THE CERVICAL SPINE AND NECK

The cervical spine has three functions: supporting the head, allowing for the head’s ROM and housing the spinal cord (Fig. 2.1).

INSPECTION

Normally, the head is held erect and perpendicular to the floor. If it is held stiffly to one side, there may be a pathological condition causing this position.

Inspect to find any abnormalities, like blisters, scars and discoloration. Surgical scars located on the anterior aspect of the neck usually indicate a previous spine or thyroid surgery.

If the base of the skull protrudes anteriorly, suspect cervical or cervicothoracic kyphosis.

PALPATION

Bony palpation

- **Hyoid bone**: located at the level of C3 vertebral body.
- **Thyroid cartilage**: its top portion is called the Adam’s apple and is at the level of C4.
- **Spinous processes**: located at the posterior aspect of the neck, in the midline, these are palpable from C2 to T1. C7 and T1 spinous processes are the largest. They are located in line with each other and any shift in their normal alignment may be due to a pathological reason like a facet joint dislocation or fracture.
- **Facet joints**: move your fingers about 2.5 cm lateral to the midline in the back of the neck to palpate facet joints. Assess to see if there is a painful facet or not. The facet joints between C5 and C6 are those which are most often involved in osteoarthritis and may be painful in palpation.
Soft tissue palpation

Sternocleidomastoid muscle: it extends from the sternoclavicular joint to the mastoid process. Ask the patient to turn the head to the opposite side of the muscle you are palpating. Evaluate the size,
shape or tone. Palpate to find any localized swelling that may be due to hematoma in the muscle that may cause torticollis or an abnormally fixed rotation of the cervical spine.

**Lymph node chain:** located along the medial border of the sternocleidomastoid muscle and anterior border of trapezius muscle. Lymph nodes are not usually palpable. If you find an enlargement in the lymph node chain, it may be due to infection in the upper respiratory tract or, sometimes, to malignancies.

**Thyroid gland:** situated at the level of C4–5 vertebrae. Normally it feels smooth and indistinct. Palpate to find any enlargement or nodule in the area.

**Parathyroid gland:** normally is not palpable and the angle of the mandible feels sharp and bony to touch. If enlarged, a baggy, soft gland covers the angle of the mandible.

**Supraclavicular fossa:** lies superior to clavicle. Palpate to find any unusual swelling or lumps.

**ROM**

First check the active ROM (Fig. 2.2). If there is any suspicion of unstable cervical spine due to trauma or tumor, do not check the passive ROM:

- Flexion and extension: the patient should be able to touch his chin to his chest (normal range of flexion) and to look directly at the ceiling above him (normal range of extension)
- Rotation (Fig. 2.3): the patient should be able to move the head to both sides so that the chin is in line with the shoulder
- Lateral bending: the patient should be able to bend his head about 45°. It can be limited by enlarged lymph nodes or torticollis.

**NEUROLOGICAL EXAMINATION**

**Muscle testing**

**Muscle testing of intrinsic muscles**

**Flexion**

- Primary flexors:
  - sternocleidomastoids (spinal accessory nerve, or cranial XI nerve).
- Secondary flexors:
  - scalenus muscles
  - prevertebral muscles.

**Extension**

- Primary extensors:
  - paravertebral extensor mass (spleenius, semispinalis, capitis)
  - trapezius (spinal accessory nerve, or cranial XI nerve).
Normal range of neck flexion

Normal range of neck extension

Normal range of neck rotation

Normal range of lateral bending

**Fig. 2.2**
ROM of the neck
Secondary extensors:
- various small intrinsic neck muscles.

Lateral bending
- Primary lateral benders:
  - scalenus anticus, medius, and posticus anterior primary divisions of lower cervical nerves.
- Secondary lateral benders:
  - small intrinsic muscles of the neck.

Neurological levels
The brachial plexus is composed of C5–T1 nerve roots (Fig. 2.4). C5–6 join to make the upper trunk; C8 and T1 join to make the lower trunk.
and C7 makes the middle trunk. These trunks contribute to make the lateral, middle and posterior cords.

The branches of these cords are:

- **Lateral cord:**
  - musculocutaneous nerve
  - branch to median nerve.
- **Medial cord:**
  - ulnar nerve
  - branch to the median nerve.
- **Posterior cord**
  - axillary nerve
  - radial nerve.

**Sensory distribution**

**C5 nerve root** (Fig. 2.5)

- Sensory distribution: lateral arm
- Motor testing: axillary nerve, deltoid muscle
- Musculocutaneous nerve (C5–6), biceps muscle
- Reflex testing: biceps reflex.
Fig. 2.5
C5 nerve root
**Fig. 2.6**

C6 nerve root

Wrist extensors: Extensor carpi radialis longus and brevis
C6 nerve root (Fig. 2.6)

- Sensory distribution: lateral forearm, thumb, index, and half of middle finger (sensory branches of musculocutaneous nerve)
- Motor testing: musculocutaneous nerve (C5–6), biceps muscle
- Wrist extensor group: C6, radial nerve
- Reflex testing: biceps reflex, brachioradialis reflex.

C7 nerve root (Fig. 2.7)

- Sensory distribution: middle finger
- Motor testing: triceps: C7, radial nerve
- Wrist flexor group: C7, median and ulnar nerves
- Reflex testing: triceps reflex.

C8 nerve root (Fig. 2.8)

- Sensory distribution: ring and middle fingers, medial forearm
- Motor testing: finger flexors
  - the flexor digitorum superficialis (proximal interphalangeal (PIP) joint)
  - the flexor digitorum profundis (distal interphalangeal (DIP) joint).

T1 nerve root (Fig. 2.9)

- Sensory distribution: medial arm
- Motor testing: finger abductors
  - the dorsal interossei
  - the abductor digiti minimi (Table 2.1).

Important dermatomes (Table 2.2)

- C2, 3, 4: face
- C4: collar
- T4: nipple.

Table 2.1
Sensory distribution

<table>
<thead>
<tr>
<th>Motor levels</th>
<th>Reflexes</th>
<th>Sensory levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>C5 Shoulder abduction</td>
<td>Biceps</td>
<td>Lateral arm</td>
</tr>
<tr>
<td>C6 Wrist extension</td>
<td>Brachioradialis</td>
<td>Lateral forearm</td>
</tr>
<tr>
<td>C7 Wrist flexion, finger extension</td>
<td>Triceps</td>
<td>Middle finger</td>
</tr>
<tr>
<td>C8 Finger flexion</td>
<td>–</td>
<td>Middle forearm</td>
</tr>
<tr>
<td>T1 Finger abduction</td>
<td>–</td>
<td>Middle arm</td>
</tr>
</tbody>
</table>
Fig. 2.7
C7 nerve root
Interossei muscles

Finger flexors

Motor

Reflex

None

Sensation

Fig. 2.8
C8 nerve root
Interossei muscles

Motor

Reflex

None

Sensation

C6

C7

C8

C6

C5

T1

T2

C6

T1 nerve root

Fig. 2.9

ORTHOPAEDIC EXAMINATION MADE EASY
SPECIAL TESTS

**Sperling's maneuver:** extension and ipsilateral rotation of the neck should produce patient’s radicular pain (very specific test).

**Lhermitte's sign:** so-called Barber Chair phenomenon. Flexion or extension of the neck produces electric shock-like sensations that extend down the spine and shoot into the limbs. When positive, this test signifies spinal cord compression from trauma, multiple sclerosis, cervical cord tumor, cervical spondylosis, or even vitamin B12 deficiency.

**Distraction test** (Fig. 2.10a): this test evaluates the effect of traction on the relief of pain due to narrowing of the neural foramen. Place the palm of one hand under chin and the other one under occiput and gently lift the head and assess its effect on pain.

**Compression test** (Fig. 2.10b): press the head down gently while the patient is sitting or lying and assess its effect on the pain.

**Valsalva test** (Fig. 2.10c): Valsalva maneuver increases the pressure of intrathecal space. Ask patient to hold his breath and bear down as if he were moving his bowels. If there is any space-occupying lesion such as a herniated disk or tumor, this maneuver will result in pain radiation to dermatomes innervated by spinal nerves.

**Swallowing test** (Fig. 2.10d): if there is any pain or difficulty upon swallowing, it may be due to a bony protuberance or osteophytes, hematoma, infection or tumor in the anterior portion of the cervical spine.

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**Table 2.2**

*Dermatomes*

<table>
<thead>
<tr>
<th>Disk</th>
<th>Root</th>
<th>Reflex</th>
<th>Muscles</th>
<th>Sensation</th>
</tr>
</thead>
<tbody>
<tr>
<td>C4–C5</td>
<td>C5</td>
<td>Biceps reflex</td>
<td>Deltoid, biceps</td>
<td>Lateral arm, axillary nerve</td>
</tr>
<tr>
<td>C5–C6</td>
<td>C6</td>
<td>Brachioradialis, biceps reflexes</td>
<td>Wrist extension, biceps</td>
<td>Lateral forearm, musculocutaneous nerve</td>
</tr>
<tr>
<td>C6–C7</td>
<td>C7</td>
<td>Triceps reflex</td>
<td>Wrist flexors, finger extension, triceps</td>
<td>Middle finger</td>
</tr>
<tr>
<td>C7–T1</td>
<td>C8, T1</td>
<td>–</td>
<td>Finger flexion, hand intrinsics</td>
<td>Medial forearm, medial anterior brachial cutaneous nerve</td>
</tr>
<tr>
<td>T1–T2</td>
<td>T1, T2</td>
<td>–</td>
<td>Hand intrinsics</td>
<td>Medial arm, medial brachial cutaneous nerve</td>
</tr>
</tbody>
</table>
**Adson test** (Fig. 2.10e): it is used to evaluate the condition of the subclavian artery to see if it is compressed by a cervical rib or other pathological conditions. To perform this test, while feeling the pulses of the radial artery, abduct, extend and externally rotate the arm. Then ask the patient to take a deep breath and to turn his head.

![Adson test diagram](image)

*Fig. 2.10*

Tests of the cervical spine. 

a. Distraction test; 
b. Compression test; 
c. Valsalva test; 
d. Swallowing test – difficulty in swallowing can be caused by cervical spine pathology.
to the opposite side. If there is any compression on the subclavian artery, pulses of the radial artery will be diminished or absent.

**LUMBAR SPINE**

The lumbar spine (Fig. 2.11) transmits the body weight to the pelvis, provides mobility for the trunk and transports the nerve roots and cauda equina to the lower extremity.

**DESCRIPTION OF A FUNCTIONAL SPINAL UNIT**

The most common slipped disk occurs at L4–L5 or L5–S1.

Check bowl/bladder incontinence and saddle anesthesia. This is a surgical emergency and the possible sign of cauda equina syndrome (S2–S4).
Fig. 2.11
The lumbar spine. a. Radiograph – anteroposterior view; b. Radiograph – lateral view; c. Radiograph – the lumbar spine and pelvis (anteroposterior view)
DESCRIPTION OF COMPONENTS

Bones

Vertebrae

- Spinous processes
- Transverse processes
- Pedicles
- Facet joints: Scotty dog – seen on an oblique plain radiograph (Fig. 2.12). Allows a clear visualization of the pars interarticularis or bone connecting the superior articular process and inferior articular process.

Muscles (origin and insertion)

There are a large number of muscles surrounding the human spine. For details please see anatomy textbooks.

Soft tissues

- Intervertebral disks
- Ligamentum flavum.

Fig. 2.12
Oblique plain radiograph showing Scotty dog sign
INSPECTION

Check the movements of patient to see whether there is any limitation or rigidity in his movements. When the patient is standing, check for:

- Kyphosis (forward spinal curvature), lordosis (backward spinal curvature) that may be due to weak abdominal musculature and any other abnormal curvatures
- Color changes like café-au-lait spots, birthmarks
- Swelling: lipoma (located in the low back can be a sign of spina bifida)
- Hair patches: an unusual hair patch on the back may be evidence of some bony defects such as spina bifida
- Lacerations
- Bruising
- Asymmetry of the flexion and extension ranges
- Ecchymosis
- Deformities.

PALPATION

The imaginary horizontal line between the tops of the iliac crests passes at the level of L4–5 junction in the midline. The umbilicus lies at the level of L3–4 which is the point where the aorta divides into two branches.

For spasm or pain:

- Spinous processes
- Paraspinal muscles.

ROM

- **Flexion:** ask the patient to bend forward and touch his toes. If he cannot do that, measure the distance between fingertips and floor. Patients with paraspinal muscular spasm will have a problem performing this test. **Extension:** ask the patient to bend backward while you place one hand on the patient’s back. Measure and record the range of extension.

NEUROVASCULAR ASSESSMENT

In order to perform a neurological examination of the lumbar spine, perform a complete examination of the lower extremity.

**Neurological level T12, L1, 2, 3**

- Sensory distribution: general area over the anterior thigh between the inguinal ligament and knee joint
- Motor testing: iliopsoas muscle (nerves from T12, L1, 2, 3) for hip flexion.
Neurological level L2, 3, 4

- Motor testing: quadriceps muscle (L2, 3, 4, femoral nerve) for knee extension
- Hip adductors (L2, 3, 4, obturator nerve).

Neurological level L4

- Sensory distribution: medial side of the leg, below the knee
- Motor testing: tibialis anterior (L4, deep peroneal nerve) for ankle dorsiflexion
- Reflex testing: patellar reflex.

Neurological level L5

Sensory distribution: lateral leg and dorsum of the foot.

- Motor testing:
  - extensor hallucis longus (L5, deep peroneal nerve) for great toe dorsiflexion
  - gluteus medius (L5, superior gluteal nerve) for hip abduction
  - extensor digitorum longus and brevis (L5, deep peroneal nerve).

Neurological level S1

Sensory distribution: lateral malleolus and lateral side and plantar surface of the foot.

- Motor testing:
  - peroneus longus and brevis (S1, superficial peroneal nerve) for ankle eversion
  - gastrocnemius–soleus (S1, 2, tibial nerve) for ankle plantarflexion
  - gluteus maximus (S1, inferior gluteal nerve) for hip extension
- Reflex testing: Achilles’ tendon reflex.

Neurological level S2, 3, 4

Sensory distribution: dermatomes around the anus.

- Motor testing:
  - anal wink
  - bladder.

Superficial reflexes

Superficial abdominal reflexes

Ask the patient to lie supine and stroke each quadrant of the abdomen with a sharp end of a pen or neurological hammer. Normally, the umbilicus will move toward that quadrant. The lack of an abdominal reflex indicates an upper motor neuron lesion. The upper quadrant is innervated by T7 to T10 segments of spine and lower quadrant by T11 to L1 segments of spine.
Superficial cremasteric reflex
Stroke the inner side of the thigh with a sharp point of a pen or neurological hammer. In males, normally, the scrotal sac will move upward in the same side. This reflex assesses T12 segment of spine.

Superficial anal reflex
Touch the perianal skin. The external anal sphincter should contract in response. It assesses S2, 3, 4 segments.

Pathological reflexes
These reflexes are mediated by the cerebral cortex and are not present normally in an adult. Their presence indicates an upper motor neuron lesion.

Babinski test
Touch the outer portion of the plantar surface of the foot. Normally, this maneuver results in plantar flexion of foot. An extended great toe, and plantar flexion and splay of other toes, is a positive test and a sign for upper motor lesion. This test can be positive in old people who do not have any pathological condition.

Oppenheim test
Run your finger along the anterior crest of tibia. Normally, there is no reaction; if you do find a response it is also, as with a positive Babinski test, a sign of upper motor neuron lesion.

- Toe walking: S1 provided by gastrocnemius and anterior tibialis. About 50% loss is necessary before a patient is unable to toe walk.
- Heel walking: L4, 5 provided by tibialis anterior. Again, about 50% loss is indicated if a patient cannot walk on their heels.

Important dermatomes:
- L4: knee, anterior and medial calf
- L5: lateral calf, dorsum of foot
- S1: posterior calf, lateral foot, perineum.

Motor assessment
- Cervical ROM: flex and extend neck and bend laterally left and right
- Cervical rotation: touch chin to shoulder on left and right
- Lumbar flexio: Schober maneuver – the distance between tip of fingers and floor on forward bending is measured. Loss of flexion occurs with diseases like ankylosing spondylitis.
COMMON TESTS

Straight leg-raising test
Ask the patient to lie supine and lift his leg upward with an extended knee. Normally, you can lift the leg without any complaint of pain from the patient for approximately 80°. If there is any compression on the sciatic nerve, the patient will feel a radiating pain from his back to below the knee. If there is pain at only the posterior aspect of the thigh, it can be due to hamstring muscles.

Cross leg (well leg) straight-raising test
Ask the patient to lie supine and lift his uninvolved leg upward with an extended knee. If there is compression on the sciatic nerve, this maneuver may result in a radiating pain in the posterior aspect of the involved leg to the foot.

Reverse leg-raising test
Ask the patient to lie prone and extend his involved leg with an extended knee. If there is compression on the femoral nerve, this maneuver may result in a radiating pain in the anterior aspect of the involved leg to the foot.

Hoover test
This is used to determine whether a patient who complains of an inability to raise his leg is malingering or not. Ask the patient to lie supine and raise his uninvolved leg while you gently put your hand under the involved foot’s calcaneus. If the patient is malingering, you will feel pressure on your hand while the patient tries to raise his uninvolved leg from table.

Milgram test
Ask the patient to lie supine and raise his legs approximately 5 cm from the table. This maneuver stretches the iliopsoas and anterior abdominal muscles and increases the intrathecal pressure. If the patient can hold this position for 30 seconds without any pain in his legs, intrathecal pathology may be ruled out.