## TO BREATHE OR Not to breath …



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Well, that's not even a question, is it? However, most of us do not give breathing a thought. Although it seems easy, respiratory function is extremely complex and is associated with many breathing pattern disorders. Although this short article will not fully elaborate on these complexity, it can usefully highlight those aspects which impact somatic dysfunction and/or can be modified by NMT and associated modalities.

Healthy breathing depends on four areas of influence:

- efficient ventilation
- gas exchange
- gas transportation to and from the tissues of the body
- and breathing regulation.

The status of the muscles and joints of the thorax, the postures used, and the way the individual breathes can influence all of these, to some extent.

Ventilation itself is dependent on:

- the muscles of respiration and their attachments
- the mechanical characteristics of the airways
- the health and efficiency of the lungs' parenchymal units.

Inhalation and exhalation involve expansion and contraction of the lungs themselves. These excursions occur by means of:

- movement of the ribs into elevation and depression which alters the diameters of the thoracic cavity.
- movement of the diaphragm, which lengthens and shortens the vertical diameter of the thoracic cavity and is the normal means of breathing at rest.

This vertical diameter further increases when the upper ribs rise during forced respiration, which often occurs when the normal elasticity of the respiratory system is insufficient to meet demands. This incorporates accessory breathing muscles, including sternocleidomastoid, scalenes and external intercostals.

The main purpose of respiration is to assist in providing gas exchange between inhaled air and the blood. Additionally, the actions of the diaphragm enhance lymphatic fluid movement by means of alternating intrathoracic pressure. This produces suction on the thoracic duct and cisterna chili, and thereby increases lymph movement in the duct and presses it toward the venous arch (Kurz 1986, 1987). Venous circulation is likewise assisted by alternating pressures between the thoracic and abdominal cavity, suggesting that respiratory dysfunction (such as 'shallow breathing') may negatively impact venous return from the lower extremities and contribute to conditions, such as varicose veins.

Kapandji (1974), in his discussion of respiration, has described a respiratory model. By replacing the bottom of a flask with a membrane (representing the diaphragm), providing a stopper with a tube set into it (to represent the trachea) and a balloon within the flask at the end of the tube (representing the lungs within the rib cage), a crude respiratory model is created. By pulling down on the membrane (the diaphragm on inhalation), the internal pressure of the flask (thoracic cavity) falls below that of the atmosphere and a volume of air of equal amount to that being displaced by the membrane rushes into the balloon, inflating it. The balloon relaxes when the lower membrane is released, elastically recoiling to its previous

A working model with similarities to thoracic air movement is demonstrated by Kapandji (1974).



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position, as the air escapes through the tube.

The human respiratory system works in a similar, yet much more complex and highly coordinated manner. During inhalation, the diaphragm displaces caudally, pulling its central tendon down, thus increasing vertical space within the thorax. As the diaphragm descends, the abdominal viscera resist it. At this point, the central tendon becomes fixed against the pressure of the abdominal cavity, while the other end of the diaphragm's fibers pulls the lower ribs cephalad, so displacing them laterally. As the lower ribs are elevated and simultaneously moved laterally, the sternum moves anteriorly and superiorly. Thus, by the action of the the vertical, diaphragm alone. transverse and anteroposterior diameters of the thoracic cavity are increased. If a greater volume of breath is needed, other muscles may be recruited.



- Abdominal muscle tone provides correct positioning of the abdominal viscera so that appropriate central tendon resistance can occur. If the viscera are displaced or abdominal tone is weak and resistance is reduced, lower rib elevation will not occur and volume of air intake will be reduced.
- The posterior rib articulations allow rotation during breathing, while the anterior cartilaginous elements store the torsional energy produced by this rotation. The ribs behave like tension rods and elastically recoil to their previous position when the muscles relax. These elastic elements reduce with age and may also be lessened by intercostal muscular tension (see tests for rib restrictions).
- Rib articulations, thoracic vertebral positions and myofascial elements must all be functional for normal breathing to occur. Dysfunctional elements may reduce the range of mobility and therefore lung capacity.
- Whereas inhalation requires muscular effort, exhalation is primarily a passive, elastic recoil mechanism provided by the tensional elements of the

ribs (see above), the elastic recoil of the lung tissues and pleura and abdominal pressure created directly by the viscera and the muscles of the abdomen.

- Being a fluid-filled container, the abdominal cavity is incompressible as long as the abdominal muscles and the perineum are contracted (Lewit 1999).
- The alternating positive and negative pressures of the thoracic and abdominal cavities participate in the processes of inhalation and exhalation, as well as in fluid mechanics, assisting in venous return and lymphatic flow.
- Gravity directly influences diaphragmatic, and therefore respiratory, function. When the individual is upright, diaphragmatic excursion has to overcome gravitational forces. When lying down, respiratory function is easier as this demand is reduced or absent. The excursion of the diaphragm is limited during sitting, especially if slumped, because of relaxation of the abdominal muscles.
- When the integrity of the pleural cavity is lost, whether by puncture of its elastic membrane or damage to its hard casing (broken ribs), inflating volume of the lung(s) will decrease, resulting in respiratory distress.
- The intercostal muscles, while participating in inhalation (external intercostals) and exhalation (internal intercostals), are also responsible for enhancing the stability of the chest wall, so preventing its inward movement during inspiration.



- Quadratus lumborum acts to fix the 12th rib, so offering a firm attachment for the diaphragm. If QL is weak, as it may be in certain individuals, this stability is lost (Norris 1999).
- Bronchial obstruction, pleural inflammation, liver or intestinal encroachment and ensuing pressure against the diaphragm, as well as phrenic nerve paralysis, are some of the pathologies which will interfere with diaphragmatic and respiratory efficiency.

Since the volume of the lungs is determined by the vertical, transverse and anteroposterior diameters of the thoracic cavity, the ability to produce movements that increase any of these three diameters (without reducing the others) should increase respiratory capacity under normal circumstances (intact pleura, etc.). While simple steps, such as improving upright posture, may influence volume, treatment of the associated musculature, coupled with breathing exercises, may substantially enhance breathing function.

- Vertical dimension is increased by the actions of diaphragm and scalenes.
- Transverse dimension (bucket handle action) is increased with the elevation and rotation of the lower ribs diaphragm, external intercostals, levatores costarum.
- Elevation of the sternum (pump handle action) is provided by upward pressure due to spreading of the ribs and the action of SCM and scalenes.



The muscles associated with respiration function can be grouped as either inspiratory or expiratory and are either primary in that capacity or provide accessory support. It should be kept in mind that the role which these muscles might play in inhibiting respiratory function (due to trigger points, ischemia, etc.) has not yet been clearly established and that their overload, due to dysfunctional breathing patterns, is likely to impact on cervical, shoulder, lower back and other body regions.

- The primary inspirational muscles are the diaphragm, the more lateral external intercostals, parasternal internal intercostals, scalene group and the levator costarum, with the diaphragm providing 70–80% of the inhalation force (Simons et al 1999).
- These muscles are supported by the accessory muscles during increased demand (or dysfunctional breathing patterns): SCM, upper trapezius, pectoralis major and minor, serratus anterior, latissimus dorsi, serratus posterior superior, iliocostalis thoracis, subclavius and omohyoid (Kapandji 1974, Simons et al 1999).

Since expiration is primarily an elastic response of the lungs, pleura and 'torsion rod' elements of the ribs, all muscles of expiration could be considered to be accessory muscles as they are recruited only during increased demand. They include internal intercostals, abdominal muscles, transverse thoracis and subcostales. With increased demand, iliocostalis lumborum, quadratus lumborum, serratus posterior inferior and latissimus dorsi may support expiration, including during the high demands of speech, coughing, sneezing, singing and other special functions associated with the breath.

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