

The Precise Neurological Exam

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The Motor System Examination

The motor system evaluation is divided into the following: body positioning, involuntary movements, muscle tone and muscle strength.

Upper motor neuron lesions are characterized by weakness, spasticity, hyperreflexia, primitive reflexes and the Babinski sign. Primitive reflexes include the grasp, suck and snout reflexes. Lower motor neuron lesions are characterized by weakness, hypotonia, hyporeflexia, atrophy and fasciculations.

Fasciculations are fine movements of the muscle under the skin and are indicative of lower motor neuron disease. They are caused by denervation of whole motor units leading to acetylcholine hypersensitivity at the denervated muscle. Atrophy of the affected muscle is usually concurrent with fasciculations. Fibrillations are spontaneous contractions of individual muscle fibers and are therefore not observed with the naked eye.



Note the position of the body that the patient assumes when sitting on the examination table.

Paralysis or weakness may become evident when a patient assumes an abnormal body position. A central lesion usually produces greater weakness in the extensors than in the flexors of the upper extremities, while the opposite is true in the lower extremities: a greater weakness in the flexors than in the extensors.

Next, examine the patient for tics, tremors and fasciculations. Note their location and quality. Also note if they are related to any specific body position or emotional state.

Systematically examine all of the major muscle groups of the body.

For each muscle group:

1. Note the appearance or muscularity of the muscle (wasted, highly developed, normal).
2. Feel the tone of the muscle (flaccid, clonic, normal).
3. Test the strength of the muscle group.

0	No muscle contraction is detected
1	A trace contraction is noted in the muscle by palpating the muscle while the patient attempts to contract it.
2	The patient is able to actively move the muscle when gravity is eliminated.
3	The patient may move the muscle against gravity but not against resistance from the examiner.
4	The patient may move the muscle group against some resistance from the examiner.
5	The patient moves the muscle group and overcomes the resistance of the examiner. This is normal muscle strength.

- Since this rating scale is skewed towards weakness, many clinicians further subclassify their finding by adding a + or -, e.g., 5- or 3+.



Starting with the deltoids, ask the patient to raise both their arms in front of them simultaneously as strongly as they can while the examiner provides resistance to this movement. Compare the strength of each arm.

The deltoid muscle is innervated by the C5 nerve root via the axillary nerve.



Next, ask the patient to extend and raise both arms in front of them as if they were carrying a pizza. Ask the patient to keep their arms in place while they close their eyes and count to 10. Normally their arms will remain in place. If there is upper extremity weakness there will be a positive pronator drift, in which the affected arm will pronate and fall. This is one of the most sensitive tests for upper extremity weakness.

Pronator drift is an indicator of upper motor neuron weakness. In upper motor neuron weakness, supination is weaker than pronation in the upper extremity, leading to a pronation of the affected arm. This test is also excellent for verification of internal consistency, because if a patient fakes the weakness, they almost always drop their arm without pronating it.

The patient to the left does not have a pronator drift.



Test the strength of lower arm flexion by holding the patient's wrist from above and instructing them to "flex their hand up to their shoulder". Provide resistance at the wrist. Repeat and compare to the opposite arm. This tests the biceps muscle.

The biceps muscle is innervated by the C5 and C6 nerve roots via the musculocutaneous nerve.



Now have the patient extend their forearm against the examiner's resistance. Make certain that the patient begins their extension from a fully flexed position because this part of the movement is most sensitive to a loss in strength. This tests the triceps. Note any asymmetry in the other arm.

The triceps muscle is innervated by the C6 and C7 nerve roots via the radial nerve.



Test the strength of wrist extension by asking the patient to extend their wrist while the examiner resists the movement. This tests the forearm extensors. Repeat with the other arm.

The wrist extensors are innervated by C6 and C7 nerve roots via the radial nerve. The radial nerve is the "great extensor" of the arm: it innervates all the extensor muscles in the upper and lower arm.



Examine the patient's hands. Look for intrinsic hand, thenar and hypothenar muscle wasting.

Test the patient's grip by having the patient hold the examiner's fingers in their fist tightly and instructing them not to let go while the examiner attempts to remove them. Normally the examiner cannot remove their fingers. This tests the forearm flexors and the intrinsic hand muscles. Compare the hands for strength asymmetry.

Finger flexion is innervated by the C8 nerve root via the median nerve.



Test the intrinsic hand muscles once again by having the patient abduct or "fan out" all of their fingers. Instruct the patient to not allow the examiner to compress them back in. Normally, one can resist the examiner from replacing the fingers.

Finger abduction or "fanning" is innervated by the T1 nerve root via the ulnar nerve.



To complete the motor examination of the upper extremities, test the strength of the thumb opposition by telling the patient to touch the tip of their thumb to the tip of their pinky finger. Apply resistance to the thumb with your index finger. Repeat with the other thumb and compare.

Thumb opposition is innervated by the C8 and T1 nerve roots via the median nerve.



Proceeding to the lower extremities, first test the flexion of the hip by asking the patient to lie down and raise each leg separately while the examiner resists. Repeat and compare with the other leg. This tests the iliopsoas muscles.

Hip flexion is innervated by the L2 and L3 nerve roots via the femoral nerve.



Test the adduction of the legs by placing your hands on the inner thighs of the patient and asking them to bring both legs together. This tests the adductors of the medial thigh.

Adduction of the hip is mediated by the L2, L3 and L4 nerve roots.



Test the abduction of the legs by placing your hands on the outer thighs and asking the patient to move their legs apart. This tests the gluteus maximus and gluteus minimus.

Abduction of the hip is mediated by the L4, L5 and S1 nerve roots.



Next, test the extension of the hip by instructing the patient to press down on the examiner's hand which is placed underneath the patient's thigh. Repeat and compare to the other leg. This tests the gluteus maximus.

Hip extension is innervated by the L4 and L5 nerve roots via the gluteal nerve.



Test extension at the knee by placing one hand under the knee and the other on top of the lower leg to provide resistance. Ask the patient to "kick out" or extend the lower leg at the knee. Repeat and compare to the other leg. This tests the quadriceps muscle.

Knee extension by the quadriceps muscle is innervated by the L3 and L4 nerve roots via the femoral nerve.



Test flexion at the knee by holding the knee from the side and applying resistance under the ankle and instructing the patient to pull the lower leg towards their buttock as hard as possible. Repeat with the other leg. This tests the hamstrings.

The hamstrings are innervated by the L5 and S1 nerve roots via the sciatic nerve.



Test dorsiflexion of the ankle by holding the top of the ankle and have the patient pull their foot up towards their face as hard as possible. Repeat with the other foot. This tests the muscles in the anterior compartment of the lower leg.



Ankle dorsiflexion is innervated by the L4 and L5 nerve roots via the peroneal nerve.



Holding the bottom of the foot, ask the patient to "press down on the gas pedal" as hard as possible. Repeat with the other foot and compare. This tests the gastrocnemius and soleus muscles in the posterior compartment of the lower leg.

Ankle plantar flexion is innervated by the S1 and S2 nerve roots via the tibial nerve.



To complete the motor exam of the lower extremity ask the patient to move the large toe against the examiner's resistance "up towards the patient's face". The extensor halucis longus muscle is almost completely innervated by the L5 nerve root. This tests the extensor halucis longus muscle.

Patients with primary muscle disease (e.g. polymyositis) or disease of the neuromuscular junction (e.g. myasthenia gravis), usually develop weakness in the proximal muscle groups. This leads to the greatest weakness in the hip girdle and shoulder girdle muscles. This weakness usually manifests as difficulty standing from a chair without significant help with the arm musculature. Patients often complain that they can't get out of their cars easily or have trouble combing their hair.

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