Saturday, November 15, 2014

Wright Auditorium
Seattle Children’s Hospital
4800 Sand Point Way NE
Seattle, WA 98105
Launched in 2008, Seattle Children’s Sports Physical Therapy Program has quickly expanded to include four locations (Seattle, Bellevue, Federal Way and Mill Creek), serving more than 800 patients a month. Our focus is on helping school-age children and teens heal after sports injuries or surgery. All of our licensed physical therapists have advanced training in pediatric and orthopedic rehabilitation, with specialties in injury prevention, posture and body mechanics, running and gait analysis, throwing and overhead sports, dance, gymnastics and team sports. Our team also includes board-certified orthopedic specialists, licensed athletic trainers and providers certified in sport-specific biomechanics, including Sportsmetrics™, ballet, Pilates and golf.

We partner with primary care providers, families and/or coaches in each patient’s treatment plan. Whether working with a young elite athlete or a child anxious to return to the playground, we have the same two goals: to safely return each child to play and to prevent future injuries.

Preventive Programs

Children’s sports physical therapists also run programs to help keep young athletes healthy. In addition to ACL-injury-prevention clinics, our sports therapists offer injury-prevention screening in the community for both individual and team sports, including injury-prevention screening for the students of the Pacific Northwest Ballet School. For more information on injury-prevention screening for local sports programs, call us at 206-884-9194.

Learn More

www.seattlechildrens.org/sports-physical-therapy/
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**Venue**

Wright Auditorium  
Seattle Children's Hospital  
4800 Sand Point Way NE  
Seattle, WA 98105

**Planning Committee**

Janet Morton, PT  
Whitney Marois, MSPT, OCS  
Summer Ice-Tseng, DPT  
Natalie Johnson, DPT  
Steve McKenzie, MSPT  
Richard Ford, Admin Assistant
8:00 AM
Orthopedic Clinical Review of the Spine

Monique Burton, MD, FAAP

Monique Burton, MD, FAAP, is a board-certified pediatrician with additional certification in Sports Medicine. She is the Director of the Sports Medicine Program at Seattle Children’s and the Chair of USA Track and Field’s Sports Medicine and Sports Science Committee. Dr. Burton has been a volunteer team physician at numerous international competitions with the United States Olympic Committee, USA Track and Field, and USA Swimming, including the 2008 Olympic Games in Beijing, China.
Orthopedic Evaluation of the Spine

Monique S. Burton, MD, FAAP
Clinical Associate Professor
Seattle Children’s
Department of Pediatrics
Department of Orthopedics & Sports Medicine

Back Pain in Children
- Back pain in children
  - Not as common in adults, but not as uncommon as previously thought
  - > 50% children experience back pain by age 15
  - Up to 36% school-age children experience an episode of back pain
  - Medical attention rarely sought → assumption back pain is uncommon

Overview
- Anatomy
- History
- Physical Examination (non-PT version)
- Additional studies
- Differential Diagnosis

Anatomy of the Spine

The Spine
- 33 vertebrae
  - Cervical: 7
  - Thoracic: 12
  - Lumbar: 5
  - Sacrum: 5 fused
  - Coccygeal: 4 fused

The Spine
- Functions
  - Support of head
  - Support of abdominal contents & pelvic girdle
  - Point of attachment for thoracic cage
  - Protection of spinal cord & neural elements while allowing motion
  - Transfer of weight & bending movements of head and trunk to the pelvis
The Spine Curvatures

- Cervical
- Thoracic
- Lumbar
- Sacral

Vertebral Curves

- Reach adult shape by age 7 – 9 years

Parts of vertebrae
- Body
- Vertebral arch
- Lamina
- Pedicle
- Transverse processes
- Spinous processes
- Superior & inferior articular processes

Vertebral Cervical

- Atlas (C1)
- Axis (C2)

Vertebral Thoracic

- Costal facets for rib articulation

Vertebral Lumbar

Vertebral Sacrum/Coccyx

- Fused segments
### Intervertebral discs
- **Parts**
  - Outer: Annulus fibrosis
  - Inner: Nucleus pulposus
- **Functions**
  - Flexibility
  - Binds vertebrae
  - Shock absorption

### Neural Elements
- **Spinal cord**
  - Occiput → L1
- **Conus medullaris or lower portion of cord**
  - T11 → L1
- **Cauda equina**
  - L1 → sacrum

### Joints
- **Facet joints**
- **Sacroiliac joint**

### Ligaments
- **Anterior & posterior longitudinal ligaments**
- **Connect vertebral bodies**
- **Ligamentum flavum**
- **Interspinous ligaments**
- **Supraspinous ligaments**
- **Primary ligaments**
- **Intervertebral disk**
- **Facet capsule**
- **Facet joint**

### Muscles
- **Anterior**
  - Anterior to plane of transverse processes
- **Middle**
  - Attached to plane of transverse processes
- **Posterior**
  - Posterior to spinous processes (erector spinae)
- **Accessory**
  - Exert effect without direct attachment
Clinical Evaluation

History
- Duration of symptoms
- Mechanism of injury

Pain Characterization
- Onset (acute, insidious, chronic)
- Character
- Quality
- Location
- Radiation
- Exacerbating or alleviating factors or activities

History
- Physical activity/sports related activity
- Changes in activity/skills, drills, etc.
- Neurological symptoms
  - Numbness, tingling, weakness, changes in balance, gait abnormalities, bowel or bladder dysfunction
- Early morning pain/stiffness
- Night pain
- Systemic symptoms
  - Fever, chills, malaise, weight loss, decreased appetite

Concerning History/“Red Flags”
- Young age (especially before school-age)
- Fever
- Acute trauma
- Weight loss
- Constant pain
- Night Pain
- Progression of symptoms over time
- Significant pain or disability
- Sciatica
- Repetitive microtrauma, esp lumbar hyperextension
- Hx of malignancy
- Hx of tuberculosis exposure
- Neurologic symptoms

Physical Examination
Physical Examination

- Inspection
- Palpation
- Range of motion
- Strength
- Neurological

Inspection

- Standing position
- Posture
- Asymmetry
  - Shoulder heights
  - Scapula prominences
  - Flank creases
- Pelvic symmetry
  - Scoliosis
  - Kyphosis
  - Leg length discrepancy

Inspection

- Midline lesions
  - Concern for spinal cord abnormality or dysraphism
  - Hairy patch
  - Hemangiomas
  - Sinuses
  - Lipomas
- Abnormal markings
  - Café au lait spots
  - Neurofibromatosis

Inspection

- Gait
  - Ataxia, spasticity, instability
  - Neurologic problem
  - Refusal to walk
  - Diskitis
- Muscle weakness
  - Atrophy
  - Fasciculations

Palpation

- Palpation
  - Musculature
  - Tenderness
  - Muscle spasm
  - Radiation
  - Bony structures
    - Spinous processes
    - Sj joints

Range of Motion

- Forward flexion
  - 40 – 60
- Extension
  - 20 - 35
- Lateral bending
  - 15 - 20
- Rotation
  - 3 - 18
**Strength**
- Hip flexion  L2, L3
- Hip extension  L5, S1
- Knee flexion  L5, S1
- Knee extension  L3, L4
- Ankle dorsiflexion (heel walk)  L4, L5
- Ankle plantar flexion (toe walk)  S1, S2
- 1st MT extension  L5, S1

**Neurological Reflexes**
- Deep tendon reflexes
  - Patellar  L4
  - Achilles  S1

**Neurological Reflexes**
- Abdominal Reflex
  - Patient supine
  - Examiner gently strokes skin on either side of midline above, at & below level of umbilicus
  - Normal  Contraction toward stimulated side
  - Abnormal reflex  May indicate pathologic process of spinal cord (e.g. syringomyelia)

**Neurological Sensation**
- L1: anterior hip
- L2: upper anterior thigh
- L3: medial knee
- L4: inner lower leg
- L5: lateral upper leg, 1st/2nd web space
- S1: lateral foot

**Special Tests**
- **Straight Leg Raise Test**
  - Lasègue’s Sign
  - Neural tension test
  - Supine position
  - Examiner passively flexes hip while holding knee in full extension and grasping ankle
  - Positive  pain or neurologic symptoms between 30 – 70
  - Sensitivity 0.52, Specificity 0.89 (Majlesi, et al 2008)
Special Tests
Slump Test/Seated SLR
• Neural tension test
• Patient slumps forward with neck in forward flexion, leg extended with foot in dorsiflexion
• Positive → reproduces neurologic symptoms

Special Tests
FABER (Flexion Abduction External Rotation)
• Patrick’s Test
• Si joint test
• Patient supine
• Knee flexed to 90°
• Foot/ankle rest on opposite knee
• Examiner stabilizes opposite iliac crest, applies posteriorly directed force against medial aspect of bent knee toward table
• Positive → reproduces pain in buttack

Special Tests
Single leg hyperextension test
• Patient standing
• Patient hyperextends lumbar spine while standing on one leg
• Positive → pain reproduced

Further work up
• Directed toward clinical findings
• Conservative management
  • Short duration of symptoms
  • Preceding trauma of back
  • Musculoskeletal presentation
  • Normal neurological examination
• Additional studies
  • Protracted pain
  • Red flags

Additional Studies
Laboratory Studies
Labs

- Indications:
  - Young children
  - Night pain
  - Coexisting constitutional symptoms

- Screening labs
  - CBC with diff
  - ESR
  - CRP
  - Blood culture (if concerned about infectious process)
  - Urinalysis

Rheumatologic labs

- HLA B-27
  - Associated w/ankylosing spondylitis, reactive arthritis, spondylitis related to psoriasis and inflammatory bowel disease
  - Rarely useful
- Rheumatoid factor (RF), ANA, Lyme serology
  - Often not useful
- Consult rheumatology if suspect rheumatologic etiology

Imaging

Plain Radiographs

- Indications: Initial screening
- AP & lateral views
- Review images for:
  - Vertebral alignment
  - Disk space narrowing
  - Vertebral end plate irregularities
  - Vertebral scalloping
  - Lytic or blastic lesions
  - Exclude congenital or acquired bony abnormalities
  - AP/PA and lateral

MRI

- Indications
  - Abnormal neurological examination
  - Known malignancy
- Evaluate for:
  - Tumors, Infections, disk herniations
  - Herniated disk
  - Spinal neoplasms
  - Syringomyelia
  - Diskitis
  - Sacroiliac joint inflammation

CT Scan

- Indications:
  - View detailed bony anatomy of areas of involvement
  - Define status and extent of process
- Evaluate for:
  - Bony architecture
    - Fractures
  - Healing process/status of pars defect
  - Bone tumors
  - Congenital lesions
Bone Scan

- Indications:
  - Useful for detecting pathologic process that affect bone
  - Evaluate for:
    - Infection
    - Benign and malignant neoplasms
    - Stress reactions/fractures (use SPECT)
  - Non-specific in defining precise nature of lesion
  - Does not detect soft tissue tumors or infections that do not impinge on bone.

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Differential Diagnosis

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<th>Possible diagnoses</th>
<th>Associated findings</th>
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<td>Acute Pain</td>
<td>Herniated disk</td>
<td>Radicular pain, +SLR</td>
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<tr>
<td></td>
<td>Slipped vertebral apophysis</td>
<td></td>
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<tr>
<td></td>
<td>Spondylolysis</td>
<td></td>
</tr>
<tr>
<td>Vertebral fracture</td>
<td>Other assoc injuries</td>
<td>Neurolologic changes</td>
</tr>
<tr>
<td>Muscle strain</td>
<td>Muscle tenderness without</td>
<td></td>
</tr>
<tr>
<td></td>
<td>radiation</td>
<td></td>
</tr>
<tr>
<td>Chronic Pain</td>
<td>Scheuermann’s kyphosis</td>
<td>Rigid kyphosis</td>
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<tr>
<td></td>
<td>Inflammatory spondyloarthropathy</td>
<td>Morning stiffness, SI joint pain</td>
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<tr>
<td>Psychological</td>
<td></td>
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</tr>
<tr>
<td>Night Pain, Constitutional syn</td>
<td>Tumor, infections</td>
<td>Fever, malaise, weight loss</td>
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Adapted from Bernstein, Cozen AAFP 2007

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Differential Diagnosis

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<td></td>
<td>radiation</td>
<td></td>
</tr>
<tr>
<td>Pain with extension</td>
<td>Spondylolysis/-listhesis</td>
<td>Lamina or pedicle injury</td>
</tr>
<tr>
<td></td>
<td>+SLR</td>
<td></td>
</tr>
<tr>
<td>Pain with recent onset of scoliosis</td>
<td>Tumor, infection</td>
<td>Febrile, malaise, +SLR</td>
</tr>
<tr>
<td>Other</td>
<td>Pyelonephritis</td>
<td>Acnl UA, dysuria, fever</td>
</tr>
<tr>
<td></td>
<td>Sickle cell crisis</td>
<td>Other bnr pain, hx SSD</td>
</tr>
</tbody>
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Adapted from Bernstein, Cozen AAFP 2007

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Differential Diagnosis

Musculoskeletal

- Nonspecific back pain
- Spondylosis/spondylolisthesis
- Scheuermann Disease
- Apophasis
- Disk degeneration &/or prolapse
- Other
  - Intervertebral disk calcification
  - Congenital absence of pedicle
  - Vertebral apophyseal fracture
  - Aneurysmal bone cyst
  - Sacroiliac stress reaction
  - Idiopathic juvenile osteoporosis

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Inflammatory

- Ankylosing spondylitis
- Psoriatic arthritis
- IBD-associated arthritis
- Reactive arthritis

Key Hx & PE findings:
- Morning stiffness, other joint pains, other rheumatologic diagnoses, hx recent viral illness

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Back Pain in Young Athletes
**Differential Diagnosis**

**Infectious**
- Vertebral osteomyelitis, including TB (Pott disease)
- Epidural abscess
- Sacroiliac joint infection
- Non spinal infection
  - Paraspinal muscle abscess
  - Pyelonephritis
  - Pneumonia
  - Pelvic inflammatory disease
  - Endocarditis
  - Viral myalgias

  *Key Hx & PE Findings:*
  - Fevers, night pain, worsening pain

**Neoplastic**
- Osteoid osteoma
- Leukemia or lymphoma
- Solid malignancy, primary or metastatic
- Other benign tumor
  - Neurofibroma
  - Vascular malformations

  *Key Hx & PE Findings:*
  - Night pain, severe pain

**Other**
- Appendicitis
- Sickle cell pain crisis
- Syringomyelia
- Cholecystitis
- Pancreatitis
- Chronic recurrent multifocal osteomyelitis
- Psychosomatic illness
- Nephrolithiasis
- Ureteropelvic junction obstruction

**Summary**
- Transient back pain relatively common in children
- Persistent or worsening back pain can be associated with underlying pathology
- History should focus on ruling out serious underlying conditions and characterization of pain
- Physical Examination useful to help establish and support differential diagnosis from history
- Laboratory and radiology studies directed by clinical findings

Thank You!
Spondylolysis in the Young Athlete

Walter Krengel, MD

Walter Krengel, MD, is an orthopedic surgeon and Chief of Spine Surgery at Seattle Children's Hospital. His specialty interests include pediatric spinal deformity, pediatric cervical spine instability, congenital deformity, and general pediatric orthopedic trauma. Dr. Krengel is a member of the American Academy of Orthopedic Surgeons, the Scoliosis Research Society, and the North American Spine Society.
**Spondylolysis and Spondylolisthesis**

(and some stuff about Back Pain)

**Adult Back Pain**

- Common
- Imaging Often No Different Than Patients Without Back Pain
- Transient
- Degenerative
- Benign - Unless
  - Neurological Symptoms
  - Weight loss
  - History of Malignancy

**Back Pain In Children and Adolescents**

- Rare?
- 1,540 children ages 11-14 years
- 37% of the children reported back pain
- 34% limited their activity due to the pain, 14% use medication for pain relief


**Back Pain In Children and Adolescents**

- Rare?
- 3,441 Children: Age 9-15 - Low Back Pain

**Back Pain In Children and Adolescents**

- Rare?
- 

Back Pain In Children and Adolescents

Thoracic Back Pain in Children: Age 9 - 15

- Major Trauma History - Rule Out Fracture
- Most Common Problems
  - Acute Spondylolysis
  - Chronic Spondylolysis / Spondylolisthesis
  - Scheuermann’s / Schmorl’s Nodes
  - No “Diagnosis”
    - Disc Herniation / DDD
    - Bertolotti
    - Abdominal (Constipation, Pyelonephritis)

Back Pain In Children and Adolescents

- Rarer and Worrisome Problems
  - Tumor
  - Infection
  - Inflammatory Disease

Acute Spondylolysis

- History
  - Acute Pain in Lower Back
  - Prevents Activity
  - Occurred During Activity
  - Worse With Activity
  - Leaning Back Worse Than Forward
  - Better With Rest

Spondylolysis and Spondylolisthesis

- Classification
  - Wiltse and Rothman
    - Type I: Congenital and Dysplastic
    - Type II: Isthmic
    - Type III: Degenerative
    - Type IV: Traumatic
    - Type V: Pathologic
    - Type VI: Postsurgical

Does this patient fit with any classic simple / common problems? Or should I be worried?
Spondylolysis and Spondylolisthesis Classification

- Wiltse and Rothman
  - Type I: Congenital and Dysplastic
    - IA: Horizontal orientation of facets
    - IB: Sagittal Orientation of facets
    - IC: All other Congenital Malformations

Herman - Pizzutillo (CORR 2005: 434:46-54)
- Type I: Dysplastic
  - II: Developmental (Incidental finding of pars defect)
  - III: Traumatic
    - A: Acute
    - B: Chronic (Involved in Sports and has pain)
      - Stress reaction
      - Stress Fracture
      - Defect (Nonunion)
  - IV: Pathologic

Spondylolysis and Spondylolisthesis Grading

- Myerding
  - Grade I - V

- Boxall
  - % Slip

Spondylolysis and Spondylolisthesis Other Measures

- Pelvic Incidence
- Sacral Inclination
- Sagittal Rotation Angle

Pelvic Incidence

<table>
<thead>
<tr>
<th>Group</th>
<th>Pelvic Incidence</th>
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</thead>
<tbody>
<tr>
<td>Pediatric Controls</td>
<td>47.4 degrees</td>
</tr>
<tr>
<td>Adult Controls</td>
<td>56.5 degrees</td>
</tr>
<tr>
<td>Low Grade Isthmic Spondyl</td>
<td>68.5 degrees</td>
</tr>
<tr>
<td>High Grade Isthmic Spondyl</td>
<td>79.0 degrees</td>
</tr>
</tbody>
</table>

Spondylolysis

- Prevalence
  - Kindergartners 3%
  - Adults 6%

- Progression
  - Increased chance if
    - young
    - endplate not ossified yet
    - Dysplastic

Back Pain in Young Athletes
Spondylolisthesis

- **Diagnosis**
  - Exam Pain With Extension Tender L5 Tight Hamstrings Neuro Normal Vertical Sacrum/Pelvis Lordosis above Reactive Scoliosis
  - Xray Normal, Sclerosis, gap
  - L5 Most Common
  - L4 Worse Prognosis for pain

- **Xray**
  - Normal, Sclerosis, gap

- **L5**
  - Most Common

- **L4**
  - Worse Prognosis for pain

Spondylolisthesis

- **Treatment**
  - Acute (Will Heal if acute on CT)
    - Rest
    - Brace
    - PT
  - Chronic (Will never heal if remodeling and Gap on CT)
    - PT
    - Activity modification
    - Brace
  - **Surgery**
    - Decompression – May Not Be Necessary
      - Issues Biomechanics as CENTRAL STENOSIS MAY BE SEVERE
    - Fusion
      - L5, A/P, Reduction?, TLIF
    - Pars Repair
      - No Slip or degen. Higher failure rate, No advantage on long term studies

High Grade Spondylolisthesis

- **Grade 3,4,5 (Spondyloptosis)**
- Recent Article Suggests do OK with Conservative Care (If not already bad)
- Posterior in Situ Fusion > Progression and Anterior Degen Changes
- Need Anterior Support via
  - A/P, Transacral Graft, TLIF
  - Gaines Procedure for Spondyloptosis (A/P resection of L5 with Reduction L4-Sacrum)
- L5-S1 Only if interbody support (Maybe)

Acute Spondylolysis

- **Mechanism(s):**
  - Lordosis of Lumbar Spine Increases Load Across Posterior Elements
  - Inferior Facet Impinges on Pars Inter-articularis In Extension
  - Pars is Vascular "Watershed"
**Acute Spondylolysis**

- It Hurts Here
- X-rays Often Normal
- Bone Scan Shows Uptake at Pars

**Acute Spondylolysis**

- Not Here
- Or Here

**Acute Spondylolysis - Treatment**

- 185 Adolescents with Spondylolysis
  - 180/185 in Sports
- CT Scan at Diagnosis and After 6 Months
- Brace and No Sports for 6 Months

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<th></th>
<th>Early</th>
<th>Progressive</th>
<th>Late</th>
</tr>
</thead>
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<tr>
<td>Percent of Defects</td>
<td>39.6%</td>
<td>29.5%</td>
<td>30.9%</td>
</tr>
<tr>
<td>Percent Healed at F/U</td>
<td>73.0%</td>
<td>38.5%</td>
<td>0%</td>
</tr>
</tbody>
</table>


**Acute Spondylolysis**

- CT – Acute Vs Chronic
- Healing Potential
- Acute (heals with rest)
- Chronic (Won’t Heal)

**Acute Spondylolysis**

- Treatment – Rest!
- +/- Brace
Bracing Teenagers With Spondylolysis?

Chronic Spondylolysis / Spondylolisthesis
- Low Back Pain
- > 6 Months
- Recurrent Symptoms
- More Activity > Worse
- Able To Participate
- Improved with rest, NSAIDS

Usually Able To See Pars Defect

Chronic Spondylolysis - Spondylolisthesis

Exam
Appearance: Normal
Gait: Normal
Extension: Increased Pain (Sometimes)

Sciatic Tension Signs? No
Tight Hamstrings? No

Lumbar Scheurmann’s
- Symptoms
  - Chronic “Lower Back” Pain
  - Actually - Upper Lumbar
  - Or Thoraco-Lumbar Junction

Lumbar Scheurmann’s
- It Does Not Hurt Here!

Lumbar Scheurmann’s
- It Hurts Here!
Notochordal Remnants may form weak area in endplate and be origin of Schmorls Nodes?

Lumbar Scheurmann’s

- Chronic Inflammatory Endplate Changes
- Intraosseous Disc Herniation
- Act Like “Arthritis”, DDD
- Bone Scan Warm

“No Diagnosis” - Nonspecific Back Pain

- Common
  - Teenage Girls
  - Pain 9-15 (0-10 scale)
  - Still Doing Everything, Often “Type A”
  - Mom or Dad Answer All Questions, Argue
  - Failed PT, NSAID
  - Diffuse Pain
  - Neck, Mid-back, Lower Back
  - Difficulty Locating Pain

- “No Diagnosis” - Nonspecific Back Pain

- Exam:
  - Look Comfortable, Irritated
  - Tender Muscles and Bony Prominences Diffuse
  - Normal ROM
  - Unusual Pain Responses to Superficial Palpation
  - Smirk / Giggle while reporting 12/10 pain

- Lab: Normal
- X-rays: Normal
  - Overlap With other Conditions
    - DDD, Spondy, Mild Scheurmann’s
  - Screening – Bone Scan versus MRI

- My Pain? It’s about a 13!

- “No Diagnosis” - Nonspecific Back Pain

- “No Diagnosis” - Nonspecific Back Pain

- Rx
  - Be Sincere, Thorough
  - Convince Nothing BAD
  - Discuss Chronic Pain
  - Refer to Adolescent Medicine

- Examples
  - Brother Choking until nearly unconscious
  - Mother Getting Drunk Every Night and Screaming
  - Multiple Recent Deaths in Family
  - Separation, Divorce, Abuse
  - Don’t Really Want to Do Sport Any More
**Disc Herniation, DDD**

Chronic Lower Back Pain
With or Without Sciatica
Frequently More Than 1 Year
Often Don't Resolve
Healthier Disc Tissue
Protrusion/Not Extrusion
Endplate Fractures
Hurt with Flexion
List, Scoliosis, Stiffness, +SLR

**Bertolotti Malformation**

- Chronic Low Back Pain
- Unilateral
- Exam Normal

Unilateral Articulation of L5 Transverse Process With Sacrum

**Bertolotti Malformation**

- Acts Like Pseudoarthrosis, “Arthrosis”
- CT can Help Define Extent / Anatomy
- Associated With Accelerated Degeneration of L4-5 Disc
- Treatment:
  - NSAID / Surgery: Excision vs Fusion

**Discitis / Osteomyelitis**

Chronic Moderate Back Pain
Usually Not Sick
Eventually Becomes Acute and Severe
X-rays May show Narrowed Disc Space
But Usually Normal First Month

MRI Shows:
- Fluid in Disc
- Signal Change in Bone
- Large Soft Tissue Mass
- Phlegmon / Swelling

Treatment:
- Antibiotics
- Surgery if ABX Fail

**Tumor**

- Night Pain
- Spontaneous Onset
- Non-Activity Related
- Younger Patients (<10)
- Stiffness on Exam
11:00 AM

Differential Diagnosis of Complex and Chronic Back Pain

Cora Breuner, MD, MPH

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Differential Diagnosis of Complex and Chronic Back Pain

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Faculty Disclosure Information
In the past 12 months, we have not had a significant financial interest or other relationship with the manufacturer(s) of the product(s) or provider(s) of the service(s) that will be discussed in my presentation.
This presentation will not include discussion of pharmaceuticals that have not been approved by the FDA

Case Study
16 year old female with history of back and sciatic pain for 8 months. Worse on the weekends. She has had a normal physical examination and normal x-rays (not brought to visit today). She has been to physical therapy and HATES IT!!
Mom wants repeat x-rays and a CT scan.
She is in your office for a 15 minute follow up visit.

Imaging Modalities for Low Back Pain in Children: A Review of Spondyloysis and Undiagnosed Mechanical Back Pain
Robert Miller, BS; Nicholas A. Beeh, BS; Norma R. Sampson, MS; Xiaowei Zhu, MS; John M. Flynn, MD, and Denis Drummell, MD

J Pediatr Orthop Volume 33, Number 3, April/May 2013
A retrospective review (10 to 19 years of age) January 1, 2000 to January 1, 2008 were identified. Patients with previous back surgery, high-energy trauma, congenital syndromes, or medical comorbidities were excluded.

N=2846 patients (63% female) with average age of 14.3 years were identified.

2159 (76%) patients had UMLBP, 61% of that had ≤2 follow-up visits.

One hundred and ninety-four patients (7.8%) were diagnosed with spondylolysis; 119 (86%) by plain film, 56 (12.5%) by BSs, and 17 (1.5%) by CTs.

Most patients (74%) with spondylolysis had a positive plain film study, with no significant difference between 2-view anterior-posterior, lateral, and 4-view anterior-posterior, lateral, right oblique, left oblique studies.

Advanced imaging was pursued in 90/354 (25%) patients with negative plain film studies. The sensitivity of BS for spondylolysis was 84% (73 of 88 BSs were positive). The sensitivity of CT for spondylolysis was 90% (44 of 49 CTS were positive).

There was no significant difference between 2-view (anterior-posterior, lateral) and 4-view (anterior-posterior, lateral, right oblique, left oblique) studies.

Advanced imaging was pursued in 90/354 (25%) patients with negative plain film studies. The sensitivity of BS for spondylolysis was 84% (73 of 88 BSs were positive). The sensitivity of CT for spondylolysis was 90% (44 of 49 CTS were positive).

Estimated Risks of Radiation-Induced Fatal Cancer from Pediatric CT
Bennet DJ et al, AJR 2001; 176:289

- Lifetime risk in a 1 year old:
  - Head CT: 0.07%
  - Abdominal CT: 0.18%
- 600,000 children < 15 years undergo CT yearly:
  - Of these, 140,000 will die of cancer (background)
  - An additional 500 might ultimately die of cancer attributable to CT radiation

Units (confusing!)
There is no 1 standard
1 Sievert=100 rem=100 rad=1 Gray (Gy)
You may see radiation expressed as any of these
Generally interchangeable/synonymous
- Dose: Sievert (Sv or mSv)
- Output: Gray

Estimated Mean Doses of Ionizing Radiation from Imaging Procedures and Malpractice Reports in Five Health Care Markets.
28
Confidentiality

- Everything is confidential* except:
  - If you are hurting yourself
  - If you are hurting someone else
  - If someone is hurting you
*Washington State 13 yo for mental health, 14 yo reproductive health

A few more questions..

- HEADSS Assessment
- Home
- Education
- Activities
- Drugs
- Sexuality
- Suicide

HEADSS: Home

- Where do you live?
- Who lives at home with you?
- Do you feel safe at home?
- Are there any weapons at home?
- How do people get along at home?

HEADSS: Education

- Where do you go to school?
- What grades do you get?
- What is the best part about school/the worst part about school?
- What do you want to do after you finish high school?

HEADSS: Activities

- What do you do for fun?
- Do you have friends/a best friend?
- What do you do with your friends?
- Are you in any clubs, team sports, have a job?

HEADSS: Drugs

- Do any of your friends smoke/drink alcohol/smoke marijuana/do drugs?
- Have you ever tried?
**HEADSS: Sexuality**

- What kinds of friends do you have? Boys and girls?
- Do any of your friends’ date? Have you ever dated anyone/is there anyone that you like? Male, female or both?
- Are you dating someone now? How many boy/girlfriends have you had?

**HEADSS: Suicide**

- Have you ever felt sad? Have you ever felt depressed? What did you do about it?
- Have you ever felt like hurting yourself? Killing your self? Hurting someone else?
Case Study

- This 16 yo admitted that her parents are getting a divorce, 19 yo brother and his girlfriend living in the basement of the family home. Both using and dealing crystal meth and have a loaded handgun under the. On weeknights there are multiple people in and out of their house so patient unable to sleep for fear that she and her 5 yo younger sister will be attacked. Tries to sleep on the sofa by the basement door.

Gun Violence / Domestic Violence

- Women represent 95% of adult victims
- Lifetime risk is ~20%
- Between 1–4 million woman abused each year

What did we do?

- Contacted CPS
- Contacted Seattle Children's Social Work
- Arranged close follow up – in two weeks
- She improved!
Case Study

- 13 yo female with rapidly progressive idiopathic adolescent scoliosis, 6 months s/p T10-L5 fusion and instrumentation, presents with back pain and poor school attendance.
- She has been taking hydrocodone 5 mg 3–4 times a day prescribed visits to various emergency rooms in her community.
- When confronted the patient admitted that she also was concerned, answering yes to three of the CRAFFT questions (Car, Relax, Alone, Forget, Family, Trouble).
- She went into inpatient treatment for 30 days with a 60 day outpatient program.
- Her pain is improved and she remains in remission.
- And yes she still has pain sometimes...

Cycle of Use

- Substance Use Progression During Adolescence
  - Experiment
  - Secondary Experiment
  - Resistant
  - Primary Experiment
  - Dependence
  - Problematic Use
  - Maintenance

Sanchez-Samper, Knight; Pediatrics in Review March 2009

Percentage of U.S. 12th Grade Students Reporting Past Year Use of Drug:
(Other Than Alcohol and Tobacco), 2006

*percentages include Xanax* (1.7%) and methamphetamine (2.7%).


Sanchez-Samper, Knight; Pediatrics in Review March 2009
Specific Demographic Concern

Compared to those without a disability... 10th graders with a disability were more likely to:
- Have used marijuana in the past 30 days (23.3% vs 15.4%) (p < 0.001)
- Have binge drink within the past two weeks (25.1% vs 17.6%) (p < 0.001)
- Use tobacco (p < 0.001) (20.6% vs 10.3%)

Conclusion
Physical Therapy Examination of the Pediatric Spine

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Physical Therapy Examination of the Pediatric Spine

Megan Miller, DPT, SCS
David Piskulic, DPT, SCS, ATC/L
November 15, 2014

Objectives
1. Identify movement patterns that contribute to increased pain symptoms through evaluation of movement-based tests in pediatric populations.
2. Explain strength progression of core and trunk exercises to assist with spine stabilization.

How common is LBP in children and adolescents?

- Meta-analysis of 59 articles (15):
  - LBP occurring 60-80% people at some point in their lives
  - Prevalence in children and adolescents:
    - Lifetime prevalence is higher than period prevalence and in turn point prevalence
    - Mean LBP point: 12%
    - Mean LBP period of 12 mo: 33%
    - Mean LBP lifetime for adolescents: 36%
    - Increases with the age of the subjects
    - Some studies found incidence higher in females vs males but not statistically significant
    - Higher in more recent studies

Anatomy

Abdominals (3)
- Rectus Abdominus
  - Flex vertebral column approximating thorax and pelvis
- External Oblique
  - Flex vertebral column; tilt pelvis posteriorly; lateral flexion; rotation of vertebral column
- Internal Oblique
  - Flex vertebral column; rotate vertebral column; depress thorax; lateral flexion
- Transversus Abdominis
  - Flatten abdominal wall
  - Decrease infrasternal angle of ribs

Back Pain in Young Athletes

Abdominals (3)
- Rectus Abdominus
  - Flex vertebral column approximating thorax and pelvis
- External Oblique
  - Flex vertebral column; tilt pelvis posteriorly; lateral flexion; rotation of vertebral column
- Internal Oblique
  - Flex vertebral column; rotate vertebral column; depress thorax; lateral flexion
- Transversus Abdominis
  - Flatten abdominal wall
  - Decrease infrasternal angle of ribs

Back Musculature

Iliopsoas
- Femoral Major and Iliacus
  - Fixed Origin (Ventral surfaces of transverse processes or T12 – L5): Flexes hip joint
  - Fixed insertion (Lesser trochanter of femur): Flexes trunk onto femur; will increase lumbar lordosis
- Contracture: Increased lumbar lordosis deformity
- Shortness: In standing; increased anterior pelvic tilt with lumbar lordosis
**Anatomical Landmarks**

- Spine segments
  - Base of skull → C2
  - Large Spinous Process → C7
  - Spine of Scapula → T3
  - Inferior Angle of Scapula → T7
  - Iliac Crest → L4-L5 interspace
  - PSIS → S2

**Evaluation**

- Postural Alignment/Assessment
  - Ideal alignment facilitates optimal movement
  - More optimal performance of controlling muscular and nervous systems
  - Less chance of causing microtrauma

- Standing Alignment
  - B: Good alignment
  - C: Poor posture
  - Forward head, kyphotic, scapula
  - D: Significant lordosis, anterior tilt

**Concepts of Movement Patterns**

- Movement System Impairments (MSI):
  - Concepts developed by Shirley Sahrmann, PT, PhD, FAPTA and colleagues
  - System for organizing musculoskeletal pain conditions into syndromes that constitute diagnostic categories to direct treatment of mechanical aspects of pain
  - Repeated movements and sustained postures alter tissue characteristics
  - Tissues are stressed by subtle impairments in movement or alignment

- Key factors:
  - Body movement follows path of least resistance
  - Research supports that the ease and rapidity in which a joint moves is more important in a movement pattern associated with pain than muscle shortness, soft tissue restrictions, or limited ROM of adjoining joint
  - This “offending” motion has to be addressed primarily and the tissue adaptations secondarily

**Movement Patterns**

- Distinguishing hypermobility versus hypomobility
  - Movement screen
  - Manual assessment of the spine
  - Muscle length presentation in determining where the body will move
    - Seated knee extension
    - Thomas test
    - Prone knee flexion

- Clarification of hypermobility
  1. Joint ROM exceeds normal
  2. Amount of accessory motion exceeds normal
  3. Frequency of movement of specific joint in a specific direction occurs more often than is considered normal

- Better to have one or the other?

**Muscle Length Presentation**

- Seated knee extension
- Thomas test
- Prone knee flexion
Movement Patterns

- FMS and SFMA
  - Concepts discussed by Grey Cook, MSPT, OCS, CSCS, and colleagues
  - Directional preferences body generates
  - Functional Movement Screen (FMS). The FMS is the 7-point movement screen designed to identify dysfunctional “movement patterns” and asymmetries within the body. “Rate and Rank Movement”. It is mainly designed for the physically active individual.
  - Selective Functional Movement Assessment (SFMA). Lengthier orthopedic based assessment when pain is present. Specific clinical assessment tests to direct the evaluation and classify “movement patterns”

Evaluation

- Overlapping concepts
  - FMS/SFMA- Having pain or unable to complete movement meeting basic criteria
  - Multi-segmental flexion:
    - Touch toes
    - 70 sacral angle
    - Posterior weight shift (T4 junction moves posteriorly over foot)
    - Uniform spinal curves
  - MSI- Where is movement occurring and at what time?
  - Trunk flexion: Posterior weight shift of hips initially, hips and spine move equally during first ½ of range, uniform spinal curves, 70 deg hip flexion, 20 deg lumbar flexion
  - Where is movement occurring with return from forward bend?
  - Basic approach: Identify painful and faulty movement with appropriate treatment methods
  - Big Question: WHAT are the most appropriate treatment methods?

Core Strength Testing and Treatments

- Bent knee versus straight leg sit-ups
- Role of the iliopsoas:
  - Creates anterior shear and compression in spine
  - Minimize iliopsoas activity when patient’s source of pain is due to compression, anterior shear, or extension
  - Example: Supine vs hooklying; straight leg (SL) vs bent knee sit-ups

EMG Studies

- Rutkowska-Kucharska and Szpala, J Strength and Conditioning Research
  - Bent knee (feet elevated), Bent knee (feet flat), and straight leg sit-ups
  - RA activation gradually increased along all positions with changing UE positioning (arms straight, behind head, elevated over head); higher in bent knee feet elevated (~5-7 μV)
  - However, RF activation significantly higher during flexion in knee and hip joints (as much as 52 μV)
**EMG Studies**

- **Using Weights**
  - Adding weight (up to 4 kg) to upper trunk during trunk flexion
  - Not effective for Rectus Abdominis
  - Greater action potencies only verified in Rectus Femoris
- **Using Equipment**
  - Variance in consistency of reports
  - Most agree on limiting involvement of hip flexors
  - Which devices do more hip flexion than core recruitment?
- **Adding Leg Lifts**
  - Children 8-10 years old
  - Exercises while lifting flexed legs did not prove efficient for strengthening rectus abdominis or external oblique
  - No EMG info on TA or IO; no exercises described pelvic positioning
- **Stability before Movement**
  - TA/IO activation increased during hollowing or bracing technique before performing movement

**Abdominal Strengthening**

- **Lower abdominal progression level 1**
  - Engage abdominals ("navel toward spine")
  - Lift one leg so hip is bent 90°
  - Reinforce abdominal contraction of necessary
  - Lift alternate leg to 90° not letting back move
  - Lower one leg to starting position
  - Lower alternate leg to starting position

- **Lower abdominal progression level 2**
  - Alternate heel slides

- **Lower abdominal progression level 3**
  - Alternate leg extension hovering above floor

- **Lower abdominal progression level 4**
  - Lift both legs off to 90° hip flexion
  - Lower feet to mat and slide heels out, slide back in

- **Lower abdominal progression level 5**
  - Hover both legs out

**Straight Leg Sit Up Progression**

- **Level 1**
  - Straight arms
- **Level 2**
  - Arms crossed
- **Level 3**
  - Hands behind head

**Conclusion**

- To successfully treat pediatric patients with LBP:
  - Observe preferred resting postures (sitting and standing)
  - Identify how the movement is performed
  - Identify the painful movement
  - Integrate and teach corrective movement patterns
  - Incorporate appropriate core exercises to functional activities and progress as progress is made
  - Eventually progress to sport-related activity: monitor and correct "faulty" movement patterns
References:

The Role of Physical Therapy in Treatment of Acute vs Chronic Spondylolysis

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Whitney Marois, MSPT, OCS, is a Seattle Children’s Sports Physical Therapist and a board-certified Orthopedic Clinical Specialist. She has advanced training in spine dysfunctions from MGH Institute of Health Professions and helped develop the Seattle Children’s spondylolysis management program. She has completed Level II NAIOMT training and is certified in Sportsmetrics for ACL injury prevention.
Physical Therapy Management of Acute Spondylolysis

Whitney Marois, MSPT, OCS

Objectives

• Review epidemiology, pathophysiology and clinical presentation of spondylolysis
• Discuss the role of physical therapy in the evaluation and treatment of patients with acute spondylolysis
• Discuss established physical therapy protocol and associated precautions
• Discuss bracing guidelines
• Review current literature on the role of physical therapy in treating acute spondylolysis

Epidemiology

• 50% of boys and 25% of girls between 8 and 16 years of age participate in organized athletics
• 47% of adolescent athletes with back pain are diagnosed with spondylolysis
• Spondylolysis is reported in approximately 6-11.5% of the general population and 7-8% in elite athletes.
• Spondylolysis is most common in L5 (71-95%); L4 (5-23%)
• Bilateral spondylolysis will progress to spondylolisthesis (50-80%)
• Females > Male athletes (though in general population male > female)
  • A defect in the pars is 2x more common in males
  • Females are more prone to high-grade spondylolisthesis
• Risk factors include family history of spondylolysis, occult spinal bifida, and Scheuermann Kyphosis

 Definitions

Spondylolysis

• A separation of the vertebral body from the vertebral arch
• Caused by a defect in the pars

Spondylolisthesis

• The defect is bilateral
• The body of the superior vertebrae slides forward on the inferior vertebrae
• Can cause compression of spinal nerves

Pathophysiology

• Full maturation of the pars does not occur until age 25 and numerous ossification centers leaves posterior spine structures vulnerable to repetitive stress
• Pars defect is often thought to be caused by repetitive microtrauma into trunk hyperextension and rotation
  • Gymnastics
  • Football (usually offensive line)
  • Dance
  • Weightlifting
  • Diving
  • Carrying a heavy backpack

Potential Risk Factors

Two potential causes for stress fracture:
• Overload
• Muscle Fatigue
Other proposed causes:
• Diet
  • Female athlete triad: disordered eating, amenorrhea, low bone density
  • Too much sugar can impair bone composition, affect mineral absorption
  • Vitamin-D deficiency can lead to increased risk for fracture in older children
• Hereditary/spinal abnormalities
• Overtraining
• Growth spurts
• Postural dysfunction
• Neurogenic inhibition
Clinical Presentation

- Nearly 50% of adolescent athletes with back pain are found to have spondylolysis.
- Patient will have pain with extension that may radiate into buttocks or posterior thigh.
- Onset of pain may be either acute or progressive.
- Pain increases with activity, pain decreases with rest.
- Tenderness, typically unilaterally at site of defect.
- May have hamstring tightness or spasm.
- Paraspinal muscle spasm.

Type I

- Female with hyperlordosis.
- Increased ROM and flexibility.
- Often dancers or gymnasts.

Type II

- Male athletes with tight paraspinals and decreased flexibility.
- Recent growth spurt.
- Usually muscular with tight hamstrings.

Type III

- Patients new to a sport.
- Deconditioned for vigorous new routines.
- Poor core muscle strength.

One Leg Hyperextension Test

- Low sensitivity and low specificity.
  - Sn = 0.50-0.55 / Sp = 0.68-0.46.
- Assesses the compression forces on the facet joints.
- Increased compressive forces in extension may cause a spondylolysis to be more symptomatic.

Healing After Spondylolysis

- A unilateral active spondylolysis has the best chances to heal.
- Chances of bony union decreases with bilateral and pseudo-bilateral fractures.
- L4 early stage BEST.
- L4 progressive or L5 early FAIR.
- L5 progressive <5%.
- L5 union is significantly associated with degree of lumbar inclination on x-ray.

Healing After Spondylolysis

- Serial MRI studies show a pars fracture can take up to 3 months to heal [Tallarico RA, Madom IA, Palumbo MA, 2008]
- Non-union can lead to progressive injury
- Osseous union and healing vs. fibrous non-union do not impact functional outcome in patients with spondylolysis [Kim HJ, Green DW, 2011]
- Most people with pars fractures do not actually heal the lesion with whatever treatment is used

When to Begin Physical Therapy

- No Randomized Control Trial studies have looked at this
- Physical Therapy intervention has been debated
- We do not believe that physical therapy will influence bony union or non-union. There is no evidence either way
- Reason for early therapy would be to prevent deconditioning, muscle atrophy, and most importantly uncover the cause of stress fracture (ie biomechanics, flexibility, strength)
- Acute pain generally subsides in 3 weeks

d’Hemecourt et al. (2002)

- Most widely referenced study starts PT immediately
  - Patients were removed from sports
  - They wore a Boston Overlap 23 out of 24 hours per day
  - PT was started to work on pelvic flexibility, anti-lordotic strengthening, and avoidance of extension
  - Patients returned to sport with brace at 4-6 weeks if they were pain free with extension and participating in PT.
  - If there was bony healing or pain-free nonunion at 4 months via CT scan, weaning from the brace occurred

Miller et al. (2004)

Longitudinal Cohort Study

- 40 subjects started exercises after 2 weeks rest
  - Nonrigid lumbar bracing 23 hours per day
  - Flexion only trunk strengthening exercises
  - If they had ongoing pain at 4 weeks put in rigid brace
  - Returned to sports at 8-12 weeks in a nonrigid brace if they were pain free at rest and with trunk hyperextension
  - 11 year follow up indicated majority (91%) good or excellent long term results.
- Conclusion: majority of athletes return to full sports participation regardless of bony union

McCleary & Congeni (2007)

- Akron Children’s Hospital Sports Medicine Center
- Base their treatment protocol on the limited literature available
- Start physical therapy within a few weeks for flexibility and core strengthening
- Rest from sports and hyperextension
- Boston Brace for acute fracture, corset with rigid molded piece for subacute and chronic fractures
- Return to play in brace at 4-6 weeks if extension is pain free
- Sports that bracing is not feasible (diving), then gradual return with impact conditioning, sport specific drills, and return to sporting activities

Referral to Physical Therapy

- Physical Therapy can address issues, such as overload and muscle fatigue discussed previously, by creating these stresses in a controlled environment
- We can address possible biomechanical causes of the stress fracture
- Biomechanical Risk Factors:
  - increased lordosis
  - tight iliopsoas
  - tight hamstrings
  - weakness in gluteals and deep hip rotators
  - thoracolumbar fascial tightness
  - abdominal weakness
  - thoracic kyphosis
  - structural abnormalities including spina bifida and spondylosis
Physical Therapy Examination

Lower Quarter Screen
- Neurological exam
- Strength and flexibility
  - muscle imbalance may impact biomechanics
- Joint mobility and ROM
  - Thoracic extension
  - Shoulder mobility
  - Hip Mobility

Functional Movement Exam
- Sahrmann
- SFMA
- FMS

Movement patterns
- Active Straight Leg Raise
- Lumbopelvic rhythm with forward bending
  - Flexion initiated at the hips
  - Reversal of the lumbar kyphotic curve
  - Return from forward bend should begin with hip extension

Physical Therapy Treatment

Manual Therapy
- Myofascial release
  - thoracolumbar fascia
  - spinal extensors
  - iliopsoas
- Thoracic mobilization
- Shoulder Mobility
- Hip Mobility

Global Muscle Groups
- Global muscles are considered "mobilizers"
  - Rectus Abdominis
  - Internal and External Obliques
  - Spinales, Iliocostalis
  - Gluteus Maximus
- Create movement and therefore generate torque
- Necessary for stability during high loading
- They can contract to create "rigidity" in order to protect a pathology, which can in turn cause spasm and pain

Local Muscle Groups
- Work at lower contraction levels
- Do not produce movement
- Work at a low force, continuous activity
- Work segmentally to create stiffness in the spine
- Control excessive physiological and translational motion.
- Activity of these muscles will increase in anticipation of movement or load.
- Stabilizers include the Transverse Abdominis, pelvic floor musculature, medial fibers of QL, deep Psoas, and Multifidus
Treatment Continued

Lumbar Stabilization

- Transversus Abdominis
  - Function of TA is to stabilize lower back and pelvis BEFORE movement of arms and legs
  - The better one is at finding this muscle, the easier it will become to fire the TA during functional activities
- Pelvic floor
  - Must work in cooperation with multifidus and transversus abdominis for spine and pelvis to be stable

O’Sullivan et al. (1997)
- A Randomized Control Trial using a 10 week specific exercise treatment
  - Training of deep abdominals with co-activation of the multifidus proximal to the pars defect
  - Exercises were then incorporated into previously aggravating static postures and functional activities
  - Control group did treatment provided by their practitioner
  - Abdominal bracing with co-contraction of multifidus during functional activities reduces pain intensity and functional disability index at 30 month follow up.
  - Control group showed no significant change

Physical Therapy Protocol for Acute Spondylolysis at Seattle Children’s

General Precautions:
- Patients should have no pain at rest or with ADL’s
- Absolutely NO exercises performed in extension
- Discontinue any painful exercises (Resume in 2 weeks if pain free)
- Bracing per MD recommendation
- No Sports until cleared by MD/PT

Early Phase 0-4 weeks
- Goals:
  - Able to activate transversus abdominis in neutral
  - Able to activate multifidus in neutral
- Precautions for Early Phase:
  - If pain occurs with any of the physical therapy interventions modify exercises and assess for appropriate activity level outside PT.

Intermediate Phase: Moderate Spinal Loading 6-8 weeks
- Goals:
  - Lumbar extension full and pain free
  - Able to perform 15 single leg squats with level pelvis and without femoral adduction and internal rotation
  - Able to perform 20 squats with good form
  - Able to hold forward plank 1 minute; lateral plank 30”

Advanced Phase: Maximum Spinal Loading 8-12 weeks
- Goals:
  - Able to co-contract TA and MF with jumping/plyometrics
  - Run 20 minutes modest speed
  - Perform deep squat meeting criteria*
  - Perform multi-segmental extension meeting criteria**
  - Single leg stance eyes closed >10 seconds, no pelvic drop

Case Report-Patient History
- 17-year-old male
- Low back pain for the past 3-4 months.
- Gradual onset, no specific event that brought on the pain.
- Was participating in CrossFit for about 8-10 months
  - 4-5 hours a day 5 days a week for a Navy Seal training program.
- Noticed that his pain first began while doing a lot of running and overhead weights.
Patient History continued

- Seen in Orthopedics 12/13/2011 for low back pain
- CT scan showed
  - Right L5 pars interarticularis fracture with sclerosis
  - A possible new left L5 pars fracture and subchondral cyst on the right SI joint with sclerosis.
- Grade I Spondylolisthesis L5 on S1
- He was placed in a Boston Overlap brace for comfort
- Lab work for possible rheumatologic etiology due to the SI joint sclerosis came back negative.
- At his Orthopedics visit on 1/26/12 he was pain free at rest but still had pain with extension.
- He was referred for PT for multifidi training in a neutral spine position.

Case Report - Physical Therapy Exam

- Initial PT evaluation was 1/27/12 six weeks from MRI
- At that visit he had returned to CrossFit for a "rehabilitation type program"
  - Extended arm holds with the rings
  - Knee to chest holds
  - Back extension machine
  - No return to running or swimming at this point
- Posture
  - Increased thoracic kyphosis and forward head and rounded shoulders
  - Flattened lumbar lordosis and mild scapular protraction bilaterally with slight winging on the right.
  - Hypertrophy of bilateral paraspinals on the right greater than the left
  - Stands with a slight left pelvic rotation. His iliac crest is elevated on the right along with his ASIS and PSIS

Case Report - Physical Therapy Exam Continued

- Strength:
  - Hip flexion 3+/5 bilaterally
  - Donar flexion 5/5
  - Quadriiceps 5/5
  - Hip internal rotation left 4+/5, right 3+/5
  - Hip external rotation: Left 4/5, right 4+/5
  - Hip abduction left 4/5, right 3+/5
  - Gluteus maximus left 5/5, right 4/5 with some mild discomfort
- He has 5/5 strength of the upper abdominals
- Good control with level 1a of the lower abdominal testing.
- Good pelvic stability with bent knee fall-outs
- Positive active straight leg raise test on the right, negative on the left with increased excursion of the greater trochanter on the right.

Case Report - Physical Therapy Exam Continued

- Flexibility:
  - Positive Ely's test bilaterally with 1 fist to buttock on the left and 1-1/2 fists to buttock on the right with pain in the back on the right side.
  - Hammstring length is -35 degrees bilaterally in a 90/90 straight leg raise position.
  - Negative Thomas test on the left and mildly positive Thomas test on the right.
  - Tight Latissimus bilaterally

Patient Education following the initial evaluation

- No return to running yet
- Hold off for the time being on swimming
- Was told that he could do some light jogging in the pool as well as aerobic training on the stationary bike or elliptical machine.
- Instructed to stop using the back extension machine at Crossfit
- He should only participate in activities that are pain-free.

Early Phase: 0-4 Weeks

- Exercises
  - Abdominal bracing in neutral in supine with progression
  - Multifidus neuromuscular re-education
  - Initiation of gluteus medius/maximus and deep hip rotator strengthening
  - Neuromuscular re-education in timing of firing of the multifidus and gluteus maximus
  - Stretches
  - Hamstring (supine or sitting reach)
  - Hip flexors (manual in side lying, avoiding spinal extension)
  - Back extensors (Child's Pose)
- Manual Therapy:
  - Myofascial release to thoracolumbar fascia
  - Thoracic mobilization to increase extension, rotation
- Cardio:
  - Bike, pool jogging deep water
Progressive Stabilization Phase: Weeks 4-6

- Exercises
  - Bird dog adding ankle/wrist weights or theraband for progression
  - Dead bug with progression
  - Begin higher level stabilization exercises
    - forward planks
    - bridging with SL extension
    - single leg bridging

Case Report—Physical Therapy Treatment

- Second PT visit—first follow-up appointment:
  - Manual Therapy:
    - Myofascial release through the thoracolumbar fascia
  - Therapeutic Procedures:
    - Education on the role of local spinal stabilizers and instruction in supine Transverse Abdominis contraction 10s 10x with VC’s to decrease use of obliques
    - Bent knee fallout with TA contraction 10s x 10
    - Prone multifid contraction with overuse of right and decreased firing on left, more difficulty with relaxation on right
    - Prone heel squeezes 10s x 10 with cues to increase use of right glut max
    - Lat stretch in sitting with shoulders in ER and flexion 30 sec x 2

Physical Therapy Treatment continued

- On the third visit we added passive stretching for shoulder flexion with scapular stabilization
- Progression of Therapeutic Exercise
  - Side-lying hip abduction x 20 each leg
  - Quadruped UE extension x 10
  - Quadruped hip extension with knee flexion x 10
  - Bridges with post tilt for glut firing
  - Wall slides with post tilt
  - Quadruped rock backs x 10 in neutral spine with movement through hips
- Fourth visit progression
  - Prone scapular retraction with hands behind head x 10 with manual and verbal cues to decrease firing of upper traps
  - Foam roll for pectoral stretch, angels, alternating UE flexion

Intermediate Phase (moderate spinal loading): Weeks 6-8

- Exercises
  - At 6 weeks begin upright closed chain exercises
    - squats
    - traveling lunges
    - lunge matrix
    - bands (monster and lateral walks)
    - single leg squats progress to variations (with lift, STAR, etc)
    - chops and lifts (progress from ½ kneel to full kneel to lunge to standing)

  - Begin Proprioception Exercises
  - Stretches
    - continue from phase I
    - Modify hip flexor stretch to half kneeling
  - Cardio
    - bike, pool jogging shallow water, TM walking on incline

Physical Therapy Treatment Progression

- Visit Five—8 weeks from diagnosis
  - Monster walks RI/F and lateral with green band around ankles 20’x4
  - Lunges alternating forward and lateral x 10 each
  - Shuttle DL 5 cords x 20, SL 4 cords x 20 each side
  - Bird dog x 10
  - Planks 30 sec x 3
  - Squats on BOSU black side up x 20
  - Prone scapular retraction with hands behind head x 10 with manual and verbal cues to decrease firing of upper traps, with UE extension x 5

- Visit Six
  - Bird dog with hands and knees on 1/2 foam rolls x 10
  - Push-ups x 20 with neutral spine and core activation
  - Squats on BOSU black side up x 20 with 49 med ball lift
  - SLs on Black side of BOSU with knee lift x 10 each leg

  - At the 8th visit we began plyometrics
  - Shuttle 7 cords DL x 20, SL x 20 each; 2 cords DL jumps 2 x 10 with neutral spine, SL jumps x 10 each leg
  - Box jumps 24” 2 x 10
  - Sissor jumps x 10 each side
**Advanced Phase (maximum spinal loading): Weeks 8-12**

- Continue intermediate phase exercises and stretches
- Add trunk extension
  - To neutral over ball
  - Side flexion over ball
- Weighted squats with medicine ball
- Weighted lunges with medicine ball or dumbbells
- Agility:
  - Ladder, walk-a-drill progressed to run-a-drill, cutting, multidirectional challenges
- Plyometrics:
  - Double limb hops progressed to single limb hops
- Cardio:
  - Til running progression

**Physical Therapy Treatment Progression**

- Visit 9-strength and flexibility re-check
  - Strength
    - Hip flexion 5/5 bilaterally.
    - Hip internal rotation left 5/5, right 4+/5.
    - Hip external rotation: Left 5/5, right 4+/5.
    - Hip abduction left 4+/5, right 4+/5.
    - Gluteus maximus left 5/5, right 4+/5
  - Flexibility:
    - Ely’s test bilaterally with 1-1/2 fists to buttock bilaterally without pain.
    - Hamstring length is ~35 degrees on the right and ~40 degrees on the left in a 90/90 straight leg raise position.
    - He has a negative Thomas test on the left and mildly positive Thomas test on the right.

We progressed plyometrics and he was given a jumping program for home and educated in footwear for running.

**Physical Therapy Treatment Progression**

- On his 10th PT visit pt. had full, pain-free lumbar extension, but did get some muscle spasm at the level of the spondylolysis with his arms overhead.
- He did some interval jogging and was given a jogging progression for home.
- Visit 11-3/7/12 (almost 3 months from diagnosis)
  - Continued muscle tightness, but improved from last re-check
  - Mild hip weakness on the right in abd, ER, and glute max.
  - He has returned to running and swimming without pain.
  - Patient education:
    - Instructed pt. to return to sidelying hip abduction and prone hip extension daily and added step-downs to his HEP.
    - Instructed pt. to hold off on the ab-mat http://www.roguefitness.com/abmat because it puts him in extension as a starting position for crunches.
    - He was also instructed to go slow with any overhead lifting at this point.
  - Visit 11-3/7/12 (almost 3 months from diagnosis)
  - Mild hip weakness on the right in abd, ER, and glute max.

**Final Physical Therapy Visit**

- At the 3 month mark pt. reported he was pain free with running, swimming, push-ups, pull-ups and crunches.
- All sections of the SFMA were functional and non-painful.
- Hip Strength full in all directions bilaterally.
- Flexibility:
  - HS: 27 degrees bilaterally.
  - Ely’s tight at end range.
  - Thomas test tight at end range.
- Patient education:
  - Reviewed Cross-fit exercises and made adjustments.
  - Discussed progression of cardio activities, new running shoes.

Pt. called at 6 month mark to report he was able to join the Navy and was working toward his goal of becoming a SEAL.

**A few words about bracing**

- Boston Overlap brace
  - Anti-lordotic
  - Reduces shear force on the pars by making them more vertical.
  - Increases inter-abdominal pressure to reduce axial compression
- Lumbar corset
  - Typically made with moldable plastic and elastic.
  - Meant to provide some lumbar support.

**Axelsson et al. (1992)**

- Effect of lumbar orthosis on intervertebral mobility.
- 7 Patients with posterolateral L/S fusion without IF.
- Examined in supine and standing one month after surgery prior to bony healing.
- Examined without lumbar support, with rigid orthosis and with canvas corset and molded posterior support.
- Neither brace had a stabilizing effect on sagittal, vertical, or transverse intervertebral translations.
- Braces only restrict gross spinal movement and not intersegmental motion.
- The use of lumbosacral brace may actually increase intersegmental motion at lumbosacral junction.
Bracing in the literature

- Studies have shown good results with the use of a bracing, but time frames and brace type are variable
  - Steiner and Micheli showed 78% good or excellent results wearing mod Boston Brace 6 months full time, then weaned 6 months
  - Also received physical therapy: hamstring stretching, thoracolumbar stretching, abdominal strengthening
  - D’Hemecourt et al. (2002) showed that 80% had good to excellent outcome with bracing and PT
  - Patients wore a Boston Overlap and returned to sports with the brace at 4-6 weeks
  - Weaned from the brace at 4 months if bony healing or fibrous non-union occurred
  - Ruiz-Cotorro et al. (2006) found no difference in outcome between brace or no brace in tennis players

A need for more research

- At this time there have been no RCT comparing brace and rest to Physical Therapy when treating Acute Spondylolysis
- There are numerous retrospective studies showing good results with rest and bracing, but no randomized trials to support brace treatment
  - Goal of bracing is to restrict repetitive hyperextension and improve sagittal alignment of the pars
- Limited evidence to support early initiation of physical therapy with only one RCT that did not differentiate chronic vs. acute spondylolysis/spondylolisthesis. [15]
  - Goal of PT is to improve core stability, flexibility, and posture
  - It is also important to address underlying biomechanical dysfunction that may have lead to the spondy in the first place

QUESTIONS?

References

2:50 PM

The Role of Physical Therapy in Treatment of Chronic Back Pain

Ellie Somers, MSPT, DPT
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Ellie Somers, MSPT, DPT, is a Seattle Children’s Sports Physical Therapist. She specializes in the treatment of orthopedic sports injuries and chronic pain in young athletes, and she helped develop a group intervention program for adolescents with chronic pain.

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Sabina Havkins, PT, ATC, is a Seattle Children’s Physical Therapist. She is a member of the multidisciplinary Pain Medicine team and has been involved in the treatment of chronic pain with the adolescent and preadolescent population for over 20 years. She is also part of the clinical team in the Seattle Children’s Bone Tumor program and Sports Physical Therapy.
Chronic Low Back Pain in Pediatrics: An Evidence-Based Approach
Dr. Ellie Somers, DPT, Janet Morton, PT and Sabina Havkins, PT

Objectives:
• Demonstrate understanding of the biopsychosocial approach to chronic pain
• Understand the neurophysiology of chronic pain
• Recognize the presentation of chronic lower back pain in children and adolescents
• Understand how to teach a patient about their pain
• Demonstrate knowledge of the evidence-based management of chronic lower back pain in children and adolescents
• Understand when a multidisciplinary approach is needed in the treatment of chronic pain

The Truth about Chronic Pain
• Chronic pain affects more individuals than heart disease, cancer and diabetes COMBINED (Sluka et al)
• Low back pain in childhood is demonstrated to contribute to the 70%-85% of adults who experience chronic back pain. (Kosseim et al)
• Chronic musculoskeletal pain disorders account for up to 25% of new referrals to pediatric rheumatologists (Hoffart, Wallace)
  - Examples: Juvenile fibromyalgia, diffuse idiopathic pain, complex regional pain syndrome, central sensitization

So what can we do about it?
• First step:
  - We must change our beliefs about chronic pain, so that we can more effectively educate and treat our patients

Nijs J, Roussel N, Wilgen CP, Koke A, Smeets R. Thinking beyond muscles and joints: therapists’ and patients’ attitudes and beliefs regarding chronic musculoskeletal pain are key to applying effective treatment. Manual Therapy. 18(2013) 96-102

Cultural Belief:
• “If it hurts, don’t do it”

Nijs J. Roussel N, Wilgen CP, Koke A, Smeets R. Thinking beyond muscles and joints: therapists’ and patients’ attitudes and beliefs regarding chronic musculoskeletal pain are key to applying effective treatment. Manual Therapy. 18(2013) 96-102

How do these patients present?

Back Pain in Young Athletes 51
Factors that affect chronic pain

- **Cognitive (Knows)**
  - Inaccurate understanding of chronic pain
  - Lack of information regarding effective therapies (PT, CBT, meds)
  - Negative expectations for ongoing pain
  - Difficulty recognizing and resolving stressful situation

- **Behavioral (Does)**
  - Protective parenting
  - Lack of compliance with pain-control therapies
  - Secondary gain (time home with mother or missed school)
  - Activity withdrawal
  - Family history of chronic pain

- **Emotional (Feels)**
  - Anxiety regarding movement or touch
  - Fear of increased pain with activity
  - Concern about prognosis
  - Stressful familial environment

Normal Sensation

- Remember: Pain is normal!
- Our nervous system is designed to interpret sensory information, in order to protect us or alert us to danger
- These reactions are physiological!
- Acute pain: hot fire, pull your hand away, sharp nail, lift your foot up, broken bone, don’t put your foot down

The Neurophysiology of Pain


Acute vs Chronic

- Most chronic pain models have taught us that chronic pain is any pain problem persisting beyond the usual period required for an injury to heal
- Basic literature shows that the term “chronic” represents MORE than a temporal dimension to pain.
  - Meaning that the neural mechanisms underlying chronic pain are different from those involved in acute pain

Chronic Pain/Central Sensitization


Pediatric Pain

- Pediatric nociceptive systems are more sensitive than those of adults (Campos et al)
  - With larger receptive fields in infancy
  - Increased potential for excitation of the central cells
  - Increased potential for pain
- Adolescence is a “vulnerable” period
  - Certain pain conditions start during this time period
- On the plus side:
  - Children’s pain perception seems relatively more plastic or modifiable, when compared to that of an adult


What does the evidence say?

- Evidence demonstrates that a key to treatment of chronic pain is EDUCATION!
- Specifically:
  - Neurophysiological pain education

Louw A et al, 2011
J. Jijs et al, 2011 and 2013
Moseley. 2005
Butler D, Mosely GL. Explain Pain etc...

The Evidence

- “In the short term, pain physiology education alone is more effective for pain relief and improving pain self-efficacy than a combination of pain physiology education and group exercise classes for patients with chronic low back pain” (Ryan et al 2010)
- “Altered pain perceptions are directly associated with altered movement performance in those with chronic low back pain, even if there is no opportunity for the patients to be physically active during the treatment” (Moseley 2002, 2004)
- This demonstrates that motor performance may be directly limited by pain perceptions
- “In patients with chronic low back pain, pain physiology education alters pain perceptions and in conjunction with physiotherapy, it improves functional and symptomatic outcomes” (Moseley 2002, 2003, 2004, 2005)

Pain in the Central Nervous System


Pain in the Central Nervous System

Pain in the Central Nervous System


The road to recovery begins here...


Common presentations

• FEAR (Simons et al, Vlaeyen et al)
  • Belief that movement is harmful or damaging to their tissues
• Catastrophizing (Nijs et al, Simons et al)
  • Ongoing and extreme pain
• Anxiety and stress
• Significant functional decline
• Extensive medical testing that is negative
• Protective parenting (Odell et al)
  • Use of assistive devices/aids
• Spreading painful symptoms or even radicular symptoms
• Sleep disturbances
• Previous, failed treatments

Treatment

• Therapeutic exercise (Kosseim et al, Sluka et al, Dobson et al, Macedo et al)
  • Believed to activate central inhibitory pathways that produce an opioid-mediated analgesia (Sluka et al)
  • Focus on function (Odell et al)
  • Motor control and graded activity (Macedo et al)
• Aerobic (Cunningham et al)
• Parental education (Odell et al, Campos et al)
  • Studies show that a parent’s response to their child’s pain behaviors and parent catastrophizing are associated with increased functional disability in the child, school impairment, activity restriction, and willingness to engage in treatment (Odell et al)

Something to ponder...

• Jane is a 3 year old girl - falls down for the first time.
  • How does the parent’s response affect the child’s response to the fall?
Encouraging independence

- Goal setting
- Minimize or eliminate passive treatments
- Cardiovascular activity – using HR
- Socialization
- Cognitive Behavioral Therapy (Odell et al, Lee et al)
  - Time to refer

Reference List


Back Pain in Young Athletes

Case Study

17 Year Old Female

- 2 year history of low back pain
- 4 year history of bilateral knee pain
- Headaches
- Other chronic issues: anxiety, depression, weight management issues

Subjective

- No history of injury
- Aching and pressure in a band across her low back
- Denies numbness, tingling or other neurological symptoms
- No bowel or bladder changes
- Pain rating 5/10
- Exacerbated by sitting, standing, lifting and forward bending
Case Study

Social History
- 12th grade and enrolled in online school
- Previous year patient missed 23 days in the second semester
- Hated school
- Patient "has no friends" and was bullied at school
- Mostly plays video games and social world is via internet
- Currently works at a grocery store requiring lifting up to 50# repetitively

Providers seen by patient between 2013-14
- OVER 13:
  - Orthopedics
  - Rheumatology
  - ADO
  - Physical and Occupational Therapy
  - Nutrition
  - Psychology

Imaging
- X-rays: Knees, Pelvis, L-Spine – All Normal
- MR Brain - Normal
- MR Spine Lumbar – Normal with incidental note of prominent endplate irregularities T6-8
- CT Head - Normal

Initial Evaluation:
- Popliteal Angle – Left 50 degrees, right 45 degrees
- SFMA – Multisegmental flexion, extension, rotation, overhead squat all dysfunctional and painful
- Ely’s – Positive right and left
- Ober’s – Positive right, negative left
- Thoracic kyphosis and poor overall posture
- Trigger points – Multiple in hip, knees, shoulders
- CALI Score = 48

ACTIVITY LEVEL
NONE

Physical activity "increases her pain"

Treatment
- Cardiovascular Training
- Desensitization
  - Foam roll, peanut ball, towel rubs, etc
  - Patient Education!!!
- Pain
- Posture and Body Mechanics
- Strength Training
- Stretching/yoga
- Relaxation techniques
- Functional Training
- Job Specific
- Modalities yes/no??
**BORG RPE Scale**

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<td>7</td>
<td>Impossible</td>
<td>110+</td>
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**Patients Goals**

**Initial**
- Be able to function without a large amount of pain
- Be able to exercise without pain or swelling issues

**2 month follow up**
- Work a full shift without taking unscheduled breaks
- Go for a 30 minute walk without needing to stop

**Therapists Goals**

- Independent home exercise program.
- Increase multisegmental flexion by 15 cm fingertips to floor.
- Increase straight leg raise range of motion by 10 degrees.
- Demonstrate correct body mechanics with bending and lifting.
- Improved proximal hip strength by 1 grade.
- Able to perform overhead deep squat maintaining neutral alignment.
- Five single leg squats maintaining neutral alignment.
- Complete 20 minutes of continuous cardiovascular activity within target heart rate range of 120-140.

**Patient Progress**

- MD visit 10/2/2014 – Reported doing better, noticing improvement
- TENS – Uses successfully to manage symptoms and increase activity level
- Popliteal Angle – Improved by 10 degrees
- CALI Score
  - 09/14 - 48
  - 11/14 - 34

**Putting The Puzzle Together**

- Integrate body and mind
- Multidisciplinary
- Educate
- Function, function, function......
- MOVEMENT!
- If pieces don’t fit: Refer...
  - Power over Pain Program - Bellevue
  - Pain Medicine Clinic - Seattle

**References:**

Chronic Back Pain - Case Study
Sabrina Havkins, PT, ATC, PT Clinical Lead - Pain Management

It's Complicated
- Time till diagnosis
- Time till treatment
- Outcomes
- Complexity

History of injury/pain
- Wrestling injury 2012
- MD report- negative imaging findings
- Normal neuro exam
- High fear avoidance
- Psychosocial stressors
- High guarding for mild low back strain

Chronology of medical assessments and rehabilitative treatments
- 12/2012 wrestling injury
- January to August 2013- Multiple treatments
- February to June- Depression and Suicide attempt
- June 2013 IPU admit
- August 2013- PMC evaluation
- February 2014- symptoms worsen
- March to July 2014- Re-evaluation, waitlist, begin PReP
- October 2014- ongoing monitoring of progress, function

Pain MD Evaluation
- Non-antalgic gait
- MMT 5/5
- Guarded FF and Rot/SB (80 degrees FF)
- Allodynia entire thoracolumbar
- No trigger points
- Teary and extreme discomfort all positions
- Pain 7/10

Pain PT Functional Evaluation
- 100’ walk & run =13.9, 8.3 secs
- SLS = normal
- Step-test =57X /min
- Stairs 3 floors = 39.9 secs (FAST!)
- 6 minute walk = 12 laps (median %ile)
- Broad jump = 4 feet **
Psychological Findings

- June 2013- IPU admit: major depressive symptoms, Suicide attempt
- Family history mental health issues
- Severe fear avoidance

Traditional Physical Therapy Intervention

Multidisciplinary Treatment Approach

1 and 3 Month PT Follow Up Findings

- 1 month- Running 2 miles
- Started karate
- Personal trainer workouts
- Summer camp – Kayaking not comfortable
- Minimal tenderness to touch
- Pushups, planks, sit-ups
- 3 month- 4/10 pain + naps
- Struggling with carrying backpack at school
- Still doing karate, trainer workouts

Psychology Follow-ups

- Sept 2014
- Functionally well
- Attending school
- Less depression
- Seeing local mental health provider
- Reviewed cognitive and behavioral strategies
- Validation of impact of pain on his life

Psychology Follow-up

- October 2014
- Spending more time with friends + girlfriend
- Improved mood & continues on psychiatric meds
- Increasing independence w/ advocating for needs etc
- Taking 1 hour naps after school for pain relief
- PhD recommends adding short walks instead of naps
- Continue with local mental health care
Physician Follow-up

- Oct 2014
- Dropped an art class due to pain from bending over
- Improved pain score 2-4/10 (vs 6/10)
- Active w/ karate and personal trainer
- Going to school and doing chores
- Full flexion w/ exam but guarded
- Tenderness throughout his back
- Doing well functionally
- Will change meds, encourage walking. F/U 1 month
Conservative Approaches to Scoliosis Management: An Evidence Based Update

Lisa Flexner, DPT, DMT, CSCS, FAAOMPT
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Lisa Flexner, DPT, DMT, CSCS, FAAOMPT, is a Seattle Children’s Sports Physical Therapist, a Fellow in the American Academy of Orthopedic Manual Physical Therapy, and is certified in the Schroth method for scoliosis management. She specializes in spine injuries and conservative scoliosis care. Lisa teaches orthopedic physical therapy in the University of Washington's Doctor of Physical Therapy program.

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Shannon Stone Cribby, DPT, is a Seattle Children’s Sports Physical Therapist and is certified in the Schroth method for scoliosis management. She specializes in conservative scoliosis care and sports medicine, and has experience in traditional pediatric physical therapy.
**Management of Adolescent Idiopathic Scoliosis Using the Schroth Method**

Lisa M Flexner DPT, DMT, CSCS, FAAOMPT
Shannon Stone Cribby DPT

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**What is Scoliosis?**

**Definitions**
- **A three-dimensional** torsional deformity of the spine and trunk
- Structural curves vs. non-structural curves
  - Cobb angle
  - Vertebral rotation
  - Vertebral wedging
- Imaging only shows 2D
  - When is imaging misleading?
- 3D morphology may be more predictive of progression than Cobb angle alone

Watanabe et al, 2012, BMC Musculoskel Disord
Nault et al, 2014

**Epidemiology**
- **Prevalence**
  - 20% pathologic/congenital; 80% idiopathic
  - Scheuermann’s: 0.4-8.3% of the population
  - Twice as common in boys as girls
  - AIS: 2.3% of children age 10-16
  - 10% will not progress, may resolve spontaneously
  - <0.3% will require surgery
  - Curves typically above 50 degrees
  - Risk of visceral compromise leading to pain and functional decline
  - More common in girls than boys
  - The steeper the Cobb angle, the greater the ratio
  - Nearly one-to-one for curves under 20 degrees, BUT
  - Girls are seven times more likely to have curves above 30 degrees
  - Dancers 12% more likely to get AIS, irrespective of hypermobility

Wong and Tan, 2010; Rigo, 2010; Longworth et al, 2014

**Pathomechanism**
- Mechanical and geometric torsion due to asymmetrical growth of the vertebral bodies
- Vertebrae grow slower where compressed, faster where tractioned (Wolff’s Law)
  - Lateral Wedging
  - Relative Spinal Overgrowth in Vertebral Bodies
    - Anterior → 3D curves seen in AIS
    - Posterior → Sagittal plane deformities (Scheuermann’s)
  - Loss of thoracic kyphosis

**Respiratory Dysfunction**
- Vertebral anomalies alter rib development
- Decreased lung volume
- Decreased chest wall compliance
- Altered air flow within the lungs
- Altered respiratory pattern
- Decrease in muscle activation in the intercostals and diaphragm in the concavities
- Decrease functional aerobic capacity

**Body Image and Psychosocial Impact**

- Onset often at crucial developmental period
- Amount of pelvic imbalance correlated with body image disturbance
- Amount of intervention correlates with later impact on mental health
  - Should we treat mild curves?
  - Need to find the right outcome measures
  - Need to use the right language
  - Family support is key
  - Mothers who model positive body image have positive impact

Metrakos et al., 2013; Phaowalak et al., 2014; Rovet et al., 2014

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**The Vicious Cycle**

- Spinal Curvature
- Asymmetrical Loading
- Asymmetrical Growth
- Intervention
- Vertebral Morphologic Change

Rigo et al., 2010

---

**The Controversial Claim**

*If sufficient force is applied to the vertebrae, the progression of scoliosis could be arrested or even reversed.*

(Rigo, 2010)

---

**Skeletal Maturity and Risk for Progression**

- Treatment decisions are based on RFP
- Chronologic age and pubertal onset are less predictive than skeletal maturity
- Use the Risser scale, based on iliac crest growth plate
  - The lower the Risser score, the more likely the child will progress
  - Juvenile IS has 100% RFP, should be closely monitored

<table>
<thead>
<tr>
<th>% RFP (Lonstein-Carlson)</th>
<th>Treatment Recommended</th>
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<tbody>
<tr>
<td>&lt; 20%</td>
<td>Observe and Educate</td>
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<tr>
<td>20-40%</td>
<td>Scoliosis-Specific PT</td>
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<tr>
<td>40-60%</td>
<td>SSPT, possibly early bracing</td>
</tr>
<tr>
<td>60-80%</td>
<td>SSPT + bracing</td>
</tr>
<tr>
<td>80+%</td>
<td>SSPT + full-time bracing</td>
</tr>
</tbody>
</table>

Kuchacki, 2009; SIOSORT Guidelines 2005

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**Natural History**

- Curve angle classification
  - Not clinically significant: < 10 degrees
  - Mild curve: 10-25 degrees
  - Moderate curve: 25-45/50 degrees
  - Severe curve: > 45/50 degrees
- Angle at skeletal maturity predicts outcomes in adulthood
  - Curves < 30 degrees at maturity tend not to progress
  - 30-50 degrees: moderate RFP and functional impact
  - Role for physical therapy, exercise/fitness
  - Over 50 degrees: tend to progress additional 1 degree per year
  - Very high RFP and potential for health and QOL decline

Weinstein et al., 2003; Weinstein & Ponseti, 1983

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**Natural History**

- Slightly more likely to have back pain
  - Intensity and duration equal to general population
  - Spinal deformity does not equal significant disability
  - Function and Quality of Life: perceptions of disability
  - Issues with body image and appearance
    - Purchasing clothes, decreased physical ability, increased self-consciousness
  - Morbidity/Mortality: curves over 100 degrees

- The primary complaint of skeletally mature patients with AIS is dissatisfaction with cosmesis.

Weinstein et al., 2003; Mayo et al., 1984
Treatment Options for Adolescent Idiopathic Scoliosis

- **Wait and See**
- **Surgery**
  - Indicated for curves above 45-50 degrees
  - Low but significant complications
  - Fewer complications if done in adolescence
  - Largely for cosmetic/psychologic purposes
- **Bracing**
  - Typically for curves 25-50 degrees
  - Brace styles: rigid vs. flexible
- **Bracing**
  - Rigo-Cheneau-Wood Brace
  - Boston Style Brace
  - Literature for traditional PT approach is poor
  - Scoliosis-Specific Exercise (e.g. Schroth)
    - Three indications
      - Prevent/delay bracing for curves <25 degrees
      - Reduce side effects of bracing for 25-50 degree curves
      - Manage the adult patient with pain
    - Evidence for SSE is growing
      - Cochrane Review: low-grade support for SSE plus other treatments more effective than other treatments alone
      - First RCT published 2013 in European Spine J. with excellent results
      - More clinical trials in process in Canada, UK, and Sweden
  - First RCT published 2013 in European Spine J. with excellent results
    - Not trying to alter the existing morphologic changes
    - Individual curve pattern is key to treatment planning

What Is the Schroth Method?

- 1921, Germany: originally developed by K. Schroth to treat her own scoliosis
- Incorporate cognitive, sensorimotor, and kinesthetic training to teach improved scoliosis posture
- Goals of Treatment
  - Improve postural appearance and decrease asymmetry
  - Stabilize posture via improved body mechanics
  - Decrease adverse mechanical forces acting on spine
  - Halt or slow scoliotic curve progression
  - Improve lung capacity/function by altering respiration
  - Prevent or delay more aggressive interventions
  - Improve postural endurance to maintain corrections
  - Educate and help patient and family with coping

The Schroth Method at Seattle Children’s
Criteria for Referral: Seattle Children’s Schroth Program

Criteria as defined by the orthopedic surgeons:

• Greater than 20 degrees Cobb
• Age 11 or older
• Cognitively mature helps!
• High risk of curve progression
• Skeletally immature

Contraindications and Precautions

Contraindications
• Reactive Scoliosis
• Tumor or active disease process
• Active Inflammatory Disease
• Major Psychologic Disorders
• Major Medical Co-Morbidities

Precautions
• Spondylolisthesis
• Inactive Inflammatory Diseases
• Osteoporosis
• Juvenile Hypermobility Syndrome
• (5+/9 on Beighton scale)
• Osteogenesis Impefecta
• Chronic Pain
• Anxiety/Depression
• [Body dysmorphic]
• [Sexual or physical abuse]

What We Do

• Hands-on Treatment
• The Language of Schroth
• Tactile/Visual/Verbal Cueing
• Passive Corrections for Set-Up
• Active Corrections
  • Axial lengthening
  • De-rotation
  • Asymmetrical muscle activation
  • Respiratory pattern training
• Cumulative progression during session and over episode of care

Typical Plan of Care

• One to two visits a week
• Twelve or more weeks
• Body awareness
• Wean off over 4-8 weeks
• Recheck every 3 months
  • Keeps patient engaged
  • Add advanced stability exercises
  • Increase tri-planar challenges
  • Decrease external stabilization

Exercise Expectations
• 6 days a week
• 20-30 minutes per day

Equipment Needs
• Multiple pieces of equipment
• Cost $150-700

Examples of Schroth Treatment
Examples of Schroth Treatment

Starting Resting Posture

Elongation

Sitting with Active Corrections

Standing with Active Corrections

References


References

Hope. Care. Cure.