Coccygeal Internal Mobilization: Clinical Reasoning and Treatment for Diagnoses Beyond the Pelvic Floor

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Outline
- History
- Associated Diagnosis/Dysfunctions
- Anatomy/Biomechanics
- Why the Coccyx
- Treatment
  - Precautions
  - Patient Education
  - Set Up
  - Treatment procedure
History

- The first record of internal work on the coccyx was in 1859 by J. Y. Simpson M.D.
  - For treatment he separated the coccyx from all the surrounding muscles, tendons, and ligaments, which was done subcutaneously, with a tenotomy knife.
- In 1937 Thiele described internal coccyx mobilization extending up to the piriformis in JAMA.
- A randomized single-blinded study in 2005 by Maigue evaluated intrarectal manipulation to treat coccydynia.
  - Good results were twice as frequent (borderline significant) in the treatment group compared to the control.

Associated Diagnosis/Dysfunctions

- Coccydynia
- Sacroiliac Pain
- Lumbar pain
- Pain with sitting
- Sciatica
- Neurotension
  - Flexion slump (Maitland)
  - Extension slump (Johnson)
- Trigger points not accessible externally
- Coccyx
  - Not treatable externally
- Sexual Dysfunctions
- Headaches
- Visceral dysfunction (slow transit times)
- Pelvic floor dysfunction
- Bowel or Bladder Dysfunction
- Dural Tension (Cervical retraction test, Johnson)
- Shin splints
- Chronic hamstring strains, especially bilateral
- Chronic plantar fasciitis
- Upper Extremity Nerve Tension
- Decreased Cervical Rotation
- Decreased Shoulder elevation
- Decreased Trunk Rotation
- Decreased Hip Rotator Strength
- Decreased Trunk Forward Flexion
- Scoliosis
- Patellofemoral Pain Syndrome (PFPS)

Anatomy

- Consists of three to five coccygeal vertebrae (Woon 2013)
  - 3 (13%)
  - 4 segments (76%)
  - 5 segments (11%)
- Overall mean length
  - Women: 3.7 ± 0.7 cm
  - Men and 4.2 ± 0.8 cm
- The first coccygeal
  - Largest segment
  - Articulates with the sacrum via a symphysial or synovial joint (Saluja, 1988)
Anatomy


- Fused joints
- Intact Disks (similar to Lumbar Spine)
- Synovial Joints
- Symphysial joint

Coccyx Angulations

- A radiographic classification of the Coccyx: Potacchini et al
  - Type I (~70%): the coccyx is curved slightly forward, apex pointing caudally
  - Type II (~15%): the coccyx is curved more markedly anteriorly, apex pointing straight forward
  - Type III (~5%): the coccyx is sharply angulated forward between the first and second or the second and third segments
  - Type IV (~10%): the coccyx is subluxed anteriorly at the level of the sacrococcygeal joint or at the level of the first or second segment
  - Type V: A coccyx with a retroverted tip (Woon et al. 2013)

FMT Coccyx Dysfunctions

Classifications

- Flexed
- Extended
- Rotated
- Side Bent
- Anterior/Posterior Shear
- Lateral Shear
- Compressed
Coccyx Mobility

- Coccyx mobility in sitting: flexion (Maigne, 1994)
  - Coccyx flexion: between 5 and 22 degrees
  - During straining/bowel movement, coccyx extension: between 5 and 15 degrees

- Postacchini: 120 asymptomatic subjects
  - Sacrococcygeal joint was mobile in 53 (63%)
  - First intercoccygeal joint was mobile in 75 (90%)
  - Second intercoccygeal joint was mobile in 47 (57%)
  - Only 7% had completely fused coccygeal segments

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Coccyx Mobility

- Woon and Maigne: 101 Patients with Coccydynia
  - Sacrococcygeal joint: 27% Fused
  - Intercoccygeal joint
    - C1/2 (first): 17% Fused
    - C2/3 (second): 47% Fused
    - C3/4 (third): 78% Fused
  - Tip of the coccyx demonstrates minimal side bend (mean of 6 degrees)

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Why the Coccyx?

*At work they call me coccyx, appendix or tail. Kind of makes me feel not so massively valued...*
Why the Coccyx?

- Nervous System
  - Dural attachment
- Ligaments
  - 7 attach to the coccyx
- Fascia
- Muscles
  - 6 attach directly to the coccyx

http://www.backandneck.ca/tail-bone-injuries/

Rufus Weaver, anatomist, 1892

Positional Mal-alignments and motion fixations of the coccyx from trauma places sustained tension through the Filum Terminale and Dura, simulating Tethered Cord Syndrome in the general population (Wardlaw)

Tethered Cord

- Signs and Symptoms
  - Intermittent pain in the back of one or both legs and in the lower back
  - Pain in a radicular distribution, elicited by a straight leg raise
  - Increased abnormal sensations in the feet (numbness, tingling, burning)
  - Sensory loss in a root distribution
  - Muscle stiffness, weakness, or atrophy
  - Progressive scoliosis
  - Abnormal lower extremity reflexes
  - Bladder problems

Filum Terminale

- Sometimes erroneously referred to as the coccygeal ligament
- Anchor for the spinal cord
- Distally, fuses with the periosteum of the dorsal aspect of the coccyx or sacrum (Tubbs, 2005)
- Consists largely of fibrous tissue containing smooth muscle, blood vessels, and peripheral nerves (Tubbs, 2005)

Spinal Motion

- Spinal Cord
  - Lengthen approximately 30% from spinal extension to spinal flexion (Troup 1986)
- Filum Terminale
  - Stretches to allow cranial movement of the spinal cord with flexion
  - Pulls the spinal cord to normal position when returning from a flexion
  - Decreased mobility leads to increased stretch to the spinal cord instead of the filum
Myodural Bridge

- A connective tissue link between the rectus capitis posterior minor muscle (RCPMi) and the cervical dura mater (Hack 1995)
  - High density of muscle spindle (Peck 1984)
- Action
  - Active when the head is translated forward at the AO joint (McPartland and Brodeur 1997)
  - May prevent in-folding of the dura mater during cervical extension (Hack et al. 1995)
- Testing
  - Cervical Retraction Test (Johnson)

Cervical Retraction Test

- Gentle traction at occiput
- Drop Leg to one side than other
- Positive Test
  - Head will be drawn inferior with leg rotation
  - Increase tension on the dura by extending the knees

Dural Connection

[Diagram of dural connection]
Lumbar Spine

- Kemper and Wooley (1998)
  - Study: 50 Patients with or without coccydynia
  - Treatment: Internal coccyx manipulation

- Results
  - Average treatment Duration
    - 3.1 visits for females
    - 4.3 visits for males
  - 7.38 inch improvement in lumbar flexion
  - Visual analogue Pain Scale (0-10)
    - Pre: (4.66/10)
    - Post: (0.66/10)

Ligaments

- Anterior Longitudinal

- Sacroccygeal ligaments
  - Extension of the ALL
  - Insertion first and sometimes the second coccygeal vertebrae
  - Thicker over the sacrococcygeal joint

- Anococcygeal
  - Extends between the coccyx and the external anal sphincter

Posterior Sacroccygeal Ligament

- Superficial
  - Sacral hiatus to dorsal surface of the coccyx
  - Corresponds to the ligamentum flavum

- Deep
  - Continuation of the posterior longitudinal ligament
  - Originates on the posterior fifth sacral segment
  - Inserts on the dorsal surface of the coccyx

- Lateral
  - Up to 3 separate ligaments
  - ILA to first coccygeal transverse processes
  - Attachments to the sacrotuberous and sacrospinous ligament
**Sacrosacral Ligaments**

- **Attachments**
  - Lateral margins of the sacrum and coccyx
  - Entire length is covered by the coccygeus muscle
  - Laxity allows for excessive posterior innominate rotation
  - Increased tension can pull the innominate into anterior rotation

  (Woodley 2005)

- **Attachments**
  - Posterior portion of the iliac crest, the lower three sacral vertebrae and the coccyx

- **Associated Ligaments**
  - Dorsal sacroiliac ligaments
  - Posterior sacroccocygeal ligament
    - Direct attachment to the dura (Barral)
  - Blends/fuses with the sacrospinous ligament

- **Nerves/Arteries**
  - Cutaneous nerve and filaments of the coccygeal plexus

**Sacrotuberous Ligaments**

- **Attachments**
  - Posterior portion of the iliac crest, the lower three sacral vertebrae and the coccyx

- **Associated Ligaments**
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**Sacrotuberous Ligament**

- **Muscle attachments**
  - Gluteus maximus
    - Most direct connection
  - Biceps femoris
    - Hypothesized to stabilize the sacroiliac joint via the sacrotuberous ligament
  - Piriformis
  - Obturator internus
  - Semitendinosus/Semitendinosus

  (Woodley 2005)
Fascia

Woon, 2012

Fascial Connections

http://www.anatomytrains.com/the-enlightened-body/blog/thoracolumbar-fascia-and-back-pain/

Anatomy Trains

Muscles

1. Puborectalis
2. Pubococcygeus
3. Iliococcygeus
4. Coccygeus
5. Piriformis
6. Obturator Internus
### Puborectalis
- U-shaped
- Most medially levator ani muscle
- Defecation
  - Relaxation of the puborectalis
  - Extension of the coccyx
- Treatment indications
  - Problems with defecation
  - Pubic Symphysis Dysfunction

### Muscles of the Hip and Pelvis
- Greater sciatic foramen
- Lesser sciatic foramen
- Obturator Internus
- Gluteus Minimus
- Piriformis
- Superior gemellus
- Obturator Internus
- Inferior gemellus
- Obturator Externus
- Quadratus Femoris

### So why coccyx?
- Nerve and Dural Tension
- Muscle length-tension relationship
- Ligament length-tension relationship
- Fascial Connections

### Why Internal Mobilization?
- Structures not assessable or treatable externally
- Nerve tension with strong pull to coccyx (especially flexion)
- Patient who has not been successfully with other treatments
Precautions

- Verify that this procedure is within the scope of your state's practice act
- This procedure requires explanation, permission, and tact
- Be sure to give clear explanation of the procedure
- Parents should always be present during examination and treatment of children
- Avoid rectal examination during menstrual period
- DO NOT force or pressure a reluctant patient
- Bleeding Hemorrhoids
- Patients who have been sexual abused
- Be aware of patients with osteopenia and osteoporosis

Complications

- The most likely risk is irritation of the rectal lining
  - May cause mild, temporary bleeding
- The more severe risk is that you tear the rectal lining
- Increased pain or nerve symptoms
- Autonomic Symptoms: Ganglion Pars
  - Instruct the patient on autonomic symptoms
  - They need to inform you if symptoms occur
    - Change in temperature
    - Increased heart rate
    - Clamminess/feeling flush
    - Increased breathing rate
    - Increased sweating
Patient Preparation
- Request that the patient to empties their bladder prior to treatment
- Verbal/nominal consent must be obtained from the patient
- An informed-consent form for the patient to sign should be standard practice
- Many clinicians choose to have an assistant in the room
  - Assistance with neurotension
  - Patient comfort and help them relax during the procedure
  - To avoid/decrease likelihood of any possible liability issues

Patient Position
- Side lying
  - Bilateral hip flexion to 70-90 degrees
  - Top leg flexed and bottom leg extended
  - Patients placed with most involved side on top

Set Up
- Gloves and lubrication
  - Make sure to use enough lubrication
  - Apply to glove and may also apply to rectal area
  - Warm up lubricate: improves patient comfort and relaxation
- Finger Choice
  - Use your index finger
  - 3rd digit is the longest, but other fingers limit you depth of palpation
- Sanitation
  - Have a waste basket, tissues and hand sanitizer next to you
  - Have tissues and waste basket for the patient to clean themselves
Set Up and Draping

- Patient comfort is First and Foremost
  - If the patient feel uncomfortable at any time let them know they need to let you know
  - Tell them that you will stop treatment and slowly remove your finger
- Draping
  - Sheet should be placed on the table and another sheet to cover the patient

Treatment Techniques

- Soft Tissue Mobilization
  - Boney contours
  - Muscle belly/trigger points
- Functional Movement Patterns (FMP)
  - Active patient movements
    - Breathing
    - Unilateral or bilateral hip rotation
    - Pelvic Tilts
    - Pelvic floor contractions
    - Hip Motion
    - Knee Motion

- Functional Mobilization (FM)
  - Resisted movements
- Nerve Mobilization (Direct treatment to the nerve)
  - Lateral mobility
  - Longitudinal mobility
  - Nerve place on tension with Lower extremity motion
  - Block segment being pulled/shifted by the nerve tension
Initiation of Mobilization

Prior to initiation
- Visual confirmation of the rectum is recommended
- Gently spread the buttocks with your free hand
- Finger facing posterior towards coccyx

There are 2 anal sphincters
- Voluntary external sphincter muscles
- Involuntary internal sphincter muscles

Initiation of Mobilization

If trigger points (TrPs) are present, insertion of the finger can be distressful even when done very carefully
- Entering the rectum
  - Have patient gently bear down
  - As they relax enter deeper into the rectum
  - May also have patient initiate posterior depression of the pelvis
- DO NOT use force to enter deeper
- Internal hemorrhoids can perpetuate TrPs
  - Perform a 360 degree assessment and treatment

Puborectalis

Located inferior to tip of the coccyx at the level of the external anal sphincter
- Restrictions will resist ability to move to higher structures

Treatment
- 360 degree STM

Key structure
- Constipation
- Pubic symphysis dysfunctions
Rectal Cancer

- Signs and Symptoms
  - Diarrhea
  - Constipation
  - Not being able to completely empty the bowel
  - Change in the size or shape of stools (narrower)
  - Bloody stool (either bright red or very dark)

- The symptoms of rectal cancer are similar to other bowel diseases, like ulcerative colitis, Crohn’s disease
- These diseases usually demonstrate periods of symptom remission
- If you feel a hard button-like area over the tissues of the rectum refer the patient to their primary physician to rule out the presence of cancer

Red Flag

Levels of Palpation

- In 2012 Joguet et al looked at the anatomy of the digital rectal examination to improve teaching methods and consistency with palpation for medical students
- These bone landmarks are less consistent for internal organ palpation
- We will utilize the palpation guidelines as a general rule
  - Remember
  - Coccyx length is variable
  - Coccyx angulations does vary
  - Index finger length is variable
  - Patient size and structure can influence palpation

Level One Palpation

- The first level (the tip of the index on the tip of the coccyx)
  - Assess tip of coccyx
    - Flexion
    - Extension
    - Side bend
    - Pelvic Floor
**Levator Ani**

- Assess Pelvic Active
  - Have your patient actively squeeze their rectum around your finger
- Assess along the margin of the coccyx
  - Lateral
  - Inferior
- Levator ani may feel like a firm sheet of muscle
- Soft tissue mobilization of these structures very helpful prior to positional corrections of the coccyx
- Treatment
  - STM
  - FMP
  - FM

**Coccyx Flexion**

- Type III (~5%) coccyx is sharply angulated forward
- Only the rectal wall between finger and coccyx
- Spring test to the coccyx to check mobility
- Flexion may occur at any of the mobile joints
- Treatment
  - Anterior to posterior mobilization
  - May apply traction
  - FMP and FM
  - If no motion is present proceed to the next structure

**Level Two Palpation**

- Distal inter-phalangeal articulation placed on the tip of coccyx
- Sacroccygeal Joint
- Anterior Longitudinal Ligament
- Sacroccygeal ligaments
  - Anterior
  - Lateral
**Coccygeus**

- **Palpation**
  - Mainly at level 2
  - Most of the muscle lies anterior to the sacrospinosus ligament
  - Gluteus maximus coccyx attachment similar to the coccygeus

- **Treatment**
  - STM
  - FMP
  - FM

**Anterior Ligaments**

- **Sacroccygeal**
  - All cross sacroccygeal joint

- **Treatment**
  - Lateral Mobility
  - Longitudinal mobility
  - STM
  - FMP
  - FM

**Shears**

- **Anterior shears**
  - Sacroccygeal
  - Individual vertebrae of the Coccyx

- **Lateral shear**
  - Sacroccygeal
  - Individual vertebrae of the Coccyx
Shears

- Sacroccocygeal joint
  - Traction is applied with the internal hand and also the external hand
  - Anterior to posterior mobilization
  - Dysfunction may be central (pure shear) or lateral (rotation)

Treatment

- FMP
- FM
- If no motion is present proceed to the next structure

Level Three Palpation

- Proximal interphalangeal articulation placed on the tip of the coccyx
  - Sacrospinous Ligament
  - Sacrotuberous ligament
  - Obturator internus muscle
  - Ischial spine
  - Pudendal nerve

Sacrospinous Ligaments

- Attachment
  - Superior and lateral to sacroccocygeal joint
  - Fibers run medial to lateral with slight inferior angulations to the ischial spine
  - Majority covered by the fibers of the coccygeus muscle

- Motion restrictions and tenderness if dysfunctional
- Important to treat at ischial tuberosity
  - STM
  - FMP
  - FM
**Sacrotuberous**

- **Palpation**
  - Posterior to the sacrospinous ligament
  - Vertical Fibers
  - Easiest to palpated superior and inferior to the sacrospinous ligament
  - Often tender and demonstrate restricted mobility

- **Treatment**
  - STM
  - FMP
  - FM

**Pudendal Nerve**

- **Palpation**
  - Round and string-like
  - Always keep same diameter with palpation
  - Landmarks
    - Coccygeus muscle
    - Sacrospinous Ligament
    - Ischial tuberosity

- **Treatment**
  - STM
  - Medial to lateral mobility
  - Longitudinal mobility

**Pudendal Canal**

- Formed by folding of the obturator internus fascia
- Follow the nerve anterior and inferior
- Just superior to ischial tuberosity

- **Treatment**
  - STM
  - Medial to lateral mobility
  - Longitudinal mobility
Oburator Internus

- Palpation
  - Level 3
  - Turn finger to face anterior lateral to anteriolateral wall of the lesser pelvis
  - Inferior to the pubic bone
  - Verify by resisting external rotation of the hip

Oburator Internus

- Treatment
  - STM
  - Critical to examine just caudal to the tip of the ischial spine
  - Most likely place for trigger points according to Travell and Simons

Level Four Palpation

- Metacarpophalangeal articulation comes into contact with the tip of the coccyx
- Piriformis
- Sacral plexus
Sacral Nerves
- Anterior to the coccygeus muscle
- Anterior aspect of the piriformis
- Round and string-like
- Always keep same diameter with palpation
  - STM
    - Medial to lateral mobility
    - Longitudinal mobility

Piriformis
- Palpation
  - Cranial to the sacrospinous
  - Usually can palpate inferior/medial edge of the muscle
  - Verify palpation with resisted hip abduct
  - If tender will often reproduce patient’s pain in a sciatic distribution
- Treatment
  - STM
  - FMP
  - FM

Review of Palpation
- [Image from Travell and Simons]
Nerve Tension

- Following mechanical treatment assess nerve tension
- Nerve consist of 50-90% connective tissue
- Beware of being too aggressive
- Clear out nerve restrictions distal prior to performing nerve mobilization at the coccyx
  - Decreased likelihood of exacerbation
- Very powerful treatment in decreasing pain, improving function and preventing recidivism

Nerve Mobilization

- Pressure placed on coccyx
- Assistant brings hip into flexion until tension is perceived in the leg or coccyx
- Block coccyx movement
  - Flexion
  - Anterior shear
- Perform flossing
- Assistant resists hip extension
- Nerve manipulation

Blocking for Nerve Tension
**Uterus**

- The uterus is located immediately dorsal (and usually somewhat anterior/superior) to the urinary bladder

When assessing the ovaries and uterus if you feel masses and growths must make a referral to an OBGYN

**Prostate**

- Inserted finger in a downwards angle as if pointing to the umbilicus
- Pressing on the prostate gland should not hurt, although it may make you feel like you need to urinate

**Consistency**

- Rubbery and firm
- Smooth surface
- Palpable sulcus between right and left lobes
- There should not be any tenderness
- There should be no nodules
The prostate ("one who stands before", "protector")
Slightly larger than a walnut
Tenderness
  - Prostatitis, a temporary inflammation, no surface changes
  - Prostate cancer can cause the surface of the prostate to become hard and bumpy
Refer to primary physician

Females: anterior and inferior to the uterus and anterior to the vagina
Males: anterior and superior to the prostate

Internal treatment following unsuccessful external treatment
Much easier to palpate with an empty bladder
STM: Puborectalis prior to internal pubic symphysis treatment
Posterior Shears
  - Mobilize the posterior pubic symphysis
Ending the Procedure

- Slowly remove your finger
- Ask the patient to contract the pelvic floor
  - This prevents them from feeling like they are having a bowel movement
- Educate the patient on the possibility of bleeding and that a small amount is normal
- Leave the room and have tissues and waste basket close to patient for clean up

Review of Palpation

- Levator Ani Muscles: Level 1/2: anterior and lateral to coccyx
- Tip of the Coccyx: Level 1: posterior to rectum
- Sacroccygeal Joint Level 2: posterior to rectum
- Sacrotuberous and Sacrospinous Ligaments: Level 3: lateral to rectum
- Pudendal Nerve: Level 2/3: lateral to rectum
- Obturator Internus: Level 2/3: anterior/lateral to rectum
- Sacral nerve Root: Level 4: posterior of rectum, anterior to piriformis
- Piriformis: Level 4: posterior of rectum and sacral nerves
- Prostate or Uterus: Level 2 to 3: anterior to rectum
- Pubic symphysis: Level: Most anterior to rectum

Case Study
Questions

References

21. All pictures contained in this presentation are from the internet unless otherwise noted.

References continued
INFORMED CONSENT FOR ASSESSMENT OF COCCYX/PELVIC FLOOR DYSFUNCTIONS

I understand that it may be beneficial for my therapist to perform a coccyx assessment and muscle assessment of the pelvic floor, initially and periodically to assess joint mobility, muscle strength, length, range of motion and scar mobility. Palpation of these muscles is most direct and accessible if done via the rectum. Coccyx/Pelvic floor dysfunctions include low back pain, SI pain, nerve tension, pelvic pain syndrome, urinary incontinence, fecal incontinence, dyspareunia, or pain with intercourse, pain from an episiotomy or scarring, vulvodynia, vestibulitis, or other similar complications. Evaluation of my condition may include observation, joint mobilization, soft tissue mobilization and nerve mobilization. I understand that I have the option to have a chaperone during evaluation & treatment that may include internal procedures. I will _____ will not _____ bring a chaperone to subsequent visits. If I opt for a chaperone, internal assessment, if allowed, will be deferred until the next visit when the chaperone is present. I understand that if I am uncomfortable with the assessment or treatment procedures at any time, I will inform my therapist and the procedure will be discussed with me. A decision will be made to either continue internal assessment/treatment or suspend it. External treatments may still be utilized. The therapist will explain all these treatment procedures to me and I may choose to not participate with all or part of the treatment plan.

I understand that no guarantees have been or can be provided to me regarding success of therapy. I have read or had read to me the foregoing and any questions, which may have occurred to me, have been answered to my satisfaction. I understand the risks, benefits, and alternatives of the treatment. Based on the information, I have received from the therapist, I voluntarily agree to standard assessment and muscular treatment techniques of the pelvic area.

[Signature]

[Date]

[Physical Therapist’s Signature]

[Date]

[Relationship to Patient]

If you are pregnant, have an infection of any kind, have vaginal dryness, are less than six weeks postpartum, post surgery, have severe pelvic pain, sensitivity to KY jelly, vaginal creams or latex, please inform the therapist prior to the pelvic floor assessment.