Clinical examination of the thoracic spine

25

CHAPTER CONTENTS

Introduction

Thoracic or abdominal wall pain is a common complaint and poses a major diagnostic challenge to physician and therapist.

The pain is often referred from visceral disorders, although the frequency of musculoskeletal lesions of the thorax and the abdomen should not be underestimated. A physician not familiar with the musculoskeletal disorders of the region could be tempted to ascribe unexplained pain to vague lesions such as intercostal neuralgia, neuritis, cardiac neurosis, pleurodynia or rib syndromes. Again, lack of an exact diagnosis leads to inadequate and unsuccessful treatment. The absence of a precise (orthopaedic) diagnosis can, to a certain extent, be a consequence of the complexity of the region itself. However, another important reason is the lack of an appropriate clinical approach to this part of the body. Thorough examination should not be restricted to the routine visceral examination (e.g. auscultation, percussion and palpation) but also must include proper orthopaedic and neurological tests. Although a large number of reliable technical investigations for detecting all types of visceral disorders are available, the same cannot be said when it comes to musculoskeletal disorders, for which technical investigations are often of limited diagnostic value.

Clinically, the thoracic region is approached in a different way from the cervical or the lumbar spine because it behaves differently in many aspects.

Principal differences between the thoracic and the lumbar and cervical spines

Visceral versus musculoskeletal pain

Because referred pain from visceral problems can mimic pain of musculoskeletal origin and vice versa, the first step towards diagnosis must always be to differentiate these two categories. The character of the pain is usually of little help in the differential diagnosis because it has the same features in both. Pain referred from heart, lungs and intestines is usually poorly localized and vaguely delineated, and is referred to a segmental or multisegmental distribution. The behaviour of the pain may also mislead the examiner. One of the main characteristics of pain in lesions of moving parts is that it is brought on by posture and movement. This is also the case in thoracic lesions: if the patient's symptoms depend on activity rather than on visceral function, a cause originating from moving parts should be considered. However, it is important to keep in mind the

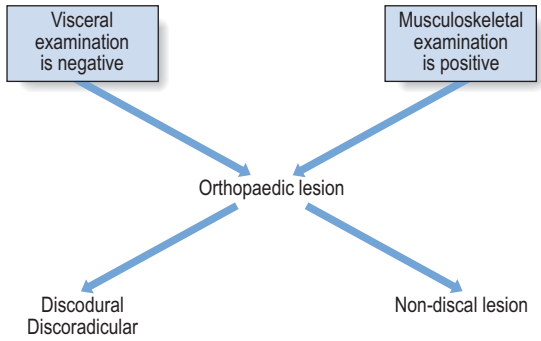


Fig 25.1 • Routine for differentiation between thoracic and abdominal wall pain.

fact that posture, physical activity, a deep breath or a cough may also influence visceral pain in the thorax or abdomen.

The best method of differentiating is to work in two complementary ways: exclusion of any visceral disorder through a thorough internal check-up, together with positive confirmation of a provisional orthopaedic diagnosis (Fig. 25.1). This routine will also safeguard against unnecessary technical investigations and delays in diagnosis and treatment.[1–3]

Discal lesions

Discodural and discoradicular interactions are well-known causes of cervical and lumbar pain.

In a discodural lesion, a shifted component of the disc impinges on the dura and causes pain that has multisegmental characteristics (crossing the midline and occupying several dermatomes). Discodural conflicts are characterized by two sets of symptoms and signs: articular and dural (see Ch. 33).

In a discoradicular lesion, the subluxated disc component impinges on the nerve root and its dural sleeve. The pain and paraesthesia that result are strictly segmental. Discoradicular conflicts are characterized by three sets of symptoms and signs: articular, root and cord.

Disc lesions also commonly occur in the thoracic spine but often show characteristics that are quite different from those found at the lumbar and cervical spines.

- *The articular signs are subtle*: a discodural interaction at the cervical or lumbar level usually presents with a clear partial articular pattern: some movements hurt or are limited and others do not, always in an asymmetrical way. This is not so in the thoracic spine. Because of the rigidity of the thorax, such an obvious pattern is seldom found. Very often, only one of the six passive movements, usually a rotation, is positive and then only slightly so. Therefore diagnosis in the thoracic spine is more tentative and may have to be based on smaller, subtler abnormalities.
- *Neurological deficit is seldom encountered in a thoracic disc lesion*: whereas some degree of neurological deficit is a common finding in cervical or lumbar posterolateral disc lesions, muscular weakness is rarely detectable in thoracic discoradicular lesions. Also, disturbance of sensation is very rare. This absence of neurological signs is probably the outcome of the location of the nerve root in the intervertebral foramen, where it lies mainly behind the lower aspect of the vertebral body and less behind the disc (see online chapter *Applied anatomy of the thorax and abdomen*).
- *There is no tendency to spontaneous recovery*: in the lumbar and cervical spines there is usually a spontaneous cure for root pain, which seldom lasts longer than 4 months at the cervical level and 12 months at the lumbar level. At the thoracic level, no such tendency exists and constant root pain can persist for many years.
- *Protrusions can usually be reduced*: although thoracic disc lesions are more difficult to diagnose, they are easily and effectively cured. Protrusions – no matter how long they have been present, or whether they are posterocentral or posterolateral, or soft or hard – can usually be reduced by 1–3 sessions of manipulations. Unlike at the lumbar or cervical levels, time is not a criterion for reducibility. Hence a disc displacement may well prove reducible after constant root pain, even of several years' standing. Traction is seldom required because the protrusions are usually of the annular type.

Non-discal lesions

In the thorax, non-discal musculoskeletal lesions are also encountered frequently. To name but a few: ribs, rib joints, cartilage, intercostal and abdominal muscles. This is in contrast to the cervical and lumbar spines, where lesions of the disc are the principal cause of dysfunction and pain.

Referred pain

Both musculoskeletal and visceral lesions can be the source of pain referred to the thoracic and/or abdominal wall.

Pain referred from musculoskeletal structures

Dura mater and nerve roots

Pain originating from the dura mater is referred in a multisegmental way: it crosses the midline and may cover several consecutive dermatomes (see p. 18). A possible explanation for this phenomenon may lie in its multisegmental origin, which is reflected in the considerable overlap between the fibres of the consecutive sinuvertebral nerves innervating its anterior aspect.[4] Recent research has demonstrated that dural pain may spread over eight segments with considerable overlap between adjacent and contralateral dura mater.[5] This may be an explanation for the fact that lower cervical discodural conflicts may produce pain that spreads into the upper thoracic level (Fig. 25.2a) or that lumbar dural pain causes pain in the lower thoracic region (Fig. 25.2b).

Pain originating from a nerve root sleeve has a strict segmental reference and is restricted to the borders of the dermatome.

Thoracic disc lesions may thus cause referred pain in the thorax, not only as the result of extrasegmental reference in

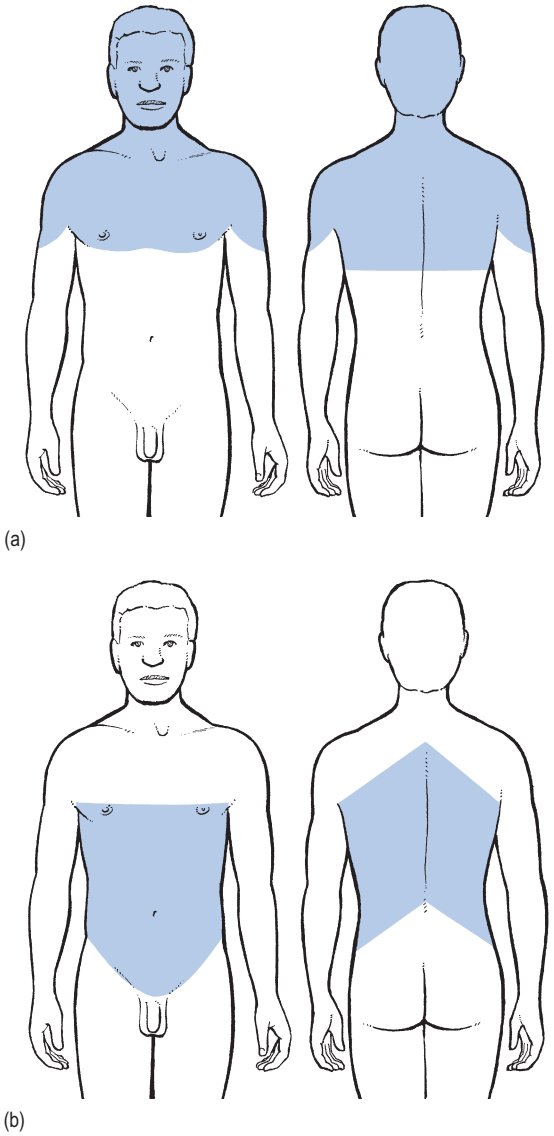


Fig 25.2 • Extrasegmental pain: (a) cervical origin; (b) thoracic origin.

the case of discodural contact, but also when a discoradicular interaction has been created. However, cervical and lumbar discal lesions may also be the origin of thoracic referred pain.

Cervical disc lesions

Some cervical disc lesions may cause pain in the thoracic region.

Cervical discodural interactions

Low cervical discodural interactions very often result in unilateral interscapular pain, usually felt above T6 and spread over several dermatomes. The pain is also often referred to the sternum and the precordial region. Exceptionally, the pain may be felt only in the anterior chest, so misleading almost all clinicians. It is important to remember that extrasegmentally referred pain of cervical origin never spreads into the upper limb (see p. 18).

Cervical discoradicular interactions

A posterolateral disc protrusion compressing the C5, C6, C7 or C8 nerve root gives rise to unilateral root pain characterized mainly by a sharp pain down the upper limb. There may also be some degree of scapular pain, especially in C7 lesions, but this is usually not very severe (see p. 156).

The C4 nerve root gives rise to pain in the trapezius area, the infraclavicular chest and the scapular region above the scapular spine.

Thoracic disc lesions

Thoracic discodural and discoradicular interactions are common causes of referred pain in the thoracic and abdominal region.

Thoracic discodural interactions

It is important to note that extrasegmental pain from a postero-central thoracic disc protrusion usually remains in the trunk itself, where it can spread anteriorly and/or posteriorly over several segments (see Fig. 25.2b). It seldom spreads into the neck or into the buttocks. The pain is usually unilateral and spreads over several segments. Exceptionally it is felt centrally at the spine, radiating bilaterally towards the sides.

Thoracic discoradicular interactions

A posterolateral impingement on the two upper thoracic roots produces pain felt in the arm (Fig. 25.3). If the T1 nerve root is involved, pain may be referred to the ulnar side of the forearm, whereas a T2 nerve root compression gives rise to pain felt over the inner aspect of the arm from the elbow to the axilla, at the anterior aspect of the upper thorax around the clavicle and at the posterior upper thorax around the scapular spine. Clinically the upper two thoracic segments belong to the cervical spine and are thus most easily examined with the cervical segments.

If the 3rd–12th root is compressed, pain spreads unilaterally as a band around the thorax, sometimes reaching anteriorly as far as the sternum (see Fig. 25.3).

The following landmarks may be helpful in determining which root is involved:

- If pain is felt around the nipple, the T5 nerve root is at fault.
- Because the epigastrium belongs to the T7 and T8 segments, pain present here arises from structures of the same origin.
- Pain at the umbilicus and in the iliac fossa may point to a lesion of the T9, T10 and T11 nerve roots.
- If the T11 or T12 thoracic root is compressed, pain may be referred to the groin or even further down to the testicle.

Lumbar disc lesions

Lumbar discodural interactions

Extrasegmentally referred pain from a lumbar discodural interaction is usually felt in the lumbar area and the abdomen, sometimes radiating into the lower limbs. The pain seldom spreads into the lower thorax.

Lumbar discoradicular interactions

Segmentally referred pain from L1, L2 and L3 nerve roots may be felt in the side and in the groin.

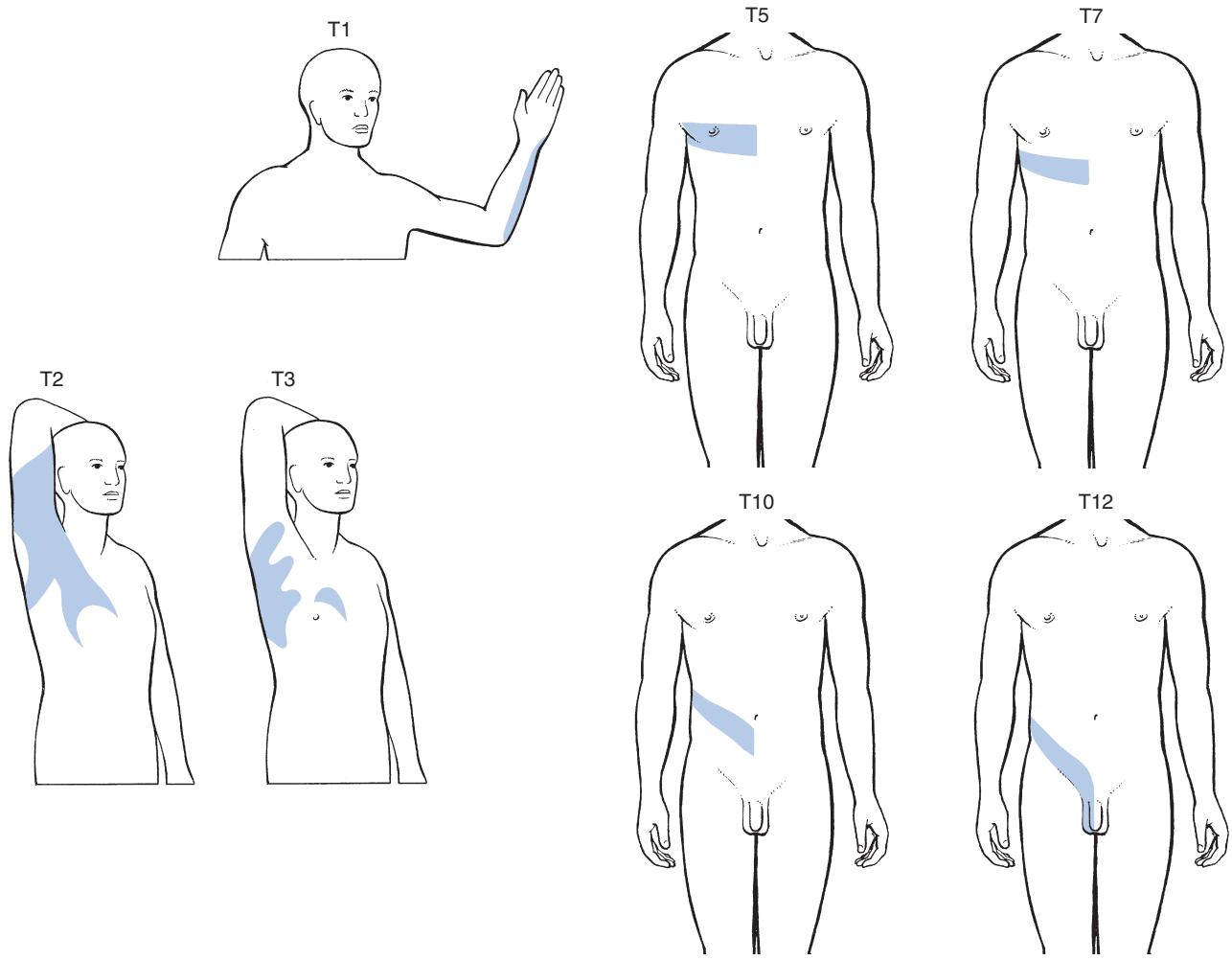


Fig 25.3 • Segmental referred pain of thoracic origin.

Nerves

Neuritis

Neuritis of the spinal accessory nerve, the long thoracic nerve and the suprascapular nerve can provoke unilateral pain at the base of the neck and over the scapula.

Herpes zoster

In that the thorax is often the seat of a herpes zoster infection, unilateral spontaneous pain of recent onset always calls for a careful inspection of the skin for erythema and grouped vesicles.

Bones

Osseous structures usually do not give rise to much in the way of referred pain; the pain remains typically local. Intense though localized pain is a warning sign and the following conditions should be considered:

- *Traumatic fracture of a vertebral body*: severe central pain is to be expected for about 2–6 weeks. For the first week there is often girdle pain. Thereafter it gradually disappears. If uncomplicated, spontaneous cure is to be expected within 12 weeks.
- *Vertebral tumours*: all types of bony tumour of the vertebrae, primary or metastatic, as well as infections, initially provoke local pain in the centre of the back.
- *Contusion or fracture of a rib*: the patient can point exactly to the tender spot. The same is the case in malignant invasion.
- *Disorders of the sternum*: traumatic disorders and tumours of the sternum may also give rise to local sternal pain.

Joints and ligaments

Ligaments and joints consistently obey the rules of referred pain, which means that the deeper the location of the affected structure and the closer its position to the midline, the more referred pain is to be expected. On the other hand, the further the lesion lies from the spinal axis and the more superficial it is, the more accurate will be its localization by the pain it provokes.

- *Manubriosternal and sternoclavicular joints*: as these are superficially located, the pain is felt locally.
- *Costochondral and chondrosternal joints* (Tietze's syndrome and costochondritis): the patient is able to indicate the site of the lesion accurately.

- *Intervertebral facet joints*: these give rise to unilateral paravertebral pain, felt deeply and locally, but not going further lateral than the medial edge of the scapula. If several joints are affected at the same time, as may be the case in ankylosing spondylitis, the pain spreads more in a craniocaudal direction than mediolaterally; the opposite is true for a disc protrusion.
- *Costovertebral and costotransverse joints*: the pain is felt unilaterally between the vertebral column and the scapula.
- *Anterior longitudinal ligament*: when this ligament is affected, pain is usually located anteriorly behind the sternum.
- *Posterior longitudinal ligament*: involvement of this ligament causes pain in the back, felt centrally between the scapulae.
- *Disorders of the costocoracoid fascia or the trapezoid and conoid ligaments* (see online chapter *Disorders of the inert structures*): the pain is usually felt in the infraclavicular fossa.

Muscular lesions

Muscular sprains of the intercostal muscles, the abdominals and the muscles of the shoulder girdle usually provoke well-localized pain at the site of the lesion.

Pain referred from visceral structures

The heart

Pain arising from disorders of the heart can be referred to dermatomes C8–T4 because the heart is derived largely from these segments. Therefore pain can radiate towards the tip of the shoulder, to the anterior chest and to the corresponding region of the back. It may also be referred towards the ulnar side of both upper limbs, though referral to the left side is more common (Fig. 25.4a). Pain from the pericardium always arises from the parietal surface because this is the only part which has a sensory innervation.

The aorta

Pain from the aorta, as in dissecting aneurysm, may be felt behind the sternum or in the abdomen, depending on the exact level of the disorder. It often radiates into the back and may expand as the lesion progresses.

The lungs

The lungs are insensitive. Therefore pain is caused either by the parietal pleura, as in pleurisy, or by invasion of the chest wall by a tumour.

The parietal pleura

Pleuritic pain is caused by an inflammation of the parietal pleura (pleurisy). Though the visceral pleura does not contain any nociceptors, the parietal pleura is innervated by somatic nerves that sense pain when the parietal pleura is inflamed. Parietal pleurae of the outer rib cage and lateral aspect of each hemidiaphragm are innervated by intercostal nerves. Pain is localized to the cutaneous distribution of those nerves. The phrenic nerve supplies innervations to the central part of each hemidiaphragm which is a C4 structure, with pain reference to the trapezius area.[6]

The oesophagus

Disorders of the oesophagus (T4–T6) usually give rise to pain felt at any part of the sternum, often radiating between the scapulae into the back (Fig. 25.4b).

The diaphragm

The central part of the diaphragm is mainly derived from the third, fourth and sometimes, although rarely, the fifth cervical segments. Pain from irritation of the central part of the diaphragm is felt at the tip of the shoulders and the base of the neck. Pain from the peripheral part is felt more locally in the lower thorax and in the upper abdomen at the costal margin (Fig. 25.4c).

The stomach and duodenum

Pain from stomach and duodenum (T6–T10) is most commonly felt in the epigastrium and upper abdomen, sometimes substernally and exceptionally in the lower thoracic part of the back (Fig. 25.4d).

The liver, gallbladder and bile ducts

The liver is derived from the right side of T7–T9. The gallbladder and bile ducts are of right T6–T10 origin. Pain is felt in the right hypochondrium and may radiate towards the inferior angle of the right scapula (T7–T9) (Fig. 25.4e).

The pancreas

Patients suffering from a pancreatic disorder complain of upper abdominal pain often referred to the back at T8 (Fig. 25.4f).

The spleen

Pain arising from disorders of the spleen is usually felt in the left hypochondrium, sometimes in the left side at low thoracic level (T7–T10).

The small intestine, appendix and colon

Problems in the small intestine (T9–T10) give rise to pain felt around the umbilicus. In disorders of the colon (T10–S5), pain is usually felt in the neighbourhood of the lesion. The appendix is a T10–L1 structure.

The kidneys and ureters

Disorders of kidney and ureters (T10–L1) give rise to pain felt posteriorly in the side, at and just below the lower ribs, and at the anterolateral aspect of the abdomen. The pain often radiates towards the testicles or the labia (Fig. 25.4g).[7]

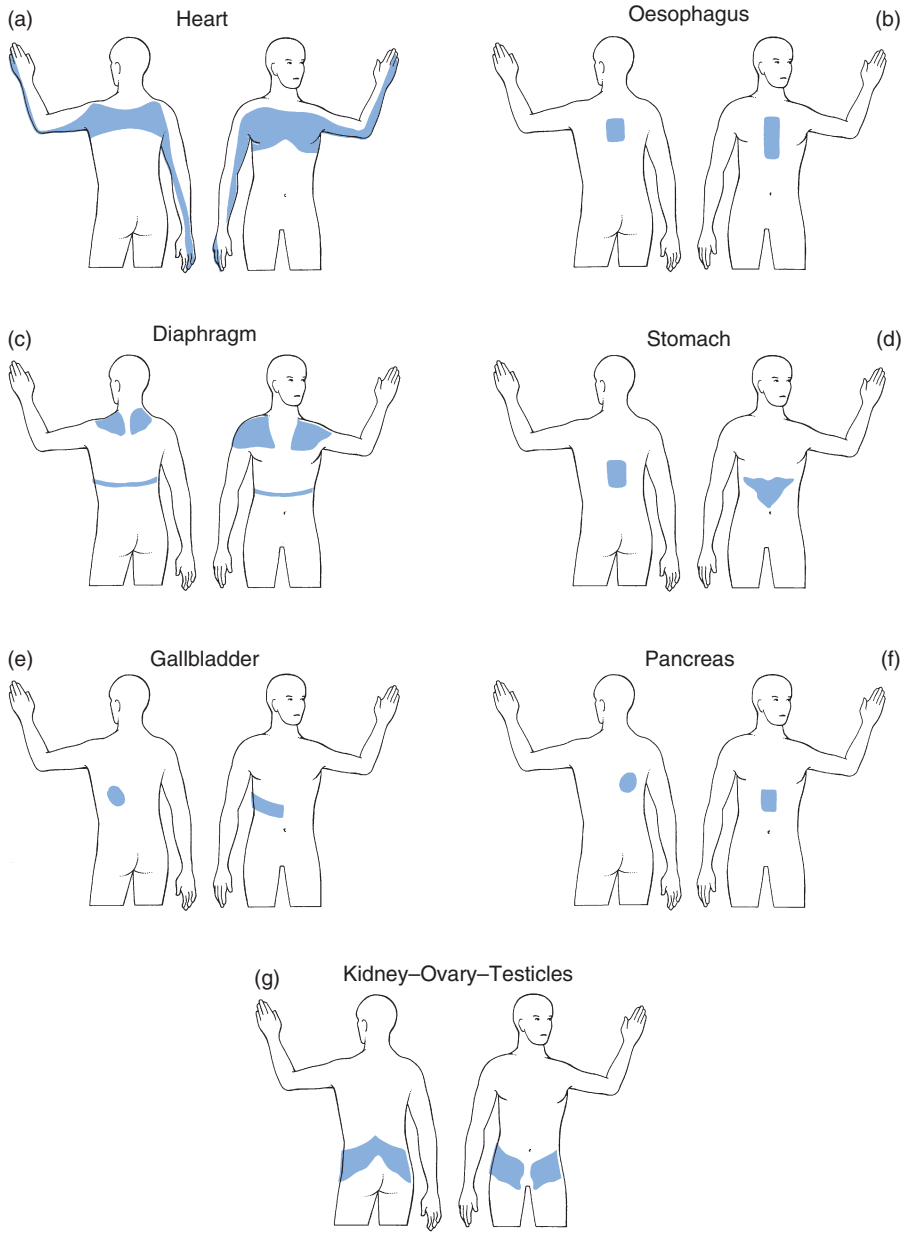


Fig 25.4 • Pain referred from visceral structures: (a) heart; (b) oesophagus; (c) diaphragm; (d) stomach; (e) gallbladder; (f) pancreas; (g) kidney/ovary/testicles.

Reproductive system

Disorders of the ovaries (T11–L1) may result in unilateral low abdominal pain, sometimes felt in the periumbilical area. Testicular problems (T11–L1) give rise to scrotal pain, sometimes radiating into the groin and to the side.

See Box 25.1 for a summary of referred pain in the thorax and abdomen.

History

In dealing with pain in the thorax or abdomen, the main goal of history taking is to differentiate between musculoskeletal and visceral problems. As already pointed out, a relationship between the patient's symptoms and positions or activities does not necessarily exclude a visceral disorder, because in several visceral disorders the same relationship exists.

The history is kept simple and clear. Detailed information is elicited about pain, paraesthesia and the intake of anticoagulants or the presence of bleeding disorders.

Pain

What made the pain come on?

If the patient mentions an injury to the chest, a bony problem of the ribs, sternum or vertebra is likely. In a pathological fracture sudden pain may follow a very trivial movement.

Box 25.1

Summary of referred pain in the thorax and abdomen

Pain of musculoskeletal origin

Dura mater and nerve roots

- Cervical disc lesions
- Thoracic disc lesions
- Lumbar disc lesions

Nerves

- Neuritis
  - Spinal accessory nerve
  - Long thoracic nerve
  - Suprascapular nerve
- Herpes zoster

Bones

- Vertebrae
  - Fracture
  - Bony tumours
  - Infections
- Ribs
  - Contusion and fracture
  - Malignant invasion of a rib
- Sternum
  - Fracture
  - Tumours

Joints and ligaments

- Manubriosternal and sternoclavicular joints
- Costochondral and chondrosternal joints
- Intervertebral facet joints
- Costovertebral and costotransverse joints
- Anterior and posterior longitudinal ligaments
- Costocoracoid and coracoclavicular ligaments

Muscular lesions

- Intercostals
- Pectoralis major
- Pectoralis minor
- Subclavius
- Latissimus dorsi
- Serratus posterior inferior
- Abdominals

Pain of a visceral nature

- Heart
- Aorta
- Pleura and lungs
- Oesophagus
- Diaphragm
- Stomach and duodenum
- Gallbladder and bile ducts
- Pancreas
- Spleen
- Small intestine and colon
- Kidney and ureters
- Genitals

When the pain has come on without trauma, it is of interest to know what the patient was doing at the time and in which position the body was held. Thoracic disc lesions are, just like lumbar ones, most often the result of a combined flexion–rotation movement. However, in disc lesions a history of such provocation cannot always be obtained, the patient stating that the pain started without any specific activity or posture.

Pain that came on after a forceful movement of trunk or arms – such as during sporting activities – may be from a muscular lesion.

Arthritis of the costovertebral, costotransverse or facet joints begins spontaneously. When it is the result of ankylosing spondylitis, pain and stiffness often occur in phases and are usually worst in the early morning.

Warning

Pain of spontaneous onset, increasing in intensity and constantly expanding, should be suspected of being caused by a tumour.

Where was the pain at the beginning, where did it spread or shift to, and where is it now?

When the pain is felt between the scapulae above T6, a cervical disc problem is most likely. In such cases, clinical examination of the cervical spine should be done initially. If this is negative, clinical examination of the thorax follows.

A thoracic disc lesion usually gives rise to discomfort felt centrally or unilaterally in the posterior thorax. Here, as in the cervical spine, the pain may be felt centrally at first and then shift more to the side. A shifting pain suggests a shifting (disc) lesion.

A posterocentral protrusion interfering with the dura normally results in unilateral extrasegmental referred pain, usually felt in the anterior chest. However, it can also give rise to abdominal pain, discomfort in the groin and even lumbar pain. Sometimes bilateral extrasegmental pain is felt posteriorly and over several segments on both sides.

An acute 'thoracic' lumbago may exceptionally cause pain felt only at the sternum. This is a most misleading phenomenon, as it is not very logical to think of a disc problem in a patient with an acute sternal ache not preceded by any posterior thoracic pain. The possibility of such reference should always be borne in mind.

In posterolateral disc protrusions, pain is felt unilaterally and is referred to one segment only. It is mainly felt posteriorly and at the side but sometimes also anteriorly. This type of protrusion usually follows a posterocentral displacement that has subsequently shifted more laterally. In this case, root pain is preceded by a period of extrasegmental referred dural pain. In the rare event of a primary posterolateral protrusion, the disc fragment moves directly in a posterolateral direction. From the onset, pain is felt to the side, radiating segmentally anteriorly and not preceded by extrasegmental pain.

Pain which increases and expands all the time is from a 'growing' disorder, usually a tumour. Older patients who are symptom-free on first waking in the morning but complain of

central posterior thoracic pain that starts after some hours and increases throughout the day, are likely to be suffering from posterior bulging of the whole content of an intervertebral disc as a consequence of excessive thoracic kyphosis.

Pain felt at the base of the neck is sometimes the result of a problem at the first costovertebral joint, the sternoclavicular joint or a fracture of the first rib.

Pain at the sternum is seldom the result of a musculoskeletal disorder. Most often it has a visceral origin. The same is true for pain felt in the abdomen: muscular lesions do exist but are rare. They usually give rise to well-localized pain.

Is the pain influenced by coughing, sneezing or deep inspiration?

When a Valsalva manœuvre or a deep breath provokes or increases the cervical or lumbar pain, it is generally interpreted as a dural symptom, from interference with the dura mater by a protruded disc or a tumour. In the thoracic area, it is not so simple. Many disorders other than problems of the dura may give rise to the same symptom. Deep inspiration may increase pain because of one of a number of visceral disorders or other musculoskeletal problems. Tumours of the respiratory tract, pleurisy, lung embolism, pneumothorax and even pericarditis can all give rise to pain increased by coughing or respiration. The same may be found in non-discal musculoskeletal problems of the ribs and sternum. Fractures and contusions of the ribs, a sprained intercostal muscle and a fracture of the sternum are all in the same class. Consequently, the influence of respiration on symptoms at the thoracic level is only regarded as a dural symptom once there is clinical certainty of disc protrusion. In thoracic disc protrusions it is more usual for deep inspiration, rather than a cough, to exacerbate the symptoms.

Paraesthesia

Protrusion of a disc in the thoracic region can produce pins and needles in two ways. First, it may be the result of compression of the spinal cord, which is characterized by extrasegmental pins and needles felt in both feet and typically increased or provoked by flexion of the neck. Cord compression and paraesthesia can also be caused by intra- and extraspinal tumours, intraspinal haemorrhage or a vertebral fracture. Second, paraesthesia can be stem from posterolateral protrusion compressing a nerve root. For example, pins and needles may be felt in the groin from compression of the T12 nerve root. In this event, the features are always localized and limited to the corresponding dermatome.

Both causes are rare, and when paraesthesia is present, other conditions, such as neuropathy due to generalized disorders (diabetes, pernicious anaemia and multiple sclerosis), must always been considered first.

Anticoagulant treatment and bleeding disorders

The use of anticoagulants is always an absolute contraindication to manipulation of the spine, because it can lead to uncontrollable intraspinal bleeding. The same applies in congenital or acquired disorders of blood coagulation.

Inspection and palpation

On inspection, the curvature of the thoracic spine is noted. Scoliosis and hyperkyphosis may be detected.

Scoliosis

A deformity in the frontal plane is named scoliosis. If present, it is important to determine whether it is located at the lumbar or thoracic level. Thoracic scoliosis can often be voluntarily corrected by the patient. In this event, it is postural and has no specific pathological implications. In structural scoliosis, the deformity cannot be corrected by muscular activity. There is often associated shoulder asymmetry too. In this event, the scapula at the convex side is usually more prominent and the arm of this side touches the hip, but the other arm hangs further away from the body.

Kyphosis

A hyperkyphotic thoracic spine with a flattened lumbar spine may suggest ankylosing spondylitis. An excessive low thoracic and high lumbar kyphosis can be the result of Scheuermann's disease or osteoporosis.

Sometimes a localized angular kyphosis is found as the result of a collapsed vertebral body, usually due to pathological or traumatic fracture or resulting from adolescent osteochondrosis. It is best felt by gliding the fingers over the spinous processes in a craniocaudal direction. It is more difficult to detect at the thorax than elsewhere because of the general kyphotic shape of the thoracic spine.

Functional examination

Clinical routine differs significantly according to the level of the pain (Fig. 25.5). For a number of reasons, pain felt above the T6 level (mid-scapular) demands a preceding clinical examination of the cervical spine and the shoulder girdle. First, the upper two thoracic vertebrae, anatomically belonging to the thoracic spine but clinically part of the cervical spine, are tested in the clinical examination of the cervical spine. Second, it was demonstrated previously that cervical discodural interactions often provoke extrasegmentally referred pain in the upper half of the thorax. Third, numerous lesions of the thoracic apex and the shoulder girdle, although causing pain in the cranial aspect of the thorax, are only detected by proper examination of the cervical spine and/or the shoulder girdle: a tumour of the apex of the lung involving the T1 nerve root is only detected by cervical tests; neuritis of the suprascapular nerve causes pain in the supraspinatus fossa and is detected by a combined weakness of supra- and infraspinatus muscles. A fracture of the first rib provokes upper thoracic pain but the diagnosis can be missed if the examiner proceeds immediately

with examination of the thoracic spine. For all these reasons, in patients with upper thoracic pain, a full cervical examination followed by examination of the shoulder girdle must be done first. Only when these are negative should a thorough examination of the thoracic spine follow.

If the patient has pain below T6, a cervical or shoulder girdle problem is unlikely and attention is immediately directed to the thoracic spine.

Functional examination of the thoracic spine consists of a large set of basic tests. The examination is performed with the patient standing, sitting and lying prone. During the procedure, dural, articular, muscular and cord signs are sought. Sometimes, when particular symptoms or signs from the basic examination warrant, the procedure is completed by specific accessory tests.

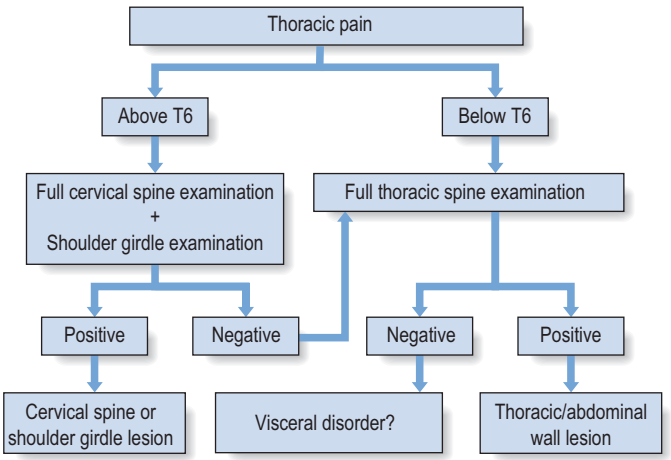


Fig 25.5 • Examination strategy in thoracic pain.

Standing

Dural tests

It is believed that deep inspiration, neck flexion and some scapular movements may indirectly stretch the dura mater.

Taking a deep breath (Fig. 25.6a)

The patient is asked to take a deep breath and to state if the pain increases. A positive test is regarded as a dural sign only when, after the rest of the examination is performed, a disc lesion seems to be present. In such a case, stretching of the dura mater via the intercostal nerve roots is interfered with.

Flexion of the neck (Fig. 25.6b)

The patient is asked to bend the head actively forward. This may increase the pain or provoke paraesthesia.

In thoracic spine problems, pain during active neck flexion is basically regarded as a dural sign because flexion stretches the dura mater from above. However, pain on neck flexion as the result of impaired dural mobility does not necessarily mean a disc lesion is present. Indeed, any kind of intraspinal space-occupying lesion that interferes with the dura, such as a tumour, may provoke pain on neck flexion. A problem with one of the posterior ligaments or posterior paravertebral muscles may also cause pain on neck flexion.

Sometimes a patient feels a sudden sensation on neck flexion, resembling an electrical discharge going down his back and occasionally even spreading towards both arms and legs. Sometimes it also occurs on extension of the neck. This is known as Lhermitte's sign and was previously regarded as pathognomonic for disorders of the cord at the cervical level. In later reports it has been suggested that problems of the thoracic cord may cause the same sign. This can be caused by

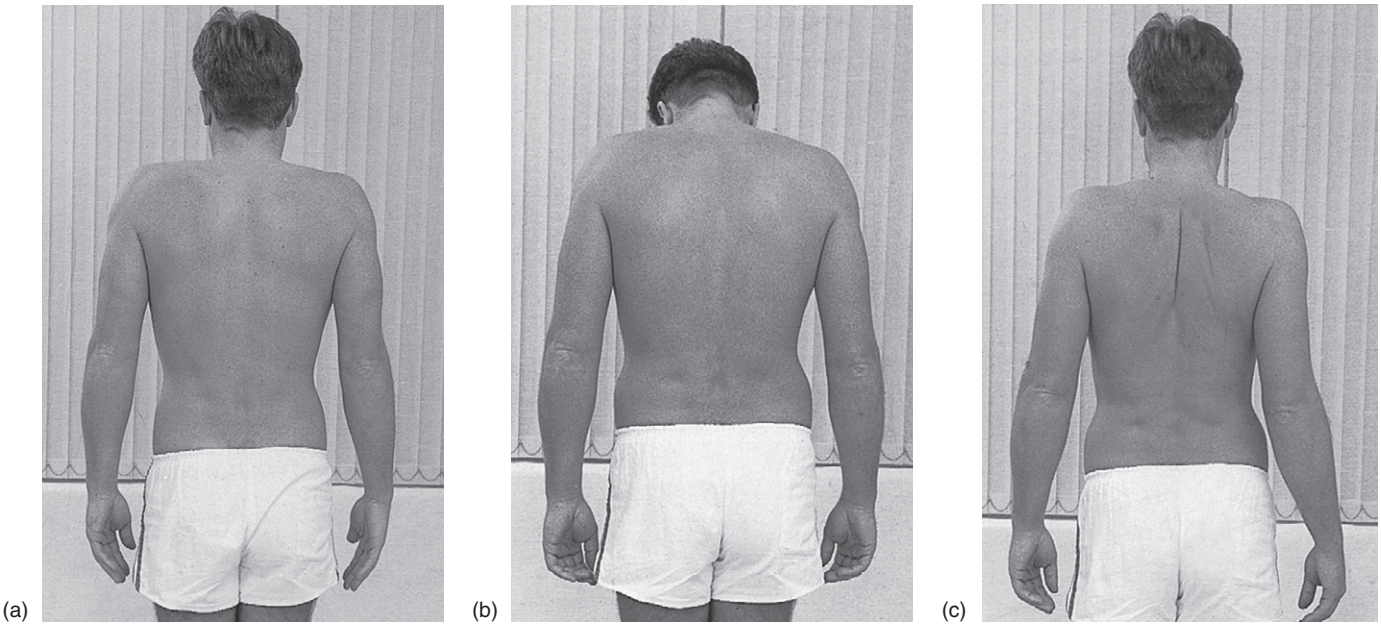


Fig 25.6 • Dural tests at the thoracic level: (a) taking a deep breath; (b) flexion of the neck; (c) backward movement of the scapulae.

multiple sclerosis, a tumour of the cord, disc lesions, tuberculosis, spondylosis, arachnoiditis or radiation myelopathy.[8]

Neck flexion may also provoke or increase pins and needles. If these are felt in one or both lower limbs, this draws attention to compression of the spinal cord at the thoracic level, which is most commonly the result of a disc lesion or a tumour.

Shoulder movements: upwards, forwards and backwards

The patient is now asked to shrug both shoulders and to bring them forwards and backwards.

These tests are basically active movements of the structures of the shoulder girdle. Therefore some will be positive when a disorder of one of those structures is present (see online chapter *Applied anatomy of the shoulder girdle*).

However, if one or all of these movements elicits pain, it is most frequently the result of a thoracic disc lesion, because they all (to a greater or lesser degree) stretch the dura mater at the thoracic level, which is elongated in a cranial direction via the T1 and T2 nerve roots (Cyriax[9]: p. 202). The most sensitive test is scapular approximation (shoulders backwards, Fig. 25.6c).

Active trunk movements

The patient is now asked to perform six active movements of the trunk. These involve both the thoracic and the lumbar spine. Differentiation is made by the level of the pain, as indicated by the patient, and on extension pressure at the end of the examination.

On flexion, extension and side flexion to both sides the range of movement is greatest in the lumbar spine, rather than the thorax. Rotation movements, in contrast, occur only slightly at the lumbar level and involve mostly the thoracic spine.

The movements performed are:

- Anteflexion (Fig. 25.7a)
- Extension (Fig. 25.7b)
- Left side flexion (Fig. 25.7c)
- Right side flexion (Fig. 25.7d)
- Left rotation (Fig. 25.7e)
- Right rotation (Fig. 25.7f).

The patient performs these movements actively. Pain and limitation are noted. In structural scoliosis the associated hump persists and is accentuated on forward bending.

While performing rotations, the patient keeps the head in neutral position in relation to the shoulders, to avoid cervical rotation.

Conclusions from active trunk movements

In principle, the six movements described so far are articular. However, because they are performed actively, they involve some contractile structures as well. Passive and resisted movements (see below) provide the key in differential diagnosis between inert and contractile structures. After these tests, the examiner should know whether an articular pattern is present or not.

The articular pattern of the thoracic spine is an equal degree of pain and limitation of both side flexions and of both rotations, together with a larger limitation of extension and little or no limitation of anteflexion (Fig. 25.8). It resembles the pattern for the cervical spine. If this is found, a disorder of the entire segment of motion, such as in ankylosing spondylitis or osteoarthrosis, is present.

Any other combination of abnormal tests is regarded as a partial articular pattern (Fig. 25.9). Such a combination could be, for instance, pain on one rotation or one side flexion together with one rotation, or one side flexion and extension, or three, four or five of the six movements being positive in producing pain or limitation. As long as abnormal tests are present in a non-symmetrical way, the pattern is regarded as being partial articular.

In all types of disc lesion a partial articular pattern is expected. In the thoracic spine, a common finding is that only one out of the six articular movements is positive – usually one of the rotations. Differentiation must always be made from a facet joint lesion or a muscular lesion, in which a partial articular pattern is also found. In the latter, some of the resisted movements are more painful.

Warning

When side flexion away from the painful side (Fig. 25.10) is the only painful and limited movement, this always indicates a severe extra-articular lesion such as a pulmonary or abdominal tumour or a spinal neurofibroma.

Sitting

The examination is now continued by looking at passive and resisted rotations to both sides, with the patient sitting. In the seated position Babinski's reflex is also elicited.

Passive tests

- Passive left rotation (Fig. 25.11a)
- Passive right rotation (Fig. 25.11b).

The patient crosses both arms in front of the chest. The knees are held between the examiner's legs to immobilize the pelvis. The patient's trunk is now twisted towards the left and the right by the examiner. Pain, range of movement and end-feel are noted.

The normal end-feel is elastic. A hard end-feel is typical of ankylosing spondylitis or advanced arthrosis. Both an empty end-feel and muscle spasm suggest a severe disorder: neoplasm, fracture and infectious disorders.

Rarely, pain is present at half range, disappearing when rotation continues. This is known as a painful arc and was regarded by Cyriax[9] as pathognomonic for a disc lesion when combined with a partial articular pattern.

At the end of both passive rotations the patient is asked to bend the head actively forwards. If this movement further increases the pain, it is regarded as a dural sign if the rest of the examination suggests that a disc lesion is present.

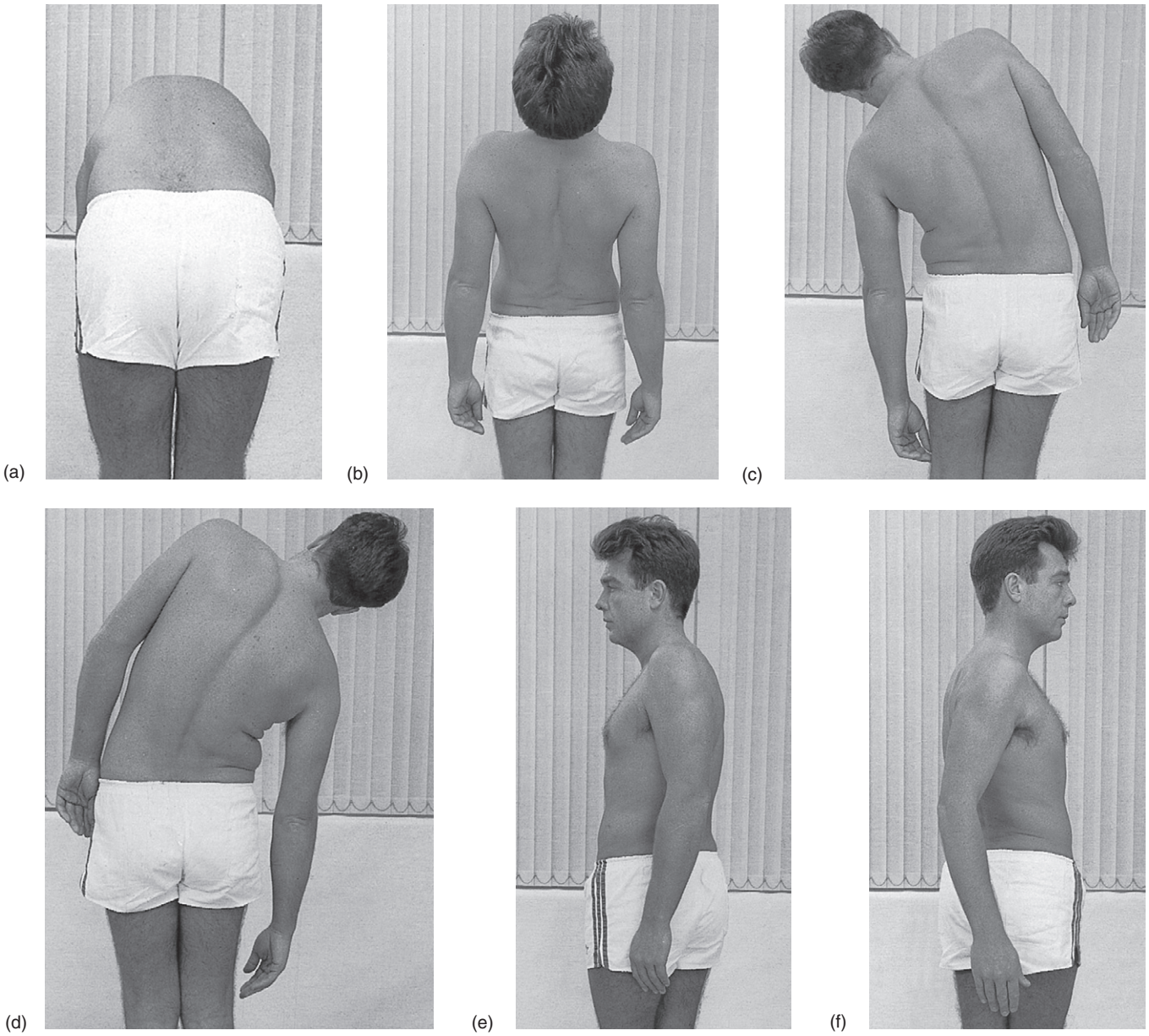


Fig 25.7 • Active trunk movements: (a) anteflexion; (b) extension; (c) left side flexion; (d) right side flexion; (e) left rotation; (f) right rotation.

Resisted tests

In the same position as used for the passive tests, isometric contractions are done. The patient is asked to twist the trunk to the left (Fig. 25.12a) and to the right (Fig. 25.12b) while the examiner applies counterpressure at both shoulders, so that the patient is kept immobile. Pain and weakness are noted. Because muscular lesions do occasionally occur at this level, these tests must always be performed.

The results of both resisted and passive rotations are carefully compared. In a disc lesion, passive rotations are more painful than resisted ones. Given that resisted movements are more painful, a muscular problem is most likely, unless a psychogenic problem or a rib fracture is present. In both events, accessory tests should follow (see below).

Cord sign: plantar reflex

The examiner glides a relatively sharp instrument along the lateral aspect of the sole, starting at the heel and moving forwards and medially towards the big toe (Fig. 25.13). Normally the toes either do not move at all or they all uniformly go into flexion. This test is pathological if the patient spreads the toes apart and the big toe moves into extension. A positive test indicates interruption of the descending motor fibres. If there is the slightest doubt about interference with the spinal cord, a full neurological examination of the lower limbs must be carried out. This includes all reflexes in the lower limbs and abdomen, resisted movements of the thigh and leg musculature, control of coordination, testing for numbness and temperature sensitivity, and the straight leg raising test.

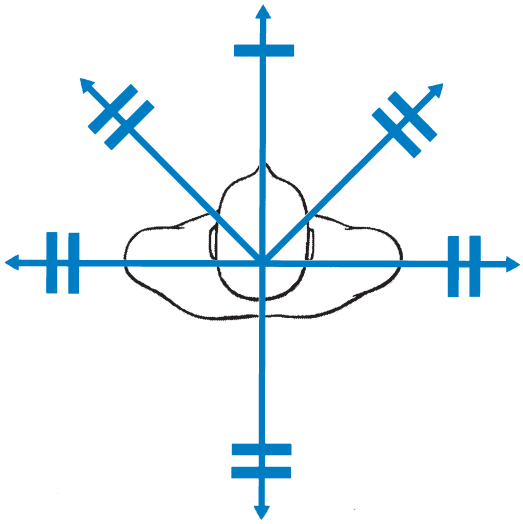


Fig 25.8 • The full articular pattern.

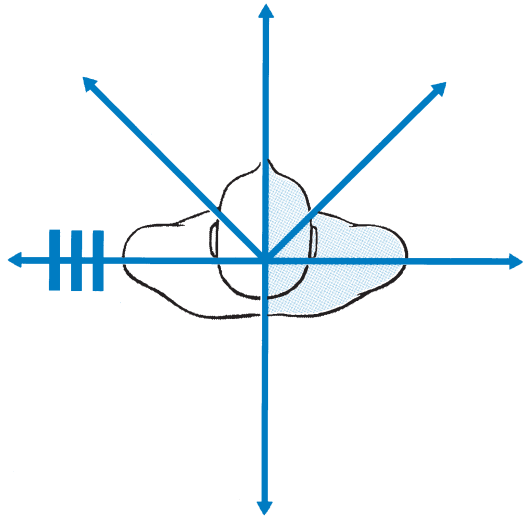


Fig 25.10 • Pain and limitation on side flexion away from the painful (coloured) side is a warning sign for serious disorders.

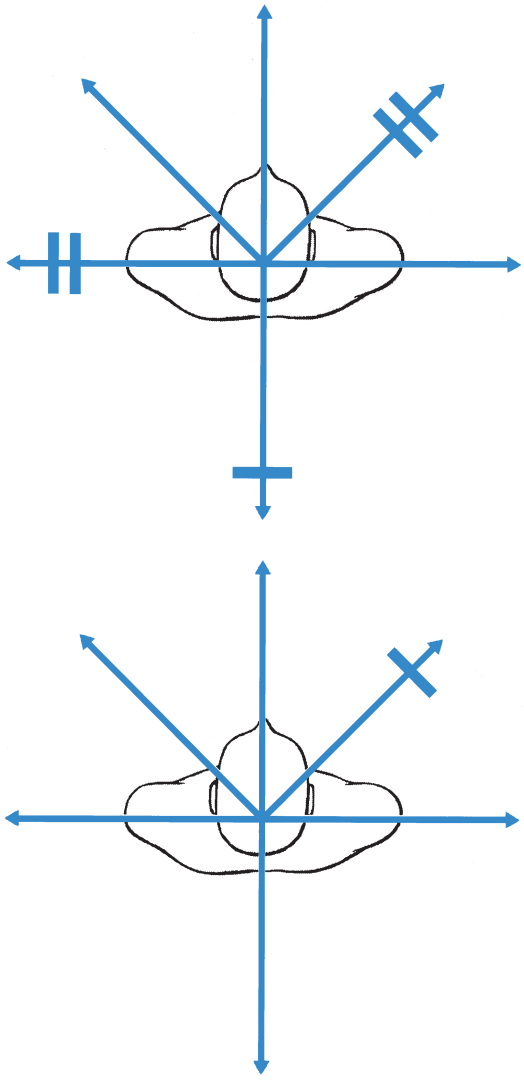


Fig 25.9 • Examples of partial articular patterns.

Lying prone

Location of affected level by passive extension thrust

The patient lies prone and a hyperextension thrust is given over every thoracic spinous process to locate the painful level. To do this, the hand is placed obliquely, with the fifth metacarpal bone on the spinous process (Fig. 25.14). Identification of the exact level is important, because some manipulations for thoracic disc protrusions are performed specifically at the level at fault.

During extension pressure, attention is also paid to the type of end-feel. Normally it is elastic. Muscle spasm is a warning of more severe disorders.

Accessory tests

To reach a diagnosis, the basic clinical examination normally suffices. In circumstances that remain unclear or when a muscular problem is suspected, accessory movements must be carried out.

Stretching the T1 nerve root

The patient is asked to lift the arm sideways from the horizontal. The hand is now put in the neck by flexing the elbow (Fig. 25.15). This movement stretches the T1 nerve root via the ulnar nerve, which may provoke pain between the scapulae or down the arm when the mobility of the T1 nerve root is impaired. The test is useful for differentiating between a problem of the cervical spine and one of the upper thorax which interferes with the dura or the T1 nerve root: if it is painful, a thoracic problem is more likely.

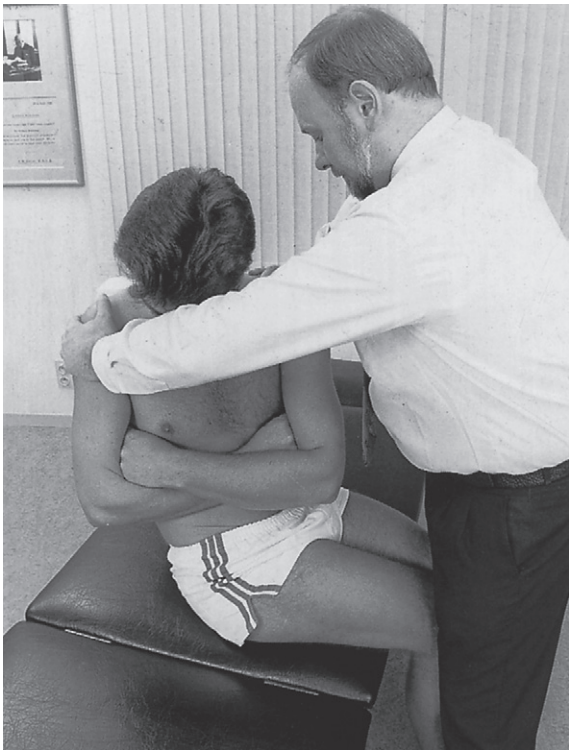
(a)   (b)

Fig 25.11 • Passive rotation: (a) left; (b) right. At the end of each movement the patient is asked to bend the head forwards.

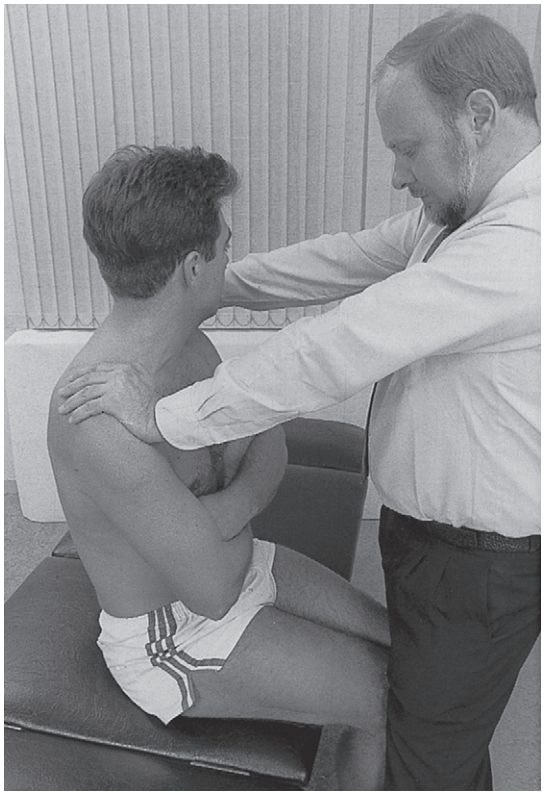
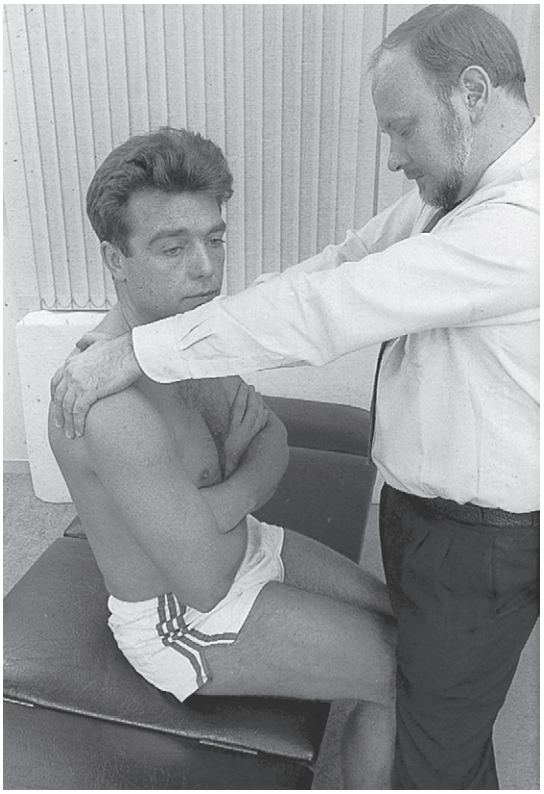
(a)   (b)

Fig 25.12 • Resisted rotation: (a) left; (b) right.

Fig 25.13 • Testing the plantar reflex.

Resisted movements and extension of the trunk

To gain more information on a muscular lesion, the following resisted movements should be performed.

Resisted side flexion (Fig. 25.16)
The patient stands, with the feet slightly apart. The examiner places himself at the patient's painless side, hips against each other, and puts the arm around the patient's farther shoulder. The patient is now asked to bend sideways away from the examiner. By holding the patient's shoulder, side flexion of the trunk is resisted.

Resisted flexion (Fig. 25.17)
With the patient sitting down, the examiner places one hand on the proximal part of the sternum and the other on the patient's knees. The patient tries to bend forwards against resistance exerted by the examiner. This is a test for all the flexors of the abdomen and of the hip.

Extension of the trunk

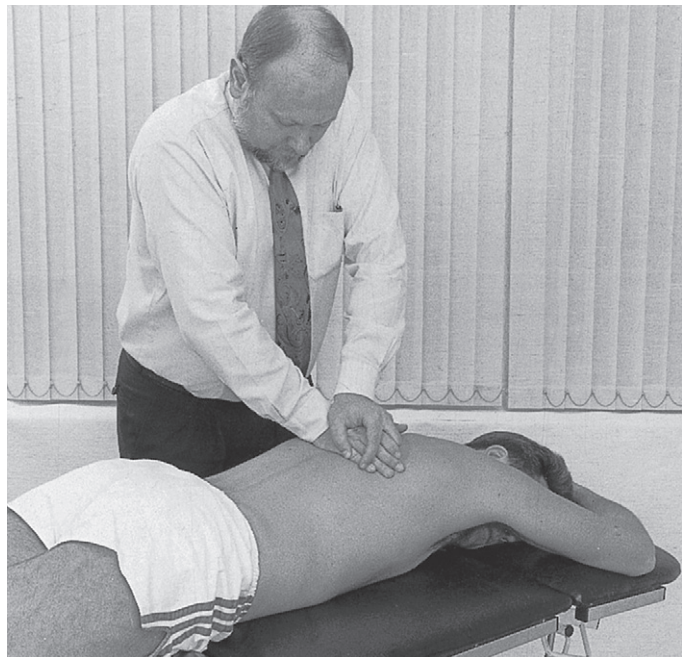
This movement is performed in three different ways.

Resisted extension (Fig. 25.18a)
Resisted extension is best done with the patient prone. Counterpressure is applied at the proximal part of the thorax and at the posterior aspect of the knees.

Active extension (Fig. 25.18b)
For active extension the patient remains prone and is asked to lay both hands on the sacrum and lift the trunk off the couch actively by use of the paravertebral muscles.

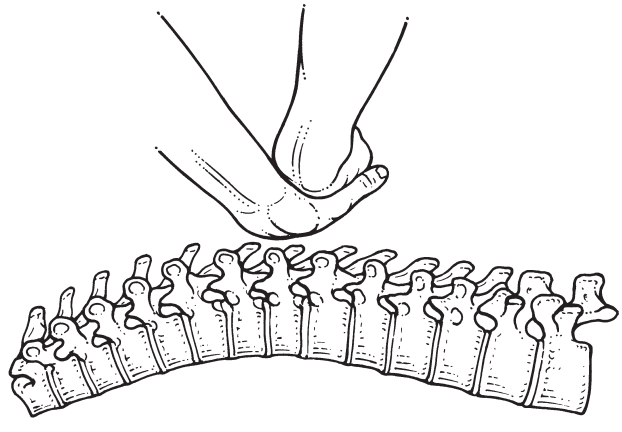
Passive extension (Fig. 25.18c)
For passive extension the patient pushes the body up off the couch by means of the arms. The pelvis must stay down on the couch.

The results of extension movements are carefully compared with each other. In a muscular lesion, active and resisted extension is painful but resisted extension is the most distressing. In a lesion of an inert structure, active and passive extension is painful but the latter provokes the most pain.



(a)

(b)



(c)

Fig 25.14 • Passive extension thrust.

Testing the long thoracic nerve

The patient pushes against a wall with the arms stretched out horizontally in front (Fig. 25.19). If the medial edge of the scapula moves away from the thorax to produce a winged appearance, a disorder of the long thoracic nerve is present.

Oscillation of a rib

The examiner stands on the pain-free side and places one hand distally on the thorax, with the fifth metacarpal bone exactly on the suspected rib. The other hand rests with the pisiform bone on the contralateral transverse process of the corresponding vertebra (Fig. 25.20). Oscillations are now given by the hand resting on the rib. At the same time, the other hand is used to prevent rotation of the vertebra by pressing simultaneously on the transverse process. These oscillations influence mainly the costovertebral and costotransverse joints. When there is inflammation, pain will be provoked; when ankylosing spondylitis is present, the movement will be less elastic.

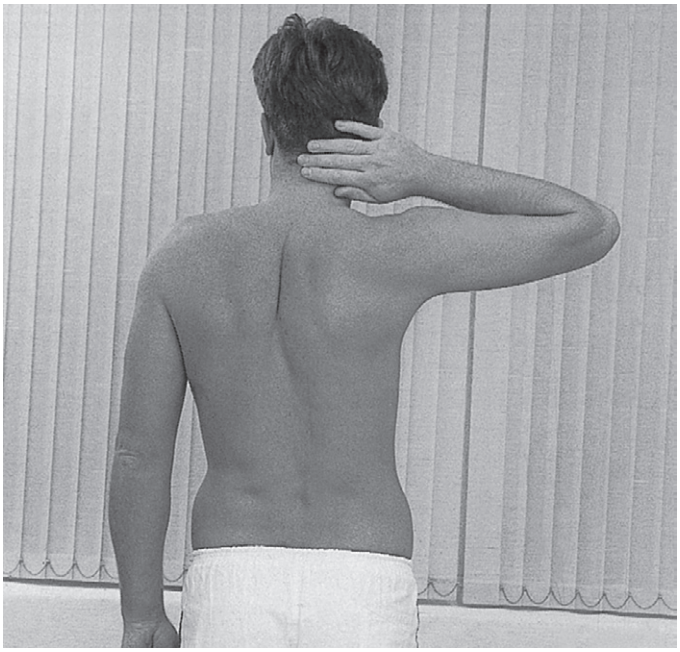


Fig 25.15 • Stretching the T1 nerve root.

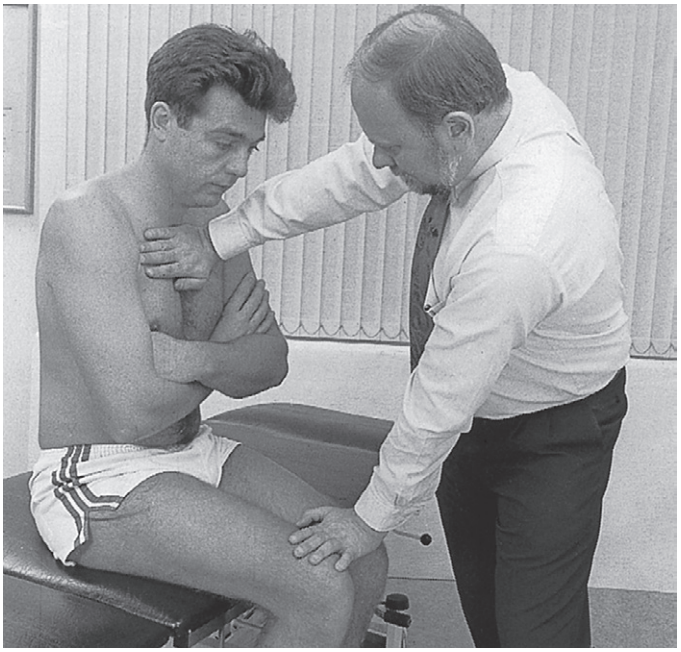
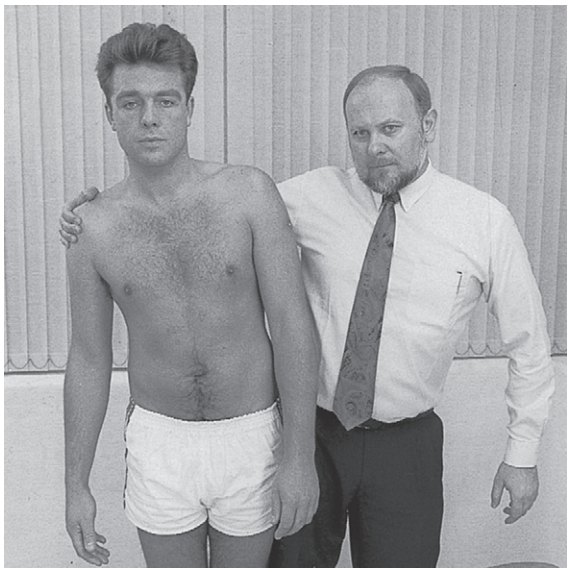
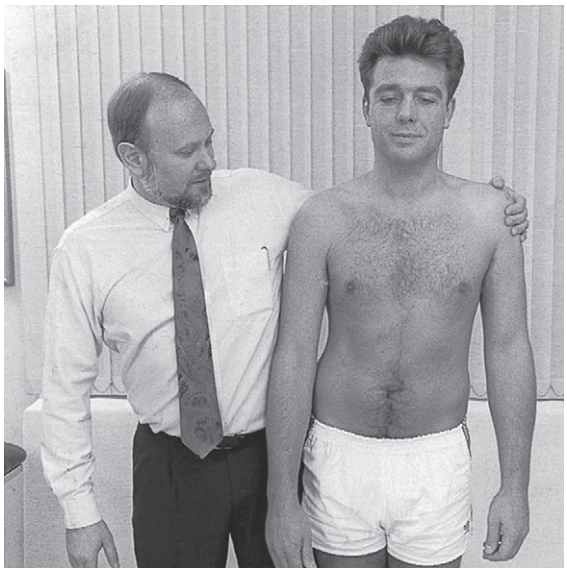


Fig 25.17 • Resisted flexion.

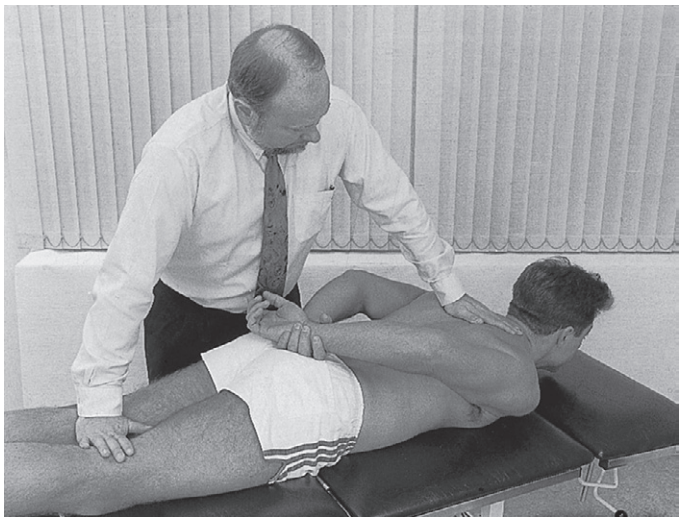
(a)



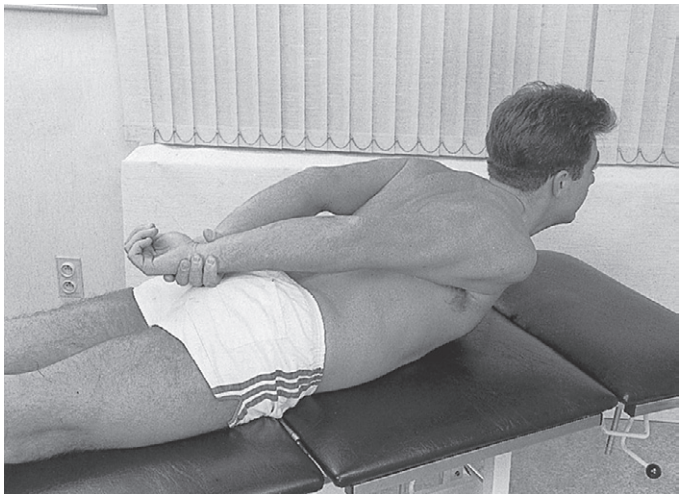


(b)

Fig 25.16 • Resisted side flexion: (a) right; (b) left.



(a)



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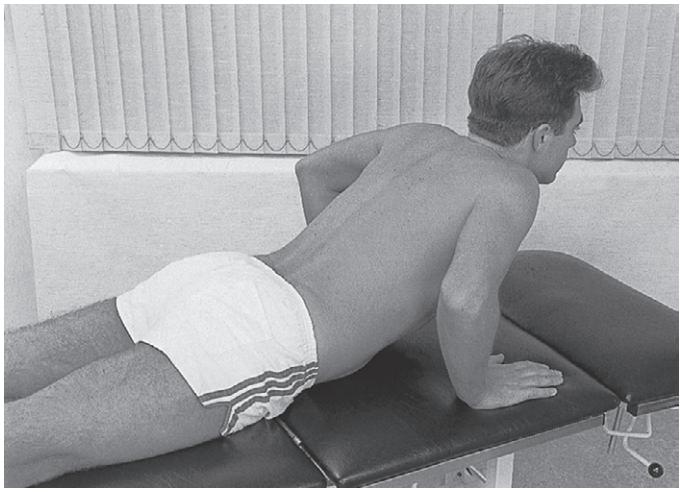


(c)

Fig 25.18 • Extension of the trunk is performed in three different ways: (a) resisted; (b) active; (c) passive.

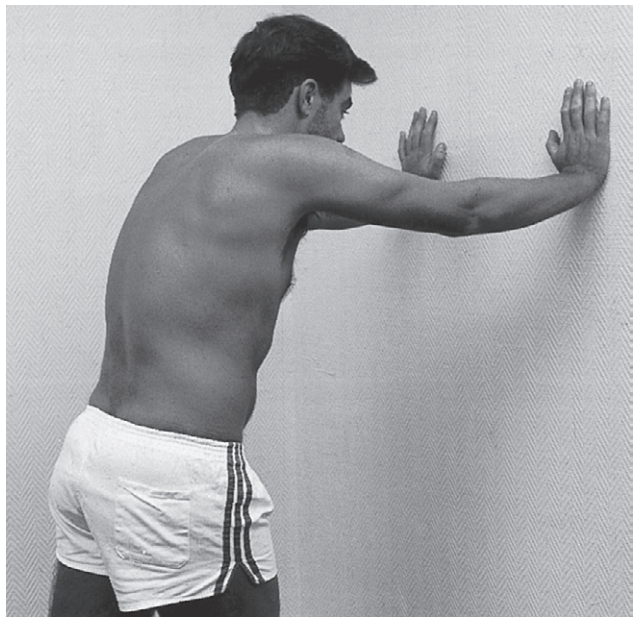


Fig 25.19 • Testing the long thoracic nerve.

Neurological examination

A full neurological examination must be carried out when compression of the spinal cord or a neurological disorder is suspected.

The following accessory tests should be performed.

Beevor's sign

The patient lies supine, crosses the arms in front of the chest and is asked to raise the trunk slightly off the couch. The examiner pays attention to the umbilicus, which should not move during this test. Any movement in a cranial or caudal direction or to the side may point towards a denervation of the contralateral muscles.

Cremasteric reflex (in men)

When the pointed end of a reflex hammer is glided over the medial aspect of the thigh, the ipsilateral half of the scrotum moves upwards via contraction of the cremaster muscle. Absence of this reflex may point towards a lesion of the spinal cord.

Full neurological examination of the lower limbs

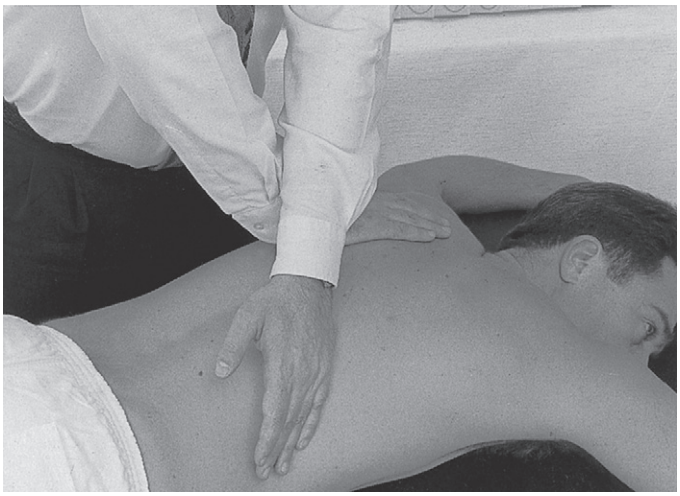
This is described in Table 25.1.

Oppenheim's sign

This may confirm a positive Babinski's sign. When the fingers are slid downwards along the tibia, no movement of the toes should occur. In cord compression, the big toe extends while the others spread. However, this test is less reliable than a Babinski's sign.

Palpation

If a muscular lesion is suspected, the affected structure should be palpated.



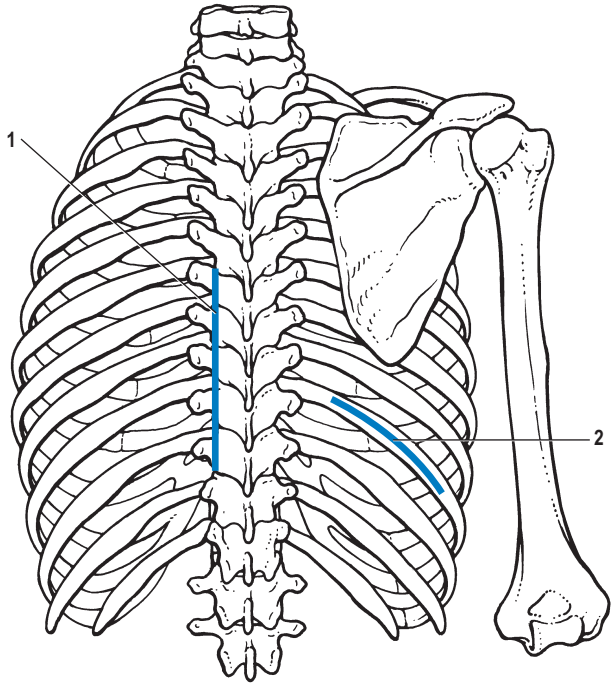


Fig 25.20 • Oscillation of a rib: 1, position of fifth metacarpal right hand; 2, position of fifth metacarpal left hand.

Palpation is also necessary to differentiate between a lesion of an intercostal muscle and a true rib problem.

In a disc lesion, cutaneous anaesthesia must always be checked. If present in the territory of one nerve root, a posterolateral protrusion is likely; bilateral numbness suggests compression of the spinal cord instead.

The clinical examination of the thoracic spine is summarized in Box 25.2.

Technical investigations

Plain radiographs are useful in confirming osseous lesions and in the evaluation of degree and development of scoliosis.

Table 25.1 Full neurological examination of the lower limbs

Tests	Nerve root
Inspection of gait	
Motor tests	
Resisted flexion of hip	L2–L3
Resisted extension of knee	L3
Resisted dorsiflexion of foot	L4
Resisted extension of big toe	L4–L5
Resisted eversion of foot	L5–S1
Resisted flexion of knee	S1–S2
Squeezing the buttocks	S1–S2
Raising on tiptoe	S1–S2
Reflexes	
Patellar reflex	L3
Achilles tendon reflex	S1
Sensitivity	
Temperature	
Numbness	

During the last decades the use of computed tomography (CT) in combination with myelography and magnetic resonance imaging (MRI) has greatly increased the ability to visualize thoracic spine disorders accurately. MRI is the best way to define the specific abnormality, as well as the effect on the adjacent spinal cord. CT after myelography may be useful as well, especially in those patients in whom there is involvement of the posterior ligamentous and osseous structures of the thoracic spinal canal.[10]

However, the superior resolution of the available imaging methods has also made the incidental detection of asymptomatic thoracic disc abnormalities more common.[11] As with the lumbar and the cervical spine, it has become evident that the correlation between gross anatomical findings on MRI and clinical signs and symptoms detected by the clinician may be lacking. A significant proportion of the population has disc disease as depicted on imaging studies, yet many have no clinical findings at all.[12,13] The relative frequency of asymptomatic thoracic herniated nucleus pulposus has been documented in several studies.[14,15] Wood *et al* reviewed MRI studies of the thoracic spines of 90 asymptomatic individuals to determine the prevalence of abnormal anatomical findings: 66 (73%) had positive anatomical findings at one level or more, including herniation of a disc in 33 (37%), bulging of a disc in 48 (53%), an annular tear in 52 (58%), deformation of the spinal cord in 26 (29%) and Scheuermann endplate irregularities or kyphosis in 34 (38%).[16]

Awwad *et al* retrospectively reviewed postmyelography CT scans of 433 patients and identified 68 asymptomatic thoracic

Box 25.2

Summary of the clinical examination of the thoracic spine

History

Pain

What made the pain come on?

- Injury?
  - Bony problem
- Spontaneous onset?
  - Disc lesion
  - Arthritis
  - Tumour
- Forceful activity?
  - Muscular lesion

Where was the pain at the beginning/where did it spread or shift to/where is it now?

- Interscapular above T6?
  - Cervical problem
  - Shoulder girdle
  - Thoracic lesion
- Interscapular below T6?
  - Thoracic lesion
- Base of the neck?
  - Costovertebral
  - First rib
  - Sternoclavicular
- Shifting pain?
  - Disc
- Increasing or expanding pain?
  - Tumour

Is the pain influenced by coughing, sneezing or a deep inspiration?

Paraesthesia

- Multisegmental/lower limbs?
  - Cord compression
- Segmental?
  - Root compression
- Undefined?
  - Other neurological disorder

Anticoagulant treatment and bleeding disorders

Inspection

Functional examination

Standing

- 3 dural tests
  - Taking a deep breath
  - Flexion of the neck
  - Shoulders backwards
- 6 active trunk movements
  - Anteflexion
  - Extension
  - Left side flexion
  - Right side flexion
  - Left rotation
  - Right rotation

Sitting

- 2 passive tests
  - Passive left rotation (+ neck flexion)
  - Passive right rotation (+ neck flexion)
- 2 resisted tests
  - Resisted left rotation
  - Resisted right rotation
- Cord sign
  - Plantar reflex

Lying prone

- Location of the affected level by passive extension thrusts

Accessory tests

- Stretching the T1 nerve root
- Resisted movements of the trunk
- Testing the long thoracic nerve
- Oscillation of a rib
- Neurological examination
- Palpation

herniated discs. After comparing the imaging characteristics with a series of five symptomatic thoracic herniated discs, the authors were unable to identify any features that could reliably classify a herniated disc as asymptomatic or symptomatic.[17]

All these studies clearly demonstrate that thoracic disc herniations shown by MRI may not be related to patients' symptoms. The diagnosis 'symptomatic thoracic disc lesion' is therefore primarily a clinical one.

Access the complete reference list online at www.orthopaedicmedicineonline.com

References

1. Grieve G. *Modern Manual Therapy of the Vertebral Column*. Edinburgh: Churchill Livingstone; 1986. p. 408.
2. Skubic J, Kostuik J. Thoracic pain syndromes and thoracic disc herniation. In: *The Adult Spine*. New York: Raven Press; 1991. p. 1443–61.
3. Bechgaard P. Segmental thoracic pain in patients admitted to a medical department and a coronary unit. *Acta Med Scand* 1981;**644(Suppl)**:87–9.
4. Edghar MA, Nundy S. Innervation of the spinal dura mater. *J Neurol Neurosurg Psychiatr* 1966;**29**:530–4.
5. Groen GJ, Baljet B, Drukker J. The innervation of the spinal dura mater: anatomy and clinical implications. *Acta Neurochir* 1988;**99**:39–46.
6. Nadel JA, Murray JF, Mason RJ. *Textbook of Respiratory Medicine*. 4th ed. Saunders; Philadelphia: 2005. p. 254, 497–8.
7. Pedersen KV, Drewes AM, Frimodt-Møller PC, Osther PJ. Visceral pain originating from the upper urinary tract. *Urol Res* 2010;**38(5)**:345–55.
8. Gauthier-Smith PC. L'Hermitte's sign in subacute combined degeneration of the cord. *J Neurol Neurosurg Psychiatry* 1973;**36**:861–3.
9. Cyriax J. *Textbook of Orthopaedic Medicine, vol. 1, Diagnosis of Soft Tissue Lesions*. 8th ed. London: Baillière Tindall; 1982.
10. Rosenbloom SA. Thoracic disc disease and stenosis. *Radiol Clin North Am* 1991;**29(4)**:765–75.
11. Vanichkachorn JS, Vaccaro AR. Thoracic disc disease: diagnosis and treatment. *J Am Acad Orthop Surg* 2000;**8(3)**:159–69.
12. Mink JH, Deutsch AL, Goldstein TB, et al. Spinal imaging and intervention. *Phys Med Rehabil Clin North Am* 1998;**9(2)**:343–80.
13. Matsumoto M, Okada E, Ichihara D, et al. Age-related changes of thoracic and cervical intervertebral discs in asymptomatic subjects. *Spine (Phila Pa 1976)* 2010;**35(14)**:1359–64.
14. Martin DS, Awwad EE, Pittman T, et al. Current imaging concepts of thoracic intervertebral disks. *Crit Rev Diagn Imaging* 1992;**1–2**:109–181.
15. Williams MP, Cherryman GR, Husband JE. Significance of thoracic disc herniation demonstrated by MR imaging. *J Comput Assist Tomogr* 1989;**13(2)**:211–4.
16. Wood KB, Garvey TA, Gundry C, Heithoff KBJ. Magnetic resonance imaging of the thoracic spine. Evaluation of asymptomatic individuals. *J Bone Joint Surg* 1995;**77A(11)**:1631–8.
17. Awwad EE, Martin DS, Smith KR Jr, Baker BK. Asymptomatic versus symptomatic herniated thoracic discs: their frequency and characteristics as detected by computed tomography after myelography. *Neurosurgery* 1991;**28(2)**:180–6.