Evidence Based Manual Therapy Techniques – Theory and Clinical Application

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Professor
Franklin Pierce University

Disclosure Slide

- No relevant relationship exists.

Review of Literature

- Manipulation performed today by practitioners managing patients with complaints of musculoskeletal pain
- Increasing evidence for use in a number of musculoskeletal conditions

Mechanisms of Manual Therapy

Mechanical  Neurophysiological
Biomechanical Effects

Man Ther

Clinical Benefits

Physiologic rotation

Gapping of L4/5 facet joint in a cadaver after incision of the capsule

McFadden KD. Taylor JR. Axial rotation in the lumbar spine and


Biomechanical Evidence


Kao and Rudy, PT, DPT; Robert Lampert, SP; and Christopher M. Poppas, PT, DPT

Pre-manipulation

Post-manipulation

Biomechanical Evidence

The Effects of Side-Posture Positioning and Spinal Adjusting on the Lumbar Z Joints

A Randomized Controlled Trial With Sixty-Four Subjects

Gregory D. Gore, DC, M.A.; Douglas M. Sayger, DC, DACBR; J. Scott Pauley, DC, DACBR; Bradley E. Mallett, DC, FIC; Jack M. White, DC,* and Jon A. Gartner, DC, DACBR**

Thoracic Spine Manipulation in Individuals With Subacromial Impingement Syndrome Does Not Immediately Alter Thoracic Spine Kinematics, Thoracic Excursion, or Scapular Kinematics: A Randomized Controlled Trial
Results

Neurophysiological

Peripheral Nervous System
Spinal Cord Mech
Supraspinal Mech

Spinal Manipulative Therapy Reduces Inflammatory Cytokines but Not Substance P Production in Normal Subjects

64 Asymptomatic Subjects

Manip
Sham
Venipuncture

Macrophage

Mast cell

Nitric oxide

Dopamine

No Change

TLR-4
CD-14
IL-1β

CD-10
LPS/LBP

Endothelial cells

IL-6

Spinal Mechanisms

Peripheral Mechanisms

Spinal Manipulative Therapy

Inflammatory Cytokines

Substance P Production

Normal Subjects

Clinical Therapy

Pre-SMT
Post-SMT
Pre-Sham
Post-Sham

Scapular Elevation
Scapular Depression
Neurophysiological Evidence
Spinal cord (Imaging)

- Injection causes activation primarily in dorsal horn of spinal cord
- Less activation in rats given knee mobilizations

First Pain Response: A-delta

Temporal Summation: C-fiber
Pain Response

Temporal Summation: C-fiber

Spinal Manipulative Therapy Has an Immediate Effect on Thermal Pain Sensitivity in People With Low Back Pain: A Randomized Controlled Trial

Joel E. Bilsky, Mark D. Bishop, Michael E. Robinson, George Zepponi Jr., Steven Z. George

36 Subjects with LBP

Temporal Summation: C-fiber

Manual Therapy

Immediate changes in pressure pain sensitivity after thoracic spinal manipulative therapy in patients with subacromial impingement syndrome: A randomized controlled study

Joseph R. Kainuma 1, Scott W. Shaffer 1, Peter E. Nielsen 1, Wensheng Z. Tan 2, Seth A. Cleatham 1, L. A. Michler 1
Results

Global Rating of Change

Neurophysiological

Peripheral Nervous System
Spinal Cord Mech
Supraspinal Mech

Methods

Using Functional Magnetic Resonance Imaging to Determine if Cerebral Hemodynamic Responses to Pain Change Following Thoracic Spine Thrust Manipulation in Healthy Individuals

Techniques

NPRS
Mean difference between pre-test and post-test indicating increased areas of activation prior to manipulation. (A-B)

Using fMRI to determine if cerebral hemodynamic responses to pain change following thoracic thrust manipulation in individuals with neck pain: A randomized trial

Sparks, Cleland, Elliot, et al, In Review.

Volunteers with mechanical neck pain (n=24)

Sham manipulation (n=12)
3 MRI scans during the delivery of mechanical stimuli administered at a frequency of 1 Hz for 10 consecutive on/off cycles (5 minutes) to the hand and foot.
Administration of 11-point NPRS
Supine HVLA thrust to midthoracic spine
3 MRI scans during the delivery of mechanical stimuli administered at a frequency of 1 Hz for 10 consecutive on/off cycles (5 minutes) to the hand and foot.
Administration of 11-point NPRS

Thrust manipulation (n=12)
3 MRI scans during the delivery of mechanical stimuli administered at a frequency of 1 Hz for 10 consecutive on/off cycles (5 minutes) to the hand and foot.
Administration of 11-point NPRS

Results

P < .05, Z > 2.3

The Real Results- 9:15am tomorrow
ACC 303 D

Using fmri to determine if cerebral hemodynamic responses to pain change following thoracic spine manipulation in individuals with mechanical neck pain

Speaker: Cheryl Sparks, PT, PhD, OCS, FAAOMPT

What about Placebo and Expectation?
Patients that expected manual therapy would help had better outcomes with manual therapy!

Patient Expectations of Benefit From Interventions for Neck Pain and Resulting Influence on Outcomes

Clinical Implications

Slide courtesy of Joel Bialosky

Neurophysiologic Effects

James Lind’s Treatise of the Scurvy (1753)

Is Manual Therapy Effective in the Management of Shoulder Pain?
Interventions

First 6 wks:
- CSI - up to 2 injections, 4 wks
- Community PT - 8 x 20" appt, 6 wks
  - “Best current evidence and current practice for pain relief and mobilisation for shoulder problems"
  - Minimum – advice/instruction, active shoulder exercises, HEP
  - Additional – US (49%), manual therapy (74%)

After 6 wks: any treatments indicated

Interventions

Usual Medical Care (UMC)
- Advice/information, therapy
- NSAIDS/analgesics & CSIs

Manipulative Therapy (MT) + UMC
- MT to neck, tx-spine & ribs, ≤ 6 sessions (in 12 wks)

Bergman et al, Annals of Internal Medicine, 2004

Results

12, 26, 52 Wks:
- “Full Recovery” – MT+UMC > UMC
- Severity of main complaint & disability – MT+UMC > UMC

Other interventions
- UMC: 28% CSI; 27% PT
- MT+UMC: 25% CSI; 23% PT; 3.8 MT visits

Bergman et al, Annals of Internal Medicine, 2004
Conclusion

Context
Shoulder pain in the absence of trauma, fracture, rupture, or dislocation can lead to substantial functional limitations and can be a difficult condition to treat.

Contribution
In this randomized, controlled trial, patients with shoulder pain and shoulder girdle dysfunction assigned to receive manipulative therapy in addition to usual general practitioner care had more rapid improvement in symptoms and fewer shoulder symptoms at 12 weeks than patients assigned to usual care alone.

Implications
Manipulative therapy appears to be an effective treatment option for patients with shoulder pain and shoulder girdle dysfunction that are not due to trauma, fracture, rupture, or dislocation.

—The Editors

Subjects

• Multicenter Randomized Controlled Trial
• n=140 participants; primary complaint shoulder pain

MT+EX Manual Therapy Techniques

Range of Motion Exercises MT+EX and EX Alone Groups

• 10 Repetitions each side; 3-4 times/daily
• Maintain usual activity within limits of pain

Exercise Program

• Protocol adopted from Tate et al. (JOSPT 2010)
• MT+EX and EX Alone Groups (visits 3-8)
• Three phases
  o Strengthening
  o Scapular stabilization
  o Flexibility
• Progression through phases
  o Patient performs 3 sets of 10 repetitions
  o Resistive band (yellow<red<green<blue)
  o (-) significant pain or fatigue with red band

Cervicothoracic Manual Therapy Plus Exercise versus Exercise Alone in the Management of Individuals with Shoulder Pain: A Multi-Center Randomized Controlled Trial

Mintken, McDevitt, Cleland, Boyles, Beardslee, Burns, Haberl, Binder, Michener

In Review
Flexibility

- 3 Repetitions; 30 seconds; once daily
- Maintain usual activity within limits of pain

Exercise Program Phase 1

Exercise Program Phase 2

Exercise Program Phase 3

Continuation of Phase 2 with above additions

SPADI

Pain (NPRS)
Global Rating of Change

Patient Acceptable Symptom State

- Considering all the different ways your disease is affecting you, if you would stay in this state for the next months, do you consider that your current state is satisfactory?

Patient Acceptable Symptom State

Discussion

- The addition of cervicothoracic MT to an evidence-based exercise program did not significantly improve pain or disability in individuals with shoulder pain, but seemed to provide a patient-perceived benefit.
TREATMENT: SUBACROMIAL CORTICOSTEROID INJECTIONS

The following dose represents a glucocorticoid potency of 400 hydrocortisone equivalents/injection (mg).

- **Location:** Subacromial space
- **Syringe:** 10mL
- **Needle:** 25 gauge, 1.5 inch
- **Anesthetic:** 7mL of 1% lidocaine
- **Corticosteroid:** 1.0-2.0 mL Triamcinolone Acetonide (Kenalog), 40 mg/mL

TREATMENT
MANUAL PHYSICAL THERAPY

- Impairment-based approach
  - Included treatment to glenohumeral, acromioclavicular, and scapulo-thoracic joints in shoulder and cervical/thoracic spine.
- Total of 6 treatment sessions over a 3-week period
there is limited evidence to support the effectiveness of both manual and exercise therapy in combination"

“No clear evidence to suggest additional benefits of MT to other interventions."

“Manual therapy appears to increase either active or passive mobility of the shoulder. A trend was found favoring manual therapy for decreasing pain, but the effect on function and quality of life remains inconclusive”

“Inconclusive evidence to support for rotator cuff pain, but still a favorable recommendation because of the low risk.

“Fair evidence for MMT of the shoulder, shoulder girdle, and/or the FK combined with multimodal or exercise therapy for rotator cuff injuries/disorders, disease, or dysfunction”
Results

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Pre-Test</th>
<th>Post-Test</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manual Therapy</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Exercise</td>
<td></td>
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<tr>
<td>Manual Therapy and Exercise</td>
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</table>

Summary

- Manual therapy plus exercise!
- Use sound clinical decision making!
- Test-retest!
- Use examination procedures that are reliable and relevant!
- Consider biomechanical PLUS neurophysiological effects of manual therapy!

Thanks!

clelandj@franklinpierce.edu
Exercise selection in scapular rehabilitation in patients with rotator cuff pathology: an update on current evidence

Role of the scapula in normal shoulder function

Scapular dyskinesis in relation to shoulder pain

Normal scapular movement and muscle recruitment patterns

Abnormal muscle recruitment patterns in patients with shoulder pain in superficial muscles
Abnormal muscle recruitment patterns in patients with shoulder pain in deeper muscles (Castelein et al. Under revision Man Ther 2016)

Muscle Population Scaption Towel wall slide Elevation with ER P-value

UT
Healthy controls
SIS patients
17.7 ± 5.5
18.7 ± 7.0
14.2 ± 4.6
14.0 ± 6.5
12.3 ± 4.1
12.0 ± 8.6

MT
Healthy controls
SIS patients
11.1 ± 4.5
13.9 ± 8.9
7.4 ± 5.7
7.5 ± 4.8
21.0 ± 11.9
24.8 ± 11.5

LT
Healthy controls
SIS patients
15.7 ± 5.3
15.6 ± 7.0
9.1 ± 4.4
8.4 ± 4.7
29.3 ± 11.6
27.0 ± 11.3

SA
Healthy controls
SIS patients
28.7 ± 14.5
25.7 ± 9.5
26.8 ± 11.9
25.3 ± 11.0
20.8 ± 9.0
19.2 ± 5.2

Pm
Healthy controls
SIS patients
9.9 ± 7.6
13.0 ± 8.4
12.3 ± 9.6
17.5 ± 12.0
9.0 ± 7.6
12.8 ± 7.5

LS
Healthy controls
SIS patients
17.1 ± 11.0
18.1 ± 12.0
13.7 ± 9.7
13.3 ± 7.2
22.1 ± 17.4
24.7 ± 17.4

RM
Healthy controls
SIS patients
26.0 ± 17.8
25.3 ± 14.6
10.9 ± 4.6
11.0 ± 9.2
31.3 ± 14.0
31.1 ± 18.4

Need for a science based rehabilitation program (Cools et al. BJSM 2014)

Scapular Rehabilitation Algorithm (Cools et al. BJSM 2014)

Scapular Rehabilitation: which exercises to prescribe?

1. Focus on neuromuscular coordination: the role of conscious correction of scapular position
2. Focus on scapular muscle balance rather than muscle strength
3. Role of kinetic chain and functional (sport specific) tasks in scapular exercises

Scapular Rehabilitation: which exercises to prescribe?

1. Focus on neuromuscular coordination: relative timing of activation (De Mey et al. JOSPT 2008)
1. Focus on neuromuscular coordination: conscious correction of scapular position

(De Mey et al. JOSPT 2013)

Scapular Rehabilitation: which exercises to prescribe?

1. Focus on neuromuscular coordination: the role of conscious correction of scapular position
2. Focus on scapular muscle balance rather than muscle strength
3. Role of kinetic chain and functional (sport specific) tasks in scapular exercises

Scapular Rehabilitation Algorithm (Cools et al. BJSM 2014)

Lack of Soft tissue flexibility → Lack of Muscle performance

Scapular muscles → GH muscles/capsule → Muscle Control → Muscle Strength

- Posterior deltoid - infraspinatus - Posterior capsule (Labrum)
- Co-contraction - force couples - lower/middle trap - serratus anterior

STRETCHING & MOBILISATION
- Manual soft tissue techniques
- Manual stretching and MWM
- Home stretching

NEUROMUSCULAR COORDINATION → STRENGTH TRAINING
- Advanced control: during basic activities → Balance - ratio
- Advanced control: during sports → Endurance/strength

Focus on muscle balance rather than muscle strength

(less/more activity)

UT/SA UT/LT LS/UT Pm/LT Pm/SA

(Cools et al. AJSM 2007)

Scapular Rehabilitation: which exercises to prescribe?

1. Focus on neuromuscular coordination: the role of conscious correction of scapular position
2. Focus on scapular muscle balance rather than muscle strength
3. Role of kinetic chain and functional (sport specific) tasks in scapular exercises
2. Focus on muscle balance rather than muscle strength (Castelein et al. JOSPT 2015)

UT ↓
SA =
Lev Scap ↓

2. Focus on muscle balance rather than muscle strength: UT/LS (Castelein et al. Man Ther 2015)

2. Focus on muscle balance rather than muscle strength: SA/Pm (Castelein et al. Man Ther 2015)

Scapular Rehabilitation: which exercises to prescribe?

1. Focus on neuromuscular coordination: the role of conscious correction of scapular position
2. Focus on scapular muscle balance rather than muscle strength
3. Role of kinetic chain and functional (sport specific) tasks in scapular exercises

Scapular Rehabilitation Algorithm (Cools et al. BJSM 2014)

- Lack of Soft-tissue flexibility
- Lack of Muscle performance
- Scapular muscles
  - Pectoralis minor
  - Serratus anterior
  - Rhomboids
- Of muscle/capsule
  - Infraspinatus
  - Humeral capsule
- Muscle Control
  - Co-contraction
  - Force couples
- Muscle Strength
  - Lower/Middle trap
  - Serratus anterior

3. Role of Kinetic Chain in exercises in OPEN chain exercises (De Mey et al. JSMS 2012)
3. Role of Kinetic Chain CLOSED chain exercises (Maenhout et al. BJSM 2009)

Electromyographic analysis of knee push up plus variations: what is the influence of the kinetic chain on scapular muscle activity? (Maenhout et al. BJSM 2009)

Highest selective SA in plyometric push up

3. Role of SPORT SPECIFIC PLYOMETRIC tasks on scapular muscle recruitment (Maenhout et al. JEK 2015)

Plyometric scapular stability exercises: an EMG study to support shoulder rehabilitation and prevention programs (Maenhout et al. JEK 2015)

Highest MT-LT in prone exercises (>80% MVC)

Lowest UT in sidelying Catching exercises
Goal of the exercise:
1. UT ↓
2. MT & LT ↑
3. SA ↑ and UT ↓
4. Overall scap muscles ↑

Take home message:
choose the right exercise for your patient

1. Focus on conscious muscle recruitment in early stages of rehab
2. Choose exercises to restore muscle balance around the scapula, including the deep muscles
3. Diagonals are in favor of optimal scapular recruitment
4. Plyometrics highly challenge scapular muscle activity

Thank You
Gent, Belgium
Rotator Cuff Disease – Evidence & Expertise: Diagnosis, Exercise & Manual Therapy
February 19, 2016

Lori A Michener, PT, PhD, ATC, SCS
Professor, Division of Biokinesiology & PT

Ann Cools, PT, PhD
Associate Professor, Dept of Rehab & PT

Josh Cleland, PT, PhD
Professor, Physical Therapy Program

Course Schedule
• 8 – 8:35: Diagnosis, Impairments, Framework for Guiding Rehabilitation – Lori Michener, PT, PhD
• 8:35 – 9:10: Therapeutic Exercise – Selection and Clinical Application – Ann Cools, PT, PhD
• 9:10 – 9:45: Evidence-Based Manual Therapy Techniques: Theory and Clinical Application – Josh Cleland, PT, PhD
• Questions and Answers

RCD: Diagnosis, Impairments, and Framework for Guiding Rehabilitation
February 19, 2016

Lori A Michener, PhD, PT, ATC, SCS, FAPTA
Director of Clinical Outcomes and Research
Director – COOR Lab

Rotator Cuff Disease
Tendinopathy → Partial thickness RC tear → Full Thickness RC tear
• Tendinopathy – Subacromial Syndrome
  – Potential inflammation (Dean, 2015)
• Partial thickness RC tear
  – Articular, bursal, mid-substance
• Full-thickness RC tear
  – Complete rupture superior to inferior
  – Not necessarily side to side
  – “Hole’ in the sock

RCD/ Subacromial Impingement Syndrome
2 predominant theories

If mechanical compression is the predominant mechanism, then….
... ALL patients would benefit with an acromioplasty
• Acromioplasty did not help all patients in multiple RCTs (Brox et al; 1993, 1999; Haahr, 2005, 2006)
• Bony pathology is not the only mechanism
  ‘Impingement’ – inappropriate umbrella term.
What’s in a name….

• ‘subacromial impingement’
  – Limited support for compression mechanism
  – Perpetuates flawed reasoning & treatment
• Rotator Cuff Tendinopathy
  – Is the tendon the pain generator?
• Subacromial Pain Syndrome (SPS)
  – Allows for uncertainty of the pain generator:
    tendons, bursae, biceps, labrum, CNS, other…
  – Allows for other mechanisms

Heterogeneous pathology

• Subacromial Pain Syndrome (SPS)
• RCD - includes SPS, PT-RCT, FT-RCT

How do we diagnosis or classify for treatment?

Staged Approach for Rehab Classification

Why classify?
• Direct intervention
• Prognosis
• Communication
  – Payers
  – Research

Key features:
1- Pathology as first step
  – But, pathology is not homogenous, thus rehab treatment is not
  – Weak relationship btw pathology and pain
2- Irritability
3- Impairments

Staged Approach for Rehab Classification

Some Common Pathoanatomic Diagnoses
Recommendation: Dx Interpretation

Screen (Rule/Out)  Confirm (Rule/IN)

- Sensitivity: SnNOut
  * Sn > 80%

- Likelihood ratio (- LR)
  * - LR ≤ 0.5

- Specificity: SpPIn
  * Sp > 80%

- +Likelihood ratio (+LR)
  * +LR ≥ 2.0

Dx SA pain - Systematic Reviews

Confirm SA pain
(R/In) – single tests
1. Painful arc
2. Resisted ER (ERRT) – pain or weakness
3. Full Can
4. Drop Arm

Screen Out SA pain
(R/Out) – single tests
1. Painful arc
2. Resisted ER (ERRT) – pain or weakness
3. Hawkins
4. Neer
5. Full Can
6. Empty/ Jobe Can

Confirm FT-RCT - Syst Reviews

Confirm FT-RCT
(R/In) – single tests
1. Painful arc
2. Resisted ER – pain or weakness
3- ER lag test – supraspinatus infraspinatus
4- IR lag & Lift off subscapularis
5- Drop arm
6- Atrophy of infraspinatus
7- Belly off – Subscapularis

Screen Out FT-RCT
(R/Out) – single tests
1. Resisted ER (ERRT) – pain or weakness
2- IR lag & Lift off subscapularis
3- Empty Can
4- Full Can

Speed’s Test
- Biceps pathology / labrum / SAIS
- Resist sh. flex w/ elbow ext & forearm supinated
- +: ant/ sup shoulder pain
- NOT useful for Rin or Rout any pathology

Combo of Tests: SA Pain
3/3 tests: (Park HB, JBJS; 2005)
Hawkins, Painful arc, ER resistance (Pain/Weak)
- All 3+: +LR of 10.56
- All 3-: –LR of 0.17

3/5 tests: (Michener LA, APMP, 2009)
– Hawkins, Neer, Painful arc, Empty can, ER resistance
- If > 3+/ 5: +LR of 2.93
- If < 3+/ 5: –LR of 0.34

Dx FT-RCT - Syst Reviews

Confirm FT-RCT
(R/In) – single tests
1. Painful arc
2. Resisted ER – pain or weakness
3- ER lag test – supraspinatus infraspinatus
4- IR lag & Lift off subscapularis
5- Drop arm
6- Atrophy of infraspinatus
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Screen Out FT-RCT
(R/Out) – single tests
1. Resisted ER (ERRT) – pain or weakness
2- IR lag & Lift off subscapularis
3- Empty Can
4- Full Can
**Lift Off and Lag Test**

- Subscapularis tear
- Hand at sacrum/LB;
- Lift-off: ask pt to lift hand away from the back
- Lag: examiner positions hand off the back and asks to hold
- "+": inability to "lift off" or "lags" back

**External Rotation Lag Sign**

- Hertel, R et al, JSES, 1996
- At 0 deg abd, 90 deg elbow flex; passive ER & ask patient to hold
- "+": "lags" back to less than full ER

**Combination of Tests: ** FT- RCT

  - >65yo, ER weak (ERRT), night pain
    - All 3 +: R/In +LR: 9.84
    - All 3 -: R/Out - LR: 0.54
- Test Combo (Park HB, et al; JBJS, 2005)
  - 3 Tests: Drop arm, Painful arc, ERRT
    - All 3 tests + R/In +LR: 15.57
    - All 3 tests - R/Out - LR: 0.16

**Predictors of RCT; n=400; prospective; arthro exam gold standard (Murrell and Walton, 2001)**

<table>
<thead>
<tr>
<th>Number of positive findings:</th>
<th>Age</th>
<th>Probability of FT-RCT</th>
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<tr>
<td>1</td>
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<tr>
<td>2</td>
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<tr>
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</tr>
<tr>
<td>None</td>
<td>Any</td>
<td>5%</td>
</tr>
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</table>

**Impairments**

- Weak/motor control
- Cuff, scapula, shoulder
- Tightness-pec minor, post shoulder
- Posture- thoracic & shoulder
- Scapular humeral motion deficits
Intrinsic factors:
- Aging
- Vascularity
- Morphology
- Mechanical

Extrinsic factors:
- Strength/m. control
- Shoulder tightness
- GH joint laxity
- Posture: spine, sh
- Bony abnormalities
- Scap & GH kinematics

SA space-impingement??

Defining Irritability
- Pain intensity
- Night/rest pain
- Pain with ROM
- AROM in comparison to PROM
- Disability/Functional loss levels

<table>
<thead>
<tr>
<th>Stage of irritability</th>
<th>High</th>
<th>Moderate</th>
<th>Low</th>
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<tbody>
<tr>
<td>Pain intensity</td>
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</tr>
<tr>
<td>Fatigue</td>
<td>Moderate</td>
<td>Low</td>
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<tr>
<td>Night/rest pain</td>
<td>Low</td>
<td></td>
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<tr>
<td>Pain during ROM</td>
<td>Low</td>
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</tr>
<tr>
<td>High disability</td>
<td>Moderate</td>
<td>Low</td>
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</tr>
<tr>
<td>Moderate disability</td>
<td>Low</td>
<td></td>
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</table>

Matched Interventions

Thank you!

lmichene@usc.edu