The Patient Response Model

Implications for Mobility, Stability, and Pain Science Education

Ron Schenk PT, PhD, OCS, FAAOMPT, Dip MDT
Learning Objectives:

At the completion of this unit of study and with students review of material, the student learner will be able to:

1. Compare and contrast exercise theories and approaches of the Australian, MDT (McKenzie), and Movement System (Sarhmann) systems.

2. Analyze pathology based and kinesiopathological models in musculoskeletal physical therapy.

3. Synthesize and integrate the principles of testing repeated spinal movements, single limb and passive movements to classify patients based on patient response.

4. Analyze examination findings to arrive at a PT diagnosis and prognosis based on a patient response system.

5. Analyze research related to MDT, Treatment Based Classification (TBC) and Movement System Balance and Pain Mechanism Classification (PM).
Expert Quotes

Pathoanatomical diagnoses

• “80% of back pain is caused by weak or tense muscles.”
• “The majority of LBP actually originates in the sacral ligaments.”
• “In 50% or more...the facet joint is the site of dysfunction.”
• “90-95% of back pain is due to disks.”
• “An extremely high percentage...have fascial problems.”
• “50%-70% of chronic symptoms are psychological in origin.”
Medical Model of Disease

Signs/symptoms analyzed

Pathology is determined

Treatment corrects pathology

Signs/symptoms disappear
Pathoanatomical models

Cyriax – annular disc
McKenzie – nuclear disc
Paris – passive intervertebral motion
Nordic/osteopathic - facet
Osteopathic – fascial
Sahrmann/Kendall – muscle balance
Diagnosis vs. Classification

Diagnosis: “The process of determining the cause of a patient’s illness or discomfort”

Classification: “The process of classifying clinical data into named categories of clinical entities for the purpose of making clinical decisions regarding therapeutic management”

(Rose, 1989)
Classification Systems for Low Back Pain

Identifiable source of LBP present in <10%

Classification systems often based on anatomical (theoretical) model

No one classification system is more reliable than others (Riddle, 1998)

Certain characteristics of particular classification systems may have appropriateness based on symptom chronicity (International Classification for Functioning 2013)
Acute Low Back Problems in Adults

Bigos S et al. Agency for Health Care Policy and Research (AHCPR) 1994
Comparison of a Guideline-Based Approach versus a Classification Approach in the Treatment of Acute, Work-Related Low Back Pain

Julie M. Fritz, PT, PhD, ATC
Anthony Delitto, PT, PhD
Richard E. Erhard, PT, DC

Department of Physical Therapy
University of Pittsburgh

Patient with acute LBP

Baseline Evaluation

R

AHCPR Group

All patients treated based on AHCPR Guidelines

Classification Group

Patients receive treatment specific to classification

Low Back Pain Classifications

Manipulation

Specific Exercise

Stabilization

Traction

Classification Criteria

Classification Criteria

Classification Criteria

Classification Criteria

Manipulation and exercise

Activities to Promote Centralization

Stabilization exercises

Mechanical/auto-traction

Patient response methods

Maitland – *patient response* to passive

Movement System Balance (Sahrmann) – *patient response* to active limb movements

MDT (McKenzie)– *patient response* to repeated end range movements
“Patient response methods...

require dedicated communication between clinician and patient for clinical decisions, without necessarily requiring a pathology based diagnosis.” *Orthopaedic Manual Therapy: An Evidence Based Approach, 2nd ed. 2011.*

End Range Forces and Manual Physical Therapy

Diagnostic Properties of End range of motion (ERP)

- Exposes dysfunction (biomechanical model)
- Reduces derangement
James Cyriax MD

“Father of Orthopaedic Medicine”
Mechanical Diagnosis and Therapy (MDT)

Examination for centralization and directional preference
Mechanical Diagnosis and Therapy (MDT)

**General Misconceptions**

- Based only on symptoms
- Classification based on pathoanatomy of the lumbar intervertebral disc
- Focused on extension exercises (prone pressup)
This is not...
Lumbar Spine Examination

Subjective
Patient Functional Questionnaires
Structural exam
AROM
Repeated end range movements
Joint mobility assessment

Muscle performance
✓ Resisted
✓ MMT
✓ Endurance
✓ Muscle balance
• Neurological
• Palpation
When should we not test end range?
Hypermobility vs. Instability

- Mechanism of injury
- Level of function
- AROM weightbearing
- PIVM weightbearing vs. nonweightbearing
- Neurological tests
- Palpation
Patient Questionnaires

- Oswestry
- Fear Avoidance Beliefs Questionnaire
- Hendler 10 Minute Screening test for Chronic Low Back Pain
- Job Satisfaction
- Yellow Risk Form (YFRF)
Quantity of movement

Flexion 40-60 degrees,

Extension 20-35 degrees - double inclinometer

Lateral flexion 15-20 degrees Rotation 30 degrees (includes thoracic – standard goniometer (AMA)

Methods: Tape measure, fingertip-to-floor, double inclinometer, Modified-Modified Schober

Quality of movement
AROM

- Extension in standing
- Sidebending in standing
- Sideglide in standing
- Flexion in standing
Repeated **End Range Movements**

- Flexion in standing
- Extension in standing
- Sidegliding in standing
- Flexion in lying
- Extension in lying
Repeated end range movements


Centralization and Directional Preference

- **Centralization** - Describes the phenomenon by which limb pain emanating from the spine is progressively abolished in a distal to proximal direction in response to therapeutic loading strategies, with each progressive abolition being retained over time (lasting change).

- **Directional Preference** - Phenomenon of preference for postures/movements that decrease, abolish or centralize symptoms and often improve a limitation of movement (lasting change).
  - Mechanical change
  - Improvement in symptoms – pain or location

Directional Preference


Centralization and Directional Preference

Efficacy of MDT Approach


Efficacy of the Repeated Movement Exam


PROM

- Flexion
- Extension
- Sidebending
- Rotation

End feels firm, may be hard in rotation and lateral flexion to same side due to approximation of zygoapophyseal joints
PROM

- Passive movements
- Passive intervertebral motion
  - Flexion in sidelying
  - Extension in sidelying
  - Sidebending in sidelying
  - Sidebending in prone
  - Rotation in prone
Passive Intervertebral Motion


Grading of PIVM

- Expected mobility at each segment
- Comparison to levels above and below
- Patient’s age
- Patient’s sex
- Comparing right and left motions to one another
Passive Vertebral Pressures (Maitland)

- PACVP
- PAUVP
- TVP
- Joint mobility testing based on patient response
Resistive Isometrics and MMT

- Trunk extension
- Pelvis elevation
- Trunk flexion
- Trunk rotation

Deficits require stabilization or strengthening?
Neurological

- Dermatomes, myotomes, deep tendon reflexes, superficial and pathological reflexes
- Neural tension testing


Reliability of Rotation Syndromes

Adherence to performance training

Special Tests

- Functional testing – Functional movement screen
- Quadrant test
- Valsalva
- McKenzie SG test

- Hoover test
- Segmental mobility tests
- Compression
- Distraction
- Dural stretch and sciatic tension tests: SLR, Slump, Bowstring, Femoral nerve tension test
Adverse Neural Tension (ANTT)

Adverse neural tension is an abnormal physiological or mechanical response from the nervous system which limits the system’s range or stretch.
Basis for Adverse Neural Tension

Affects

- Improvement of vascularization
- Improvement of axoplasmic flow
- Improvement of mechanical properties of the nervous system
Sites for ANTT

- Soft tissue, osseous, or fibrosseous tunnels
- Where nervous system branches
- Where nervous system is fixed
- At points of friction
Slump Test

To assess the mobility of pain sensitive structures in the vertebral canal and intervertebral foramen

The test evaluates limitation of motion and reproduction of the patient’s symptoms (Maitland, 1979)
Slump Test

- Lumbar flexion
- Neck flexion
- Knee extension
- Foot dorsiflexion
- Neck extension
Straight Leg Raise Tests

- Neck flexion (Soto Hall)
- Dorsiflexion (tibial nerve - Braggard’s)
- Adduction
- Internal rotation (peroneal nerve tract)
- Plantarflexion/inversion (peroneal nerve tract)
- Dorsiflexion/inversion (sural nerve)
Documentation Criteria

P1  when symptoms start
P2  when symptoms occur at limit of range
R1  when resistance is first encountered
R2  when resistance stops further movement
Palpation - irritability

- Skin rolling
- Skin puckering
- Tone
- Ligamentous tenderness
- Direct palpation over nerve may produce symptoms.
- Palpation to differentiate
- Nerve tenderness
- Methods of palpation
Myofascial Restrictions

Indication for soft tissue intervention?
Evaluation – synthesis of examination findings
PT Classification


Fritz JM, Delitto A, Erhard RE. Comparison of Classification-Based Physical Therapy with Therapy Based on Clinical Practice Guidelines for Patients with Acute Low Back Pain. Spine. 2003;28(13):1363-1372
Patient Response Model

Manipulation

- Classification Criteria
  - Joint provocation indicating hypomobility

Directional preference (DIP)

- Classification Criteria
  - DIP with repeated end range testing in various planes and with differing loading strategies

Stabilization

- Classification Criteria
  - Muscle imbalance
  - Joint provocation indicating hypermobility

Traction

- Classification Criteria
  - No DIP, positive neuro

Non-thrust and Thrust Manipulation

- Postural correction
  - DIP exercise

Postural correction

- Stabilization exercises

Manual/mechanical traction
Pathoanatomical diagnosis or movement based diagnosis
Derangement
More recent derangement terminology

Central Symmetrical (previously 1,2,7)
Unilateral Asymmetrical Symptoms to Knee (previously 3,4,7)
Unilateral Asymmetrical to Below Knee (previously 5,6)

Responder?
Psychosocial


Biopsychosocial Model

Unconscious or repressed negative emotions (psychosomatic disorders)
Depression, anxiety, and anger (emotional disorders)
Conscious tendency to misinterprets or over interpret nociception (catastrophizing)
Heightened concern about pain and its source (fear avoidance)
Inability to cope with past trauma (post traumatic stress disorder)
Social and cultural factors influence illness and behavior
Readiness to change (self-efficacy)

Kolski MC, O’Connor A. A World of Hurt. 2015
Classification of Central Pain Mechanisms

Joe Lorenzetti PT, DPT, MS, FAAOMPT,
Cert. MDT, MTC
Spine Team Leader, Catholic Health System of Buffalo
Pain Classification and Chronic Pain

• Nociceptive: Inflammatory
• Nociceptive: Ischemia
• Peripheral Neurogenic
• Central sensitization
• Affective
• Motor/Autonomic

A World of Hurt  A Guide to Classifying Pain
Melissa C. Kolski and Annie O’Connor
Yellow Flag Risk Form (YFRF)

1. Please indicate your usual level of pain during the past week.
   No Pain
   | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Worst possible 10
   |   |   |   |   |   |   |   |   |   |   |  

2. Does pain, numbness, tingling, or weakness extend into your leg (from back) &/or arm (from neck)?
   None of the time
   | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | All of the time 10
   |   |   |   |   |   |   |   |   |   |   |  

3. How would you rate your general health?
   Poor
   | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Excellent 10
   |   |   |   |   |   |   |   |   |   |   |  

4. If you had to spend the rest of your life with your condition as it is right now. How would you feel about it?
   Delighted
   | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Terrible 10
   |   |   |   |   |   |   |   |   |   |   |  

5. How anxious (e.g., tense, uptight, irritable, fearful, difficulties in concentrating / relaxing) have you been feeling during the past week?
   Not at all
   | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Extremely anxious 10
   |   |   |   |   |   |   |   |   |   |   |  

6. How much have you been able to control (i.e., reduce / help) your pain / complaint on your own during the past week?
   I can reduce it
   | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | I can't reduce it at all 10
   |   |   |   |   |   |   |   |   |   |   |  

7. Please indicate how depressed (e.g., down in dumps, sad, downhearted, in low spirits, pessimistic feelings of hopelessness) have you been feeling in the past week.
   Not depressed at all
   | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Extremely depressed 10
   |   |   |   |   |   |   |   |   |   |   |  

8. On a scale of 0-10, how certain are you that you will be doing normal activities or working in six months?
   Very certain
   | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Not certain at all 10
   |   |   |   |   |   |   |   |   |   |   |  

9. I can do light work for an hour.
   Completely agree
   | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Completely disagree 10
   |   |   |   |   |   |   |   |   |   |   |  

10. I can sleep at night.
    Completely agree
    | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Completely disagree 10
    |   |   |   |   |   |   |   |   |   |   |  

11. An increase in pain is an indication that I should stop what I am doing until the pain decreases.
    Completely disagree
    | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Completely agree 10
    |   |   |   |   |   |   |   |   |   |   |  

    Completely disagree
    | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Completely agree 10
    |   |   |   |   |   |   |   |   |   |   |  

13. I should not do my normal activities including work, with my present pain.
    Completely disagree
    | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Completely agree 10
    |   |   |   |   |   |   |   |   |   |   |
YFRF Scoring and Domains

< 49 = **Green** = Low Risk for psychosocial factors
50 – 64 = **Yellow** = Moderate Risk for psychosocial factors
65+ = **Red** = High risk for psychosocial factors

Three main domains related to slower recovery and delay of normal activity:
1) Fear/Escape Avoidance Behavior toward physical activity (# 9, 11, 12, 13)
2) Confidence in general health and condition (# 3, 4) and pain control and normal ability (# 6, 8)
3) Emotion and social well being – depression and anxiety (# 5, 7)
Pain

“A multisystem output, activated by specific pain neuromatrix. This neuromatrix is activated whenever the brain concludes it is in danger and action is required.”

Butler D, Moseley, L Explain Pain, 2003
Chronic Pain

126.1 million adults in the USA had some pain over the last 3 months

25.3 million adults are suffering from chronic pain

Pain and Threat Perception

Brain determines degree of threat and pain function.

Perception of threat is key factor.

Threat perception makes a significant contribution to the effectiveness of pain education.

Survival is the most basic function.

Pain is protection against threat of danger.
Threat Perception

How dangerous is this?

This is dangerous more information

Facilitation neuronal adaption
Threat Perception (Cont.)
Threat and Fear Avoidance

Systematic Literature Review of Imaging Features of Spinal Degeneration in Asymptomatic Populations

<table>
<thead>
<tr>
<th>Imaging findings for 3,110 asymptomatic individuals</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Disk degeneration:</strong></td>
</tr>
<tr>
<td>37% of 20-year-old individuals.</td>
</tr>
<tr>
<td>96% of 80-year-old individuals.</td>
</tr>
<tr>
<td><strong>Disk bulge:</strong></td>
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<tr>
<td>30% of those 20 years of age.</td>
</tr>
<tr>
<td>84% of those 80 years of age.</td>
</tr>
<tr>
<td><strong>Disk protrusion:</strong></td>
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<tr>
<td>29% of those 20 years of age.</td>
</tr>
<tr>
<td>43% of those 80 years of age.</td>
</tr>
<tr>
<td><strong>Annular fissure:</strong></td>
</tr>
<tr>
<td>19% of those 20 years of age.</td>
</tr>
<tr>
<td>29% of those 80 years of age.</td>
</tr>
</tbody>
</table>

Reconceptualization of Pain

Pain is a multiple system output, activated by an individual’s pain neuromatrix.

Neuromatrix theory
- Collection of brain areas activated during a pain experience
- Conceptualizes that areas of brain work as a network
Pain Neuromatrix

A typical pain neuromatrix

1. Premotor/Motor cortex
   Organize and prepare movements

2. Cingulate cortex
   Concentration, focusing

3. Prefrontal cortex
   Problem solving, memory

4. Amygdala
   Fear, fear conditioning, addiction

5. Sensory cortex
   Sensory discrimination

6. Hypothalamus/Thalamus
   Stress responses, autonomic regulation, motivation

7. Cerebellum
   Movement and cognition

8. Hippocampus
   Memory, spatial recognition, fear conditioning

9. Spinal cord
   Gating from the periphery


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CLASSIFICATION BASED SYSTEMS
Pain Classifications
(Gifford and Butler 1997)

Peripheral Nervous System Pain Mechanisms
- Nociceptive: Inflammatory Mechanical vs Chemical
- Nociceptive: Ischemic
- Peripheral Neurogenic

Central Nervous System Pain Mechanisms
- Central Sensitization
- Affective Pain Mechanism Conscious vs Unconscious
- Autonomic/Motor Pain Mechanism
Classification Based Systems

Why Classification Based Systems?

Shirley Ryan Abilitylab

Average duration of visits = 15 visits

Duration of visits trained MDT and Pain Mechanism Classification System (PMCS) = 6.93 visits
Central Mechanisms
What is Central Sensitization?

Central sensitization = “An amplification of neural signaling within the central nervous system that elicits pain hypersensitivity” and “increased responsiveness of nociceptive neurons in the central nervous system to their normal or subthreshold afferent input.”

Central Sensitization

Nociceptor inputs can trigger a reversible, yet prolonged increase in the excitability of neurons in central nociceptive pathways (Wolf, 2011).

Evidence has shown inhibitory interneurons are destroyed and random excitatory connections may form.

Symptoms associated with the lowering of change in excitability include:

- Hypersensitivity
- Hyperalgesia
- Allodynia
Normal vs. Central Sensation

[Diagram showing neural pathways for normal and central sensitization, comparing nociceptors and mechanoreceptors, and illustrating hyperalgesia and allodynia.]
Why Central Sensitization Happens

Starts with changes in dorsal horn of spinal cord following intense peripheral noxious stimuli, tissue damage, nerve damage and inflammation.

These changes cause reduction pain threshold, amplification of pain responses, and spread of pain sensitivity to non-injured areas.

These changes occur through the central nervous system.
Chronic or Persistent Pain Conditions with a Central Sensitization Component

RA
Knee OA
TMJ disorders
Fibromyalgia
HA’s
Neuropathic pain
CRPS
Post surgical pain
Visceral pain hypersensitivity syndromes (IBS)

Wolf, 2011
Subjective Characteristics

Location – wide spread, non-anatomical distribution of pain
Frequency- constant, unremitting, spontaneous, latent
Descriptors- catastrophic terms, pain threat high
Intensity – high severity and irritability
Onset – chronic, past expected tissue healing, pain disproportionate
History – multiple failed interventions
24 hour behavior – erratic, inconsistent
Psychosocial – maladaptive and harmful beliefs/poor self efficacy
Aggravating/alleviating factors – disproportionate, non-mechanical, unpredictable

Kolski MC, O’Connor A. A World of Hurt. 2015
Objective Characteristics

Movement testing – disproportional, no coloration between stimulus and response

Palpation – diffuse non-anatomical areas of tenderness

Posture - antalgic with atrophy of muscles

Neurological testing – hyperalgesia, allodynia

Proprioceptive screen - negative

Breath assessment – upper respiratory

Yellow flag assessment – positive for catastrophization, fear avoidance, harmful thoughts, distress

Readiness stage - variable

Fear avoidance belief – FABQ physical activities >14

Kolski MC, O’Connor A. A World of Hurt. 2015
Musculoskeletal pain

Is neuropathic pain present and able to explain the clinical picture?

Yes  No

Predominant neuropathic pain

Disproportionate pain experience?

Yes  No

Diffuse pain distribution?

Yes  No

Predominant central sensitization pain

Central Sensitization Inventory score of ≥40?

Yes  No

Predominant central sensitization pain

No central sensitization

Intervention

Education

- Explain hurt vs. harm
  - Non-damaging nature of pain

Activity Pyramid

- Flare up managements
- Green, yellow, and red lights

Pain mechanism educating

Pain journal (control negative thoughts)

Control to the patient

- Explanation of the no worse concept

Coping strategies

- Diaphragmatic breathing
- Relaxation

Kolski MC, O’Connor A. A World of Hurt. 2015
“If It Hurts, Don’t Do It”

From Louw A, Puentedura EJ: Therapeutic neuroscience education, Minneapolis, 2013, OPTP.
It’s all in your head.
Pain means you did something wrong.
It runs in the family.
Your ______ is out of place.
Your ______ doesn’t move correctly.
Flare up = harm
Discontinue any exercise which caused you pain.
Your MRI looks terrible.

Kolski MC, O’Connor A. A World of Hurt. 2015
Words that Heal

Good pain/movement safe pain.
All pain is REAL.
Your test results are a normal part of aging.

Kolski MC, O’Connor A. A World of Hurt. 2015
Affective Pain Mechanism
Conscious vs Unconscious

Happened a while ago but the brain does not know that.
Not an input but is output driven.
Psychosocial
Anger, worry, fear, depression (conscious emotions) cause symptoms.
Good candidate for a cognitive behavioral therapist.
Affective Intervention

**Pain mechanism education:**
- Brain’s role in pain
- Psychology for coping
- Understand movement safe pain to return to rewarding activities
- Master non pharmacy sleep hygiene, stress management, healthy lifestyle
Autonomic Motor

Primary somatosensory cortex
Short circuit from the virtual body to the actual body
Brain driven
The brain is shutting down body parts
“Brain dysfunction” which takes 16-24 weeks to remodel
If brain is in the final stage of protection, it is shutting down the body part.
Phantom pain
Training Brain to Periphery

Graded motor imagery (GMI)—rehab process consisting of left-right discrimination recognition tasks, imagined movements, and mirror therapy.

GMI

- Left/right discrimination
- Explicit motor imagery
- Mirror therapy

Systematic review displayed good level 2 evidence of the GMI’s effective in reducing pain in adults with CRPS type 1.
YFRF Patterns and Best Pain Science Education

YFRF Pattern 1 = Central Sensitivity Pain Mechanism

• High Questions: 9, 11, 12, 13
• Activity Traffic Light – A Guide to movement and safe pain
• Reframe cognitions, thoughts and words can alter sensitivity toward movement
YFRF Patterns and Best Pain Science Education

YFRF Pattern 2 = Affective Pain Mechanism

• High questions 3, 4, 5, 6, 7, 8
• Role of emotions and social imbalance, conflict, stress to pain
• Encourage discovery through journaling
• Purpose: Trigger focused – non pharmacy coping
• Restore meaningful activities and rewarding life
YFRF Patterns and Best Pain Science Education

YFRF Pattern 3 = Peripheral Neurogenic Pain Mechanism

• High questions 1, 2, 6, 12
• Neurodynamic Exercise – nerves need movement
• Nerve tissue is longest – 3% of body weight
• Nerve is strongest tissue – 3x tensile load of body weight
• Nerve is dynamic – consumes 26% of blood volume
• Nerve is sensitive – negative thinking increases sensitivity
• Nerve exercise – Slider vs. tensioner
Pain Mechanisms and Intervention

• Nociceptive: Inflammatory – Chemical/Direction
• Nociceptive: Ischemia – Tissue remodel
• Peripheral Neurogenic – Entrapment/Tight
• Central sensitization - Cognitive
• Affective - Coping
• Motor/Autonomic - Sensorimotor

A World of Hurt  A Guide to Classifying Pain
Melissa C. Kolski and Annie O’Connor
Low Back Pain Classifications

Social Environment

Illness Behavior

Psychological Distress

Attitudes & Beliefs

Pain