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

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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?

Breathing Patterns
• A normal breath…- Kolar 2013
• “If breathing is not normalized no other motor pattern can be”- Karl Lewit 2007
• Breathing is context specific- Chaitow 2014
• Biomechanical
• Biochemical
• Psychological

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.
  o Chest wall moves in an inhalation and out during exhalation
  o Opposite of normal pattern
• Hyperventilation syndrome (HVS) – extreme
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, environmental, altitude
- O₂ and CO₂ (pH 7.2-7.4) (Chaitow, 2004; Clifton Smith, 2011)
  - CO₂ in blood regulates the breathing drive
- Compensating for...
  - Pathologies (diabetes, kidneys)
  - Asthma (similar s/s) 11/32 had HVS (Rome, 1991, view 2011)
- 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 (Buss et al., 2013)
The Mechanics of Respiration

Isolated View of Diaphragm in Motion
Video Demo

www.3D-Yoga.com

Anatomy of the Diaphragm

- Provides 70-80% of the inhalation forces (Simons, 1998)
- Two portions of the diaphragm: crural (skeletal/costal) (Richardson, 1999)
  - Partially 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 scalene elevate the sternum
- Produces an upward pressure
- Efficiency is dependent upon the pumping action created by the neuromuscular and skeletal exertion
- 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 til 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

5/19/17
Theories

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

• Regional Interdependence (RI) (Frank et al., 2013)
  o Vladimir Janda
  o Dynamic and stabilizing function of the kinetic chain muscles.
  o Identify the shortened muscles/structures
  o Release of those structures and re-education
• Dynamic Neuromuscular Stabilization (DNS)
  o Professor Pavel Kolar, PT, PHD, Czech Physiotherapist
  o Manual and rehabilitative approach to optimize the movement system based upon the principles of developmental kinesiology.
  o 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
  o Effecting Strength and Flexibility
• Breathing regulates IAP
  o Increase in IAP, increases spinal stability
• Abnormal stabilization
  o 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)
  o Observe relaxed and deep breathing patterns to determine incidence of normal or faulty breathing patterns
  o 94 Participants; 68% females, 32% males; ages 11-80
  o 67.2% experienced some kind of pain in the head, neck, middle back, lower back, buttocks, arm, or leg.
  o 56.4% had faulty breathing in a relaxed position; 73% had faulty breathing with a deep breath
  o Statistically significant relationship between faulty breathing and neck pain
Current Research

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

• 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 trunk stability muscles were being tested and resulting in breathing changes. Severity of pain was not linked to the motor control tests.

• 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 neuromusculoskeletal system
  - Chaitow et al., 2014
  - Chaitow, 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
- BPDs can alter core stability and motor control
- May contribute to musculoskeletal pain stemming from poor core stability
References