Altered Breathing Patterns in Chronic Low Back Pain Patients

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The Study

Title: "Altered Breathing Patterns During Lumbopelvic Motor Control Tests in Chronic Low Back Pain: A Case-Control Study."

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Background Information

Chronic low back pain (CLBP) can be debilitating, often requiring multimodal intervention including manual therapy (manipulation, soft-tissue therapy), general and specific exercise modalities, acupuncture, tissue-sparing strategies, ergonomic advice, and so on. One aspect that is frequently ignored (I admit that I am often guilty of this) is the assessment and rehabilitation of breathing patterns.

Breathing is a fundamental, automatic part of our daily lives, yet very few of us ever consciously pay attention to how we breathe, let alone how our patients breathe. There is an interesting and growing body of evidence emphasizing the importance of the mind-body connection, as well as relaxation and stress management, as they pertain to chronic pain management – breathing assessment connects nicely to these concepts.
Breathing also relates to spinal stability; the diaphragm represents the top of the "muscular cylinder" that supports and moves the lumbar spine (the bottom being the pelvic floor). The diaphragm is responsible for many tasks: regulating intra-abdominal pressure, contributing to lumbopelvic stability, and of course, maintaining ventilation. In healthy subjects, the diaphragm has no trouble performing this multifaceted role.

Further, during pain syndromes or after trauma, it has been established that the strategies employed by the central nervous system to control trunk muscles may be altered. For example, a previous study suggested that those with sacroiliac joint pain displayed impaired kinematics of the diaphragm and pelvic floor, which are thought to be neurologically connected. Commonly, the observed impairments include patients "holding their breath" while they perform dynamic tasks.

This constant contraction of the diaphragm during breath holding likely represents a compensatory strategy to increase lumbopelvic stability. (I would suggest that they may be "unable to breath" for fear of becoming unstable?) Such impairments have been reversed after motor control rehabilitation programs, suggesting that this is a parameter that we can positively affect. Although the exact relationship has not been delineated, there seems to be a correlation between postural/movement control and respiratory function.

The purpose of this study was to evaluate the breathing patterns in CLBP patients and healthy subjects in both standing and supine positions, under three different conditions: spontaneous breathing, deep breathing, and breathing during the performance of three different motor control tasks.

**Study Methods**

Ten healthy subjects and 10 patients with CLBP participated in this case-control study. All CLBP patients were between the ages of 18-65 with insidious-onset LBP of greater than three months duration that was limiting their function. They had to receive a diagnosis of nonspecific mechanical LBP from a physician.
Controls had no previous history of LBP or other serious disease.

Breathing patterns were assessed by one clinician both visually and via palpation (the clinician was blinded as to whether the subject was in the control or CLBP group). Costodiaphragmatic breathing, defined as a displacement of the rib cage in cranial, lateral outward and ventral directions, and outward abdominal movement reversed on expiration, was considered the ideal pattern. Paradoxical breathing, upper-costal breathing, mixed patterns, and breath holding were all considered as impairments – these patterns have been shown to adversely influence alveolar ventilation.

Breathing patterns were assessed in both standing supine positions under the following conditions: spontaneous breathing – no specific instructions given; deep breathing – patients were instructed to take a "deep breath"; and during the performance of these three motor control tasks:

1. **Active straight-leg raise** (ASLR): With the patient lying supine, one leg at a time was lifted 20 cm off the table and held for 10 seconds.
2. **Knee-lift abdominal test** (KLAT): With the patient supine in crook-lying position, they were instructed to lift one foot off the table with both the hip and knee in 90 degrees of flexion while keeping the lumbar spine stable.
3. **Bent-knee fall out** (BKFO): With the patient supine in crook-lying position with one leg straight and one bent, they lowered the bent leg to approximately 45 degrees of abduction/lateral rotation while keeping the foot against the straight leg – then they returned to the starting position.

During all motor tasks and all supine conditions, a pressure biofeedback unit was placed under the lumbar spine (excessive pressure changes indicate movement in the lumbar region, normally a flattening of the lumbar lordosis). Subjects were not informed that breathing patterns were being evaluated to avoid potential influence. After each test, all subjects completed a **visual analogue scale** (VAS) to assess the severity of their LBP, and a BORG exertion scale.

**Pertinent Results**

- At rest, no significant differences were noted between healthy controls and CLBP patients in the supine position ($p > 0.05$).
- In a standing position, there were no differences with quiet breathing, but differences were noted during deep inspiration ($p < 0.05$).
All subjects were able to complete the motor control tests, but more altered breathing patterns were noted in CLBP patients during the motor control tasks ($p = 0.01$) compared to healthy subjects.

Changes in breathing patterns during motor control tasks were not related to LBP severity ($p > 0.01$), but were related to dysfunctions in motor control ($p = 0.01$).

None of the healthy subjects changed their patterns during the ASLR or BKFO (see below), while 5/10 and 6/10 CLBP patients, respectively, altered their patterns.

Pressure biofeedback unit (PBU) measures were altered in CLBP patients compared to controls.

**Study Strengths/Weaknesses**

This was a simple study with a few limitations that should be kept in mind when interpreting and applying the results:

- No reliability assessment was made by the clinician who assessed the breathing patterns – clearly, intra-observer variation could have occurred. (It is worth noting that previous studies indicate that inter-observer reliability is fair to moderate for breathing assessment.) Future studies should include more than one assessor.

- As mentioned, only visual inspection and manual palpation were performed during breathing assessment – to date, there is no gold standard for assessing this variable.

- The use of EMG could have greatly strengthened the results of this study, and should be included in future research.

- This study design cannot establish cause and effect – prospective trials are necessary for this.

**Clinical Application & Conclusions**

This study is unique, representing the only (to my knowledge) study to date that has investigated breathing patterns in LBP patients during motor control tasks. Although preliminary, the results of this study suggest that compared to healthy subjects, approximately 5-60 percent of CLBP patients demonstrate altered motor control strategies, specifically relating to breathing patterns, during simple motor control tasks that challenge spinal stability. Further, these breathing pattern impairments were not related to back pain severity.

Based on these results, it is plausible that these patients may use their diaphragm to supplement stability at the expense of "normal" breathing patterns. It is now accepted that most (if not all) muscles of the abdomen,
pelvic floor and lumbar spine contribute to spinal stability, and the diaphragm is included in this group. The interplay among these muscles as they attempt to stabilize the spine and pelvis while maintaining ventilation is still not completely clear – but progress is being made. It is worth noting here that this study did not record EMG activity in the diaphragm – this could be an improvement to keep in mind for future studies.

Until further research is conducted, prudent clinicians should at the very least begin to observe their patients’ breathing patterns. There are simple exercises and activities that can be employed to improve breathing, all of which can be incorporated easily into general spinal stability rehabilitation programs. Some examples include quadruped abdominal expansion breathing, Brugger postural relief exercise with emphasis on elevating and expanding the rib cage during inspiration, or even simply placing a small book on the chest and practicing deep inspiration (instruct the patient to “raise the book with your chest as you breathe in”). The ideal rehabilitation methods for dysfunctional breathing also require further study.

Additional References


Dr. Shawn Thistle is founder and president of the Research Review Service (www.researchreviewservice.com), from which all content for this and other articles by Dr. Thistle is derived. Research Review Service posts approximately 60 reviews like this each year and currently has a database of more than 250 reviews. Dr. Thistle graduated from the Canadian Memorial Chiropractic College, where he has been a faculty member since 2004. He holds an honours degree in kinesiology (McMaster) and a certificate in contemporary medical acupuncture. He is also fully ART-certified and is a certified strength and conditioning specialist. Dr. Thistle practices full time at Shape Health and Wellness Centre in Toronto.