Mastering The Disc

Seminar Goals
1. Improve patient outcomes by identifying the derangement and direction of benefit.
2. Improve your certainty/specificity about the care you give and the exercise you prescribe through the use of mechanical testing.
3. Help patients take an active role in their own care through education and exercise.
4. Identify and treat the source of neck and lower back pain using a system of mechanical testing and manual therapy skills. The focus will be on the discs.

Mastering The Disc (cont’d)

Seminar Goals Continued:
5. Demonstrate the value and necessity of repetitive movement testing, end range loading strategies, and the use of baselines and guidelines (evidence based approaches) to properly assess mechanical problems.
6. Apply these same principles to the extremities
7. Expect immediate and dramatic results with each and every new patient.
The Truth

Well over 70% of *spinal and extremity conditions are derangements, can be evaluated in a mechanical and predictable manner, and have the ability to be rapidly reversibel!

*disc

What if?

Sprain

“IT IS MY BELIEF THAT IN THE LUMBAR SPINE, IF IN NO OTHER AREA, THE DISTURBANCE OF THE INTERVERTEBRAL DISC MECHANISM IS RESPONSIBLE FOR THE PRODUCTION OF SYMPTOMS IN AS MANY AS 95% OF OUR PATIENTS”

Robin McKenzie
Key Points

- The DISC degenerates 1st — before arthritis (facets)
- About 70 - 80% of LBP sufferers have characteristics of directional preference and centralization at the initial visit, and are classified as DISC derangements
  - Another 60% go on to centralize after the initial visit
- 50% of healthy young adults have at least one level of DISC degeneration / bulging (that's using a recumbent MRI, and it's not counting internal disc derangement) - No signs of muscle strain
- Injuries often occur in A.M. and involve flexion
- 9 out of 10 work injuries involve flexion/rotation
- Neck and LBP often an obstructive type lesion (positive kemp, cerv. compression tests, pain with press-up)

Recurrences worsen over time

- Spreading into their legs (Precursor to disc herniation)
- Increase in severity and duration, until the latest episode no longer recovers as in the past, and becomes chronic
- More disabling, resulting in more lost work days than in the previous episodes
- Increase costs to both the patient and society

LBP: Is it truly self-limiting?

Although the majority of patients discontinue seeking medical care for their LBP, nearly 80% of these patients continued to experience some pain or disability at one year following their initial clinical visit for LBP.


After 1 Year

- Only 21% completely recovered at 3 months
- 33% still experiencing moderate intensity LBP
- 15% still having severe LBP
- 20-25% reported substantial activity limitations

*Kongstead A, Kent P, Hestbaek L, Vach W. Patients with LBP had distinct clinical course patterns that were typically neither complete recovery nor constant pain; a latent class analysis of longitudinal data. Spine J. 2015 May 1;15(5):885-94.

- 1,082 patients treated by PCP only

The majority of PCP patients do not become pain-free within a year

Identify and treat the Sprain!
Much of the healthcare profession is giving exercises in the same direction of movement that led to the injury in the first place!

Adams and Hutton 1982; King 1993; Gordon et al 1991; Wilder, Pope, and Frymoyer, 1988; Callaghan and McGill 2001

Repeated or sustained flexion is necessary to cause herniation

“In fact, herniation of the disc seems impossible without full flexion”

Stuart McGill


FLEXION BIASED WORLD

This study used sensor strips on 208 non-symptomatic volunteers during daily living to measure sagittal spinal movements over 24 hrs. Volunteers spent much more time in flexion than extension, reaching full flexion 50 times and zero times reaching full extension. This study substantiates the previous data suggesting a great predominance of flexion in everyday life.
Why is the spine treated so differently?


- Followed 200 persons without prior significant LBP over a 5 yr. period (MRI baselines performed)
- 51 had 2nd MRI shortly after an episode of severe acute back pain
  No Signs of Muscle Strain

Disc Derangement

- Occurs when the internal contents of the disc are disrupted or altered due to injury to the annular wall, resulting in limited or abnormal movement and possible pain.

- Caused by mechanical deformation of soft tissues as a result of internal derangement. Alteration of the position of the fluid nucleus within the disc, and possibly the surrounding annulus, causes a disturbance in the normal resting position of the two vertebrae enclosing the disc involved. (McKenzie)

Sprain/ Weakness

Obstructive Type Lesion!

Obstructive Lesion

Kemp’s Test
Cervical Compression Test
Types of Disc Derangements

2. Posterior Disc Derangements
   (with or without relevant lateral component)

2. Anterior Disc Derangements

Posterior Disc Derangement

When the contents of the disc are disrupted or altered due to a sprain/weakness to the posterior annular wall

*extension is often painful and/or obstructed

McKenzie (extension) Exercises
Anterior Disc Derangement

When the contents of the disc are disrupted or altered due to a sprain/weakness in the anterior annular wall

*forward flexion is often painful and/or limited


Demonstrated that anterior herniations also can be a source of pain
Derangements

- The repetition of test movements or sustained postures can have a rapid effect on this condition and the patient may improve or worsen in a matter of seconds/minutes, depending on the direction of movement and posture. (rapidly reversible)

- Associated with the *centralization phenomenon*, *peripheralization* and *directional preference*


Centralization

- Centralization occurs when symptoms lessen at their present location, or travel closer to the midline of the spine with certain movements or postures by the patient. A transient increase in central discomfort may be associated with centralization.

- Centralization is often accompanied by an increase in range of motion due to a reduction in the derangement.

- Well established phenomenon in which symptoms originating from the spine, but not necessarily felt there, are abolished distally to proximally, in response to therapeutic loading strategies.


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The prevalence rate of pure or partial centralization was 70% in 731 *sub-acute* back patients, and 52% in 325 *chronic* back patients. It is a symptom response that can be reliably assessed during examination. Centralization was consistently associated with a range of good outcomes, and failure to centralize with a poor outcome. Centralization appears to identify a substantial sub-group of spinal patients; it is a clinical phenomenon that can be reliably detected, and is associated with a good response. Centralization should be monitored in the examination of spinal patients.

“Centralization was the only clinical feature found to increase the likelihood of the discs as the source of pain”

Peripheralization

- When symptoms intensify in their present location or travel further away from the midline of the spine with certain movements or postures.

- Directions of movement and postures that lead to peripheralization are often ones that cause further derangement/obstruction.


PAIN PATTERNS
(Centralization vs. Peripheralization)
Discogenic Stimulation and Patterns of Referred Pain

Spine; Dec 15, 2002;27(24):2776-81

25 patients undergoing intradiscal electrothermal annuloplasty (IDET) were studied for pain response to the procedure. All provoked pain was familiar to the patients. 16 had back pain only, 6 back and thigh, 3 radiated into the calf. The distance pain was referred correlated to intensity of stimulus as measured by heat and duration, and always preceded in order from back, then calf.

Directional Preference

- The direction of repeated movements or sustained postures that reduces the derangement (not just extension!)
- Marked by centralization and/or an increase in R.O.M.
- Often the opposite motion of excessive mechanical stress
  *offers a green light in terms of management strategy and direction of force with manipulation


Inverse relationship between excessive mechanical stress and directional preference
Since symptomatic response determines directional preference, it supports the need and benefits for an extensive mechanical lumbar assessment (repeated movement testing, sustained postures)

Disc Derangements
- Ability to be rapidly reversible (*gel-like property)
- Centralization phenomenon
- Directional preference
- Obstructive Quality

Review of the Literature
- Out of 130 patients, 86-90% classified as derangement (Razmjou et al 2000, Kilipkoski et al 2002, Clare et al 2005)
- Out of 1056 patients, 70% prevalence rate of centralization (Aina et al 2004)
- Out of 312 patients, 75% showed directional preference (Long et al 2004)
- Out of over 600 patients, 78% classified as derangement (May 2006)
- Out of over 300 patients, 80% classified as derangement (Hefford 2008)

From a range of study designs involving well over 2000 patients, the figures are very consistent – 70-80% of back *and neck* pain demonstrate directional preference, centralization phenomenon, and derangement classification. 

70 – 80% rapidly reversible


Up to 60% of patients who do not centralize at the first visit go on to demonstrate centralization

**BILATERAL PAIN?**

*Alternating Pain?*
Common Signs and Symptoms of Posterior Disc Derangements

LMNOPQRST

Strong Signs
- pain/stiffness/forward flexed with rising
- forward flexed antalgia, lateral shift
- radicular pain
- **Painful/obstructed Extension**
- Alternating pain
- Mechanism of injury – *Flexion*
- Worse in the a.m.

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Prolonged sitting or standing decreases disc height by driving water out of the disc matrix. The deformation and reduced thickness of the disc is thought to increase laxity of the posterior points, which increases the range of intervertebral motion, as well as the possibility of instability and injury. Prolonged recumbency then restores the original disc shape and volume as water returns to the matrix. *Forward bending and lifting activities generate particularly high bending stresses on the lumbar spine when performed in the first hour after rising*.

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After Bed Rest

- Increased posterior disc height
- Decreased lumbar lordosis

Limiting forward bending in the morning effective in reducing symptoms in a group of back-troubled patients.

Causes of Posterior Disc Derangements
(Posterior Annular Wall Sprain)
1. *Poor Posture* (Slouched sitting for long periods)
2. *Poor Body Mechanics* (lifting/bending/exercise, etc. without maintaining lordosis)
3. Trauma
4. *Regional Interdependence* (tightness/instability)
5. *Lifestyle* (diet, smoking, overweight, etc.)
6. *Cumulative Trauma* (forward flexion & rounded lower backs)

Adams and Hutton 1982; King 1993; Gordon et al 1991; Wilder, Pope, and Frymoyer, 1988; Callaghan and Mcgill 2001

Repeated or sustained flexion is necessary to cause herniation

“In fact, herniation of the disc seems impossible without full flexion”

Stuart McGill
“at any time, the annulus resists twisting movements with only half of its compliment of collagen fibers”


Increased risk of disc herniation in those who perform sedentary jobs.


• Decrease disc height and lumbar lordosis after sitting 15 min.

• Increase in disc height after chair decompression exercises (4 sets of 5 second holds)
2 Common Exam Findings

1. Pain or Obstruction in Extension (+ Kemps, + cervical compression test)
2. Worse after Flexion

How do we evaluate disc lesions?

INFLAMMATION

Irritable
- Difficult to accurately diagnosis
- Difficult to determine directional preference
Mechanical vs. Chemical Pain

**Mechanical Pain**
- No significant inflammation
- *Intermittent pain (comes and goes with certain movements)*
- Often better as the day goes on with movement and activity (unless prolonged sitting or frequent flex)
- Can usually determine a specific direction that effectively reduces disc derangement
- Pain abolished with lying down and/or traction
- *Lasting improvement with correction of derangement*

**Chemical Pain (Inflammation)**
- Symptoms *fairly constant*, even at rest (difficulty sleeping)
- Throbbing/Pulsating
- Sometimes worse with activity and toward end of day.
- Initial stiffness after inactivity
- Sometimes better upon wakening (better with rest)
- Temporary improvement with NSAIDs & ice
- Swelling (not seen in the spine)
- *No clear direction of correction with lasting benefit* (repetitive movement exam often aggravates pain)
Side-lying Test
(less painful side down)

To successfully treat LBP, or joint pain anywhere, you must first resolve the issues of inflammation. Inflammation will undermine the effectiveness of manipulation, mobilization, exercise and other active care.

Reduce Inflammation 1st

To successfully treat LBP, or joint pain anywhere, you must first resolve the issues of inflammation. Inflammation will undermine the effectiveness of manipulation, mobilization, exercise and other active care.

Anti-Inflammatory Approach

- Ice (hours)
- Natural Anti-inflammatory Supplements
- NSAIDs (steroids for more severe inflam. cases)
- Neutral Postures (mid-range)
- Sometimes Rest

No Stretching
No Heat
Avoid / Limit Sitting *No mixing
No Mixing and Matching

I’ve tried ice and I’ve taken NSAIDs, but they’re not helping.

End Range Loading Strategies

*Repeated end range movements and/or sustained end range positions are required to influence and assess the integrity of the disc.

*and also to correct the disc derangement


“The McKenzie assessment was found to be superior to MRI in distinguishing painful from non-painful discs.”
Disc surgery reduced by 2/3 in a county where McKenzie assessment was utilized as a screening tool prior to surgery. 

32-52% of pre-surgery patients centralized and avoided surgery. 


(Contant, 2003) (Cedogan, 2011)

- Over-reliance on single orthopedic tests
- Single orthopedic tests can be unreliable
- Lack of research to support conventional orthopedic testing


In response to shear deformations, the nucleus pulposis exhibited significant viscoelastic effects, characteristic of a fluid and a solid.
Fennel AJ, Jones AP, Hukins DW. Migration of the nucleus pulposis within the intervertebral disc during flexion and extension of the spine. Spine 1996; 21 (23):2753-2757

In vivo flexion tends to cause posterior displacement of the nucleus pulposis and extension causes anterior displacement using MRI.


- Between flexion and extension, a significant increase in anterior disc height and anterior displacement of the nucleus was observed.
- Hyperextension gave a significantly increased height recovery compared with prone posture.
- Hyperextension could be considered as prophylaxis against the height loss in occupational loading.
- In asymptomatic individuals, posterior bulging of the disc occurred with flexion and usually decreased with extension.
Aultman-CD; Scannell J; and McGill SM. Predicting the direction of nucleus tracking in bovine spine motion segments subjected to repetitive flexion and simultaneous lateral bend. Clinical Biomechanics (2005) 20: 126-129.

*The direction of bending will determine the location of annulus damage

(i.e. Forward flexion to the right will likely lead to posterior lateral bulge to the left.)

Baselines and Guidelines

(Objective and Subjective)

- **Extension baseline (obstructive lesions)**
  - Centralization/Peripheralization (symptom response – subjective)
  - Assessing R.O.M. before and after different movements and postures (mechanical response - objective)
Extension Baseline

- In a sense, when a patient leans back, that's frequently the disc bulge they are feeling.

- Extension provides critical information as to the size, location and overall irritability of the disc at any moment in time. It's like taking a snapshot of the disc.

- There's no better baseline than extension to assess for changes in the disc!

Extension Baseline

- An extension baseline in the form of a standing extension and/or press-up extension is a valuable tool that can be used before and after each test or exercise to quickly determine the effect a particular movement had on the contents of the disc — especially the size of the bulge.

3 key findings:

- 1) The intensity of symptoms.
- 2) The location of symptoms (especially the most distal location)
- 3) "The R.O.M. at which symptoms are experienced.

End range loading strategies, baselines and patient feedback help to identify derangements (rapidly reversible conditions/complaints), determine direction of correction, and to move forward with a proven treatment strategy.

No Guesswork
Testing the Integrity of the Posterior Annular Wall

(Look for signs of peripheralization during testing And after testing – including further loss of motion)

STEP 1: Initial Baseline

1. Perform Initial Extension Baseline
   - Standing Extension and/or Press-up
   - Standing Extension – Rotation (Kemp’s Test) (for asymmet. or unilateral pain)

2. Note:
   1. Location of symptoms (esp. most distal)
   2. Intensity of symptoms (including stiffness, pressure, “feel good pain”, etc.)
   3. *R.O.M. at which symptoms are experienced

Far Lateral Derangements

- Extension may be painless

- ADD 1) Standing Kemp’s Test and/or 2) pure Lateral Flexion as pre and post baselines.

Some lateral derangements are not easily influenced by Repeated Flexion and/or Extension Testing
STEP 2: Load Back Wall & Assess

Perform Forward Flexion Testing (look for peripheral.)

1. Repeated Forward Bends (10-20 reps of 1-2 second holds – do not return fully)

2. *Slouched Sitting (3-10 minutes)

3. Knee to Chest Stretches (same)

**perform all 3 tests if necessary and look for signs of peripheralization, including increased difficulty with rising

Flexion Testing

Bent Knee Forward Bends  Slouched Sitting Test  Knees to chest

Back Bending vs. Hip Hinging
STEP 3: Follow-up Baseline & Reassess

Perform Follow-up Extension Baseline (note any changes in location of symptoms, intensity of symptoms, and ROM at which they are experienced)

*look for signs of peripheralization (including loss of extension ROM)

Press-up  Standing Extension  Standing Kemps

Positive Findings for Posterior Wall Weakness

• Peripheralization during testing (including increased difficulty with rising)

• Signs of peripheralization with follow-up extension baseline (especially reduced R.O.M. in extension)
Reasons why a true posterior disc derangement fails to worsen with flexion

1. Already at full derangement (may actually reduce slightly with the repeated extension that can occur when rising from forward bending)

2. Small percentage of degenerated discs/herniations reduce with flexion

3. Inflamed

4. Far lateral derangement (Extension may be painless; may not be easily influenced by Repeated Flexion and/or Extension Testing

Paradoxical Pain Responses

The initial response is the opposite of what you would expect (false negatives)

(i.e. repeated flexion appears to centralize pain and/or lead to better extension)

2 main reasons

1. Prior sitting
2. Extension Involved with rep.
3. Standing flexion

STEP 4: For those with neg. exam findings, yet painful and/or obstructed extension

- Confirm by correcting the derangement
- Perform Disc Reducing Exercises (attempt to restore full and pain-free extension)
  - retest in flexion after
- Necessary, due to such a high rate of posterior disc derangements (And also to avoid being fooled because a small % of deg. discs move forward with flexion)
• **Reduce first** (if pain with extension testing)

• **Flexion Testing Second** (quicker and more accurate after the disc has been reduced)

  It's much easier to make a disc bulge worse after it has first been reduced

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**Test After**

*(during report of findings)*

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• **Assume posterior derangement** *(if patient has symptoms/limited motion in extension)*

• **Skip the assessment** *(the provocative portion and don't even consider the small percentage of ant. der.)*

• **Try posterior disc reducing exercises** *(1-5 min.)*
Posterior Disc Reducing Exercises

Central or Symmetrical Pain
1. Standing Extensions
2. Press-ups (w or w/o overpressure)
3. Prone Lying With Pillow(s)

Unilateral or Asymmetrical Pain
4. Lateral Flexion
5. Rotations
6. Press-ups with painful side leg off (w or w/o overpressure)

Goals

1. Centralize pain

2. Restore full and pain-free extension
   (Fully reduce the derangement – including excessive “stiffness”)
PAIN IS O.K.

Three Possible Outcomes (when reducing disc)

1. **Peripheralization** (pinching the disc too soon and possibly increasing the derangement – includes loss of extension)

2. **No Change** (just hitting the disc; not reducing or increasing – irritating it)

3. **Centralization** (including incr. ROM in ext.) (able to get around bulge and reduce it)

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Signs of an effective disc reducing exercise

1. Centralization or painless while performing the exercise

   **And**

2. **Better in Extension after**

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Extension Baselines

1. Perform **Initial & Follow-up Extension Baselines**
   - Standing Extension and/or Press-up (Kemp’s)

2. Note:
   1. Location of symptoms (especially most distal)
   2. Intensity of symptoms *(including* stiffness, pressure, “feel good pain”, etc.)
   3. **R.O.M.** at which symptoms are experienced
Stiffness/pressure/rigidness and “feel good pain” with extension can be assessed and may be the only sign/symptom for some derangements.

Point out normal

Change matters; not intensity

Standing Extension

Rarely effective, initially. Used more often after recovery as a preventative exercise.

Lean back until you reach a pain level of 2-3, hold 1 sec, 5-10 reps.
Press ups

overpressure with sag
To either further reduce the disc or to evaluate more subtle disc derangements

Prone Lying w/ Pillow
(disc cannot be actively reduced and may, otherwise, be irreducible)

Begin pillow placement at level of ASIS

Prone Lying Pillow on Elbows

For bulges that don’t tolerate the stretch to the posterior annulus
Prone Lying Pillow
• Large & Small Discs
• Difficult Discs
• Discogenic Stenosis
• Spondylolisthesis
• To Fully Reduce Disc

Approximately 50 % of patients with posterior disc derangements will have a relevant lateral component that will not respond to extension, initially.


The goal for posterior disc derangements, however, will be to work toward and achieve full and pain-free extension. Only then is the derangement considered fully reduced.

Press ups with painful side leg off
(to address lateral component)

Combines extension & lateral flexion
Press up w/ painful-side leg off and overpressure

Contact lateral torso between ribs and iliac crest & lift toward opp. arm/shoulder region

*must be painless when applying overpressure

When applying patient or doctor generated forces (overpressure, mobilization with movement, traction), the exercise, movement or mobilization that was previously painful must now be absolutely PAINLESS!

*The purpose, in terms of disc derangements, is to apply traction to create a little more starting room in order to get around the disc.

Lateral Flexion (with forward flexion)
(for more lateral disc derangements – use standing extension as baseline before & after to verify it’s effectiveness)

Try a few different flexion angles – up to 45 degrees if nec.
Rotation
(painful side down)
(for a more lateral disc derangement - use press-up as a baseline to
double check effectiveness)

Faster for the
Dr to perform

Press ups w/ overpressure

Contact 1"-2" on each side of the spinous process & lift
toward the upper abdominal region (about 45° <)

*must be painless when applying overpressure

LPB Disc Reducing Exercise Order
1. Standing Extensions (7-10)
2. *Lateral Flexion (must be painless & better in extension after -
   try different angles)
3. Press-ups (7-10)
4. Prone lying pillow (painless within 2-3 minutes & better in
   extension afterward, different heights/placements)
5. *Press-ups (painful side leg off; must be better in extension after)
6. *Rotation (painful side down; must be better in extension after)
7. *Press-ups with painful side leg off with overpressure

*for unilateral or asymmetrical symptoms only

Exercises 2, 6 & 7 must be painless to perform
Posterior Derangement
Patients must reduce the derangement frequently with exercise, hold it in with good posture (must maintain lordosis) and limit their sitting and bending, for the posterior annular wall to tighten up and heal.

Common Mistakes
1. Ignoring baselines and instructing patients to perform exercises just because in theory they should work (i.e. extension for central pain, wall glides for pain to one side)
2. Giving up after standing extension and press-ups (won’t work initially in over 50% of cases)
3. Giving additional knee to chest stretches or posterior pelvic tilts, when extension was found to be the directional preference (to stretch in both directions)
4. Not recognizing and addressing inflammation first

Recommendations
1. Disc reducing exercises 4 to 6 times per day (1 to 2 sets of 8 to 10 reps) (5-15 minutes for time dependent exercises)
2. Limit sitting to 20 minutes at a time; when home – stand walk or lay down on less painful side down
3. Maintain lordosis at all times (no lying propped up in bed or in recliner with feet up, no back bending)
4. Perform core strengthening exercises 1 to 2x/day – must be painless and never worse in extension afterward
5. Can return to forward bending after about 7 to 10 days of no pain with extension (after posterior wall tests strong)
Each Subsequent Visit

- Re-assess effectiveness of initial disc reducing exercise
- Re-assess active extension exercises, if the patient began with rotation, lateral flexion, press-ups with painful side leg off or prone lying pillow
- Add stability / mobility exercises when appropriate
- PATIENT EDUCATION! (disc, posture, bending/lifting, exercise, trouble shooting)

Postural Re-education

- Sitting/Standing/Lying down
- Bending (9 out of 10 work injuries involve flexion-rotation)
- Rising
- Lifting (wide stance lifting, golfer’s lift, bracing....)
- Ergonomics


Lordosis helps preserve proper positioning of the nucleus pulposis.
Lifting & Bending

- Wide stance
- Tip the load
- Tripod
- Bracing
- Golfer’s bend
- Bridging

Proper Lifting Technique

- Maintain natural arch in lower back (look up, chest up before lift)
- Wide stance
- Keep the load close to body (approach from corner when possible)
- Left with the legs, not with the back
- Hinge at the hips, don’t bend at the back
- Up and down like an elevator, don’t bend like a crane
- Pivot at hips instead of twisting at lower back
- Brace with arms and legs when possible
- Assess the load and plan out your lift (use lifting devices/assistance)

Wide Stance Lifting, Tip the Load, Tripod Lift, Golfer’s Bend, Bracing (lean bar)

Mobility issues that affect proper lifting

1. Limited Hip Flexion
2. Limited Thoracic Extension
3. Limited Ankle Dorsiflexion
Core Strengthening

- Quad. opp. arm & leg
- Standing kick/punch
- Planks
- Prone opp. arm & leg
- One leg deadlift
- Hip in & outs
- Squat pose
- Backward lunge
- Deadbug
- Bridges


Segmental atrophy on the symptomatic side as quickly as 24 hours after the injury.


Atrophy of the multifidus muscle has been shown to persist years after the resolution of symptoms.


Atrophy is not confined solely to the multifidus. Atrophy also can develop in the iliocostalis, longissimus, psoas, and quadratus lumborum in subjects with chronic low back pain.

Study assessing the endurance of back stabilizing muscles in healthy teenagers and in teenagers with chronic LBP reported that poor endurance can occur in several groups of muscles. Teens with chronic LBP were found to have poor endurance of the trunk extensors, hip extensors and quads.


Back muscles are designed for endurance capacity. A stable spine requires endurable muscles, not necessarily strong muscles.

McGill S. Low Back Disorders: Evidence Based Prevention and Rehabilitation, 2002:130-1.

Muscle endurance, not strength, is linked to better back health.

Hollowing vs. Bracing

When the hollow and the brace were compared, the brace contraction produced significantly greater posterior to anterior stiffness of the spine.


- Abdominal bracing involves the co-contraction of the transverse abdominis, internal and external obliques, rectus abdominis, quadratus lumborum, erector spinae, and multifidus muscles

- Abdominal bracing emphasizes locking the rib cage to the pelvis, to eliminate spinal twisting or torsion by transforming the involved muscles into isometric stabilizers


- Bracing fostered torso co-contraction, reduced lumbar displacement and increased trunk stability

- Hollowing was not effective in reducing the kinematic response to sudden perturbation

- Hollowing, which isolates the multifidus and transverse abdominis, may decrease the activation of many muscles that are normally active during dynamic movements, thus preventing the natural abdominal co-contraction of the other core-stabilizing muscles.

- This process of isolating the multifidus and transverse abdominis comes at the cost of inhibiting the internal oblique, external oblique, and rectus abdominis.

Test for Return to Flexion

1. Test after 7-14 days of pain-free extension, and no stiffness with rising

2. 10 bent knee toe touches and 10 knee to chest stretches (hold 1-2 sec.)

Regional Interdependence

The idea that seemingly unrelated impairments in a remote anatomical region may contribute to, or be associated with, the patient's primary complaints

*alternating regions of stability / mobility

Van Tulder MW, Koes BW, Bouter LM. Conservative treatment of acute and chronic non-specific LBP. A systematic review of randomized controlled trials of the most common interventions. Spine. 1997;22(18);2128-56.

Interventions and treatment plans focused upon a single pathological structure can often result in poor outcomes, in particular with spinal disorders for which a pathoanatomic source tissue cannot be identified in the majority of cases.

Risk Factors for Future Injury

1. Previous injury (unavoidable)

2. Basic Stability and/or Mobility Issues

3. Right-to-Left Asymmetries

Hips, ankles, mid-back, coordination?
Clinical Prediction Rule

1. Score of < 19 on Fear Avoidance Belief Questionnaire
2. No symptoms distal to knee
3. Symptom duration of fewer than 16 days
4. Minimum of 1 hip with greater than 35 degrees internal rotation
5. Palpable hypomobility of the L-spine during posterior-anterior assessment

Mobility Screen for LBP Sufferers

1. Supine Hip Flexion
2. Supine or Seated Hip Internal Rotation
3. Standing Thoracic Extension
4. Standing or Seated Thoracic Rotation
5. Press-up (lumbar extension)
6. Hip Flexors & Hamstrings
7. Ankle Dorsiflexion

Low Back Pain Mobility Screen
Regional Interdependence

- Thoracic rotation
- Thoracic extension
- Ankle dorsiflexion
- Hip internal & external rotation
- Hip flexion
- Lumbar extension
- Hip flexors (Thomas Test)
- Hamstrings
Corrective Exercises

- Hip flex (knee to chest, chest to knee, mountain climbers, lion stretch, squats)
- Hip int. rot. (reverse clam shells, chest to knee with internal rotation)
- Hip ext. rot. (clam shells, st. hip in and out, add. stretch)
- Full body/thoracic rotation (Bretzel 1.0 and 2.0, seated rotation, reverse scorpion)
- Thoracic extension (seated, supine on foam roller, prone opposite arm and leg)
- Hip flexors, hamstrings, and ankle dorsiflexion
- Lumbar ext. (prone on elbows (can add knee flexion))


Subjects with chronic low back pain had less spinal extension ROM.

Patient Education

Discuss Report of Findings/Lifetime Maintenance
Possible Reasons Why Exercises or Mobilizations May Not Have Worked.

2. Inflammation
3. Not a posterior disc derangement problem (could be a facet, SI jt., anterior disc derangement, etc)
4. Non-mechanical pathology (complaints are atypical, patients cannot easily identify what makes it better or worse, and symptoms are not reproducible upon examination)
5. Regional Interdependence

The Evidence Based Approach to Rehabilitation of Disc Derangements

1. Disc Reducing Exercises to directly affect the disc (centralization and improved extension)
2. Stabilization exercises to improve function in the muscles around the disc
3. Postural/Lifting/Bending Re-education
4. Regional Interdependence (address mobility issues)

Irreducible Disc Derangement

- In response to movement testing, the symptoms will remain the same or increase peripherally and there will be no centralization
- You can make them worse, but you can't make them better
- Often involves incompetent or ruptured annular wall (inflammation can make it appear worse)
- TIME & Monitor neurological symptoms (2,6,12)
Trouble Shooting

1. Posture. What does that patient do when they leave your office?
2. Body Mechanics / Ergonomics
3. Frequency of exercises, compliance
4. Bed/sleeping postures (will be like starting all over again each morning if not corrected)
5. Weak core muscles
6. Recovery of function/ flexion
7. Patient Education (leads to better compliance)

Patients Must Limit Sitting

- Increased intradiscal pressure compared to standing postures (Nachemson, 1966)
- Increase in posterior annular strain (Pope et al., 1977)
- Creep in posterior passive tissues (McGill and Brown, 1992)
Videman et al. 1990
- Herniations associated with sedentary occupations and the sitting posture

Wilder and Colleagues 1988
- Annular tears associated with prolonged sitting and cyclic compressive loading of young calf spines (simulated truck driving)

Kelsey 1975
- Link between prolonged sitting and incidence of herniation

Videman et al. 1990
- Sedentary work associated with disc degeneration in later years

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**Mechanical Assessment and Treatment of Anterior Disc Derangements**

- First, rule out posterior disc derangement (anterior derangement patients should never be worse in extension after forward bending exercises)

- Due to the inherent weakness of the posterior annular wall compared to the anterior wall, and close proximity to the nerve roots and spinal canal, caution should always be taken before proceeding with a treatment strategy that involves forward bending

- Must reverse thought process and now visualize a sprain or weakness to the anterior annular wall.

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**Mechanical Assessment and Treatment of Anterior Derangements Continued:**

- Flexion is the main baseline.
- After ruling out posterior wall weakness, test the competency of the anterior wall with repetitive or sustained extension movements/postures. (If weakness is present, extension should lead to further anterior migration and derangement of the nucleus pulposis. Flexion baseline should be worse at comparison.)
- Determine direction (disc reducing exercise) that centralizes pain and leads to improved flexion.
- Core Strengthening (exercises that promote flexion and maintain derangement)
- Recovery of Extension
*No neurological compromise & Rarely symptoms below knee

**Typical Anterior Derangement History**
- Rarely symptoms below the knee (atypical referral pattern)
- No neurological deficits
- Forward flexion often more painful / limited (extension may be relatively normal and pain-free)
- Sometimes backward flexed antalgia, and fairly rigid and even hyperlordotic upon rising & lowering
Causes of Anterior Disc Derangements
(Anterior Annular Wall Sprain)

1. *Prolonged Extension Postures (sway back posture, high heels, stomach sleepers, pregnancy, etc.) – especially in combination (cumulative trauma)
2. Trauma (hyperextension injury)
3. *Regional Interdependence (tight hip flexors, weak abs. – lead to increased lordosis) (decreased T-ext)
4. *Lifestyle Choices

FLEXION BASELINE

- Range of motion before experiencing symptoms
- Location of most distal symptom
- Intensity of symptoms

TESTING INTEGRITY OF ANTERIOR ANNULAR WALL

1) Begin with initial flexion baseline (standing flexion), then perform:

   Repeated extension in standing
   (10 to 12 reps., hold 1- to seconds)

2) Perform follow-up flexion baseline
Positive Findings for Anterior Wall Weakness

- Peripheralization during testing

•Worse in Flexion after
  (peripheralization and/or loss of flexion R.O.M. – hit the derangement sooner)

Anterior Disc Reducing Exercises

1. *Bent knee forward bends
2. *Forward bends with one leg on chair
3. Supine (legs up on a chair)
4. Knee to chest stretch, lion stretch

*can add patient or doctor assisted overpressure.
(No significant lateral component to address)

*should never be worse in extension afterward
Bent Knee Forward Bends

Forward Bends with Overpressure
Must be painless

Bent Knee Toe Touches with Doctor Generated Overpressure
Supine with Legs Up

Anterior Derangements
Patients must reduce derangement frequently with exercise, hold it in with fair posture, and limit sitting and backward bending, for anterior wall to regain its’ strength and competency

*Be cautious of overcorrection (posterior wall is thinner)

Anterior Derangements

- Report of Findings
- Lifetime Maintenance – include discussion of posterior wall and the importance of returning to extension for a full recovery and proper maintenance of both front and back annular walls.
**Anterior & Posterior Wall Weakness**

- Concentrate on core strengthening exercises – must be performed frequently throughout day (Unstable)
- Limit sitting and end range movements/activities/postures (no stretching)
- Can perform occasional partial ext. or flex. to counteract sustained or repetitive movements of the opp. direction
- Can be difficult to treat (worn out disc)

---


- Predictable pattern of nuclear migration in undegenerated discs, where annular wall is intact and hydrostatic mechanism functioning
- Nuclear migration less consistent in degenerated discs
- Greater deg. – greater the bulging & inconsistency

---


- 91% of those that centralized had an intact annulus
- Centralization may be somewhat dependent on a competent annulus
Disc? Facet? Subluxation? Tracking Problem? ...

“I no longer believe that the precise identification of the structure involved is necessary or a prerequisite for the prescription and safe delivery of appropriate mechanical therapeutic interventions; nor do I believe it is always possible to make such an identification. Irrespective of the structure involved, ultimately the mechanical therapeutic strategy is determined solely from the responses obtained from tissue loading and the effect the loading has on symptomatology”.

Robin McKenzie

The search for direction of correction should be the primary focus in the assessment process
Mechanical Assessment and Treatment of Thoracic Disc Lesions

Baselines: deep breath, rotation, ask what hurts?

Review

Assume posterior disc derangement until proven otherwise

1. Determine if inflammation is present
2. Identify and correct the disc lesion (sprain) 1st – [assume posterior derangement and look for direction and exercise that reduces disc]
3. Good posture and body mechanics
4. Core strengthening & stretching exercises (reg. inter.)
5. PATIENT EDUCATION!

Key Points

- The DISC degenerates 1st – before arthritis
- About 70 - 80% of LBP sufferers have characteristics of directional preference and centralization at the initial visit, and are classified as DISC derangements
  - Another 60% go on to centralize after the initial visit
- 50% of healthy young adults have at least one level of DISC degeneration / bulging (that’s using a recumbent MRI, and it’s not counting internal disc derangement) – No signs of muscle strain
- Injuries often occur in A.M. and involve flexion
- 9 out of 10 work injuries involve flexion/rotation
- Extension (press-up) frequently painful/obstructed
• Assume posterior derangement (if they have limited/painful standing ext.)

• Skip the assessment (don't even consider the small percentage of ant. der.)

• Try posterior disc reducing exercises (1-5 min.)

• Test in Flexion after

---

**Posterior Disc Reducing Exercises**

- Standing extension
- Press-up
- Press-up painful side leg off
- Prone lying pillow(s)
- Prone lying pillow(s) on elbows
- Side bends
- Rotations

---

Identify and treat the *Sprain!*

(think disc until proven otherwise)
Low Back Pain is **not** a Mystery

*The disc is very mechanical in nature and should make mechanical sense when evaluated*

"It is my belief that in the lumbar spine, if in no other area, the disturbance of the intervertebral disc mechanism is responsible for the production of symptoms in as many as 95% of our patients”

Robin McKenzie

**Disc Derangements**

Just because > 80 percent are reversible doesn’t mean they will reverse on their own!
230 subjects with acute, subacute and chronic LBP and/or leg pain that centralized at the initial McKenzie assessment, divided into three different treatment groups

1. McKenzie treatment 95% were better or recovered at 2 weeks, none worse

2. General stretches and exercises 42% were better, 15% were worse, 1/3 withdrew due to no change or worse

3. Opposite direction exercises 23% were better, 15% were worse, 1/3 withdrew due to no change or worse

Common Misdiagnoses

1. Muscle Spasm
2. Muscle Strain (Pull)
3. Arthritis
4. Muscle Knot

Obstructive Lesion
Carragee et al.

- Followed 200 persons without prior significant LBP over a 5 yr. period (MRI baselines performed)
- 51 had 2nd MRI shortly after an episode of severe acute back pain

No Signs of Muscle Strain

Dysfunction

- Adaptive soft tissue shortening
- Global subluxation
- Severe arthritic changes
- Stenosis
- Regional interdependence

Mechanical Assessment and Treatment of Cervical Disc Derangements

- Guidelines are identical to lumbar disc derangements
- Proper history, exam findings and repetitive movement testing (along with the use of important baselines)
- Test integrity of posterior wall with flexion testing (rep. movements or sustained postures.)
- Determine direction of movement that centralizes pain, improves r.o.m., and reduces disc derangement.
- Rotation becomes an added baseline due to the orientation of the facet joints and significant amount of rotation present in the cervical spine.

Cervical discs function in parallel with lumbar discs

On the nature of neck pain, discography and cervical zygapophysial joint blocks Pain. August 1993;54(2):213-21

“Neck muscle injury does not provide a satisfying model for persistent or chronic neck pain, because muscle injuries to extremities heal rapidly in days or weeks”


Intradiscal pressure decreased gradually when the specimen was moved from 20 degrees flexion, to 10 degrees flexion, to neutral, to 10 degrees extension, then 20 degrees extension.
Assessing Posterior Annular Wall
(look for signs of peripheralization)

Step 1: Initial Baselines

1. Extension
2. Rotation
3. *Retraction – Extension (if needed for more subtle and lower bulges, or as patient recovers)

• Note
1. Location of symptoms (especially most distal)
2. Intensity of symptoms (including stiffness)
3. *ROM at which symptoms are experienced

Step 2: Stress/Load the back wall

1. Repeated or sustained forward flexion (10-15 reps, 1-2 sec.)
2. Repeated protrusion

Observe for signs of peripheralization
Step 3: Follow-up Baselines

1. Extension
2. Rotation
3. Retraction-extension

Assess for Changes in:

1. Location of Symptoms
2. Intensity of Symptoms
3. *ROM at which Symptoms are experienced

Positive Findings (for posterior wall weakness)

• Peripheralization (during testing or after)

• Loss of motion in extension and/or rotation with follow-up baseline(s)
  • Did they experience their symptoms (bump into the bulge) sooner?

Step 4: If Negative Findings

Yet signs of an obstructive lesion common to disc derangements, like limited and/or painful extension and/or rotation

(still assume disc)

Attempt to abolish the pain and restore range of motion with disc reducing exercises, then re-test the back wall with forward flexion
Cervical Disc Reducing Exercises for Posterior Derangements

1. Retraction (more effective as a preventative exercise)
2. Extension with Self-Traction
3. Partial (to Full) Retraction-Extension with Self-Traction
4. *Side Bends
5. *Rotation with Dr. Traction
6. *Rotation with Self-Traction

*for unilateral or asymmetrical symptoms only

Exercises 2 through 6 must be painless
Add overpressure when appropriate (Dr. or pt.)

Goals

1. Centralize pain
2. Restore full, pain-free extension and rotation

PAIN IS O.K. (for retraction only)

Three Possible Outcomes (with disc reducing excerc.)

1. Peripheralization (pinching the disc too soon and possibly increasing the derangement – includes loss of extension and/or rotation)
2. No Change (just hitting the disc; not reducing or increasing – irritating it – could inflame)
3. *Centralization (including incr. ROM in extension and rotation)
Extension & Rotation Baselines

1. Perform Initial and Follow-up Extension & Rotation Baselines to evaluate effectiveness of exercise

2. Note:
   1. Location of symptoms (especially most distal)
   2. Intensity of symptoms (including stiffness, pressure, "feel good pain", etc.)
   3. R.O.M. at which symptoms are experienced

Retraction

More effective as a prophylactic exercise

Cervical Retraction

Mid – lower cervical extension
Protrusion

- Mid – lower cervical spine flexion
- Upper cervical spine extension

FHP – S-curve, lower C-flexion, most common area of disc loading, bulging and thinning

Extension with Self-Traction

add over-pressure

Supine Extension - Traction
“mean segmental extension at C6-7 increased 53.4% using retraction plus extension compared to extension only”
Exhaust Extension First

Even if symptoms are more or all to one side and lateral flexion and/or rotation help to reduce derangement

Side Bends (For left sided neck pain)

Partial chin tuck with 20-45 deg. forward flexion, then pull head toward painful side, slight rot. to the opposite side

Lateral Flexion (for L sided pain/bulging)

*Toward side of pain
**Rotation with Dr. Assisted Traction**

Line of drive is through the forearm

L forearm during L rotation

R forearm during R rotation

(with overpressure by patient)

---

**Re-enforced Thumb Contact**

1. Contact articular pillars/facet joints on opposite (R) side of pain
2. Big tissue pull toward ear (*along the plane of the facet joints*)
3. The lift/traction comes from the legs
4. Maintain the line of drive (mob.) toward ear as the patient turns left

---

**Left Rotation with Self Traction**

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**Posterior Derangement**
Patients must reduce the derangement frequently with exercise, hold it in with good posture and limit flexion, protrusion and opposite side bending/rotating for the posterior annular wall to tighten up and heal.

Good upper thoracic posture is the key.

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**Head Lifts**
(deep neck flexors)

---

**Prone Opposite Arm and Leg**
(with chin tuck)
Supine Neck Flexion Test

*Screening test for faulty head and neck flexion

Neck Pain Mobility Screen
Regional Interdependence

Thoracic rotation
Thoracic extension

Shoulder external rotation
Shoulder internal rotation
Neck Extension

Sacroiliac Joint Pain

SIJ pain is located primarily over the joint (inferior sulcus) and may refer distally, but not to the low back.

“The SIJ is a pain-sensitive structure richly innervated by a combination of unmyelinated free nerve endings and the posterior rami of L2 (anterior joint) through S3 (posterior joint).”

Van Helvoirt H, May S. Sacro-iliac joint pain – how much of it is there and what might be the problem? International Journal of Mechanical Diagnosis and Therapy. 2009 vol. 4: no. 1; 3-7.

- Out of 278 patients, 12% appeared to have pain originating from SIJ
- The L-spine was ruled out through the absence of directional preference, centralization, and lateral shift
- Hip was excluded by pain provocation tests and
- 3 out of 5 of the following SIJ pain provocation tests needed to be positive for the SIJ to be source of pain: 1) distraction, 2)thigh thrust, 3)compression, 4)sacral thrust, and 5)Gaenslan’s
SIJ Cont’d

- Majority of the 12% diagnosed as SIJ had a chemical pathology
- Moderate improvement in over 60% of patients who underwent corticosteroid injections
- No change in 23%

Certain clinical characteristics stand out
1. 76.5% female
2. Onset commonly related to trauma (56%) and pregnancy (20.5%)
3. Constant pain was common (68%)

COMMON CLINICAL FEATURES

- + Hop Test, + Standing Kemps Test, + Yeoman’s Test, Patrick’s (either side), Standing Extension, (make up your own baseline)

- Increased pain with walking, up and down stairs

- No LBP

- Tenderness to palpation at SI jt.

- * Significant difference in terms of pain and/or ROM between weight bearing and non-weight bearing extension (st. ext. vs. press-up)

S.I. Joint Derangements

<table>
<thead>
<tr>
<th>Derangement</th>
<th>Correction</th>
</tr>
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<tbody>
<tr>
<td>1. Posterior Rotation (PI Ilium)</td>
<td>1. Extension (hip extension or “psoas stretch”)</td>
</tr>
<tr>
<td>2. Anterior Rotation (AS Ilium)</td>
<td>2. Flexion (standing or supine knee to chest)</td>
</tr>
</tbody>
</table>

*Add overpressure and/or accessory glide during the press-up
S.I. Extension  S.I. Flexion

½ Kneeling S.I. Stabilization Exercise

S.I. Extension with a sustained lateral to medial mobilization
Treatment to correct R SI jt. that is posteriorly and laterally rotated

---

**Structural Rehabilitation**

- Foam Roller
- Apex Orthosis
- Supine Translation Traction

---


Reversed curves are 3.0 times and straight curves are 5.3 times as frequent compared to controls.


Statistically significant decrease in the C4/C5 angle was found in chronic WAD subjects.

- Survey of over 6000 cases of chronic headache sufferers.
- **Trauma is one of the most important factors.** "Trauma may be so slight or so far in the past that its causal relationship is either forgotten or thought by the patient to be of no importance"... "It is not unusual for the headache to be delayed for days, months, or years after injury."
- "Complete or segmental loss or reversal of the normal lordotic curve of the cervical spine is the most consistent characteristic feature and very often the only abnormality found."


- Sagittal "curves are important because they are useful to increase strength, and to maintain balance, shock absorption and fracture protection”
- Straightening of the C-spine led to a 24-33% loss of motion and an increased stress of 5-95% in "the facet joint cartilage, uncovertebral jt. and disc"
- **Stress concentrations may lead to “abnormal tensions on the hind-brain, cranial nerves, cervical cord, and cervical nerve roots”**


- C-kyphosis may create tension on spinal cord and has been associated with myelopathy. (Cord becomes compressed and flattened with increased kyph.)
- Thoracic curve has greater impact on the C and L curves than the other way around
Over 70% - reducible derangements

Wherever we find torn cartilage, loose bodies, intra-articular inclusions, meniscoids, or disc derangements, we may find obstructions to joint movements that can rapidly change with repeated end range movements, mobilizations or manipulations.

Robin McKenzie
The Human Extremities: Mechanical Diagnosis and Therapy

“Internal derangements may cause a disturbance in the normal resting position of the affected joint surfaces. This will, in turn, deform the capsule and peri-articular supportive ligaments resulting in pain”.

(loose bodies, meniscoid cartilage displacement/ tear, etc.)

“Repeated movements that increase the displacement also increase the obstruction that in turn increases the pain. Repeated movements that progressively reduce the pain also progressively reduce the obstruction and derangement and allow the restoration of normal pain-free movement”.
Brian Mulligan

“I suspect that minor positional faults occur following injury or strain resulting in movement restrictions and/or pain. These are not readily palpable or visible on x-ray but when a correctional mobilisation (a repositioning) is sustained, pain free function is restored and several repetitions will begin to bring lasting improvements.”

Extremity Derangement Correction

1. Repeated movements (often in the opposite direction that led to the derangement) – Pain is o.k.

2. Mobilizations with motion - Painless

Derangements have the ability to be rapidly reversible

Patient History

Inverse relationship between excessive mechanical stress and directional preference

(ADLs, work duties, mechanism of injury)
79% of the 19 patients with wrist pain were derangements. Demonstrated opposite mechanical relationship (i.e., patients with extension biased ADLS required the opposite movement of flexion to correct derangement).

A significant prevalence of patients awaiting total knee replacement were classified as derangements.

Commonly used orthopedic tests for the elbow, shoulder, knee and wrist change from positive to negative in the presence of derangements.

*derangements mimic impingements, tendonopathies, etc. (possibly even tears)
“I no longer believe that the precise identification of the structure involved is necessary or a prerequisite for the prescription and safe delivery of appropriate mechanical therapeutic interventions; nor do I believe it is always possible to make such an identification. Irrespective of the structure involved, ultimately the mechanical therapeutic strategy is determined solely from the responses obtained from tissue loading and the effect the loading has on symptomatology”.

Robin McKenzie


- Grade II ankle sprains in teenagers treated with Mulligan ankle mobilizations
- Immediate decreases in pain and increases in function
- Returned to competition (on average) in 9 days and in 5 treatments or less vs 4 to 8 weeks with standard physical therapy protocols

**Shoulder**

**Most Common Direction of Correction**

- Internal Rotation
- Extension (internal / external rotation)
- A to P (and I to S) Glide (slight traction)
- *accessory glide as needed

**Common Mobilization**

lower trap pull downs
Most Common Correction for Shoulder Derangements

Internal Rotation

Extension

Internal / External Rotation

Match Stabilization Exercise to the Direction of Correction

Extension

Lower Trap Pull Downs
Common Mobs. (Slight traction, A-P, and I-S)

Shoulder raise  abduction  horizontal abduction

Shoulder Abduction Self Mobs.

Mob. For A.C. Joint Derangements
(Contact distal clavicle – A-P, S-I, and med-lat)
Hip

Most Common Direction of Correction

- Hip Extension
- *Hip Abduction

Mobilization

- Med. to lateral glide
- A to P glide
  *tinker

Can use with bridge exercise

Common Corrections for Hip Derangements

- Extension
- Flexion/Abduction

Add Mob. (to most common direction of correction)

*must be painless
Bridge exercise Mob.

Knee

Most Common Direction of Correction

- Extension (with internal or external rotation)

Most Common Mobilization

- Glide lower leg toward side of pain (with int./ext. rotation)

Lateral Knee Pain
1. Slight traction  
2. Glide lower leg toward side of pain  
3. Add rotation if needed

1 Leg Squat Knee Self Mob.  
(LOAD it more)

Elbow

Most Common Direction of Correction

<table>
<thead>
<tr>
<th>Extension (supination/pronation)</th>
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Most Common Mobilization

<table>
<thead>
<tr>
<th>Glide forearm toward side of pain</th>
</tr>
</thead>
</table>

87
Lateral elbow pain (tennis elbow)  Medial elbow pain (golfer’s elbow)

Self Mob. For Tennis Elbow

Mobilization and Taping for Lateral Ankle Sprains