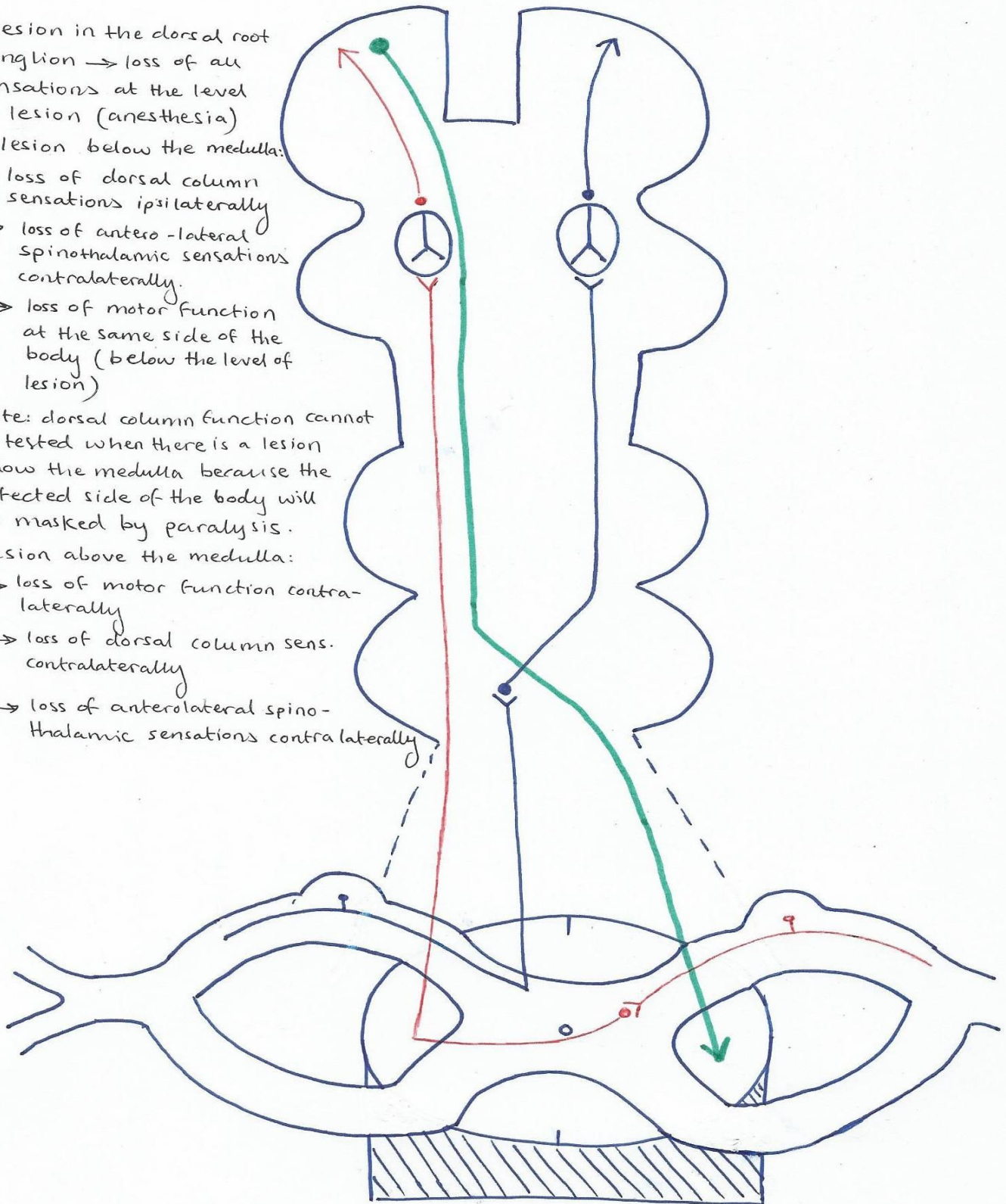




- A lesion in the dorsal root ganglion → loss of all sensations at the level of lesion (anesthesia)
- A lesion below the medulla:
 - loss of dorsal column sensations ipsilaterally
 - loss of antero-lateral spinothalamic sensations contralaterally.
 - loss of motor function at the same side of the body (below the level of lesion)

- Note: dorsal column function cannot be tested when there is a lesion below the medulla because the affected side of the body will be masked by paralysis.

- Lesion above the medulla:
 - loss of motor function contralaterally
 - loss of dorsal column sens. contralaterally
 - loss of anterolateral spinothalamic sensations contralaterally



This figure is illustrating 3 tracts:

- The cortico-spinal tract (green)
- lateral spino-thalamic tract (red)
- dorsal column tract (blue)



- **Normal EMG activity:**
 - **Motor unit action potentials (MUAPs):** these are action potentials reflecting the electric activity of a single motor unit (a motor unit is 1 motor neuron and all muscle fibers which it innervates). MUAP is a compound action potential of those muscle fibers within the recording range of the electrode.
 - ✓ **A simple definition of motor unit action potentials (MUAPs):** electrical changes produced by the excitation of individual motor units.
 - **Recruitment pattern:** refers to successive activation of the same and new motor units with increased strength of voluntary muscle contraction.
- **When does paralysis of muscles occur?**
 - **Upper motor neuron lesions** → spastic paralysis.
 - **Lower motor neuron lesions** → flaccid paralysis.
 - **Myogenic disorders** (diseases affecting the muscle itself).
- **What are the findings of EMG?**
 - **Insertional activity:** a momentary discharge provoked by the movement of the needle.
 - **Spontaneous activity:** which includes:
 - ✓ Positive sharp waves.
 - ✓ Fibrillations: cannot be seen – only detected by EMG – spontaneous.
 - ✓ Fasciculations: can be seen.
 - **Interference pattern:** it is the electrical activity recorded from a muscle during maximum voluntary effort.
- **What are the typical findings in a lower motor neuron lesion?**
 - **Insertional activity:** ↑
 - **Spontaneous activity:** presence of fibrillations and positive sharp waves.
 - **MUAPs:** large, polyphasic with reduced recruitment.
 - **Interference pattern:** reduced pattern with individual MUAPs firing at a fast rate.
- **What are the typical findings in a myogenic disorder?**
 - **Insertional activity:** normal.
 - **Spontaneous activity:** none.
 - **MUAPs:** small, polyphasic with early recruitment.
 - **Interference pattern:** low amplitude pattern at less than maximal effort.

EMG Steps	LESION		MYOGENIC LESION	
	NORMAL	NEUROGENIC LESION Lower Motor	Myopathy	Polymyositis
Insertional Activity	Normal 	Increased 	Normal 	Increased
Spontaneous Activity	—	Fibrillation Positive Wave 	—	Fibrillation Positive Wave
Motor Unit Potential	0.5-1.0 mv 5-10 msec 	Large Unit Limited Recruitment 	Small Unit Early Recruitment 	Small Unit Early Recruitment
Interference Pattern	Full 	Reduced Fast Firing Rate 	Full Low Amplitude 	Full Low Amplitude



- **How are nerve studies done?**

- The nerve is stimulated.
 - And the recording will be from the muscle.
- Aim:** is to check the integrity of the muscle.

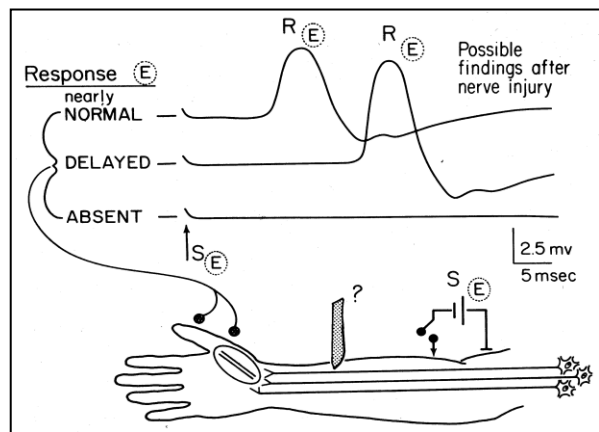
- **Important terms:**

- **Motor conduction velocity:** it is the speed of an impulse traveling in a motor nerve.
- **Sensory conduction velocity:** it is the speed of an impulse traveling in a sensory nerve.

- **When a lower motor neuron is stimulated** → an action potential is going to be generated and it will travel along the axon of the nerve fiber until it reaches the neuromuscular junction → where the neurotransmitter Ach will be released and binds to its receptors which are present on the muscle membrane → this will cause local depolarization and generation of an action potential → which will cause the release of calcium ions from sarcoplasmic reticulum → calcium ions will bind to troponin C and expose the active sites for binding of myosin heads → and thus contraction of the muscle will occur.

- **Note that this time which is spent in the contraction process of a muscle does not represent the velocity of impulse in the nerve (it is considered as latency). This latency can be:**

- ✓ **Normal.**
- ✓ **Delayed:** in which there is increased latency and normal/decreased amplitude.
- ✓ **Absent:** in which there is no response to supramaximal stimulation.



- **How to calculate nerve conduction velocity:**

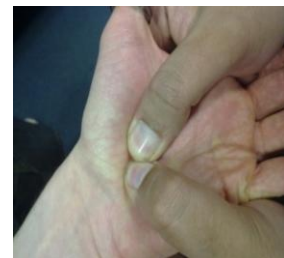
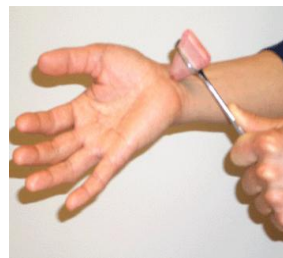
$$\frac{\text{Distance between distal and proximal electrodes (mm)}}{\text{Time difference (T2-T1)(msec)}} = \text{m/s}$$

- Normal nerve conduction velocity ranges from 50-60 m/s. A neuropathy is considered when the conduction velocity is < 25 m/s

- **Examples on neuropathies and their clinical manifestations:**

• **Carpal tunnel syndrome:**

- ✓ **Definition:** compression on the median nerve which is passing in carpal tunnel.
- ✓ **How to test for carpal tunnel syndrome?**
 - ❖ **Phalen's test:** wrist flexion (60 degrees) produces pain and parasthesia in less than a minute.
 - ❖ **Tinel's sign:** lightly tapping on the median nerve to elicit a sensation of tingling or pins and needles in the distribution of the nerve.
 - ❖ **Durkan test:** pressure for 30 seconds on the median nerve will produce pain.
- ✓ **Treatment:** incision of flexor retinaculum to release the median nerve from pressure.





- **Compression on the ulnar nerve:**
 - ✓ Where does it occur? Behind the medial epicondyle where the ulnar nerve passes.
 - ✓ Clinical manifestation: claw hand.
- **Radial nerve injury:**
 - ✓ Common with: mid-shaft fracture of the humerus.
 - ✓ Clinical manifestation: wrist-drop which is also known as:
 - ❖ Saturday night paralysis.
 - ❖ Honey-moon paralysis.
- **Injury to deep fibular nerve:**
 - ✓ Resulting in paralysis of tibialis anterior muscle and thus dorsiflexion will be lost.
 - ✓ Clinical manifestation: foot drop. The patient will have a steppage gait to compensate for this condition.



- **What do nerve conduction studies show when there is demyelination of peripheral nerves?**
 - **Conduction block:** because demyelinated areas will be only lifted with K-channels. Therefore, there will be no influx of sodium ions (which normally cause depolarization) and no action potential will result.
 - **Slowing of conduction.**
 - **Prolonged F-waves and H-reflex.**
- **Relation between neuropathies and nerve conduction studies:**
 - **In axonal degeneration:** the conduction velocity is normal but spontaneous activities will still be detected by EMG.
 - **Demyelination:** in which the conduction velocity is decreased.
- **Somatosensory evoked potential (SSEP):**
 - An electrode is stimulating a finger.
 - And 2 electrodes recording from the cortex.
 - **Measuring the delay to the cortex. If this delay is present, it indicates a problem in the cortex.**