

Chapter 8

Prevention and rehabilitation: core stability and breathing retraining



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The requirements for preventing low back injury have been summarized by Liebenson (2000a) as:

- 'Conditioning or adaptation', i.e. avoiding undue stress and improvement of flexibility and stability, leading to greater tolerance to strain
- He also suggests that there is evidence that too little (or infrequent) tissue stress can be damaging, as can too much (or too frequent, or prolonged) exposure to biomechanical stress. In other words, deconditioning through inactivity provokes dysfunction just as efficiently as does excessive and inappropriate biomechanical stress
- McGill (1998) suggests that a neutral spine should be used in all loading tasks to reduce the chance of injury. He also warns that it is important to avoid bending and stooping to lift
- Additional common sense methods are suggested, including rotation of tasks to vary loads, introduction of frequent short rest breaks, and maintaining loads close to the spine when lifting (McGill & Norman 1993)
- Particular caution is needed at vulnerable times (for the spine), after long periods of rest, for example early morning soon after rising from bed, and after sitting for 30 min or more (Adams et al 1987).

CORE STABILIZATION ASSESSMENT AND EXERCISES

Both the abdominal musculature and the trunk extensors are important in restoring stability to the spine (Cholewicki & McGill 1996, Liebenson 2000b).

A variety of exercises have been developed to achieve core stability involving the corset of muscles which surround, stabilize and, to an extent, move the lumbar spine, such as transversus abdominis, the abdominal oblique muscles, diaphragm, erector spinae, multifidi, etc.

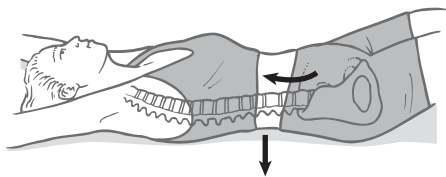


Figure 8.1 'Neutral spine' coordination test. (Reproduced with permission from *Journal of Bodywork and Movement Therapies* 2000; 4(2):110.)

Basic 'dead-bug' exercise/test

A 'coordination' test that assists in evaluating the patient's ability to maintain the lumbar spine in a steady state during different degrees of loading has been developed. This 'dead-bug' exercise (Richardson et al 1999) easily becomes a core stability exercise if repeated regularly.

- The patient adopts a supine hook-lying position, with a pressure (bio)feedback pad (inflatable cushion attached to pressure gauge, similar to the unit used to test blood pressure) under the lumbar spine
- The inflated pad registers the degree of pressure being applied by the lumbar spine towards the floor. The objective is to maintain the pressure throughout the performance of various degrees of activity, all the while maintaining normal breathing (Figs 8.1, 8.2A–G)
- First, the patient is asked to hollow the back, bringing the umbilicus towards the spine/floor, so initiating co-contraction of transversus abdominis and multifidus, and to maintain this position as increasing degrees of load are applied by either:
 - 1 Gradually straightening one leg by sliding the heel along the floor: This causes the hip flexors to work eccentrically and, if this overrides the stability of the pelvis, it will tilt. Therefore, if there is a change (reduction) in pressure on the gauge or if a pelvic tilting/increased lumbar lordosis is observed or palpated before the leg is fully extended, this suggests *deep abdominal muscular insufficiency* involving transversus abdominis and internal obliques.
 - 2 Once the basic stabilization exercise of hollowing the abdomen – while maintaining pressure to the floor – is achievable *without the breath being held*, more advanced stabilization exercises may be introduced.
 - 3 These involve, in a graduated way, introducing variations on lower limb or trunk loading, and

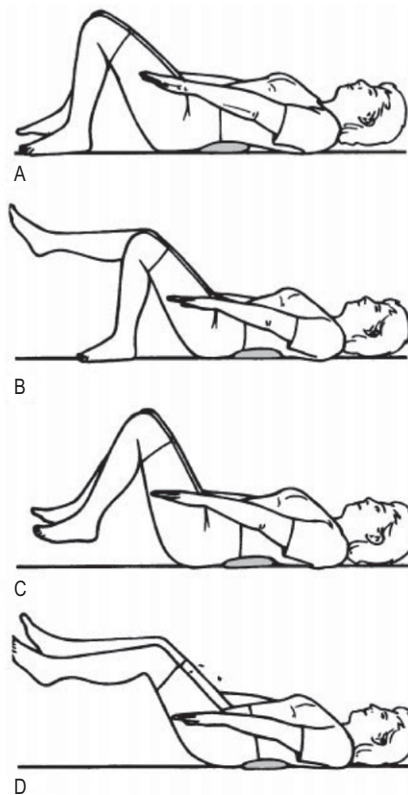


Figure 8.2 (A–D) Neutral spine coordination test with added load. (Reproduced with permission from *Journal of Bodywork and Movement Therapies* 2000; 4(2):111.)

are performed while maintaining the lumbar spine pressed towards the floor (confirmed by a relatively constant reading on the pressure gauge or by observation). See examples of exercises later in this chapter for an evolution of increasing difficulty.

- 4 These graduated stabilization exercises involve the adoption by the patient of positions which progress as illustrated in Figure 8.2A–G.
- 5 As well as abdominal tone and stability, it is necessary to encourage extensor function to be optimal and coordinated with abdominal muscle function. The 'superman' pose (below) encourages this.

Warm-up first

To encourage spinal extensor tone and strength, in order to encourage spinal and 'core' stability, simple home exercise protocols are suggested.

The exercises described below, for encouraging stability, are safe. Ideally, these should be performed after warming-up and not immediately in the morning or after prolonged sitting (Green et al 2002).

Note: Ideally, whoever teaches these to patients should be trained in exercise physiology, or be a Pilates trainer, or equivalent.

Abdominal bracing

This involves co-activation of muscles 360° around the lumbar spine during performance of all/any of these exercises. It involves a light contraction, using no more than 10% of available strength (the amount of contractile effort that you would use if you were being tickled) (McGill 2002, McGill et al 2003).

It is absolutely essential to the effectiveness of this that the person performing the exercise does not hold the breath while bracing the trunk muscles.

The *cat-camel* exercise is an ideal way to warm-up the spine. It is not a stretch but teaches the spine and associated muscles to move in a coordinated way.

Instructions to patient:

- Kneel on a carpeted floor so that the weight is taken on your flexed knees and elbows
- Your thighs should be at right-angles to the floor
- To focus on mobilizing the upper thoracic spine, have the elbows level with your ears
- Breathe in deeply and arch your back upward as far as is possible, allowing your head to drop towards the floor, rounding the thoracic spine.
- Try to imagine that, as this is being done, your navel is being pulled upwards to meet the spine, thus effectively increasing the degree of arching (and increasing stability) (Fig. 8.3A)
- After holding your breath for 5 s, release it and simultaneously start to lower your thoracic spine towards the floor, while also raising the head (Fig. 8.3B)
- This effectively flattens and depresses your thoracic spine
- Hold this position for 5 s before inhaling and arching again

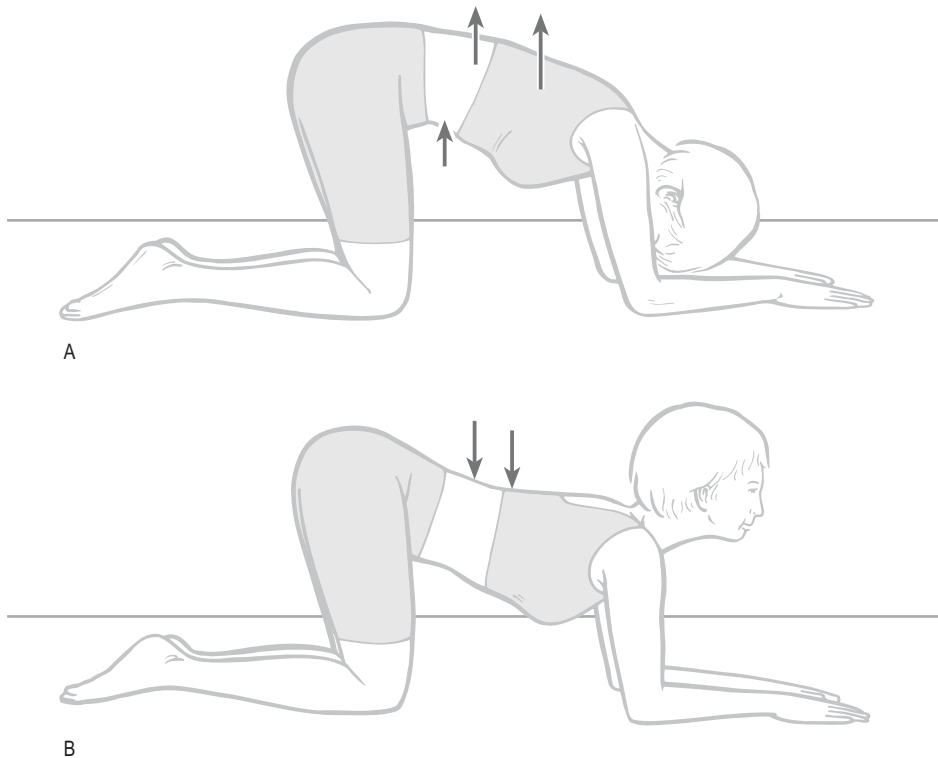


Figure 8.3 Positions for spinal mobilization. (A) Camel (B) Cat. (From Chaitow 2003.)

- Repeat the 'cat/camel' exercise five or six times in each direction
- In order to localize the effect of this mobilization at the junction of the lumbar and thoracic spine, your hands – rather than the elbows – should be used for floor support
- All other aspects of the procedure remain the same.

Performing this mobilizing sequence is ideal before doing core stability exercises.

The '**superman**' pose, also known as the 'quadruped leg reach', teaches control of a 'neutral' spine during periods of limb motion (Fig. 8.4).

Instructions to patient:

- Kneel on all fours, balanced on your hands and lower legs, spine straight
- Introduce the braced abdomen contraction
- Extend one leg behind you (you are now balanced on two hands and one lower leg), gradually raising it until it is level with your waist
- Hold this for 5 s
- Maintain your 'braced abdomen' and a straight spine throughout, and breathe normally and slowly
- Lower the leg and repeat until you start to find it difficult
- Now do precisely same with the other leg raised until you start to feel difficulty
- When you can perform each of these 12 times, add the next progression, which involves raising one leg as above, as well as *the opposite* arm (a sort of 'superman' position)
- Once you can raise the right arm and left leg, as well as the left arm and right leg, 12 times, for 5 s each, while maintaining a 'braced abdomen', you will be sure to have toned your multifidi to an excellent state of endurance.

The key to performing this is avoiding any twist of the spine, or lumbar hyperextension.

More advanced stability exercises

Motor control or stability training requires an emphasis on endurance rather than strength (Richardson et al

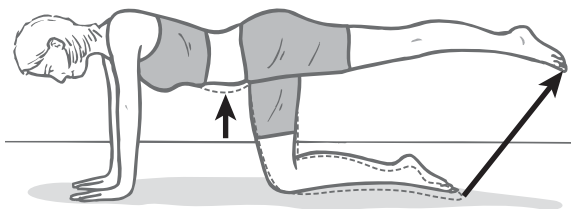


Figure 8.4 Quadruped leg reach. (After Liebenson 2004.)

1999). These exercises should be repeated (Brügger 1960), eight, then six times. Each exercise should be performed slowly with a prolonged isometric hold time.

They should be performed twice a day for up to 3 months to achieve optimal results. Learning to coordinate breathing while simultaneously bracing is one of the key skills to be learned. The *side bridge* is an excellent, safe way to train the lateral oblique musculature (for side bridge on knees, see Fig. 8.5).

Instructions to patient:

- Lie on your side with legs flexed at the knee, one on the other
- Use the forearm that is resting on the floor to raise you sideways until your hips are off the floor, and your body is in a straight line (i.e. no sagging)
- Your free arm should either lie alongside your trunk, or be crossed over the chest so that the hand can rest on the opposite shoulder
- Keep breathing normally all the time
- Normal holding time for young healthy individuals (early 20s) should be 60 s for males, and 40 s for females
- Alternatively, see whether you can perform 10 repetitions of raising yourself into this position, and holding for 5 s before lowering and repeating.

The abdominals can be trained with the *supported dead bug*, where one foot stays on the floor as the other is moved/raised, progressing (when this is easy to

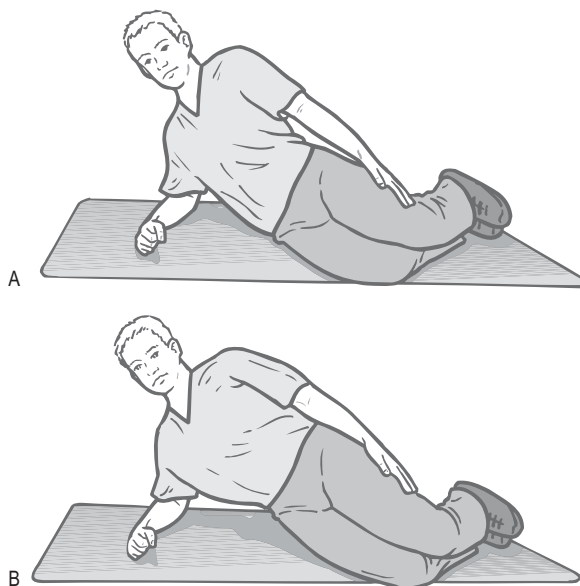


Figure 8.5 Side bridge on knees. (A) Start position. (B) Final position. (After Liebenson 2004.)

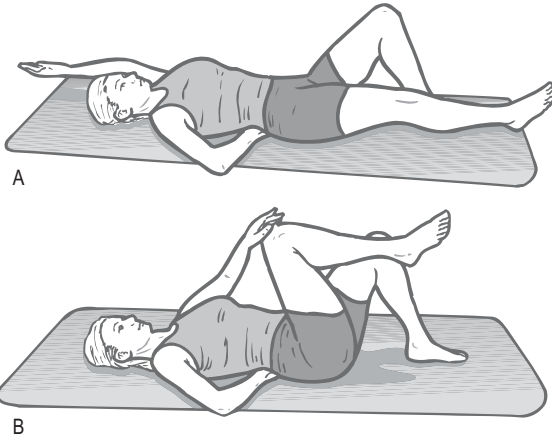


Figure 8.6 Dead bug supported. (A) Start position. (B) Final position (After Liebenson 2004.)

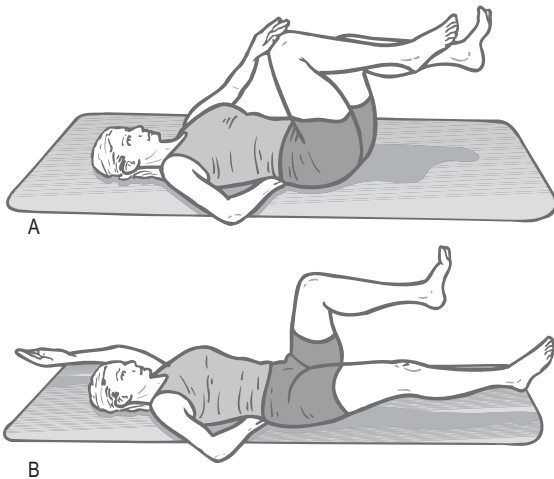


Figure 8.7 Dead bug unsupported. (A) Start position. (B) Final position. (After Liebenson 2004.)

perform) to *unsupported dead-bug* where neither foot is on the floor (Figs 8.6, 8.7).

A further progression involves a *partial curl-up* with spinal neutral control (slight lordosis).

Instructions to patient:

- Lie on your back, hips bent to 45°, knees bent to 90°, feet flat on the floor (or with one knee flexed and the other leg straight) and with hands behind your back, elbows touching the floor (Fig. 8.8)
- Brace your core muscles by bearing down slightly, without holding your breath
- Slowly raise your head and shoulders from the floor, and then slowly round your back as you curl up further

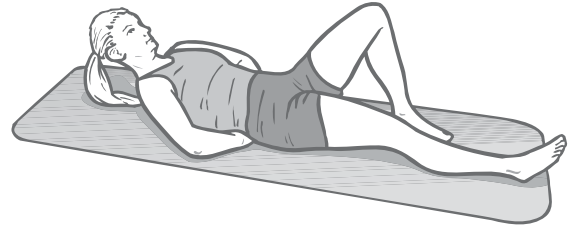


Figure 8.8 Trunk curl-up. (After Liebenson 2004.)

- Stay in this position as you breathe in and out slowly, twice
- Be careful not to poke your chin forwards, and keep your elbows on the floor
- If you feel any strain in the back when doing this, stop, lie down again, brace the abdomen against the spine and start again
- Slowly roll down again, without arching your back and repeat for a total of 12 times
- When this is easy to perform, do the same exercise but when you have introduced the curl, lift your elbows from the floor.

Brügger's relief position

Brügger's relief position for postural and breathing rehabilitation (Brügger 1960, Lewit 1999) reverses many of the stresses caused during long periods of sitting, facilitating muscles which tend to inhibition, and inhibiting muscles which tend to shortening (Fig. 8.9).

These are the instructions that should be given to the patient:

- 1 Sit close to the edge of a chair ('perch'), with your arms hanging down, palms facing forward
- 2 Place your feet directly below knees, which are apart and lower than the hips
- 3 Your feet should be turned slightly outward, with ankles directly below the knees
- 4 As you slowly exhale, let your pelvis roll back and allow the spine to fall into 'C'-shape
- 5 The neck and head should follow the spinal curve
- 6 As you inhale, roll your pelvis slightly forward to produce a *small* degree of arching of the lower back
- 7 As the spine slightly extends, easing the sternum slightly forward and up, allow your neck, head and eyes to follow the spinal curve, chin in
- 8 At same time, turn your arms outward, until the thumbs face slightly backwards
- 9 Exhale as you repeat the process, slightly rounding your back, and inhale as you slightly arch your back and turn the arms outward.

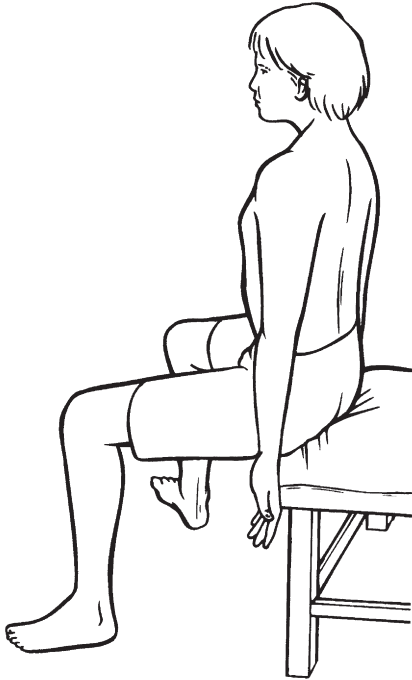


Figure 8.9 The Brügger relief position. (After Liebenson, from Chaitow 2003.)

Repeat the entire process several times a day at least and whenever you sense muscle tension, or feel a need for deeper breathing.

BREATHING REHABILITATION

It has been established that disturbed breathing patterns have a negative effect on core stability, motor control, balance and pain perception (Balaban & Thayer 2001, Hodges & Richardson 1999). Learning better breathing can enhance better spinal function (the diaphragm is a major part of the spinal support system) (Loeppky et al 2001).

Breathing pattern disorders affect large numbers of people, mainly female (Hodges et al 2001) – partly because of progesterone, a respiratory accelerator it is thought – and evidence suggests that a combination of retraining exercises, education and appropriate bodywork (see suggestions below) can help normalize the majority of such problems, over a period of months (Aust & Fischer 1997, Han et al 1996).

Retraining essentials

Breathing retraining requires a combination of elements that also seem to operate in postural retraining (such as the Alexander technique):

- *Understanding* the processes: a cognitive, intellectual, awareness of the mechanisms and issues involved in breathing pattern disorders
- Retraining exercises that include aspects that operate *subcortically*, allowing replacement of currently habituated patterns with more appropriate ones
- Biomechanical *structural modifications* that remove obstacles to desirable and necessary functional changes
- *Time* for these elements to merge and become incorporated into moment-to-moment use patterns.

Pursed lip breathing

Pursed lip breathing (Faling 1995, Tisp et al 1986), combined with diaphragmatic breathing, enhances pulmonary efficiency.

- The patient is seated or supine with the dominant hand on the abdomen and the other hand on the chest
- The patient is asked to breathe in through the nose and out through the mouth, with pursed lips, ensuring diaphragmatic involvement by means of movement of the abdomen against the hand on inhalation
- Exhalation through the pursed lips is performed slowly, and has been shown to relieve dyspnea, slow the respiratory rate, increase tidal volume, and to help restore diaphragmatic function
- Thirty or more cycles should be repeated morning and evening as part of the anti-arousal exercise, see below.

Anti-arousal breathing

Patient's instructions for anti-arousal breathing (Cappo & Holmes 1984, Grossman et al 1985) are as follows:

- 1 Sit or recline comfortably, and exhale slowly and fully *through pursed lips*
- 2 Imagine a candle flame about 6 in from your mouth and blow a thin stream of air at it
- 3 As you exhale, count silently to establish the length of the outbreath
- 4 When you have exhaled fully, without strain, pause for a count of 'one', then inhale through the nose. Full exhalation creates a 'coiled spring', making inhalation easier
- 5 Count to yourself to establish how long your in-breath lasts
- 6 Without pausing to hold the breath, exhale slowly and fully, through pursed lips, blowing the air in a thin stream, and pause for a count of one
- 7 Repeat the inhalation and exhalation for not less than 30 cycles (morning and evening)

- 8 After some weeks of daily practice, you should achieve an inhalation phase which lasts 2–3 s, and an exhalation phase of 6–7 s, without strain
- 9 Exhalation should always be slow and continuous, there is little value in breathing the air out in 2 s and then simply waiting until the count reaches eight before inhaling again
- 10 Practice twice daily, and repeat the exercise for a few minutes (6 cycles takes about 1 min) every hour if you feel anxious, or when stress or pain increases
- 11 Practice on waking, and before bedtime, and if at all possible before meals
- 12 Always incorporate methods that reduce over-activity of neck/shoulder muscles, as described below.

Inhibiting shoulder rise during breathing retraining

When applying breathing retraining it is important to teach tactics that restrict over-activity of the accessory breathing muscles, in order to reduce 'shoulder rising' on inhalation. The methods might include:

- Pushing elbows/forearms onto arms of the chair, on inhalation (Fig. 8.10A)
- Arms behind back, grasping wrist with other hand and pulling down, on inhalation (Fig. 8.10B)
- Reclining with hands behind head ('beach pose') to open chest and reduce shoulder movement (Fig. 8.10C)
- Interlocking hands on lap and applying finger-pad pressure to dorsum of hands, on inhalation, to inhibit shoulder movement
- Adopting Brügger's relief position throughout breathing exercises (see above).

Suggested manual treatment sequence for breathing pattern disorder (BPD) problems

Treatment and retraining commonly involves 12 weekly sessions, followed by treatment sessions every 2–3 weeks, to approximately 6 months.

An educational component should be included at each session.

First two sessions (not less than weekly)

- Upper fixators/accessory breathing muscles (upper trapezii, levator, scalenes/SCS, pectorals, latissimus dorsi) release/stretch, plus attention to trigger points

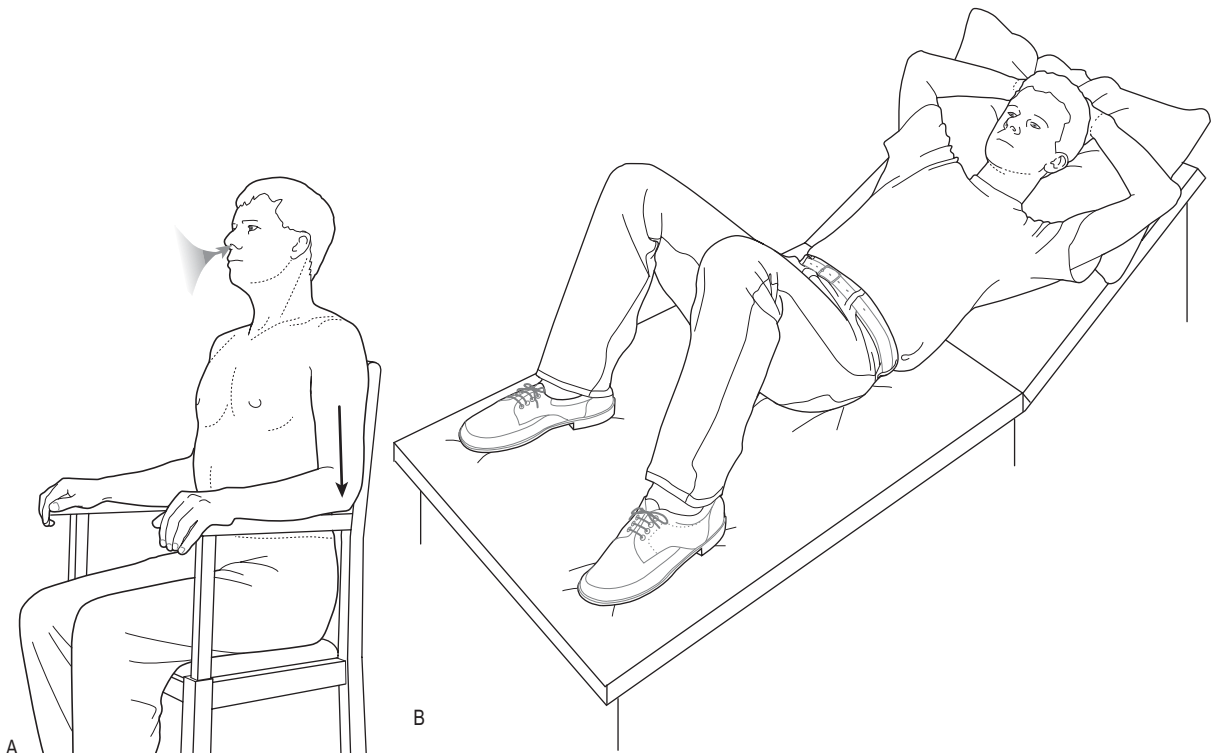


Figure 8.10 (A) Restricting shoulder movement by pressing forearms downward on inhalation. (B) 'Beach pose' for breathing retraining (after Bradley).

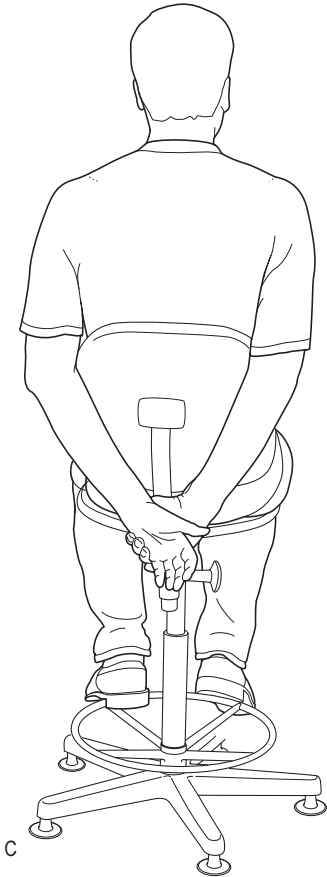


Figure 8.10 (C) Seated with arms behind back allows restriction of shoulder movement on inhalation (after Bradley). (From Chaitow 2003.)

- Diaphragm area (anterior intercostals, sternum, abdominal attachments costal margin, quadratus lumborum, psoas) release/stretch, plus attention to trigger points
- *Retraining*: pursed lip breathing/control pause/restricting tendency for shoulder rise with upper chest pattern.

Sessions 3 and 4 (weeks)

- As above, plus mobilization of thoracic spine and rib articulations (plus lymphatic pump)
- Address fascial and osseous links (cranial, pelvic, lower extremity)
- *Retraining*: anti-arousal breathing pattern, plus specific relaxation methods (autogenics, visualization, meditation, etc.), stress management.

Sessions 5–12 (weeks)

- As above, plus other body influences (ergonomics, posture)
- *Retraining*: additional exercises as appropriate.

Weeks 13–26

- Review and treat residual dysfunctional patterns/tissues
- Plus, as indicated: nutrition, counseling, stress management.

Adjunctive methods used throughout as applicable: hydrotherapy, tai chi, yoga, Pilates, massage, acupuncture.

KEY POINTS

- Core stability is a central element of prevention and rehabilitation
- All core stability exercises ('dead-bug', 'superman', 'side-bridge', etc.) should be performed with abdominal and low back muscles 'braced', using no more than 10% of muscle strength
- During performance of all core stability exercises with braced trunk muscles, it is essential that the individual maintains normal breathing, and not a held breath
- A warm-up is helpful before performance of core stability exercises (e.g. 'cat-camel')
- Brügger's relief position offers an excellent way of easing stressed postural muscles and encouraging better breathing
- Breathing rehabilitation is a key aspect of back rehabilitation
- Postural and/or breathing rehabilitation take time: 3–6 months, as old habits are altered
- Breathing rehabilitation involves a combination of breathing exercises (e.g. 'pursed-lip' breathing) as well as reduction of excessive accessory muscle activity, plus bodywork to mobilize the structures of the breathing mechanism
- The bodywork element of breathing retraining focuses on mobilization of the thorax (ribs, etc.) as well as releasing and stretching (where appropriate) shortened muscles associated with breathing, such as upper fixators of the shoulder, diaphragm, psoas and quadratus lumborum
- Trigger point deactivation may also be required.

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