

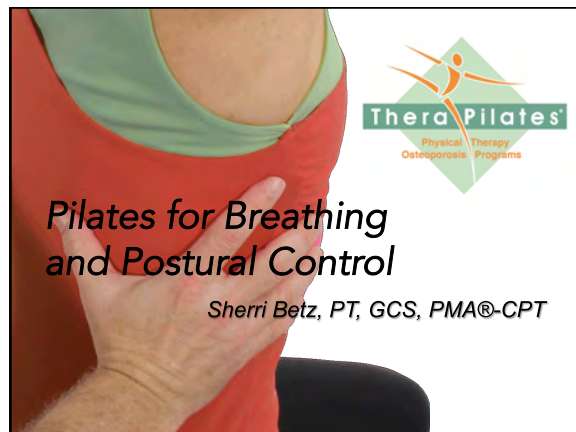


Pilates for Breathing & Postural Control

Dr. Sherri Betz

PT, DPT, GCS, CEEAA, PMA-CPT

www.therapilates.com



What keeps me awake at night...

- What is the physiological effect of teaching breathing techniques?
- Does conscious breathing change subconscious breathing?
- What do the biomechanics of breathing have to do with O₂/CO₂ balance?
- Does breathing cause our posture or does posture determine our breathing style?
- Is it dangerous to hold your breath and lift?

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Still can't sleep....

- Some schools of Pilates place strong emphasis on breathing.
- Some schools of Pilates perform a percussive breathing technique.
- Who is right?
 - Diaphragmatic Breathing as in Yoga?
 - Costal Breathing as in Pilates?
 - Percussive Breathing?
- Further still are meditation practices that begin with focus on the breath...

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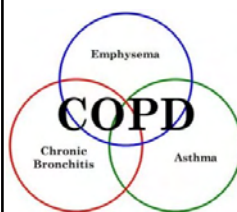
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Look up...

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COPD



- PURSED LIP BREATHING taught to get the trapped air out of the lungs by increasing intra-thoracic pressure and decrease shortness of breath.
- If COPD patients use forced exhalation, the structurally weakened airways collapse.

Breathe in normally but breathe out through a narrow orifice of the lips, which slows exhalation at the mouth. This keeps positive pressure in the airways, thus preventing their collapse and allowing some forced exhalation without subsequent collapse.

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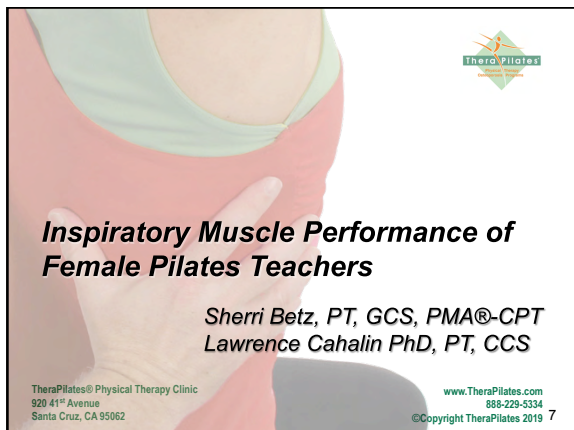
Incentive Spirometer

- Breathe in as slowly and as deeply as possible.
- Hold breath for 2–6 seconds.
This provides back pressure which pops open alveoli. It is the same maneuver as in yawning.
- An indicator provides a gauge of how well the lungs are functioning, by indicating sustained inhalation vacuum.
- Perform many repetitions a day while measuring progress by way of the gauge.



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Inspiratory Muscle Performance of Female Pilates Teachers

Sherri Betz, PT, GCS, PMA®-CPT
Lawrence Cahalin PhD, PT, CCS

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Inspiratory Muscle Performance of Female Pilates Teachers

Purpose: A major component of most Pilates styles is a focus on breathing.


- Numerous claims have been made suggesting that Pilates improves breathing, but no published study examining breathing could be found in the literature.
- Examine the inspiratory performance of Pilates instructors and compare the observed results to predicted values.
- Compare the inspiratory performance of Pilates instructors performing Pilates with a breathing emphasis (BE) to those without a BE.

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Inspiratory Muscle Performance of Female Pilates Instructors

Methods: 61 female Pilates instructors underwent the Test of Incremental Respiratory Endurance (TIRE)




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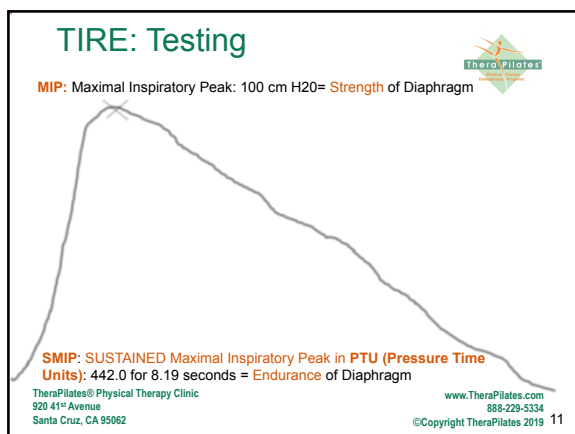
Test of Incremental Respiratory Endurance (TIRE)

Methods:

- Maximal Inspiratory Pressure (MIP)
- Sustained Maximal Inspiratory Pressure (SMIP)
- SMIP duration



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Inspiratory Muscle Performance of Female Pilates Instructors

Methods:

- The obtained MIP (Maximal Inspiratory Pressure) was compared to the predicted MIP based on age, weight, and height using the Baltimore Longitudinal Study of Aging reference equation for women.
- The obtained MIP of Pilates instructors performing Pilates with and without BE was compared via independent t-tests.
- Correlation and linear regression analyses were performed to examine relationships and predictors of inspiratory performance.

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Inspiratory Muscle Performance of Female Pilates Instructors



Results:

- Pilates instructors have significantly greater **MIP** (Maximal Inspiratory Pressure) values compared to predicted **MIP** values.
- Pilates with **BE** (Breathing Emphasis) or **yoga** combined with Pilates is associated with greater inspiratory performance.
- Aerobic exercise combined with Pilates was **NOT** associated with greater inspiratory performance.

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Inspiratory Muscle Performance of Female Pilates Instructors



Results:

- Age was a near significant predictor of **SMIP** and was a significant predictor of **SMIP** duration with both relationships being negative.
- Lifetime Pilates minutes was a significant negative predictor of MIP which may be due to the manner Pilates instructors breathe while performing Pilates (typically through the nose with less force) and warrants future measurement of inspiratory performance via the nose.

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Inspiratory Muscle Performance of Female Pilates Instructors



Conclusions:

- Female Pilates instructors have significantly greater **MIP** (Maximal Inspiratory Pressure) than predicted values.
- Pilates instructors who performed Pilates with a **BE** (Breathing Emphasis) or yoga had significantly greater inspiratory performance.
- If improvement in inspiratory performance is a goal of Pilates it should be performed with **BE** (Breathing Emphasis).

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The 3 Guiding Pilates Principles

(PMA, 2005)



- Whole Body Health
- Whole Body Commitment
- **Breath**



The 3 Guiding Pilates Principles

(Pilates J. 1945, PMA 2005)



▪ Breath

- Joseph Pilates, as told to Ron Fletcher
 - "above all, learn how to breath correctly"
 - "In d the air to out d air"
 - "Exhale completely"
- The breath is an integral part of overall body functioning, increasing volume capacity, oxygenation and other physiological changes. Full consistent inhalation and exhalation helps the circulatory system nourish all the tissues with oxygen-rich blood while carrying away impurities and metabolic waste. Pilates referred to this cleansing mechanism as the "internal shower" which resulted in mental and physical invigoration and rejuvenation.

▪ PMA Study Guide p.18

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Pilates Evolved Movement Principles

(Pilates J., 1945)



- "Physical fitness is the first requisite of happiness. Our interpretation of physical fitness is the attainment and maintenance of a uniformly developed body with a sound mind, fully capable of naturally, easily and satisfactorily performing our many and varied daily tasks with spontaneous zest and pleasure"

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Principle 1

(Pilates J, 1945)



■ Breathing

- "Your blood will flow with renewed vigor as a direct result of your faithfully performing the Contrology exercises. These exercises induce the heart to pump strong and steadily. As a result, the bloodstream carries and discharges from your system more of the accumulated debris created by fatigue."

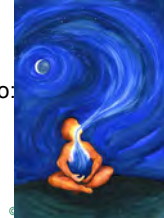
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Yogic Breathing: Pranayama



- Prana: Breath, Breath of Life, Energy, Spirit
- Yama: Suspension, Expansion or Extension
- 50 different forms of Pranayama or breathing practices identified
- Nadisuddhi Pranayama (alternate nostril breathing) has been shown to:
 - increase parasympathetic activity
 - lower systolic blood pressure
 - lower respiratory rate



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Upadhyay, 2008

Yogic Breathing



■ Ujjayi Breath

- Ujjayi is a **diaphragmatic** breath, which first fills the lower belly, rises to the lower rib, and finally moves into the upper chest and throat.
- Both inhalation and exhalation are performed through the **nose**.
- "Ocean sound" is created by moving the **glottis** as air passes in and out.
- Length and speed of the breath is controlled by the diaphragm
- Purpose is to strengthen the diaphragm

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Yogic Breathing



■ Kapalabhati Breath

- Skull Shining or Illumination breath
- Intended mainly for cleaning the cranial sinuses
- Consists of alternating short, explosive exhales and slightly longer, passive inhales.
- Exhales are generated by powerful contractions of the lower belly which push air out of the lungs.
- Inhales are responses to the release of this contraction, which draws air back into the lungs.

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Yogic Breathing



- The point of Yoga is not to become an expert on any of the patterns. **It is to confront a physical obstacle and maintain your composure through your breath.**
- In a dysfunctional pattern you will often see dysfunctional breathing. Not sure if the breathing is driving the pattern or the pattern is driving the breathing. Doesn't matter...

Gray Cook

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Yogic Breathing



- Diaphragmatic breathing during strenuous poses such as Upward Facing Dog or Chaturanga Dandasana can be detrimental for spinal stability. With diaphragmatic breathing, the abdominals must relax to allow for the expansion of the abdominal wall. In my opinion, costal breathing would be better to provide more support and core control in those vulnerable positions of the spine.



Breathing

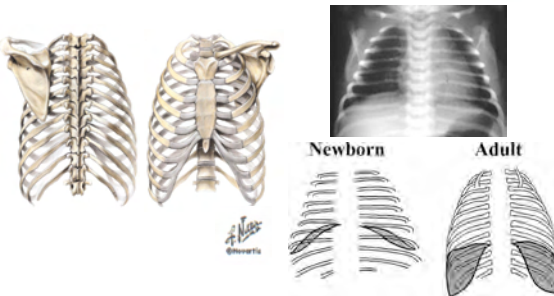


Movement facilitates Breath
Breath facilitates Movement

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Breathing: Anatomy & Physiology

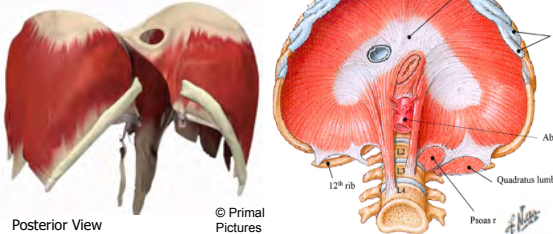


Look at posture of the Rib Cage (Flared, Depressed, Elevated) and Sternal position (Vertical, Inverted, Everted)

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Breathing: Inspiration

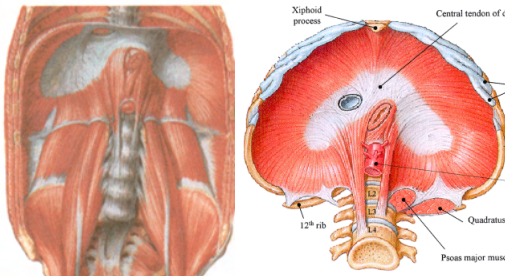
Muscles of Inspiration: Diaphragm



Posterior View

Inferior View

© Primal Pictures



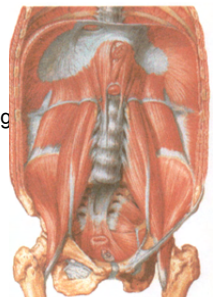
Inferior View:
Looking up at the diaphragm

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Diaphragmatic Breathing

- ◆ Upper Lung Breathing Assessment
- ◆ Accessory Breathing Assessment
- ◆ Costal Lower Lung Breathing

Towel Exercise for external feedback



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Inhalation

- Scalenes contract to a small degree with every breath. They create negative pressure in pleurae to hold the ribs elevated.
- Diaphragm-pulls down on the central tendon and pulls up on the lower ribs
- Ext Intercostals + Diaphragm
- Erector Spinae - slight extension occurs
- QL: helps maintain position of lower ribs
- PF Muscles: eccentrically contract but PF descends

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Exhalation

- Passive elastic recoil process if you are relaxed laying on your back.
- If standing: you must have abdominal activation to push the diaphragm up for exhalation.
- With increasing demands for respiration you get more and more abdominal recruitment.
- Contraction of only TrAb: get pushing up of the diaphragm and descent of the PF

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Exhalation

- TA has the most effect by pushing the diaphragm up.
- External Oblique and Internal Oblique has most of it's effect by pulling the ribs down.
- Rectus can cause a bit of flaring.

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*All muscles of the trunk are
muscles of respiration...*

Paul Hodges

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Mary Massery, PT, DPT, DSc

- The DIAPHRAGM is not a respiratory muscle, it is a pressure regulator.
- Diaphragm is dome-shaped due to high pressure in abdominal cavity and low pressure in thoracic cavity.
- If any portion of that "can" is opened (breached), whether it is opened via a tracheotomy on top, stress incontinence on the bottom, or weak abdominal, diaphragm or chest muscles in the middle, the entire "can" is not functional!
- *"I do not care how many Pilates classes you go to, the abdominal muscles alone cannot provide core stability!"*
stated by Mary Massery

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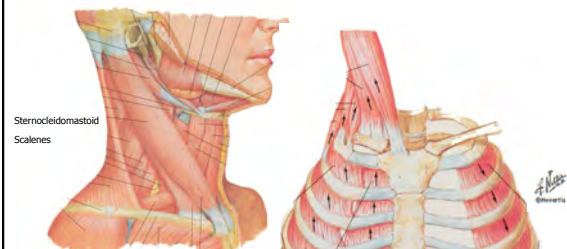
The Mechanics of Respiration

Isolated View of Diaphragm in Motion
Video Demo

www.3D-Yoga.com

Breathing: Inspiration


Muscles of Inspiration: Accessory muscles of breathing



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Accessory Muscles of Inspiration:



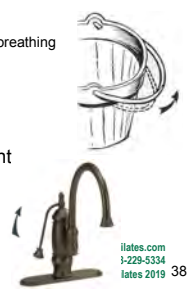
- Often over-active in cervical pathologies
- Teach diaphragmatic breathing first to inhibit Accessory breathing so that patient can use arms without excessive recruitment of cervical musculature.

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Breathing: Inspiration

(DeTurk WE, Cahalin LP 2011; Kiser C, Colby L 2007)

- Movement of the thoracic wall during inspiration
 - Vertical diameter movement
 - Diaphragmatic breathing; Accessory muscle breathing
 - Transverse diameter movement
 - "Bucket handle" movement – ribs 2-10
 - Ribs swing outward and upward
 - Anterior Posterior diameter movement
 - "Pump handle" movement – ribs 2-6
 - Sternal end of ribs rise with movement at costovertebral joint



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Breathing: Inspiration

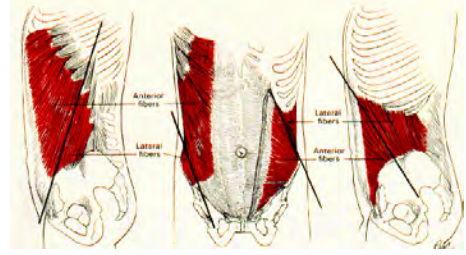
- INHALATION:
 - **Forced/Deep:** Expand Low Belly or Expand Ribcage

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Breathing: Expiration

Muscles of Expiration: Abdominals

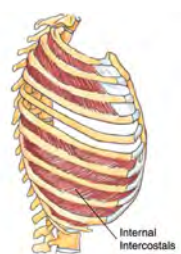


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Breathing: Expiration

Muscles of Expiration: Internal Intercostals

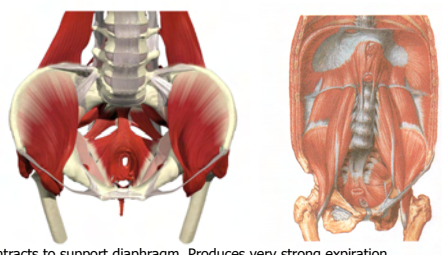


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Breathing: Expiration

- Pelvic Floor



Contracts to support diaphragm. Produces very strong expiration.

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Breathing: Expiration

EXHALATION:

- **Forced:** Yell, Cough, Grunt, Blow
- **Controlled:** Talk, Sing, Hum, Gentle Pursed Lip Breathing
- **Passive:** No effort, No control, "Letting go"

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Purpose of Breathing in Pilates

- Control of Intra-Abdominal Pressure in challenging positions
- Directional breath to facilitate movement or stability



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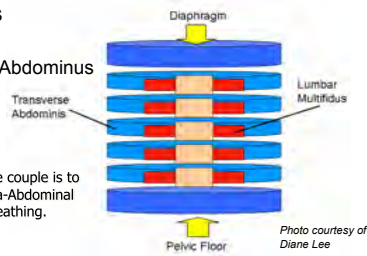
Breathing: Biomechanics

(Richardson et al, 1999)

Force Couples

- Diaphragm
- Transversus Abdominus
- Pelvic Floor

One function of this force couple is to create and maintain Intra-Abdominal Pressure (IAP) during breathing.



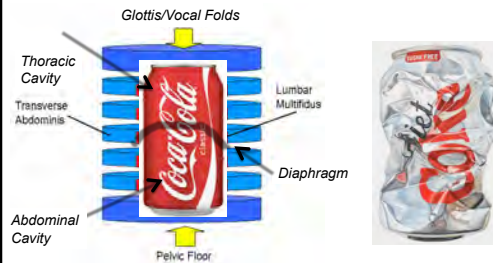
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Breathing: Biomechanics

(Massery, M 2011)

Mary Massery's: Soda Pop Can Model of Stability



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Breathing: Motor Control

- Normal Movement / Organization
 - Does the breath facilitate or interfere with the movement?
 - How can breath challenge the movement?
 - The breath should match the demand of the activity
 - Resting or sedentary activity
 - Advanced movement with increased demand for stability or complex organization

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Breathing: Motor Control

(Kolar et al 2012; DeTurk WE, Cahalin LP 2011)

Faulty Movement / Organization

Structural

Postural

- Flared Rib Cage
 - Can be associated with diminished exhalation, poor control of thoraco-lumbar junction, excessive lumbar lordosis, ribcage shifted forward of pelvis
- Excessive thoracic kyphosis
 - Can be associated with collapsed posture, forward head, decreased diaphragm strength, pathology such as osteoporosis


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Breathing: Motor Control

(DeTurk WE, Cahalin LP 2011; Kisner C, Colby L 2007)

- **Faulty Movement**
 - **Paradoxical Breathing**
 - Exhale-lower belly bulges out
 - Inhale-lower belly sucks in



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Breathing: Applications

- Neutral Spine/Pelvis
- Sidelying Diaphragmatic (*allow belly to spill onto mat*)
- Sidelying Costal (*Expand ribs with inhalation while keeping abdominal wall still*)
- Supine Diaphragmatic
- Supine Costal with Strap around Ribs
- Prone as Above
- Quadruped as Above
- Standing as Above
- Add Arm/Leg Movements Coordinated with Breath

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Breathing: Applications

(Kisner C, Colby L 2007)

- **Breath facilitates Movement**
 - **Directional breath**
 - An anterior inhalation can facilitate thoracic extension



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Breathing: Applications

(Kisner C, Colby L 2007)

- **Breath facilitates Movement**
 - **Directional breath**
 - Forced exhalation can facilitate spine flexion



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Breathing: Applications

- **Breath facilitates Movement**
 - **Directional breath**
 - Unilateral breathing can facilitate lateral flexion
 - Reduce scoliotic concavity




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Breathing: Applications

- **Breath facilitates Movement**
 - **Directional breath**
 - Exhalation can facilitate rotation (if ribs are elevated and lungs are full, rotation is inhibited)



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Breathing: Applications

(Kendall FP et al, 2005)



- Breath facilitates scapular movement
 - Inhalation generally facilitates shoulder elevation
 - Exhalation generally facilitates shoulder depression



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Breathing: Applications



- Breath facilitates Movement
 - Directional breath
 - Combination of breathing can facilitate flexion/rotation
 - Breathe at end range to perform "contract-relax"



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Breathing: Applications

(Kisner C, Colby L)



- Movement facilitates Breath
 - Thoracic extension -> Anterior inhalation
 - Spine flexion -> Posterior breathing
 - Lateral flexion -> Unilateral breathing



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Breathing: Applications

Massery M, 2011, 2012



- Breath facilitates Stability (Postural Control)
 - Spine stability may be achieved by choosing the breath pattern that supports the movement.
 - Inhalation generally facilitates spine stability when the hips move into flexion or when the shoulders move into extension
 - Exhalation generally facilitates spine stability when the hips move into extension or when the shoulders move into flexion
 - The breath may also be used to challenge the movement

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Breathing: Manual Cueing



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Assessing Breathing



TheraPilates® Physical Therapy
Science of Breathing Workshop
Sherri R. Betz, PT, GCS, PMA®-CPT

Breathing Assessment Scoresheet

FEET:	Neutral-Correct <input type="checkbox"/> Pronation <input type="checkbox"/> Supination <input type="checkbox"/>	Score= <u> </u> /1
KNEES:	Neutral-Correct <input type="checkbox"/> Valgus <input type="checkbox"/> Varus <input type="checkbox"/> Hyperextension <input type="checkbox"/>	Score= <u> </u> /1
PELVIS:	Neutral-Correct <input type="checkbox"/> Anterior <input type="checkbox"/> Posterior <input type="checkbox"/>	Score= <u> </u> /1
RIB RELATIONSHIP TO PELVIS:	Neutral-Correct <input type="checkbox"/> Forward <input type="checkbox"/> Backward <input type="checkbox"/>	Score= <u> </u> /1
RIB TO PELVIS DISTANCE:	4 Fingers-Ideal <input type="checkbox"/> 3 Fingers <input type="checkbox"/> 2 Fingers <input type="checkbox"/> 0-1 Fingers <input type="checkbox"/>	Score= <u> </u> /4
SHOULDER GIRDLE:	Neutral-Correct <input type="checkbox"/> Protracted <input type="checkbox"/> Retracted <input type="checkbox"/> Elevated <input type="checkbox"/>	Score= <u> </u> /1

TOTAL /20

Breathing Assessment Scoresheet

OCCIPUT TO WALL DISTANCE:
Neutral-Correct ☐ **Forward** Inches/cm: ☐ Score= /2

GOAL POST:
Position #1 ☐ **Ribs Lift #1** ☐ Position #2 ☐ **Ribs Lift #2** ☐ Score= /2

BREATHING TYPES/Dominant Pattern: (Assess in Standing) Score= /3
 Diaphragmatic ☐ **Upper Thoracic** ☐ **Lower Thoracic** ☐
 (Abdominal/Belly) (Pump Handle) (Costal)

RIB EXPANSION: (Standing) Receive 1 point per inch up to 4" Score= /4
 Rest **Inhalation** ☐ **Exhalation** ☐

TOTAL /20

Posture: Feet & Knees

FEET:
Neutral-Correct ☐ **Pronation** ☐ **Supination** ☐ Score= /1

KNEES:
Neutral-Correct ☐ **Valgus** ☐ **Varus** ☐ **Hyperextension** ☐ Score= /1

5 = Left and Right Subtalar Neutral Ankle Alignment

5 = Left and Right Neutral Knee Alignment

Posture: Pelvis

PELVIS:
Neutral-Correct ☐ **Anterior** ☐ **Posterior** ☐ Score= /1

1 = Neutral Pelvis Alignment

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Ribcage Relationship to Pelvis

RIB RELATIONSHIP TO PELVIS:
Neutral-Correct ☐ **Shifting Forward:** ☐ **Shifting Backward:** ☐ Score= /1

1 = Ribcage balanced over pelvis. Lumbar paraspinals relaxed.

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Rib to Pelvis Distance

RIB TO PELVIS DISTANCE:
4 Fingers-Ideal ☐ 3 Fingers ☐ 2 Fingers ☐ 0-1 Fingers ☐ Score= /4

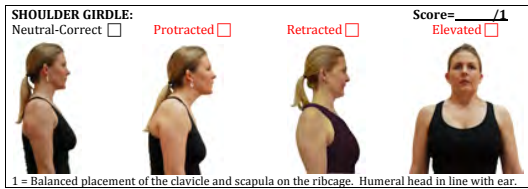
Measure distance from 10th rib to pelvis at axillary line with fingers aligned vertically. If unequal bilaterally, record lowest score and note bilateral scores in comments.
 Less than 2 fingers is strongly predictive of current lumbar compression fracture.

4 = 4 Fingers
 3 = 3 Fingers
 2 = 2 Fingers
 1 = 1 Finger

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Shoulder Girdle/Sternum



Sternum Position: Vertical ☐ Inverted ☐ Everted ☐

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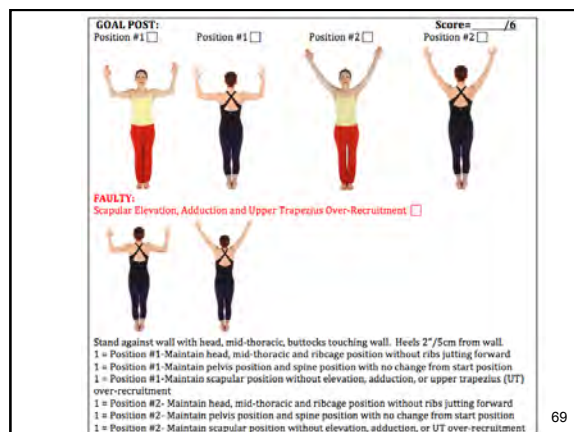
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Occiput to Wall Distance



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Dominant Breathing Style



Assess subject's dominant style of breathing by observing subject's breathing style throughout the assessment. Then ask subject to take a deep breath to assess dominant style.

Assess subjects ability to use the following 3 breathing styles:

- 1 = Able to take a *Diaphragmatic* Breath with expansion of low abdomen without perturbation of pelvis/spine
- 1 = Able to take an *Upper Thoracic* (Pump Handle) breath with sagittal expansion of sternum and upper thoracic spine without upper trapezius over-recruitment
- 1 = Able to take a *Lower Thoracic* (Costal) breath with expansion of lower ribs bilaterally in the frontal plane without upper trapezius over-recruitment.

Ribcage Expansion



To assess resting position, ask subject to take a 2-3 deep breaths and exhale in a relaxed manner. Measure circumference at Xiphoid Process, T7, and Base of Scapulae at rest. Record score. Ask subject to inhale as deeply as possible expanding the ribcage laterally into the arms/armpits. Record Inhalation score. Then ask subject to exhale as fully as possible. Record Exhalation Score.
 1 = 1-2" expansion of lower ribs from rest position to full/deep inhalation
 1 = >2" expansion of lower ribs from rest position to full/deep inhalation
 1 = 1-2" decrease of lower rib circumference from rest position to full or forced exhalation
 1 = >2" decrease of lower rib circumference from rest position to full or forced exhalation

Points to Remember:

- Identify client's state: (Sympathetic *stressed* vs. Parasympathetic *relaxed*)
- Identify client's preferred breathing style and posture
- Teach diaphragmatic or costal breathing to balance client's state
- Use your breathing to enhance or control movement
- For better core control practice costal breathing
- For cardiovascular exercise most will use a combination of diaphragmatic and costal

Enjoy this fabulous tool for restoring your client's quality of life!

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**THANK YOU to Kathy Corey and
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