VISUAL ACUITY

Visual Acuity: the shortest distance by which two lines can be separated and still perceived as two lines.

It depends on:

1. Refractive media (Cornea and lens) of the eye
2. The density of the photoreceptors.

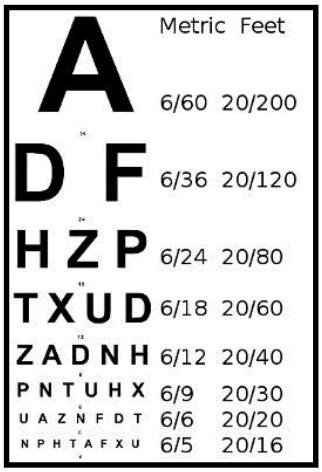
Refractive ability: the ability of the eyes to bend parallel rays of light coming from infinity to focus on the retina.

I. **The fovea centralis** is the place of greatest visual acuity **during the daylight**
II. **The mid-peripheral portion of the retina** is the place of greatest visual acuity **in the dim light.**

REFRACTIVE ERRORS:

	Myopia (nearsightedness)	Hyperopia/Hypermetropia (farsightedness)	Astigmatism
Definition	refractive error in which **close objects are seen clearly, but the far objects appear blurred**	refractive error in which **close objects are seen blurred, but the far objects appear clearly**	refractive error **that causes blurred vision**
Causes	1. Eyeball is too long 2. Lens has too much curvature	1. Eyeball is small 2. Lens is weak	1. Irregular shape of cornea 2. Uneven curvature of lens
Site of light's focusing	In front of the retina	Behind the retina	_____
Corrected by	1. Biconcave lenses (minus) 2. Flattened cornea by surgery	Biconvex lenses (plus)	Cylindrical lenses
Test	Snellen's chart **(test for far vision)**	Jaeger's Chart **(test for near vision)**	Astigmatism Chart

TEST FOR FAR VISION



Equipment:

Snellen's Chart

Interpretation:

$$\text{Visual Acuity (VA)} = \frac{d}{D}$$

d = the distance from where the subject is reading the chart
D = the distance from where a normal subject can read the chart.
Normal Visual Acuity for far vision is 6/6 (in meters) or 20/20 (in feet).

Suppose the smallest letter that can be read by the subject is in the line below which the distance is mentioned "9 meter", then the Visual Acuity of that eye is:

$$\text{Visual Acuity (VA)} = \frac{6}{9}$$

It means that the subject is able to read the smallest letter from 6 meters only which a normal person can read from 9 meters.

TEST FOR NEAR VISION

Equipment:

Jaeger's Chart

Interpretation:

The near vision test is **measuring your ability to read and see objects within an arm's distance from the body.**

This test is important if you have:

1. **Hypermetropia**
2. **Presbyopia "in old age".**

TEST FOR ASTIGMATISM

Equipment:

Astigmatism Chart

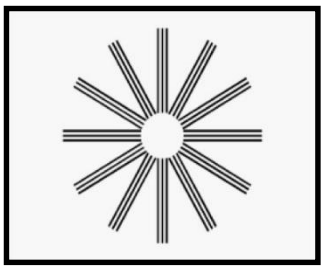


DIAGRAM OF ASTIGMATISM CHART

DEMONSTRATION OF BLIND SPOT

Blind spot (scotoma): the place in the visual field where an object cannot be seen keeping one eye closed.

- This is due to the light rays from that part of the visual field **focus on the optic disc of the retina, which lacks the light-detecting photoreceptor cells.** Which the optic nerve and blood vessels pass.
- The optic disc of the retina is located **medial to fovea centralis (means blind spot is lateral to visual field)**
- ***We don't perceived the blind spot because:***
  we have two eyes. Which each one will cancel the blind spot for other eye.

Equipment:
Blind Spot Card

DETERMINATION OF NEAR POINT

Near point is **the nearest possible distance at which the near object can be clearly seen.**

- **Decrease by aging**

Equipment: Common Pin

AGE	NEAR POINT
10 YEARS	8 cm
20 YEARS	10 cm
30 YEARS	12.5 cm
40 YEARS	18 cm
50 YEARS	40 cm
60 YEARS	83 cm
70 YEARS	100 cm

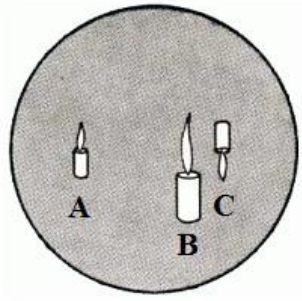
TEST FOR ACCOMMODATION

The process of accommodation can be tested by observing **PURKINJE-SANSON IMAGES in a dark room**.

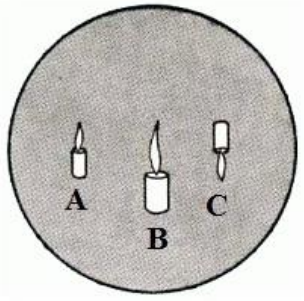
Equipment: A candle and a dark room

If a small bright light, usually a candle, is held in front of and a little to one side of the eye in a very dark room, three images are seen:

Image	Comes from	Properties
First image (A)	cornea	Small – bright - upright
Second image (B)	Anterior surface of lens	**Large** – less bright - upright
Third image (C)	Posterior surface of lens	Small – bright - **inverted**



Before Accommodation



After Accommodation

During accommodation, the second image **comes closer to the first image and also becomes smaller** than when the eye was at rest. **"Because lens become more convex"**

TEST FOR COLOR VISION

Color vision is the function of the cones. There are three types of cones in our eyes; red, green and blue. Relative lack or deficiency of one, two or all of them will lead to a defect in color vision.

Equipment:

Ishihara's Colored Plates

TYPE OF COLOR BLINDNESS	DEFINITION & PATHOLOGY
PROTANOPIA (RED BLINDNESS)	**A form of colorblindness characterized by defective perception of red and confusion of red with green or bluish green due to the complete absence of red cones.**
DEUTERANOPIA (GREEN BLINDNESS)	**A form of colorblindness characterized by insensitivity to green, moderately affecting red–green hue discrimination due to the complete absence of green cones.**
TRITANOPIA (BLUE BLINDNESS)	**A very rare visual defect characterized by the inability to differentiate between blue and yellow due to the complete absence of blue cones.**
PROTANOMALY	**A type of anomalous trichromatic vision with defective perception of red due to less sensitivity of red cones.**
DEUTERANOMALY	**A type of anomalous trichromatic vision in which the green cones have decreased sensitivity, mildly affecting red–green hue discrimination.**
TRITANOMALY	**A rare type of anomalous trichromatic vision in which the blue cones have decreased sensitivity, affecting blue–yellow hue discrimination.**

Hearing Tests and Pure Tone Audiometry

Air conduction

This test assesses the transmission of sound waves through air to the auditory cortex via auditory nerve involving **outer, middle and inner ears.**

Bone conduction

This test assesses the transmission of sound waves through the bones of the skull to the cochlea and then through the auditory pathways to the auditory cortex, bypassing the outer and middle ears. **(Inner ear is working only)**

Why air conduction is better than bone conduction in normal person?

The sound is amplified **22 times** when it is transmitted through **air conduction** by:

1- The tympanic membrane (17 times)
2- The ossicles (1.3 times).

Masking Sound

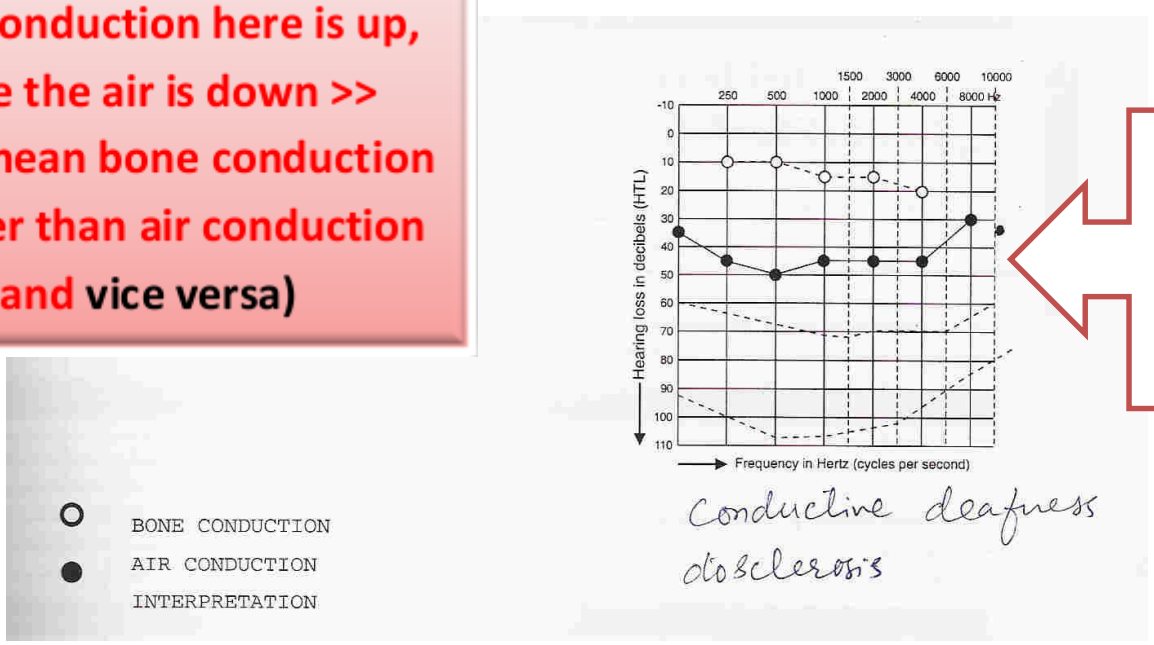
Masking sound is the sound present in the background that interferes with the sound that we want to listen.

TUNING FORK TESTS

	Rinne's test	Weber's test
Used for	**compares the air conduction with the bone conduction**	**Distinguishes between conductive and sensorineural deafness.**
Technique	**Applied vibrating tunic fork in base of mastoid process then in front of the ear**	**Applied vibrating tunic fork in vermis of subject**
In normal person	Sound in **air conduction twice as long as bone conduction.** (They will still hear it in front of the ear when they can't hear any from the base of the mastoid bone.)	Sound equal in both eyes
Conductive deafness	Sound in **Bone conduction will be better than air conduction**. (when the subject stops hearing sound from the mastoid bone and brings the tuning fork in front of the ear, he will not hear any sound there too.)	Sound heard **better in diseased ear** because **loss of masking effect**
Sensorineural deafness	Sound in **air conduction is heard longer than bone conduction in affected ear**. but less than twice longer as is the case in normal subjects.	Sound heard **better in normal ear** because **cochlea and neural pathway are intact.**

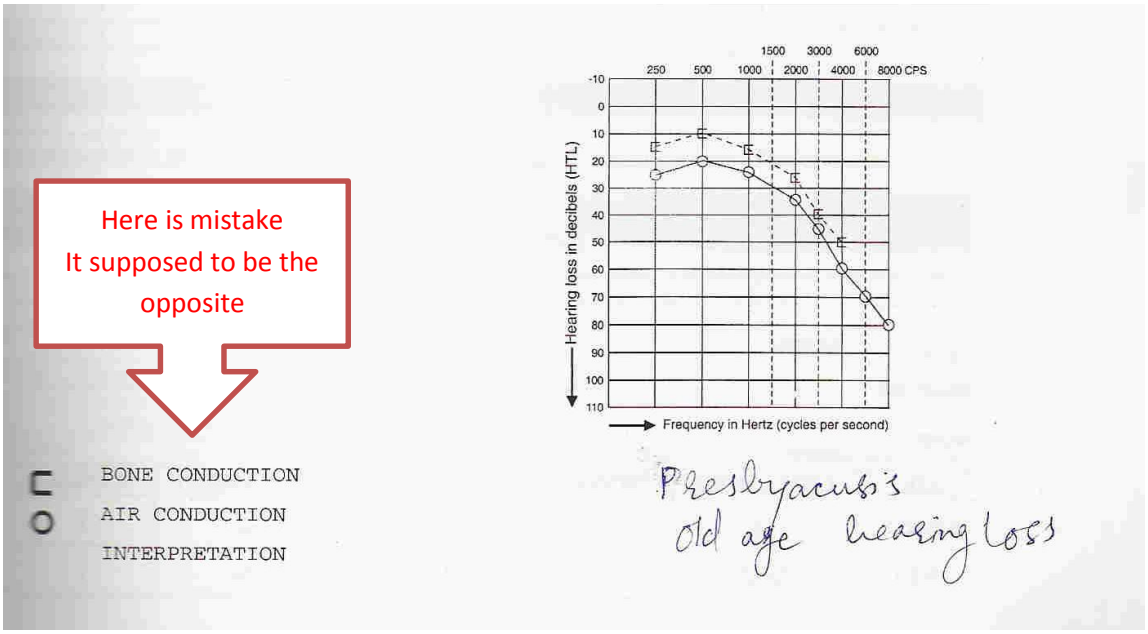
Pure tone Audiometry

Bone conduction here is up, while the air is down >> that's mean bone conduction is better than air conduction (and vice versa)

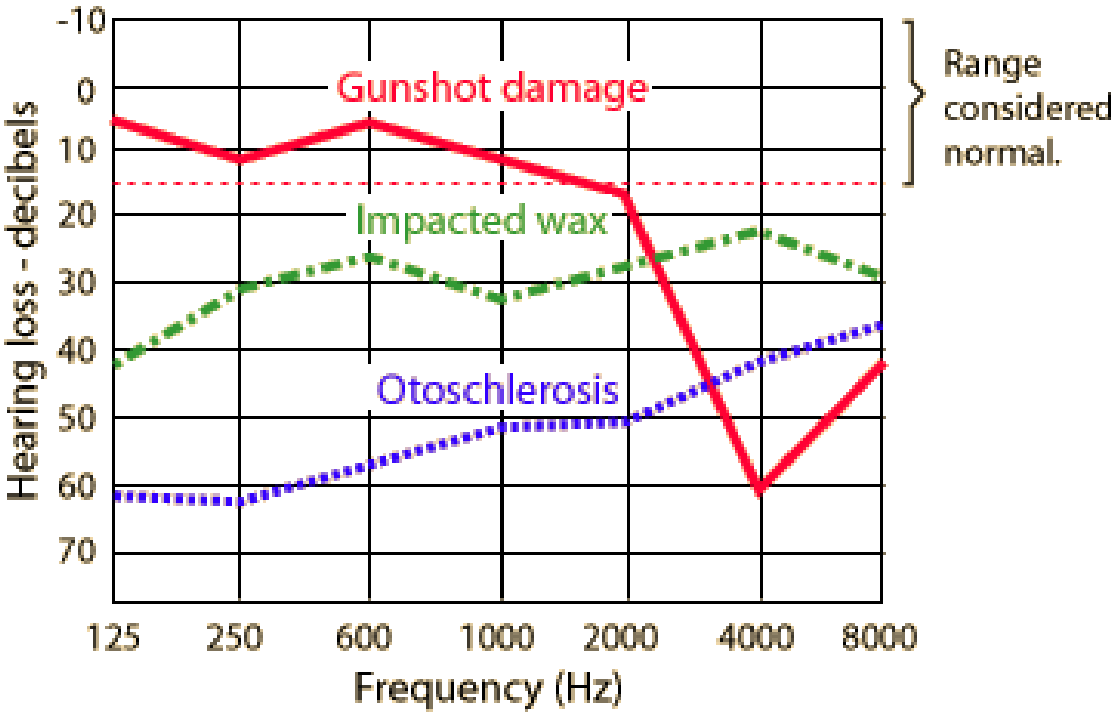


Only if they crossed the cause will be Otosclerosis

Conductive deafness caused by Otosclerosis.



sensorineural deafness at higher frequencies, and is commonly seen in old age and the condition is called Presbycusis.



The above depicted diagrams of audiograms show various patterns of air conduction curves seen in different cases such as gunshot, impacted wax and otosclerosis.

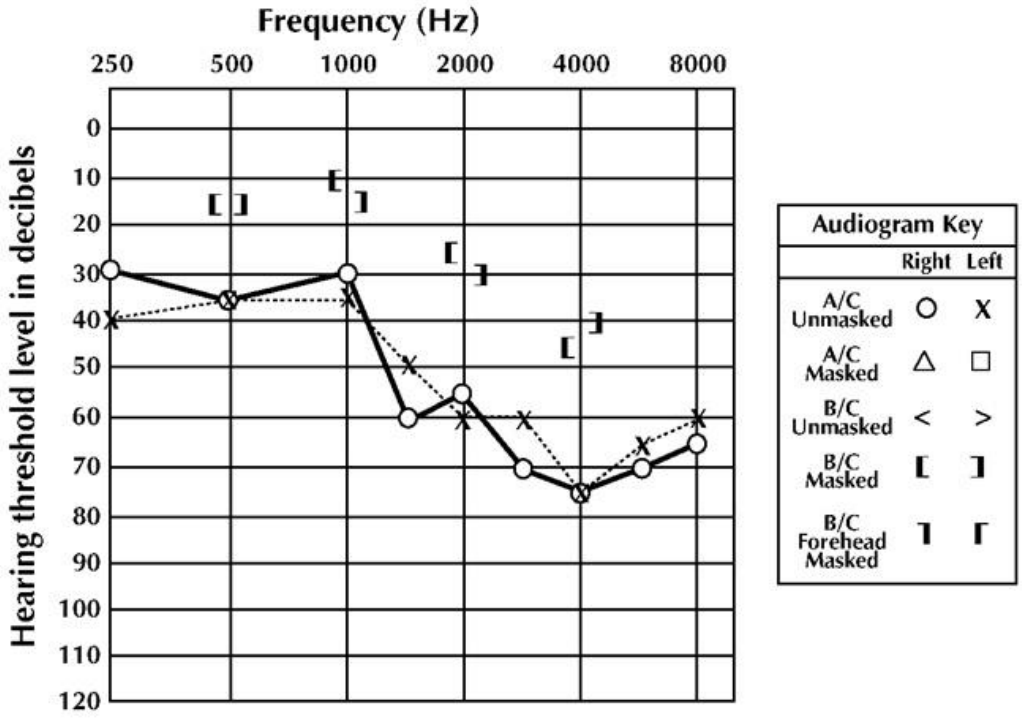
In the Noise-induced hearing loss, the hearing threshold is affected in only one particular frequency; most likely 4000 Hz

TYPES OF HEARING LOSS (DEAFNESS)

	Conductive deafness	Sensorineural deafness	Mixed hearing loss
Parts that affected	**Outer or middle ear**	**Inner ear or neural pathway**	**Middle or outer with inner or neural pathway**
Conduction	• Air conduction is reduced • Bone conduction is better "due to loss of amplification"	• Air conduction is better than bone conduction • Frequencies between them is within **10 Hz** • Sound threshold must be **more than 30 dB** for each frequency to be heard	• Bone conduction is better than air conduction • Frequencies between them is **more than 10 Hz** • Sound threshold must be **more than 30 dB** for each frequency to be heard
Causes	1. Wax in ear canal 2. Rupture of tympanic membrane 3. Otitis media 4. Otosclerosis	1. Meniere's disease 2. Head trauma 3. Malformation of inner ear 4. Drugs that toxic for inner ear	

Otitis media: fluid in middle ear

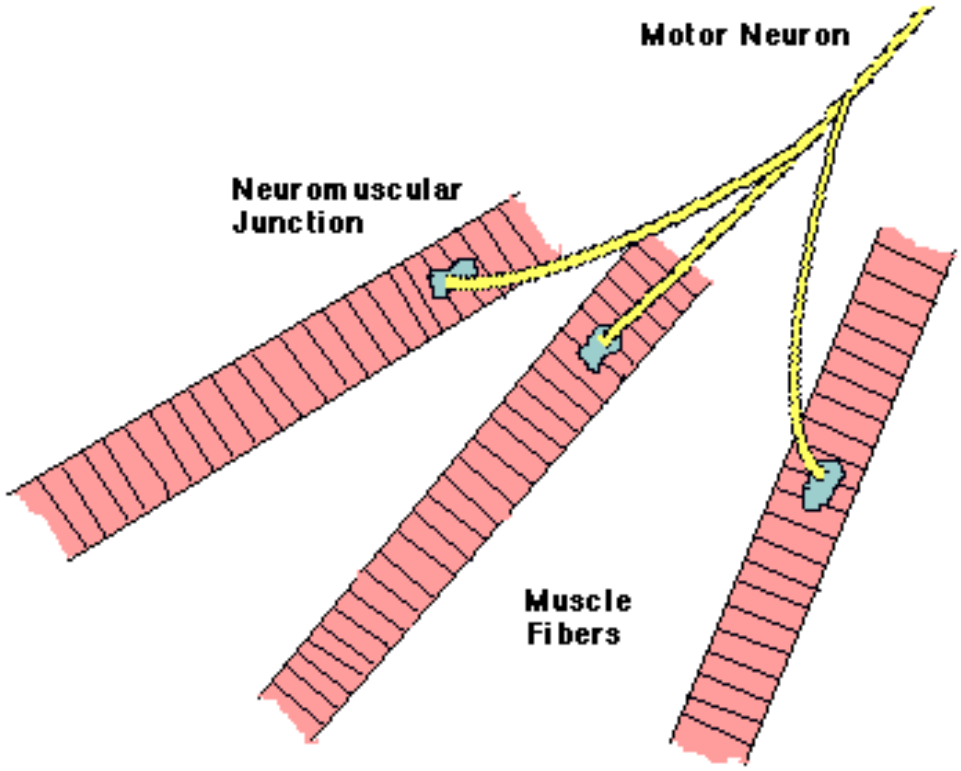
Otosclerosis: fixation of footplate of stapes in oval window



Mixed hearing loss

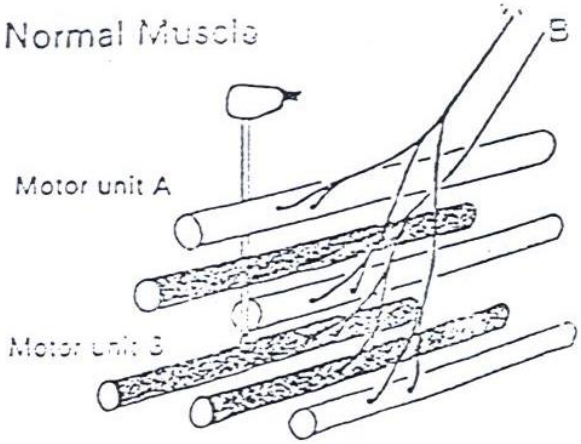
ELECTROMYOGRAPHY (EMG)

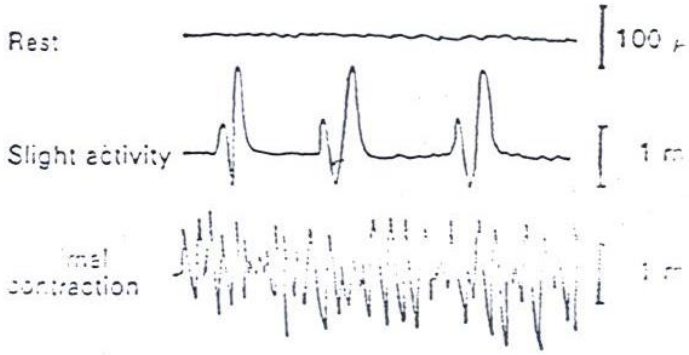
- It is a recording of electrical activity of the muscle by inserting needle electrode in the belly of the muscles or by applying the surface electrodes.
- The potentials recorded on volitional effort are derived from motor units of the muscle, hence known as **motor unit potentials (MUPs).**
- A motor unit is defined as **one motor neuron and all of the muscle fibers it innervates.**



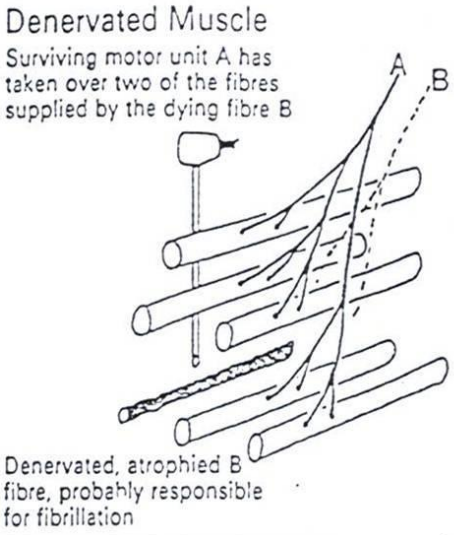
- EMG along with motor nerve conduction velocity study is considered as an extension of the **physical examination** rather than a simple laboratory procedure.

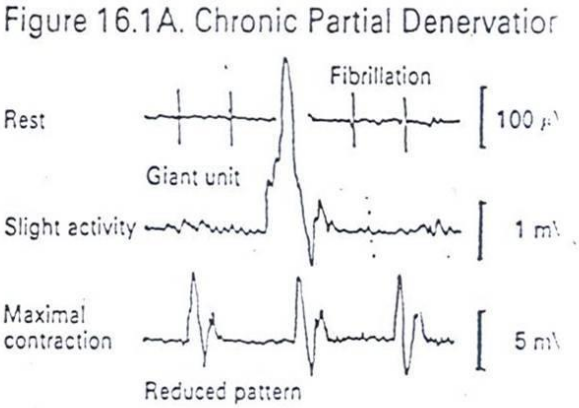
Normal EMG



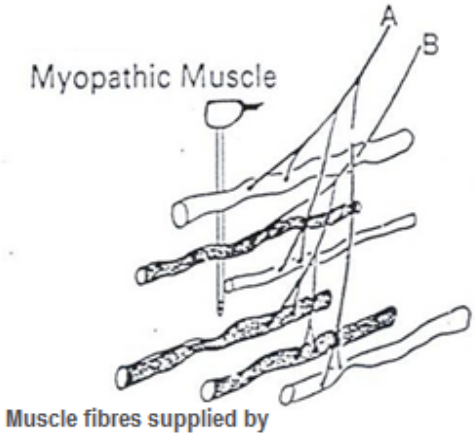


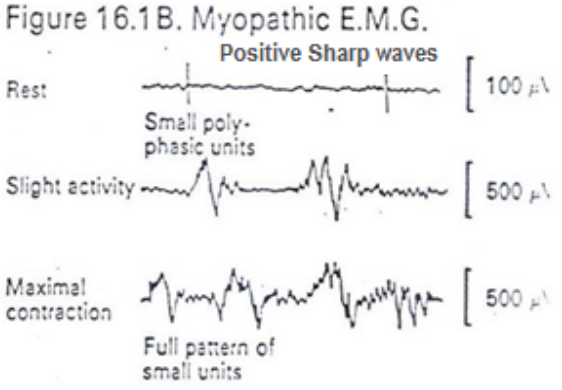
Neuropathic EMG changes





Myopathic EMG changes





ANALYSIS OF A MOTOR UNIT POTENTIAL (MUP)

MUP	NORMAL	NEUROGENIC	MYOPATHIC
Duration (msec)	3 – 15 msec	longer	Shorter
Amplitude	300 – 5000 µV	Larger	Smaller
Phases	Biphasic / triphasic	Polyphasic	May be polyphasic
Resting Activity	Absent	Present	Present
Interference pattern	full	partial	Full

-Why there is a gap in partial interference pattern?

Due to some motor units are not activated

SPONTANEOUS ACTIVITY AT REST

The skeletal muscle is silent at rest in normal people, hence spontaneous activity is absent, when we are not using a muscle and that muscle is at rest.

FIBRILLATION POTENTIALS

- These occur at rest when the patient is not contracting his testing muscles.
- These are randomly occurring small amplitude potentials.
- These are seen in cases of **neuropathy.**

These potentials are generated from the **single muscle fiber of a denervated muscle,** possibly due to **denervation hypersensitivity to acetylcholine.**

NERVE CONDUCTION STUDIES

- A nerve conduction study (NCS): is a test commonly used to evaluate the function, especially the ability of electrical conduction, of the motor or sensory nerves of the human body.
- Motor Nerve conduction velocity (MNCV) is a common measurement made during this test.

- Based on the nature of conduction abnormalities two principal types of peripheral nerve lesions can be identified: ***Axonal degeneration and segmental demyelination.***

CALCULATION OF MNCV

It can also be calculated by formula

MNCV = Distance
L1 – L2

L_1 = latency at elbow.

L_2 = latency at wrist

It should be calculated in m/sec.

NORMAL VALUES FOR CONDUCTION VELOCITY

✓ In arm

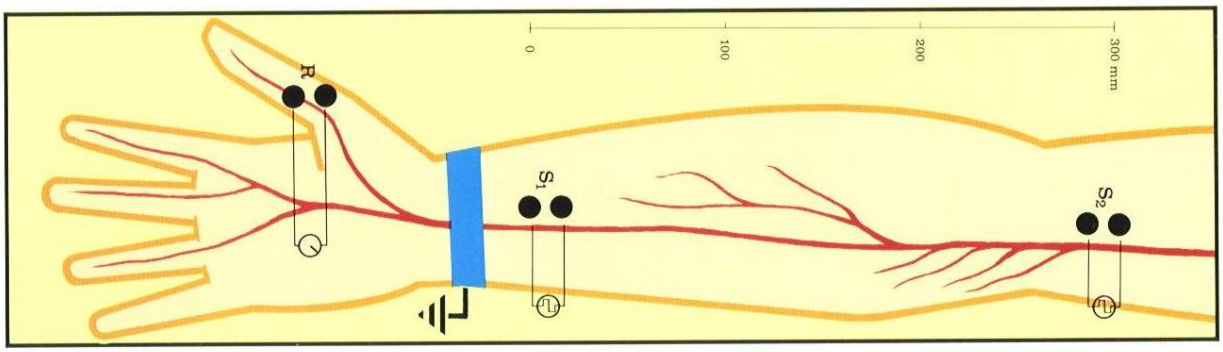
50 – 70 m / sec.

✓ In leg

40 – 60 m / sec.

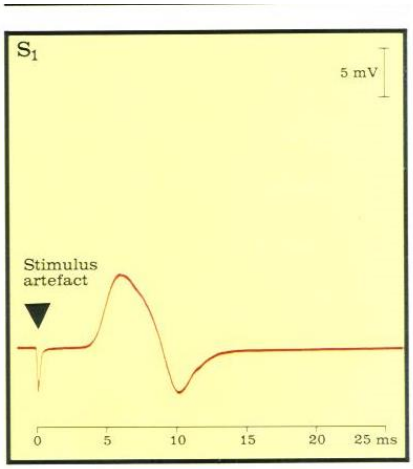
Lower than those values indicate:

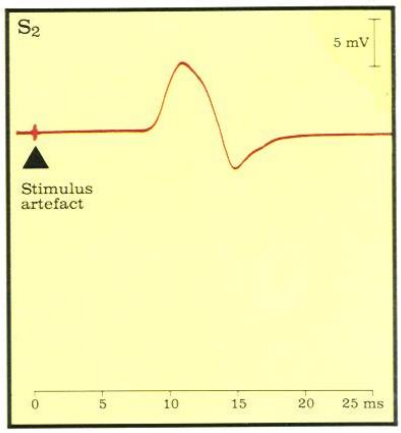
1. **Axonal degeneration**
2. **Segmental demylination**



Distance

d = 285 mm





Latency At wrist

L2 = 3.5 ms

Latency At elbow

L1 = 8.5 ms

Hence, MNCV = 285 / 8.5 – 3.5 = 57 m/sec.

- **They may give you the name of the enerve so you should know the site of the nerve (upper limb or lower limb)**
- **They will give the distance in cm and you should convert it to mm by multiply in 10**

Done by: Mojahed Otayf & Rahma Al Shehri

Thank You