six motions measured ($p < .001$). A comparison of the mean range of motion values between the two groups found that the elderly group had approximately 12% less flexion, 32% less extension, 22% less lateral flexion, and 25% less rotation. The elderly group also had a wider variation of cervical range of motion values as compared to the younger group. Women had greater cervical range of motion values than men in both age groups.

# Cervical ROM—Testing Protocol

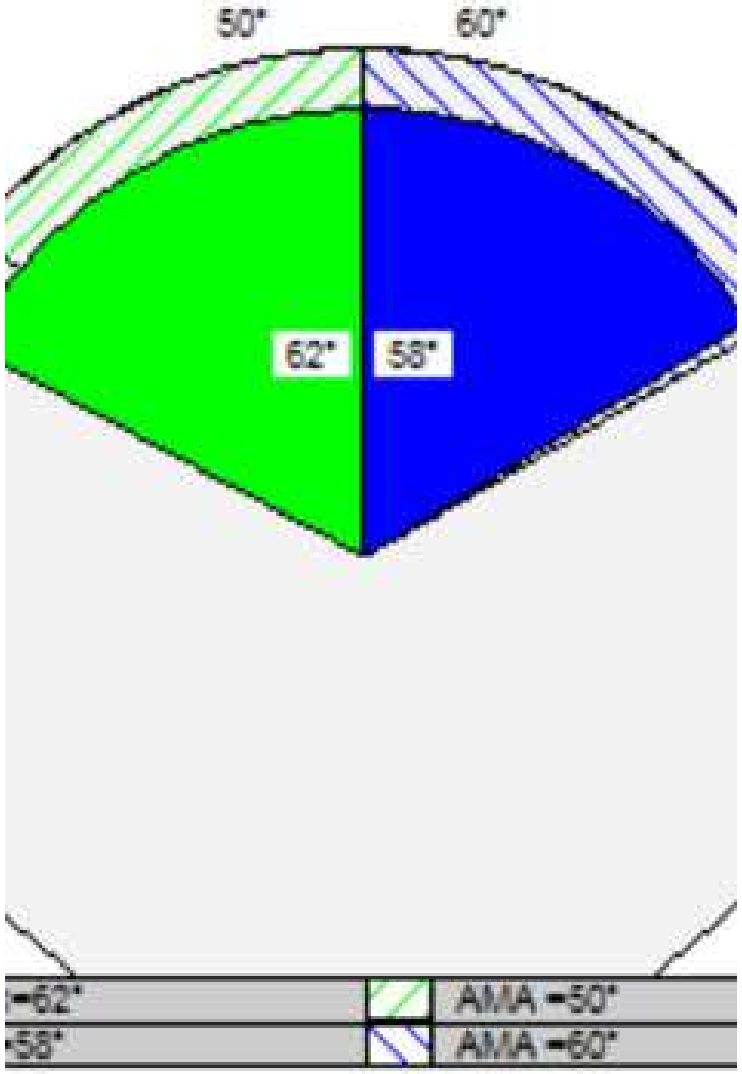
Physiother Res Int. 2002;7(3):136-45.

## The effect of measurement protocol on active cervical motion in healthy subjects.

Dvir Z[1], Werner V, Peretz C.

- Used an ultrasound-based system
- Protocol A: reciprocal-intermittent testing (pause @ neutral)
- Protocol B: reciprocal-continuous testing (no pause)
- Protocol C: consisted of three repetitions of the same primary direction with a break between two consecutive primary directions.
- Protocol D: Three sets of six randomly ordered primary directions
- CONCLUSION: A, B, C all okay. Protocol D underestimates

# What About ROM Tests that are Normal? Who does that help?

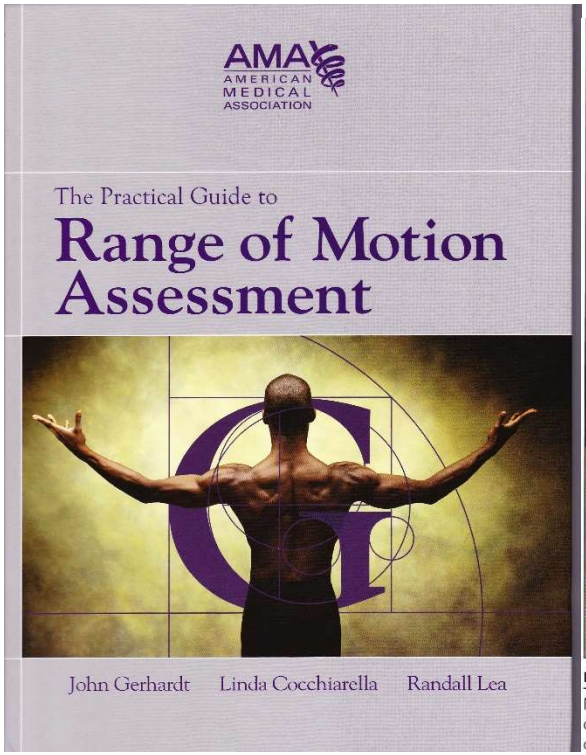



# DynaROM: Establishing need for care, with normal MRI, normal CT, Normal X-rays and Normal ROM

***"…has achieved a level of medical acceptance as a valuable diagnostic tool for injuries of the spine and upper and lower back"***

**DONE AND ORDERED!**

Diane Cleavinger
DIANE CLEAVINGER
Administrative Law Judge



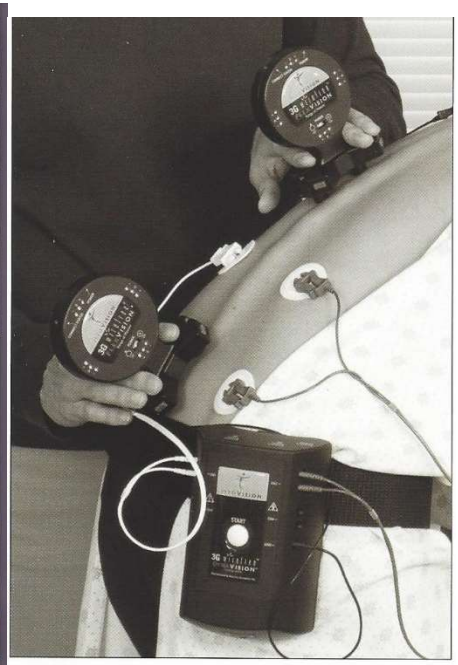
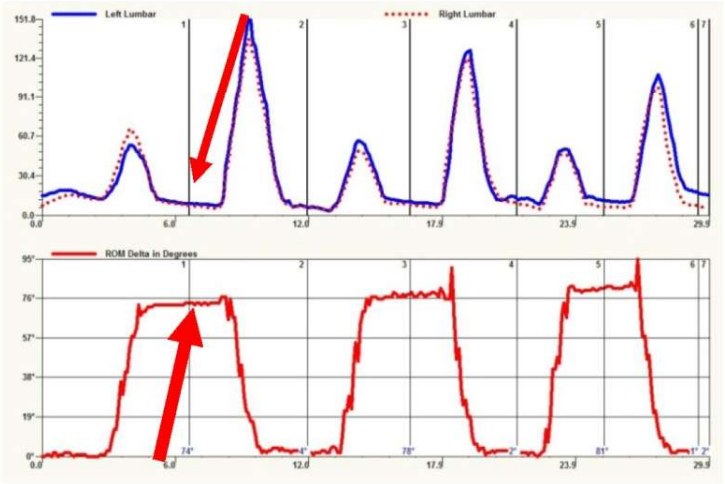



**FIGURE 2-27**
Measuring lumbar spine flexion. Position and stabilization of the electronic wireless dual inclinometers and placement of the S-EMG with electrodes are shown.

# ROM, sEMG & WAD

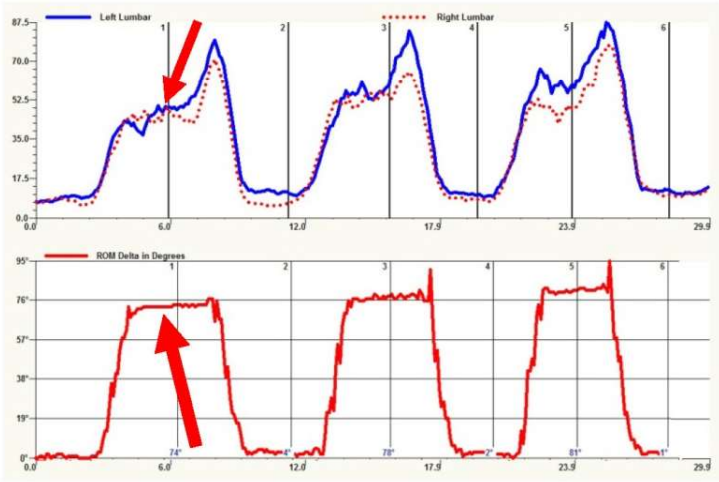
## Combine Range of Motion and Dynamic sEMG shows ROM & Muscle Guarding: Crucial to "Seal" the Case.

Normal Range of Motion, No bracing (normal sEMG)




*Top graph shows Lumbar Muscle activity, Bottom graph shows Range of Motion: Graph to right proves that normal ROM can be accompanied with guarding and bracina& iniurv*

Normal ROM, Abnormal Muscle Bracing: Establishes ROM without Dynamic sEMG ("guarding" lacks clinical accuracy



# The ability of the device to evaluate for “soft tissue injury”:  Patented !!!!

(12) **United States Patent**
**Marcarian**

(10) **Patent No.: US 9,808,172 B2**
(45) **Date of Patent: Nov. 7, 2017**

(54) **SYSTEMS AND METHODS FOR PERFORMING SURFACE ELECTROMYOGRAPHY AND RANGE-OF-MOTION TEST**

(75) Inventor: **David Marcarian**, Seattle, WA (US)

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,320,767 A * 3/1982 Villa-Real ..... 600/493
4,492,029 A * 1/1985 Tanaka et al. ..... 33/366.14
(Continued)

(57) **ABSTRACT**

A soft-tissue-injury diagnostic system for diagnosing soft tissue injury within a patient includes a set of hand-held inclinometers configured and arranged for measuring angles formed between a first inclinometer disposed in proximity to a patient joint and a second inclinometer disposed distal to the joint during controlled patient movements of the joint. A plurality of measuring electrodes are coupleable in proximity to the patient's spine along the body portion that moves along the joint. The measuring electrodes are configured and arranged for measuring action potentials along patient muscle groups during the controlled patient movements of the joint and transmitting the measured action potentials to a dynamic surface electromyograph ("sEMG") module. A hub receives and processes data from the inclinometers and the dynamic sEMG module. A visual display is configured and arranged for receiving and displaying the processed data.

# Flexion-Relaxation Phenomenon

THE LANCET
Volume 257, Issue 6647, 20 January 1951, Pages 133-134

ORIGINAL ARTICLES

## FUNCTION OF ERECTORES SPINÆ IN FLEXION OF THE TRUNK

W.F. Floyd B.Sc. Lond., F.Inst.P., A.M.I.E.E. (SENIOR LECTURER IN PHYSIOLOGY), P.H.S. Silver M.B. Lond. (SENIOR DEMONSTRATOR OF ANATOMY)

The Journal of Physiology
Volume 129, Issue 1, 28 July 1955, Pages 184-203

## The function of the erectores spinae muscles in certain movements and postures in man (Article)

Floyd, W.F., Silver, P.H.S.

# Flexion-Relaxation Phenomenon

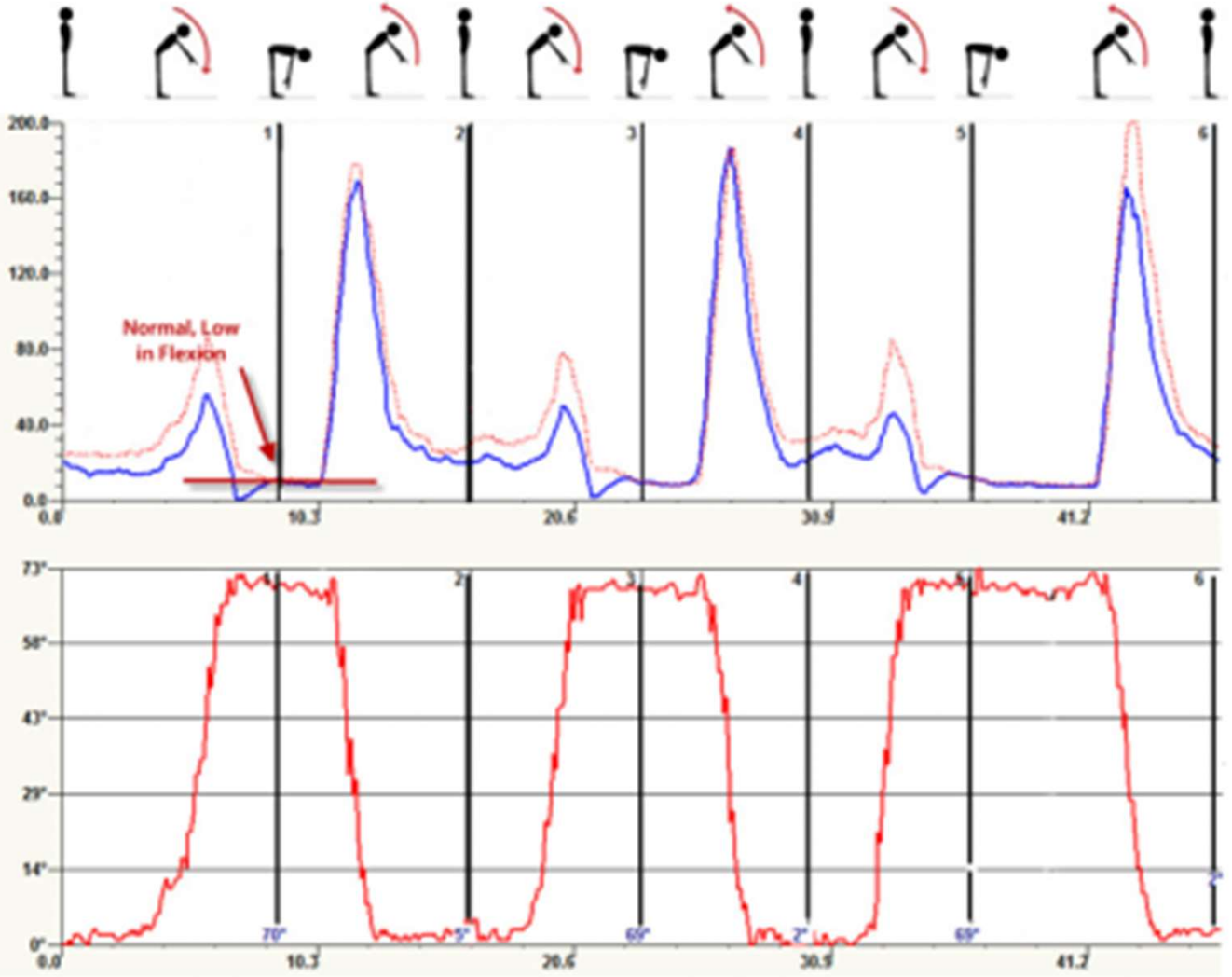
- The flexion–relaxation (FR) phenomenon, a normal pattern in muscle activation, originates from the lumbar region and is defined as an electrical silence response in the erector spinae muscles during a full forward-bending trunk posture (Floyd and Silver, 1951).

- The causes of this phenomenon were seen as transferring extensor moment from superficial erector spinae to passive paraspinal structures or deep muscle such as quadratus lumborum.

# Flexion-Relaxation Phenomenon

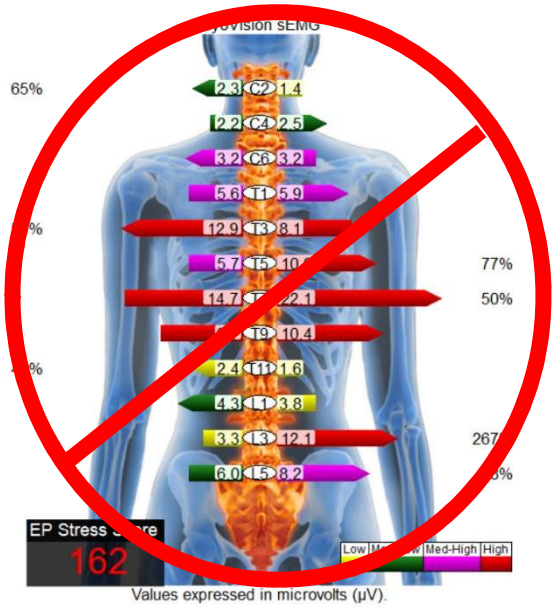


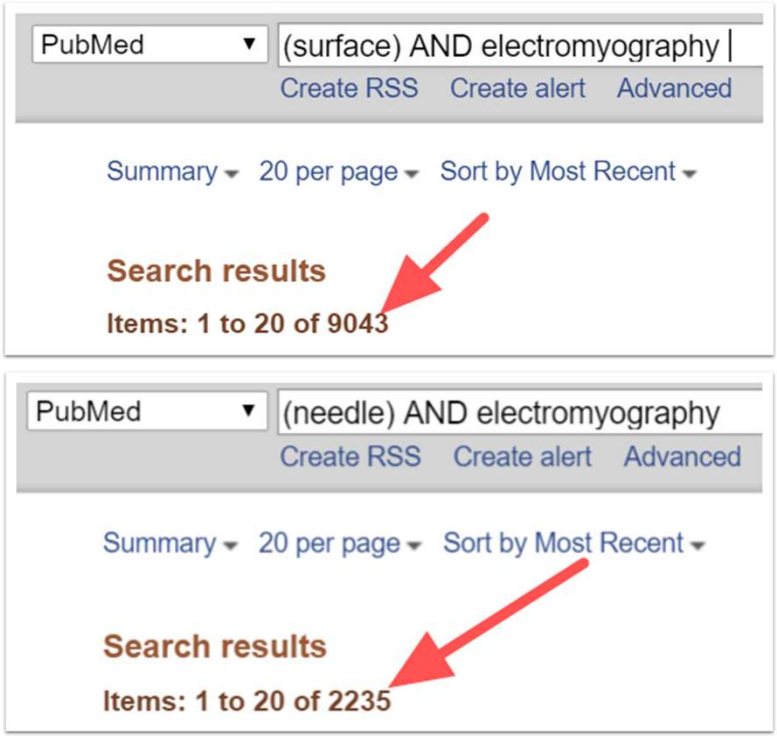




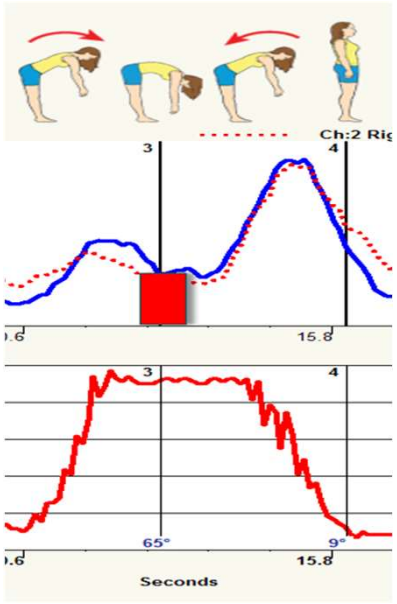
# Why is Surface EMG associated with “Junk Science”… Case of Mistaken Identity!

Static sEMG:
“Photograph”




DynaROM sEMG:
“Video”



# Pain-Related Fear, Lumbar Flexion, and Dynamic EMG Among Persons With Chronic Musculoskeletal Low Back Pain

*Michael E. Geisser, PhD,* Andrew J. Haig, MD,*† Agnes S. Wallbom, MD,* and Elizabeth A. Wiggert, PT**

*Clin J Pain* • Volume 20, Number 2, March/April 2004

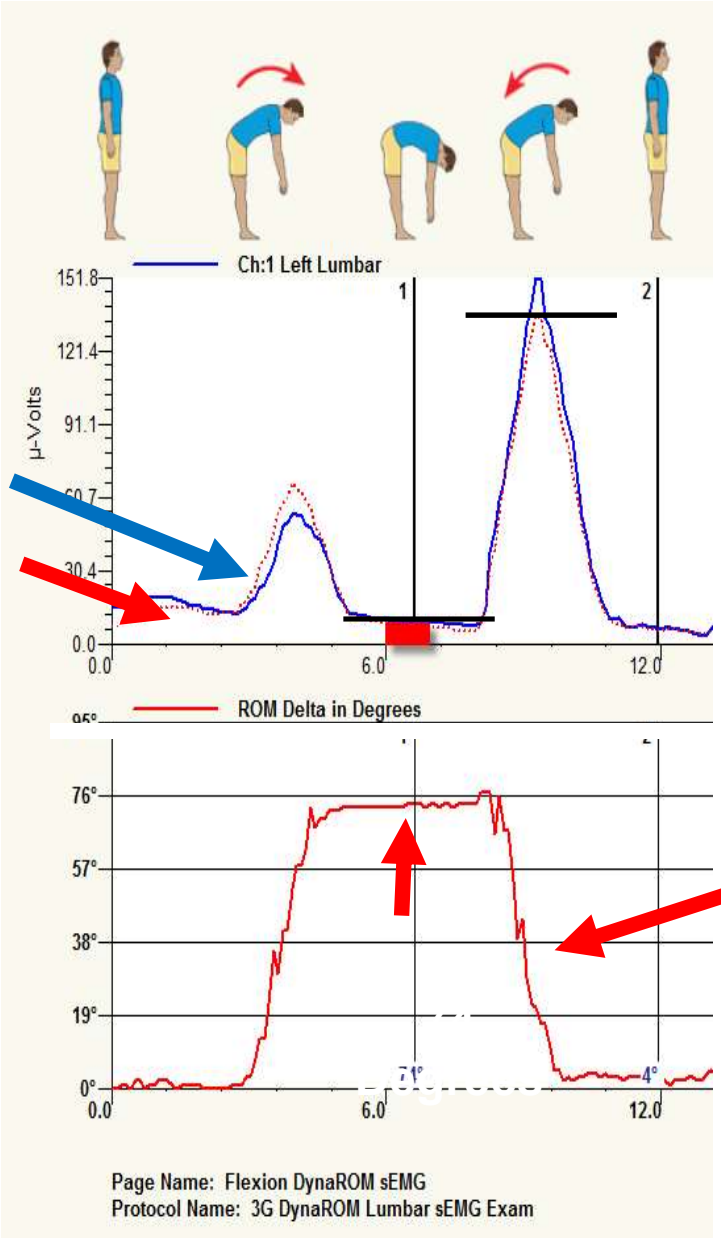
- Explore the relationship between pain-related fear, angle of flexion, and EMG activity
- Pain-related fear is significantly associated with decreased lumbar flexion in persons with CLBP
- Pain-related fear influences the FRR both through its association with maximal muscle activity during flexion, as well as increased muscle activity in full flexion

**Attached Electrode Dynamic sEMG**

Left Lumbar Blue, Right Lumbar Red

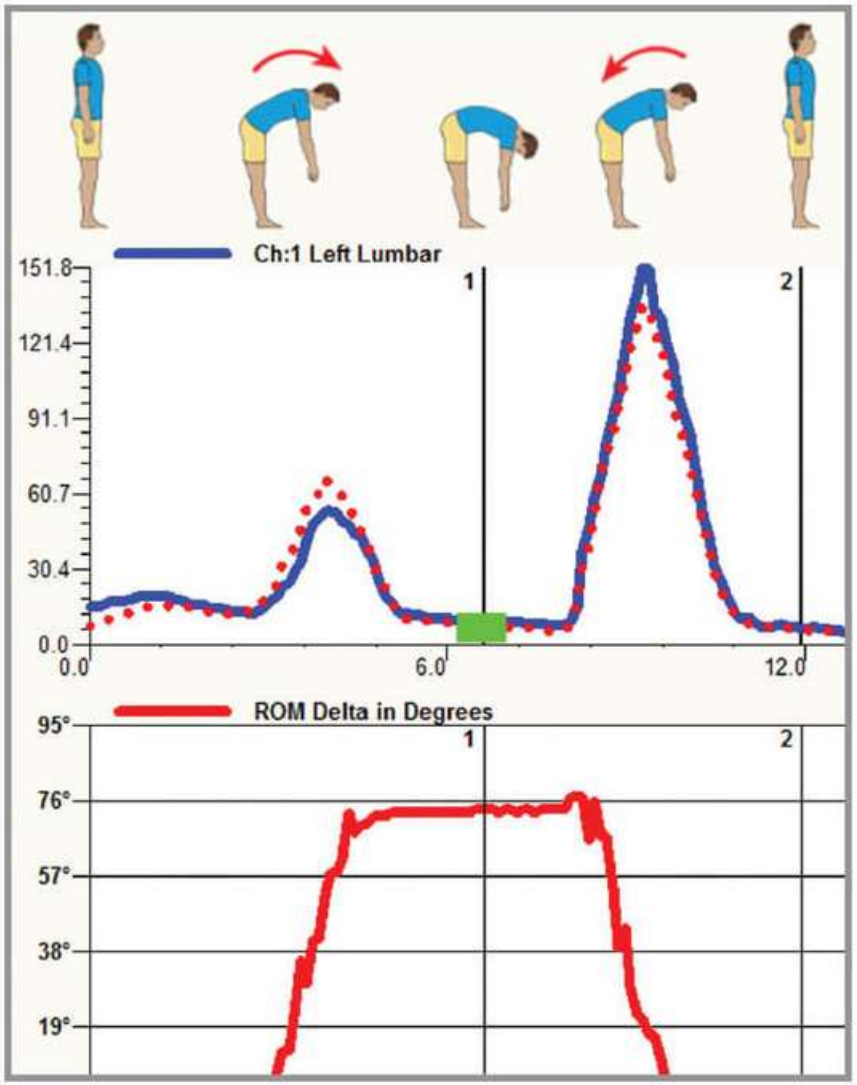
**Graphed Range of Motion.**

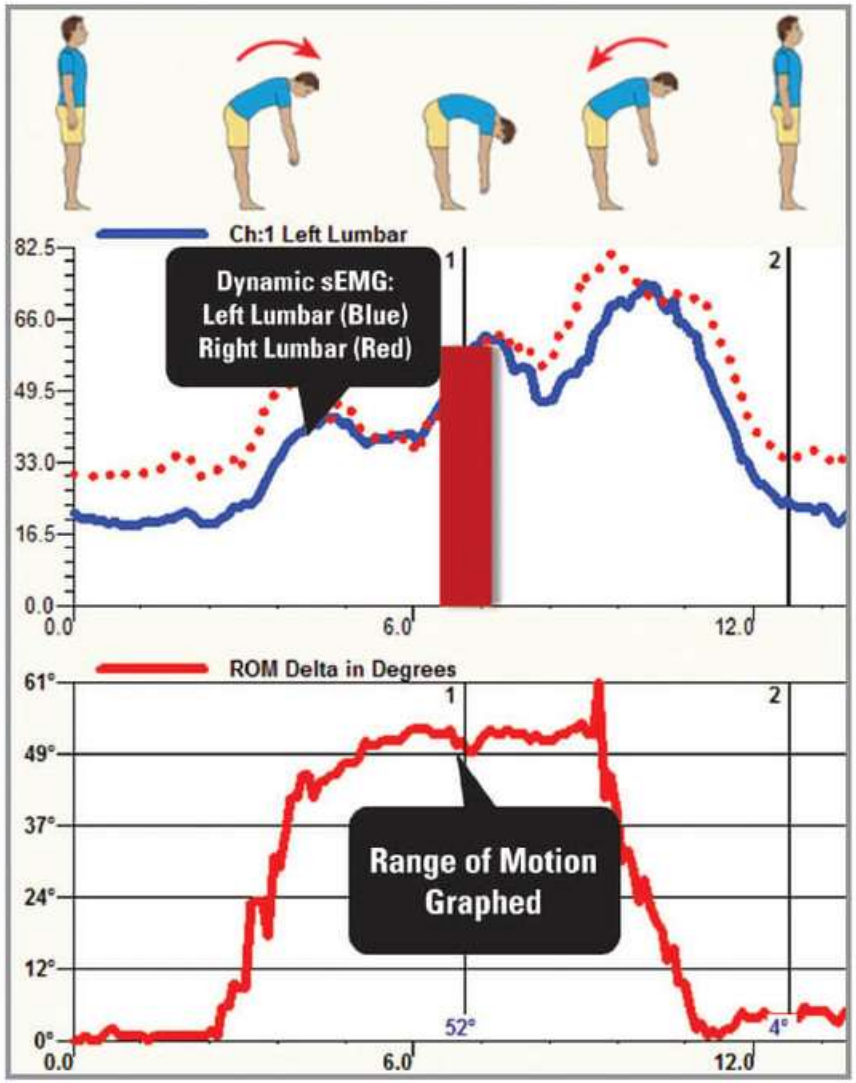
Shows "Quality" of Motion, not just end point value.




FR Ratio (FRR):
Mean at extension
TO
Mean at FR
(N=3:1 to 4:1)

# Show Guarding and Pain Even if End-ROM Point is Normal



Eur Spine J (2013) 22:162–168
DOI 10.1007/s00586-012-2517-3

ORIGINAL ARTICLE

# A comparative investigation of flexion relaxation phenomenon in healthy and chronic neck pain subjects

Nader Maroufi · Amir Ahmadi ·
Seyedeh Roghayeh Mousavi Khatir

- 22 women with chronic neck pain (VAS 20.9 mm) vs 21 healthy controls
- Avg age 23 yo, avg cervical flexion 50° and 51°
- Measured ROM using electrogoniometers simultaneously with and SEMG on cervical erector spinae

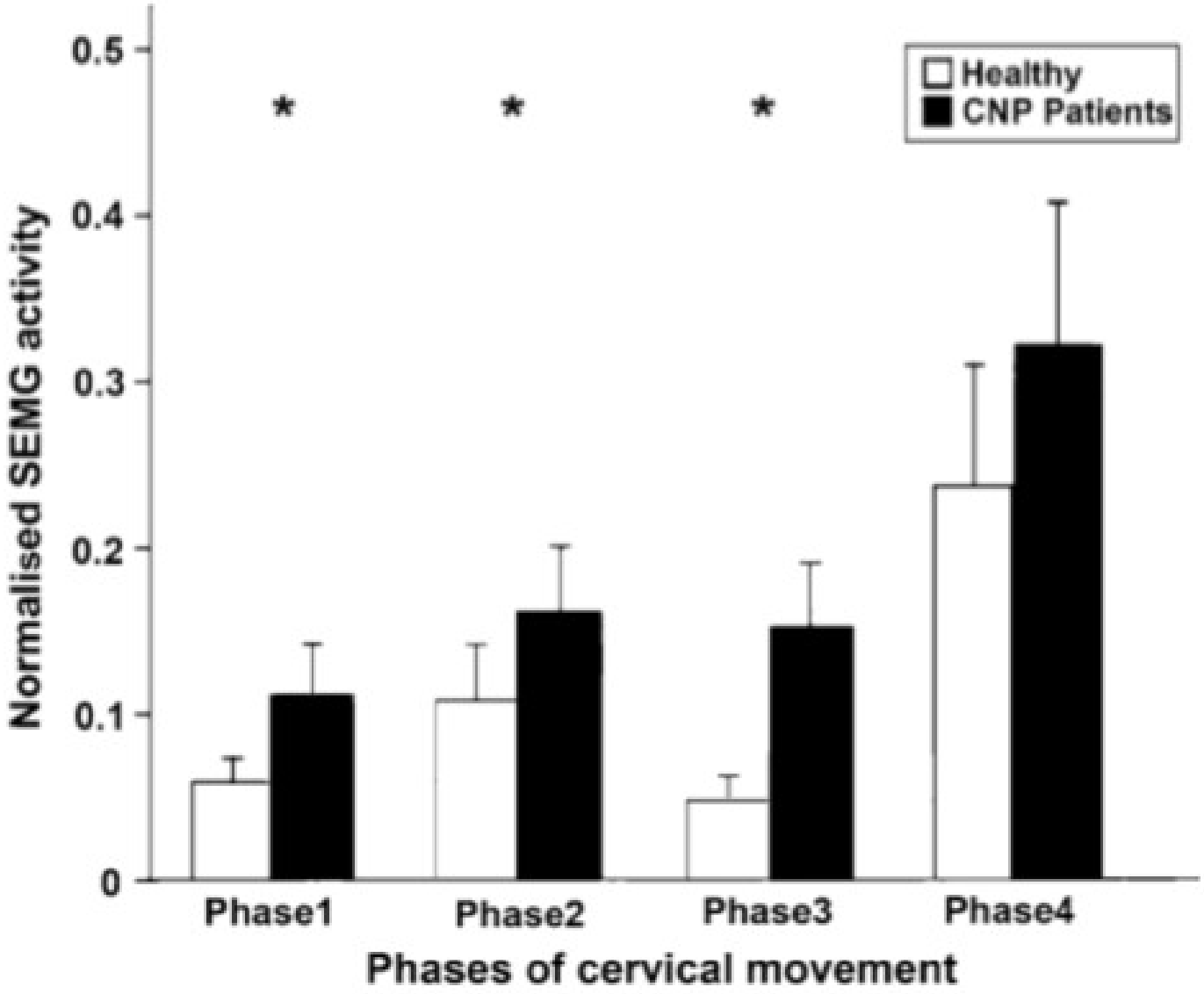



**Fig. 3** Normalised SEMG activity of CES muscles in different phases of movement. *Phase 1* Maintain the starting position. *Phase 2* Complete cervical flexion. *Phase 3* Sustain cervical full flexion. *Phase 4* Extension with return to the starting position

Journal of Electromyography and Kinesiology 26 (2016) 8–17

Contents lists available at ScienceDirect

Journal of Electromyography and Kinesiology

journal homepage: www.elsevier.com/locate/jelekin

# Flexion–relaxation ratio in computer workers with and without chronic neck pain

Carina Ferreira Pinheiro [a,b,1], Marina Foresti dos Santos [a,c,1], Thais Cristina Chaves [a,b,d,*,1]

# Cervical Flexion-Relaxation Phenomenon

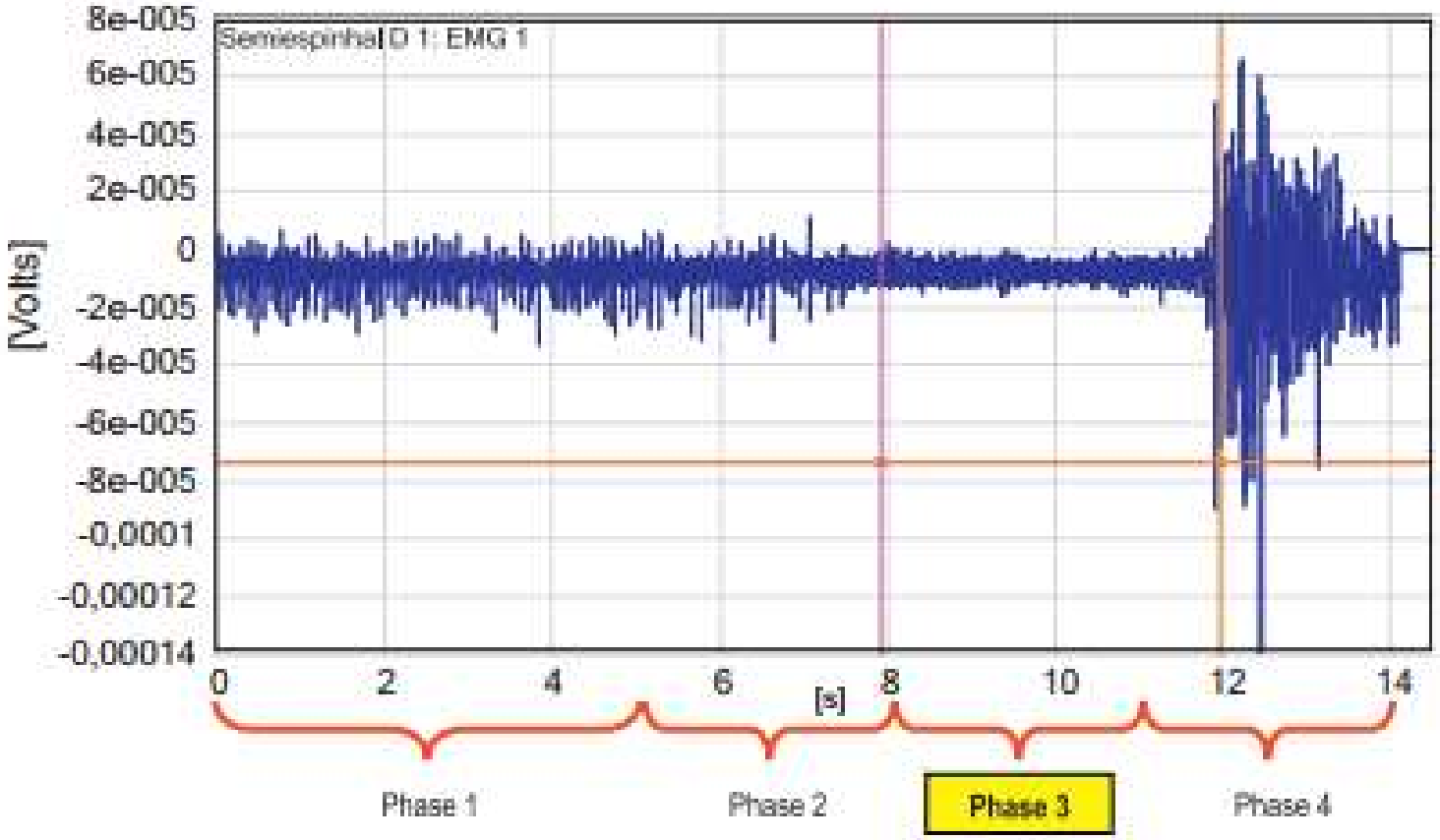



**Fig. 2.** Electromyography signal showing task phases and flexion–relaxation phenomenon during the 3-s full flexion hold phase (phase 3). Phases: Phase 1 – Rest (5 s); Phase 2 – Flexion (3 s); Phase 3 – Full Flexion (3 s); Phase 4 – Re-extension (3 s).

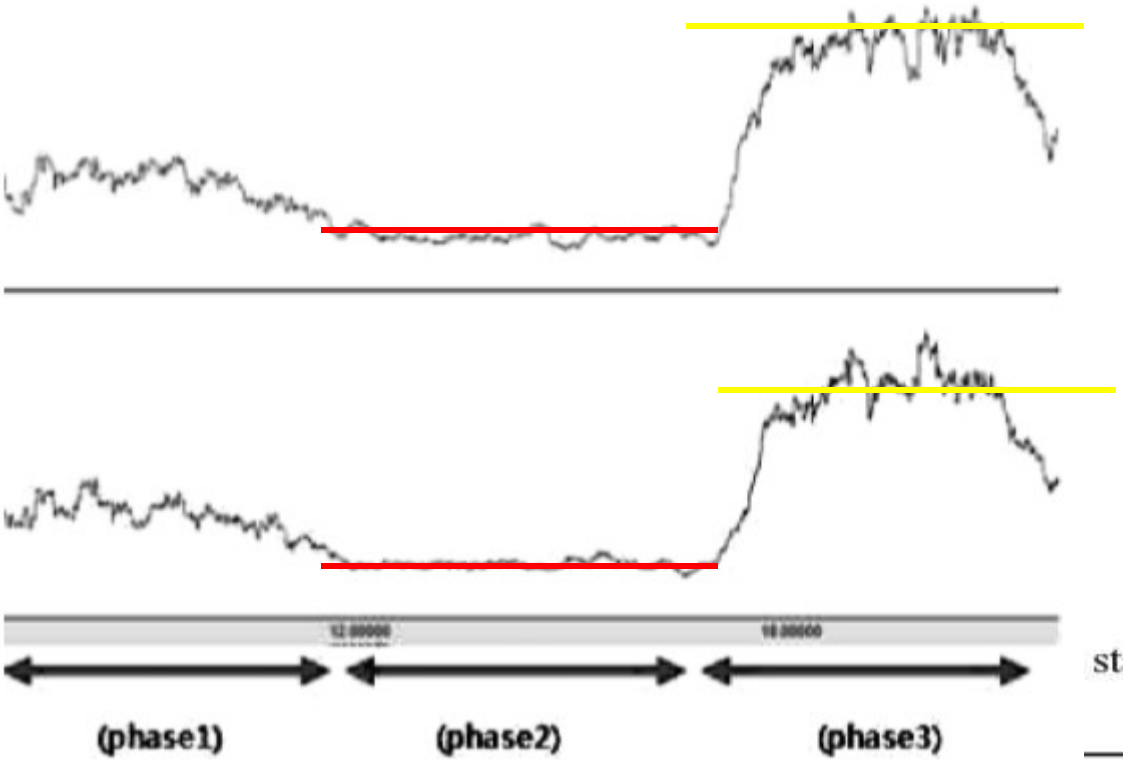
Journal of
PHYSIOLOGICAL
ANTHROPOLOGY

# Relationship between Active Cervical Range of Motion and Flexion–Relaxation Ratio in Asymptomatic Computer Workers

Won-Gyu Yoo[1], Se-Yeon Park[2] and Mi-Ra Lee[3]

1) *Department of Physical Therapy, College of Biomedical Science and Engineering, Inje University, Republic of Korea*
2) *Department of Physical Therapy, The Graduate School, Inje University, Republic of Korea*
3) *Department of Physical Therapy, Dong Rae Wooridul Hospital and Department of Physical Therapy & The Graduate School, Inje University, Republic of Korea*

- 20 asymptomatic male computer workers
- Average age 23




statistics for the active cervical range of motio

| Cervical range of motion | Mean±SD |
|---|---|
| Flexion | 59.2±12.9 |
| Extension | 68.4±8.0 |
| Right lateral flexion | 42.7±8.0 |
| Left lateral flexion | 46.6±10.1 |
| Right rotation | 64.5±10.3 |
| Left rotation | 69.3±7.9 |
| FR ratio | Mean±SD |
| Right side | 2.60±1.11 |
| Left side | 2.54±1.08 |

Original Article

# Comparison of Cervical Range of Motion and Cervical FRR between Computer Users in Their Early and Late 20s in Korea

Won-gyu Yoo[1)]

J. Phys. Ther. Sci.
26: 753–754, 2014

- Small study comparing asymptomatic computer users in early 20's vs late 20's
- The cervical FRR in the late 20s computer users (1.2±4.8) was significantly lower compared with the cervical FRR in the early 20s computer users (2.2±1.0).
- Cervical flexion (degrees) was equal between groups

Clinical Biomechanics 29 (2014) 277–282

Contents lists available at ScienceDirect

Clinical Biomechanics

journal homepage: www.elsevier.com/locate/clinbiomech

# Impact of shoulder position and fatigue on the flexion–relaxation response in cervical spine

Ashish D. Nimbarte *, Majed Zreiqat, Xiaopeng Ning

- FRP doesn't occur in shrugged shoulder position
- Induced fatigue (Sorenson protocol) causes earlier onset of FRP

# Nimbarte, et al, 2014

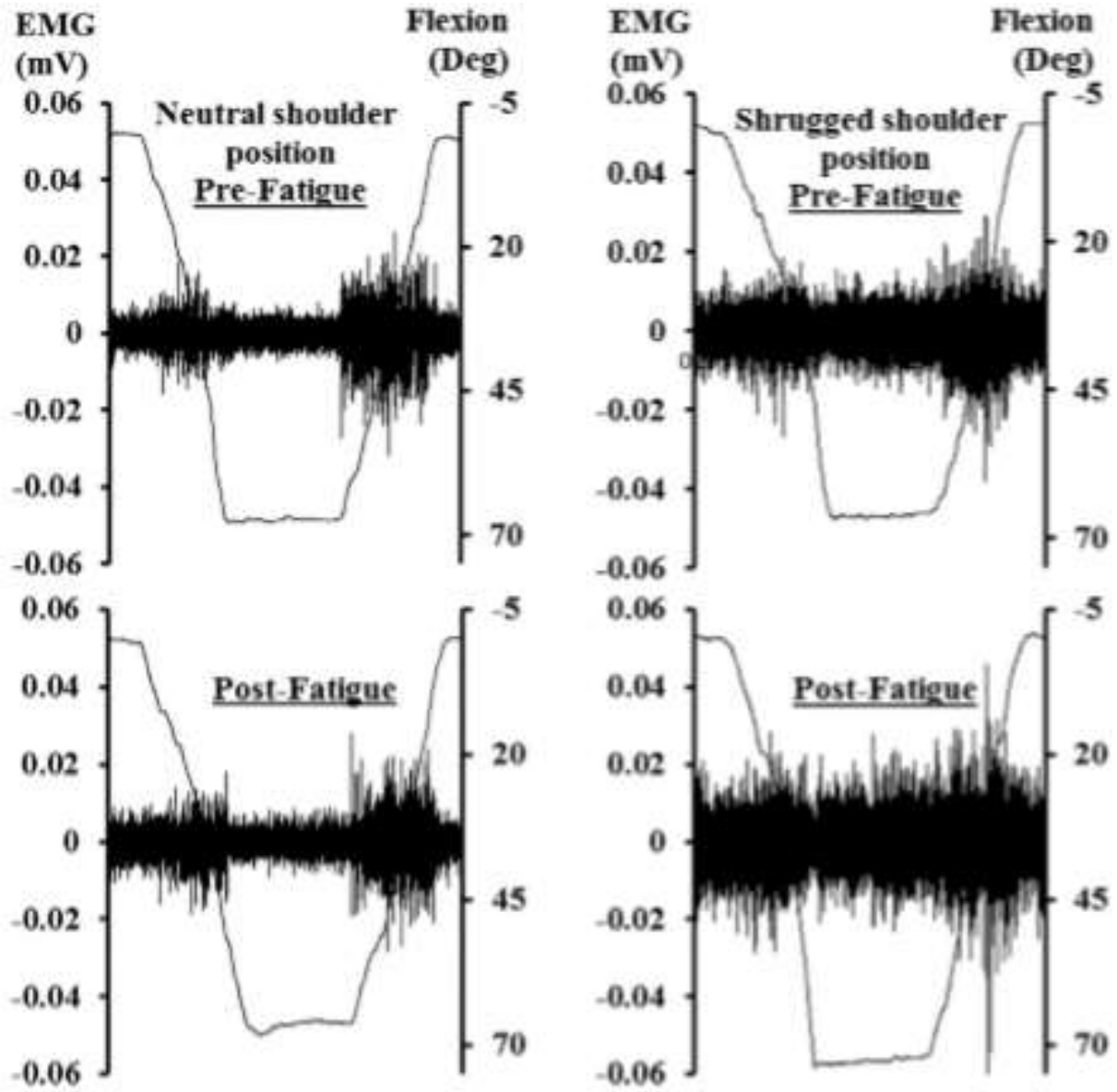



Fig. 2. Raw EMG and head flexion extension data for one of the subjects during four experimental conditions.

Pialasse *et al. BMC Musculoskeletal Disorders* 2010, **11**:46
http://www.biomedcentral.com/1471-2474/11/46

BMC
Musculoskeletal Disorders

RESEARCH ARTICLE Open Access

# Load and speed effects on the cervical flexion relaxation phenomenon

Jean-Philippe Pialasse[1,3*], Danik Lafond[1], Vincent Cantin[1], Martin Descarreaux[2]

- Studying the load and speed on cervical FRP EMG and kinematic parameters
  - 5s,3s,5s vs 2s,3s,2s
- Also assessed FRP repeatability
- Load affected FRP, speed had no effect
- Moderate to excellent repeatability for the kinematics was observed in all phases

Spine (Phila Pa 1976). 2010 Nov 15;35(24):2103-8. doi: 10.1097/BRS.0b013e3181cbc7d8.

# The cervical flexion-relaxation ratio: reproducibility and comparison between chronic neck pain patients and controls.

Murphy BA[1], Marshall PW, Taylor HH.

- 14 Chronic NP vs 14 control (no neck pain)
- Measured at baseline and 4 weeks later
- Pain gr: FRR=1.93 +/-0.8, and 1.73 +/-0.61 at 4-wks
- Pain gr: intraclass correlation coefficient (ICC) was 0.83 (95% CI 0.67–0.92)
- Control gr:  FRR=4.09 +/-1.58 at baseline and 4.27 +/-.71 on retest 4 weeks late
- Control gr: ICC was 0.89 (95% confidence interval 0.76–0.95)

Spine (Phila Pa 1976). 2010 Nov 15;35(24):2103-8. doi: 10.1097/BRS.0b013e3181cbc7d8.

# The cervical flexion-relaxation ratio: reproducibility and comparison between chronic neck pain patients and controls.

Murphy BA[1], Marshall PW, Taylor HH.

- "The cervical extensor muscles exhibit a consistent flexion-relaxation phenomenon in healthy control subjects and the measurement is **highly reproducible** when measured 4 weeks apart in both controls and chronic neck pain patients."
- "The FRR in neck pain patients is significantly higher than in control subjects suggesting that this measure may be a useful marker of altered neuromuscular function."

Journal of Chiropractic Medicine (2016) 15, 102–111

ELSEVIER

JCM JOURNAL of CHIROPRACTIC MEDICINE

www.journalchiromed.com

# Novel Electromyographic Protocols Using Axial Rotation and Cervical Flexion-Relaxation for the Assessment of Subjects With Neck Pain: A Feasibility Study

James W. DeVocht, DC, PhD [a,*], Kalyani Gudavalli, PT, MS [b], Maruti R. Gudavalli, PhD [c], Ting Xia, PhD [d]

# Devocht, et al 2016…

- Cervical FRP was conducted as reported in the literature with the participants seated, except that they started with the head fully flexed instead of being erect.
- Data were also collected with participants laying prone, starting with their head hanging over the edge of the table.
- Additional data were collected from cervical paraspinal and sternocleidomastoid (SCM) muscles while the seated participants rotated their head fully to the right and left.

# Devocht, et al 2016…

**Fig 1.** Participant performing axial rotation to the left showing the EMG electrodes attached for the right paraspinal and sternocleidomastoid muscles with the ground attached over the right clavicle.

Used MyoVision sEMG technology w/out ROM

**Fig 2.** Participant in the starting prone position for flexion-relaxation with the head over the end of the table and fully relaxed.

# Devocht, et al 2016…

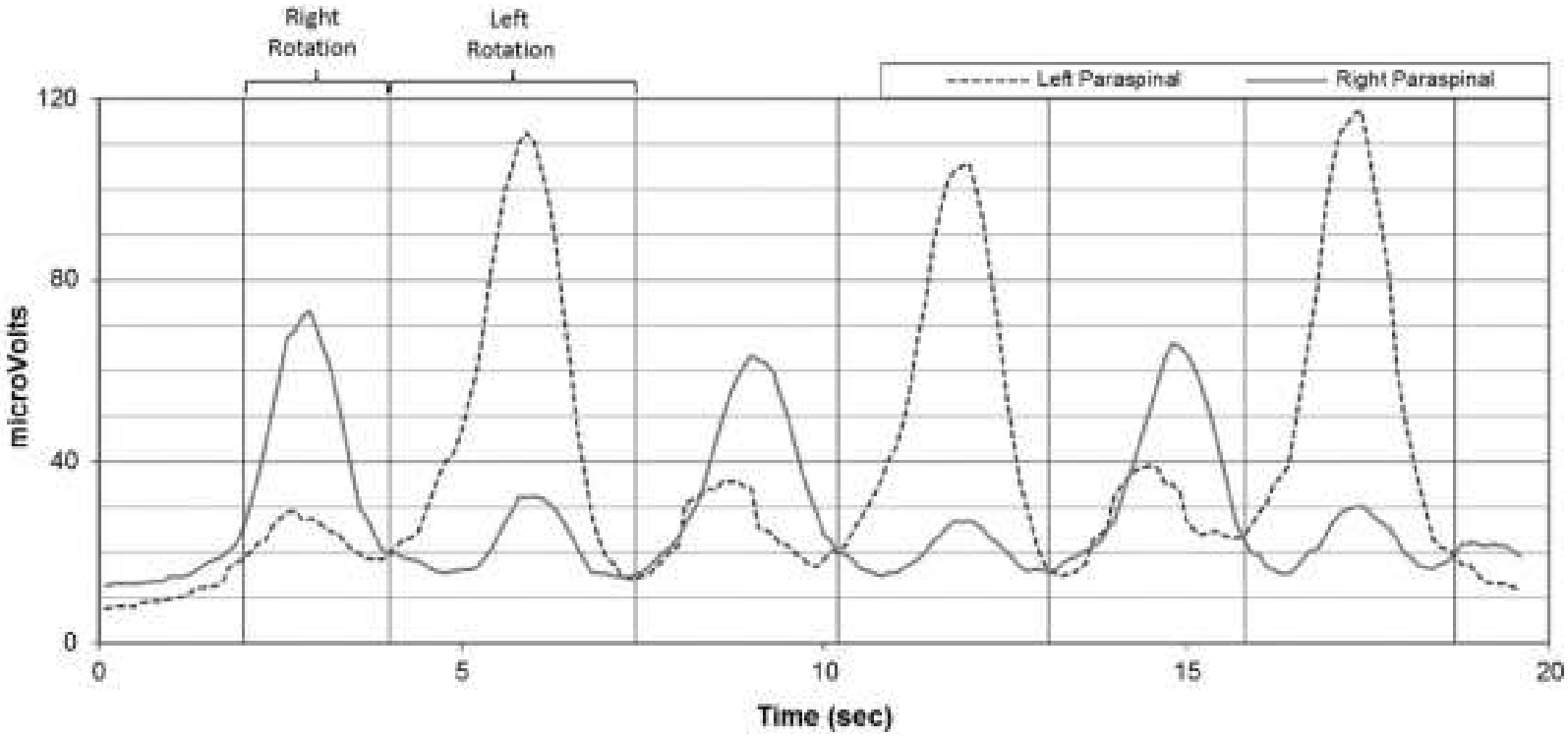



**Fig 4.** Plot of EMG data taken from the left and right cervical paraspinal muscles while performing cervical axial rotation by first rotating right and then left, repeated 3 times. The vertical lines indicate borders of regions where the maximum peak values are determined by a custom Microsoft Excel macro.

# Devocht, et al 2016…

**Table 1** Means and SDs of EMG Ratios for FRR and ARR of 4 Assessment Protocols for 5 Participants With Neck Pain (P) and 5 Controls Without Neck Pain (C)

| Method | Group | Both Sides Mean (SD) |
|---|---|---|
| FRR: sitting | C | 2.7 (1.4) |
| | P | 1.5 (0.6) |
| FRR: prone | C | 2.9 (1.0) |
| | P | 1.8 (1.0) |
| ARR: paraspinals | C | 2.6 (0.7) |
| | P | 2.0 (1.2) |
| ARR: SCMs | C | 5.4 (2.2) |
| | P | 2.6 (2.3) |

*ARR*, axial rotation ratios; *FRR*, flexion-relaxation ratio; *SCM*, sternocleidomastoid; *SD*, standard deviation.

# Coding for ROM Testing

- 1st visit using 9920x code—cannot bill for computerized ROM
- Perform visual estimation day 1… order computerized ROM w/without SEMG
- Day 2, do computerized dual inclinometry ROM w/without simultaneous SEMG (dynaROM)

# Coding for ROM Testing

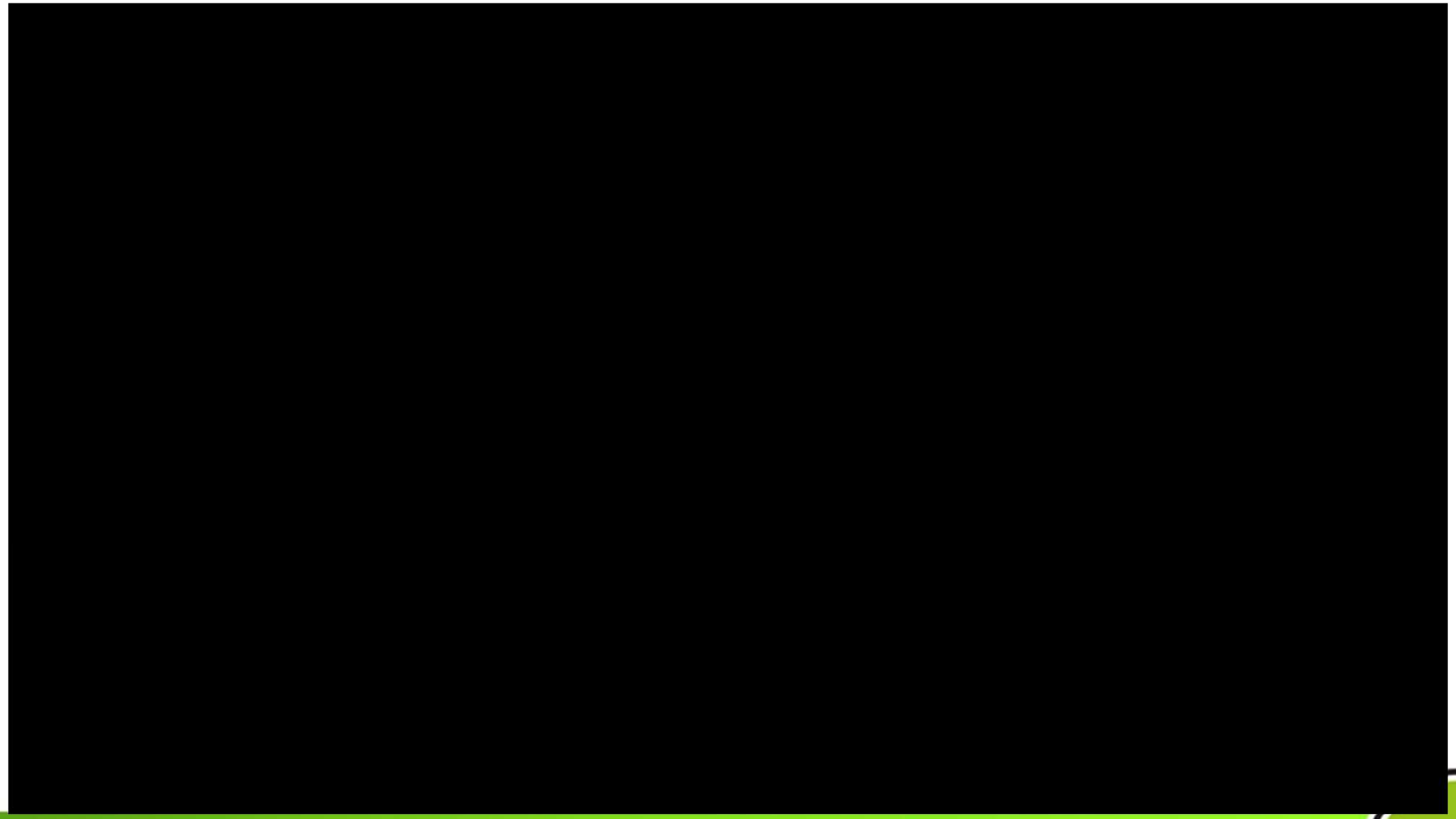
- 95851 - Range of motion measurements and report (separate procedure); each extremity (excluding hand) or each trunk section (spine)
  - 2 Units if doing cervical and lumbar regions
- 95852- Range of motion measurements, and report, hand, with or without comparison with normal side.

- If w/ E&M code, can try using modifier -25
  - CCI edits will bundle them

# Coding for SEMG

- 96002, dynamic surface electromyography, during walking or other functional activities
- 96004, Physician review and interpretation of comprehensive dynamic surface electromyography during walking or other functional activities, with written report

Why does it work so well?  WATCH CLOSELY!
Same time as ROM but with Muscle Guarding.



# Manual Muscle Testing

- Muscle testing is indicated in patients with complaints of impaired muscle performance including impairments of strength, power, or endurance.
- 95831 - Muscle testing, manual (separate procedure); with report; **extremity** (excluding hand) **or trunk**
- 95832 - Muscle testing, manual, **hand**, with or without comparison with normal side

# Physical Performance Test (97750)

- Physical Performance Test or Measurement (e.g., musculoskeletal, functional capacity) with written report, each 15 minutes.
- “Intended to focus on patient performance of a specific activity or group of activities,"
  - so it is not limited to one test, but can be a battery of functional tests specific the patient's condition and disability.

# Physical Performance Test (97750)

- Examples:
  - static back endurance, squatting, horizontal side bridge, one-leg standing, repetitive sit-up, timed up and go, Tinetti, Berg balance, Figure-of-Eight Walk Test (F8W), the Timed “Up & Go” Test (TUG), the Frailty and Injuries: Cooperative Studies of Intervention Techniques–4 (FICSIT–4) Balance Test, the Chair Rise Test (CRT), and the Jamar dynamometer.
  - requires a post-test report, along with discussion of how the results of the testing will impact the treatment plan

# Physical Performance Test (97750)

- Computerized ROM (95851 and 95852) and MMT (95831 and 95832) are considered inclusive to 97750 and cannot be billed separately.
- Must diagnosis point correctly
  - Ex// Cannot link to sprain strain
  - Should be okay within M00-M99 Diseases of the musculoskeletal system and connective tissue

# Pain Drivers

Anatomical:

- Disc
- Facets
- Endplates (Bone marrow edema changes)
  - Type 1 Modic Changes: decreased signal intensity on T1-weighted spin-echo images and increased signal intensity on T2-weighted images)
  - Type 2 Modic Changes: increased signal intensity on T1-weighted images and isointense or slightly increased signal intensity on T2-weighted images
- Muscles
- Ligaments
- Nerve Roots
- Peripheral nerves
- Spinal Cord
- Brain

# Negative MRI w/ Radicular Symptoms??

Published in final edited form as:
*Pain*. 2009 March ; 142(1-2): 59–67. doi:10.1016/j.pain.2008.11.013.

## Periganglionic inflammation elicits a distally radiating pain hypersensitivity by promoting COX-2 induction in the dorsal root ganglion

**Fumimasa Amaya**[a,b,1], **Tarek A. Samad**[a,*,1], **Lee Barrett**[a], **Daniel C. Broom**[a], and **Clifford J. Woolf**[a]

[a] Neural Plasticity Research Group, Department of Anesthesia and Critical Care, Massachusetts General Hospital and Harvard Medical School, USA

[b] Department of Anesthesiology, Kyoto Prefectural University of Medicine, Japan

"periganglionic inflammation increases cytokine levels, including IL-1 β, leading to the transcription of COX-2 and prostaglandin production in the affected DRG, and thereby to the development of a dermatomally distributed pain hypersensitivity"

Published in final edited form as:
*J Pain*. 2016 September ; 17(9 Suppl): T50–T69. doi:10.1016/j.jpain.2016.03.001.

# Towards a mechanism-based approach to pain diagnosis

**Daniel Vardeh**[1], **Richard J Mannion**[2], and **Clifford J Woolf**[3]

[1] Division of Pain Neurology, Dept. of Neurology and Anesthesia, Brigham and Women's Hospital and Harvard Medical School, Boston, MA.

[2] Dept. of Academic Neurosurgery, Cambridge University Hospitals NHS Trust, Hills Rd, Cambridge, UK CB2 0QQ.

[3] FM Kirby Neurobiology Center, Boston Children's Hospital and Harvard Medical School, Boston, MA.

## 4 States of Chronic Pain

1. Nociceptive: activation of nociceptors (high threshold primary sensory neurons) by intense mechanical stimuli
2. Inflammatory: hypersensitivity-either sterile or pathogen-driven
3. Neuropathic: damage to the nervous system
4. Dysfunctional/Centralization: abnormal pain amplification within the CNS

# Structural Outcomes: X-ray, Posture, Pathology

## Structural Outcomes:

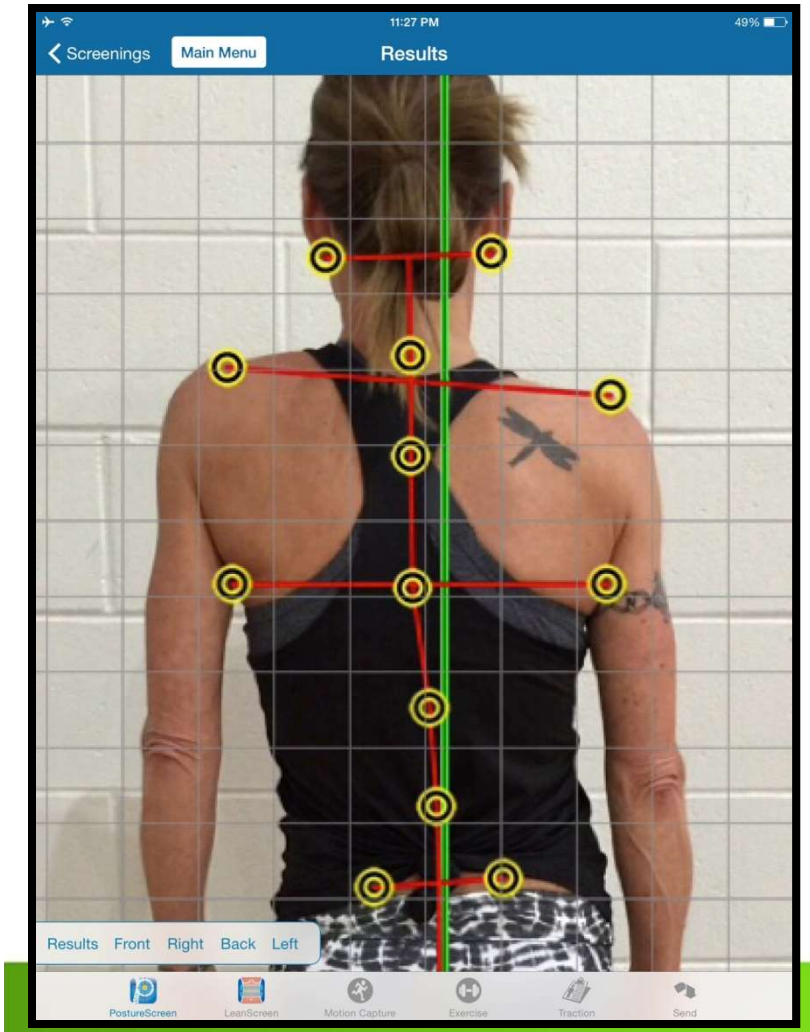
- X-ray for Biomechanical Assessment of Subluxation
  - Qualitative (PRS) vs. Quantitative (mm or deg.)
  - See PCCRP Textbook
- Posture—Qualitative vs. Quantitative
- Surface or Moiré topography
- Scoliometer
- Flexicurve, spinal mouse—Reliable and Valid??

# Structural Outcomes: X-ray, Posture, Pathology

**Six Types of Biomechanical Subluxation on X-ray:**

1. Segmental displacements of a functional spinal unit:
   - 6 Rotations & 6 Translations
2. Abnormal postural rotations and translations in 3 DOF with associated normal coupling patterns
3. Snap-Through buckling in the sagittal plane: cervical kyphosis, S-Curves, etc… (can be induced through "whiplash" mechanism of injury)
4. Euler buckling compression, flexion overload/injury
5. Scoliosis deformities
6. Dynamic ligamentous instability (e.g. flex/ext, or APOM lateral flexion films) preferably DMX

Not just for spinal screening. . . . True clinical documentation with follow up examination documentation for practice.

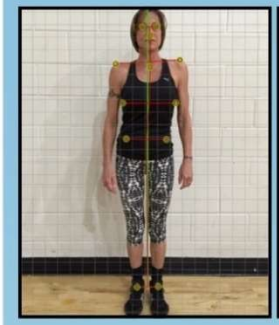



YOUR LOGO GOES HERE

PostureScreen Mobile™
Accurate Postural Assessment

**Exam for Kelly Ferrantelli performed on 10/25/14**

**Anterior View**

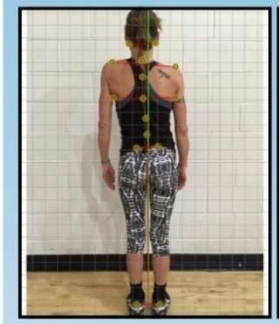


**Right Lateral View**

**Posture Displacements**

| Body Region | Anterior Translations | Anterior Angulations | Lateral Translations | Lateral Angulations |
|---|---|---|---|---|
| Head | 0.19" right | 1.3° right | 3.73" anterior | 27.96° anterior |
| Shoulder | 0.24" left | 3.6° right | 2.50" posterior | 5.82° posterior |
| Ribcage | 0.68" left | n/a | n/a | n/a |
| Hip/Pelvis | 0.31" right | 1.0° left | 1.58" anterior | 6.29° anterior |
| Knee | n/a | n/a | 2.16" anterior | 8.02° anterior |
| Total | 2.46" | 5.0° | 9.97" | 36.5° |

**Posterior View**



**Left Lateral View**

**Posture Displacements**

| Body Region | Posterior Translations | Posterior Angulations | Lateral Translations | Lateral Angulations |
|---|---|---|---|---|
| Head | 0.40" left | 1.5° left | 2.31" anterior | 21.27° anterior |
| Shoulder | 0.02" left | 4.1° right | 1.67" posterior | 3.83° posterior |
| Ribcage | 0.73" left | n/a | n/a | n/a |
| Hip/Pelvis | 0.23" right | 3.9° left | 0.47" anterior | 1.84° anterior |
| Knee | n/a | n/a | 2.16" anterior | 8.06° anterior |
| T1-T4 | 0.02" left | 0° | n/a | n/a |
| T4-T8 | 0.08" left | 0° | n/a | n/a |
| T8-T12 | 0.64" left | 8.0° left | n/a | n/a |
| T12-L3 | 0.28" left | 4.3° left | n/a | n/a |
| L3-Mid PSIS | 0.30" left | 1.5° left | n/a | n/a |
| Total | 2.70" | 23.3° | 6.62" | 27.3° |

0 1 2 **3** 4 5 6 7 8 9 10

3 - Slight pain, Starting To Interfere With Daily Living Tasks

Estimated Effective Head Weight secondary to head vs. shoulder posture is 15.4 lbs instead of 9.0 lbs

**CLIENT NOTES**
Initial examination

**Averaged Lateral Postural Displacements**

| | Head | Shoulder | Hip/Pelvis | Knee |
|---|---|---|---|---|
| Lateral Translations | 3.02" anterior | 2.09" posterior | 1.03" anterior | 2.16" anterior |
| Lateral Angulations | 24.61° anterior | 4.83° posterior | 4.06° anterior | 8.04° anterior |

# PostureScreen Mobile

J. Phys. Ther. Sci. 28: 3398–3402, 2016

The Journal of Physical Therapy Science

Original Article

## Inter- and intra-rater agreement of static posture analysis using a mobile application

David M. Boland, DPT[1], Eric V. Neufeld, BS[1], Jack Ruddell, BS[1], Brett A. Dolezal, PhD[1]*, Christopher B. Cooper, MD[1]

[1] *Exercise Physiology Research Laboratory, Departments of Medicine and Physiology, David Geffen School of Medicine at the University of California, Los Angeles: 10833 Le Conte Ave, Los Angeles, California, USA*

# PostureScreen Mobile

- 10 subjects, 3 examiners (1 DPT, 2 undergrads) photos taken
- 3 sets of photos taken on 2 separate visits
  - 1st w/ normal clothes, 2nd w/ minimal clothed (both no shoes), 3rd 48 hrs later (min clothed)
  - Inter-rater agreement of the fully clothed exam was at least substantial (ICC>0.60), but very good for head postures
  - Acceptable levels of agreement were found among the measurements of three different examiners of varying experience.

**Perceptive Outcomes**: Pain, Disability and Health-Related Quality of Life Measures

# 6 Classes of Outcome Assessment Instruments:

1. Pain perception
2. Condition-specific
3. General health
4. Disability prediction
5. Psychometric
6. Patient satisfaction instruments

ICA Guides: www.icabestpractices.org

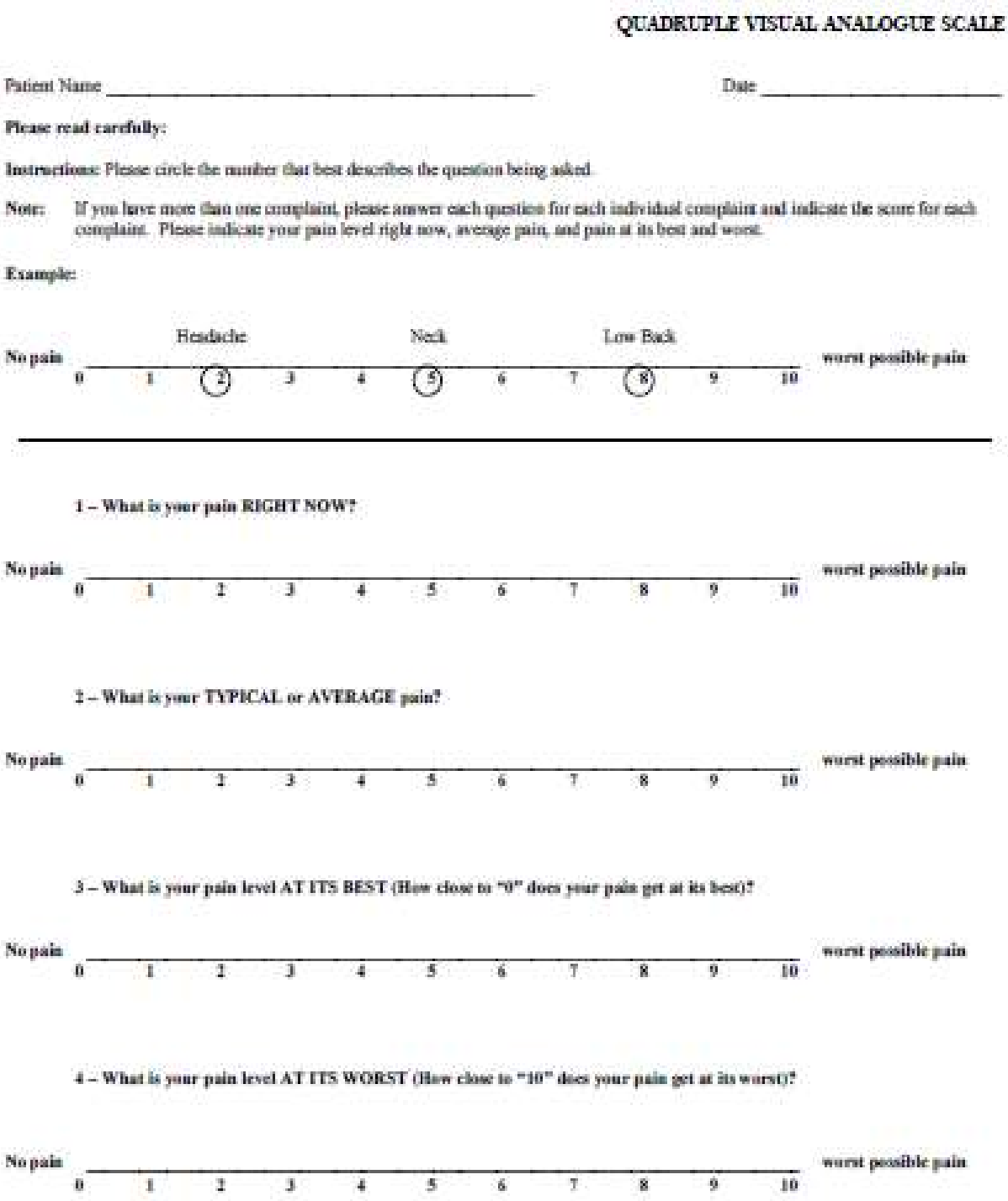
# MVC Important Outcome Assessment Questionnaires

- Numerical Rating Scale,
- Quadruple Visual Analog Scale,
- Neck Disability Index Questionnaire,
- Oswestry Disability Index Questionnaire,
- Roland Morris Disability Questionnaire,
- SF-36 Health Status Questionnaire,
- Whiplash Disability Questionnaire,

# Quad VAS

Pain is reported:

1. Right Now
2. Average
3. At its Best
4. At its Worst



QUADRUPLE VISUAL ANALOGUE SCALE

Patient Name _____ Date _____

**Please read carefully:**

**Instructions:** Please circle the number that best describes the question being asked.

**Note:** If you have more than one complaint, please answer each question for each individual complaint and indicate the score for each complaint. Please indicate your pain level right now, average pain, and pain at its best and worst.

**Example:**

Headache Neck Low Back

No pain 0 1 (2) 3 4 (5) 6 7 (8) 9 10 worst possible pain

**1 – What is your pain RIGHT NOW?**

No pain 0 1 2 3 4 5 6 7 8 9 10 worst possible pain

**2 – What is your TYPICAL or AVERAGE pain?**

No pain 0 1 2 3 4 5 6 7 8 9 10 worst possible pain

**3 – What is your pain level AT ITS BEST (How close to "0" does your pain get at its best)?**

No pain 0 1 2 3 4 5 6 7 8 9 10 worst possible pain

**4 – What is your pain level AT ITS WORST (How close to "10" does your pain get at its worst)?**

No pain 0 1 2 3 4 5 6 7 8 9 10 worst possible pain

Spine (Phila Pa 1976). 2004 Jan 15;29(2):182-8.

# Characterization of acute whiplash-associated disorders.

Sterling M[1], Jull G, Vicenzino B, Kenardy J.

80 whiplash subjects (WAD II or III) within 1 mo of injury, and 20 control subjects

- Motor function (cervical range of movement [ROM],
- joint position error [JPE];
- activity of the superficial neck flexors [EMG] during a test of cranio-cervical flexion),
- quantitative sensory testing (pressure, thermal pain thresholds, and responses to the brachial plexus provocation test),
- and psychological distress (GHQ-28, TAMPA, IES)

Conclusions: “Acute whiplash subjects with higher levels of pain and disability were distinguished by sensory hypersensitivity to a variety of stimuli, suggestive of central nervous system sensitization occurring soon after injury. These responses occurred independently of psychological distress. These findings may be important for the differential diagnosis of acute whiplash injury and could be one reason why those with higher initial pain and disability demonstrate a poorer outcome.”

# McGill Pain Questionnaire

# Pain Rating Index (PRI)

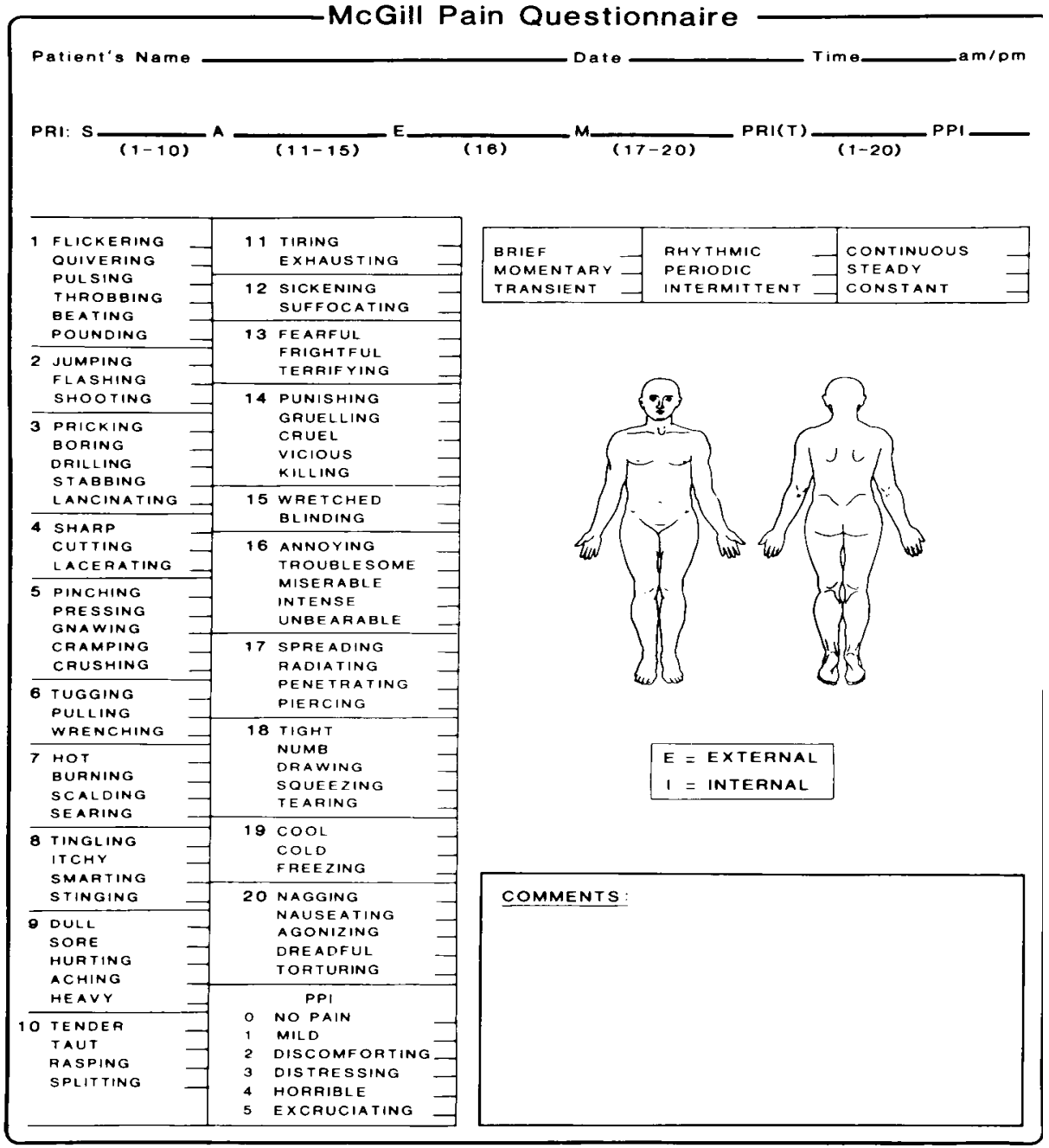



**FIG. 2.** McGill Pain Questionnaire. The descriptors fall into four major groups: sensory, 1 to 10; affective, 11 to 15; evaluative, 16; and miscellaneous, 17 to 20. The rank value for each descriptor is based on its position in the word set. The sum of the rank values is the pain rating

# The association between neck pain, the Neck Disability Index and cervical ranges of motion: a narrative review

J Can Chiropr Assoc 2011; 55(3)

Journal of the Canadian Chiropractic Association

Emily R. Howell, BPHE (Hons), DC*

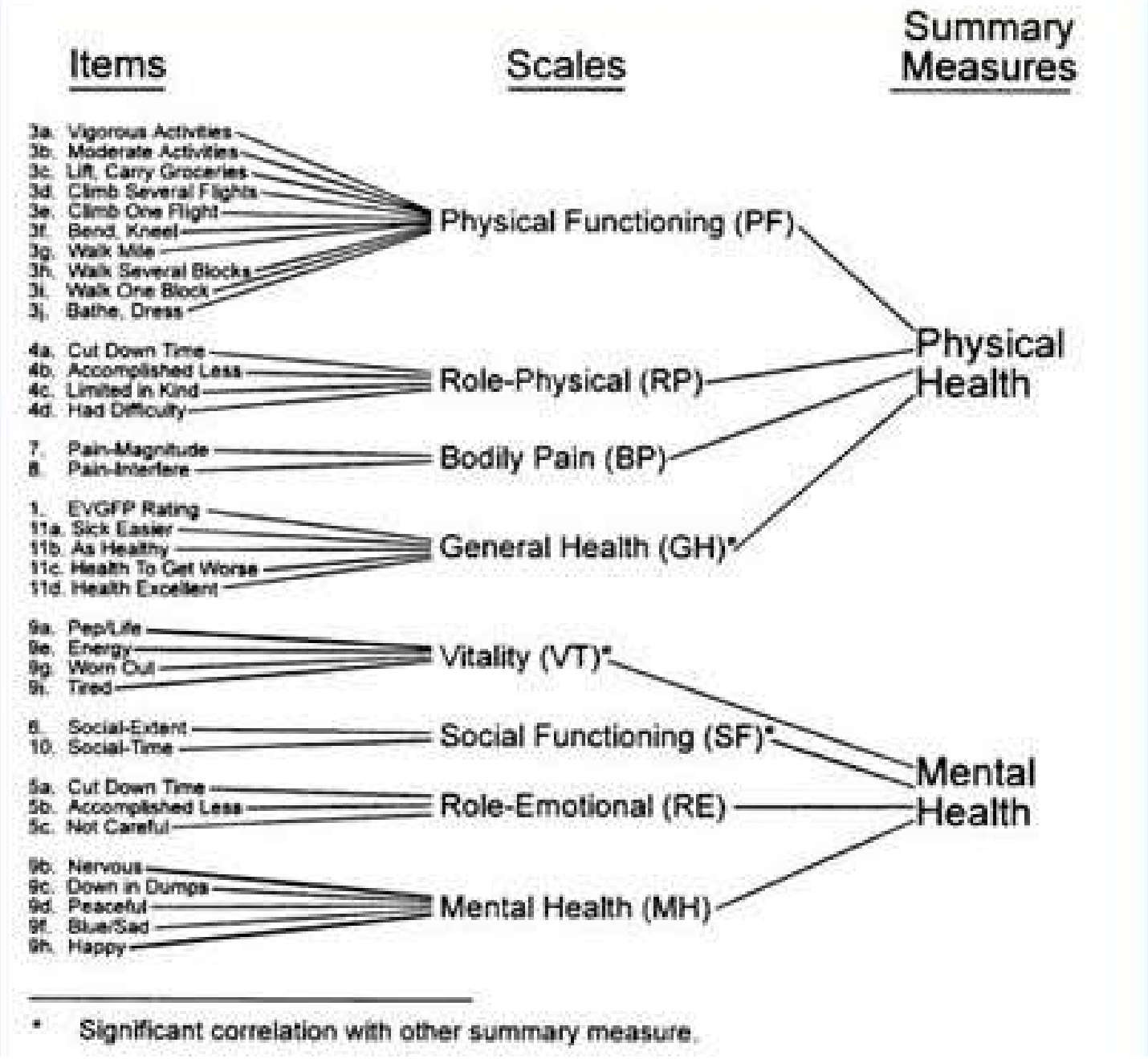
Table 3 *NDI and whiplash*

| Study | Design strength | Design limit | Measure | Results |
|---|---|---|---|---|
| Vernon 2008 | 41 NDI and WAD studies Review | Review done by NDI author himself (could have some bias) | NDI | NDI most widely used and strongly validated self-rated disability measure for neck pain; best outcome predictor (especially of longer term physiological dysfunction and physical impairment) |
| Kaale et al 2005 | N = 92 chronic grade 2 WAD patients & 30 controls | Controls were being treated by physical therapist for other conditions (not specified); controls slightly older than WAD patients. | MRI , NDI | Transverse ligament and posterior atlanto-occipital membrane lesions relate to NDI scores. |
| Pereira et al 2008 | N= 30 WAD and 30 controls Case control study | WAD patients older, had more driving experience, had higher composite driving tasks scores and used more assistance with driving than controls; measures were taken in laboratory and not in real driving context; | NDI, GHQ-28, IES-R, TSK, DHQ, CROM (with Fastrak), cervical joint position sense, smoother pursuit neck torsion test | WAD had CROM deficits (more so in flexion, extension and rotation); moderate correlation between driving task scores and pain and disability levels |
| Stewart et al 2007 | N = 132 chronic WAD patients Cohort study | Baseline and 6 weeks follow-up measurement (after 12 session of exercise program); used diary (not supervised exercise). | NDI, pain intensity, bothersomeness, SF-36, PSFS, FRS, Copenhagen Scale, SF-36 physical summary | NDI and other region-specific measures no more responsive than other general disability measures; region-specific measures are easy to administer and score and are relevant to neck pain population |
| Vernon et al 2009 | N = 107 chronic WAD Cross-sectional correlation design | Pain and disability status of sample higher than previous studies; referral bias of obtaining subjects; no-fault insurance system jurisdiction; | NDI, TSK, pain VAS, pain diagram. | Fear avoidance beliefs and pain amplification have some moderate influence on self-reported disability (and NDI scores) in WAD subjects; Pain diagram correlates with NDI scores |

# Whiplash Disability Questionnaire

- The Whiplash Disability Questionnaire (WDQ) (Pinfold et al 2004) is a 13-item questionnaire designed to measure disability caused by whiplash associated disorders (WAD).
- Clinicians can be 90% confident that a change of at least 15 points over a one month period is not due to measurement error.

# SF-36 Outcome Assessment Questionnair



# SF-36 Health Status Questionnaire

Rebbeck T, et al. A prospective cohort study of health outcomes following whiplash associated disorders in an Australian population. Inj Prev 2006;12(2):93-98.

- **WAD subjects at 3 months, 6 months, 2-years administered the SF-36 and Functional Rating Index**
- **Only 50% recovered at 2 year follow-up, Mental Health important.**

Gun RT, et al. Risk factors for prolonged disability after whiplash injury: a prospective study. Spine 2005;15(30):386-391.

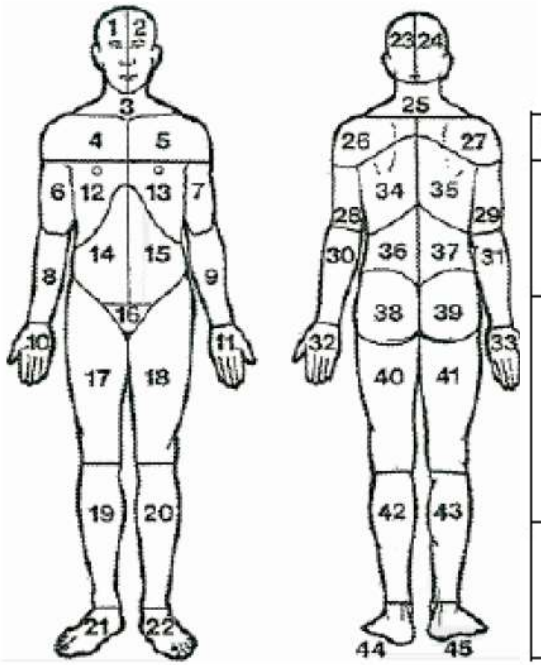
- **147 acute WAD, 135 received a 1 year follow-up.**
- **SF-36 & pain scales: Bodily pain & role emotional predicted outcomes.**

# Perceptive Outcomes

## Pain Perception: Location, Quality, Intensity

**Location:**

Figure 2.
Pain diagram depicting the body region method of scoring described by Margolis et al. (Reprinted, with permission, from Margolis RB, Tait RC, Krause SJ. Pain 1986;24:57– 65.13
Copyright © 1986 by Elsevier Science.)




**Quality: Achy, sharp, stabbing, etc vs. The McGill Pain Questionnaire developed by Dr. Melzack at McGill University**

**Intensity:**

| Pain Intensity Instrument | Description |
|---|---|
| *Verbal Rating Scale (VRS)* | Patients read over a list of adjectives describing levels of pain intensity and choose the word or phrase that best describes their level of pain. (0-3 score, 3=worst). |
| *Visual Analog Scale (VAS)* | Patients place a mark on a 10 cm line (on paper, or using a mechanical device), with ends labeled as the extremes of pain (10=worst), to denote their level of pain intensity. A quantifiable score is derived from millimetric measurement (0-100). |
| *Numerical Rating Scale (NRS)* | Patients verbally (or using a pencil) rate their pain from 0-10 (11-point scale), 0-20 (21-point scale), or 0-100 (101-point scale) to rate their pain intensity (highest score worst). |

# Examination

Hancock MJ, Maher CG, Latimer J, Spindler MF, McAuley JH, Laslett M, Bogduk N. Systematic review of tests to identify the disc, SIJ or facet joint as the source of low back pain. Eur Spine J. 2007; 16:1539–1550.

Examination procedures do not reliably find pain drivers

Pain becomes chronic and widespread after central amplification due to increased excitation and reduced inhibition in central nociceptive circuits

# Chronic Pain

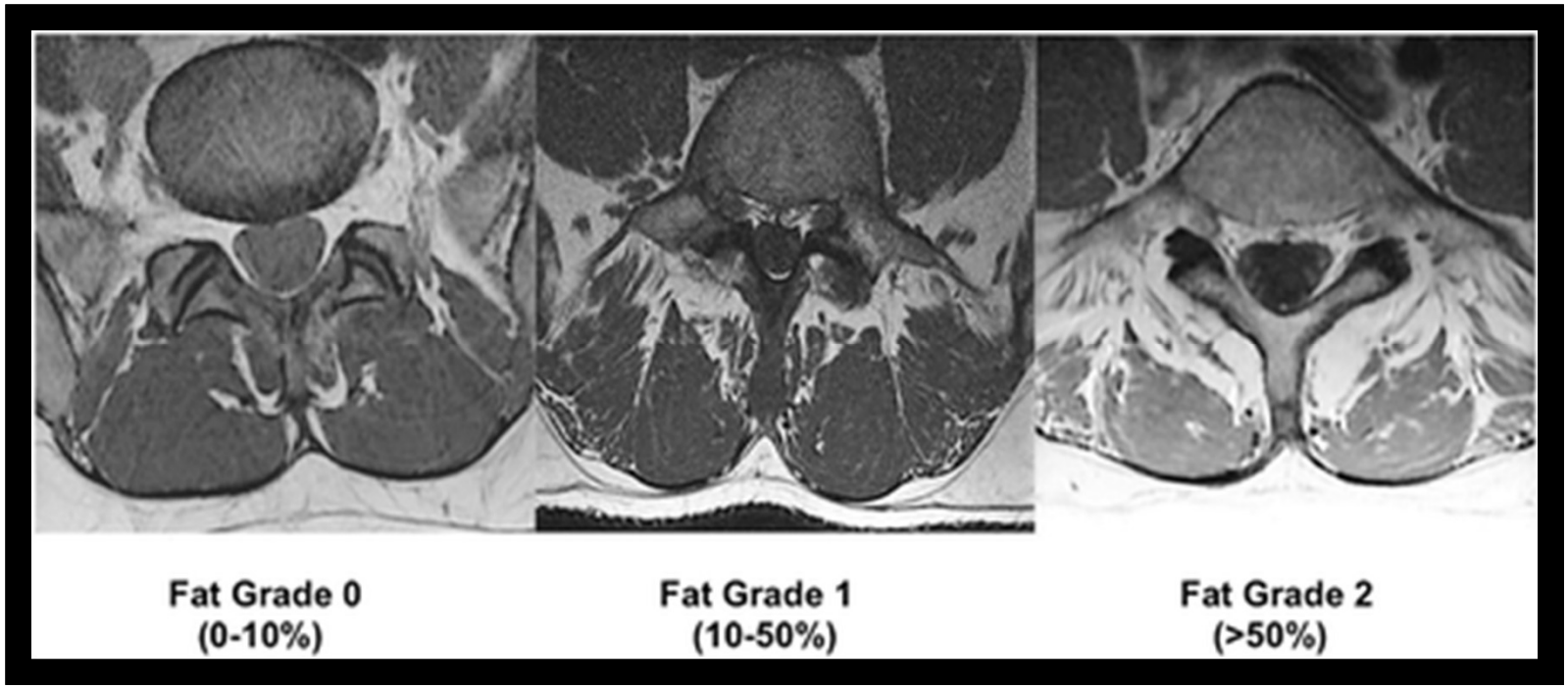
- “central sensitization” is an umbrella term comprising a multitude of different mechanisms taking place in the dorsal horn of the spinal cord, ascending and descending pathways in the dorsal column, the brainstem and pain centers in the forebrain, all leading ultimately to amplification of innocuous and painful stimuli and to the extension of receptive fields

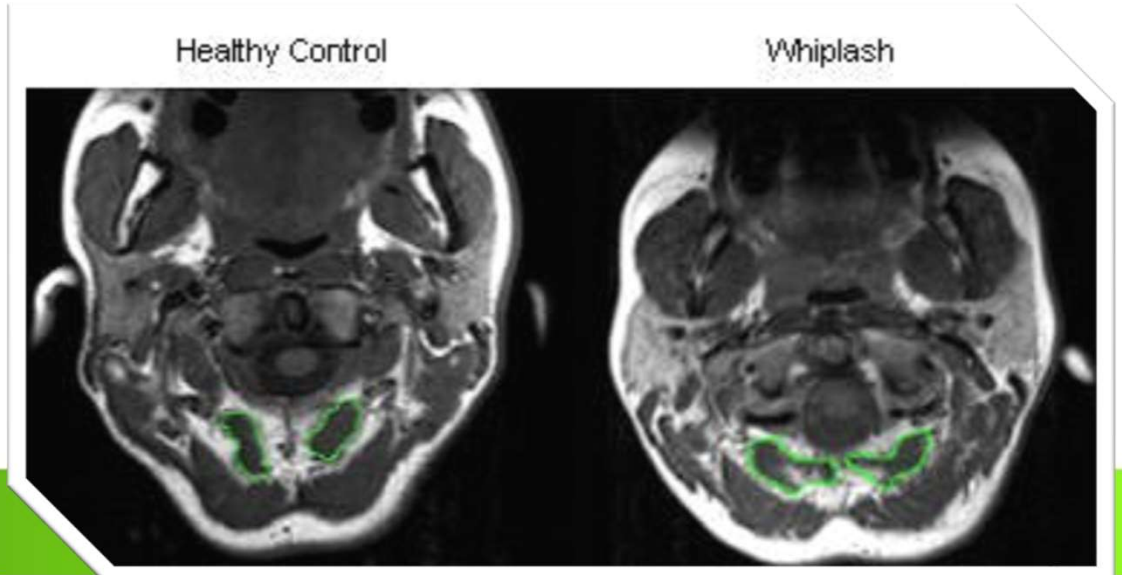
# Chronic WAD: Muscular Fatty Infiltration

J Back Musculoskelet Rehabil. 2017 Nov 6;30(6):1209-1214. doi: 10.3233/BMR-150506.

- Development of muscle fat infiltration (MFI) in the neck muscles is associated with poor functional recovery following whiplash injury.
- MRI multifidus

# Muscular Fatty Infiltration



# Re-Examination--Assessment of Findings

- All Goals set forth in initial Assessment should measurable/quantifiable.
- If goals (% improvement) are not met, explain WHY.
    - Then explain IF you will change the type of treatment, order tests, refer out, etc…
    - Don’t keep doing the same thing, expecting different results
- Make statement regarding “Maximum Medical Improvement”, and whether the patient has reached “Pre-Injury Status”

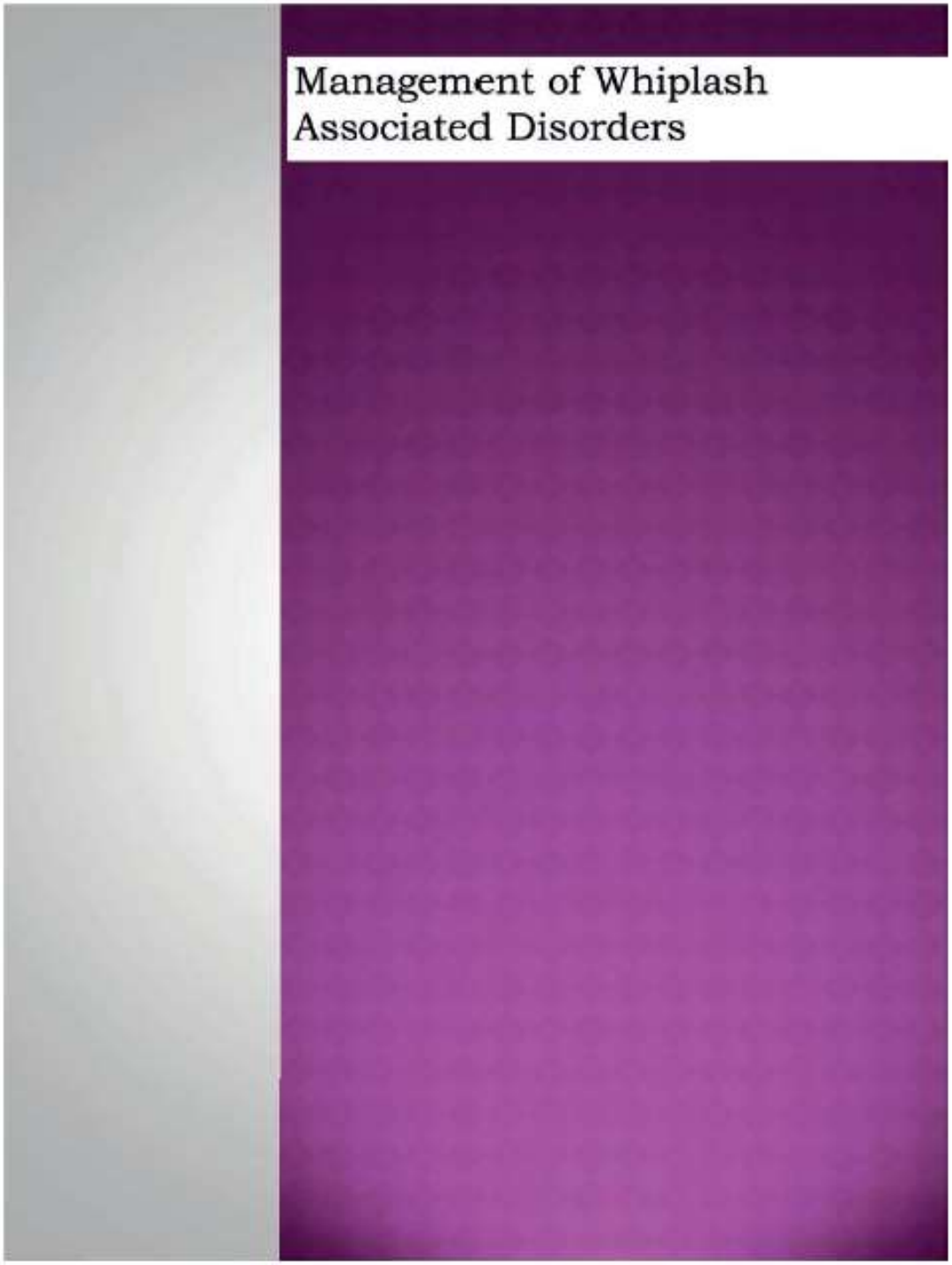
# MMI

**Maximum Medical Improvement**: “Condition is well stabilized and unlikely to change substantially in the next year, with or without treatment.”

American Medical Association. *Guides to the Evaluation of Permanent Impairment,* Chicago, Ill: American Medical Association

# Whiplash Guidelines

1. "Croft Guidelines" (6 tables from the 12th chapter of his text Whiplash Injuries: The Cervical Acceleration/ Deceleration Syndrome: 2001)
2. International Chiropractors Association of California. Management of whiplash associated disorders. 2nd Ed. 2014
3. Quebec Task Force on Whiplash-Associated Disorders. 1999 (comprised of a cohort study, a best evidence synthesis and consensus recommendations)
   - Canadian Chiropractic Association and the Canadian Federation of Chiropractic Regulatory and Education Accrediting Boards, Clinical Practice Guidelines Development Initiative (The **CCA•CFCREAB-CPG**). Practice Guide for the Management of Whiplash-Associated Disorders in Adults. June 2010. http://www.chiropractic.ca/wp-content/uploads/2013/12/whiplashpracticeguide2010_eng.compressed.pdf
4. Australian Guidelines: "Clinical guidelines for best practice management of acute and chronic whiplash-associated disorders" 2001
   - Updated 2007: http://www.maa.nsw.gov.au/default.aspx?MenuID=115

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# WAD Frequency and Duration Parameters: *ICA Best Practices*

**Table 13**
**Some of the few Historical papers that Report Frequency and Duration for Whiplash Victims.**[323-331]

| Year | Author | Duration | Frequency |
|---|---|---|---|
| 1953 | Billig | Several Months | 3X/day, Then 3X/wk |
| 1958 | Seletz | N/A | Start Early, Daily 2-3 wks, Then 3X/wk |
| 1978 | Jackson | N/A | Daily 1-2 wks, Then 3X/wk |
| 1986 | Ameis | Mild: up to 6 mo<br>Mod: 6mo-3 yrs | NR |
| 1990 | Gargan | 2 yrs | NR |
| 1992 | Mercy Document | Uncomplicated: 16 wks<br><br>Complicated: 24 –32 wks | Daily for 2 wks, Then 3X/wk for 4 wks, Then 2X/wk for 10 wks = 42 visits<br>1.5 or 2X the uncomplicated frequency |
| 1994 | Schofferman | 2 mo – 2 yr 1 mo<br>Mean: 7mo 1 wk | NR |
| 1994 | Barnsley | 3 mo – 2 yrs | NR |
| 2005 | Tomlinson | 3 mo – 2 yrs | NR |

# WAD Frequency and Duration Parameters: *ICA Best Practices*

ICA Best Practices and Practice Guidelines adopted much of the "Croft Guidelines"

Based partially upon the stages of tissue repair

**Table 14**

**Repair Time and Stages of Repair**

| Stage | Stage Description | Healing Time |
|---|---|---|
| I | acute inflammatory stage | 0 - 72 hours; |
| II | repair stage | 72 hours - 14 weeks; |
| III | remodeling stage | 14 weeks - 12 months or more |
| IV | chronic; permanent | |

# WAD Frequency and Duration Parameters: *ICA Best Practices*

## Croft Guidelines (continued)

**Table 15**
**Croft's Grades of Injury**[333]

| Grades | Severity | Anatomical and Clinical Description |
|---|---|---|
| I | minimal | no limitation of range of motion, no ligamentous injury, no neurological symptoms |
| II | slight | limitation of range of motion, no ligamentous injury, no neurological findings |
| III | moderate | limitation of range of motion, some ligamentous injury, neurological findings present |
| IV | moderate to severe | limitation of range of motion, ligamentous instability, neurological findings present, fracture or disc derangement |
| V | severe | requires surgical treatment and stabilization. |

# WAD Frequency and Duration Parameters: *ICA Best Practices*

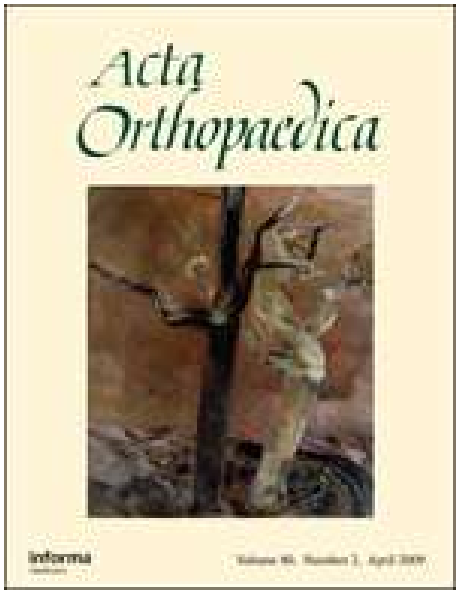
## Croft Guidelines (continued)

**Table 16**
**Croft's Frequency & Duration Table for the Different Grades of MVA Injury[333]**

| Grade | Daily | 3x/wk | 2x/wk | 1x/wk | 1x/mo | Duration | # visits | ICA Equivalent |
|---|---|---|---|---|---|---|---|---|
| Grade I | 1 wk | 1-2 wk | 2-3 wk | > 4 wk | ----* | > 10 wk | > 21 | #1C |
| Grade II | 1 wk | > 4 wk | > 4 wk | > 4 wk | > 4 mo | > 29 wk | > 33 | #2C |
| Grade III | 1-2 wk | > 10 wk | > 10 wk | > 10 wk | > 6 mo | > 56 wk | > 76 | #6C |
| Grade IV | 2-3 wk | > 16 wk | > 12 wk | > 20 wk | ** | ** | ** | |
| Grade V | Surgical stabilization necessary - chiropractic care is post surgical | | | | | | | |

**may require permanent monthly or permanent palliative care

Hildingsson C, Toolanen G. Outcome after soft-tissue injury of the cervical spine. A prospective study of 93 car-accident victims. Acta Orthop Scand. 1990 Aug;61(4):357-9.




“At follow-up, on an average 2 years after the accident, 42 percent had recovered completely, 15 percent had minor discomfort, and 43 percent had discomfort sufficient to interfere with their capacity for work.”

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# Expectations for Recovery Important in the Prognosis of Whiplash Injuries

Lena W. Holm[1*], Linda J. Carroll[2,3], J. David Cassidy[4,5], Eva Skillgate[6], Anders Ahlbom[1,7]

May 2008 | Volume 5 | Issue 5 | e105

"Expectations for recovery were measured with a numerical rating scale (NRS 0–10) where the respondents were asked to *rate how likely it was that he/she would have a complete recovery*. The anchors were labeled 'not likely' (0) and 'very likely' (10)"

- After controlling for severity of physical and mental symptoms, individuals who stated that they were ***less*** likely to make a full recovery (NRS 0-5), were ***more*** likely to have a high disability compared to individuals who stated that they were very likely to make a full recovery (odds ratio [OR] 4.2 [95% confidence interval (CI) 2.1 to 8.5].
- For the intermediate category (NRS 6-9), the OR was 2.1 (95% CI 1.2 to 3.2).

Associations between expectations and disability were also found among individuals with moderate disability.

# Risk Factors: ICA Best Practices Chapter 11, Table 7

**Table 7**

**The patient may present with pain, but with some of the complications listed below. Complicating factors may include these conditions, but are not limited to these.**

1. <5 yrs at same employer
2. Abnormal joint motion
3. Abnormal Posture
4. Absolute cervical spinal canal stenosis (10-12 mm)
5. Advanced age
6. Asymmetry of muscle tone
7. Cervical Kyphosis
8. Compression fracture
9. Condition chronicity
10. Congenital fused cervical segments
11. Dens fracture
12. Emotional stress
13. Employment satisfaction
14. Ergonomic factors
15. Expectations of recovery
16. Facet fracture
17. Falling as a mechanism of prior injury
18. Family/relationship stress
19. Fixated segment on flexion/extension films
20. Increased spine flexibility
21. Laterolisthesis
22. Leg length inequality
23. Leg pain greater than back pain
24. Level of fitness
25. Likely mechanical tissue damage
26. Loss of cervical lordosis
27. Loss of consciousness after trauma
28. Lower wage employment
29. Lumbar Kyphosis
30. Managing Named Diseases (eg., MS, Chrones Disease, Asthma, etc)
31. NRS $\geq$ 7.0
32. Obesity
33. One-sided sports/exercise activity
34. Osteoarthritis
35. Pain with radicular signs/symptoms
36. Physical limitations (can't exercise, can't walk, wheelchair, etc)
37. poor body mechanics
38. Poor spinal motor control
39. Pre-existing degenerative joint disease
40. Prior recent injury (<6 mos.)
41. Prior surgery in area of complaint
42. Prolonged static postures
43. Reduced muscle endurance
44. Relative cervical spinal canal stenosis (13-15 mm)
45. Retrolisthesis
46. Rheumatoid arthritis
47. Scoliosis (define: 10° or more?)
48. Smoking
49. Spinal Anomaly
50. Spondylolisthesis/spondylolysis
51. Surgically fused cervical segments
52. Sustained (frequent/continuous) trunk load > 20 lbs.
53. Traumatic causation
54. Wearing high heel shoes
55. Work-related duties

# WAD Frequency and Duration Parameters: *ICA Best Practices*

## Croft Guidelines (continued)

**Table 17**
**Croft's List of Complicating Factors**

1. Advance Age
2. Disc protrusion/herniation
3. Prior vertebral facture
4. Metabolic disorders
5. Spondylosis and/or facet arthrosis
6. Osteoporosis or bone disease
7. Congenital anomalies of the spine
8. Arthritis of the spine Spinal or foraminal stenosis
9. Development anomalies of the spine
10. AS or other spondylarthropathy
11. Paraplegia/tetraplegia
12. Degenerative disc disease
13. Prior cervical or lumbar spine surgery
14. Prior spinal injury; scoliosis

JOSPT Journal of Orthopaedic & Sports Physical Therapy

# Risk factors for persistent problems following acute whiplash injury: update of a systematic review and meta-analysis.

Walton DM, et al. J Orthop Sports Phys Ther. 2013 Feb;43(2):31-43. doi: 10.2519/jospt.2013.4507. Epub 2013 Jan 14.

The significant variables included:
- high baseline pain intensity (greater than 5.5/10)
- report of headache at inception
- less than postsecondary education
- no seatbelt in use during the accident
- report of low back pain at inception,
- high Neck Disability Index score (greater than 14.5/50)
- preinjury neck pain
- report of neck pain at inception (regardless of intensity)
- high catastrophizing
- female sex
- WAD grade 2 or 3, and
- WAD grade 3 alone.

PAIN® 154 (2013) 2198–2206

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# Derivation of a clinical prediction rule to identify both chronic moderate/ severe disability and full recovery following whiplash injury

Carrie Ritchie *, Joan Hendrikz, Justin Kenardy, Michele Sterling

*Centre of National Research on Disability and Rehabilitation Medicine (CONROD), University of Queensland, Brisbane, Australia*

Premise—Recovery following a whiplash injury is varied:

- approximately 50% of individuals fully recover,
- 25% develop persistent moderate/severe pain and disability, and
- 25% experience milder levels of disability.

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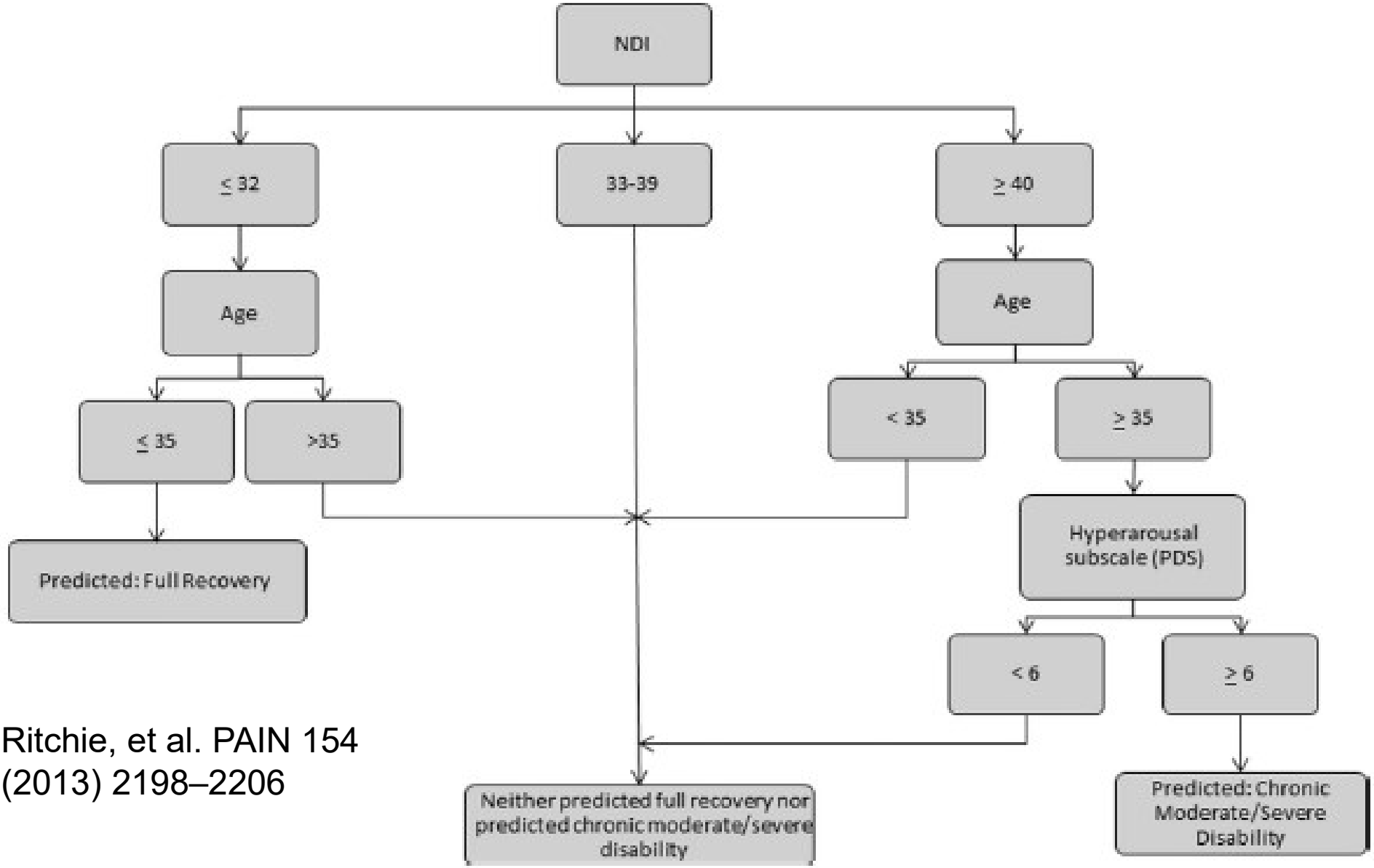
"An increased probability of developing chronic moderate/severe disability was predicted in the presence of older age and initially higher levels of NDI and hyperarousal symptoms (PDS) (positive predictive value [PPV] = 71%). The probability of full recovery was increased in younger individuals with initially lower levels of neck disability (PPV = 71%)."

# Clinical Prediction Rule




Ritchie, et al. PAIN 154 (2013) 2198–2206

Journal of
PHYSIOTHERAPY
journal homepage: www.elsevier.com/locate/jphys

Appraisal Trial Protocol

# Trauma-focused cognitive behaviour therapy and exercise for chronic whiplash: protocol of a randomised, controlled trial

Letitia Campbell [a], Justin Kenardy [b,c], Tonny Andersen [d], Leanne McGregor [a], Annick Maujean [a], Michele Sterling [a]

Several RCT's are underway looking at coordinating care with a specialist in trauma-focused behavioral therapy in combination with traditional care


THANK YOU!!