



Biomechanical Examination & Treatment for the Lumbar Spine

Biomechanical Aspects of Clinical Reasoning

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Objectives

- To Discuss & Illustrate A Biomechanical Examination Approach To Lumbar Assessment.
- To Discuss Integrating A Biomechanical Approach Into A Comprehensive Examination And Into Multimodal Treatments.
- To Discuss & Illustrate Various Manual Therapy Techniques Commonly Used To Treat Lumbar Dysfunctions (Lab: Slides 70+ on shared drive).
- (Regional Interdependence: Thoracic and SI Joint Exam & Treatment Future Presentations ?)

Differential Diagnosis Exam

Material **NOT** Included In Lab Presentation

- Subjective Exam
- Medical History
- Medical Screening & Constitutional Symptoms
- Red Flags & Serious Pathology
- Yellow Flags
- Questionnaires: Functional Outcomes, Pain Scales, Body Charts...
- Differential Diagnosis: Objective Tests

Differential Diagnosis Exam

- **Inductive Evaluations:** Judgments are withheld until a relatively complete and thorough evaluation has been completed.
- **Deductive Evaluations:** Therapist develops an early hypothesis about the patient's diagnosis, usually in the presence of minimal information (don't get biased by MD diagnosis or Imaging).
- **On Going Re-Assessments:** Re-examine throughout care is needed to confirm or refute your diagnosis hypothesis and treatment plan.

Differential Diagnosis Exam

- Differential diagnosis is finding out if the patient is appropriate for PT and “what” is wrong.
- Ongoing evaluations (biomechanical or other approaches) should be looking for “why” it is happening & guide treatment decision making.

Differential Diagnosis

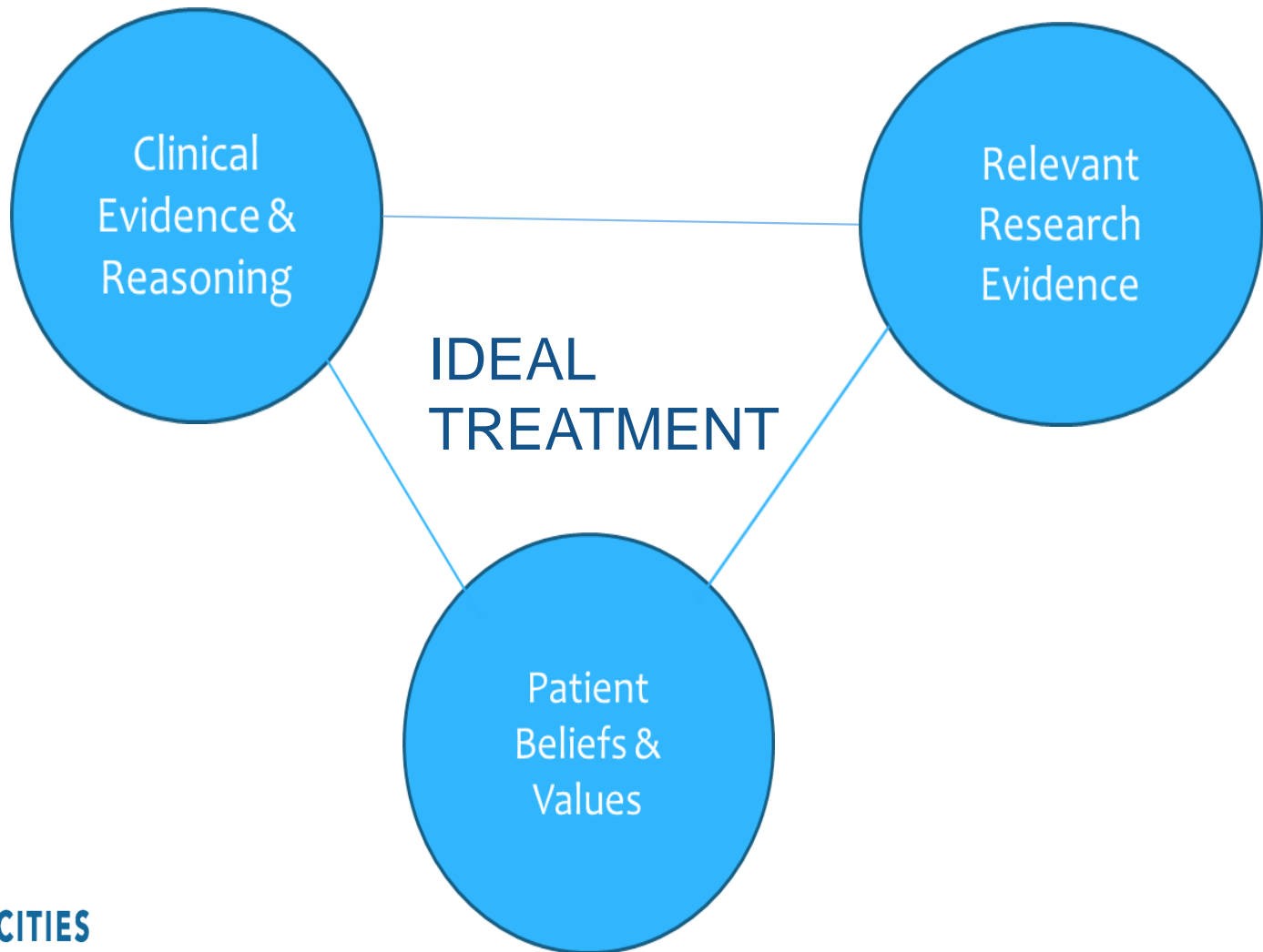
Exam Findings

1. (+) Red Flags.
MD/surgical consult then treat if cleared.
2. Radicular symptoms or radiating pain that centralize with traction (Especially Cervical Spine)
3. Radicular symptoms or radiating pain that centralize with directional preference exercises
4. **Mechanical LBP** : Biomechanical hypomobilities and/or instabilities contributing and/or causing pain. (Biomechanical exam needed to confirm).
5. (+) Yellow Flags (Including Chronic Pain).
MD/ psychology consult if needed along with PT.

Non-Differential Diagnosis Evaluations

1. Biomechanical Examination
2. Treatment Determined Exam:
McKenzie Classifications:
Postural, Dysfunction, Derangement.
3. Treatment Based Classification /
Clinical Predictor Rule Based Exam.
4. Other Approaches

Pillars of Evidence Based Practice



Grades of Evidence: JOSPT Lumbar Clinical Practice Guideline (2012)

- Directional Preference/Centralization = A (Strong) Evidence
- **Manual Therapy = A Evidence**
- Stabilization: Trunk Coordination/ Strengthening = A
- Progressive Endurance/Fitness Activities = A Evidence
- Patient Education = B (Moderate) Evidence
- Flexion Exercises = C (Weak) Evidence
- Lower Quarter Nerve Mobilization Procedures = C
- Traction = D (Conflicting) Evidence
- (E= Theoretical/Foundational Evidence)
- (F= Expert Opinion)

Multimodal PT with “A” Rated Lumbar Treatments

(Traction: “D” rated)

Directional Preference/ Specific Exercise/ ROM (A)

Manual Therapy (A)

Stabilization (A)

Progressive
Fitness/Aerobics (A) +
Pain Edu (Phase II)

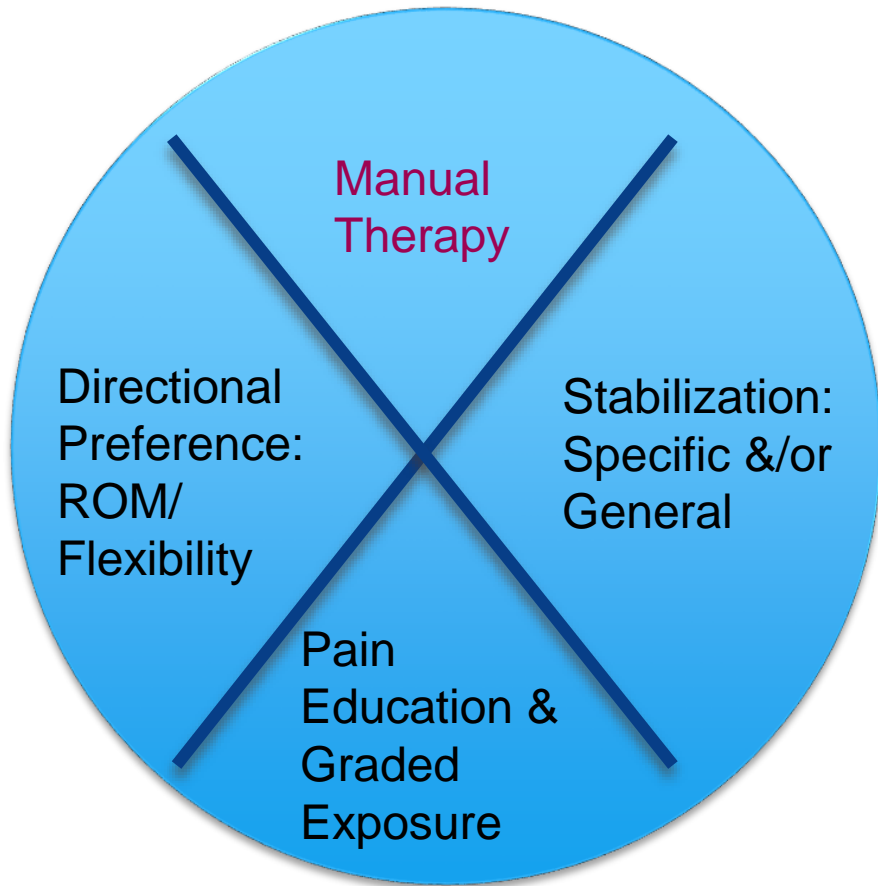
Home Program (Gym Program/Phase III)

Multimodal PT

Multimodal PT = Comprehensive treatment.

- This is **NOT** a shot gun approach but is based on exam findings & clinical reasoning.
- Clinicians don't have to be hampered by the constraints that researchers have placed on them—more pragmatic in practice.
- Treatment combinations obscure the effect of the individual interventions that make up multimodal treatment (Slaven EJ et al).

Lumbar Multimodal PT



Clinical Reasoning Based on Exam Findings to Determine the % of Each Treatment Type For a Given Patient.

The % Typically Changes During the Course of Treatment.

Lumbar Multimodal PT

Treatment	Patient 1	Patient 2	Patient 3	Patient 4
Directional Preference: ROM/Flexibility	25%	10%	0%	10%
Manual Therapy	25%	60%	10%	10%
Stabilization: Specific or General	25%	20%	80%	10%
Chronic Pain Edu with Graded Exposure	25%	10%	10%	70%

- Clinical Reasoning Based on Exam Findings to Determine the % of Each Treatment Type For a Given Patient.
- % Typically Changes During the Course of Treatment.

Multimodal PT

- **Manual Therapy** should not be done as stand alone treatments.
- Combine with appropriate exercises (ROM &/or Stabilization/Strengthening).
- Combine with education including Pain Neuroscience Education & Graded Exposure concepts.
- Put the “**Bio**” back in Biopsychosocial Model.

Acute PT Treatment Goals

- Reduce Pain/Centralize Symptoms:
(Directional Preference/Manual Therapy)
- Restore Mobility:
(Manual Therapy/Range of Motion Exercises)
- Restore Function
(Stabilization/ Strengthening Exercises)
- Teach Self Management Strategies &
Self Confidence/Resiliency of the body.
(Graded Exposure, Pain Neuroscience.)



Manual Therapy Evidence

Evidence To Support Manual Therapy

Manual Therapy Defined

Manual Therapy = A CPT/Billable Treatment Code.

Manual Therapy = Any hands on treatment technique.

Manual Therapy = **Advanced Clinical Reasoning**

1. Examination determined need for and type of treatment(s).
2. Manual therapy treatment(s) performed.
3. Re-examination to determine effectiveness of treatment(s).

2012 JOSPT LBP Clinical Practice Guidelines

Manual Therapy is an “A” Rated Treatment Intervention.

- Clinicians should consider utilizing thrust manipulative procedures to reduce pain and disability in patients with mobility deficits, **acute** low back, and back-related buttock or thigh pain.
- Thrust manipulative and non-thrust mobilization procedures can also be used to improve spine and hip mobility and reduce pain and disability in patients with **subacute and chronic** low back and back-related lower extremity pain.

2012 JOSPT LBP Clinical Practice Guidelines

- The **lumbar manipulation CPR** (5 predictors) and modified lumbar manipulation CPR (2 predictors) was included in 2012 JOSPT LBP clinical guidelines.
- There is evidence for the use of thrust manipulation in patients who **do not meet** the lumbar manipulation CPR, including chronic LBP, lateral stenosis, and spinal stenosis.

Lumbar Manipulation CPR

1. *No symptoms distal to knee.
2. *Recent onset of symptoms (<16 days).
3. Low FABQW (<19).

ALL of the top 3 criteria are PROGNOSTIC

* (#1 and #2) 2 prognostic factor CPR is also used.

4. Hyomobility of lumbar spine: BIOMECHANICAL.
5. Hip IR >35 in at least one hip.
 - Part of the TBC: Manipulation (NOT Manual Therapy).
 - (+) 4/5: prevalence 23-59%.

Lumbar Manipulation CPR

Which prognostic factors for low back pain are generic predictors of outcome across a range of recovery domains? PTJ. 2013; 93(1): 32-40. Cook CE et al.

- Meeting the CPR was **prognostic** for all outcome measures and should be considered a universal prognostic predictor.
- Patients with a (+) CPR were **4.8 x** more likely to improve compared to patients with a (-) CPR and have a rate of recovery of 75% or greater regardless of treatment group.
- Patients received thrust or non-thrust intervention for 2 visits then care directed by PT for subsequent visits.

Manipulation CPR VS Mobilizations

No difference in outcomes in people with low back pain who met the clinical predictor rule for lumbar spine manipulation when a pragmatic non-thrust manipulation was used as the comparator. Physiotherapy Canada. 2014; 66(4): 359-366.

- All patients met the lumbar manipulation CPR
- If patients met the CPR they **do equally well** with thrust manipulation or non-thrust mobilizations.
- Both groups had significant improvements in pain reduction (NPRS) and functional gains (ODI).

2012 JOSPT LBP Clinical Practice Guidelines

- **Assessment of hypomobility**, in the absence of contraindications, is sufficient to consider the use of thrust manipulation as a component of comprehensive treatment.
- Mobilizations and manipulations are more effective in combination with active therapies as a component of a comprehensive treatment plan--**Multimodal PT**.
- Interventions targeting the hip joint as part of a more comprehensive treatment program for LBP patients can be considered— **Regional Interdependence**.

Manipulation Evidence

Lumbar spine segmental mobility assessment: an examination of validity for determining intervention strategies in patients with low back pain. Arch Phys Med Rehabil. 2005; 86:1745-1752. Fritz JM et al.

- Patients who were assessed as having lumbar **hypomobility** demonstrated more significant improvements with thrust manipulation and stabilization exercises (Multimodal PT) than with stabilization exercises alone.
- 74% with **hypomobility** and received manipulation has successful outcomes.
- 26% with **hypermobility** (or lack of hypomobility) and received manipulation had successful outcomes.

Manipulation Evidence

Effectiveness of physical therapist administered spinal manipulation for the treatment of low back pain: a **systematic review** of the literature. IJSPT. 2012; 7(6): 647-662. Kuczynski J K et al.

- 6 Randomized controlled trails included.
- There is evidence to support the use of spinal manipulation by PTs in clinical practice.
- PT spinal manipulation appears to be a safe intervention that improves clinical outcomes (pain & function) for patients with LBP.
- All studies found **positive effects** favoring manipulation (or manipulation and exercise combined) versus a control group.

Manual Therapy Evidence

The relative effectiveness of segment specific level and non-specific level spinal joint mobilization on pain and range of motion: results of a **systematic review** and meta-analysis. JMMT. 2013. 21(1): 7-17. Slaven EJ et al.

- Joint mobilizations **improved outcomes by 20%** relative to controls who did not receive mobilizations.
- When used for treatment there is good evidence to support the combination of joint mobilization and exercise--
Multimodal PT.
- However, treatment combinations obscure the effect of the individual interventions that make up that treatment—research dilemma.

Manual Therapy Evidence

The efficacy of manual therapy and exercise for different stages of non-specific low back pain: an update of **systematic reviews**. JMMT. 2014. 22(2): 59-74. Hidalgo B et al.

- There is **moderate to strong evidence** for the benefit (pain relief, functional improvement, overall health and quality of life) of manual therapy compared to sham manual therapy for **all stages** of LBP (acute, subacute, chronic).
- A variety of manual procedures combined or not with other interventions, including exercise, may improve patient management– **Multimodal PT**.

Manual Therapy Evidence

The efficacy of manual therapy and exercise for different stages of non-specific low back pain: an update of **systematic reviews**. JMMT. 2014. 22(2): 59-74.
Hidalgo B et al.

- There is **moderate evidence** to support manual therapy over usual medical care for pain, function, and overall health and quality of life for **all stages** of non-specific LBP.
- There is moderate evidence to support manual therapy combined with exercise (or back school) for pain, function, and return to work— **Multimodal PT**.
- There is limited to no-difference in efficacy of manual therapy combined with extension exercises compared to extension exercises alone for pain.

Manipulations VS Mobilizations

Early use of thrust manipulation versus non-thrust manipulation: A randomized clinical trial. Manual Therapy. 2013; 18(3): 191-198. Cook C et al.

- Non-thrust mobilizations and thrust manipulation are **equally effective** in producing the same outcomes in mechanical LBP patients.
- Both groups had significant improvements in pain reduction (NPRS) and functional improvements (ODI).
- **Pragmatic design** used: highly skilled PTs were allowed to use mobilizations and manipulation as done in clinical practice according to the patient's presentation (segmentally).

Manual Therapy VS Exercise

A perspective for considering the risks and benefits of spinal manipulation in patients with low back pain. Manual Therapy. 2006; 11(4): 316-320. Childs et al.

- Manipulation group at 4 weeks:
97% better; 3% no better or worse.
- Exercise group at 4 weeks:
89% better; 11% no better or worse.
- Exercise group 8x more likely to experience a worsening in disability.
- Manipulation group also did exercises -- **Multimodal PT**.
- **Risk of not manipulating**: 5-10% more “failed” patients with exercise approach alone.

Manual Therapy Key Points

1. Manual therapy (manipulations & mobilizations) is effective for treating **all stages** of LBP (Acute, Subacute, Chronic).
2. **Treatment effects** include: reduced pain, improved motion, improved function, improved neurodynamics (SLR), and increase water diffusion into the nucleus of the intervertebral disc.
3. The lumbar manipulation **CPR** can be used as a guideline to assist with clinical reasoning –not a hard fast “rule”.

Manual Therapy Key Points

4. Segmental manipulation of a **hypomobile segment** in the absence of contra-indications is appropriate & effective.
5. Segmental vs gross manual therapy (manipulations & mobilizations) of the lumbar spine are both effective.
6. Thrust manipulation vs non-thrust mobilization are equally effective—but one might be more beneficial than the other for a individual patient (get proficient at both).
7. Manual therapy & exercise are both effective for treating LBP but both are better when combined— **Multimodal PT**.

Physical Therapy Effects

Manual Therapy/Physical Therapy Effects

- Biomechanical Effects.
- Neurophysiological Effects.
- Desensitization of Hypersensitive Tissues.
- Placebo/Nocebo Effects.
(Don't be a Nocebo!)
- Therapeutic Alliance (Patient Beliefs Matter!)

Neurophysiological Effects

Immediate effects of regional-specific and non-regional specific spinal manipulative therapy in patients with chronic low back pain: a randomized controlled trial. PTJ. 2013; 93(6):748-756. de Oliveira RF et al.

- The immediate changes in pain intensity and pressure pain threshold after a single high-velocity manipulation **do not differ** by region-specific (painful lumbar area) versus non-regional specific (upper thoracic spine) manipulation techniques in patients with chronic LBP.
- Short-term/transient neurophysiological effects are the same.
- (Is that the goal of the treatment?)
- (Why manipulate the painful level/potential instability?)

Manual Therapy Effects

Manual Therapy:

- Thorough Evaluation and ongoing Re-evaluations.
- + Healing Hands/ Manual Therapy Techniques.
- + Healing Words/ Appropriate Education.
- + Appropriate Therapeutic Exercise/ Home Exercises.
- = Ritual between PT and patient with the formation of a
Therapeutic Alliance.

Abraham Verghese, MD: A Doctor's Touch.

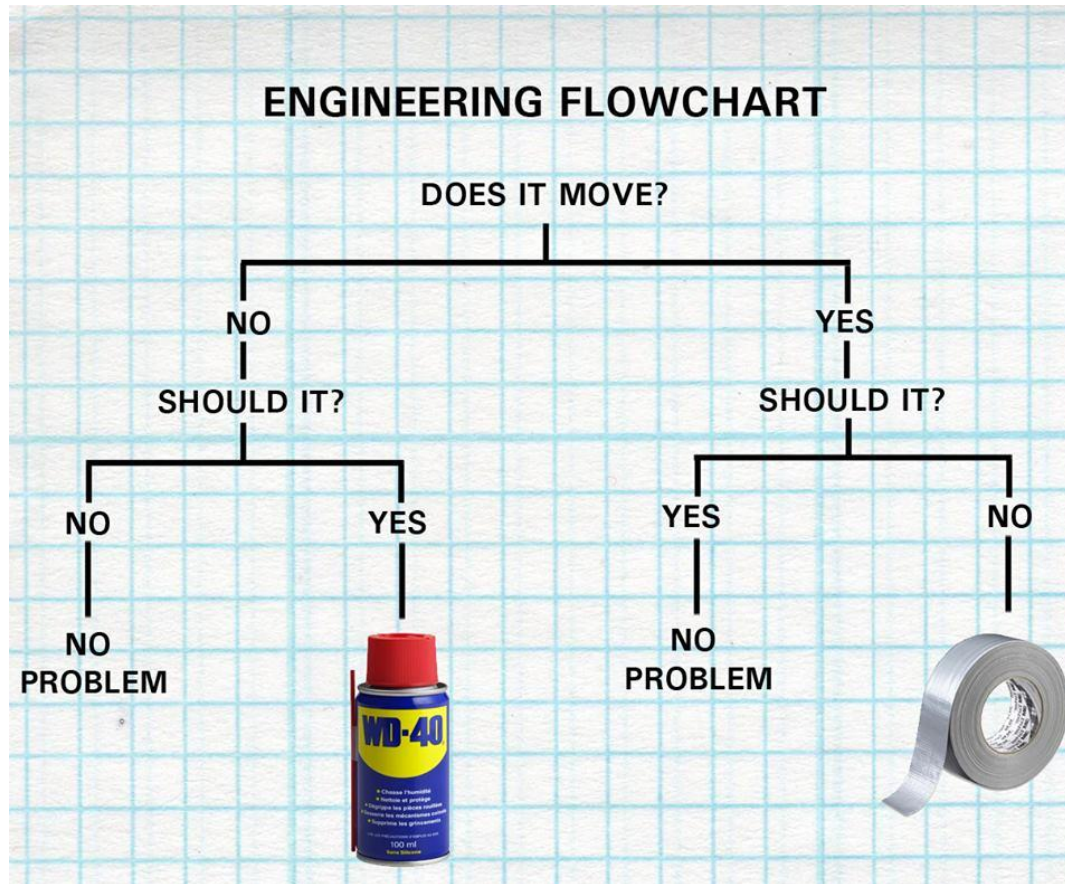
Link to Youtube video of TED TALKS (approx 20 min).



Biomechanical Exam Findings

Finding Hypomobilities

Biomechanical Clinical Reasoning



Biomechanical Evaluation

1. Passive Physiological Inter-Vertebral Movements (**PPIVM**) or Passive Physiological Movements (PPM) in peripheral joints.
2. Passive Accessory Inter-Vertebral Movements (**PAIVM**) or Passive Accessory Movements (PAM) in peripheral joints: GLIDES.
3. Posterior to Anterior Pressures (**CPAs/UPAs**).
4. Secondary Stress Test (Segmental or Joint Stability Tests).

Intervertebral Motion Testing

2012 JOSPT LBP Clinical Practice Guidelines

- Assessment of hypomobility, in the absence of contraindications, is sufficient to consider the use of thrust manipulation as a component of comprehensive treatment.

- Taken From:

Lumbar spine segmental mobility assessment: an examination of validity for determining intervention strategies in patients with low back pain. Arch Phys Med Rehabil. 2005; 86:1745-1752. Fritz JM et al.

Intervertebral Motion Testing

Finding Hypomobilities helps improve outcomes:

- Patients who were assessed as having lumbar **hypomobility** demonstrated more significant improvements with thrust manipulation and stabilization exercises. (Fritz JM et al 2005).
- **Risk of not manipulating:** 5-10% more “failed” patients with exercise approach alone. (Childs et al 2006)

Intervertebral Motion Testing

2012 JOSPT LBP Clinical Practice Guidelines

- Segmental mobility testing: Prone PA's & Side lying PPIVM.
- Reliability for presence of any **hypomobility or hypermobility** during intervertebral motion testing demonstrated **moderate to good agreement**.
- Kappa = 0.38-0.48.
- Validity has been established with correlation of radiographic lumbar segmental instability and with response to treatment.
- PA's for **pain** provocation: **moderate to good agreement**.
- Kappa = 0.25-0.55.

Intervertebral Motion Testing

Intertester reliability and validity of motion assessment during lumbar spine accessory motion testing. Phys Ther 2008. 88(1): 43-9. Landel R et al.

- The inter-tester reliability for identifying the **least mobile segment** using posterior to anterior pressures (PA's) was **good** (agreement =82.8%; kappa= 0.71; 95% CI= 0.48-0.94).
- The inter-tester reliability was **poor** for identifying the **most mobile segment** (kappa= 0.04; 95% CI= 0.13-0.71) despite having good agreement (79.3%).
- PA's had poor agreement versus MRI measured intervertebral motion (Least mobile segment: kappa= 0.04; 95% CI =0.16-0.24 and Most mobile segment: kappa= 0.00; 95% CI=0.09-0.08)

Intervertebral Motion Testing

Spinal Motion Palpation: A Review of Reliability Studies. JMMT. 2002; 10(1): 24-39. Huijbregts, PA et al. (2 slides)

- Intrarater reliability is higher than interrater reliability.
- **Intrarater reliability** varies from less than chance to substantial agreement depending on the study (and palpation skill level).
- **Interrater reliability** only rarely exceeds poor to fair agreement.
- **Presence of Pain** during motion testing had a higher reliability than perceived motion.

Intervertebral Motion Testing

Spinal Motion Palpation: A Review of Reliability Studies. JMMT. 2002; 10(1): 24-39. Huijbregts, PA et al. (2 slides)

- PT's **without** advance manual therapy training have been shown to have poor interrater reliability in correctly locating specific spinal levels.
- PT's **with** advanced manual therapy training have good interrater reliability in locating specific spinal levels.
- Interrater reliability impacted if cannot locate spinal levels.
- **Clinically**, it is more important to identify the presence of a motion abnormality (& treat it) than to identify the spinal level.

Intervertebral Motion Testing

The science of spinal motion palpation: a review and update with implications for assessment and intervention. JMMT. 2013. 21(3): 160-67. Nyberg RE et al. (2 slides)

- The decision to utilize manipulation for the purpose of improving spinal mobility, or a motor control exercise approach to provide spinal stabilization, may be determined at least in part from an accurate interpretation of **spinal motion by palpation**.
- The accuracy in interpreting spinal segmental motion by palpation is, therefore, likely to affect treatment **outcome**.

Intervertebral Motion Testing

The science of spinal motion palpation: a review and update with implications for assessment and intervention. JMMT. 2013. 21(3): 160-67. Nyberg RE et al. (2)

Clinical considerations to improve accuracy and reliability:

- Use one or both of 1st two finger tips.
- Light force is better than strong forces.
- Slow motions are better than fast motions.
- Touch sensors (vs pressure sensors) are better at feeling motion.
- Visually watch what you are doing to enhance accuracy.
- Use visual imagery.
- Practice frequently & Don't over-analyze.

Intervertebral Motion Testing

Other clinical considerations to improve accuracy & reliability:

Use multiple techniques to confirm/validate your finding.

Use a cluster of 3-5 tests (like a CPR)—NOT JUST PAs.

1. PPIVM.
2. PAIVM: overpressure with endfeel.
3. PA's (somewhat non-specific but used in most studies)
4. Segmental stability tests (&/or prone instability test)
5. Patient report of irritability/stiffness during testing.
6. A/PROM and combined movement testing.
7. Subjective history presentation.

Biomechanical Exam Results

- If **PPIVM** or PPM Tests are positive (+), then a hypomobility is present
- If **PAIVM** or PAM Tests are also positive (+), then an **Articular Hypomobility** exists
- If pain with glide then Acute or Subacute lesion
- If no pain with glide then Chronic Lesion
- **PA's** would also be (+) for hypomobility

Types of Articular Hypomobilities

Articular Hypomobility

1. Facet Fixation (subluxation/pathomechanical dysfunction).
 - a) Facet Fixation In Flexion (Flexion Fixation):
cannot ext, SB left OR right
 - b) Facet Fixation In Extension (Extension Fixation):
cannot flex, SB left OR right.
2. Pericapsular Hypomobility:
Capsular pattern of loss (extension loss >> flexion loss).
3. Ankylosis/Fusion:
Fibrous Contracture, Bony Ankylosis, or Surgical Fusion

Types of Articular Hypomobilities

1. **Fixated Joint** (Subluxation):

Pathomechanical endfeel /Jammed.

Non-capsular pattern of motion loss

PPIVM/PPM/PAIVM/PAM:

(+) away from fixated position

(-) toward fixated position

Best Suited For Manipulation Treatment or

Erratic Grade 3+/4+ Joint Mobilizations When Appropriate

Types of Articular Hypomobilities

2. Pericapsular Hypomobility

Hard Capsular or spasm endfeel

Capsular pattern (usually)

PPIVM/PPM/PAIVM/PAM:

(+) in capsular pattern of loss of motion

Best Suited for Non-Manipulation Treatments:

Graded Joint Mobilizations,

Mobilizations with Movement, etc

Capsular Pattern of Spine

- Cervical Spine (C2-T1): Side Bending loss = Rotation loss
- Thoracic and Lumbar Spine: Ext Loss >> Flex Loss
Bilateral extension, side bending and rotation loss much greater than flexion loss of motion.
- Unilateral Thoracic or Lumbar Facet:
Extension, ipsilateral side bending, and either contralateral or ipsilateral rotation loss much greater than flexion loss off motion.

Biomechanical Exam Results

- If **PPIVM** or PPM tests are positive (+),
then a hypomobility is present
- If **PAIVM** or PAM tests are negative (-),
then an **Extra-Articular/Myofascial Hypomobility** exists
- **PA's** would be (-) for hypomobility

Types of Extra-articular Hypomobilities

1. Muscle, tendon, myofascial
 2. Contractures, scars
 3. Hypertonus
- All will have elastic (not hard) end feel
 - All will have a non-capsular pattern of loss of ROM
 - Best Suited for Muscle Assisted Mobilizations (MAM), Muscle Energy Techniques (MET), Soft Tissue Mobilizations (STM), etc

Biomechanical Diagnosis

1. Articular Hypomobility

Fixated, Pericapsular, Fused

2. Extra-Articular Hypomobility

3. Joint Hypermobility

4. Joint Instability

Biomechanical Manipulation “CPR”

Biomechanical Manipulation “CPR”:

Presense of a Articular Fixation Hypomobility:

(+) History

(+) Scanning Exam: A/PROM, quadrant tests (H&I), & PAs: hypomobile.

(+) Biomechanical exam: PPIVM, PAIVM, & PAs with a hard / pathomechanical end feel.

AND (-) contra-indications for manual therapy.

Biomechanical Manual Therapy “CPR”

Biomechanical Manual Therapy “CPR” (Not Manipulation):

Presence of a Articular Capsular Hypomobility OR

Presence of an Extra-Articular Hypomobility:

(+) History

(+) Scanning Exam: A/PROM, quadrant tests, & PAs:
hypomobile +/- capsular pattern of loss of motion.

(+) Biomechanical exam: PPIVM, (+/-) PAIVM, & (+/-) PAs
with a capsular end feel OR a soft/myofascial end feel.

AND (-) contra-indications for manual therapy.

Hypomobility Treatment

Graded Joint Mobilizations

- **Grade 1-4:** stimulate mechanoreceptors (type II primarily—possible type I) & have neurophysiological pain modulation as oscillations preclude mechanoreceptors from shutting down as they accommodate the stimulus (gate control theory) plus descending pathway inhibition (dPAG/mid-brain).
- **Grade 1-2:** Neurophysiological pain modulation
- **Grade 3-5:** Neurophysiological effect plus biomechanical effect on the barrier to movement.

Hypomobility Treatment

Graded Joint Mobilizations

- Grade 1:** Small Amplitude, rhythmic oscillations performed at the beginning of ROM. Used to treat pain and spasm.
- Grade 2:** Large Amplitude, rhythmic oscillations performed within available ROM (before barrier). Used to treat pain and spasm.
- Grade 3:** Large Amplitude oscillations performed up to end ROM.
Used to treat pericapsular hypomobility. Grade **3+** into resistance.
- Grade 4:** Small Amplitude oscillations performed at end ROM. Used to treat pericapsular hypomobility. Grade **4+** into resistance.
- Grade 5:** Small Amplitude, high velocity at end ROM / manipulation / thrust. Used to treat pathomechanical /subluxed /fixated joints.
Erratic grade 3+ mobilizations may also be effective.

Hypomobility Treatment

Mobilization With Movement (MWM):

- No pain should be experienced with MWM techniques.
- Joint mobilizations should be parallel or perpendicular to joint surface—MWM are primarily parallel mobilizations (NAGS).
- MWM are sustained throughout movement (SNAGS).
- Bony positional faults contribute to painful joint restrictions.
- Minor bony positional faults are not palpable or visible on X-ray.
- MWM repositions joint so it can move pain-free (10 reps).

Hypomobility Treatment

Active Mobilizations:

- Muscle Energy Techniques (MET)
- Muscle Assisted Mobilizations (MAM)
- Positional Isometric Techniques (PIT)
- Used to treat Myofascial/ Extra-Articular Hypomobilities
- Useful as a preparation technique prior to mobilizations or manipulations.
- Useful as initial post mobilization or manipulation neuromuscular re-education technique.

Hypomobility Treatment

Soft Tissue Mobilizations (STM):

- Tool / Instrument Assisted STM (TASTM) / (IASTM)
- Cross Friction STM
- Trigger Point STM
- Visceral Mobilization
- Myofascial Release/Massage
- Myofascial Decompression (MFD) / Cupping
- Massage Gun (Recover Fun, Hypervolt etc)

Dry Needling:

NOT INCLUDED IN JOSPT LBP CLINICAL GUIDELINES

Hypomobility Treatment

Dural Mobilizations: Tensioners and Sliders.

- May be considered Therapeutic exercise or Neuromuscular Re-education versus Manual Therapy.
- Lower Quarter Nerve Mobilization Procedures = C (Weak) Evidence in the JOSPT LBP Clinical Guidelines.



Functional & Clinical Instability

Finding Instabilities

Intervertebral Motion Testing

Accuracy of the clinical examination to predict radiographic instability of the lumbar spine. European Spine Journal. 2005; 14(8): 743-750. Fritz JM et al.

- A Central Poster-Anterior (CPA) test finding of “**lack of hypomobility**” was the **BEST** individual test for diagnosing lumbar instability.
- If a clinician had 50% certainty that a patient had lumbar instability, then a “lack of hypomobility” based on CPA testing would increase the probability of instability to 90%.
- Combining a finding of lumbar flexion AROM of >53 degrees with a CPA test finding of a “lack of hypomobility” increased the likelihood of instability from 50% to 93%.

Biomechanical Exam Results

- If **PPIVM** or PPM Tests are negative (-), then joint movement is normal OR if felt to be excessive a **joint instability or hypermobility** is present.
- **PAIVM** or PAM would be also be (-) so normal or excessive joint movement present which is difficult to assess (so a lack of hypomobility may be adequate).
- **PA's** would be (-) for hypomobility but may be (+) for pain or muscle hypertonicity (might have pain with PAIVM too).
- **Secondary Stress Tests** (segmental or joint stability test) can help ID instability (which is often difficult to assess).

Functional Instability Exam Findings

History Findings:

- Episodic LBP
Often progressively worsening. But may be first episode.
- Subjective Crepitus, Clunk, or “Giving Away” with Bending or Twisting.
- Greater Pain Returning From Flexion, Than With Flexion.
- Difficulty Changing Positions (Catching, Locking, Pain):
Rolling in bed, supine to sit, sit to stand, etc.
- Discomfort Or Pain With Unsupported Sitting Or Sustained Positions.
- Increase Pain With Sudden or Mild Movements.
- Prior good but short term relief with manipulation.
- Frequently Feeling Need to “Crack or Pop” Back.
- Relief with immobilization—bracing.

Clinical Instability Exam Findings

Differential Diagnosis / Scanning Examination Findings:

- (+) Aberrant Spinal Motion with AROM Testing:
 - Gower's Sign: walking up thighs. Painful arc. Instability catch.
 - Reversal of lumbopelvic rhythm. Deviation from sagittal plane.
- (+) Excessive ROM and /or Pain at End Normal ROM.
- (+) H & I Tests: Combined Movement/Quadrant Tests.
- (+) Objective Crepitus or Clunk With ROM or Other Tests.
- (+) Prone PA Pressures: Provocative not Hypomobile.
- (+) Prone Instability Test (PA + PA with extensor contraction).
- (+) Secondary Stress Test (Sidelying Anterior Shear)
- (+/-) Primary (General) Stress Tests:
 - Traction, Compression, Torsion.
- (+/-) Directional Preference or Centralization:
 - Often instability pain with sustained positions.

Biomechanical Clinical Instability “CPR”

Presences of a Clinical Instability:

(+) History

(+) Differential Diagnosis Exam:

Excessive ROM / Hypermobility: A/PROM,
Quadrant Tests (H & I), PAs, Prone Instability Test.

(+) Biomechanical Exam: Hypermobility (**lack of hypomobility**):

PPIVM, PAIVM, PA & empty/ pain/ spasm end feel.

(+) Secondary (Segmental) Stress Tests (S/L Anterior Shear)

- Lumbar, Thoracic, Sacroiliac Joint, & Hip Assessed.

Hypomobilities often found in adjacent structures.



“LAB”: Objective Examination

A/PROM Testing (Part of Diff Dx Exam)

Lateral Shift Examination



Lateral Shift Correction Exercises



Active Range of Motion Testing

- Range of Motion: Degree or Percentage.
- Patient's Willingness to Move
- Pattern of Restriction
- Quality of Movement
- Presence of **Aberrant Motion**
- Onset and Type of Symptoms (kappa 0.51-0.76)
- Presence of **Centralization/Directional Preference**
- Typically the Cardinal Planes of Motion are Tested
- Combined Movements/Quadrant Tests are done if Full or Near Full ROM is Present.

AROM: Extension & Flexion



Presence of Aberrant Movement

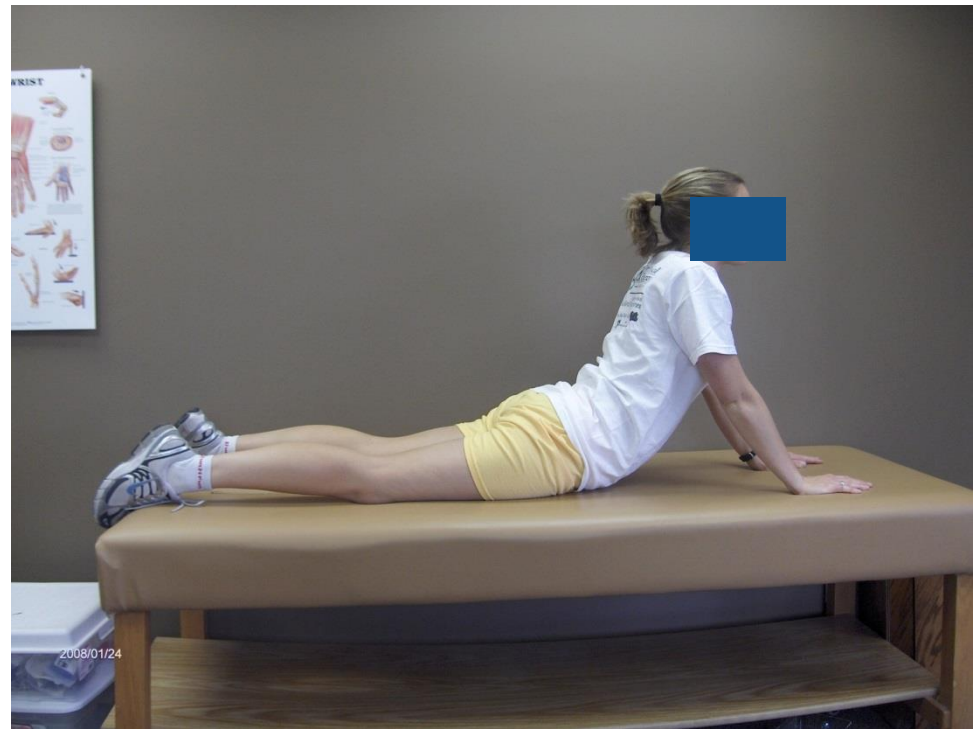
Includes the presence of any of the following:

- Painful arc with flexion or return from flexion
- Instability catch
- Gower Sign = Thigh climb
- Reversal of lumbopelvic rhythm

Directional Preference Therapy

- Clinician judges the behavior of symptoms in response to movement testing to assess whether **centralization or peripheralization** of symptoms occurs.
- The patient is asked to flex and extend in the sagittal plane (or laterally shift the pelvis in the frontal plane) in standing, supine/quadruped, and prone with single and repeated movements in a systematic fashion.

Extension Preference Exam



Flexion Preference Exam



Extension & Flexion Preference



AROM: Side Bending & Rotation



Passive Range of Motion Testing

- Passive assessment of the integrity of inert tissues: capsule, ligaments, bone, bursa, fascia, dura / nerve
- Test for:
 - * Amount of PROM: Degree or Percent.
 - * Range Differences Between Passive & Active Tests
 - * Patient willingness to move/anxiety with movements.
 - * End feel.
 - * Quality of Motion.
 - * Aberrant Movement patterns: Mode of Recovery from End-Position.
 - * Symptoms Produced (type and location)

PROM with Overpressure: Extension & Flexion



PROM with Overpressure: Side Bending & Rotation



Combined Movement/Quadrant Testing

- Tests both the ROM and function of the joint complex.
- Best used in subacute or chronic stages of healing.
- Can assist in detecting hypomobilities, hypermobilities, and instabilities.
- If planar motions fail to reproduce symptoms and AROM is full or near full, then combined motions can be introduced.
- Combined Motion: Typically Diagonal Patterns.
 - * H TEST:
(More sensitive detecting lateral instabilities)
 - * I TEST:
(More sensitive detecting A/P instabilities)

H & I: Quadrant Testing



Seated SLR & SLUMP Tests



Straight Leg Raise (SLR)



Prone Knee Bend Test





Objective Examination

Lumbar Primary Stress Tests
NOT INCLUDED



Objective Examination

Palpation & Peripheral Joint Screening
NOT INCLUDED



Objective Examination

Stabilization Strength Testing
NOT INCLUDED



Biomechanical Examination

PPIVM's, PAIVM's, and PA's

* Sign

- Key objective sign that warrants manual therapy treatment.
- Segmental joint hypomobility (PA, PPIVM, PAIVM).
- Hypertonicity/ myofascial restriction.
- PROM restriction.
- AROM and combined motion restriction.
- Can have subjective input like “Comparable sign” for finding painful hypermobilities/instabilities (Grade 1-2 treatments) or assist with finding hypomobilities (Grade 1-5 treatments).
- After treatment, this key objective finding is retested to confirm treatment effect or lack of effect.

Biomechanical Evaluation

1. Passive Physiological Inter-Vertebral Movements (**PPIVM**) or Passive Physiological Movements (PPM) in peripheral joints.
2. Passive Accessory Inter-Vertebral Movements (**PAIVM**) or Passive Accessory Movements (PAM) in peripheral joints: GLIDES.
3. Posterior to Anterior Pressures (**CPA/UPAs**).
4. Secondary Stress Test (Segmental or Joint Stability Tests).

Lumbar PPIVM/PAIVM

Passive Physiological Intervertebral (Segmental) Motion & Passive Accessory Intervertebral (Segmental) Motion: GLIDES.

- Flexion
- Extension
- Right/Left Side Bending
- Right/Left Rotation
- Combined Movements

Step Test: Positional Test

Lumbar Flexion PPIVM/PAIVM

- The pt is positioned in side lying facing the PT. They are asked to slide close to the edge of the table—the PT can place their fist close to the edge of the table to mark where the patient should lie.
- PT's cranial arm hooks under the pt's top arm & the PT's hand palpates for segmental motion.
- PT's caudal arm holds the pt's legs against the PT's thighs. Flexion motion is introduced by the PT's arms & body.
- Overpressure (PAIVM) can be done with caudal hand while stabilizing the top segment with the cranial hand.

Lumbar Flexion PPIVM/PAIVM



Lumbar Extension PPIVM/PAIVM

- The pt is positioned in side lying facing the PT. They are asked to slide close to the edge of the table. The pt moves their shoulder back toward the center of the table to bias extension.
- PT's cranial arm hooks under the pt's top arm & the PT's hand palpates for segmental motion.
- PT's caudal arm holds the pt's legs against the PT's thighs with the pt's knees flexed. Extension motion is introduced by the PT's arms & body.
- Overpressure (PAIVM) can be done with caudal hand while stabilizing the top segment with the cranial hand.

Lumbar Extension PPIVM/PAIVM



Lumbar Side Bending PPIVM/PAIVM

- The pt is positioned in side lying facing the PT. They are asked to slide close to the edge of the table.
- PT's cranial arm hooks under the pt's top arm & the PT's hand palpates for segmental motion.
- PT's caudal arm holds the pt's pelvis against the PT's body. Side bending motion is introduced by the PT's arms & body.
- Overpressure (PAIVM) can be done with cranial hand while stabilizing the lower segments through the pelvis.
- Side bending can be done ipsilaterally (L SB if in R S/L) or contralaterally (R SB if in R S/L).

Lumbar Side Bending PPIVM/PAIVM



Right SB



Left SB

Lumbar Side Bending

PPIVM/PAIVM: Alternative

- The pt is positioned in side lying facing the PT. They are asked to slide close to the edge of the table.
- PT's cranial arm hooks under the pt's top arm & the PT's hand palpates for segmental motion.
- PT's caudal hand holds the pt's legs above the ankles with the pt's legs against the PT's thighs. Side bending motion is introduced by the PT's arms & body by raising or lowering the patients distal legs. Can do ipsi- & contralateral SB.
- Overpressure (PAIVM) can be done with cranial hand while stabilizing the bottom segments through the pelvis.

Lumbar Side Bending

PPIVM/PAIVM: Alternative



Right SB



Left SB

Lumbar Rotation PPIVM/PAIVM

- The pt is positioned in side lying facing the PT. They are asked to slide close to the edge of the table.
- PT's cranial arm hooks under the pt's top arm & the PT's hand palpates for segmental motion.
- PT's caudal arm stabilizes the pt's pelvis against the PT's body & the caudal hand palpates for motion of the inferior segment.
- Rotation motion is introduced by the PT's cranial arm & body.
- Overpressure (PAIVM) can be done with cranial hand while stabilizing the bottom segment with the caudal hand.

Lumbar Rotation PPIVM/PAIVM



Lumbar Combined Motion PPIVM/PAIVM



Flexion, SB, Rot



Extension, SB, Rot

Lumbar/Thoracic Step Test

Positional Test:

- The patient is positioned in side lying facing the PT. The patient's top side is being tested.
- The PT positions the patient in flexion, rotation, and (contra-lateral) side bending and/or extension, rotation, and (ipsi-lateral) side bending combined motion positions.
- The lower thoracic and lumbar spine is visually inspected and palpated for deviation from a gradual, even curve from pelvis to the treatment table (like a spiral stair case).
- (+) = deviation from a gradual, even curve.

Lumbar/Thoracic Step Test



Flexion Bias



Extension Bias

Posterior to Anterior (PA) Pressures

- **Primary Stress Test : Pain Provocation** with Segmental PA Testing: PA pressure is applied at each spinal level and pain provocation is judged as present or absent (Spring Tests can be done multi-segmentally).
- **Segmental Mobility Test**: PA pressure is applied to each spinal segment movement. Movement judged as normal, hypomobile, or hypermobile (lack of hypomobility).
- Maitland/Cook use Central PAs and Unilateral PAs along with patient's feedback (**Comparable/* Sign**) vs end feel.
- Passive Physiological Intervertebral Motion (PPIVM) Tests and Passive Accessory Intervertebral Motion (PAIVM) Tests are part of the biomechanical examination and are used for clarification/validation of abnormal PA motion findings.
- Even though PA's are done segmentally, they are considered a primary/general stress test.

Posterior to Anterior Pressures: Central PA's (CPA's)



Posterior to Anterior Pressures: Unilateral PA's (UPA's)



Positional Testing

- Osteopathic (Michigan State) Approach: Muscle Energy.
- Extended, Rotated, and Side bent (ERS) and Flexed, Rotated and Side bent (FRS) biomechanical diagnosis based on visual inspection and palpation of individual vertebra in neutral, flexion, and extension.
- Potentially less reliable than segmental motion testing.
- Anomalies & asymmetries are common / “normal”.
- Have not seen research on this nor is it included in the JOSPT LBP clinical guidelines.
- Can be a helpful clinical tool for some clinicians.

Positional Testing

- Positional testing done in neutral, flexion, & extension to give a positional diagnosis: flexed, side bent, & rotated (FRS) or extended, side bent, & rotated (ERS).
- Can have (+) positional findings for hypomobility, hypermobility, anomaly, or compensatory scoliosis.
- Therefore, not specific for biomechanical movement dysfunction – can be combined with motion testing.
- Additional testing needed to confirm hypomobility versus other potential (+) findings.



Biomechanical Examination

Lumbar Secondary Stress Tests

Prone Instability Test & Modified Prone Instability Test

Prone Instability Test (More of a Primary Stress Test)

- Patient is prone with legs over edge of table and feet resting on floor. PT applies PA force to lumbar spine (segmentally). Any provocation of pain is noted.
- Patient lifts LE's off floor and PA re-applied to lumbar spine (segmentally).
- (+) if pain is present with PA in resting position but subsides in the contracted position.
- Modified Pone Instability Test: Prone PA then prone PA with LE's lifted of table (better flow with examination process).

Prone Instability Test & Modified Prone Instability Test



Segmental Stability Test: Anterior Shear

Anterior Shear (Biomechanical exam: secondary/segmental test)

- Patient is in sidelying with hips flexed and lumbar neutral.
- An anterior shear force implemented by stabilizing the top segment and pushing the patient's bottom segment posteriorly through the patient's femurs.
- (+) = pain reproduction and/or therapist's palpation of muscle guarding or excessive segmental motion/glide (crepitus / catching / clicking) .
- Can re-test with transversus abdominis contraction.
- Can re-test with posterior pelvic tilt.

Segmental Stability Test: Anterior Shear with TrA

Anterior Shear with TrA activation (ADIM/Kegel)

- If anterior shear test is (+) retest that segment with lumbar spine still in neutral and add transversus abdominis (TrA) contraction (ADIM/Kegel).
- If symptoms reduce then treat with stabilization program.
- If still (+) then worse prognosis.

Segmental Stability Test: Anterior Shear with PPT

Anterior Shear with posterior pelvic tilt (PPT)

- If prone instability test is (+) then retest that segment in lumbar flexion to get stability from posterior ligaments and fascia.
(Posterior Longitudinal Ligament/Supraspinous Ligaments etc).
- If symptoms reduce than better prognosis and can use posterior pelvic tilt rehabilitation strategy.
- If still (+) then worse prognosis.

Segmental Stability Test: Anterior Shear





Biomechanical Examination

Other Secondary Stress Tests

NOT INCLUDED



Lumbar Treatment

Manual Therapy

Manual Therapy

Contra-Indications

1. Evidence that condition is not musculoskeletal: Cancer, bone disease, infections process, septic or traumatic arthritis, acute RA or AS
2. Evidence of serious trauma: fracture, dislocation, rupture, bony or empty endfeel, adverse joint environment (spasms)
3. Long term steroid use
4. Bleeding disorder/ on anticoagulants
5. Signs/symptoms of spinal cord involvement
6. Cauda Equina Signs/ Symptoms

Manual Therapy

Contra-Indications

7. Involvement of more than one spinal nerve root (C/T spine) or >2 adjacent or 2 non-adjacent nerve roots (L-spine).
8. 1st or 2nd lumbar root palsy
9. Sign of Buttock
10. Sign of Vertebro-Basilar Insufficiency (VBI)
11. C1/C2 Transverse ligament instability
12. Emotionally dependent patient.

Manual Therapy with Caution

1. Rheumatoid Arthritis
2. Osteoporosis
3. Past History of Cancer
4. Systemic Steroid Therapy
5. Pregnancy
6. Presence of Neurological Signs:
Fatiguable weakness of key muscle (myotome),
Deep tendon reflex changes,
Dermatomal sensory changes, Pathological Reflexes—
NOT pain (referred or radiating pain not a neuro sign)

Manual Therapy with Caution

- 7. Primary Posterolateral Disc Protrusion
- 8. Hypermobility / Instability
- 8. Spondylolisthesis
- 9. Acute Inflammation Signs/Symptoms
- 10. Dizziness
- 11. Cervical Trauma Onset of Symptoms
- 12. Chronic Pain Central (& Peripheral) Nervous System Sensitization

General Manual Traction

Supine Lumbar Traction Via Leg Pull:

- Bilateral, Unilateral.
- Variable Angles (0-60), (70-90 From Pelvis) +/- Belt.

Prone Lumbar Traction Via Leg Pull:

- Bilateral, Unilateral.
- Variable Angles (0-30) +/- Belt.

Directional Preference

- Lateral Shift +/- Manual Therapy
- Extension Preference Exercises +/- Manual Therapy
 - Graded Mobilizations
 - Mobilizations with Movement
- Flexion Preference Exercises +/- Manual Therapy
 - Graded Mobilizations
 - Mobilizations with Movement

Lumbar Segmental Locking for Traction, Mobilizations, & Manipulations

Locking from Above:

1. Neutral (not flexed or extended).
2. Flexion: SB/ipsilateral rotation & SB/contralateral rotation.
3. Extension: SB/ipsilateral rotation & SB/contralateral rotation.

Locking from Below:

1. Neutral (not flexed or extended).
2. Flexion: SB/ipsilateral rotation & SB/contralateral rotation.
3. Extension: SB/ipsilateral rotation & SB/contralateral rotation.

5 options from above & 5 from below = **25 positional options**

Lumbar Mobilization Treatments



Traction: Neutral Lock From Above and Below



Side Lying Blanket Roll
Semi-Specific Traction

Lumbar Mobilization Treatments



Extension: Extension Lock From Above and Below



Flexion: Flexion Lock From Above and Below

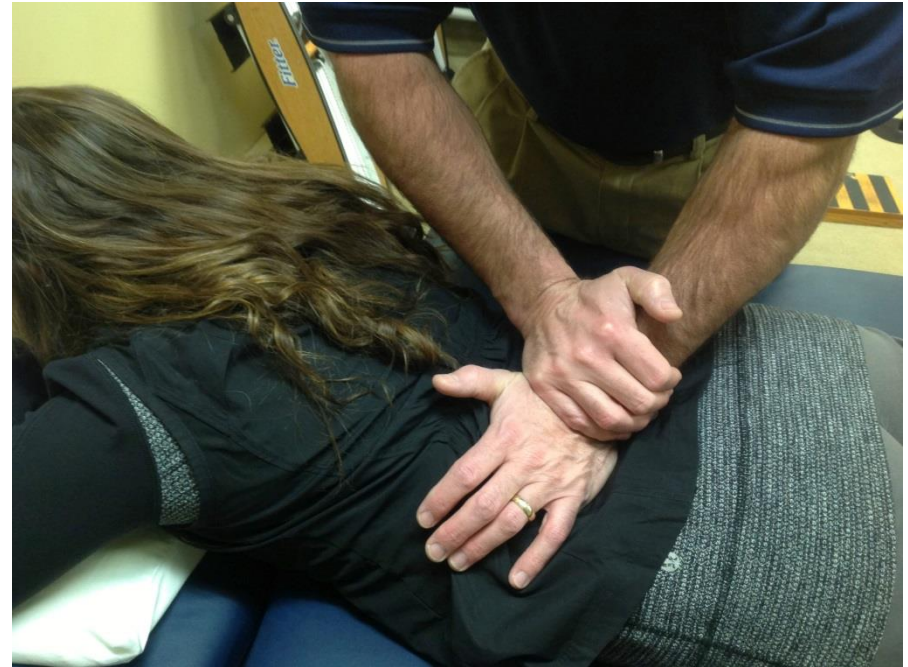
Lumbar Mobilization Treatments

- Posterior to Anterior Pressures (PA/CPA/UPA)
 1. Reduce pain.
 2. Improve motion-Extension
(non-physiological motion).
 3. Improve disc hydration.
- Graded Joint Mobilization for Treatment.
- Mobilization with Movement:
Combined With Extension Exercise

Lumbar Mobilization Treatments

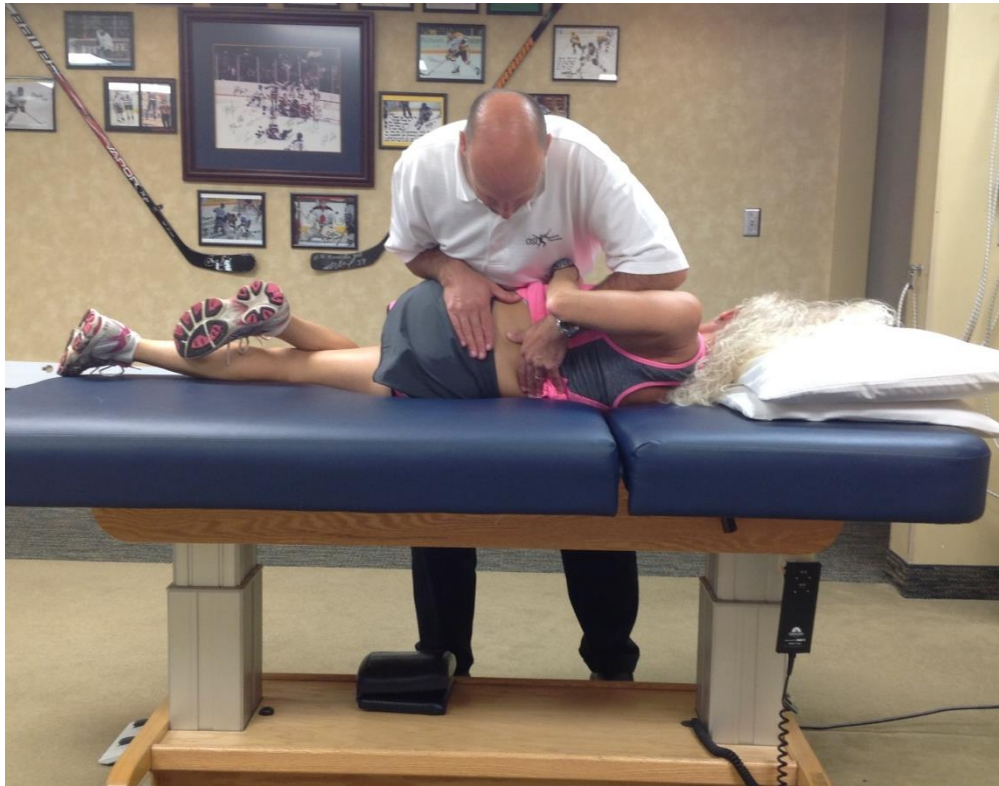


Central PA's



Unilateral PA's

Lumbar Segmental Manipulations



Gapping: Neutral Lock From Above and Below

Lumbar Segmental Manipulations



Extension: Extension Lock
From Above and Below



Flexion: Flexion Lock From
Above and Below

Lumbar Non-specific Manipulation





Lumbar Treatment

Early Lumbar Stabilization Concepts

Stabilization Therapy

- Avoidance of excessive ROM by patient
- Posture and Body Mechanics Correction
- Reduce stress from adjacent joints : treat surrounding hypomobilities including hips, thoracic and lumbar spine, SI Joints—Biomechanical Exam & Manual Therapy.
- Anti-inflammatory modalities if necessary
- Bracing if necessary (Structural/Clinical Instability)
- Remove or decrease pain/reflex inhibition if necessary with de-facilitation manual therapy techniques
- Stabilization Therapy/Exercises

Stabilization Therapy Sequencing

1. Pelvic Floor
2. Abdominal Muscles: Transversus Abdominis, Internal/External Obliques, Rectus Abdominis.
3. Multifidus.
4. Hip Stabilizers if needed: Glutes & Hamstrings
5. Psoas if needed
6. Diaphragm if needed .

Specific Exercises Not Covered Today



Regional Interdependence: Biomechanical Aspects of Clinical Reasoning

Thoracic & SI Joint Exam & Treatment

Next Presentations



References

Evidence Based Practice

Research Component of Evidence Based Practice

- American Physical Therapy Association (APTA):
Physical Therapy Journal (PTJ).
- Orthopedic Section of the APTA: Journal of Orthopaedic and Sports Physical Therapy (JOSPT).
- 2012 JOSPT Low Back Pain Clinical Practice Guidelines.
- American Academy of Orthopaedic Manual Physical Therapist (AAOMPT): Journal of Manual & Manipulative Therapy (JMMT).
- Links from AAOMPT, MAPS, NAIOMT, Physiopedia etc.

NAIOMT

- Level I: Bill Temes, PT, OCS, COMT, FAAOMPT.
- Level II A: Michele Roy, PT, MCPA, FCAMT.
- Level II B: Michele Roy, PT, MCPA, FCAMT.
- Level III A: Jim Meadows, PT, MCPA, FCAMT.
- Level III B: Erl Pettman, PT, MCSP, MCPA, COMT.
- Level IV: Erl Pettman, PT, MCSP, MCPA, COMT.

2010 NAIOMT Symposium:

- Functional Approach to Motor Control Rehabilitation of the Lumbopelvic Complex. Kathy Berglund, PT.
- Hidden Link of Spondylolisthesis. Ken Cole, PT; Mark Looper, PT; Laura Von Wullerstorff, PT.
- Thoracolumbar Syndrome. Kent Keyser, PT.
- The “Dynamic” Pelvis. Erl Pettman, PT.

NAIOMT

2015 NAIOMT Symposium: Sacroiliac Joint.

- Overview of Anatomy/Function: Earl Pettman, PT.
- SI Joint: Cliff Fowler, PT.
- The True Role of SI Joint in Lower Quadrant Dysfunction: Ann Porter Hoke, PT.
- Odd Dysfunction Presentations in the SI joint: Kent Kayser, PT.
- Is this SI joint pain?: Susan Clinton, PT
- SI joint pain in runners: Kathy Stupanski, PT.

Chad Cook: Medbridge

- Evidence Based Evaluation of Lumbar Spine
- Evidence Based Treatment of Lumbar Spine
- Evidence Based Evaluation of Thoracic Spine
- Evidence Based Treatment of Thoracic Spine

(Chad Cook is a Maitland/MAPS Trained PT)