DYNAMIC CORE FOR KIDS: ONLINE

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Housekeeping

- Full length mirror
- Piece of theraband (2-3 yards)
- Small ball (5-6 in diameter) or yoga block
- One or two each: Hand towel, bath towel
- Pillows (2 of different thickness, and size)
- Handouts (pdf or printed)
- Selfies
- Snacks
- Questions

Dynamic Core for Kids Part One

Day One: Core Function
Core Strategy TAP
Typical and Regional Development
Core Optimizing Alignment
Antigravity Core Components

Case Examples
Group Case Study
Different Populations
Q & A Adios

Day Two: Q & A/Review
Synergistic Postural Relationships/Reactive Core
Case Examples
Different Populations
Q & A Adios
Foundation of Our Physical House

Drafty Windows

Deficits in:
- Postural Control
- Balance
- Gross Motor Skills
- Sensory Processing Skills
- Fine Motor Skills
- Phonation
- Continence

Zoe 101
Anticipatory Core

- Respiratory Diaphragm (D)
- Pelvic Floor (PF)
- Transversus Abdominis (TA)
- Multifidus (M)

Our Paths Cross

Our Paths Cross at the Core
Tug O' War

Integration: TAP

Stability that is responsive to the demands of function (non-uniform response)
- Teamwork
- Alignment
- Preparation

Integration: TAP

Stability that is responsive to the demands of function (non-uniform response)
- Teamwork
Gears in the Core Machine

- Diaphragm
- Transversus Abdominis
- Pelvic Floor
- Multifidus

Teamwork

Machine is optimized when all gears work together.
- Gears must move or the machine will fail
- Coordinated interaction will produce central stability

The Core Machine

Postural and Respiratory Functions of the PFM
Hodges, Sapsford, Pengel (2007)
- PFM followed respiratory cycle (ant, not post)
- PFM expiratory activity more associated with abs (low-level tonic activity w/bursts at movement frequency)
- PISTON
Teamwork

Contraction of the PFM During Abdominal Maneuvers
Sapsford and Hodges (2001)
- 3 levels of Ab contraction
- Consistent inc in PFM before Ab pressure (PF inc w/Ab force)

Teamwork

Changes in IAP during Postural and Respiratory Activation of the Human Diaphragm
Hodges et al (2000):

Teamwork
Teamwork

- Balanced interplay between the diaphragm, pelvic floor and abdominals preserves relative IAP throughout the respiratory cycle.
- A dynamic and coordinated model of core function
- 5th member of our team
- Intersection of multiple systems
- Breath gives us a new gateway

Teamwork

- The Piston, driven by the action of the diaphragm, is a dynamic model for core function.
- Accessing the deep core system through breath provides a gateway for our pediatric clients.

Integration: TAP

Stability that is responsive to the demands of function (non-uniform response)

- Teamwork
- Alignment
- Preparation

Alignment

The Core Machine

Machine works best if all the gears line up

- Muscles are strongest at the midpoint of available ROM
- Muscles are weakest when long or short
- Neutral Pelvis and Ribcage alignment (ribcage over pelvis) puts the Core in midrange positioning.
Alignment

Different Ways to Balance the Spine
Claus et al (2009):
- Flat, Long Lordosis, Short Lordosis, Slump
- Short Lordosis best activity for TA and Multifidus
- Flat-Least***

Alignment: Claus et al

Alignment: Claus et al
Different Ways to Balance the Spine
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- Flat, Long Lordosis, Short Lordosis, Slump
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- Flat-Least***

Sitting Postures Affects PFM Activity in Parous Women
- Slump, Upright Unsupported, and Very Tall Unsupported (thoracic)
- Increased resting activation of PFM as alignment improved
Sitting Postures Affects PFM Activity in Parous Women

- Slump, Upright Unsupported, and Very Tall Unsupported (thoracic)
- Increased resting activation of PFM as alignment improved

Neutral Rib Cage and Pelvis

- Position of optimum Core recruitment (range)
- Move toward neutral
- “Sweet Spot”: optimized for your patient

Integration: TAP

Stability that is responsive to the demands of function (non-uniform response)

- Teamwork
- Alignment
- Preparation
Preparation

Neuromuscular Strategy:
Preprogrammed motor control system, engaged through nervous system. The sensory system feeds information to create a graded response.

Anticipatory + Reactive = Fxn
Prepares for task + engaged based on demands of task = Function/movement

Preparation

Transverse Abdominis is not Influenced by the Direction of Arm Movement
Hodges et al (1997)
- TA EMG increased prior to deltoid regardless of UE direction
- EMG of superficial abdominals varied with movement direction

Preparation

Contraction of the Human Diaphragm During Rapid Postural Adjustments
Hodges et al (1997):
- Same result for the Diaphragm
- Anticipatory contraction occurred regardless of phase of respiration
- Same result for elbow motions, not hand or digits
Preparation

Hodges et al (2007)
- Same result for the pelvic floor
- Pelvic floor preceded the abdominals

Sjödahl et al (2009)
- PF precedes supine LE movement

Luginbuehl et al (2013)
- PF precedes heel strike in running

Integration

Build a clinical model that:
- Teamwork: All gears moving
- Alignment: Optimized
- Preparation: Strategy

Core Redefined

CORE STRATEGY: NEUROMUSCULAR
CORE EXERCISE: MUSCULOSKELETAL
Clinical Application

Is Balance Different in Women with and without Stress Urinary Incontinence
- Greater COP displacement in SUI group
- Both groups had greater COP displacement w/full bladder

Core Strategy: Defined

Core Strategy is a system that harnesses the neuromuscular relationship that exists between the Anticipatory Core, Reactive Core, IAP Stability Cycle, Sensory System and the Brain. A cascade of force from the inside-out that provides both the stability and flexibility required to respond to the task at hand. #balance

Questions?
In contrast to the adult literature, very little pediatric research has specifically investigated the inner core musculature.

What do we know about postural control in children with CP?

**Altered Trunk Movements During Gait in Children with Diplegia: Compensatory or Underlying Trunk Control Deficit?**

*Heyrman L et al. 2014*

- Looked at correlation between trunk movement and LE movement
- Provided support for a primary trunk control deficit NOT just as a result of LE impairment
Pediatric Core Research

Differences in Respiratory and Pulmonary Function Among Children with Spastic Diplegia and Hemiplegia Cerebral Palsy in Comparison with Normal Controls.

Kwon YH, Lee HY 2015

- Children with spastic diplegic and hemiplegia generate decreased respiratory pressure

Pediatric Research

Development of Postural Responses During Standing in Healthy Children and Children with Spastic Diplegia

Woollacott et al. 1998

- Group of typical children standing in alignment of child with spastic diplegia, showed similar disordered recruitment pattern during postural adjustments

Pediatric Core Research

Anticipatory and Compensatory Postural Adjustments in Sitting in Children with Cerebral Palsy

Bigongiari et al 2011

- Tested in sitting
- Main postural control strategy is compensatory
- Increased levels of co-activation in outer core muscles & others
Pediatric Core Research

**Anticipatory Postural Adjustments in Children with Hemiplegia and Diplegia**

Girolami G et al 2011

- Tested in standing
- Higher levels of co-activation reported in outer core muscles & others

Pediatric Research

**Effects of Seat Surface Inclination on Respiration and Speech Production in Children with Spastic Cerebral Palsy**

Shin et al 2015

- FVC was significantly improved with anterior inclination

Pediatric Research

**Effect of Seat Surface Inclination on Postural Stability and Forward Reaching Efficiency in Children with Spastic CP**

Cherng et al. 2009

- Studied effects of seat angle on postural stability and forward reach
- Forward incline (=anterior inclination) more beneficial for both stability and reach for typical children and those with CP
Pediatric Research

Seat Surface Inclination May Affect Postural Stability During Bocci Ball Throwing in Children with CP
Tsai et al. 2014
- GMFCS levels I, II and III
- Anterior inclination associated with better postural stability and improved amplitude of elbow movement

Pediatric Research

Effects of an NDT-Based Trunk Protocol for Infants with Posture and Movement Dysfunction
Arndt et al. 2008
- Protocol for treatment specified alignment prior to activation
- Improved functional outcomes

Pediatric Research

What do we know about children with DCD?
Differences in Postural Control and Movement Performance During Goal Directed Reaching in Children with DCD
Johnston et al 2002
- Studied 9 trunk muscles
- Onset activation of muscles altered for children with DCD

Core Stability Group Program for Children with DCD: 3 Case Reports
Kane K, Bell A. 2009
- Defined core muscles as superficial and deep intrinsics of lumbopelvic and abdominal regions
- Outcome of study mixed; variable core stability changes
- Noted that alignment changes were clinically significant with regards to impact on core stability (although not measured in study)

Contributions of trunk muscles to anticipatory postural control in children with and without DCD
Kane K, Barden J 2012
- Measured using surface EMG
- Children with DCD had later onset of TA/IO muscles
What do we know about children with ASD?

Motor control and children with autism: deficit of anticipatory function?

Schmitz et al 2003

- Children with ASD substitute reactive postural control for anticipatory postural control
- This can lead to timing and coordination issues.

Collectively studies suggest that children with ASD have:

- impaired anticipatory postural control
- decreased postural stability
THE ROLE OF CORE FUNCTION IN
TYPICAL DEVELOPMENT

Examining details of typical development allows us to infer more about the development of the Core musculature.
Typical Development

- At birth, there is relatively low tone in the Core musculature
  (Hulme J, 2005)

Implications for Core Activity

- Resting tone of Core gradually increases during the first 2 – 3 years
  (Hulme J, 2005)

- This occurs as motor tracts form increased number and strength of connections with neurons in spinal cord during early movement
Typical Development: Newborn

Physiological Flexion
- High, triangular-shaped rib cage
- Ribs close together

Implications for Anticipatory Core Activity
- Alignment of rib cage allows for inferior excursion of diaphragm only
- Little activity of the PF or TA

Typical Development: Newborn Milestones

Motor Function:
- Belly breathing
- Feeding
- Sleeping
- Uncontrolled elimination
Typical Development: 0-3 Months

Asymmetry
- Expansion of anterior chest with activity of UEs in supine and prone
- Decreased hip flexion with LE activity

Implications for Anticipatory Core Activity
- Some increased excursion of diaphragm contributes to increased activity in PF
- Increased excursion of diaphragm, activity of PF and LEs contributes to activation of TA; the team is developing
Implications for Reactive Core Activity

- Pushing against surface in prone begins to activate reactive core POS (contralateral latissimus dorsi and glute max) (Lee D, 1999)

Implications for Reactive Core Activity

- Activation of reactive core AOS (abdominal oblique and contralateral adductor) follows (Lee D, 1999)
- Creates balance of extension and flexion activity

Typical Development: 0-3 Milestones

Motor Function:
- Prone: head lifting
- Supported sitting: head bobbing
- Begins to swipe at objects
- Voiced sounds with movement
Symmetry
- With increased muscle activation and independent movement, general increase in space between ribs occurs.

Implications for Anticipatory Core Activity
- Increased space between ribs supports change in rib cage shape allowing:
  - Deeper excursion of diaphragm
  - Improved activity of intercostals
  - Increased activity of PF and TA
Implications for Anticipatory Core Activity

- Increased rotation activity around hip joints contributes to activation of PF

Implications for Reactive Core Activity

- As hip flexion decreases, the POS becomes increasingly active, gains strength within the available range and contributes to anti-gravity function

Typical Development: 4-6 Milestones

Motor Function:
- Supine: bridges, rolling
- Prone: propping on extended arms, superman, rolling
- Sitting with hands propped/ free
- Beginning to reach forward (humeral flexion)
- Transfers hand to hand
- Deeper breaths, longer sounds
Typical Development: 7-9 Months

Rotation
- Shape of rib cage is elongating, changing alignment of shoulder girdle
- Transitional movement creates functional linkage between the shoulder girdle and pelvic girdle
Implications for Anticipatory Core Activity

• Increased hip ROM and capacity to maintain midline hip rotation ramps up activation of PF
• Increased differentiation of control of diaphragm for postural stability, air flow and sound for speech (Alexander R, 1991)

Implications for Reactive Core Activity

• POS contributes hip extension for active base of support (anti-gravity extension)
• AOS contributes to increased active rotation (protective reactions and transitional movement)

Implications for Reactive Core Activity

• Crawling and ½ kneeling positions reflect activity in reactive core Lateral synergist (Contralateral Glute Med/Min and Adductors) and Rotational Synergist (Ipsilateral Hip Lateral Rotators and Adductors) (Lee D, 1999)
Typical Development: 7-9 Months

Motor Function:
- Pushing up into sitting, creeping/crawling, kneeling, pulling to stand, cruising
- UEs for play, maturing grasp pattern
- Produces sound independent of movement

Typical Development: 10-12 Months

Gross Motor Independence
- Rib cage becoming more rectangular in shape
- Movement begins in all planes against gravity
Implications for Anticipatory Core Activity

- Trunk movement in all planes increases activation of diaphragm
- Increased demand on mid-range hip control in standing contributes to activation of PF

Implications for Anticipatory Core Activity

- Diaphragm, pelvic floor and TA partnership provides increased stabilization of lumbar spine and pelvis allowing initiation of movement from pelvis rather than upper trunk

Implications for Reactive Core Activity

- Increased activity in all postural synergists in tandem with anticipatory core team
Typical Development: 10-12 Milestones

Motor Function:
- Climbing stairs, taking first steps
- Manipulates and combine fine motor in play, dressing and feeding
- Increased air intake, decreased respiratory rate
- Abdominal-thoracic breathing pattern begins
Typical Development: 12-24 Months

I Can Do It Myself
- effective Core muscle activation now in place for maintenance of stable trunk with simultaneous movement of the body in all planes

Typical Development: 12-24 Milestones

Motor Function:
- continued refinement in all areas of development

Effective Core Strategy

Core Strategy
- stable head
- mobile trunk
- stable pelvis
- dynamic postural control within function
Atypical Development

Motor development can be impacted by difficulties in either the motor or the sensory systems.
Atypical Development

- Disruption of the attachment process can also impact balanced flexion and extension (Barthel K, 2009)

- Ultimately, lack of physiological flexion at birth fundamentally impacts alignment
  - This negatively impacts the development of Core Strategy

Movement patterns develop to compensate for this inefficient postural control:
- Breath holding
- Head/neck extension
- Stabilization by using end ranges
Atypical Development: Breath holding

Task:
Stabilize body against gravity

Compensation:
Breath holding

Implications for Anticipatory Core Activity

- Rib cage remains high and compact
- Decreased activation of respiratory diaphragm

Atypical Development: Breath holding

Functional Consequences:
- Poor midline head control
- Dislikes prone, unable to push off surface with UEs
- Compromised movement – moving for as long as breath holding
- Decreased sounds
- Monocular fixation retained
Atypical Development: Neck Hyperextension

**Task:**
Stabilize head to provide stable base for eyes.

**Compensation:**
Neck hyperextension possibly combined with active tongue retraction.

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Implications for Anticipatory Core Activity

- Rib cage remains high and compact secondary to shoulder elevation.
- Decreased activation of respiratory diaphragm.

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Atypical Development: Neck Hyperextension

**Functional Consequences:**
- Poor midline head control.
- Dislikes prone.
- Decreased ability to pair UE function or movement with vision.
- Belly breathing.
- Voiced sounds with movement.
- Monocular fixation retained.
Atypical Development: Dynamic Holding

**Task:**
Stabilizing the trunk against gravity

**Compensation:**
Active holding with rectus abdominus, iliopsoas and diaphragm

Implications for Anticipatory Core Activity

- Muscles used isometrically for stabilizing during movement and against gravity
- Substituting phasic muscle activity for postural muscle activity
- Anticipatory core offline

Functional Consequences:

- Supine preferred
- Sitting with posterior pelvic tilt
- Humerus remains internally rotated w/elbow, wrist and hand flexed
- Breath holding with movement
- Difficulty with development of binocular vision
Atypical Development: Dynamic Holding

- Changing alignment and muscle activation alters dynamic holding
- Can improve postural control
SENSORY & MOTOR: It's all connected
From the time we take our first breath, sensory and motor processes are connected.

- The diaphragm receives input from the vestibular system (vestibulorespiratory reflexes)

  Mori R, 2001

- This connection intimately links the anticipatory core team to the sensory systems.
One of the first major challenges for babies is self-regulation.

Development of Self-Regulation

**FIRST ORDER**
- Automatic functions: temperature, blood pressure, heart rate, respiration, sleep/wake cycles
- Muscle/cortical tone
- State maintenance
- Monitoring for survival

**SECOND ORDER**
- Suck/swallow/breathe synchrony
- Selective attention
- Visual scanning, monitoring, orienting
- Gaze: hand, head, eye
- Hands use of form, size, texture, temperature, movement
- Body/versa use of movement patterns, planes of movement

**THIRD ORDER**
- Sustained attention
- Intention
- Working memory
- Cluster of a goal
- Anticipatory planning
- Self-monitoring
- Problem solving
- Language for organization
- Organization of space, time, task

Sensory & Motor

- Breathing pattern (optimal activation of diaphragm) modulates the ANS with every breath
- This contributes to self-regulation at the first order level

Baekley DM, 2012
Longo DJ, 1984
Tang YY, 2009
With development of efficient motor function, self-regulation is supported at the second order level as well.

- Anticipatory core creates a stable center, as physiological flexion decreases.
- Therefore the anticipatory core also contributes to the development of our perceptual sense of midline.
Many children with movement challenges exhibit low muscle tone in axial muscles.

This may indicate involvement of the vestibular system (Shumway Cook A, 2007).

If vestibular system is compromised, then activation of the diaphragm may be compromised.

Alterations in alignment occur.

Breath holding/inefficient breathing patterns develop.

Central stability is compromised.

The same inefficient breathing patterns impacts PNS/SNS balance.

These contribute to sympathetic dominance (fright, flight, fight or freeze).
Sensory & Motor

SNS dominance = high arousal

Compromised anticipatory core activation negatively impacts:
- Sensory processing
- Self-regulation
- Postural control
- Efficient movement

Q and A
Alignment

The Lynchpin

Muscle Activation Characteristics of Stance Balance Control in Children with Spastic Cerebral Palsy


- Neurologically typical kids in crouch position characteristic of CP.
- Similar recruitment pattern in balance perturbation.
- Balance deficits due to neural and mechanical differences. (Noted similar impact in gait in previous studies).

Alignment Impacts...

- Muscular recruitment (midrange optimization)
- Vestibular input, cranial nerves (head position)
- Proprioceptive
- Visual
- Breathing patterns
- Joint centration
- All inputs for brain to evaluate threat for protective output
Alignment

- Enhance or diminish components of the central stability system
- Alignment based intervention is critical
- Name that muscle!

Alignment

- Accepted terminology:
  - Hyperlordosis/Ant Tilt
  - Hypolordosis/Post Tilt
  - Neutral Pelvis/L-spine
- What about the position and forces imposed by upper quarter?

Pop Quiz

Name that alignment?
K Pre-Botox

K 8 Weeks Post-Botox

Alignment: Function follows Form

Ribcage position dictates:
- Excursion and contribution of the diaphragm to physiologic priorities, postural control and movement support
- Impacts the capacity of the diaphragm to set up the IAP pressure system
Alignment

How Do Anterior/Posterior Translations of the Thoracic Cage Affect Lumbar Spine, Pelvic Tilt, and Thoracic Kyphosis
Harrison et al (2002):
Posterior Thoracic Cage Translation
- Decrease lumbar lordosis (7.4)
- S-curve L-S (T-12-L2 flex) "apex"
- Increase pelvic posterior tilt (15.9)
- Sacral base posterior tilt (13.1), closer to horizontal

Posterior Ribcage Translation

Position of the ribcage relative to the pelvis
- Part 1: Military
- Part 2: Slouch
Rib Cage Tip

- Lower Ribcage: Anterior/Superior (Top of the RibCage behind pelvis)
- Lower Ribcage: Post/Inf (Bottom of the Ribcage behind pelvis)

Dixie Cup on a Stick

- Lower Ribcage: Anterior/ Superior
- Named by lower rib cage

Dixie Cup on a Stick

- Lower Ribcage: Posterior/ Inferior
- Named by lower rib cage
Let's play

Seated Lab

Make your rib cage tip Ant/Sup

Named by lower ribcage

Seated Lab

Make your rib cage tip Post/Inf

Named by lower ribcage
Defining Neutral Alignment

**Neutral Ribcage/Pelvis**
- Position of optimum recruitment of the Diaphragm/Pelvic Floor Piston
- Balance of flexors and extensors
- “Sweet Spot” within neutral range, balancing their structure, muscular forces, and pressure

Alignment: Clinical Presentation

**Hyperlordosis/Anterior Tilt**
- Sit in posterior tilt
- Stand in anterior tilt
- Reverse C’s

**Hypolordosis/Posterior Tilt**
- Sit and stand in posterior tilt
- C’s
Alignment: Today’s Presentation

Mixed Posture Type
- Former AT → PT
- Former PT → Kinked
- Somewhere in between

Alignment

How do we distinguish?

Alignment Screen
- Apex of the lumbar curve
- Ribcage position
- Gluteal definition
- Pelvic tilt?
How do we distinguish?

Alignment Screen

• Apex of the lumbar curve
• Ribcage position
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• Pelvic tilt?

Alignment Screen

Apex of the lumbar curve

Landmark: L4 at iliac crest

Screen: Apex of the Lumbar Curve
Alignment Screen

Apex of the lumbar curve
- **AT**: Deep apex at L4/L5
- **PT**: Flat at L4/5; Kink/Apex at T12/L1
- **Mixed**: Shallow at L4/5 (apex shifted superiorly)
- **Elbow Sign**

How do we distinguish?

Alignment Screen
- Apex of the lumbar curve
- **Ribcage position**
- Gluteal definition
- Pelvic Tilt?

Alignment

Ribcage Position
**Visual**: Translation, bell, take a breath
**Palpation**: Landmarks: ribcage and L5/sacral base
Stacy clip: Ribcage position

Alignment

Ribcage Position
- Visual Inspection
- AT: Posterior translation; Top of ribcage posterior to L5 (rung up)
- PT: Flat/stacked or minimal ribcage translation posterior to L5 (kink at T12/L1); Bottom of ribcage posterior L5 (rung down)
- Mixed: Ribcage max posterior translation behind L5 (Can ring up or down)

<table>
<thead>
<tr>
<th>AT</th>
<th>PT</th>
<th>Mixed</th>
</tr>
</thead>
<tbody>
<tr>
<td>![AT Image]</td>
<td>![PT Image]</td>
<td>![Mixed Image]</td>
</tr>
</tbody>
</table>
How do we distinguish?

Alignment Screen
- Apex of the lumbar curve
- Ribcage position
- Gluteal definition
- Pelvic Tilt?

Alignment

Gluteal Definition
Visual Scan!

Screen: Glute definition
Alignment

Gluteal Definition
AT: Present
PT: Flat Bum
Mixed: Upper glute flat

How do we distinguish?

Alignment Screen
- Apex of the lumbar curve
- Ribcage position
- Gluteal definition
- Pelvic tilt?
Screen: Pelvic Tilt

Alignment

Pelvic Tilt?
Landmarks: Bilateral Ilium
  • Can you tilt the pelvis?
  • Move pelvis to see impact on lordosis
  • Pull on your bum string
  • Lift your tailbone on inhalation

Alignment

Pelvic Tilt?
AT: Very limited anterior, if at all
PT: Posterior or limited toward neutral
Mixed: Very tilt-able anteriorly
Let's Review

Anterior Tilt
  • Deep apex at L4/L5
  • Ribcage post shift to pelvis
  • Glutes present
  • Pelvis will not tilt anteriorly any further

Let's Review

Posterior Tilt
  • Flat L4/5; Kink at T12/L1
  • Ribcage flat or min post shift
  • Glutes flat
  • Pelvis will posteriorly tilt more, or can move minimally toward neutral

Let's Review

Mixed Posture Type
  • Shallow apex at L4/L5
  • Ribcage max post shift
  • Glutes flattening (upper glute)
  • Pelvis can be tilted anteriorly easily and farther than you expect (try pulling on the bum string)
Screen G

- Self-evaluate in Mirror or with smartphone selfie
- Where is the apex of your lumbar curve?
- Do you have an elbow sign?
- Are you: Bell rung up? Bell rung down?
- Is your ribcage translated posteriorly or stacked?
- Do you have glute bulk? Flat bum? Upper glute atrophy?
- Can you tilt your pelvis? Pull on your bum string and/or lift your tailbone?
- Where is your weight in your feet?
Let's Review

Demo Neutral
- Ski jump back to middle
- Pull on your bum string
- Lift tailbone on inhale
- Find your breath
- Goals: Quiet bells, even weight distribution, breasts parallel to floor, ease of breath

Neutral Demo
- Ski Jump
- Bum String
- Tailbone
- Where's your weight?
- Find your breath
- Ease of breath

Optimized Alignment
Alignment Self-Corrections Lab

- Ski Jump
  - Let ribcage glide over pelvis (avoid using abs to pull ribcage over pelvis)
  - Observe passive change in pelvic position
  - Shift back to middle and maintain relative position (relax)
  - Feel weight distribution change in feet (goal: even)
- Pull on bum string
  - Observe rib cage shift
  - Avoid overcorrection, and/or rib thrust
- Lift your tailbone (couple with inhale)

Ski Jump

| Good | Bad (forgot the ribcage) |
Core Components

DIAGRAM

Origin:
- Vertebral-bodies L1-2 (L), L1-3 (R)
- Costal-inner aspect lower 6 ribs
- Sternal-posterior xiphoid

Insertion:
- Central tendon inserts at L3
**Diaphragm**

**Anatomy 101: Action**
- Diaphragm is cross section of multiple systems: respiration, aides circulation, lymphatics, GI motility, continence, postural stabilization, movement control, limbic system, ANS down regulation
- Mobilizes rib, thoracic, and lumbar segments
- Contributes to the elasticity of the pelvic floor

**Diaphragm: Function**

**Function:**
- Utilize A-P, Lateral, and Vertical components
- IAP on inhale stabilizes trunk as abdomen and pelvic floor undergo eccentric lengthening
- Exhale will engage Core trunk stabilizers (Piston)
- Diaphragm is gateway to the rest of Core ("Blow Before You Go")

**Diaphragm: Dysfunction**

**Chest Breathers:**
- Causes thoracic extension
- Sustained inspiratory position
- Decrease inferior excursion of diaphragm (decrease IAP gradient potential)
- High, flared ribcage
## Diaphragm: Dysfunction

### Belly Breathers:
- Rigid, compressed ribcage
- Sustained expiratory position
- Reduced abdominal tone (decrease IAP gradient potential)
- Decreased intercostal contribution to a balanced breath

### Breath Holding:
- Valsalva: large loads
- Substitution for the Core in postural control, movement strategies, transitions and prepping for small exertions
- Repeated high intra-thoracic (ITP) and IAP can contribute to incontinence and constipation

### Chest and Belly Breathers:
- Lateral component dysfunction (lower 6 ribs)
- Keeps ribs high and flared or fixed
- Core disconnected/IAP potential is reduced
- Both use breath holding as a stability strategy
Diaphragm: Intervention

Umbrella Inhale

Close the Umbrella Around the Handle

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Umbrella Breath Demo

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Shelley’s Cues for Umbrella Breathing

- Alignment is the key!
- Teach using an actual umbrella
- Use visual of diaphragm action
Shelley's Cues for Umbrella Breathing

- Place your hands around ribs 8-10 and provide gentle resistance throughout breath:
  - “Breathe into my hands”
  - “Make my hands move out”
- Use Theraband around ribs 8-10 and provide resistance (home program)
- Emphasize gentle breath in
- Breathe out “through a straw”; some children may need a straw to work with
- Some children may have increased difficulty with lip pursing (orbicularis oris = flexion activity)

Cueing in Supine
Chest Breathers Intervention

Belly Breathers Intervention
Alignment is the key!

Independent Diaphragm Standing Lab

- Re-assess breath pattern in mirror and in pre-taped video (standing)
- Use preferred alignment cue (ski jump, bum string, tailbone lift) and re-assess breath (see and feel for change)
- Try a 360° umbrella inhale (ribs cage opens to side, front and back)
- Try umbrella breath in new alignment, and old alignment which is easier?
- Shift back to middle and see if you maintain the breath
- Relax abdomen and observe for change in pattern
- Relax pelvic floor and observe for change in pattern
Independent Diaphragm Supine Lab

- **Chest Breather**: Pillow under head, shoulders and top of rib cage
  - Play with pillow height, number (less ribcage protrusion)
  - Observe changes in breath pattern with pillow transitions
  - Use hand on chest to remind, hand on ribcage to encourage direction of inhale
  - Align pelvis with hand triangle, or middle of extremes (feel how this changes breath)
  - 360° umbrella inhale, allow gentle belly rise with abdomen open
  - Gentle exhale through a straw (blowing petals off a flower)
  - Use an extended exhale to help close the ribs, so that you experience a fuller lateral excursion on inhale
  - Note abdomen follows breath (rise on inhale, fall on exhale), do not force the exhale

Independent Diaphragm Supine Lab

- **Belly Breather**: Pillow under head to maintain airway, align spine
  - Play with pillow height
  - Observe changes in breath pattern with pillow transitions
  - Use hand on belly to remind, hand on ribcage or sternum to encourage direction of inhale
  - Align pelvis with hand triangle, or middle of extremes (feel how this changes breath)
  - 360° Umbrella inhale, draw air in to open the ribcage to the front, back and sides
  - Start with small breaths that don't create a large belly rise
  - Gentle exhale through a straw (blowing petals off a flower)
  - Note abdomen follows breath (rise on inhale, fall on exhale), do not force exhale

Independent Diaphragm Lab

- **Goal**: 360° umbrella breath (front, back and sides), gentle belly rise (be sure you relax your abdomen)
- Think through props, assists, and modifications for clients
Questions?

Core Components

Diaphragm  Pelvic Floor

CORE

Pelvic Floor: Anatomy 101

Ischiococcygeus
- O: Ischial spine
- I: Coccyx

Leverator Ani:
- Pubococcygeus
  O: Pubic ramus
  I: Lower sacrum/coccyx
- Iliococcygeus
  O: Reinforced fascial band
  I: Interdigitates with Pubococcygeus
- Puborectalis
  O: Public symphysis
  I: Sling behind rectum
Urogenital Diaphragm

Anatomy 101:
• Two muscular and connective tissue layers inferior to Pelvic Floor
• Origin/Insertion: Pubic Symphysis (PS), Pubic Rami, Perineal Body, ischial Tuberosity (IT), (Coccyx)
• Perineal Body
  – Interdigitates with urethral and anal sphincters thru Transverse Perineal Muscles (Deep and Superficial)
  – Anal sphincter interdigitates with Puborectalis

Pelvic Floor

Anatomy 101: Action
• Anticipatory contraction to stabilize lumbosacral, SI, pelvic-hip, and PS joints
• Force couple with multifidus to control the sacrum
• Synergist with TA (1˚ Anterior)
• Ebbs and flows with the Diaphragm (1-7 mm)
• Supports pelvic viscera
• Pelvic floor (slow twitch) and urogenital diaphragm (fast twitch)
• S2,3 nerve roots for PF and foot intrinsics

Continence

• Continence Review: Anatomy Pre-Reading
• Add incontinence to intake questionnaires

Pelvic Floor: Function

**Function:**
- Needs to be integrated into Core recruitment, and functional patterns
- Anticipatory, balanced contraction between:
  - anterior/posterior
  - Right (R)/Left (L)
- Spine length remains the same; No pelvic movement
- Concentric/Eccentric
- Creating a motor program, strategy, and resting tone

Pelvic Floor: Dysfunction

**Dysfunction:**
- Bum gripping
- No link to the rest of Core
  - No TA
  - Breath holding
- Movement
  - Hollowing
  - Pelvic rocking
  - Ribcage elevation/depression
  - Teeth gritting

Pelvic Floor: Tricks

**Tricks:**
- Ski Jump
- Pursed lips/open mouth
- Turn feet in/out
- Lift your arches
Pelvic Floor Demo

Pelvic Floor: Assessment

Palpation:
- Posterior Pelvic Floor Palpation with TA
- Landmark this on your self:
  - PF: West of IT, East of anus
  - TA: Bulge/brace vs. TA tensioning on exhale
- Qualitative assessment: does it lift? Does it lower? Does it follow diaphragm?
- L vs. R

Observation:
- Looking for appropriate motor strategies and dysfunctional patterns
- Pelvic stability in function (single leg squat)

Self-Palpation Demo
Independent Pelvic Floor Standing Lab

- Play with the ski jump to feel how an alignment shift will elicit a response from the back half vs. front half of the pelvic floor
- Shift back to the middle to see if you can still maintain your connection with both halves
- Goal is access to both halves, use in a balance way
- Self-palpation
- Self-assess functional testing (SLR, Single Leg Squat)

Independent Pelvic Floor Side Lying Lab

- Check in with alignment: Feet, Fanny and back of head aligned. Pillow between knees, and under head
- Gently open/melt anus to close on a red kidney bean, lift it 1 cm into your body (back bean)
- Connect with breath cycle: Umbrella inhale, gentle belly rise, open anus, drop the bean
- Begin exhale through a straw: close on the bean and lift up & in 1 cm
- Follow this pattern as you add a 2nd bean lower and lift with vaginal opening (front bean)
- Inhale open, exhale close and lift = PISTONS

Independent Pelvic Floor Side Lying Lab

- Observe/feel for substitutions (bum grip, breath hold, abdominals)
- Ball squeeze to enhance closing on the beans (optional)
- Seated vs Side Lying may create added proprioception
Pelvic Floor and Kids

Primarily look at PF in function - pelvic stability in:
- Crawling
- Standing
- Moving from bilateral to unilateral stance
- Unilateral stance
Palpation

• Generally don’t palpate for motor function – observation!
• Dealing with continence, always palpate

Permission

• Ask permission of child and/or adult
• Explain why
• “I need to put my hand here (demonstrate on yourself) to feel what your PF is doing. Is that OK with you?”
• Document, have another person present, use TA
Pelvic Floor Cues

- Alignment is key!
- Gently “stop a toot”
- Break sequence down:
  - Practice PF
  - Inhale, extend the exhale
  - Blow before you go
  - Then practice movement
  - “Beans” for teens

Questions?

Core Components

[Diagram of Core Components: Diaphragm, Pelvic Floor, TA]
Transversus Abdominis

Anatomy 101:
Origin:
- Thoracodorsal fascia
- Lower 6 ribs
- Interdigitates with costal fibers of the diaphragm

Insertion:
- Upper and middle fibers blend with RA sheath reaching linea alba in midline
- Inferior fibers blends with insertion of IO at pubic crest

Action:
- Anticipatory contraction to stabilize the spine
- Expiratory muscle at the end of an extended exhale
- Synergist with PF (anterior)
- Physical link between thoracic cage-spine-pelvis
- Deepest abdominal: leverage
- Control fxn, not movement fxn
- Flattens abdomen
- Cinches waist
- Slow twitch, becomes fast twitch in presence of dysfunction

Function:
- Preparatory contraction
- Slow tensioning
- Abdomen will flatten or descend
- Concentric with expiration
- Eccentric with inspiration

Dysfunction:
- Quick bulge or bracing
- Breath holding
Independent Transversus Abdominis Lab

- Repeat brace vs. tension
- Supine, Standing or All-Fours
- Palpate medial to ASIS or superior to PS
- Monitor response of the TA on umbrella inhale
- Monitor response of the TA to extended exhale alone
- Monitor response to TA with Piston cycle
- Play with bean lifts (full, back, front, R and L) monitor TA response, asymmetries
- Observe for compensation

PF/TA Self-Palpation

Questions?
Dynamic Core for Kids

Day One: Core Function → Core Strategy (TAP) → Typical and Atypical Development

Clinical Application ← Anticipatory Core Components ← Core Optimizing Alignment

CLINICAL PROBLEM SOLVING

ASSESSMENT

Clinical Problem Solving: Assessment

What do you see?
Clinical Problem Solving: Assessment

What do you see?

Clinical Problem Solving: Assessment

What do you see now?

Clinical Problem Solving: Assessment

What do you see now?
Clinical Problem Solving: Assessment

What do you see?