Chapter 4

Low back pain: palpation, observation and assessment approaches

CHAPTER CONTENTS

In this chapter, as explained in Chapter 1, we are not discussing those forms of back pain where pathology or structural anomalies are the causes (see Ch. 2).

The most common (97%) reported (Andersson 1997) 'causes' of low back pain (see Box 1.1) are:

- Heavy physical work
- Bending
- Twisting
- Lifting
- Pulling and pushing
- Repetitive work patterns
- Static postures
- Vibrations.

ADAPTATION

Almost all non-specific back pain arises from a background of failed adaptation. In order for the spine to remain flexible, stable and pain free, a number of basic requirements need to exist.

Liebenson (2000a) has pointed out, 'Spinal injury occurs when stress on a tissue exceeds the tissue's tolerance. It is not so much excessive load as too much motion which is the primary mechanism of injury. Spinal injury and recovery depends on a number of factors such as avoiding repetitive motion, end-range loading, and early morning spinal stress. Also important is improving muscular endurance'.

Canadian researcher, Stuart McGill (2004) describes the components that are required: 'The muscular and motor system must satisfy the requirements to sustain postures, create movements, brace against sudden motion or unexpected forces, build pressure, and assist challenged breathing, all the while ensuring sufficient stability'.

The lumbar spine, in particular, requires maximum stability and flexibility, if back pain and dysfunction are to be avoided.

MUSCLE FATIGUE

How tired muscles are is important. Fatigue is the end result of poor stamina, when muscles are unable to cope with whatever demands are being made.

Repetitive tasks such as bending and lifting gradually give way to stooping and decreased postural stability, as fatigue increases (Cholewicki et al 1997).

Liebenson (2000b) also emphasizes how important it is for the extensor muscles to have the quality of 'endurance', pointing out that the more easily fatigued the back muscles are, the more likely it is for back pain to commence.

THE KEY FEATURES NEEDED TO AVOID BACK PROBLEMS

Clearly, if the muscles of the back, pelvis and lower limbs are strong, balanced and supple, ligaments supply appropriate support to the joints, intervertebral discs are in good repair, and the motor supply to the soft tissues is optimal, most stress factors would be handled adequately, and no back pain would result from overuse and misuse.

But if some muscles are shortened, hypertonic and/or contain active trigger points, with other muscles inhibited and weak; or if neural input is less than optimal, and the normal firing sequence of muscles is uncoordinated, the load (bending, lifting, etc.) may easily overwhelm pelvic and spinal stabilizing efforts, allowing local injury to occur, with pain almost inevitably following.

There is then a failure of adaptation.

In order to offer appropriate care to a painful back, it is important to be able to evaluate shortness and weakness in those muscles involved in providing flexibility and stability, and to be able to identify trigger points in them.

QUESTIONS AND ANSWERS

The most important of these supportive contributory factors will be discussed in this chapter, as will some basic ways of assessing whether they are operating normally.

- Is this person's spine flexible and stable?
- Are the muscles that help to maintain stability and flexibility in good working order; toned, supple and free of local changes (such as trigger points) that could interfere with normal function?

Which structures are involved?

Paris (1997) has noted: 'In back management, … medical diagnosis is unable to find or agree on most causes of low back pain … the reason for this is that physicians are trained in disease, not in detecting dysfunctions, and dysfunctions are usually multiple rather than singular'.

Back pain seems to be largely caused by an accumulation of dysfunctions, each contributing a noxious stimulus, which, when a threshold is reached, are first interpreted as discomfort and eventually as pain, resulting in the patient seeking assistance.

Paris also suggests that we move away from single cause thinking, but instead try to decide on which structures are involved.

Awareness of the structures involved in back pain (muscle, joint, ligament, etc.), as well as the habits and/or events which have loaded (stressed) them, allows for the use of helpful prevention, therapeutic and rehabilitation interventions. This way of thinking is in line with research (Selye 1956) into stress that has shown that multiple minor stressors have the same effect as one major stress event (Fig. 4.1).

What are the 'minor' signs and features of dysfunction?

This message is of great value to us because it emphasizes the need to look for as many 'minor' signs and features of dysfunction as we can, by observation,

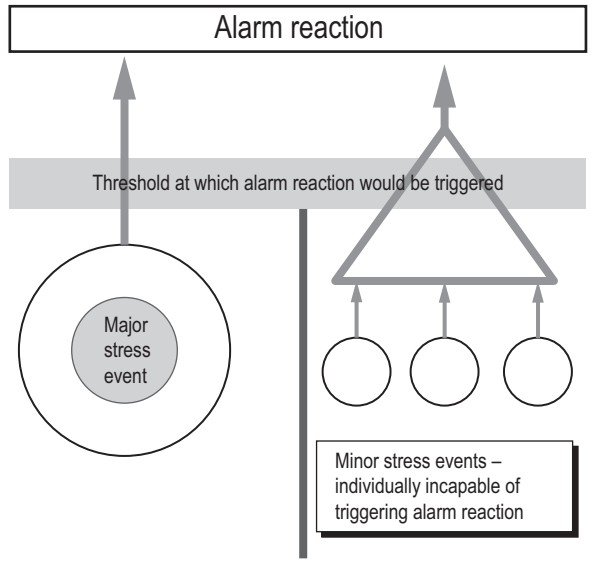

Figure 4.1 A combination of minor stresses, each incapable of triggering an alarm reaction in the general adaptation syndrome can, when combined or sustained, produce sufficient adaptive demand to initiate that alarm. In fibromyalgia a combination of major and minor biochemical, biomechanical and psychosocial stressors commonly seem to be simultaneously active. (From Chaitow 2003a.)

palpation and assessment, rather than seeking one single 'cause'.

- What's short?
- What's tight?
- What's contracted?
- What's restricted?
- What's weak?
- What's out of balance?
- What firing sequences are abnormal?
- What has happened, and/or what is the patient doing, to aggravate these changes?
- What can be done to help these changes to normalize?

Our task then is to reduce the adaptive burden that is making demands on the structures of the back and/or pelvis and, at the same time, to enhance the functional integrity of the back and pelvis so that the structures and tissues involved can better handle the abuses and misuses to which they are routinely subjected.

Soft tissue treatment methods, including massage and appropriate exercise, are major parts of the formula that will achieve the best therapeutic results.

FUNCTIONAL ASSESSMENTS

Janda (1982) and Lewit (1999) have developed a series of functional assessments that offer a quick and accurate 'snapshot' of how particular groups of muscles are behaving, and what this means in terms of their contribution to any pelvic or low back dysfunction.

There are three main functional assessments:

1. The prone hip extension test
2. The side-lying hip abduction test
3. Various strength tests, for example abdominal muscles and gluteals.

Hip extension test

- The patient lies prone and the therapist stands to the side, at waist level, with the cephalad hand spanning the lower lumbar musculature and assessing erector spinae activity, left and right (Fig. 4.2)
- The caudal hand is placed so that its heel lies on the gluteal muscle mass, with the fingertips resting on the hamstrings on the same side
- The person is asked to raise that leg into extension as the therapist assesses the firing sequence
- Which muscle fires (contracts) first?
- The normal activation sequence is (1) gluteus maximus, (2) hamstrings, followed by (3) contralateral erector spinae, and then (4) ipsilateral erector spinae

  Note: not all clinicians agree that this sequence is correct; some believe the hamstrings should fire first, or that there should be a simultaneous contraction of hamstrings and gluteus maximus, but all agree that the erector spinae should not contract first
- If the erectors on either side fire (contract) first, and take on the role of gluteus maximus as the prime

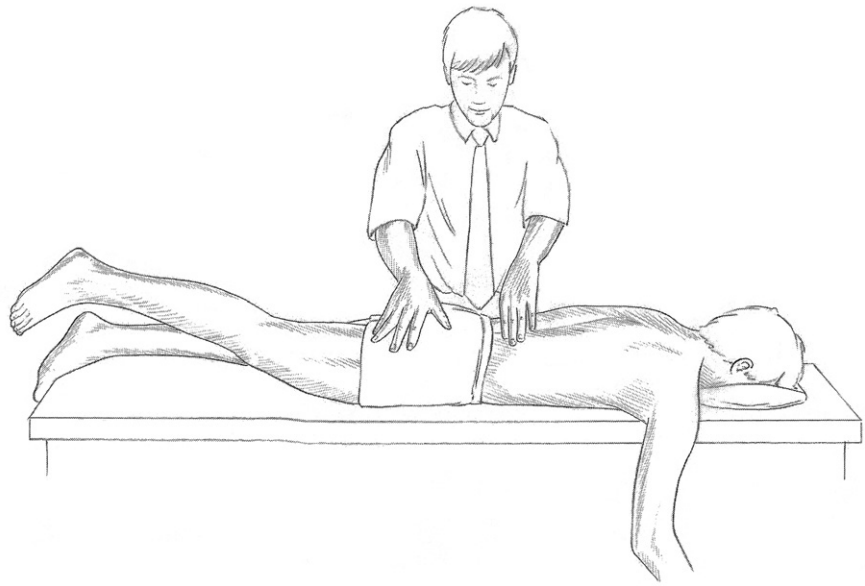

Figure 4.2 Hip extension test. The normal activation sequence is gluteus maximus, hamstrings, contralateral erector spinae, ipsilateral erector spinae.

movers in the task of extending the leg, they will become shortened and will further inhibit/weaken gluteus maximus
- Janda (1996) says, 'The poorest pattern occurs when the erector spinae on the ipsilateral side, or even the shoulder girdle muscles, initiate the movement and activation of gluteus maximus is weak and substantially delayed … the leg lift is achieved by pelvic forward tilt and hyperlordosis of the lumbar spine, which undoubtedly stresses this region'.

The therapeutic approach Stretch and normalize tone in the hamstrings and erector spinae muscles while suggesting exercises to help tone gluteus maximus (see Chs 7 and 8 in particular, for treatment details).

Hip abduction tests

1 Observation
- The patient lies on the side, ideally with head on a cushion, with the upper leg straight, in line with the trunk and the lower leg flexed at hip and knee, for balance
- You stand behind, at the level of the waist and observe (no hands-on yet) as your patient is asked to abduct the leg slowly
- Observe the area just above the crest of the pelvis – does it 'jump' at the outset of the abduction, or at least obviously activate before a 25° abduction has taken place? If so, the quadratus lumborum (QL) is overactive and probably short
- Have your patient relax completely and repeat the abduction which should be maintained for 10 s or so
- Does the leg 'drift' anteriorly during abduction? If so, the tensor fascia lata (TFL) is probably short
- Do the leg and foot turn outward (externally rotate)? If so, piriformis is probably short (Fig. 4.3A).

2 Palpation
- Now, still standing behind your side-lying patient, place one or two finger pads of your cephalad hand lightly on the tissues overlying quadratus lumborum, approximately 2 in (5 cm) lateral to the spinous process of L3 (Fig. 4.3B)
- Place your caudal hand so that the heel rests on gluteus medius and the finger pads on the TFL
- Assess the firing sequence of these muscles during hip abduction
- If the QL fires first (you will feel a strong twitch or 'jump' against your palpating fingers), it is overactive and short
- The ideal sequence is TFL followed by gluteus medius and finally QL (but not before about 20–25° abduction of the leg)
- If either TFL or QL are overactive (fire out of sequence), then they will have shortened, and the gluteus medius will be inhibited and weakened (Janda 1986).

The therapeutic approach Stretch and lengthen the shortened muscles, and find ways for the patient to tone and strengthen the gluteus medius. Ideally, any trigger point activity that is adding to hypertonicity, or creating inhibition, should be identified and removed (see Chs 7 and 8 in particular, for treatment details).

Tests for muscle weakness

The most important muscles that influence spinal and pelvic stability, when they are inhibited/weak, are the gluteus maximus and medius, as well as the internal obliques and transversus abdominis (Hodges & Richardson 1996). These deep abdominal muscles are among the most important of the trunk's stabilizing muscles; their antagonists are the thoracolumbar erector spinae.

The transversus abdominis is the first and most used of these, being activated with almost every movement of the trunk, legs or arms (Hodges 1999). When the transversus is weak, the body may substitute the rectus abdominis, or the external oblique muscles, to do its work. When this happens, low back problems become more likely.

Trigger point activity in the abdominal or spinal muscles can inhibit the function of these muscles, as can excessive tightness/activity of the antagonists such as the erector spinae.

This following test screens for lumbopelvic instability during trunk flexion.

Test for weakness of internal obliques and transversus abdominis
- Your patient should lie supine, with the hips and knees flexed, and feet as close to the buttocks as possible with the arms folded across the chest
- You stand at the side of the table at the level of the patient's pelvis
- The patient is asked to raise the head and shoulders from the floor
- The feet should remain planted on the resting surface throughout the test, and not leave the table
- If the feet elevate off the supporting surface, this suggests recruitment of the hip flexors in order to provide adequate leverage to perform the task (Jull & Janda 1987)
- Does the abdomen 'dome', protrude, or does it flatten (Fig. 4.4A,B)?
- If the deeper stabilizing muscles, such as the transversus abdominis, are weak then they will not

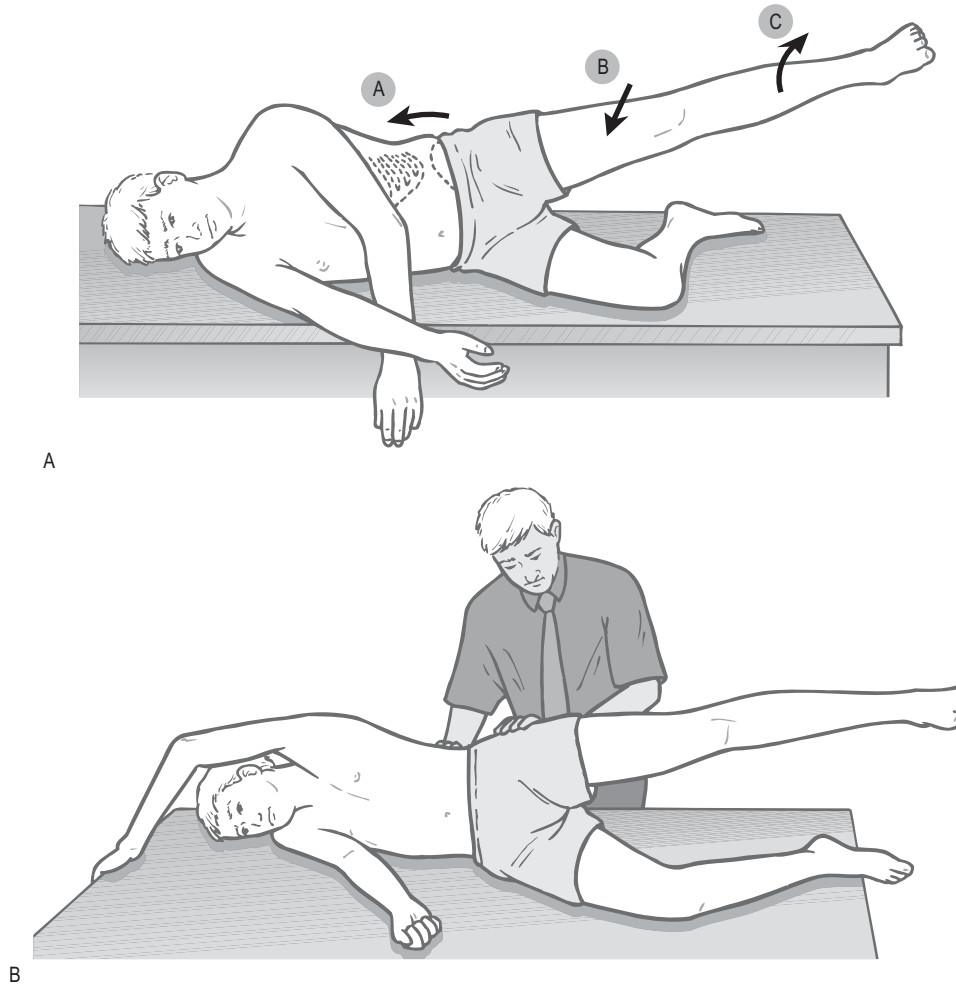

Figure 4.3 (A) Hip abduction observation test. Normal firing sequence is gluteus medius or tensor fascia lata (TFL) first and second, followed by quadratus lumborum (QL). If QL fires first it is overactive and will be short. If TFL is short, the leg will drift into flexion on abduction. If piriformis is short, the leg and foot will externally rotate during abduction. (B) Palpation assessment for quadratus lumborum overactivity. The muscle is palpated, as is the gluteus medius and TFL, during abduction of the leg. The correct firing sequence should be gluteus and TFL, followed at around 25° elevation by quadratus. If there is an immediate 'grabbing' action by quadratus it indicates overactivity, and therefore stress, so shortness can be assumed. (After Chaitow 2003.)

be able to hold the rectus abdominis down as it contracts, and it will dome

- Even if the head and shoulder can lift, without doming the abdomen, can that position be held for 10 s without difficulty (muscles start to quiver or shake)?
- The abdomen may dome, or the lower back may either stay straight or extend (bend backwards) rather than being able to round (flex) as the head and shoulders are lifted and the position is maintained
- This is even more likely to happen if the superficial abdominal muscles, such as the rectus abdominis, have lengthened as well as being weak (such as in someone with a protruding 'pot' belly, see Crossed syndrome posture below).

The therapeutic approach If weakness is demonstrated in these core stabilizing muscles, there is an urgency to initiate toning exercises as described in Chapter 8. In addition, reasons for the weakness should be addressed, including improved posture, and removal of excessive tone and shortening in the antagonists, such as erector spinae and hip flexors. Ideally, any trigger point activity that may be adding to hypertonicity, or creating inhibition, should be identified and removed (see also Ch. 7).

Test for weakness of the gluteus medius

Method 1 (Lee 1997)

- The patient should be side-lying, with the leg to be tested uppermost and knee extended
- The hip is placed and supported in slight extension, abduction and external rotation, and the patient is asked to maintain the position of the trunk and leg when support for the leg is released (Fig. 4.5)
- When the support is released, and if the gluteus medius is weak, there may be posterior pelvic rotation if TFL assists the effort; or the spine may be pulled into side-flexion as quadratus attempts to brace the leg
- If the patient can maintain the original position for 10 s, pressure is then applied to the leg in the direction of hip flexion, adduction and internal rotation, thereby resisting gluteus medius posterior fibers
- If the posterior fibers of gluteus medius are weak, the patient will be unable to hold the position against pressure.

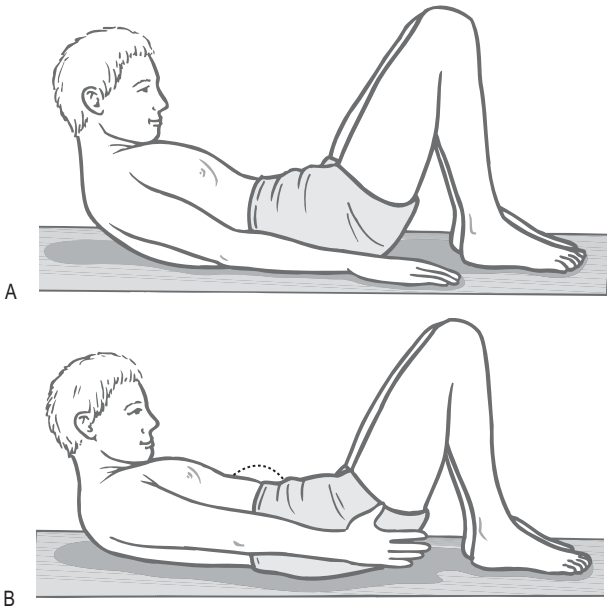

Figure 4.4 (A,B) Test position to assess internal oblique and transversus abdominis strength. (After Chaitow 2003b.)

If weakness is established, there are negative implications for the sacroiliac joint during the gait cycle.

The therapeutic approach Reasons for the relative weakness should be assessed, which could possibly involve excess tone in the antagonists, or trigger points in gluteus medius or associated muscles. Special attention should be given to searching for trigger points in those muscles which refer into the gluteus medius region, such as the quadratus lumborum, gluteus maximus and minimus, iliocostalis lumborum, piriformis, and rectus abdominis (see Chs 7 and 8 for treatment details).

Method 2

- For this test (known as the Trendelenburg test) the patient stands and the sacral dimples (which should

Figure 4.5 Testing for weakness and toning gluteus medius and minimus (From Chaitow 2003b.)

Figure 4.6 Test and toning position for gluteus maximus. (From Chaitow 2003b.)

be level) are located, and their relative height to each other noted
- The patient stands on one leg (say the right) and the gluteus medius on the right side should contract, sidebending the pelvis to the right, causing elevation of the pelvis on the left
- If this happens, the test is negative (i.e. the muscle is behaving normally)
- If the muscle is inadequate to the task of sidebending the pelvis (i.e. it stays level or the left side drops), the test is positive and gluteus medius is assumed to be weak or not functioning normally, on the right (Fig. 5.16).

The therapeutic approach The reasons for this dysfunction should be investigated and might include pathologies which bring the attachments close to each other (fractures of the greater trochanter, slipped capital femoral epiphysis), congenital dislocation, poliomyelitis, or nerve root lesions (Hoppenfeld 1976). Referral to a practitioner licensed to make a diagnosis is suggested.

Test for weakness of the gluteus maximus
- The patient lies prone
- The knee on the side to be tested is flexed to 90°
- The thigh is lifted without arching the back and this position is held until the task becomes difficult (Fig. 4.6)
- If the position cannot be held for 10 s, this suggests weakness of the gluteus maximus
- If the position can be held without difficulty for 20 s, this suggests normal strength in gluteus maximus
- If the indication is of weakness, psoas may be shortened and hypertonic.

The therapeutic approach Remove overactivity in antagonists (such as psoas) and increase tone in the weakened gluteus maximus muscle (possibly by regularly adopting the test position until maintaining the contraction for 20 s becomes easy). Ideally, any trigger point activity adding to hypertonicity, or creating inhibition, should be identified and removed (see Chs 7 and 8 for treatment details).

When the gluteus maximus is weakened Lee (1997) provides an insight into the problems that can occur when the gluteus maximus is weakened: 'Clinically gluteus maximus appears to become inhibited whenever the sacroiliac joint (SIJ) is irritated or in dysfunction. The consequences to gait can be catastrophic when … the stride length shortens, and

the hamstrings are overused to compensate for the loss of hip extensor power … in time, the SIJ can become hypermobile. This is often seen in athletes with repetitive hamstring strains. The hamstrings remain overused and vulnerable to intramuscular tears'.

The therapeutic approach should be to normalize the strength of the gluteals and to reduce the hypertonicity of the hamstrings.

Tests for spinal muscle (e.g. multifidi) weakness

When there is low back pain, a major influence is often found via the multifidi (Liebenson 2000b).

These muscles may actually atrophy when unused, as happens when – because of back pain – a person rests instead of starting some form of rehabilitation exercising as soon as the acute phase has eased. This is known as 'deconditioning' and the exercises described in Chapter 8 can help to prevent this.

Standing arm elevation test for multifidi weakness

- The patient stands against a wall, with the buttocks and spine touching the wall, and the heels placed about 2 in (5 cm) from it
- The arms should be raised directly in front so that the backs of your hands can be placed against the wall above the head (Fig. 4.7).

If, as this is done, the low back arches forward, or the wall cannot be touched by the backs of the hands, the suggestion is that the mid-spine (mid-thoracic) is restricted and that there is a need for mobilization of that area, as well as improvement of stability of the deep muscles such as multifidi (see exercise description below).

Trunk extension test and exercise

- The patient lies on the floor prone, with hands interlocked behind the neck, elbows pointing forward so that they lie as close to parallel with the floor as possible
- The chest is lifted from the floor approximately 2 in (5 cm) before lying down again. Figure 4.8A,B shows examples of correct and incorrect performance
- The legs and feet should remain in touch with the floor throughout (there will be a tendency for the feet and lower legs to rise, and this shows excessive effort from the superficial erector spinae)
- With a pause of no more than 2 s between each repetition, this movement should be repeated 15 times, with the final lift being held for 30 s.

If the patient accomplishes this, the multifidi are normal. If not, this exercise can be repeated until it is easily accomplished.

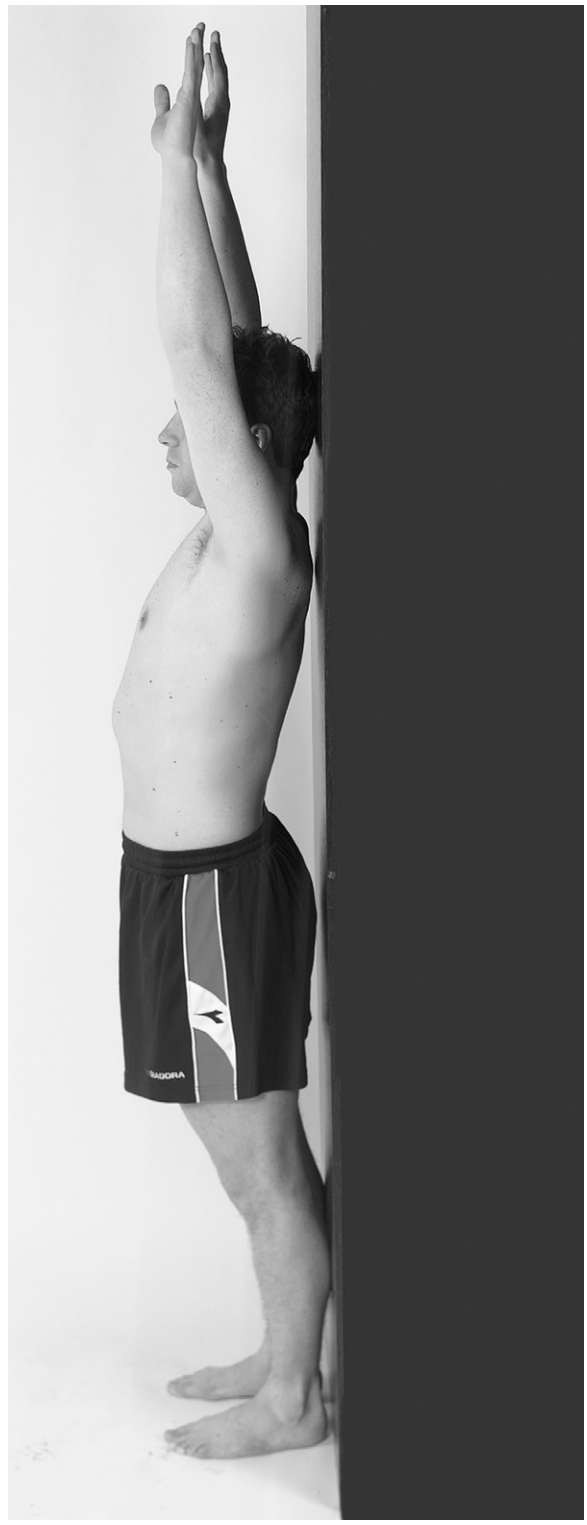

Figure 4.7 Standing arm elevation test performed incorrectly: arms cannot reach wall and low back arches. (From Chaitow 2003b.)

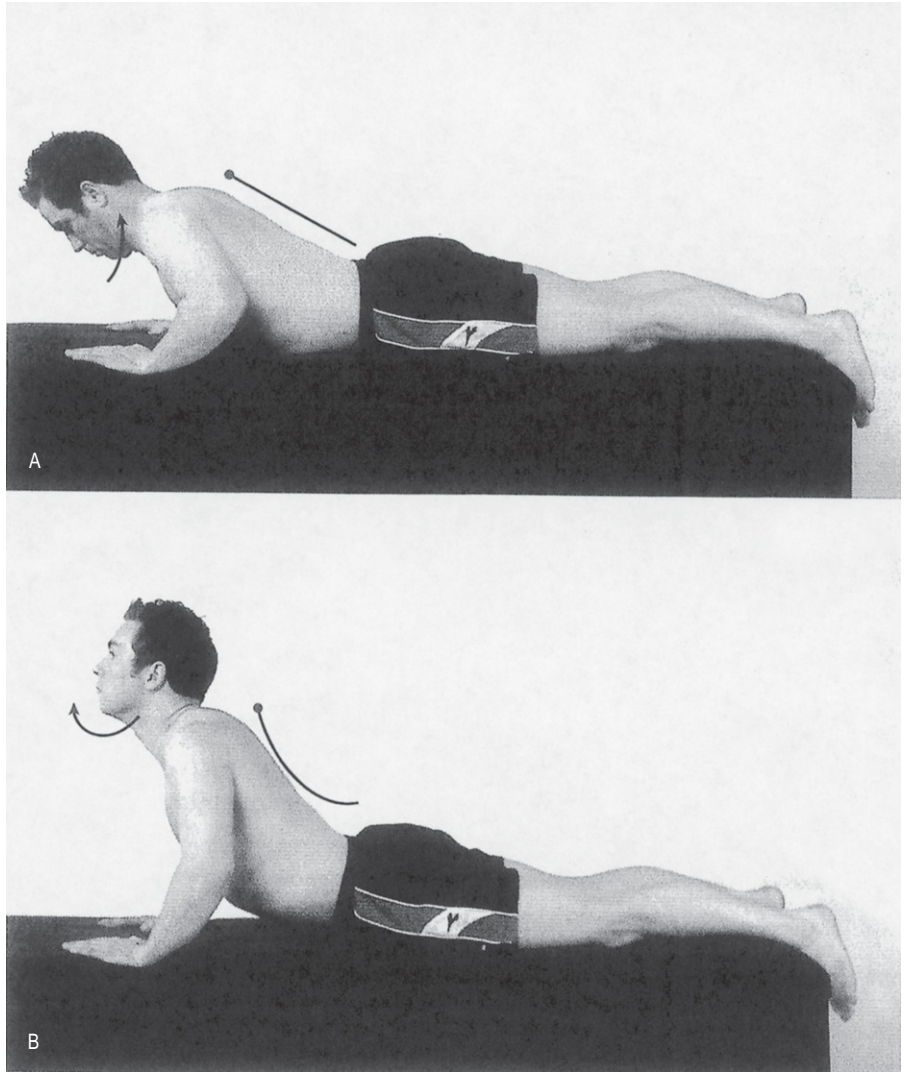

Figure 4.8 (A) Prone trunk extension test correctly performed. (B) Prone trunk extension test incorrectly performed: note neck and spine extend instead of staying in line. (From Chaitow 2003b.) Note: The method illustrated is a less stressful version than the one described, where hands are clasped behind the neck.

CROSSED SYNDROME PATTERNS

As compensation occurs to overuse, misuse and disuse of muscles of the spine and pelvis, some muscles become overworked, shortened and restricted, with others becoming inhibited and weak, and body-wide postural changes take place that have been characterized as 'crossed syndromes' (Lewit 1999) (Fig. 4.9A,B). These crossed patterns demonstrate the imbalances that occur as antagonists become inhibited due to the overactivity of specific postural muscles. The effect on spinal and pelvic mechanics of these imbalances (which would have shown up when the hip extension and hip abduction tests were performed) would be to create an environment in which pain and dysfunction (such as sacroiliac joint) would become more likely to occur.

One of the main tasks in rehabilitation of such pain and dysfunction is to normalize these imbalances, to release and stretch whatever is over-short and tight, and to encourage tone in those muscles that have become inhibited and weakened (Liebenson 1996).

- In the upper crossed pattern, we see how the deep neck flexors and the lower fixators of the shoulder (serratus anterior, lower and middle trapezius) have weakened (and possibly lengthened), while their antagonists the upper trapezius, levator scapula and the pectorals will have shortened and tightened
- Also short and tight, are the cervical extensor muscles, the suboccipitals, and the rotator cuff muscles of the shoulder
- In the lower crossed pattern we see, in Figure 4.9B, that the abdominal muscles have weakened, as have the gluteals, and at the same time psoas and erector spinae will have shortened and tightened
- Also short and tight, are tensor fascia lata, piriformis, quadratus lumborum, hamstrings and latissimus dorsi.

In the section below outlining tests for shortness, the key muscles that have influence on the low back and pelvis are listed (see Chs 7 and 8 for treatment options).

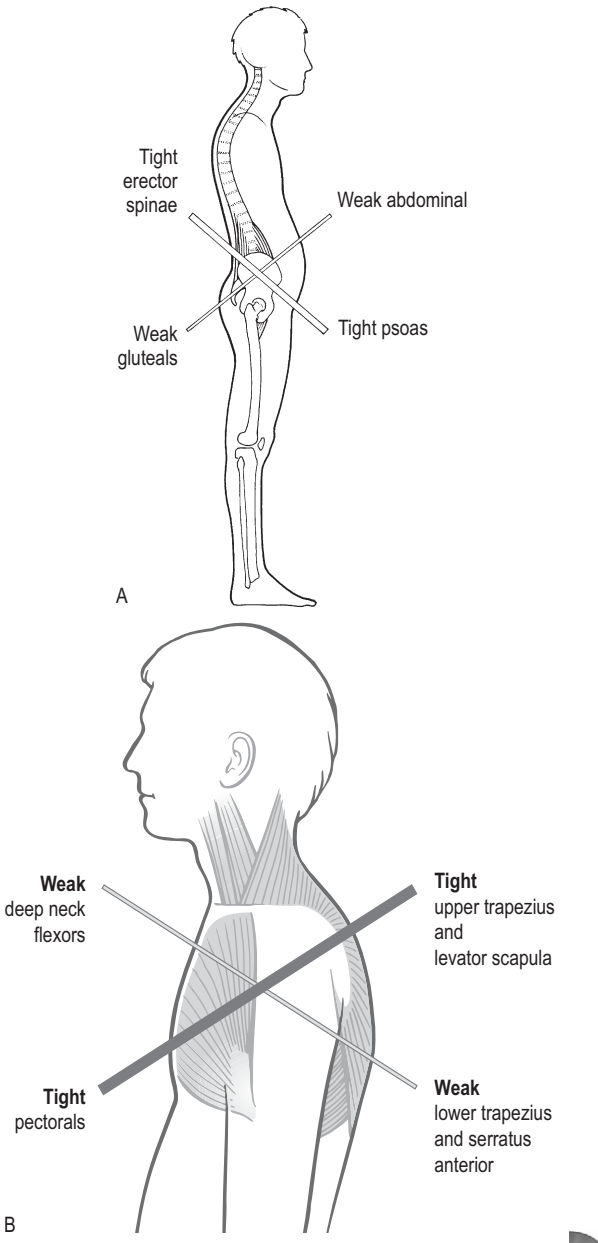

Figure 4.9 (A) Lower crossed patterns of weakness and tightness. (B) Upper crossed patterns of weakness and tightness. (From Chaitow 2003b.)

Tests for muscle shortness

The tests for muscle shortness, listed below, focus on those most likely to be involved in both back and pelvic pain problems. In Chapter 5, which pays specific attention to pelvic pain, additional assessments will be described. The following tests are derived from the work of Janda (1983), Kendall et al (1993) and a variety of other sources.

Test for hamstring shortness: upper fibers (straight leg raise)

- In order to assess for shortened hamstrings (biceps, femoris, semitendinosus and semimembranosus), your patient should lie supine with the leg to be tested outstretched and the other leg flexed at both knee and hip, to relax the low back

- In order to assess tightness in the left leg hamstrings (upper fibers), you should be standing at the side of the leg to be tested, facing the head of the table
- The lower leg is supported by your caudal hand, keeping the knee of that leg in light extension and if possible resting the heel of that leg in the bend of the elbow to prevent lateral rotation
- The cephalad hand can then rest on the hamstrings, around mid-thigh, to evaluate for 'bind' as elevation takes place (Fig. 4.10A)
- The range of movement into hip flexion should (with a supple hamstring group, and no neural restrictions) allow painless elevation of the tested leg to about 80° before tension is noted
- Does the first sign of resistance, bind, occur before 80°?
- If so, the hamstrings are almost certainly shortened.

The therapeutic approach Aim at releasing and relaxing, and possibly stretching, the shortened hamstring fibers (see Chs 7 and 8 for treatment details).

Test for hamstring shortness: lower fibers

- To make this assessment, the tested leg is taken into full hip flexion (helped by the patient holding the upper thigh with both hands) (Fig. 4.10B)
- You should place a hand onto the fibers just inferior to the popliteal space to assess for bind as the leg straightens
- The knee is then passively straightened until resistance is felt, or bind is noted by this palpation hand resting on the lower hamstrings
- If the knee cannot easily straighten with the hip flexed, this indicates shortness in the lower hamstring fibers, and a degree of pull behind the knee and lower thigh will be reported during any attempt to straighten the leg
- If the knee is capable of being straightened with the hip flexed, having previously not been capable of achieving an 80°, straight-leg raise, then the lower fibers are cleared of shortness, and it is the upper hamstring fibers which require therapeutic attention.

The therapeutic approach Aim at releasing and relaxing, and possibly stretching, the shortened hamstrings (see Chs 7 and 8 for treatment details).

Caution In a person with a history of an unstable sacroiliac joint, or in someone who is generally hypermobile, it is possible that excessive tension in the hamstrings (and/or the presence in these muscles of active trigger points) could be acting to stabilize the joint via traction on the sacrotuberous ligament (Vleeming et al 1997). In such cases, caution should be employed before stretching the hamstrings, or deactivating the trigger points, as the joint could be made more unstable.

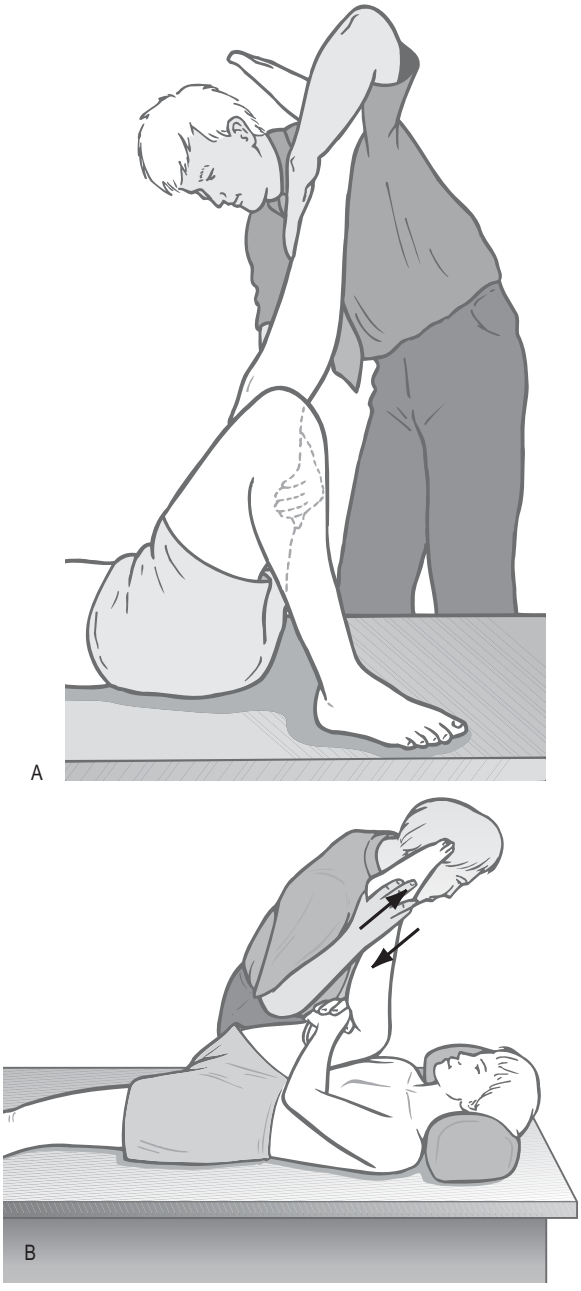

Figure 4.10 (A) Assessment for shortness of hamstring, upper fibers, by palpation during leg raising. (After Chaitow 2003c.) (B) Assessment for shortness of hamstring, lower fibers, by palpation during leg straightening. (From Chaitow 2003c.)

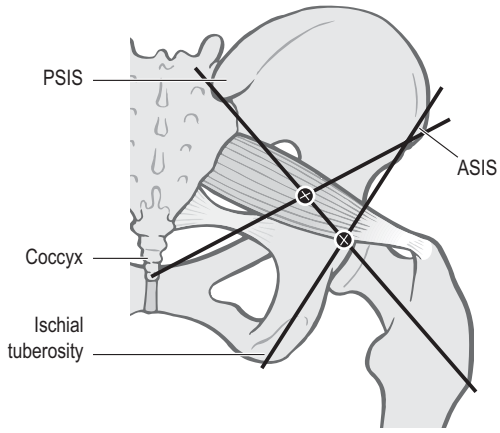

Figure 4.11 Landmarks are used as coordinates to locate the attachment of piriformis at the hip, and also the site of major trigger point activity in the belly of the muscle. (From Chaitow 2003c.)

Palpating for shortness of piriformis

When short, the piriformis will cause the affected side leg of the supine individual to appear to be short and externally rotated.

- Have your patient side-lying, tested side uppermost
- You should stand in front of and facing the pelvis
- In order to contact the insertion of piriformis, draw two imaginary lines: one runs from the ASIS to the ischial tuberosity and the other from the PSIS to the most prominent point of the trochanter (Fig. 4.11)
- Where these lines cross, just posterior to the trochanter, is the attachment of the muscle, and pressure here will produce marked discomfort if piriformis is short or irritated
- In order to locate the most common trigger point site, in the belly of the muscle, the line from the ASIS should be taken to the tip of the coccyx rather than the ischial tuberosity
- The other line from the PSIS to the trochanter prominence is the same as above
- Pressure where one line crosses the other will access the mid-point of the belly of piriformis, where trigger points are common
- Light compression here, that produces a painful response ('jump sign'), is indicative of a stressed and probably shortened muscle.

The therapeutic approach Aim at releasing and relaxing, and possibly stretching, the shortened piriformis fibers (see Chs 7 and 8 for treatment details).

Paravertebral muscle shortness assessment

1 Your patient should be seated on the treatment table, legs extended, pelvis vertical.
   - Flexion is introduced in order to approximate the forehead to the knees without strain
   - An even curve should be observed and a distance of about 10 cm from the knees achieved by the forehead
   - No knee flexion should occur and the movement should be a spinal one, not involving pelvic tilting (Fig. 4.12)
2 Your patient should be seated at the edge of the table, knees flexed and lower legs hanging over the edge, relaxing the hamstrings.
   - Forward bending is introduced so that the forehead approximates the knees
   - If flexion of the trunk is greater in this position than when the legs were straight, then there is probably tilting of the pelvis and shortened hamstring involvement
3 Observe the spinal curve as your patient sits in the forward bending position, as in 1, above.
   - During these assessments, there should be a uniform degree of flexion throughout the spine, with a 'C' curve apparent when looked at from the side
   - However, all too commonly, areas of shortening in the spinal muscles may be observed, particularly as areas which are 'flat', where little or no flexion is taking place
   - In some instances lordosis may be maintained in the lumbar spine even on full flexion, or flexion may be very limited, even without such lordosis
   - There may also be obvious overstretching of the upper back, as compensation for the relative tightness of the lower back
   - Generally 'flat' areas of the spine indicate local shortening of the erector spinae group
   - Can you observe 'flat', tense, areas of the spine, during any of these flexion exercises?
   - Identify such areas and palpate them lightly as your patient moves into flexion
   - Compare the feel of the tissues as they tighten, bind, compared with those areas which are flexible, where the curve is normal
   - Also, if you identify flat areas, have your patient lie prone and palpate lightly with your fingertips to assess the degree of hypertonicity.

See which of the following variables is evident in your patient:

1 Normal length of erector spinae muscles and posterior thigh muscles
2 Tight gastrocnemius and soleus; an inability to dorsiflex the feet indicates tightness of the plantarflexor group

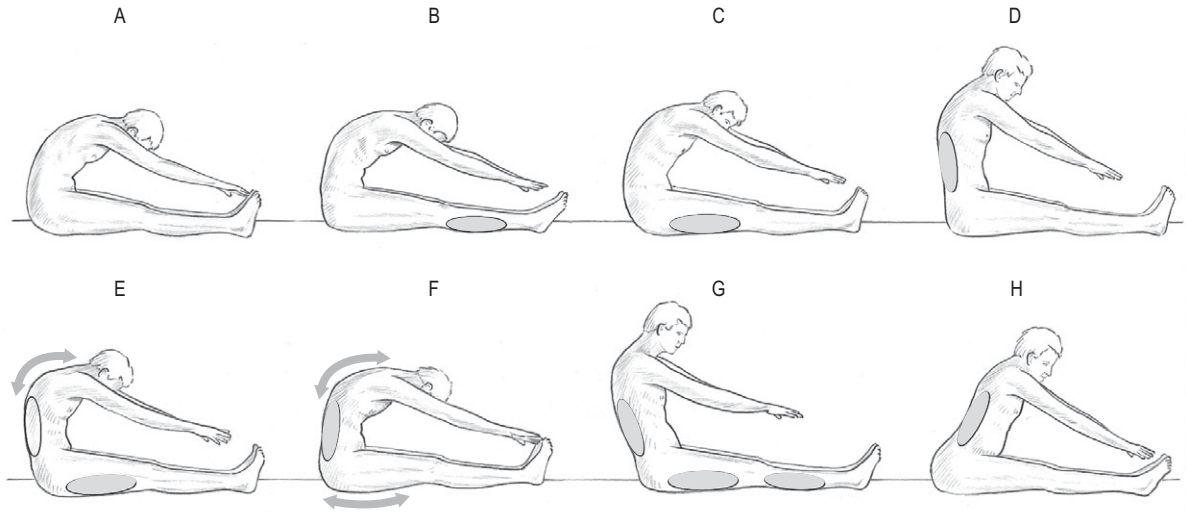

Figure 4.12 Tests for shortness of the erector spinae and associated postural muscles. (A) Normal length of erector spinae muscles and posterior thigh muscles. (B) Tight gastrocnemius and soleus; the inability to dorsiflex the feet indicates tightness of the plantarflexor group. (C) Tight hamstring muscles, which cause the pelvis to tilt posteriorly. (D) Tight low back erector spinae muscles. (E) Tight hamstring; slightly tight low back muscles and overstretched upper back muscles. (F) Slightly shortened lower back muscles, stretched upper back muscles and slightly stretched hamstrings. (G) Tight low back muscles, hamstrings and gastrocnemius/soleus. (H) Very tight low back muscles, with lordosis maintained even in flexion. (From Chaitow 2003c.)

3 Tight hamstring muscles, which cause the pelvis to tilt posteriorly
4 Tight low back erector spinae muscles
5 Tight hamstring; slightly tight lower back muscles and overstretched upper back muscles
6 Slightly shortened lower back muscles, stretched upper back muscles and slightly stretched hamstrings
7 Tight lower back muscles, hamstrings and gastrocnemius/soleus
8 Very tight low back muscles, with lordosis maintained even in flexion.

The therapeutic approach Aim towards restoring normal flexion potential to the spine by means of releasing and relaxing excessively short and tight muscles and encouraging better tone in weakened ones (see Chs 7 and 8 for treatment details).

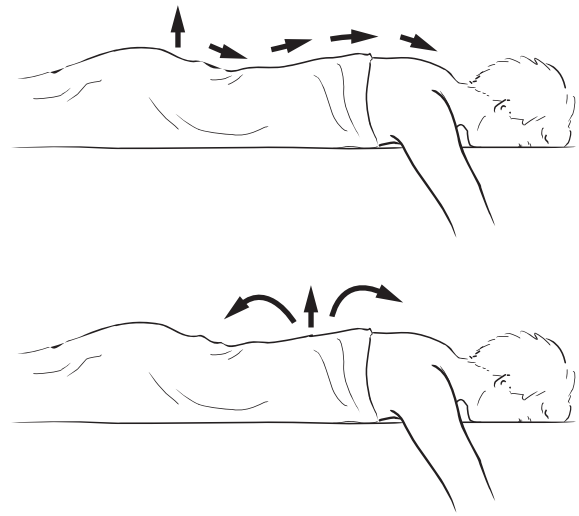

Figure 4.13 Functional (top) and dysfunctional (bottom) breathing wave movement patterns. (Reproduced with kind permission from Chaitow & DeLany 2000).

Breathing wave

With the patient prone, observation is made of the 'breathing wave' – the movement of the spine from sacrum to base of neck on deep inhalation.

A full inhalation in this position, with a fully flexible spine, will demonstrate a wave-like movement starting close to the sacrum and finishing in the upper back.

When areas of the spine are restricted (and this would have shown up in the seated flexion observation discussed above, particularly in examples 4, 5, 6 and 7) the spinal response to inhalation will be of several segments rising together as a 'block' (Fig. 4.13).

Pain is common in the more mobile segments of the spine, immediately above and below such restricted

areas, and this may reduce or vanish when mobility is restored.

The therapeutic approach It is these 'blocked' areas of the spine that need to be gently mobilized by means of releasing and relaxing of associated muscles, as well as by stretching exercises (see Chs 7 and 8 for treatment details).

Breathing pattern and spinal well-being

Motor control is a key component in spinal (and all joint) injury prevention. Loss of motor control involves failure to control joints, commonly because of poor coordination of the agonist-antagonist muscle co-activation.

Three subsystems work together to maintain spinal stability (Panjabi 1992):

- The central nervous subsystem (control)
- The osteoligamentous subsystem (passive)
- The muscle subsystem (active).

There is evidence that the effects of breathing pattern disorders, such as hyperventilation, result in a variety of negative influences and interferences, capable of modifying each of these three subsystems (Chaitow 2004).

- Breathing pattern disorders (the extreme form of which is hyperventilation) automatically increase levels of anxiety and apprehension, which may be sufficient to alter motor control and to markedly influence balance control (Balaban & Thayer 2001).
- Hyperventilation results in respiratory alkalosis, leading to reduced oxygenation of tissues (including the brain), smooth muscle constriction, heightened pain perception, speeding up of spinal reflexes, increased excitability of the corticospinal system (Macefield & Burke 1991, Seyal et al 1998), hyper-irritability of motor and sensory axons (Mogyoros et al 1997), changes in serum calcium and magnesium levels (George 1964) and encouragement of the development of myofascial trigger points (Simons et al 1999) – all or any of which, in one way or another, are capable of modifying normal motor control of skeletal musculature.
- Diaphragmatic and transversus abdominis tone are key features in provision of core stability, however it has been noted that reduction in the support offered to the spine, by the muscles of the torso, may occur if there is a load challenge to the low back combined with a breathing challenge (McGill et al 1995).
- It has been demonstrated that, after approximately 60 s of over-breathing, the postural (tonic) and phasic functions of both the diaphragm and transversus abdominis are reduced or absent (Hodges et al 2001).

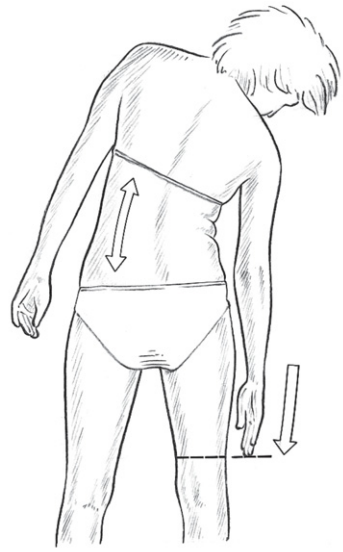

Figure 4.14 MET self-treatment for quadratus lumborum. Patient assesses range of sidebending to the right. (From Chaitow 2001.)

It is therefore important to pay attention to the breathing pattern of anyone with back pain, and guidelines are offered in Chapter 8.

Quadratus lumborum muscle shortness assessment

The hip abduction test (above) will have given a clear indication of overactivity of QL, and the simple assessment (below) identifies the shorter side, as well as the degree of shortness (Fig. 4.14).

- The patient stands with back towards you
- Place your index fingers onto the crests of the pelvis, left and right and evaluate whether they are level or not
- Any leg length disparity (based on pelvic crest height) should be equalized by using a book or pad under the short leg heel
- With the patient's feet shoulder-width apart, a pure side-bending is requested, so that the patient runs a hand down the lateral thigh/calf. (Normal level of side-bending excursion allows the fingertips to reach to just below the knee.)
- If sidebending to one side is less than to the other, then QL is apparently short on the side away from which the excursion is shortest

- If there is an obvious shortness *and* the short side was also shown to be overactive during the hip abduction test, then treatment of the QL is called for.

This is outlined in Chapters 7 and 8.

Rectus femoris, iliopsoas muscle shortness assessment

- The patient lies supine with buttocks (coccyx) as close to the end of the table as possible, the non-tested leg in flexion at both hip and knee, held by the patient
- Full flexion of the hip helps to maintain the pelvis in full rotation with the lumbar spine flat. This is essential if the test is to be meaningful and stress on the spine avoided
- If the thigh of the tested leg lies in a horizontal position in which it is parallel to the floor/table (Fig. 4.15A) then the indication is that iliopsoas is not short
- If however, the thigh rises above the horizontal (Fig. 4.15B) then iliopsoas is probably short
- In this supine testing position, if the lower leg of the tested side fails to hang down to an almost 90° angle with the thigh, vertical to the floor, then shortness of rectus femoris is indicated (Fig. 4.15B)
- Rectus femoris shortness can be confirmed by seeing whether or not the heel on the tested side can easily flex to touch the buttock when the patient is prone. If rectus femoris is short, the heel will not easily reach the buttock (Fig. 4.16).
- If TFL is short (a further test proves it, see below) then there should be an obvious groove apparent on the lateral thigh, and sometimes the whole lower leg will deviate laterally

Treatment choices are outlined in Chapters 7 and 8.

Tensor fascia lata muscle shortness assessment

- The test is a modified form of Ober's test
- The patient is side-lying with back close to the edge of the table
- You stand behind the patient, whose lower leg is flexed at hip and knee and held in this position, by the patient, for stability
- You support the leg to be tested as illustrated in Figure 4.17
- You should ensure that there is no hip flexion, which would nullify the test
- The leg is extended to the position where the iliotibial band lies over the greater trochanter
- The tested leg is supported at ankle and knee, with the whole leg in its anatomical position, neither abducted nor adducted, and not forward or backward of the trunk
- You should carefully introduce flexion at the knee to 90°, without allowing the hip to flex, and then, while supporting the limb at the ankle, remove your hand from under the knee and allow it to fall towards the table
- If the TFL is normal, the thigh and knee will fall easily, with the knee usually contacting the table surface (unless there is unusual hip width, or a short thigh length preventing this)
- If the upper leg remains aloft, with little sign of 'falling' towards the table, then either the patient is not relaxing, or the TFL is short and does not allow it to fall
- As a rule, the band will palpate as tender under such conditions.

Treatment options are outlined in Chapters 7 and 8.

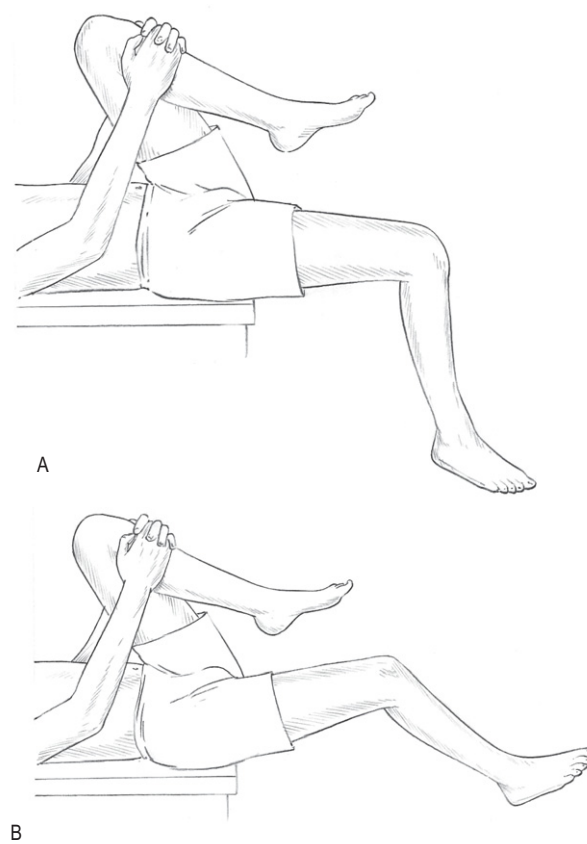

Figure 4.15 (A) Test position for shortness of hip flexors. Note that the hip on the non-tested side must be fully flexed to produce full pelvic rotation. The position shown is normal. (B) In the test position, if the thigh is elevated (i.e. not parallel with the table) probable psoas shortness is indicated. The inability of the lower leg to hang more or less vertically towards the floor indicates probable rectus femoris shortness (TFL shortness can produce a similar effect). (From Chaitow 2001.)

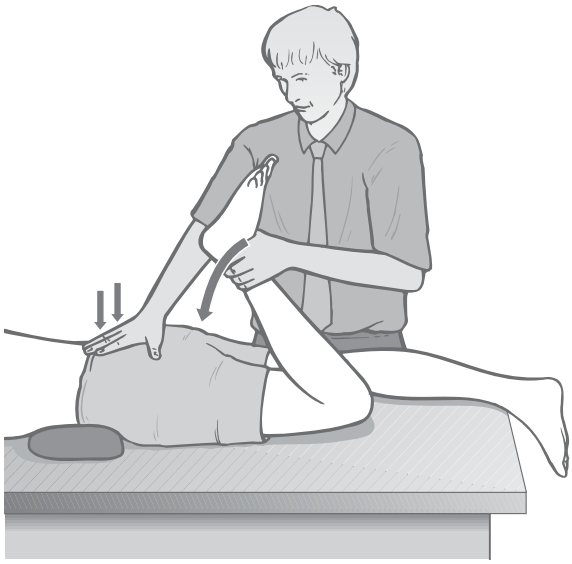

Figure 4.16 Test for rectus femoris shortness. A normal muscle will allow the heel to reach the buttock without force. (From Chaitow 2001.)

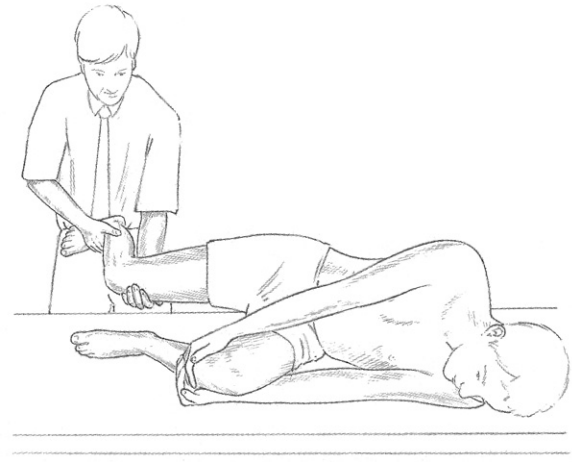

Figure 4.17 Assessment for shortness of TFL – modified Ober's test. When the hand supporting the flexed knee is removed the thigh should fall to the table if TFL is not short. (From Chaitow 2001.)

PALPATING FOR TRIGGER POINTS

In osteopathic medicine, an acronym 'STAR' is used as a reminder of the characteristics of somatic dysfunction, such as myofascial trigger points.

STAR stands for:

- **S**ensitivity (or 'tenderness'): this is the one feature that is almost always present when there is soft tissue dysfunction
- **T**issue texture change: the tissues usually 'feel' different (for example they may be tense, fibrous, swollen, hot, cold or have other 'differences' from normal)
- **A**symmetry: there will commonly be an imbalance on one side, compared with the other, but this is not always the case
- **R**ange of motion reduced: muscles will probably not be able to reach their normal resting length, or joints may have a restricted range.

If two or three of these features are present, this is enough to confirm that there is a problem, a dysfunction. It does not however explain why the problem exists, but is a start in the process towards understanding the patient's symptoms.

Research (Fryer et al 2004) has confirmed that this traditional osteopathic palpation method is valid. When tissues in the thoracic paraspinal muscles were found to be 'abnormal' (tense, dense, indurated), the same tissues (using an algometer; see Ch. 3) were also found to have a lowered pain threshold. Less pressure was needed to create pain.

While the 'tenderness', altered texture and range of motion characteristics, as listed in the STAR acronym, are always true for trigger points, additional trigger point changes have been listed by Simons and colleagues (1999):

- The soft tissues housing the trigger point will demonstrate a painful limit to stretch range of motion, whether the stretching is active, or passive (i.e. the patient is stretching the muscle, or you are stretching the muscle)
- In such muscles, there is usually pain or discomfort when it is contracted against resistance, with no movement taking place (i.e. an isometric contraction)
- The amount of force the muscle can generate is reduced when it contains active (or latent) trigger points; it is weaker than a normal muscle
- A palpable taut band, with an exquisitely tender nodule exists, and this should be found by palpation, unless the trigger lies in very deep muscle and is not accessible
- Pressure on the tender spot produces pain familiar to the patient, and often a pain response ('jump sign').

Treatment of trigger points is outlined and discussed in Chapters 7 and 8.

KEY POINTS

- There are usually a number of 'causes' and aggravating factors, as well as different structures, involved in any case of back pain, rather than just one cause
- The first objectives are to identify what these factors and tissues are, and to use treatment to enhance function and reduce the adaptive load
- Functional tests (hip abduction for example) demonstrate through observation and palpation which muscles are being overused, misused or disused and are therefore likely to be shortened and/or weakened
- These patterns of imbalance create crossed syndromes that can be recognized by observation
- Tests for weakness indicate which muscles require toning; either through exercise, or through removal of inhibition from antagonists, or both
- Tests for shortness indicate which muscles require releasing, relaxing and stretching
- Palpation methods using the STAR ingredients offer a useful way of identifying local dysfunction
- Tests for the presence of trigger points help to locate and identify those in need of deactivation (active points)
- Breathing pattern disorders can disturb motor control of the spine and encourage back problems
- By restoring balanced muscle activity, reducing tightness, increasing tone in weak structures, encouraging better breathing, and deactivating trigger points – normal function is encouraged. Stages of care should include:
  - Relieving pain (massage, trigger point deactivation, ice, etc.)
  - Easing adaptive demands (better posture and use patterns)
  - Improving function (exercise, improved stability etc.)

References

Andersson G 1997 Epidemiology of spinal disorders. In: Frymoyer JL (ed.) The adult spine, 2nd edition. Raven Press, New York, p 93–141

Balaban C, Thayer J 2001 Neurological bases for balance-anxiety links. Journal of Anxiety Disorders 15(1–2):53–79

Chaitow L 2001 Muscle energy techniques, 2nd edn. Churchill Livingstone, Edinburgh

Chaitow L 2003a Fibromyalgia syndrome, 2nd edn. Churchill Livingstone, Edinburgh

Chaitow L 2003b Maintaining body balance, flexibility and stability. Churchill Livingstone, Edinburgh

Chaitow L 2003c Palpation skills. Churchill Livingstone, Edinburgh

Chaitow L 2004 Breathing pattern disorders, motor control, and low back pain. Journal of Osteopathic Medicine 7(1):34–41

Chaitow L, DeLany J 2000 Clinical applications of neuromuscular technique, Volume 1. Churchill Livingstone, Edinburgh

Chaitow L, Bradley D, Gilbert C 2002 Multidiscipliary approaches to breathing pattern disorders. Churchill Livingstone, Edinburgh

Cholewicki J, Panjabi M, Khachatryan A 1997 Stabilizing function of the trunk flexor-extensor muscles around a neutral spine posture. Spine 19:2207–2212

Fryer G, Morris T, Gibbons P 2004 Relation between thoracic paraspinal tissues and pressure sensitivity measured by digital algometer. Journal of Osteopathic Medicine 7(2):64–69

George S 1964 Changes in serum calcium, serum phosphate and red cell phosphate during hyperventilation. New England Journal of Medicine 270:726–728

Hodges P 1999 Is there a role for transversus abdominis in lumbo-pelvic stability? Manual Therapy 4(2):74–86

Hodges P, Heinjnen I, Gandevia S 2001 Postural activity of the diaphragm is reduced in humans when respiratory demand increases. Journal of Physiology 537(3):999–1008

Hodges P, Richardson C 1996 Inefficient muscular stabilization of the lumbar spine associated with low back pain. Spine 21:2640–2650

Hoppenfeld S 1976 Physical examination of the spine and extremities. Appleton and Lange, Norwalk

Janda V 1982 Introduction to functional pathology of the motor system. Proceedings of the VIIth Commonwealth and International Conference on Sport. Physiotherapy in Sport 3:39

Janda V 1983 Muscle function testing. Butterworths, London

Janda V 1986 Muscle weakness and inhibition (pseudoparesis) in back pain syndromes. In: Grieve G (ed.) Modern manual therapy of the vertebral column. Churchill Livingstone, Edinburgh

Janda V 1996 Evaluation of muscular imbalance. In: Liebenson C (ed.) Rehabilitation of the spine. Williams and Wilkins, Baltimore

Jull G, Janda V 1987 Muscles and motor control in low back pain: Assessment and management. In: Twomey L, Grieve G (eds) Physical therapy of the low back. Churchill Livingstone, Edinburgh, p 253–278

Kendall F, McCreary E, Provance P 1993 Muscles, testing and function, 4th edn. Williams & Wilkins, Baltimore

Lee D 1997 Treatment of pelvic instability. In: Vleeming A, Mooney V, Dorman T et al (eds) Movement, stability and low back pain. Churchill Livingstone, Edinburgh

Lewit K 1999 Chain reactions in the locomotor system. Journal of Orthopaedic Medicine 21:52–58

Lewit K 1999 Manipulation in rehabilitation of the motor system, 3rd edn. Butterworth Heinemann, London

Liebenson C 1996 Rehabilitation of the spine. Williams & Wilkins, Baltimore

Liebenson C 2000a The quadratus lumborum and spinal stability. Journal of Bodywork and Movement Therapies 4(1):49–54

Liebenson C 2000b The trunk extensors and spinal stability. Journal of Bodywork and Movement Therapies 4(4):246–249

Macefield G, Burke D 1991 Paresthesia and tetany induced by voluntary hyperventilation. Brain 114:527–540

McGill S 2004 Functional anatomy of lumbar stability. Proceedings of the 5th Interdisciplinary World Congress on Low Back and Pelvic Pain. Melbourne, Australia, p 3–9

McGill S, Sharratt M, Seguin J 1995 Loads on spinal tissues during simultaneous lifting and ventilatory challenge. Ergonomics 38(9):1772–1792

Mogyoros I, Kiernan K, Burke D et al 1997 Excitability changes in human sensory and motor axons during hyperventilation and ischaemia. Brain 120(2):317–325

Panjabi M 1992 The stabilizing system of the spine. Part 1. Function, dysfunction, adaptation, and enhancement. Journal of Spinal Disorders 5:383–389

Paris S 1997 Differential diagnosis of lumbar and pelvic pain. In: Vleeming A, Mooney V, Dorman T et al (eds) Movement, stability and low back pain. Churchill Livingstone, New York

Selye H 1956 The stress of life. McGraw Hill, New York

Seyal M, Mull B, Gage B 1998 Increased excitability of the human corticospinal system with hyperventilation. Electroencephalography and Clinical Neurophysiology/Electromyography and Motor Control 109(3):263–267

Simons D, Travell J, Simons L 1999 Myofascial pain and dysfunction: the trigger point manual, Vol 1, Upper half of body, 2nd edn. Williams & Wilkins, Baltimore

Vleeming A, Mooney V, Dorman T et al (eds) 1997 Movement, stability and low back pain. Churchill Livingstone, Edinburgh