Breathing Pattern Disorders (BPDs): Assessment and Treatments to Improve Motor Control and Core Stability

Jena Hansen-Honeycutt DAT, LAT, ATC

GEORGE MASON UNIVERSITY | School of Dance

Clinical Question

- Do breathing pattern exercises, for breathing pattern disorders, improve motor control and movement in athletes with musculoskeletal pain related to poor core stability?

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Breathing Patterns

- A normal breath… (Kolar, 2013; Chaitow 2004; Chaitow, 2014)
- "If breathing is not normalized no other motor pattern can be"- Karl Lewit (Perri, 2007; Clifton Smith, 2011; Bradley, 2014)
- Breathing is context specific (Chaitow, 2014)
  - Biomechanical
  - Biochemical
  - Psychological

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What is a BPD?

- BPD are disorders not diseases- however, they may co-exist with diseases.
- "Inappropriate breathing which is persistent enough to cause symptoms, with no apparent organic cause." (Smith and Rowley, 2011)
- Reflection of the respiratory system, biochemical, biomechanical system, and cognitive state. (Smith and Rowley, 2011)
- Thoracic versus Abdominal
- Paradoxical is the most extreme form of a BPD.
  - Chest wall moves in on inhalation and out during exhalation
  - Opposite of normal pattern
- Hyperventilation syndrome (HVS) – extreme

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Psychological Factors

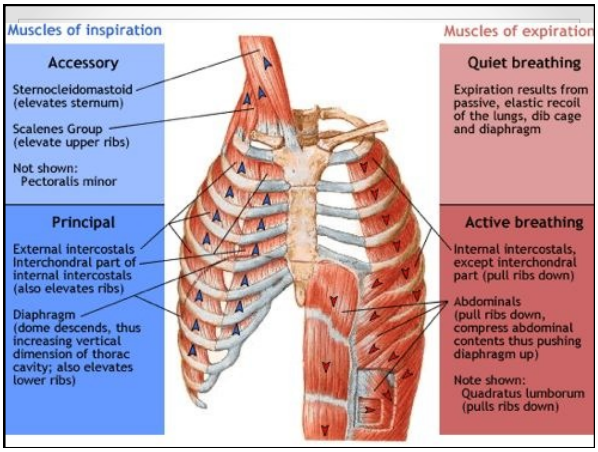
- Modern thinking attempts to separate mind-body
  - Stress, anxiety, work stress, cultural beliefs, personality traits, emotions, learned responses, pain (Courtney, 2011)
- ANS helps control BR and HR
  - BR can be overridden by conscious input of the SNS or PNS
- Thoracic breathing (Apical) can increase cardiac output, protective
  - Helps adjust to various demands (Perri, 2004; Chaitow, 2004)
  - Effects endocrine and immune system, muscle function, pain perception and emotions (Perri and Halford, 2004, Chaitow et al., 2014)

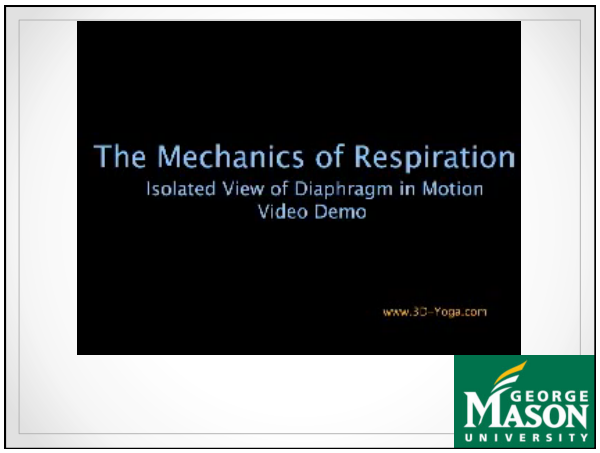
Biochemical Factors

- The body regulates its chemical state through the breath (Kox et al. 2014)
  - Allergies, diet, medications, exercise, hormonal, environment, altitude
- O_2 and CO_2 (pH 7.2-7.4) (Chaitow, 2004; Chaitow, 2014; Clifton Smith, 2011)
  - CO_2 in blood regulates the breathing drive
- Compensating for… (Chaitow, 2014)
  - Pathologies (diabetes, kidneys)
  - Asthma (similar s/s) 11/32 had HVS (Hammo, 1999; Miller, 2005)
  - Exercise increases demands (volume and rate)

Biomechanical Factors

- FMS score and BPD
  - 75% who failed FMS – thoracic dominant BP
- Core Stability, LBP, and the Diaphragm (Boyle et al., 2010)
- CNS develops in a sequential process
  - Diaphragm initiates core stability process
  - Assists in development
- Breathing assists in maintaining the neuromuscular system (Frank, Kobesova, & Kolar, 2013)
  - BPD in LBP patients during motor control tests (Roussel et al., 2009)





Anatomy of the Diaphragm

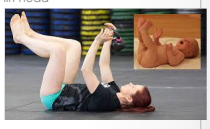
- Provides 70-80% of the inhalation forces (Simons, 1998)
- Two portions of the diaphragm crural and skeletal (costal) (Richardson, 1999)
  - Partial innervated by the vagus nerve, allows for co-activation with swallowing (Young et al., 2010)
- 3 functions: respiratory, postural, and visceral (Pickering and Jones, 2002)
- Direct continuity of fascia from the apex of the diaphragm to base of the skull and joins the dura (Simons, 1998)

Biomechanics of Breathing

- The diaphragm lengthens and shortens the vertical diameter of the thoracic cavity
- TA eccentrically contracts upon inhale
- The ribs move into inhalation and depress with exhalation
- Sternocleidomastoid and scalenes elevate the sternum
  - Produces an upward pressure
- Efficiency is dependent upon the pumping action created by the neuromuscular and skeletal exertion (Chaitow et al., 2014)
- Valsalva Maneuver/ Bracing

Diaphragm Function from a Developmental Perspective

- Ontogenetic Development (Murphy & Woodrum, 1998)
  - Diaphragm initiates respiration
- Neonatal Developmental Stage (Chaitow et al.,2014, Kolar, 2013)
  - First 28 days of life
  - Diaphragm begins to contribute to both postural and sphincter functions
  - Non-respiratory function- prop up onto forearms and lift head
  - Muscle co-activation develops at the end of stage
- 3 Months
  - Stabilization quality of muscle synergies increases
  - Cervical and thoracic spine straightens
  - Development of lower costal breathing
- 4 1/2 Months
  - Support and stepping (grasping) movements
  - Function of trunk muscles and abdominal cavity
  - Intra-abdominal pressure regulation = spinal stabilization
  - Coordinate breathing with vocalization
- 6 Months
  - Costal breathing is fully established
  - Sphincter function of the esophagus and diaphragm fully mature by end of 6 months



Theories

- Developmental Kinesiology (Frank et al., 2013)
  - Based upon the the development of human motor function in early childhood.
  - Genetically predetermined, predictable pattern
    - Central movement patterns
  - Postural control and maturity of the CNS
- Selective Functional Movement Assessment (SFMA) (Cook et al., 2014)
  - Examination and exercise progressions build on changes in neurodevelopmental postures

Theories

- Regional Interdependence (RI) (Frank et al., 2013)
  - Vladimir Janda
  - Dynamic and stabilizing function of the kinetic chain muscles.
  - Identify the shortened muscles/structures
  - Release of those structures and re-education
- Dynamic Neuromuscular Stabilization (DNS)
  - Professor Pavel Kolar PT, PHD, Czech Physiotherapist
  - Manual and rehabilitative approach to optimize the movement system based upon the principles of developmental kinesiology.
  - Functional norms from a developmental perspective.

Breathing and Posture/ Structural Considerations

- Reduced efficiency of the diaphragm, TA, multifidus, and pelvic floor muscles can impair the mechanical stability of the spine
  - Effecting Strength and Flexibility
- Breathing regulates IAP
  - Increase in IAP, Increases spinal stability
- Abnormal stabilization
  - Dysfunctional Breathing Pattern
- Gradual change in postural muscles due to fatigue

Current Research

- Pain and Faulty Breathing Patterns: A Pilot Study (Perri and Halford, 2004)
  - Observe relaxed and deep breathing patterns to determine incidence of normal or faulty breathing patterns
  - 94 Participants; 68% females, 32% males; ages 11-80
  - 87.2% experienced some kind of pain in the head, neck, middle back, lower back, buttocks, arm, or leg.
  - 56.4% had faulty breathing in a relaxed position; 75% had faulty breathing with a deep breath
  - Statistically significant relationship between faulty breathing and neck pain

Current Research

- Breathing Retraining- A 5-year follow-up of patients with dysfunctional breathing (Hagman, Janson, and Emtner, 2011)
  - 11/32 had HVS (Hammo, 1999; Miller, 2005)
  - 22 BPD and 23 asthma
    - DB Group: Breathing retraining, information, advice, and diaphragmatic breathing.
      - One to Four PT sessions based upon patient needs.
    - Asthma Group: No physiotherapy intervention
  - BPD patients had positive results with breathing retraining compared to the asthma patients that did not receive any breathing training or information regarding the disease
    - Improved "physical function."
    - Improved Quality of Life

Current Research

- Altered breathing patterns during lumbopelvic motor control tests in chronic low back pain: A case-control study (Roussel et al., 2009)
  - 10 LBP and 10 Healthy Individuals
  - Tests: Standing BP, Supine BP, Active Straight Leg Raise, and Bent Knee Fall Out
  - Increase in altered breathing patterns in those with chronic LBP during motor control testing
  - Increase in pressure deviations from baseline value compared to the healthy group
  - BPD was noted in patients where the truck stability muscles were being tested and resulting in breathing changes. Severity of pain was not linked to the motor control tests.

Current Research

- Postural Functions of the Diaphragm in Persons with and without Chronic Low Back Pain (Kolar et al., 2012)
  - 29 Healthy participants and 18 CLBP
  - Dynamic MRI and Spirometry Assessment, Mouth breathing, Tidal breathing
  - Reduced diaphragm movement with isometric flexion against resistance of the upper or lower extremities with CLBP.
  - Diaphragm excursions were significantly smaller in the patient population. No TB difference were noted between the two groups until postural tasks occurred.
  - Compromised diaphragm function could play a role in postural stability

Self Evaluation

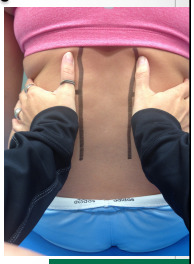
Number count

Hi Lo

Describe your breath…
How does it feel?

Assessment

- Assessments
- Self evaluations
  - Number count
  - Hands on lower rib cage
- Clinician Evaluations
  - Hands on belly and hand on chest
    - Supine, Seated, Standing
  - Measure chest and belly expansion
  - Posterior lower rib assessment



BPD Classifications

- Paradoxical/ HVS
- Apical (Thoracic)
- Abdominal variations
- Asymmetrical versus symmetrical
- Over breathing

Exercises

- Reflex Triggering
  - Clam shell, twist
- Squeeze and Breathe
- Theraband
- Diaphragm Reset (PRRT)
- 6 Inhale-3 Hold-6 Exhale-3 Inhale

Conclusion

Do breathing pattern exercises, for breathing pattern disorders, improve motor control and movement in athletes with musculoskeletal pain related to poor core stability?

- Breathing is rarely assessed regardless of effects on neromusucloskeletal system (Bradley & Esformes, 2014; CliftonSmith & Rowley, 2011; Perri & Halford, 2004; N. A. Roussel, Nijs, Truijen, Smeuninx, & Stassijns, 2007; N. Roussel et al., 2009)
- It is agreed that a normal abdominal breathing pattern is rare (Chaitow et al., 2014; Chaitow, 2004; Perri & Halford, 2004)
- BPDs can alter core stability and motor control
- May contribute to musculoskeletal pain stemming from poor core stability

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