DYNAMIC CORE FOR KIDS: PART ONE
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Pre and Post
- Photo of your partner
- Assess alignment
- Assess breathing pattern
- Rate your knowledge/skills in training core stability in your clients from 1 – 5

Our Paths Cross at the Core
Dynamic Core for Kids Part One

Day One: Core Function

- Case Strategy
  - TAP
  - Typical and Atypical Development
  - Core Optimizing Alignment

- Typical Case
  - Functional Postural Patterns

- Case Examples

Day Two: Q & A/Review

- Clinical Application
  - Anticipatory Core Components

- Q & A

Foundation of Our Physical House

Drafty Windows

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

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

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 mov't 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

- 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

Ideal: Balance

Real: Disrupts the IAP System
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
**Alignment**

- 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.

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**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***

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**Alignment: Claus et al**

Flat

Long Lordosis
Alignment: Claus et al

Claus et al (2009):
- Flat, Long Lordosis, Short Lordosis, Slump
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Alignment

Different Ways to Balance the Spine
Claus et al (2009):
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Alignment

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

Effect of Different Head-Neck Postures on the Respiratory Function in Healthy Males

- Healthy adult males had reduced SNIP scores in forward head posture and right torticollis position
- No change FEV$^1$ and FVC
Alignment

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
Sjodhal et al (2009)
• PF precedes supine LE movement
Luginbuehl et al (2013)
• PF precedes heel strike in running
Integrating

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

Core Redefined

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
Clinical Application

**The Relationship between Urinary Bladder Control and Gait in Women**
Booth et al (2013)

- Spatial and temporal gait parameters studied in 36 continent women FDV, SDV, and PV
- Decreased gait velocity and stride length with SDV

Clinical Application

**Changes in IAP during Postural and Respiratory Activation of the Human Diaphragm**

Movement Support: Whiteboard

- Shoulder flexion/extension w/breathing
- Shoulder flexion/extension w/breath holding
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?

Pediatric Core Research

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

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

Effects of inspiratory muscle training in children with cerebral palsy: a randomized control trial
Keles et al 2018
- Children with CP who had inspiratory muscle training showed improved trunk control

Pediatric Research

Development of Postural Responses During Standing in Healthy Children and Children with Spastic Diplegia
Woolacott et al. 1998
- Group of typical children standing in alignment of child with spastic diplegia, showed similar disordered recruitment pattern during postural adjustments

Pediatric Research

Anticipatory Postural Adjustments in Children with CP and Children with Typical Development
Liu WY et al. 2007
- 7 children with CP tested on force platform
- Control of APAs is a problem for some children with CP
- Recommended intervention to improve anticipatory 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
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

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

Effects of seat surface inclination on respiration and speech production in children with spastic Cerebral Palsy
- 3 positions-0°, 15° ant, 15° post
- Significant improvement in FVC from anterior or to posterior (but not horizontal)
- No change in FEV₁
What do we know about children with DCD?

**Pediatric Research**

- 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

**Pediatric Core Research**

- 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)
**Pediatric Core Research**

**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

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**Pediatric Research**

What do we know about children with ASD?

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**Pediatric Research**

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)
Implications for Core Activity

• This occurs as motor tracts form increased number and strength of connections with neurons in spinal cord during early movement (Kasumovic N 2010, Martin JH 2005, Petersen TH 2012, Shumway-Cook A, 2007)

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

Typical Development: 4-6 Months

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, airflow 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 Milestones

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 combines 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

Q and A

WHAT HAPPENS TO CORE FUNCTION IN ATYPICAL DEVELOPMENT?
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).

Atypical Development

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

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

Implications for Anticipatory Core Activity

- Rib cage remains high and compact secondary to shoulder elevation
- Decreased activation of respiratory diaphragm
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
Atypical Development: Dynamic Holding

**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

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Atypical Development: Dynamic Holding

- Changing alignment and muscle activation alters dynamic holding
- can improve postural control

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Atypical Development: Dynamic Holding

**Muscle Tone**

- Neurological (spasticity or hypotonia)
- Mechanical (stiffness)
- Dynamic Holding

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Atypical Development: Dynamic Holding

**Muscle Tone**

- Neurological (spasticity, hypotonia)
- Mechanical (stiffness)
- Dynamic Holding

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SENSORY & MOTOR: It's all connected

Sensory & Motor

From the time we take our first breath (and before), sensory and motor processes are connected

- The vestibular system is the only sensory system fully functional at birth
- Provides us with a gravitational reference point for movement
- It is foundational to all other sensory systems
Sensory & Motor

- The diaphragm receives input from the vestibular system (vestibulorespiratory reflexes)
  Mori R, 2001

Sensory & Motor

- This connection intimately links the anticipatory core team to the sensory systems

Sensory & Motor

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 searching/monitoring/directing
- Adaptive movement
- Oral: taste, texture, temperature, suck, blow, chew, lick, bite, crunch
- Hands: use of form, size, texture, movement
- Body: joint use of movement patterns, planes of movement

**Third Order**
- Sustained attention
- Intention
- Working memory
- Choice of a goal
- Anticipatory planning
- Self-monitoring
- Problem solving
- Language for organization
- Organization of space, time, body

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

Sensory & Motor

With development of efficient motor function, self-regulation is supported at the second order level as well
Sensory & Motor

- 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.

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Sensory & Motor

- 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)

SNS dominance = high arousal
Sensory & Motor

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

Q and A

Alignment

The Lynchpin
Alignment

Muscle Activation Characteristics of Stance Balance Control in Children with Spastic Cerebral Palsy
- Neurologically typical kids in crouch 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

Posterior Ribcage Translation

Position of the ribcage relative to the pelvis
- 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

Seated Lab
Let's play
Seated Lab

Make your rib cage tip Ant/Sup

Named by lower rib cage

Seated Lab

Make your rib cage tip Post/Inf

Named by lower rib cage

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

Alignment

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
How do we distinguish?

Alignment Screen

Volunteers-mini eval
Pain? OB/Gyn Hx? Fitness?
SLStance? SLSquat

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
• Gluteal definition
• Pelvic tilt?
Alignment Screen

Apex of the lumbar curve
Landmark: L4 at Iliac Crest

• 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

How do we distinguish?

Alignment Screen

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

Gluteal Definition
Visual Scan!

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?
Alignment

Pelvic Tilt?
Landmarks: Bilateral ileums
• 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/S; 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)

Let's Review

Demo Neutral
- Ski jump back to middle
- Pull on your bum string
- Lift tailbone on inhale
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

**Ski Jump**

<table>
<thead>
<tr>
<th>Good</th>
<th>Bad (forgot the ribcage)</th>
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<tbody>
<tr>
<td>![Image 1]</td>
<td>![Image 2]</td>
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18-09-06
Before and After

Questions?
Homework

Dynamic Core for Kids

Core Components
Core Components

Diaphragm

CORE

Diaphragm Anatomy 101

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

Insertion:
- Central tendon inserts at L3

Diaphragm Anatomy 101: Action

- Diaphragm is cross section of multiple systems: respiration, aids 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

**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 preparing 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
Shelley’s Hints for Umbrella Breathing
- Alignment is the key!
- Teach using an actual umbrella
- Use visual of diaphragm action

Demo Umbrella Inhale

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)
Diaphragm: Intervention

Umbrella Breaths:
- Retrains lateral component
- Restores a balanced breath
- Maintains alignment
- Forces breathing focus
- "Blow before you go!"

Tip: Chest Breathers-
Need help closing ribs
Tip: Belly Breathers-
Need help opening ribs

Alignment is the key!
Diaphragm: Lab It!

Lab
- Standing Re-assessment
- Breathing tricks
- Supine Assessment
- Supine Training: Hand Cues
- Umbrella Breath in Standing

Questions?
Core Components

**Diaphragm**

**Pelvic Floor**

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Core Components

**Diaphragm**

**Pelvic Floor**

CORE

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Pelvic Floor: Anatomy 101

Ischiococcygeus
- Origin: Ischial spine
- Insertion: Coccyx

levator Ani:
- Pubococcygeus
  - Origin: Pubic ramus
  - Insertion: Lower sacrum/coccyx
- Rasoococcygeus
  - Origin: Reinforced fascial band
  - Insertion: With Pubococcygeus
- Puborectalis
  - Origin: Pubic symphysis
  - Insertion: Sling behind rectum


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Urogenital Diaphragm

**Anatomy 101:**

- Two muscular and connective tissue layers inferior to Pelvic Floor
- Origin/Insertion - Pubic Symphysis (PS), Pubic Ramus, Perineal Body, Ischial Tuberosity (IT), (Coccyx)
- Perineal Body
  - Interdigitates with urethral and anal sphincters: (Muscles Transverse Perineal, Deep and Superficial)
  - Anal sphincter interdigitates with Puborectalis
Continence

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

Pelvic Floor

Pelvic Floor Anatomy 101: Action
- Anticipatory contraction to stabilize lumbo-sacral, 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

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: 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)
Pelvic Floor: Intervention

**Positioning:**
- SDL, Supine (Gyn hx)

**Engagement:**
- Access through the anus
- Access through breath
- Imagery
- Ball squeeze between knees
- Tip: May need gravity to assist

Pelvic Floor: Lab

**Lab**
1. Open and close the anus (back bean)
2. Connect with inhale: open, exhale: close and lift up & in
3. Add front bean for a 2 bean lift along with breath
4. Observe/feel for substitutions (bum grip, breath hold, abs)
5. Ball squeeze to close on bean (optional)

Demo Sitting Piston Posture

Pelvic Floor: Tips

**Tips**
1. Train with exhale to start.
2. Use beans as conscious engagement, goal is subconscious.
3. Awareness: train the subconscious recall, can they feel it?
4. Bean lift should match level of exertion, pencil or could? “Beans to your chin.”
5. Cue asymmetrically if needed. “Lift your right bean.”
6. Eventually mobil on inhale as well.
7. If you cannot palpate a PF engagement, check alignment, check breath, or “hypervigilant”

Demo Sitting Piston Posture
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 showing core components: Diaphragm, Pelvic Floor, TA, and CORE]
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 blend with insertion of IO at pubic crest

Anatomy 101: 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
Transversus Abdominis: Assessment

Assessment/Lab
- Supine or all 4's
- Palpate at medial to ASIS or superior to PS
- 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

Transversus Abdominis: Intervention

Tricks
- Cue breath through a straw/Exhale LONGER
- C-Student: follow the breath
- Relax the abdomen; allow organs down
- Diaphragm is long and relaxed on exhale
- Gravity assist in all 4's
- Lower cueing in all 4's near PS
- “Let it go”

Questions?
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?