“Why do the cervical and lumbar spine get all the glory?”

Rehab concepts for the thoracic spine and sacroiliac joints

Hugo Klaers, PT, DPT
& Shannon Kelly, PT, DPT

Objectives

• Define the concept of regional interdependence as it applies to spinal pathology and treatment
• Describe the treatment of thoracic spine as it relates to cervical, shoulder, and lumbar dysfunctions
• Review the physical therapy examination of the thoracic spine and SIJ
• Demonstrate manual therapy techniques for the thoracic spine and the SIJ
• Describe application and progression of exercises for the thoracic spine and SIJ
• Apply “sling stabilization” concepts to the SIJ

Incidence of thoracic conditions

• Thoracic spine dysfunction: rare compared to cervical and lumbar
• Thoracic spine dysfunction is treated effectively with manual therapy techniques

Incidence of thoracic conditions

• Often looked at as an isolated structure
• However, the role of the thoracic spine is not typically recognized in cases of cervical, shoulder, or lumbar dysfunction

Regional interdependence

“With respect to musculoskeletal problems, regional interdependence refers to the concept that seemingly unrelated impairments in a remote anatomical region may contribute to, or be associated with, the patient’s primary complaint.”

~Robert Wainner, PT, PhD, FAAOMPT

Regional interdependence

What it is NOT…
• Treating the source of radiating/referred pain
• Ignoring the primary region of complaint

What it IS…
• Looking up & down the kinematic chain
• For neck, shoulder, and back complaints: Consider contributions from the thoracic spine
Biomechanics of t-spine and cervical motion

- Cervical rotation includes segmental motion through T4 (Sizer et al., 2007)
- T1-4 demonstrate primarily axial rotation (White et al., 1990)
- Same coupling pattern as lower C-spine (White et al., 1990)

Unilateral sagittal and scapular plane shoulder elevation (Theodoridis & Ruston, 2002)

- T2-7 segments demonstrated:
  - Ipsilateral sidebend and rotation coupling
  - Extension
- Bilateral shoulder elevation includes thoracic extension (Edmondston, 2012)
  - Bilateral elevation → 12.8° thoracic ext from T3-T11

Biomechanics of t-spine and lumbar motion

- Thoracolumbar junction shows blended anatomy
- T11-12 demonstrate primarily flexion-extension, same coupling pattern as L-spine (White et al., 1990)
- Thoracolumbar spine: “principal load-bearing structure of the body” (Resnick et al., 1997)

Examination

- Posture
- Mobility
  - AROM, segmental
Segmental Mobility

Examination

- Posture
- Mobility
  - AROM, segmental
- Layers
  - Osseous
  - Inert
  - Neural tension, disc, capsule, ligamentous

Examination

- Posture
- Mobility
  - AROM, segmental
- Layers
  - Osseous
  - Inert
  - Contractile
    - Resisted isometrics
    - Strength
      - Particular emphasis on mid/low trap
      - Core

THE SACROILIAC JOINT
The Plan...

• **Rings:** remember the anatomy of the pelvis is a ring, engage the ligaments via the muscles

• **Slings:** Utilize the muscular slings to improve the stability of the SI joint

• **Other things:** Address joint and soft tissue issues via manipulations and mobilizations

In 200 patients with low back pain complaints:
• 10 found to have solely SIJ pathology
• 29 found to have SIJ involvement in combination with lumbar &/or hip

**PT Eval: Consider the Lumbar Spine**

• Differential diagnoses for the low back: Posterior facet joint, nerve root irritation, discogenic pain, spondylolisthesis

Lumbar Screen:
- Range of motion
- Repeated motions into flexion/extension

**PT Eval: Consider the Hip**

• Morgan et al. 2013
  - 76% of subjects presenting with SIJ pain also had radiographic evidence of FAI

• Cibulka et al. 2002
  - Evaluated hip ROM in patients with LBP
  - Hip ER/IR ROM values differed in those with SIJ involvement
  - A hip screen can help rule in SIJ involvement

**Physical Therapy Examination**

Looking for the pattern

• Subjective:
  - Unilateral pain
  - Inferior to PSIS
  - Pain into the buttock
  - Preceded by sudden episodic joint stress/trauma OR
  - Preceded by cumulative/repetitive joint stresses

• Objective:
  - Provocation testing to reproduce patient’s primary pain and indicate the SI as the pain generator
  - Strength
  - Motor control assessment

**Palpation Based Testing**
Active Straight Leg Raise

Pain Provocation Testing

Clinical Prediction Rule
- Laslett et al. 2008
- Patients with LBP have >70% probability of having primary SIJ pain involvement with the presence of:
  - Three or more positive SIJ provocation tests
  - Centralization of pain is not achieved during a McKenzie evaluation of repeated movements and sustained positions

At the End of the Evaluation...
- Lumbar Spine Involvement: RULED OUT
- Hip Involvement: RULED OUT
- POSITIVE SIJ Provocation Tests

NOW WHAT??

Treatment Approach
- Manual Therapy
- Therapeutic Exercise
Thoracic Rx for Cervical Dysfunction

- Manipulation group better on NDI and NPRS (50.5% and 58.5%) vs. mob group (12.8% and 12.6%)
- C1-2 PROM and craniocervical flexor performance also better in thrust group
- NNT = 1.8-2.3

Dunning et al, 2012

Thoracic Rx for Cervical Dysfunction

- Experimental group significantly better on NPRS and NDI
- 31/33 (94%) vs. 11/31 (35%) had GROC of +4 or higher
- NNT = 2

Masaracchio et al, 2013

Thoracic Rx for Shoulder Dysfunction

1.) Sx’s <30 days
2.) No sx’s distal to shoulder
3.) Looking up does not aggravate
4.) FABQ-PA <12
5.) Diminished upper thoracic kyphosis (T3-T5)
6.) Cervical extension ROM <30°

3/6 present increased probability of success from 54% to 86%

Cleland et al, 2007

Thoracic Rx for Shoulder Dysfunction

- 14% increase in manipulation group vs. 3% in placebo group
- Low trap inhibition secondary to extension limitations T8-T12 (Flynn, 2006)

Cleland et al, 2004

Thoracic Rx for Shoulder Dysfunction

- Less pain during:
  - Neer
  - Hawkin’s-Kennedy
  - Resisted empty can, ER, IR
  - Active ABD
- Improved SPADI

Boykins et al, 2009

Thoracic Rx for Shoulder Dysfunction

- No changes in ROM or scap kinematics
- EMG: small, significant increase in middle trap activity
- ***Less pain with impingement tests & flexion AROM
- ***Improved shoulder function

Muth et al, 2012
Thoracic Rx for Lumbar Dysfunction

- Both groups improved NPRS, no sig diff between groups
- T-manipulation group improved PPT significantly

Fernando de Oliveira et al, 2013

Thoracic Rx Summary

Cervical
- NDI, NPRS improve with addition of thoracic manipulation to cervical mobilizations
- Manipulation shows better improvements than mobilization
- Can also improve C1-C2 PROM and craniocervical flexor performance

Fernando de Oliveira et al, 2013

Shoulder
- Thoracic manipulation results in:
  - Increased activation of low and mid trap
  - Decreased pain with Neer, HK, resisted empty can/ER/IR, active ABD and flexion
  - Improved SPADI scores

Lumbar
- Similar decrease in pain regardless of whether lumbar manipulation or thoracic manipulation is performed
- Thoracic manipulation increases pain pressure threshold

Why does manipulation work?

- Biomechanical: Regional interdependence (Wainner et al, 2007; Cleland et al, 2005)
- Neurophysiological
  - Stimulation of descending inhibitory mechanisms (Sparks et al, 2013; Cleland et al, 2005)
  - Change in pain modulation via biochemical response (Plaza-Manzano et al, 2014)
  - Stimulation of ANS/DRG’s???
- Placebo??? (Kardouni et al, 2014)

Two Key Elements

Therapeutic Exercise

Manual Therapy

Mobility

Strength
Thoracic Ex's - Mobility

Egan et al, 2011

Mobility

Egan et al, 2011

Mobility

Mobility

Mobility
Strength

Mobility & Strength

Mobility & Strength

Mobility & Strength
THE SACROILIAC JOINT: RINGS

LAB

Anatomy: Bones

- Part of three different mechanical chains
  - LE Chain: sacrum, innominate, lower extremity
  - Spine Chain: L4/L5/Sacrum
  - Pelvic Chain: Innominate/Sacrum/Ilium

- Form closure

Anatomy: Anterior Ligaments

- Sacrospinous ligament
  - Blends into the hamstrings
- Iliolumbar ligament
  - Blends into quadratus lumborum, erector spinae and multifidi
- Anterior sacroiliac ligament

Anatomy: Posterior Ligaments

- Sacrotuberous ligament
  - Blends into the hamstrings
- Long dorsal ligament
- Posterior sacroiliac ligaments
A Common Question: Does it Move?

- Minute amounts of rotation and translation

- The SI joint adapts throughout the life span

- Ossification of ligaments leading to increased stiffness

THE SACROILIAC JOINT: SLINGS

Anatomy Review: Anterior Muscles

- Form closure
- Force closure

Anatomy Review: Posterior Muscles

- Two muscle systems that influence the sacroiliac joint
  - Deep muscle system
  - Superficial muscle system
Deep Muscle System

- These are the muscles that are most commonly thought of as stabilizing muscle

- This is the cylinder:
  - Top: Diaphragm
  - Bottom: Pelvic Floor
  - Sides: TrA, IO, Multi

(Snijders et al, Liebenson et al)

Deep Muscle System

- Supine
- Hooklying
- Prone
- Quadruped

Superficial Muscle System

1. Posterior oblique sling
2. Anterior oblique sling
3. Longitudinal sling
4. Lateral sling

#1 Posterior oblique sling

- Muscles involved:
  - Latissimus Dorsi
  - Contralateral Gluteus Maximus

- Mooney et al. (2001)
  - 15 healthy subjects: reciprocal relationship between latissimus and glut max.
  - Patients with SI pain showed increased activity of the gluteus on the involved side

Posterior Oblique Sling Exercises

Posterior Oblique Sling Exercises
Posterior Oblique Sling Exercises

#2 Anterior Oblique Sling

- Muscles involved:
  - External oblique
  - Transverse abdominus
  - Contralateral internal oblique
  - Contralateral adductors

- Attach through the abdominal sheath on the anterior aspect
Anterior Oblique Sling Exercises

Muscles involved:
- Thoracolumbar fascia
- Erector spinae
- Multifidi
- Hamstrings

#3 Longitudinal Sling

Muscles involved:
- Thoracolumbar fascia
- Erector spinae
- Multifidi
- Hamstrings
#4 Lateral Sling

- Muscles involved:
  - Hip abductors
  - Internal Oblique
  - Contralateral quadratus lumborum

Lateral Sling Exercises

Lateral Sling Exercises

Lateral Sling Exercises

Lateral Sling Exercises

Combinations

- At this point in working the different slings, you are only limited by your imagination
- Combine different movements to activate different slings and different muscle groups
- Train muscles to work together and in unison

Tensioning the ligaments

- Utilizing the ligaments to increase the stability of the joints
- Done via the muscular and fascial attachments
  - Sacrotuberous and Biceps Femoris
    - Van Wingerden et al. (1993)
  - Long Dorsal Ligament and Erector Spinae and TLF
    - Vleeming et al. (1996)
OTHER THINGS

The Hamstrings & Gluteus Maximus

• Vleeming et al (2012) discussed the hamstrings’ pull on the pelvis
• Arab et al (2011) investigated the relationship between hamstring length and gluteal muscle strength
  – Tightness in the hamstrings seen in conjunction with gluteal weakness
  – Clinical takeaway: don’t stretch the hamstrings without strengthening the gluteals

The Hamstrings & Gluteus Maximus

• Hungerford et al (2003) used EMG to record hip and trunk muscles activation in those with SIJ pain compared to those without
  – Clinical takeaway: timing is key for stability, getting the right muscles to fire at the right time
• Hoissen and Nokes (2008) identified poor gluteus activation during gait in a subject with SIJ pain

Is SIJ Manipulation Beneficial?

• Tullberg et al (1998) showed that a manipulation did not alter the position of the joint
  – The subjects did report decreased pain
• Kamali and Shorkri (2011) provided lumbar and SIJ manipulations and showed decreased pain
• Cibulka et al (1988) created bilateral innominate rotation with a manipulative technique
  – Pain was not assessed in these subjects

MANUAL THERAPY

MANIPULATIONS
MOBILIZATIONS
SOFT TISSUE

Sacroiliac Joint Manipulation
**Sacroiliac Joint Mobilizations**

**Soft Tissue Manual Therapy**

- Iliopsoas
- Piriformis
- Tensor fascia lata
- Lumbar paraspinals Adductors
- Gluteus medius
- Quadratus lumborum

**ALTERNATIVE OPTIONS**

**STABILIZATION BELTS**

**TAPING TECHNIQUES**

**Stabilization Belts**

- Recommended wear time will vary from patient to patient
- Can perform stabilization exercises with the belt on

**Taping Techniques**

- Kinesiotape
- Leukotape

**LAB**
Summary

Principles of PT Management

Summary thoughts

- **Rings**: remember the anatomy of the pelvis as a ring, engage the ligaments via the muscles
- **Slings**: Utilize the muscular slings to improve the stability of the SI joint
- **Other things**: Address joint and soft tissue issues via manipulations and mobilizations

Principles of PT Management

- **REGION SPECIFIC TREATMENTS!!!**

**Cervical**
- Manual traction
- Segmental mobility
- Cervical flexor endurance
- STM

**Lumbar**
- Directional preference
- Axial separation
- Core stab

Principles of PT Management

- **REGION SPECIFIC TREATMENTS!!!**
- Manual therapy techniques - manipulation, mobilization
- Neuromuscular re-ed
  - Emphasis on thoracic extension and rotation
- Strengthen
  - Periscapular & postural musculature
  - Heavy emphasis on mid/low trap!!!

Thoracic References
