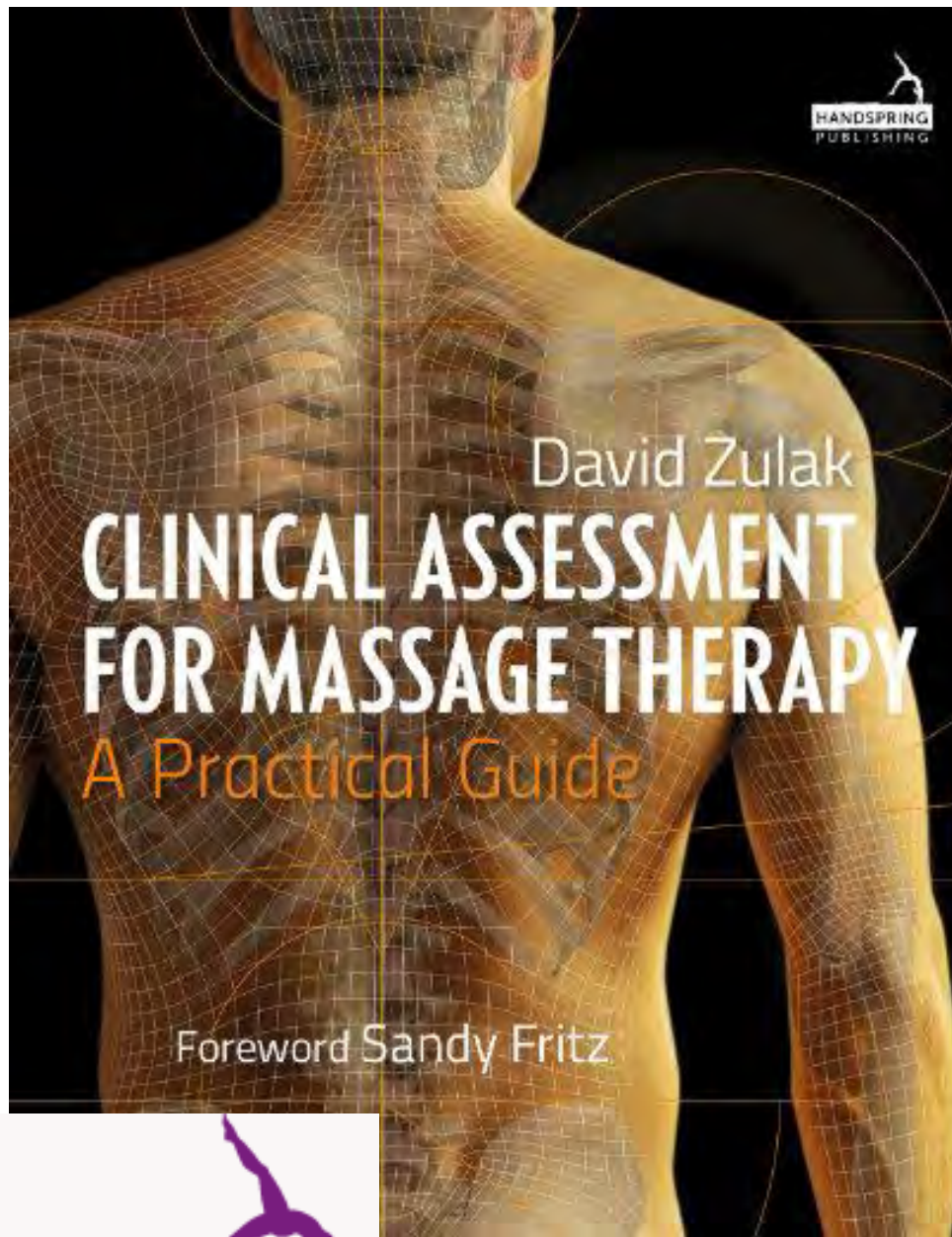


Notes for Embodied Health Learning's webinar *Dermatomes and Myotomes in Clinical Assessment*



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FIGURE 14.61 Swallowing test

Have the patient swallow and report if they feel a lump in the throat or have difficulty swallowing. If so, refer out.



FIGURE 14.62A, B Tinel's sign at the neck

The patient side-bends and rotates to one side. The therapist lightly presses (momentarily) or "taps" over the tips of TVPs behind the SCM.



FIGURE 14.63 Test for Bakody's sign

The patient places their forearm on top of their head. Reduction of symptoms is positive.

nerve roots as they exit the spine. The patient may be seated or supine. The positive sign is reproduction of the patient's neurological symptoms in the upper limb ("*and the door-bell rings*"). This test is often unproductive or inconsistent in its results. Local pain where pressure was applied is not positive for nerve root pathology.

Bakody's sign

Another way to check if a nerve root is involved in shoulder or arm pain is for the patient to place the affected side's forearm on top of their head. If this brings clear relief it is a positive Bakody's sign. The test works by lifting the clavicle and shortening the distance the nerve needs to travel to the brachial plexus and upper arm. This action reduces the pull on the nerve roots and it may possibly reduce symptoms of neural compression.

However, it may also be reducing symptoms originating not from the cervical spine per se but from other soft tissue and joints such as entrapment between the clavicle and the first two ribs. Nonetheless, when it does reduce symptoms it has traditionally been said that it indicates that the nerve root lesion exists at the C5 or C6 region. At best this is a "screening test" that when positive suggests a need for further detailed testing.

Introduction to specific neurological testing

If the patient tests positive for any neurological test refer them to their physician. It would be wise for you to write a note that they can take with them explaining what testing was positive during the neurological assessment and at what levels so that their physician knows what testing to do to try and repeat your results.

Dermatome testing

Initially the therapist may wish to do some quick testing for sensory nerve enervation dysfunctions relating to sensory nerve roots. This can be done with the patient seated or standing. Test bilaterally at the same time by brushing over both arms and

hands simultaneously. Inform and show the patient what you are going to do. By brushing we mean to lightly drag over the patient's skin using your relaxed fingers. Repeat over each dermatome several times (refer back to Figure 13.73).

Ask the patient if they notice any difference side to side and if there is any change in the quality of sensation on either arm in any specific area. Often a delayed response or uncertainty on the patient's part can be considered a possible positive sign (of a mild problem). If you wish you can repeat this with deep touch, hot and then cold, two-point discrimination and vibration.

If the patient reports any changes or absence of sensation note which dermatome area those changes are in. You can then brush each specific dermatomal area (always bilaterally) several times and ask each time if the patient notices any difference one side to the other or to the prior area tested. Even if you feel that you have already identified the dermatome through case history questioning then perform the testing in several of the dermatomes above and below and never test just the one you suspect. Remember that if the patient has not seen their primary physician regarding any positive results then they need to be encouraged to do so. If you do not find any positive results but the patient's symptoms seem to be neurological and you find no other cause (like trigger point referral zones) then also refer them back to their primary health care provider.

The areas to brush listed below correspond to the generally undisputed areas of the various dermatome maps developed

over the last 100 years or so. Further, dermatomes overlap to some degree in everyone. Therefore, it is suggested you test the central areas of each dermatome.

Red flag

If two or more dermatomes are affected the patient may be suffering from stenosis of the spinal canal; in other words a compression within the spinal canal. A stenosis can also cause bilateral loss. *This is a red flag* and the patient should be advised to see a physician promptly. However, having a positive may also point to a peripheral nerve lesion. Remember that peripheral nerves also suffer from compression syndromes and dysfunction. Compare your dermatome findings especially if the results are not clear with a map of peripheral nerve sensory innervation. (See peripheral nerve testing on the pages following dermatome testing.)

NOTATION: To record your findings of brushing write them as C3 Derm +. If you have tested various levels and different kinds of sensations note them accordingly, e.g., C3 Derm + light touch and vibration.

Dermatomes

Table 14.1 is a dermatome chart. Compare this chart with the peripheral nerve chart presented later in this section. Comparing your findings with these charts and maps will help to differentiate between nerve root dermatomes and peripheral nerve cutaneous enervation.

TABLE 14.1
Sensory areas of the dermatomes

Dermatome	Sensory area
C1 and C2	C1 Back of the head, or behind the ears
C3	Above the clavicle
C4	Below the clavicle
C5	Lateral shoulder and arm down into the lateral elbow
C6	Whole thumb, and up into the lateral wrist
C7	Both dorsal and ventral surfaces of the middle finger
C8	Ulnar border of little finger and wrist and distal forearm
T1	Medial forearm up to the elbow



FIGURE 14.64 C1 and C2 dermatome test

The therapist brushes the back of the patient's head or behind the ears.



FIGURE 14.65 C3 dermatome test

Brush above and along the length of the clavicle.



FIGURE 14.66 C4 dermatome test

Brush below and under the clavicle along its entire length.



FIGURE 14.67 C5 dermatome test

Brush the lateral portion of the deltoid, down toward (but not to) the elbow.



FIGURE 14.68 C6 dermatome test

Brush from the base of the thumb, along its lateral side down to the tip of the thumb.



FIGURE 14.69 C7 dermatome test

Brush the middle finger's dorsal and ventral sides from the MCP to the fingertip.



FIGURE 14.70 C8 dermatome test

Brush the ulnar border of the little finger from the wrist to the fingertip.



FIGURE 14.71 T1 dermatome test

Brush the proximal ulnar border of the forearm up to the medial elbow.

Dermatome tests (Figures 14.64–14.71)

This testing can be done very quickly.

Sensory testing of the face (Figures 14.72–14.74)

The face is innervated by the three divisions of the trigeminal nerve (CN V). See the peripheral nerve map in Figure 14.75.

Peripheral nerve testing

For suspected peripheral nerve impairments see Table 14.2 and Figure 14.75. For other means of testing these nerves see Chapters 15, 17.



FIGURE 14.72 Testing CN V1 – ophthalmic nerve

Brush over the eyebrows.

Chapter 14

Table 14.2
Sensory areas of peripheral sensory nerves

Peripheral sensory nerve	Sensory area
Axillary (C5–6)	Lateral arm and deltoid area on upper arm – but distinctive is total loss of circular area mid-lateral deltoid – down to elbow and over to medial forearm
Musculocutaneous (C5–6)	Lateral forearm
Radial (C6–T1)	Dorsal surface of lateral hand and onto thumb; and also dorsal surface index, middle finger and lateral portion of the 4th finger, all up to DIP joint but not including surface of the distal phalanges
Median (C6–7)	Tips of index, middle and medial side of 4th digit, and ventral surface of those fingers and the palm of the hand
Ulnar (C8–T1)	Dorsal and ventral surfaces of little finger and lateral half of the 4th digit



FIGURE 14.73 Testing CN V2 – maxillary nerve
Brush from under the eyes over the cheek bones.



FIGURE 14.74 Testing CN V3 – mandibular nerve
Brush along the mandible, from its angle toward the chin.

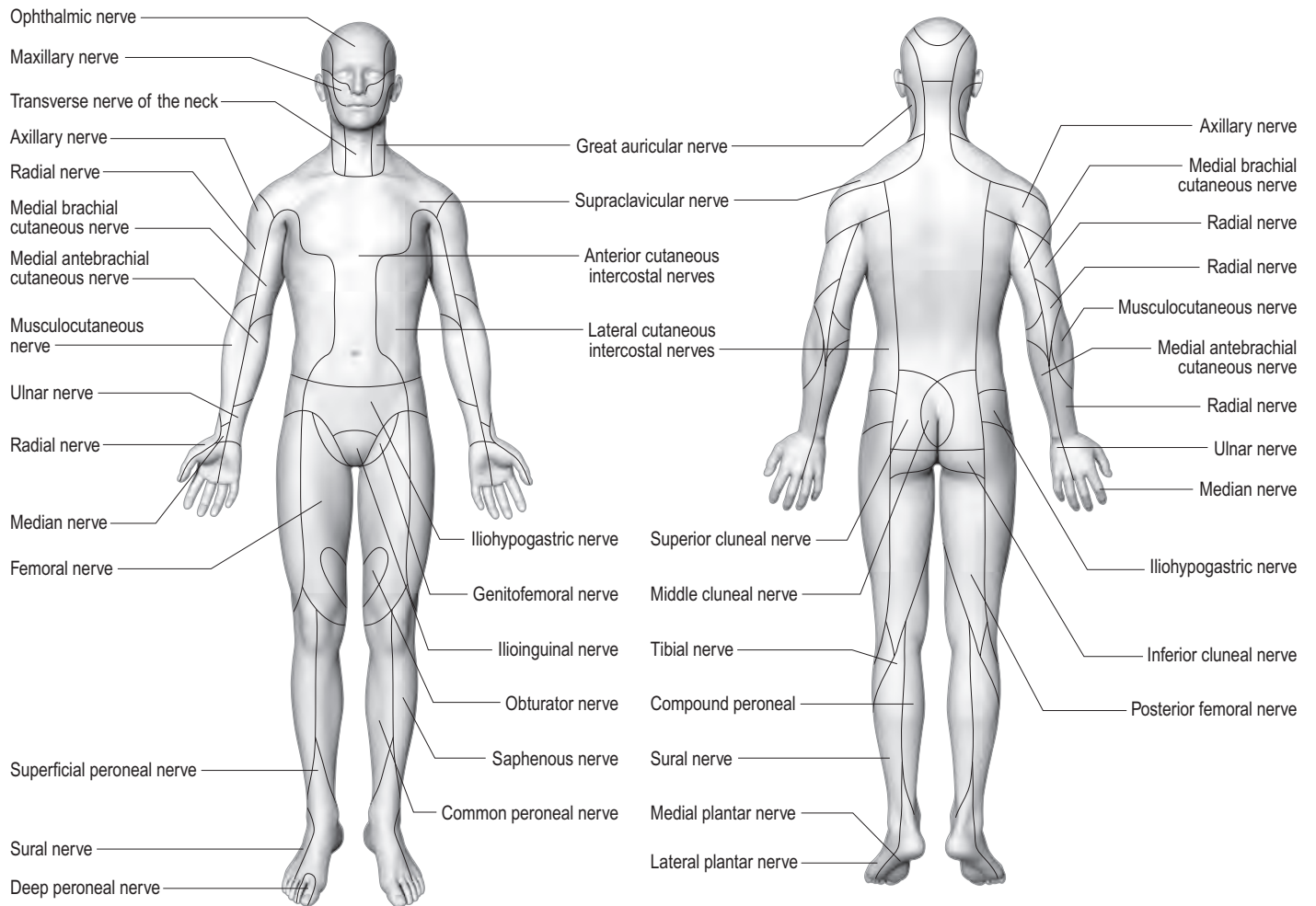


FIGURE 14.75
Peripheral nerve map.

Myotome testing for the cervical spine (Figures 14.76–14.83)

Patients must use their full strength in neurological tests or when doing any strength testing for that matter because they may inadvertently mislead the therapist about the true strength of a muscle. If you ask for only half their strength when testing the patient will often only be able to gauge that by the resistance they feel being applied. Hence, they may use 50 percent of their strength on the uninjured side of their body being tested first and 70 percent on the other; pushing against the therapist's resistance until both sides feel the same. The patient is not trying to trick the therapist. They will believe they have applied the same force because it felt the same. The reason given for using half-strength has traditionally been cited as a way to prevent further injury. However, if the testing is performed correctly (progressively) then this rule is unnecessary.

Just like AR-ROM testing, during myotome testing the patient should be instructed to begin their effort or resistance with min-



FIGURE 14.76 Testing C3 myotome

Forward head nodding (from OA joint, rather than neck flexion). Resist movement at the forehead. Ask the patient to tuck the chin in rather than just telling them to push the forehead into your hand.

imal effort and take a good five seconds to build up to maximum strength. If the therapist is applying the effort for the patient to resist they need to follow the same rules by slowly building up to maximal effort. The patient is further instructed to stop and slowly decrease their effort as soon as there is any pain or recurrence of symptoms. This can in fact be more protective to re-injury than giving the patient some specific level of strength to use during testing. Another rule of myotome testing is that the maximum effort by the patient is sustained for at least five seconds. This is done because a muscle suffering from a minor or moderate neurological deficit may still be able to generate a normal maximal effort for a second or two but then will noticeably begin to lose strength.

Scale for isometric strength testing of myotomes

Record testing results by placing the numerical value of your finding over 5, e.g., 4/5 R Myo C5, or by recording as Good R



FIGURE 14.77 Testing C1 and 2 myotome

Side-bending. Resist the patient at the side of the head and the ipsilateral shoulder using crossed forearms. The therapist can bring the forearm down on top of their hand for better leverage for both resisting side-bending and lifting of the shoulder. Ask the patient to bring the ear down to the shoulder but try not to bring the shoulder up to the ear.

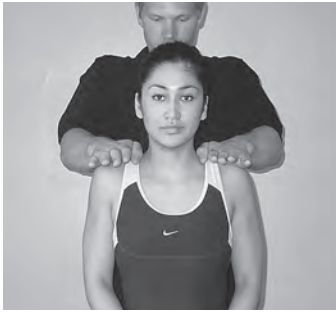


FIGURE 14.78 Testing C4 myotome

Resist shoulder elevation bilaterally. It is best if the patient lifts the shoulders first then the therapist pushes the shoulders down while the patient resists.



FIGURE 14.79 Testing C5 myotome

Shoulder abduction. Have the patient hold the upper arms at 45° then apply resistance to engage the deltoid muscle (this also tests the axillary nerve).



FIGURE 14.80A, B Testing C6 myotome

Wrist extension is fairly specific, while testing elbow flexion draws on C5 and C6. Resisting elbow flexion also tests the musculocutaneous peripheral nerve.



FIGURE 14.81A, B Testing C7 myotome

Wrist flexion is more specific; some test elbow extension. Both tests will challenge radial nerve.



FIGURE 14.82 Testing C8 myotome

Finger flexors. Have the patient grasp your fingers and tell them to not let you open their hand.



FIGURE 14.83 Testing T1 myotome

Abduction of fingers. Abduction of the little finger on its own is sometimes used to test the ulnar nerve.

Myo C5. Kendall et al. (2005) suggest that a negative (-) or positive sign (+) can be added to the number or term applied to the finding in order to fine tune them to the variety of functionality observed in clinical settings.

5 = Normal: full strength available with strong resistance applied.

4 = Good: can resist with only slight resistance applied.

3 = Fair: can only resist the affect of gravity alone.

2 = Poor: cannot resist gravity but can move the limb in the horizontal plane.

1 = Trace: no movement, only “flickering” of muscle present.

0 = Zero: no trace, no flickering, flaccid.

Do the following resisted testing either having the therapist resist the patient’s movement or better still, have the patient hold their position while the therapist applies force. The actions resisted below to test the myotomes have been chosen for their specificity, and for the ease of comparing bilaterally.

Testing motor function of peripheral nerves (Figures 14.84–14.95)

NOTE: Axillary, musculocutaneous and radial nerve tests are very similar to myotome testing, while the ulnar and median nerve motor tests can be more specific (Waxman 2000).



FIGURE 14.84 Axillary nerve test

Have the patient forward flex their extended arms and tell them to hold position while you place your hands on their forearms and try to push their arms down. The purpose here is to test the (anterior) deltoid muscle.



FIGURES 14.85, 14.86 Radial nerve test

The radial nerve innervates most extensor muscles; hence, we can test the lower portion by testing the extensors of the wrist or the upper portion by testing triceps.



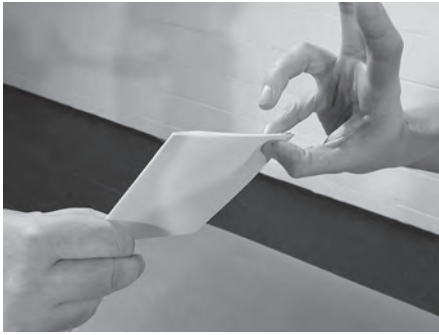
FIGURE 14.87 Musculocutaneous nerve test

Biceps brachii is tested. Though this muscle is often used to test the C6 myotome it is not that specific to a single nerve root and thus, more accurate to musculocutaneous nerve.



FIGURE 14.88A, B Ulnar nerve motor test

To be very specific to the ulnar nerve and not use the thumb (which can be synergistically making use of the median nerve) have the patient supinate the arm. Demonstrate and ask them to move the little finger until its tip touches the base of the thumb. First, see if the patient can complete this maneuver. If they cannot, yet there is no pain, the ulnar nerve may be severely impaired. To ensure they are not prevented from doing the maneuver by fascial or other restrictions see if you can complete the movement passively for them. Second, if the patient completes the maneuver then hook your index finger under their little finger and slowly and gently increase your effort to lift the little finger away from the palm of the hand as the patient resists.



FIGURES 14.89 and 14.90 Fromet's sign and alternate Fromet's sign

A common test for the ulnar nerve. The patient places the tips of little finger and thumb together in opposition. Ask the patient to hold a piece of paper between the digits and not let you pull it out. Alternatively, you can also just hook your index finger into a circle made by the patient's thumb and little finger and try to pull the tips apart by pulling your finger through them while the patient tries to prevent you from doing this. If at first it appears that there is weakness (a positive sign) then repeat two or three times to confirm and ensure the patient is trying hard to resist you.



FIGURE 14.91 Median nerve motor test



FIGURE 14.92 Alternate median nerve motor test

To test the median nerve resist the patient's attempt to flex their extended thumb across the palm of the hand. You resist at the distal phalange. Alternatively, you can have the patient abduct their thumb and tell them to hold the position as you attempt to push the thumb toward the lateral border of the palm.

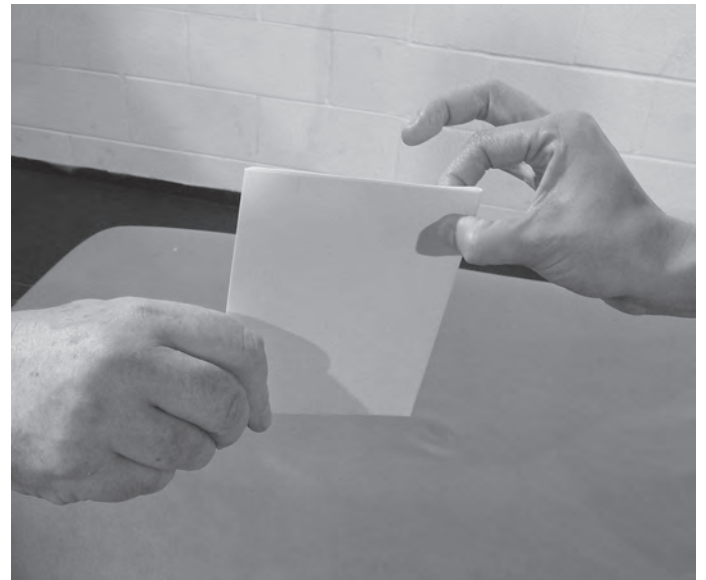


FIGURE 14.93 Alternate median nerve test 2

The patient pinches the thumb and index finger as in making an okay gesture. Then have the patient do this with a piece of paper pinched between the tips of the fingers. The therapist tries to pull the paper out from the pinch. Positive sign is the patient unable to hold.

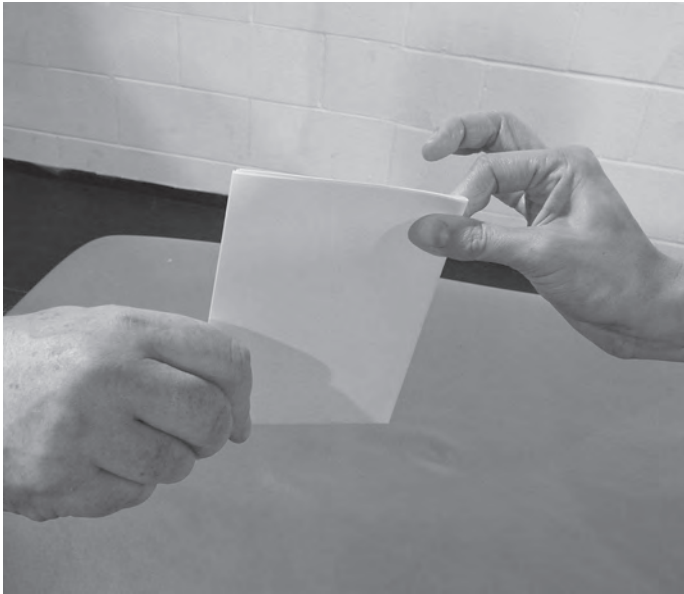


FIGURE 14.94 Alternate 2: positive sign

The test is positive for median nerve root dysfunction even if the patient can hold the paper but does so only if the finger and thumb extend and cannot hold tip-to-tip. Digits collapse and the paper is held by the finger pads. If this happens, repeat the test and ask the patient to try to sustain tip-to-tip pinching only. If the patient is unable to do so and involuntarily reverts to a pad-to-pad grip this is considered a positive sign.



FIGURE 14.95 Alternate median nerve test 3

Alternatively, to test the median nerve you can also just hook your index finger into a circle made by the patient's thumb and index finger. Now try to pull the tips apart by pulling your finger through them while the patient tries to prevent you from doing this. If at first it appears that there is weakness (a positive sign) repeat two or three times more to confirm and to make sure patient is trying hard to resist you.

sections of the upper extremity/limb (i.e., the shoulder, arm, forearm, wrist and fingers) in specific patterns or positions.

Instructions for upper limb tension testing (ULTT) for peripheral nerves are shown in Chapter 15.

Deep tendon reflexes (DTR) (Figures 14.96–14.98)

Rather than the classic one strike or two with a reflex hammer it is wise to test each DTR on each side of the body with seven to 10 strikes to see if there is a progressive lessening of the response. This decreasing response is a positive sign.

The obvious positive sign for DTRs is a difference bilaterally. You can have a decreased or absent reflex on one side as a positive sign or you could have a hyper-reflexive response on one side as a positive sign. If you get little or no response from both sides that is what is normal for that person and in no way is it a positive sign. Lack of response is due to the fact that we are using a stretch reflex to test innervation. If the muscle is long or low in tone the response could be minimal or absent.

Reflex grading scale

- 0 = No response. Pathological if unilateral; if bilateral the test is considered negative.
- 1 = Hyporeflexive, trace of movement. Pathology may be present if response is unilateral; if bilateral it may be due to hypotonicity or deconditioning.
- 2 = Normal response.
- 3 = Brisk or greater than normal response. May be pathological if unilateral; if bilateral it may be due to hypertonicity of the musculature involved in the reflex.
- 4 = Non-sustained clonus or a repetitive contraction-relaxation (vibratory) movement in the muscle for a short period of time; or hyper-reflexia, a gross exaggeration of movement.
- 5 = Sustained clonus or a prolonged contraction-relaxation of the muscle involved; or hyper-reflexia that seems to spread to other muscles nearby.



FIGURE 14.96 C5–6 DTR (at biceps tendon)

Place the patient's forearm over your forearm and ask them to relax. Place your thumb over the biceps tendon at the elbow and hit your own thumb. You may not see a response of reflex but rather just feel the tendon go tense and firm.



FIGURE 14.97 C5–6 DTR (over brachioradialis)

Hard to find and even harder to get a reliable response. Some health care professionals will lay their fingers over the site of the tendon and then strike their middle finger (at the middle phalange) to aid in getting a response. It is thought that this spreads the tap of the hammer over a wider area and there is an increased chance of hitting the appropriate site. Note that a positive sign of this test is observing flicking of the wrist (radial deviation), which occurs because of a slight but quick flexion of the elbow (i.e., the muscles quick active flexion of the forearm and then its sudden drop due to gravity).



FIGURE 14.98 C7 DTR (triceps tendon in olecranon fossa)

The trick here is to get the patient to relax the arm enough to let you get a reflex.

To record your findings place the numerical equivalent over 5. Examples: 3/5 DTR R C6 equals a finding of number 3 grading on the right for the biceps tendon DTR; 0/5 DTR R C7 equals number 0 grade for the right triceps tendon reflex. These notations imply that the contralateral side is normal.

Responses 0 and 1 can be normal if bilateral (though a few do regard 0 as abnormal). They are usually only considered positive if seen unilaterally. 3 can be normal if bilateral. It may be abnormal if seen unilaterally if there is no reason for that side's muscle to be hypertonic (e.g., due to strain or overuse). 4 and 5 are considered positive. If bilateral there may be a systemic pathology or the presence of an upper motor neuron lesion (UMNL), i.e., a lesion in the central nervous system.

Pathological nerve impairment testing: upper motor neuron testing (Figures 14.99, 14.100)

Babinski's is the classic test for upper motor neuron dysfunction or pathology which means there is a lesion in the brain and/or in a neuron as it extends down into the spinal cord (specifically, the corticospinal tract). The sole of the foot is stroked with a fingernail or the pointed end of a reflex hammer. Start at the lateral side of the heel and run up the lateral side of the sole of the foot and across the metatarsal heads toward the big toe. A positive sign is that the big toe extends upward toward the head and the other toes splay (abduct). A negative sign (or normal response) is that the toes flex. This negative sign is only seen in those over two years of age. Babinski's sign is normal in newborns and disappears once the child learns to walk. After that it is a pathological reflex when present.

Spastic paralysis versus flaccid paralysis

Upper motor neuron lesions (UMNL) also present differently symptomatically. Initially, there is weakness or a loss of tone in the affected muscles (hypotonia) but the muscles will soon (in two or three weeks) develop resistance to passive movement (known as spastic paralysis) where the tissues will resist sudden passive movement of the applicable joint. This stage is accompanied by hyper-reflexia of DTR. This progression is highly distinctive for an UMNL.



FIGURE 14.99

Babinski's sign or reflex (positive).

In contrast a lower motor neuron lesion (LMNL) presents as weakness or even paralysis known as flaccid paralysis. This is accompanied by loss of DTR. The muscle often presents with distinctive tremors or fasciculation for two or three weeks after paralysis which then disappears. **NOTE:** If fasciculation begins again several weeks later this can imply that the nerve is regenerating.

There are a number of tests for UMNL but Babinski's test remains the most common and works well in providing a clear positive or negative sign.

Trigger point referral symptoms

Although there are many steps in doing a thorough neurological examination and this may not seem the time to mention any further complication of the issue we would be remiss if we did not mention at least one of the most common mimics of neurological symptoms: trigger point (TrP) referral.

TrP referral is not limited to pain. TrP referral can also manifest as weakness, tingling, or burning (i.e., paresthesia) as possible symptoms experienced by patients suffering from TrPs. By using charts that map TrPs and their common referral zones you can test (using appropriate palpation techniques) for the TrP that could be causing a referral into the area of the body that



FIGURE 14.100

Babinski's sign or reflex (negative).