

Examination of the Spine

Neck and back pain are common presentations in primary care. Many cases of neck and back pain are due to benign functional or postural causes but a thorough history and examination is essential to assess the cause (see articles [Low Back Pain and Sciatica](#), [Thoracic Back Pain](#) and [Neck Pain](#)), any associated psychological difficulties (eg [depression](#), [anxiety](#) or [somatisation disorder](#)), and any functional impairment, including restrictions with work, leisure and domestic activities.

General examination of the spine

- The examination should begin as soon as you first see the patient and continues with careful observation during the whole consultation.
- It is essential to observe the patient's gait and posture. Inconsistency between observed function and performance during specific tests may help to differentiate between physical and functional causes for the patient's symptoms.

Inspection

- Examination of any localised spinal disorder requires inspection of the entire spine. The patient should therefore undress to their underwear.
- Look for any obvious swellings or surgical scars.
- Assess for deformity: [scoliosis](#), [kyphosis](#), loss of [lumbar lordosis](#) or hyperlordosis of the lumbar spine. Look for shoulder asymmetry and pelvic tilt.
- Observe the patient walking to assess for any [abnormalities of gait](#).

Palpation

- Palpate for tenderness over bone and soft tissues.
- Perform an [abdominal examination](#) to identify any masses, and consider a [rectal examination](#) ([cauda equina syndrome](#) may present with low back pain, pain in the legs and unilateral or bilateral lower limb motor and/or sensory abnormality, bowel and/or bladder dysfunction with saddle and perineal anaesthesia, urinary dysfunction and bowel disturbances, and rectal examination may reveal loss of anal tone and sensation).

Movement

- The normal range of movements are outlined in the relevant sections below.
- Examination of the spine must also include [examination of the shoulders](#) and [examination of the hips](#) to exclude these joints as a cause of the symptoms.

Neurovascular examination

- A thorough examination of sensation, tone, power and reflexes should be performed (see article on [Neurological History and Examination](#)).
- Always consider the possibility of acute spinal [cord compression](#), which is a neurosurgical emergency.
- All [peripheral pulses](#) should also be checked as vascular claudication in the upper and lower limbs can mimic symptoms of radiculopathy or canal stenosis (see articles on [Cardiovascular History and Examination](#) and [Examining the Pulse](#)).

Psychosocial factors

- The assessment should include psychological, occupational and socio-economic factors, which may either play a role in the cause of back problems, or be severely adversely affected as a result of back problems.

- Waddell's signs have been used to indicate non-organic or psychological component to chronic low back pain:^[1]
 - Superficial non-anatomical tenderness.
 - Overreaction.
 - Pain on simulated manoeuvres: pain on axial loading of skull, pain on passive rotation of shoulders and pelvis.
 - Straight leg raise testing discrepancy: straight leg raising when sitting and when supine not consistent; sitting test performed while distracting patient.
 - Non-physiological examination: non-dermatomal sensory loss, cogwheel or give-way weakness
- A full **psychiatric assessment** may be required.

Neck examination

Neck problems are common in general practice, either chronic discomfort, such as with **cervical spondylosis**, or following acute trauma, eg **whiplash** injuries following road traffic accidents. Evaluation of any neurological symptoms in the upper limbs must include an assessment of possible causes in the neck. **Spinal cord compression** in the neck may lead to lower limb problems and **abnormal gait**, as well as bladder and bowel disturbance.

Neck inspection

- Deformity: may be seen in cervical spondylosis or acute **torticollis**.
- Instability of the cervical spine: check that the patient can easily support their head (obvious if mobile but instability may be missed in a supine patient).
- Abnormal head posture may be due to neck problems but also other causes, eg weakness of the ocular muscles.
- Asymmetry, eg of scapulae, or supraclavicular fossae, eg **Pancoast's syndrome** due to a malignant tumour at the apex of the lung.
- **Torticollis** (affected side and chin often tilted to opposite side) or sternomastoid 'tumour' in infants. Causes of acquired torticollis include upper respiratory tract infection, vertebral malalignment or trauma.
- Arms and hands: for wasting, fasciculation, motor abnormalities (tone, power), sensory deficits and any indication of **thoracic outlet syndrome** (see articles on **Neurological Examination of the Upper Limbs** and **Cervical Disc Protrusion and Lesions**).
- Lower limb motor or sensory deficits may be caused by cervical spinal cord compression.

Neck palpation

- Palpate for tenderness and masses:
 - Posterior in the midline.
 - Lateral.
 - Supraclavicular - cervical rib (see article on **Cervical Ribs and Thoracic Outlet Syndrome**), lymph glands, tumours.
 - Anterior - including thyroid examination.
- Midline tenderness in the cervical spine: may be due to supraspinous damage following whiplash injuries or may also indicate more major **neck trauma**.
- Midline tenderness localised to 1 space is common in cervical spondylosis.
- Palpate lateral aspects of vertebrae for masses and tenderness (the most prominent spinous process is T1).
- Paraspinal tenderness radiating into trapezius is common in cervical spondylosis.
- Crepitation: facet joint crepitus may be detectable with flexion and extension of the neck by either palpation or auscultation on either side of cervical spine; facet joint crepitus is common in cervical spondylosis.

Cervical movement

- Flexion: normal range is 80° with chin able to touch region of sternoclavicular joint.
- Extension: normal range 50°, so normal for full flexion to full extension is 130°, primarily involves the atlanto-axial and atlanto-occipital joints.

- Lateral flexion: normal range is 45° to both sides; restriction of lateral flexion is common in cervical spondylosis. Inability of lateral flexion without forward flexion at same time suggests atlanto-axial and atlanto-occipital joint abnormalities.
- Lateral rotation: normal range is 80° to both sides; normally just short of plane of shoulders at full rotation. Rotation is restricted and painful in cervical spondylosis.

Neurological involvement

See article on [upper limb examination](#) (and dermatome diagrams in the article). Neurological features associated with cervical radiculopathy: ^[2]

- C5 nerve root:
 - Muscle weakness: shoulder abduction and flexion/elbow flexion.
 - Reflex changes: biceps.
 - Sensory changes: lateral arm.
- C6 nerve root:
 - Muscle weakness: elbow flexion/wrist extension.
 - Reflex changes: biceps/supinator.
 - Sensory changes: lateral forearm, thumb, index finger.
- C7 nerve root:
 - Muscle weakness: elbow extension, wrist flexion, finger extension.
 - Reflex changes: triceps.
 - Sensory changes: middle finger.
- C8 nerve root:
 - Muscle weakness: finger flexion.
 - Reflex changes: none.
 - Sensory changes: medial side lower forearm, ring and little finger.
- T1 nerve root:
 - Muscle weakness: finger abduction and adduction.
 - Reflex changes: none.
 - Sensory changes: medial side upper arm/lower arm.

Thoraco-lumbar spine examination

Low back pain is a very common presentation in general practice. Although the cause and severity of back problems are often fairly clear, it is often essential to make a thorough assessment and detailed examination of the back. A thorough examination of the lower limbs is essential (see article on [Neurological Examination of the Lower Limbs](#)).

Inspection

- Observe for abnormal gait and posture, which may provide clues as to the nature and severity of the problem.
- Superficial landmarks include:
 - T1 is the most prominent spinous process at the base of the neck.
 - T7/T8: lower border of scapulae.
 - L4: iliac crests.
 - S2: dimples at posterior superior iliac spines.
- Assess curvature: kyphosis, scoliosis.
- Ask the patient to bend forwards: postural [scoliosis](#) resolves; a structural scoliosis does not disappear and therefore needs further assessment. A lumbar scoliosis may be associated with a [prolapsed intervertebral disc](#). Disappearance of a scoliosis when sitting suggests that the scoliosis may be secondary to shortening of a leg. Idiopathic scoliosis leads to [short stature](#) with the trunk short in proportion to the limbs.

- Ask the patient to extend their lower back. An increased kyphosis which is regular and mobile is found in postural kyphosis. Common causes of a fixed regular kyphosis are senile kyphosis (may be associated with **osteoporosis**, **osteomalacia** or **pathological fracture**), **Scheuermann's disease** and **ankylosing spondylitis**. Common causes of an angular kyphosis, with a gibbus or prominent vertebral spine include fracture, **tuberculosis** or a congenital vertebral abnormality.
- Lumbar curvature: flattening or reversal of the normal lumbar lordosis as in a prolapsed intervertebral disc, **osteoarthritis** of the spine and ankylosing spondylitis. An increase in the lumbar curvature may be normal or due to **spondylolisthesis**, or secondary to an increased thoracic curvature or a flexion deformity of the hip.
- Look for any other abnormalities, eg café-au-lait spots, which may suggest **neurofibromatosis**, a fat pad or hairy patch suggestive of **spina bifida**, or scarring suggestive of previous thoracotomy or spinal surgery.
- Functional overlay:
 - Ask the patient to sit up on the couch. A genuine patient will have to flex the knees or they will fall back on the couch with pain.
 - Axial loading: apply pressure to the head. Overlay is suggested if this aggravates the back pain.

Palpation

- Check for bone tenderness of the spine: tenderness may indicate serious pathology such as infection, fracture or malignancy.
- Ask the patient to lean forwards: tenderness between the spines of the lumbar vertebrae and at the lumbosacral junction and over the lumbar muscles may occur with prolapsed intervertebral disc and mechanical back pain.
- Check for tenderness over the sacroiliac joints. This may also occur in cases of mechanical back pain and with inflammation of the sacroiliac joints.
- A palpable step at the lumbosacral junction may indicate spondylolisthesis.

Percussion

- Ask the patient to bend forward. Lightly percuss the spine from the root of the neck to the sacrum.
- Significant pain is a feature of infections, fractures and neoplasms.
- An exaggerated response may be a feature of a non-organic problem.

Movements

- Flexion:
 - Observe carefully as hip flexion can account for apparent motion in a rigid spine.
 - Flexion may be recorded by the distance between the fingers and the ground (most normal people can reach within 7cm of the floor) or the level that the person can reach (eg mid-tibia).
 - The overall flexion is due to a combination of thoracic, lumbar and hip movements, and does not distinguish between them.
 - Schober's test:
 - When the spine flexes, the distance between each pair of vertebral spines increases. Schober's test can be used to provide a quantitative evaluation of flexion of the lumbar spine.
 - A tape with a 15 cm mark is placed vertically in the midline upwards from the level of the dimples at the level of the posterior superior iliac spines). Mark the skin at 0 and at 15 cm and then ask the patient to flex as far forward as they can.
 - Record where the 15 cm mark on the skin strikes the tape. The increased distance along the tape is due only to flexion of the lumbar spine and is normally about 6-7 cm (less than 5 cm should be considered as abnormal).
 - Flexion in the thoracic spine may be measured with the upper point 30 cm from the previous zero mark. Thoracic flexion is normally only about 3 cm.
- Extension:
 - Ask the patient to arch their back; pain and restricted extension is particularly common in prolapsed intervertebral disc and spondylolysis.
 - Maximum range is thoracic 25° and lumbar 35°.

- Lateral flexion:
 - Ask the patient to slide their hands down the side of each leg in turn, and record the point reached, either in centimetres from the floor or the position that the fingers reach on the legs.
 - The contributions of the thoracic and lumbar spine are usually equal.
- Rotation:
 - The patient should be seated and asked to twist round to each side.
 - The normal range is 40° and is almost entirely thoracic; lumbar contribution is 5° or less.
 - Performing the test with the patient's arms folded across their chest gives a more accurate assessment.

Suspected prolapsed intervertebral disc

- Straight leg raising:
 - Passively flex thigh with extended leg while patient is supine. Dorsiflexion of foot helps to elicit pain. Stop when the patient complains of back or leg pain (hamstring tightness is not relevant). The test is negative if there is no pain. Paraesthesiae or pain in root distribution is very significant, indicating nerve root irritation.
 - A positive result on the same side as the pain is said to be about 80% sensitive but only 40% specific; a positive result with the unaffected leg is said to be only 25% sensitive but 75% specific.
 - Back pain suggests, but is not indicative of, a **central disc prolapse**, and leg pain suggests a lateral protrusion. Pain must be below the knee if the roots of the sciatic nerve are involved.
 - Lower the leg until pain disappears and then dorsiflex the foot. This increases tension on the nerve roots, aggravating any pain or paraesthesiae (positive sciatic stretch test).
- Bowstring test:
 - Once the level of pain has been reached, flex the knee slightly and apply firm pressure with the thumb in the popliteal fossa over the stretched tibial nerve. Radiating pain and paraesthesiae suggest nerve root irritation.
- Lasegue's sign:
 - With patient supine and hip flexed, dorsiflexion of the ankle causes pain or muscle spasm in the posterior thigh if there is lumbar root or sciatic nerve irritation.
- Femoral stretch test:
 - With the patient prone and the anterior thigh fixed to the couch, flex each knee in turn. This causes pain in the appropriate distributions by stretching the femoral nerve roots in L2-L4.
 - The pain produced is normally aggravated by extension of the hip.
 - The test is positive if pain is felt in the anterior compartment of thigh.

Neurological involvement

- Test the patellar (L3, L4) and achilles (L5, S1) reflexes.

- Root pressure from a disc may affect myotomes and **dermatomes** in a selective fashion; record any muscle wasting (compare girths of calf and thigh muscles):
 - Myotomes:
 - L2, L3: hip flexion and internal rotation
 - L4, L5: hip extension and external rotation
 - L3, L4: knee extension
 - L5, S1: knee flexion
 - L4, L5: ankle dorsiflexion
 - S1, S2: ankle plantar flexion
 - L4: ankle inversion
 - L5, S1: ankle eversion
 - Dermatomes:
 - L2: upper thigh
 - L3: knee
 - L4: medial aspect of the leg
 - L5: lateral aspect of the leg, medial side of the dorsum of the foot
 - S1: lateral aspect of the foot, the heel and most of the sole
 - S2: posterior aspect of the thigh
 - S3-S5: concentric rings around the anus, the outermost of which is S3

Suspected thoracic cord compression

- Thoracic cord compression may be assessed by testing the abdominal reflexes. Use a blunt object to stroke the skin in each paraumbilical skin quadrant.
- Failure of the umbilicus to twitch in the direction of the stimulated quadrant suggests cord compression on that side at the appropriate level.
- The muscles of the upper quadrants are supplied by T7-T10, and the lower quadrants by T10-L1.

Suspected thoracic motor root dysfunction

- Ask the patient to place their hands behind their head, flex their knees and sit up.
- Movement of the umbilicus to one side suggests a weakness of the abdominal muscles on the opposite side.
- Possible causes of nerve root compression include an osteophyte, tumour or **spinal dysraphism**.

Chest expansion

- Chest expansion may be particularly relevant in suspected cases of ankylosing spondylitis.
- Check the patient's chest expansion at the level of the 4th interspace.
- The normal range for an adult of average build is at least 6 cm.
- Less than 2.5 cm is considered abnormal.

Abdominal and cardiovascular examination

- Depending on individual presentation, it is essential to consider non-musculoskeletal causes of back pain, eg urological, gynaecological, gastrointestinal, **aortic aneurysm**.
- Assessment of peripheral vascular system in lower limbs may be important with patient presenting with leg symptoms, to evaluate **peripheral vascular disease**.
- Consider primary malignancy sites which may have metastasised to the spine, especially **breast cancer, thyroid cancer, renal cancer, prostate cancer and lung cancer**.

Hip and sacroiliac joint examination

- Check the hip joints for range of movement and for pain or limitation. **Hip problems** may present with predominantly back and buttock pain as well as pain in the groin. A loss of range on internal rotation of the hip is often the earliest sign of hip disease.
- Osteoarthritis of the hip may be clinically confused with low back pain, particularly prolapsed intervertebral disc.

- To assess the sacroiliac joint:
 - With the patient lying prone, elicit sacroiliac joint tenderness by applying firm pressure with one hand over the sacrum and the upper natal cleft.
 - Then flex the hip and knee, and then adduct the hip. Pain may indicate sacroiliac joint involvement, such as in ankylosing spondylitis or **Reiter's syndrome**.

Further reading & references

- **Neck pain - non specific**, Clinical Knowledge Summaries (January 2009)
 - **Low back pain**; NICE Clinical guideline (May 2009)
 - Douglas G, Macleod J, Nicol F, Robertson C; Macleod's Clinical Examination 11th edition
 - McRae R; Clinical Orthopaedic Examination 5th edition
 - **Back pain - low (without radiculopathy)**, Clinical Knowledge Summaries (November 2009)
 - **Sciatica (lumbar radiculopathy)**, Clinical Knowledge Summaries (November 2009)
1. **Waddell G, McCulloch JA, Kummel E, et al**; Nonorganic physical signs in low-back pain. Spine (Phila Pa 1976). 1980 Mar-Apr;5(2):117-25.
 2. **Neck pain - cervical radiculopathy**, Clinical Knowledge Summaries (January 2009)

Disclaimer: This article is for information only and should not be used for the diagnosis or treatment of medical conditions. EMIS has used all reasonable care in compiling the information but make no warranty as to its accuracy. Consult a doctor or other health care professional for diagnosis and treatment of medical conditions. For details see our **conditions**.

Original Author: Dr Colin Tidy	Current Version: Dr Colin Tidy	
Last Checked: 11/12/2009	Document ID: 1095 (v22)	© EMS

View this article online at [www.patient.co.uk/doctor/Back-Examination-\(Thoraco-lumbar\).htm](http://www.patient.co.uk/doctor/Back-Examination-(Thoraco-lumbar).htm).

Discuss Examination of the Spine and find more trusted resources at www.patient.co.uk.

EMIS is a trading name of Egton Medical Information Systems Limited.