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Glossary

Afferent - Sensory nerve fibres
Ataxia - A group of disorders that affect co-ordination, balance and speech.
Clonus - Involuntary rhythmical muscular contractions
Dysmetria - Lack of co-ordination in performing the nose to finger test.
Efferent - Motor nerve fibres.
Extrapyramidal - The part of the motor system responsible for involuntary movement.
Flocculus - Small lobe on the posterior border of the cerebellum.
Gait - Limb and body position during walking.
Hypermetria - Pointing past the finger in the nose to finger test.
Hypometria - Under pointing in the nose to finger test.
Myotome - A group of muscles innervated by a spinal nerve.

Proprioception - These are specialised afferent nerve receptors that occur in muscles, joints and tendons and provide awareness of posture and movement (kinaesthesia).
Rigidity - Hypertonia caused by a lesion in the extrapyramidal system.
Rombergism - A swaying or toppling in a patient while standing erect with feet together and eyes closed.
Spasticity - Velocity dependant hypertonia caused by an upper motor neurone lesion.

Learning Objectives

Year 2

• To know the basic anatomy and function of the motor system.
• To be able to understand and carry out a bedside assessment of the motor system and assess a patient’s co-ordination.
• To be able to elicit monosynaptic tendon reflexes on a patient.
• To adhere to waste disposal policies including sharps and clinical waste.
• To assess coordination as part of a neurology examination.
• To be aware of the indications for assessing a patient’s coordination.
• To be able to recognise some different patterns of ataxia.
Introduction

Motor and Co-Ordination Examinations whilst, sometimes accessed in isolation, usually form two components of a wider Neurological Examination consisting of:

- Motor Examination
- Co-ordination Examination
- Sensory Examination
- Cranial Nerve Examination
- Ophtalmoscopy

During a Motor and Co-Ordination examination the patient will have to undertake a range of movements, therefore it is important that you understand the relevant terminology related to anatomical movements. It is recommended that you refer back to your Year 1/2 MSK study guide for further information.
Surface Anatomy / Relevant Physiology

Motor System
Signals originate from the motor cortex. Once at the level of the spinal cord they are carried via the anterior corticospinal and lateral corticospinal tracts.

Spinal Nerves
From the spinal cord these signals exit at different levels via spinal nerves, to peripheral nerves terminating at the muscle.

Muscle groups (Myotomes) are innervated by spinal nerves, these nerves are numbered in relation to the spinal column:

There are 8 Cervical nerves as each nerve sits above its corresponding vertebra. In total there are:

- 8 Cervical nerves
- 12 Thoracic nerves
- 5 Lumbar nerves
- 5 Sacral nerves
Motor Neurones
Many of the presentations you will see in clinical practice that are due to a motor cause will vary significantly depending on whether the area affected is part of an upper or lower motor neurone. Therefore, it is important to understand which areas of the motor nerve pathway we are referring to for each:

Upper Motor Neurone (UMN)
From the motor cortex to anterior horn cell (relay station) of the spinal cord.

Lower Motor Neurone (LMN)
From anterior horn cell to neuromuscular junction

Tone: Spasticity, Rigidity and Flaccidity
Tone relates to the resistance of muscles within a limb. In normal tone, resistance within the limb should be neither hypertonic or hypotonic.

Hypertonia is an increase in muscular resistance, which can be further subdivided into spasticity or rigidity:

- **Spasticity**: Velocity dependant hypertonia, meaning that muscular resistance increases with the speed passive movement. Spasticity is usually unidirectional, e.g. increased resistance may only occur during flexion and be absent in extension. Spasticity is associated with UMN lesions causing a reduction in the dampening effect of muscular reflexes.

- **Rigidity**: Persistent hypertonia which is non velocity dependant and omnidirectional. Rigidity is commonly caused by lesions within the extrapyramidal tract, responsible for involuntary movement. As pathways target muscle groups rather than individual muscles. In extrapyramidal conditions such as Parkinson’s disease this can
also cause cogwheel rigidity, which is caused by a combination of rigidity and tremor.

Hypotonia is a decrease in muscular resistance, the term flaccidity is commonly used:

- **Flaccidity**  Commonly caused by lower motor neuron lesions, causing hypotonia within the limb.

**Power**

Weakness within limbs may be cause by either UMN or LMN lesions and present differently. Limb weakness caused by an UMN lesion due to the lack of spinal level suppression, causes larger muscles within muscle groups to overpower smaller ones. This leads to characteristic postures such as those seen in people who have had a stroke, causing contraction of the upper limb and extension of the lower limb. LMN lesions cause generalised weakness, which can be more pronounced distally.

**Monosynaptic Reflexes**

A monosynaptic reflex is an involuntary movement caused by a sensory stimulus which is elicited at the level of the spinal cord with no involvement from the brain.

For a reflex to be elicited intact afferent and efferent neuron pathways, and muscle (effector) are required.

UMN lesions due to the lack of dampening effect will cause reflexes to become brisk.

LMN lesions due to disruption in the pathways between the spinal cord and muscle will be reduced or absent.

**Clonus**

Like spasticity and brisk reflexes, clonus is related to UMN lesions. When a reflex is triggered it may continue to elicit a response in the form of multiple rhythmical contractions.

**Co-Ordination**

Co-ordination requires intact sensory, motor and vestibular systems. The sensory element of co-ordination relies on proprioception sense to be intact along with normal vision. The motor element of co-ordination requires normal cerebellar function and connections.
From a functional anatomical perspective, the patient is required to demonstrate the afferent and efferent pathways of their neurological tract or more specifically their cerebellar function. Cerebellar conditions give rise to a series of involuntary movements that are collectively termed as Ataxia. The centres for co-ordination are centred in the cerebellum which sits superiorly to the brain stem and inferiorly to the cerebrum.

The cerebellum itself is primarily divided between a central vermis and two lateral hemispheres.

Cerebral Hemispheres

The function of the two hemispheres are as follows;
- Planning & execution of movements
- Co-ordinating complex movements with their execution
- Cognition
- Language
- Learning
- Emotions

Central Vermis

The function of the central vermis is as follows;
- Muscle tone
- Distal part of limbs
  - Hands, fingers, feet & toes
- Proximal part of limbs
  - Trunk & head

On the anterior inferior surface of the cerebellum are two flocculus with nodes. These are the flocculonodular lobes. The function of these lobes is to;
- Integrate sensory information from the vestibular senses and the eyes.
Afferent Fibres

Afferent pathway from the limbs via the spinal cord to the cerebellum are of multiple types of nerve fibres that form the pontocerebellar axons.

Efferent Fibres

Efferent nerve fibres flow from the cerebral cortex to the target organ or muscle via the somatomotor fibres which arise from the ventral horns of the gray matter within the spinal cord, carrying impulses to the target skeletal muscle(s) via the neuromuscular junction.

There are two types of motor efferent neurones, those being the;

1. Alpha neurone fibres which target skeletal muscle.
2. Gamma fibres target the proprioceptive fibres, which are referred to as intrafusal fibres. Intrafusal fibres are specialised skeletal muscle fibres that have a sensory function and have both efferent and afferent pathways. Intrafusal refers to the shape of the fibres and these fibres have a proprioceptive function.

Proprioceptive Fibres

These are specialised intrafusal skeletal muscle fibres that have a specialised sensory role and detect the movement and positioning of joints and muscle in the body, essentially allowing the body to “know it’s position in space”

Vestibular receptors in the inner ear are also classed as proprioceptors.

The proprioceptive centres within the brain are the Parietal cortex and the pre-motor cortex.

Ataxia

This is a term for a group of disorders that affect co-ordination, balance, movement and speech.

There are three categories that cause ataxia;

- Hereditary – genetic where gradual degeneration is evident.
- Idiopathic late – onset cerebellar ataxia (ILOCA) gradual deterioration with unknown cause.
- Acquired ataxia – symptoms develop following a trauma, eg: CVA/MS/Toxins/Tumour.

For Ataxia generally, the three causes may be divided into the patient exhibiting Appendicular ataxia or Truncal ataxia. (It can be combined in catastrophic cerebellar damage / lesions)
Appendicular Ataxia
This affects the distal musculature and co-ordination and is caused by lesions to the hemispheres of the cerebellum.
Patients with appendicular lesions have difficulty with such tasks as aiming a tooth brush into their mouth and like tasks. Accompanying this may be speech impairment.

Truncal Ataxia
This affects the proximal musculature responsible for balance and mobility and is caused by lesions to the cerebellar vermis located in the medial aspect of the cerebellum. In truncal cases patients will exhibit abnormal gait.

Gait
Being able to move around in a co-ordinated fashion is something that we all take for granted and when problems arise with mobility it becomes frightening and disconcerting.

Patients with cerebellar lesions have what is referred to as an Ataxic gait which is not to be confused with an Antalgic gait
Antalgic gait, which roughly translates from Latin meaning against painful walking. The antalgic patient modifies how they mobilise in order to avoid pain or in order to increase the efficiency of movement given their condition.
Antalgic gait can cover the following conditions and are not necessarily caused by cerebellar lesions.

Antalgic gait
Myopathic gait or waddling gait. This is caused by a proximal weakness of the pelvic girdle muscles. The characteristic feature is circumduction medial to lateral movement of the lower limbs

Parkinsonian gait Caused by a decrease in dopamine in the basal ganglia, located in the mid brain but with strong links to the cerebellum. The patient may typically exhibit what is described as a propulsive walk / gait, characterised by a stooped posture with short shuffling steps. Patients with Parkinson’s go through a period of degenerative decline that gradually makes their gait worse.

Peripheral Nerve neuropathies These conditions can include such things as dysesthesia of the feet where the patient has painful sensations in their legs & feet that can cause the patient to move “gingerly” to minimise the discomfort. This may be seen in patients with MS.
In diabetes the opposite may occur where the patient has reduced sensation and consequently plants their feet firmly when walking.

Ataxic gait
Cerebellar

This can be caused by intoxication (Alcohol / or drugs) The patient exhibits a wide stanced gait. A patient may present with a cerebellar lesion or tumour that will cause an abnormal gait. The patient may have a wide based stance with swaying.

Proprioception –

Proprioceptors are in muscles, tendons and joints that enable you to judge your body’s position and enable you to co-ordinate movement. Loss of proprioception can be accommodated for by looking at your movement, however when the eyes are closed, controlled movement becomes very difficult.

History

Patients may provide a history of symptoms that they find confusing and frightening and as such it is down to a clinical examination to note any signs; whether that is something you observe in the patient from a general inspection or obtain from a clinical examination.

Indications

Prior to any clinical examination a detailed history should be taken from the patient, this will enable you to tailor the examination to the patient’s presenting complaint and additional symptoms the patient may elude to when you elicit a full history. For guidance on history taking please see MBCHB students – Year 2 – History taking.

Indications for performing a Motor/Co-ordination examination include:

- Abnormal gait
- Abnormal posture and limb position
- Alcohol / drugs
- Asymmetrical or reduced muscle bulk
- Brain tumor
- Following an injury/trauma
- General Neurological examination
- Involuntary movements
- Multiple sclerosis
- Muscle fasciculation
- Parkinsonism
- Speech and language changes
- Stroke
- Vomiting with postural changes
- Weakness
Preparation

Patient Safety

To ensure a safe and effective consultation and examination you may wish to consider the following:

- Introduce yourself
- Check the patient’s identity and allergies
- Explain what you want to do
- Gain informed consent
- Consider an appropriate chaperone
- Adequate exposure maintaining dignity
- Position the patient appropriately – consider moving and handling
- Wear Personal Protective Equipment as required.
- Wash your hands before and after you touch the patient (as per WHO guidelines)

On first meeting a patient introduce yourself and confirm that you have the correct patient with the name and date of birth, if available please check this with the name band, written documentation and the NHS number/ hospital number/ first line of address.

Check the patient’s allergy status, being aware of the equipment you will be using in your examination.

Ensure the procedure is explained to the patient in terms that they understand and gain informed consent.

Whilst this procedure is not deemed to be an intimate examination, there are instances where you may require the presence of a chaperone. A chaperone must be familiar with the examination and can ensure that nothing inappropriate occurs by either party. The chaperone can be a useful resource, not just being present to ensure the patient is treated appropriately, but to help and support the patient.

Personal protective equipment is not routinely used when carrying out a motor examination, however there are instances where you will be required to don personal protective equipment if you are likely to encounter bodily fluids, e.g. open wounds. Also ensure good hand hygiene and wash your hands before and after touching the patient.

Patient Positioning / Exposure

Dependant on the presenting complaint this examination may require exposure of all limbs, to ensure privacy, dignity and patient comfort is maintained it is important that you consider the following:

- The environment should be warm and private,
- Provide the patient with a gown or blanket to maintain their modesty,
- A chaperone may be present.
For this examination the patient will be undergoing a range of movements in standing, sitting and lying positions. Dependant on the patient’s mobility and range of movement you may require additional help the patient move e.g. getting onto the examination couch.

**Equipment**

For this examination you will need;

1. Hand wash
2. Examination Couch
3. Tendon Hammer
4. Alcohol/Detergent Wipes (to clean tendon hammer).
**Inspection**

**General Inspection**
Inspection begins on first meeting the patient. Some clinicians will call the patient from the waiting area to observe their movement and gait as they walk into the room.

Observe the patient for their ambulatory gait / balance as described above or any other lack of co-ordination, this may include such things as walking aids or as they move veering towards one side more than the other. This information may have been gathered as part of your history and may well be part of the presenting complaint.

**Specific inspection**

Observe limb posture and gait, look for asymmetry of muscle bulk in all 4 limbs and specific hand muscles - Dorsal interosseous and thenar eminence for atrophy (muscle wasting).

The images above is shows atrophy of the muscle to the patient's right thenar eminence (fig 7) and atrophy to the patient's right leg (fig 8) both findings are due to an upper limb motor neuropathy. There are a wide variety of causes of muscular atrophy including: Multiple sclerosis, cerebrovascular accident (CVA) and trauma.

**Tone**
Tests should be carried out on both limbs by asking the patient to relax their limb whilst passive movements are performed. Movements are carried out on opposing limbs to compare and contrast findings. If tone is normal there should be no hypertonia or hypotonia observed during the following passive movements:
Assessment of Tone in Upper Limbs

Supination and Pronation of Wrist

Support the patient’s elbow with one hand and take control of the patient’s hand as if shaking hands.

Supinate (image 9A) and pronate (image 9B) the arm, then place the wrist in supination and sharply pronate the wrist.

Flexion and Extension of Elbow

Whilst still supporting the elbow hold the patient’s forearm just below the wrist to flex and extend the elbow (image 10).
Assessment of Tone in Lower Limbs

Internal and External Rotation of Hip

Place your hands on the patient’s thigh and roll the whole leg, observing the movement of the foot (figure 11). If the tone is normal the range of movement of the foot lags slightly behind the rotation of the leg.

Flexion and Extension of Knee

Support the patient’s leg below the knee joint ensuring their heel is not in contact with the examination couch. Then flex and extend the knee, assessing for abnormally increased or decreased resistance (figure 12).

Clonus

Position the patient with the knee flexed and the hip externally rotated. Sharply dorsiflex the foot and maintain this (Figure 13). In most people with normal tone the foot will not move but 2-3 beats of clonus (plantar flexion followed by dorsiflexion of the foot) can be within normal limits. Sustained clonus is a sign of an upper motor neurone problem.
Power

Power is tested through a range of upper and lower limb movements. With each movement ask the patient to perform this on their own to assess whether they can sustain active movement against gravity. If this movement can be performed actively, next repeat the movement whilst applying resistance (shown in the images below) remembering this is not a test of relative strength and mechanical advantage must be given to the patient and not the practitioner.

It is important to ensure that only the intended muscle groups are tested, this is achieved by using one hand to stabilise the joint proximal with your other hand.

Perform the movement on opposing limbs to compare and contrast using the same arm for each test, as switching between dominant and non-dominant sides during the examination may alter the examiners perception of strength.

Assessment of Power in Upper Limbs

Shoulder Abduction (C5/6) and Adduction (C6/7/8)

Position the patient with the shoulders abducted to slightly above 90° and elbow flexed with forearm towards the midline.

Place one hand on top of the upper arm and stabilise by placing your other hand above the patient’s shoulder (figure 14). Next ask the patient:

“Stop me from pushing your arm down.”

In the same position adjust the patient’s arm so that it is adducted to slightly above 90°.

Place one hand underneath the upper arm and stabilise by placing your other hand above the patient’s shoulder (figure 15). Next ask the patient:

“Stop me from pushing your arm up.”
Elbow Flexion (C5/6) and Extension (C7/8)

Position the patient with their arm by their side and elbow flexed to slightly below 90° (figure 16).

Place one hand at the forearm and stabilise by placing your other hand between the elbow and shoulder joint. Next ask the patient:

“Stop me from straightening your arm.”

In the same position adjust the patient’s elbow so that it is extended to slightly above 90° (Figure 17).

Place one hand at the forearm and stabilise by placing your other hand between the elbow and shoulder joint. Next ask the patient:

“Stop me from bending your arm up.”

Finger Flexion (C8) and Extension (C7)

Position the patient with their fingers slightly flexed, curling them towards their palm.

Place one hand with your fingers curled underneath the patient’s and stabilise by placing your other hand around the patient’s hand between the wrist joint and fingers (figure 18A). Next ask the patient:

“Stop me from straightening your fingers.”

Alternatively, this can be tested by placing your fingers within the patient’s palm (figure 18B) and ask the patient:

“Squeeze my fingers.”
Position the patient with their fingers extended and stabilise by placing one hand between the wrist and fingers (figure 19). Next ask the patient:

*Stop me from bending your fingers.*

**Assessment of Power in Lower Limbs**

**Hip Flexion (L1/2) and Extension (C6/7/8)**

Position the patient supine, with their leg straight and elevated to approximately 30°

Place one hand on top of the thigh (figure 20A). Next ask the patient:

*“Stop me from pushing your leg down.”*

Next place your hand, palm up, underneath the patient's thigh with their leg straight and resting flat against the couch (figure 20B). Next ask the patient:

*“Stop me from lifting your leg up.”*

**Knee Flexion (S1) and Extention (C3/4)**

Position the patient sat up slightly with their heel off the couch and knee flexed slightly less than 90°.

Place one hand behind the calf and stabilise by placing your other hand on top of the patient's thigh (figure 21). Next ask the patient:

*“Stop me from straightening your leg.”*
In the same position adjust the patient’s leg so that it is extended slightly more than 90°.

Place one hand onto the patients shin and stabilise by placing your other hand behind the patient’s thigh (figure 22). Next ask the patient:

“Stop me from bending your knee.”

Dorsiflexion (L4/5) and Plantar Flexion (S1/2) of the Ankle

Position the patient with their heel in contact with the couch and toes elevated in a slight dorsiflexion.

Place one hand on top of the dorsum of the foot and stabilise by placing your other hand proximal to the patient’s ankle (figure 23). Next ask the patient:

“Stop me from pushing your foot down.”

In the same position adjust the patient’s foot so that it is in a slight plantar flexion.

Place one hand underneath the plantar of the foot and by placing your other hand proximal to the patient’s ankle (figure 24). Next ask the patient:

“Stop me from lifting your foot up.”

Grading of Power

Power of each limb is graded using the muscle power grading scale detailed below:
<table>
<thead>
<tr>
<th>Grade 0</th>
<th>No Contraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 1</td>
<td>Flicker or trace of contraction</td>
</tr>
<tr>
<td>Grade 2</td>
<td>Active movement, with gravity eliminated</td>
</tr>
<tr>
<td>Grade 3</td>
<td>Active movement against gravity</td>
</tr>
<tr>
<td>Grade 4</td>
<td>Active movement against gravity and resistance</td>
</tr>
<tr>
<td>Grade 5</td>
<td>Normal power</td>
</tr>
</tbody>
</table>

(Medical Research Council, 1943)

It is important to understand the distinctions between gradings on this scale, especially grades 2, 3 and 4 which can be more subtle. A good example is to consider the patient drinking a cup of tea. If the patient was able to slide their affected limb across a surface such as a table in order to hold the cup this would be grade 2 (gravity eliminated), if they were able to lift their hand up to their mouth without the cup this would be grade 3 (against gravity) and if they were able to lift the cup up to their mouth this would be grade 4 (against gravity and resistance).
Reflexes

A normal reflex arc requires:

- Stimulus to stretch receptors
- Intact sensory afferent pathway
- Link with a motor unit
- Intact motor neurone
- Contractile element

Testing reflexes should be done in a systematic way comparing the response on each side. It is vital that the patient is relaxed and allows the limb being tested to be unsupported by them and ‘floppy’.

Normal reflexes can often produce subtle muscular contraction; therefore it is advised to observe the tested muscle for contraction rather than exaggerated limb movement.

Hold the tendon hammer like a hammer, don’t be too tentative. You will not hurt the patient if you strike the intended tendon. Position the limb correctly, place your finger over the tendon and strike it the finger with the percussor or tendon hammer, although for some reflexes you will strike the tendon itself.

Reinforcement

Where a reflex appears difficult to elicit, reinforcement techniques should be incorporated. This attempts to distract the UMN component of the motor pathway, often making it easier to elicit a reflex response.

Following one unsuccessful attempt without reinforcement, ask the patient to close their eyes and for:

- Upper limb reflexes Ask the patient to clench their teeth
- Lower limb reflexes Ask the patient to grasp the fingers of each hand and to pull apart as the reflex is tested

Figure 25
Assessment of Reflexes in Upper Limbs

**Supinator Reflex (C6)**

Position the patient sitting relaxed, elbows flexed and hands resting on their thigh.
Place the index and middle fingers of your non dominant hand over supinator tendon.
Strike your finger with the tendon hammer.
Observe slight elbow flexion and contraction of the brachioradialis muscle (the X in figure 26).

---

**Biceps Reflex (C5)**

Position the patient with their arms in their lap, resting the arm being tested on top of the other.
Hold the patient’s elbow with your non dominant hand so that the biceps tendon can be felt under your thumb or finger (figure 27).
Strike your thumb or finger with the tendon hammer.
Observe for elbow flexion, and contraction of the bicep muscle.

---

**Triceps Reflex (C7)**

Position the patient with their arm across their abdomen with their elbow flexed to 90°.
Support the upper arm with your non dominant hand
Strike the triceps tendon directly.
Observe for elbow extension or contraction of the tricep.
Finger Jerk (C8)

Position the patient sitting relaxed, with their fingers resting across the fingers of your hand slightly flexed (figure 33).
Strike your fingers, if a reflex is elicited, the patient’s fingers will flex.

Finger jerk reflex testing should only be carried out if clinically relevant.

Assessment of Reflexes in Lower Limbs

Knee Reflex (L3/4)

Position the patient onto an examination couch, lying supine with the backrest elevated if required.
Support the leg by placing your arm underneath the patient’s knee, to create a slightly bent.
Strike the patellar tendon directly.
Observe for knee extension and contraction of the quadriceps.

Ankle Reflex (S1)

The ankle reflex may be elicited in either of the two positions shown:

Technique 1
Position the patient with the hip is externally rotated and the knee flexed.
The ankle is held in slight dorsi-flexion to stretch the achilles tendon.
Strike the achilles tendon directly.
Observe for plantar flexion.
**Technique 2**
Position the patient with their leg flat on a couch. Place your hand on the ball of the patient's foot and passively dorsiflex the ankle. Strike your fingers. Observe for plantar flexion.

**Plantar Response (S1/2)**
Position the patient with their leg flat on a couch. Drag a thumbnail or blunt object along the lateral border of the foot and across the sole towards other side. Observe for plantar flexion.

**Grading of Reflexes**
Reflex measurements are documented using the following symbols:

<table>
<thead>
<tr>
<th>Reflex Description</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absent</td>
<td>-</td>
</tr>
<tr>
<td>Present with reinforcement</td>
<td>+/-</td>
</tr>
<tr>
<td>Normal</td>
<td>+ or ++</td>
</tr>
<tr>
<td>Brisk</td>
<td>+++</td>
</tr>
</tbody>
</table>
Patterns of Reflex Change

**UMN lesion**
- reflexes are brisk below the level of the lesion
- plantar response is usually extensor
- a pathologically brisk finger flexion jerk is the upper limb equivalent of an extensor plantar response

**LMN lesion (peripheral neuropathy)**
- reflexes are absent
- distal reflexes are first to be lost

<table>
<thead>
<tr>
<th>Parameter</th>
<th>UMN lesion</th>
<th>LMN lesion (peripheral neuropathy)*</th>
<th>Peripheral neuropathy</th>
</tr>
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<tbody>
<tr>
<td>Posture</td>
<td>Flexed UL, Extended LL</td>
<td>May be wasting, fasciculation</td>
<td>Altered gait in diabetes</td>
</tr>
<tr>
<td>Tone</td>
<td>Increased (spasticity)</td>
<td>Reduced (flaccidity)</td>
<td>Reduced muscle tone e.g. 10q trisomy (rare chromosomal disorder)</td>
</tr>
<tr>
<td>Power</td>
<td>Weakness of UL extensors and LL flexors</td>
<td>Distal weakness</td>
<td>Weakness associated with diabetes</td>
</tr>
<tr>
<td>Reflexes</td>
<td>Brisk</td>
<td>Absent</td>
<td>Absent</td>
</tr>
<tr>
<td>Plantar response</td>
<td>Extensor</td>
<td>Flexor or absent</td>
<td>Absent</td>
</tr>
</tbody>
</table>
Co-ordination

Normal co-ordination requires intact sensory, motor and vestibular systems. The sensory element of co-ordination relies on proprioception sense to be intact along with normal vision. The motor element of co-ordination requires normal cerebellar function and connections.

A person with normal co-ordination can:

- Accurately approach or touch a target with the tip of a finger, with eyes open and closed
- Accurately slide their heel down their opposite shin
- Maintain standing balance with eyes closed
- Walk in a straight line

Finger to Nose

Ask patient to repeatedly touch their nose and then the examiner’s finger (held at the patient’s arm’s length). The test is carried out slowly at first, then increasing in speed, repeated with eyes open and closed. Additionally, the test can increase in complexity by moving the target when the patient’s eyes are open. The test is performed on both limbs. Observe for:

- Intention tremor – An increasing tremor as the patient’s finger approaches target.
- Past pointing (Hypermetria) – overshooting the target.

Both errors occur with cerebellar disease. Lack of co-ordination in finger to nose pointing is called dysmetria.

Dysdiadochokinesia

The patient is asked to place one hand on top of the other. Then is asked to repeatedly and quickly, pronate and supinate the top hand in a rhythmical clapping motion.

If co-ordination is normal, the patient will be able to carry out these actions. In cerebellar disease the motion is slow and clumsy. Inability to co-ordinate this movement is termed dysdiadochokinesia.
**Heel to Shin Co-ordination**

The patient is instructed to lift one leg high and carefully place the lifted heel on to the opposite knee, then to run their heel slowly down their shin and lifts the leg off once it reaches the ankle. This movement is repeated several times.

The movement is then repeated with the patient’s eyes closed. If co-ordination is normal the patient is able to carry out these actions.

In cerebellar disease the foot may wander side to side or overshoot the knee, with eye opening or closure making little difference. If loss of proprioception is present the lack of co-ordination will increase during eye closure. Lack of co-ordination in heel – shin movement is called dysmetria.

**Altered Speech**

Observe the patient’s speech, staccato speech may occur in patients with a cerebellar lesion, this is where patients may speak in a raised voice and words are broken down by syllables. This may become more pronounced if the patient is asked to repeat certain phrases. Common phrases used in clinical practice include; “The British Constitution” or “Baby Hippopotamus”.

**Gait**

Ask the patient to walk normally for a few metres, turn quickly and return. Observe for:

- Stride length
- Pattern of leg movements
- Posture
- Arm swing
- Balance
- Symmetry

For a detailed description of different types of gait please refer to the Year 2 Musculoskeletal Examination Study Guide.
Heel to Toe gait

Ask the patient to walk a few steps, putting heel of one foot directly ahead of the contralateral toes - “As if walking on a tightrope”

Romberg Test
This test must be performed by an expert and must not be performed if the patient is suspected to have proprioceptive loss (an inability to orientate themselves to their position within space).
If required it involves a patient standing with their feet 6 inches apart, asking the patient to close their eyes for 10 seconds. The patient should not be touched during the test. If the patient becomes unsteady during the test, then they are showing positive signs of Rombergism.
Additional Tests / Special Tests

Power: Hand

If a patient presents with a history indicating a weakness of the hand, the additional specific tests should be performed.

Finger Abduction

Support the patient’s wrist and ask the patient to spread their fingers and to maintain this position. Next ask the patient:

“Stop me from pushing your fingers.”

With your index finger apply inward pressure to the side of each finger observing whether this can be opposed.

Thumb Abduction (T1/Median)

Support the patient’s wrist and ask the patient to lift their thumb upwards and to maintain this position. Next ask the patient:

“Stop me from pushing your thumb down to your palm.”

Thumb Opposition (T1/Median)

Support the patient’s wrist, ask the patient to place the tip of their thumb to the base of their little finger and to maintain this position. Next ask the patient:

“Stop me from lifting your thumb.”
Thumb Adduction (T1/Ulnar)

Support the patient’s wrist, ask the patient to trap your index and middle fingers between the base of their thumb and their index finger and to maintain this position. Next ask the patient:

“Stop me from lifting your thumb.”

Documentation

Complete the patient’s notes detailing the neurological examination and associated findings. Using the grading scales for power and reflexes summarised in the previous tables. This must be communicated to your supervisor and the patient.
Bibliography & Further Reading


Picture Credits

1. **Figure 1: Spinal Cord Motor Tracts** - CSTLC, School of Medicine, University of Liverpool.
3. **Figure 3: Motor Neurones** - Rcchang16 / CC BY-SA (https://creativecommons.org/licenses/by-sa/4.0) Available At: [https://commons.wikimedia.org/wiki/File:UMN_vs_LMN.png](https://commons.wikimedia.org/wiki/File:UMN_vs_LMN.png) [Accessed 20 April 2020]
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8. **Figure 8: Leg Wasting**
9. **Figure 9: Supination and Pronation of the Wrist** - CSTLC, School of Medicine, University of Liverpool.
10. **Figure 10: Flexion and Extension of the Elbow** - CSTLC, School of Medicine, University of Liverpool.
11. **Figure 11: Internal and External Rotation of the Hip** - CSTLC, School of Medicine, University of Liverpool.
12. **Figure 12: Flexion and Extension of the Knee** - CSTLC, School of Medicine, University of Liverpool.
13. **Figure 13: Clonus** - CSTLC, School of Medicine, University of Liverpool.
14. **Figure 14: Shoulder Abduction** - CSTLC, School of Medicine, University of Liverpool.
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18. **Figure 18: Finger Flexion** - CSTLC, School of Medicine, University of Liverpool.
19. **Figure 19: Finger Extension** - CSTLC, School of Medicine, University of Liverpool.
20. **Figure 20: Hip Flexion and Extension** - CSTLC, School of Medicine, University of Liverpool.
21. **Figure 21: Knee Flexion** - CSTLC, School of Medicine, University of Liverpool.
22. **Figure 22: Knee Extension** - CSTLC, School of Medicine, University of Liverpool.
23. **Figure 23: Dorsiflexion** - CSTLC, School of Medicine, University of Liverpool.
24. **Figure 24: Plantar Flexion** - CSTLC, School of Medicine, University of Liverpool.
25. **Figure 25**: Reinforcement - CSTLC, School of Medicine, University of Liverpool.
26. **Figure 26**: Supinator Jerk - CSTLC, School of Medicine, University of Liverpool.
27. **Figure 27**: Biceps Jerk - CSTLC, School of Medicine, University of Liverpool.
28. **Figure 28**: Triceps Jerk - CSTLC, School of Medicine, University of Liverpool.
29. **Figure 29**: Finger Jerk - CSTLC, School of Medicine, University of Liverpool.
30. **Figure 30**: Knee Jerk - CSTLC, School of Medicine, University of Liverpool.
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38. **Figure 38**: Thumb Abduction - CSTLC, School of Medicine, University of Liverpool.
39. **Figure 39**: Thumb Opposition - CSTLC, School of Medicine, University of Liverpool.
40. **Figure 40**: Thumb Adduction - CSTLC, School of Medicine, University of Liverpool.