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Motor Exam II

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Overview

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There are two main types of reflexes that are tested on a neurological examination: stretch (or deep tendon reflexes) and superficial reflexes. A deep tendon reflex (DTR) results from the stimulation of a stretch-sensitive afferent from a neuromuscular spindle, which, via a single synapse, stimulates a motor nerve leading to a muscle contraction. DTRs are increased in chronic upper motor neuron lesions (lesions of the pyramidal tract) and decreased in lower motor neuron lesions and nerve and muscle disorders. There is a wide variation of responses and reflexes graded from 0 to 4+ (Table 1).

DTRs are commonly tested to help localize neurologic disorders. A common method of recording findings during the DTR examination is using a stick figure diagram. The DTR test can help distinguish upper and lower motor neuron problems, and can assist in localizing nerve root compression as well. Although the DTR of nearly any skeletal muscle could be tested, the reflexes that are routinely tested are: brachioradialis, biceps, triceps, patellar, and Achilles (Table 2).

Superficial reflexes are segmental reflex responses that result from stimulation of a specific sensory input (cutaneous or conjunctival) and the corresponding motor response. These reflexes include the corneal, conjunctival, abdominal, cremasteric, anal wink and plantar (Babinski) reflexes. The plantar reflex is a polysynaptic reflex elicited by stroking the lateral aspect of the sole with the normal response being plantar flexion of the great toe. This reflex changes with the normal development of the nervous system. In infants the toe will dorsiflex, but by 2 years of age the toe responds by plantar flexing. With damage to the pyramidal system, there is an unmasking of the more primitive reflex and the toe becomes "upgoing" or a positive Babinski sign.

The evaluations of coordination and gait are performed as a part of the neurological motor examination and can help a clinician localize lesions or recognize movement disorders. The coordination of movements and gait has complex multi-level regulation and requires an integrated function of different components of the nervous system. This part of the neurological examination allows the examiner to assess the function of the cerebellum, the cerebellar connections, and other tracts including brainstem structures. Coordination is assessed by looking for smooth and accurate movement, and requires the integration of sensory feedback with motor output, most of which occurs in the cerebellum. An impaired ability to coordinate the rate, range, timing, direction, or force of voluntary movement is called ataxia. Testing coordination includes evaluation of rapid alternating movements and point-to-point coordination, both of which can be altered as a result of cerebellar dysfunction. As in other parts of the examination, observation is the first step in the evaluation of the patient. A careful observation of a patient's gait can help the clinician screen for problems including weakness, movement disorders, spasticity, and cerebellar disease. No neurologic examination is complete without the assessment of gait. Occasionally, the only sign of a serious neurologic disorder is an impaired gait.

Procedure

1. Reflexes testing.

The proper use of the reflex hammer and the relaxation of the patient and muscle to be tested are critical in eliciting DTRs. The reflex hammer should be held loosely in the hand and guided by the thumb and index finger. The swing should be in an arc-like fashion, making use of the angular momentum, keeping the wrist loose and striking the tendon briskly. Close attention to the position of the limb is important to ensure the muscle is in a relaxed position. Clearly identify the tendon of the muscle to be tested. It can be helpful to make conversation with the patient to promote relaxation. Observe the muscle for contraction, and look for limb movement. If despite following all these procedures a DTR is not elicited, try the other side. If again a DTR is not elicited, then try the Jendrassik maneuver (described in the next section).

1. Upper Extremity Reflexes
    1. Biceps Reflex
        1. Have the patient relax the arm, and pronate the forearm midway between flexion and extension. Palpate the biceps tendon in the antecubital fossa, and place one finger on the tendon. Use the reflex hammer to tap your finger using proper technique.
        2. Observe for biceps muscle contraction. The elbow may flex slightly or the muscle may simply contract without other observable movement.
    2. Brachioradial Reflex
        1. Have the patient place the forearm in semiflexion and semipronation. Ensure that the patient's forearm is resting on the patient's lap in a seated position (on the patient's abdomen if lying down) to ensure full relaxation.
        2. Place your finger on the tendon (1-2 inches above the wrist) and use the broad area of the reflex hammer to tap. Observe for flexion at the elbow and supination at the wrist.
    3. Triceps Reflex
        1. Have the patient flex the forearm at the elbow midway between flexion and extension, and pull the arm toward the chest. Tap the triceps tendon 2 inches above the elbow. Observe for contraction of the triceps muscle and extension at the elbow.

2. Another maneuver is to hang the patient's arm over your arm, and make sure the patient is placing the full weight of the arm on yours. Tap the triceps tendon in this position, and again observe for contraction of the triceps muscle and extension of the elbow.

2. Lower Extremity Reflexes
    1. Patellar Reflex
        1. If the patient is sitting, with the legs dangling off the side of the bed or examination table, place your hand on the patient's quadriceps muscle and strike the patellar tendon firmly. Feel for contraction of the quadriceps, and extension at the knee should be observed.
        2. If the patient is lying supine in bed, place the arm under the knee so that the knee is flexed to slightly less than 90°, and strike the knee below the patella. Watch the quadriceps for contraction and the knee for extension.

    2. Achilles Reflex (Ankle jerk)
        1. If the patient is sitting, place a hand under the patient's foot to partially dorsiflex the ankle. With the wide end of the reflex hammer, tap the Achilles tendon just above its insertion on the posterior aspect of the calcaneus. Note contraction of the calf muscles and plantar flexion at the ankle.
        2. If the patient is lying down, hold foot in a partially dorsiflexed position with a medial malleolus facing the ceiling. The knee should be flexed and lying to the side. Strike the Achilles tendon directly. Watch the muscles of the calf for contraction, and feel for plantar flexion of the foot.
        3. Assess for clonus at the ankle. Dorsiflex the ankle briskly, and maintain the foot in that position. Note the clonus, which is rhythmic muscle contraction. More than 3 beats of clonus or any asymmetry between feet is abnormal.

3. Plantar Reflex
    1. Gently stroke the bottom of the foot, starting laterally and near the heel, and moving up and across the ball of the foot (metatarsal heads). If no response, increase your pressure. A normal response is the great toe moving downward.
    If there is a disorder of the pyramidal tract or upper motor neuron (or in infants), the great toe will extend and the other toes will fan out. This pathological response of toe dorsiflexion is referred to as the Babinski sign.

4. Reinforcement of reflexes (Jendrassik maneuver)
    1. If a reflex is unobtainable, perform a reinforcement (Jendrassik) maneuver by having the patient perform isometric contraction of other muscles, which increases the response of deep tendon reflexes.
    2. To increase responses in upper extremities, ask the patient to clench the teeth as you swing the hammer.
    3. To reinforce responses in lower extremities, ask the patient to link the hands across the chest, and pull one against the other as you swing the hammer.

2. Coordination and Gait Testing

1. Rapid Alternating Movements
    1. Ask the patient to slap the palm of the hand on the thigh, then turn it over and strike the back of the hand on the thigh. Demonstrate the task, and ask the patient to do it with one hand and then to do it faster. Assess for rhythmicity, and then ask the patient to repeat it on the other side.
    2. Ask the patient to tap the tip of the index finger against the distal joint of the thumb, and demonstrate the task to the patient.
        1. Have the patient repeat the movement on one side and then the other side. Compare how smoothly the task is done, and assess the speed and rhythm.
        Patients are often a bit slower performing these tasks on the non-dominant side. Inability to perform smooth rapid alternating movements due to cerebellar disease is called dysdiadochokinesia.
        2. Ask the patient to tap the ball of the foot against the floor or your hand in a rhythmic fashion (as if to music: one, two, three; one, two, three). Repeat on the other side and compare. Normally, the movement should be rhythmic and performed without difficulty.

2. Point-to-point Coordination
    1. Finger-to-finger-to-nose test
        1. Ask the patient to use the index finger to touch your finger and then the patient's own nose.
        Have the patient repeat the task, and to do it faster. Move your finger as the patient performs the movement, making the patient search for the target and assess for rapidity, for smooth movements, and for accuracy
        2. Repeat on the other side, and compare. Observe for any side-to-side movements when approaching the target, dysmetria, or an intention tremor, which may be signs of cerebellar disease.

    2. Heel-to-knee-to-shin test
        1. With the patient in a supine position, ask the patient to tap the heel under the knee and then run the heel up and down the shin from ankle to knee.
        2. Have the patient repeat it on the other side. Assess for any signs of dysmetria. The ability to perform this task may be compromised by weakness.

3. Gait and Station
    1. Observe the patient sit and then stand. Note the ability to maintain a balanced and upright posture. Then observe the patient walking across the room or down the hall.

2. Observe for the presence of the symmetrical swinging of the arms, a normal rhythm to the gait (including equal transit time of each leg), and signs of spasticity, such as circumduction of one or both legs, or even a diplegic "scissoring" gait. Observe for any abnormal movements such as a tremor or choreiform movements.
3. Observe if the turns are accomplished in a smooth motion or completed in multiple small steps, as may occur in Parkinson's disease.
    1. Specific gait patterns can reflect certain conditions. Some examples of these patterns include:
    Patients with unilateral weakness and spasticity may hold the lower limb stiffly and extended. The patient may drag the weak limb around the body in a circumducting pattern.
    A wide based unsteady gait may suggest cerebellar dysfunction.
    A patient with foot drop (an inability to dorsiflex of foot or toes due to muscle or nerve damage) will tend to lift the effected foot high; this is termed "steppage gait."
    A parkinsonian gait is characterized by small shuffling steps and a general slowness of movement. Patients with Parkinson's disease may have difficulty starting, but also have difficulty stopping after starting, and may feel propelled forward.

4. Ask the patient to walk on the heels and then on the toes. Walking on the toes tests plantar flexion, and walking on the heels tests the strength of dorsiflexion at the ankles, which helps screen for weakness as may be seen in patients with a foot drop.
5. Ask the patient to perform tandem walking. Instruct the patient to walk heel touching toe in a straight line (as if walking on a tight rope). Balance and coordination need to be intact to perform tandem walking and heel-and-toe walking. Tandem gait is an excellent test of cerebellar function.
6. Romberg sign
    1. Ask the patient to place the feet together and maintain balance. This is a test of the cerebellar function when done with the eyes open, as cerebellar dysfunction results in impaired balance when in an erect position.
    2. Once it's determined that the patient can maintain balance with eyes open, ask the patient to close the eyes. Have your arms prepared to steady the patient.
    3. Note if the patient can maintain balance with the eyes closed. Romberg sign is considered positive when the patient can maintain an erect position with the eyes open, but exhibits instability (excessive sway or falling to one side) with the eyes closed. This suggests proprioception (joint position sense) disorder. The cerebellar dysfunction results in excessive sway or instability whether the eyes are open or closed.

Results

Testing the deep tendon reflexes and eliciting the plantar reflex are important components of the neurologic examination and are helpful in localizing the site of a neurologic injury. Knowledge of the anatomy of the muscles being tested and the nerves and nerve root supplying them is critical in performing and interpreting this portion of the examination. Testing the plantar reflex is an important tool in assessing for an upper motor neuron or pyramidal tract lesion. Abnormalities of the coordination exam can be seen in various diseases such as tumor, stroke, intoxication (such as with alcohol), multiple sclerosis, and genetic degenerative diseases. The evaluation of coordination is mainly directed toward assessing the cerebellar function. The disorders affecting the cerebellum often manifest with dysarthria, nystagmus, hypotonia, and ataxia. As the cerebellum is very sensitive to the effects of alcohol, the characteristic slurred, thickened speech of an intoxicated individual may be heard in patients with cerebellar disease. If the lesion is in one of the cerebellar hemispheres, the symptoms are on the same (ipsilateral) side. Tests of coordination are more difficult to interpret in the setting of weakness. It is important to remember that coordination and gait require normal and integrated functioning of several components of the nervous system. Observation of a patient's walking can be an important screening tool for a spectrum of neurological abnormalities ranging from movement disorders to mass lesions. A clinician should be able to recognize a pattern of pathological gait, such as ataxic (cerebellar), hemiplegic, parkinsonian, and others.

Score	Reflexes
0	Absent
1	Hypoactive or present only with reinforcement
2	Readily elicited with a normal response
3	Brisk with or without evidence of spread to the neighboring roots
4	Brisk with sustained clonus

Table 1. Reflex-Grading System

Muscle	Spinal Roots	Nerve
Biceps	C5 (6)	Musculocutaneous
Brachioradialis	C (5) 6	Radial
Triceps	C7	Radial
Patellar	L(3)4	Femoral
Achilles	S1	Tibial

Table 2. Muscles, spinal roots and nerves tested