Dear Class,
Please be informed that the most important points are highlighted in red and summarized at the end of this file.. You can go through details for more knowledge.

VISUAL ACUITY

- **Visual Acuity** is defined as the shortest distance by which two lines can be separated and still perceived as two lines.
- It depends on the refractive ability of (Cornea and lens) of the eye and the density of the photoreceptors.
- The fovea centralis is the place of greatest visual acuity during the daylight (cons) and the mid-peripheral portion of the retina is the place of greatest visual acuity in the dim light (rods).

- Definition
- May give you a chart **(snellen's chart)** and ask what is the name of this chart & why do we use this 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 which a normal subject can read that line.

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 **(Example):**

$\text{Visual Acuity (VA)} = \frac{6}{9}$ It means that the subject is able to read from 6 meters only which a normal person can read from 9 meters, so his visual acuity for the far vision is disturbed. Normal Visual Acuity for far vision is 6/6 (in meters) or 20/20 (in feet).

We have to know 5 things:

- **The name of this chart (SNELLEN'S CHART)**
- **For what do we use it (To test visual acuity)**
- **What is your interpretation: (the patient is able to see from 6 m, while the normal subject is able to see from 24 m)**
- **What is the condition (myopia)**
- **What type of lenses do we need for correction (biconcave or we can say minus)**

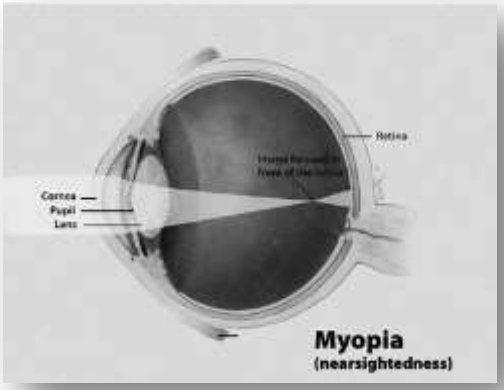
Diagram of SNELLEN'S CHART to test Visual Acuity

REFRACTIVE ERRORS:

We have to know the definition, the cause and the lenses for correction

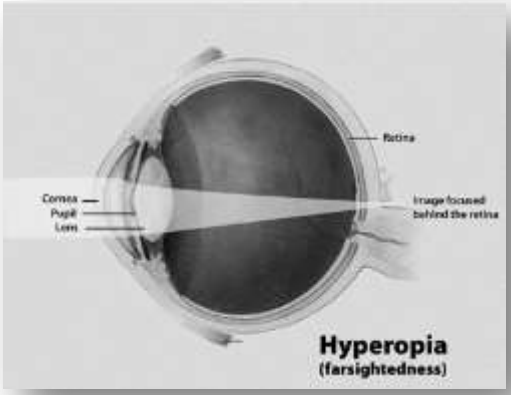
MYOPIA: (SNELLEN'S CHART)

Myopia is a refractive error in which close objects are seen clearly, but the far objects appear blurred, that is why this condition is also called ***nearsightedness***. It occurs if the eyeball is too long or the lens has too much curvature. As a result, the light entering the eye from a distant object isn't focused exactly on the retina but focuses in front of it, so that distant object looks blurred. This refractive error can be corrected by applying ***biconcave (minus) lenses*** in front of the eyes or performing surgery to flatten cornea that will decrease the refractive ability of the cornea and the light rays from a far object will focus on the retina.



HYPERMETROPIA / HYPEROPIA: Jaeger's Chart

If the eyeball is smaller or the lens is weak, the image from a near object is focused behind the retina, making the object look blurred. In these cases near vision is affected and the distance vision remains intact, so this refractive error is known as ***farsightedness*** or in medical terms, hypermetropia. These patients need ***biconvex (plus) lenses*** in front of eye so that the light rays entering the eyes from any near object will focus exactly on the retina and the near objects can be seen clearly then.



TEST FOR NEAR VISION

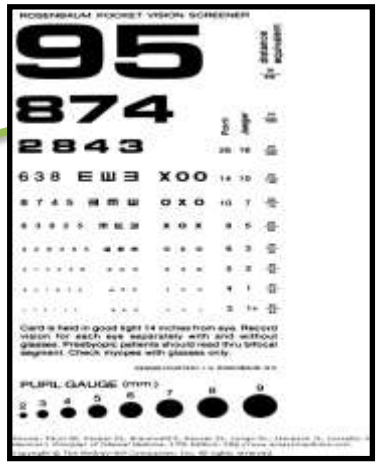
The near vision test is measuring your ability to read and see objects within an arm's distance from the body. This test is important if you have hypermetropia or presbyopia (in old age).

Equipment: Jaeger's Chart

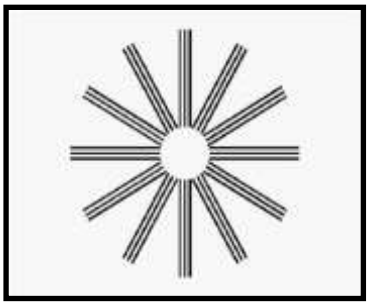
We have to know:

- **The name of chart (Jaeger's Chart)**
- **For near vision.**
- **The cause.**
- **What type of lenses do we need for correction (biconvex)**

For Near Vision and to diagnose Hypermetropia



TEST FOR ASTIGMATISM



Astigmatism is a type of refractive error that causes blurred vision mainly due to the irregular shape of the cornea and sometimes uneven curvature of the lens inside the eye can also cause Astigmatism. Slight amounts of astigmatism usually don't affect vision and don't require treatment. However, larger amounts of astigmatism cause distorted or blurred vision, eye discomfort and headaches and need to be treated by adding ***cylindrical lenses*** in eyeglasses that will correct the astigmatism by altering the way light enters your eyes.

Equipment: Astigmatism Chart

- **What is the name of the chart (Astigmatism Chart)**
- **Used for what (test for astigmatism)**
- **What type of lenses do we need for correction (cylindrical)**

DEMONSTRATION OF BLIND SPOT

A blind spot, also known as a scotoma, is 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. The optic disc of the retina is located medial to fovea centralis and is the part of retina through which the optic nerve and blood vessels pass. Since there are no photoreceptors to detect light on the optic disc, a part of the field of vision is not perceived. The brain fills in the blind spot with surrounding detail and there is also information from the other eye, so the blind spot is not normally perceived when both eyes are open.

- **Where is the blind spot (it is located lateral of the visual field because the optic disc is in the medial side)**
- **Optic Disc has NO photoreceptors (rods & cones)**
- **We do not feel it because we have 2 eyes**

DETERMINATION OF NEAR POINT

Near point is the nearest possible distance at which the near object can be clearly seen. The near point of vision changes dramatically with age, averaging about 8cm at the age of 10 and about 100 cm at the age of 70.

Equipment: Common Pin

We have to know only the definition & the equipment and near point of vision colored in red in the table.

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.

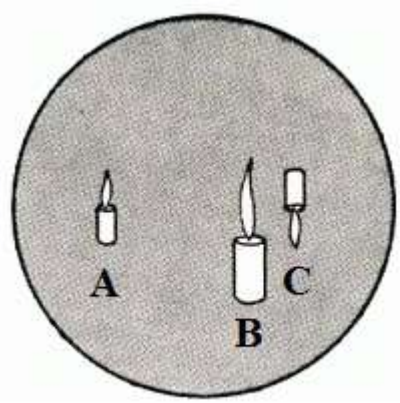
***PURKINJE-SANSON IMAGES:* to test accommodation**

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:

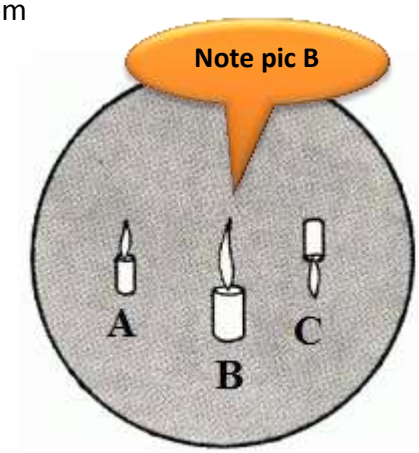
1. The first image comes from the cornea and it is small, bright and upright.
2. The second image comes from anterior surface of the lens. It is large, upright but less bright.
3. The third or last image comes from posterior surface of the lens and it is small, bright and inverted.

During accommodation, the second image comes closer to the first image and also becomes smaller than when the eye was at rest.

Equipment: A candle and a dark room



Before Accommodation



After Accommodation

A = First image from Cornea

B = Second image from anterior surface of lens

C = Third image from posterior surface of lens

They can ask you about the Properties of each picture

-For Example: What are the Properties of picture C?

The third or last image comes from posterior surface of the lens and it is small, bright and inverted

- The image (purkinje-sanson image).
- Used for Accommodation.
- Last image (C) is inverted.
- The biggest image is (B).
-After accommodation the lense become more convex. The anterior part is more mobile >> 2nd image move forward (close to A).
-WHY ACCOMODSATION is happen (to see near object clearly).

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.

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.**

Equipment:

Ishihara's Colored Plates.

We have to know:

The information in the table above (the name & why they are named like this) and the equipment

Hearing Tests and Pure Tone Audiometry

Some Important Terminology Related To This Practical

1.3 * 17 = 22

Air conduction **Air is better than bone conduction … Why?**

This test assesses the transmission of sound waves through air to the auditory cortex via auditory nerve involving outer, middle and inner ears. The sound is amplified 22 times when it is transmitted through air conduction by the tympanic membrane (17 times) and the ossicles (1.3 times). That is why, air conduction is always better than bone conduction in a normal person.

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 (only inner ear is working)

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

TUNING FORK TESTS

1- The Rinne's Test: To compares the air conduction with the bone conduction.

Technique

1] Place the vibrating tuning fork on the base of the mastoid bone.

2] Immediately bring the tuning fork just in front of the ear.

Interpretation:

- Normal subjects will hear sound through 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.
- With conductive deafness, bone conduction will be better than air conduction. In this case, 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.
- With sensorineural deafness, the sound through air conduction is heard longer than bone conduction in affected ear, but less than twice longer as is the case in normal subjects.

2- The Weber's Test: **to distinguish between conductive and sensorineural deafness.**

Technique:

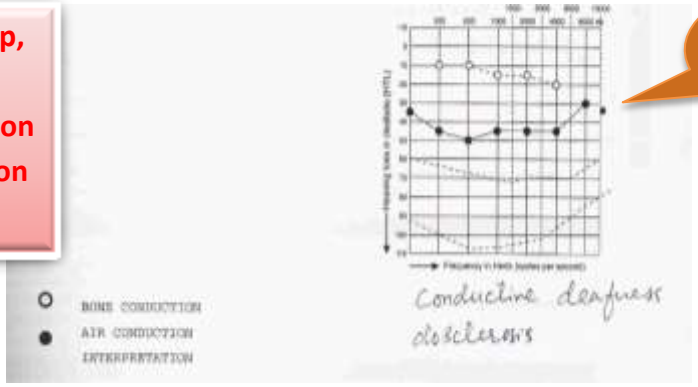
1] Place the vibrating tuning fork on the vertex of the subject.

2 Possible Results:

- If the hearing is normal, the sound is heard equally in both ears.
- The sound is heard more from one ear as compared to the other ear due to one of following 2 reasons:
  1. The sound is heard better in the affected or diseased ear in a subject with conductive deafness because of the loss of masking effect of the environment and all the receptors for hearing in the affected ear are free to hear the sound.
  2. The sound is obviously heard better in the normal ear than the affected ear in a subject with sensorineural deafness because the cochlea and the neural pathway is intact on the normal side.

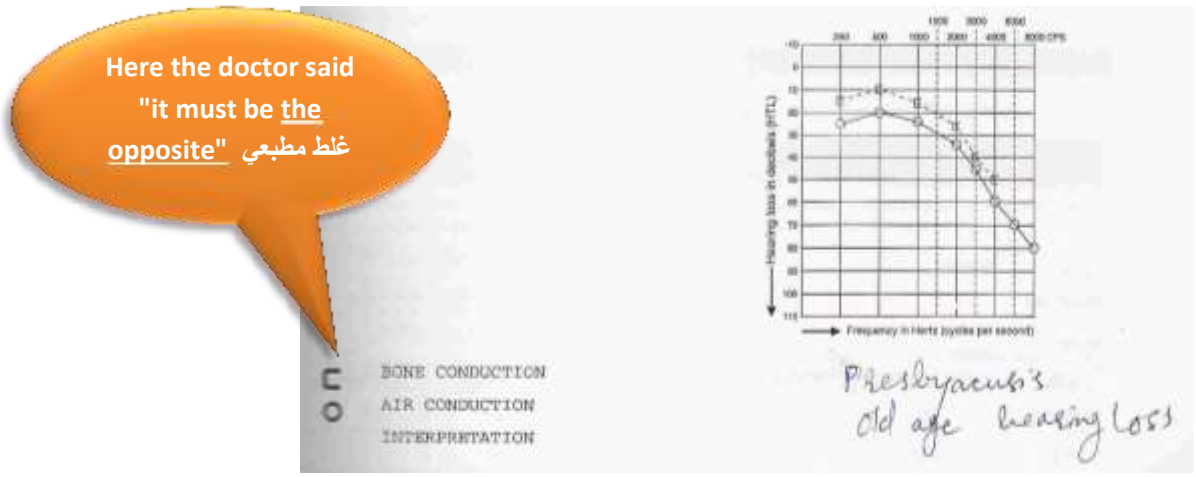
Pure tone Audiometry

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 above audiogram is showing conductive deafness, caused by Otosclerosis.



- **The above audiogram is showing 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 the above air conduction curve in a case of gunshot damage.**

TYPES OF HEARING LOSS (DEAFNESS)

- ❖ Conductive hearing loss
- ❖ Sensorineural hearing loss
- ❖ Mixed hearing loss

-Conductive Hearing loss (deafness)

The problem is either in the outer or in the middle ear.

Bone conduction becomes better than air conduction due to the loss of amplification of sound in all cases of conductive deafness.

The causes of conductive deafness include **wax** in the ear canal, **ruptured tympanic membrane**, fluid in the middle ear system (**otitis media**), and fixation of the footplate of stapes to the oval window (Otosclerosis).

-Sensorineural Hearing loss (deafness)

Sensorineural hearing loss occurs when there is damage to the inner ear (cochlea), or to the nerve pathways from the inner ear to the brain.

- Air conduction is better than bone conduction

The hearing threshold should be more than 30 db in one frequency of sound at least.

Some possible causes of Sensorineural hearing loss include:

- ❖ Illnesses like labyrinthitis (inner ear infection) and Meniere's disease
- ❖ Drugs that are toxic to hearing
- ❖ Hearing loss that runs in the family (genetic or hereditary)
- ❖ Aging
- ❖ Head trauma
- ❖ Malformation of the inner ear
- ❖ Exposure to loud noise (noise-induced)

You have to know at least 4 causes

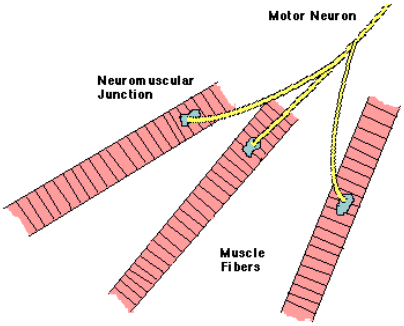
Mixed Hearing loss خل يولى ☺

~~Sometimes a conductive hearing loss occurs in combination with a sensorineural hearing loss . In other words, there may be damage in the outer or middle ear and in the inner ear (cochlea) or auditory nerve. When this occurs, the hearing loss is referred to as a **mixed hearing loss.**~~

~~In these cases, bone conduction is better than air conduction and the difference between them is more than 10 db and the hearing thresholds for air conduction in most of the frequencies is more than 25 db.~~

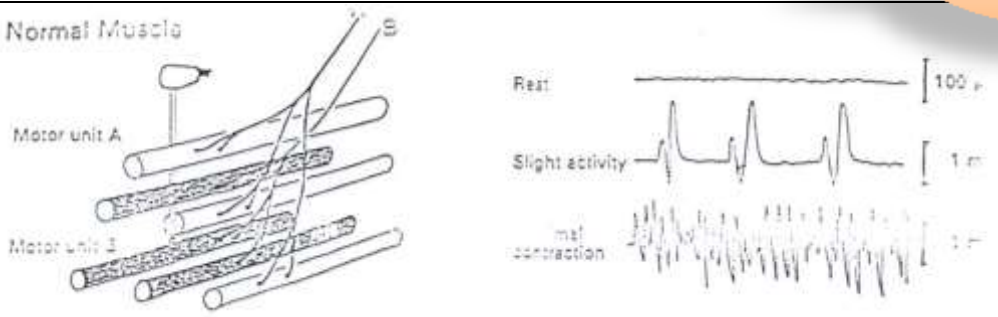
ELECTROMYOGRAPHY (EMG)

- 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.



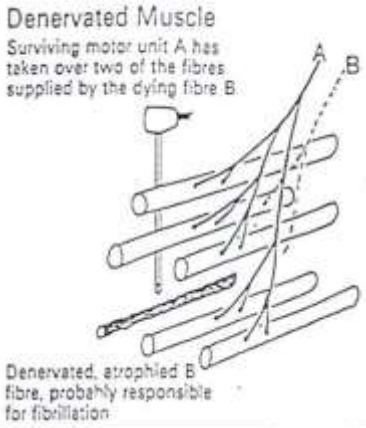
Normal EMG

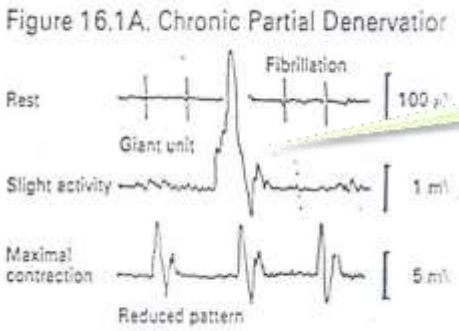
Full interference pattern



Neuropathic EMG changes

Partial interference pattern





Fibrillation potentials

In which disease we can see giant unit (Fibrillation potentials)?

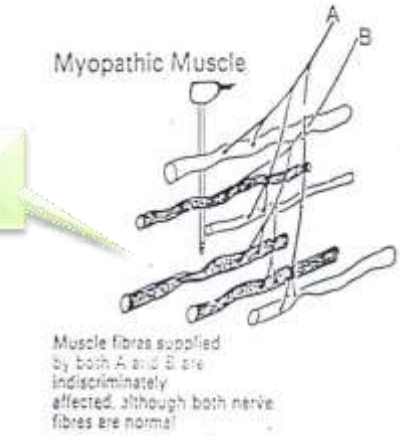
Neuropathic (denervation)

-Why there is a gap in partial interference pattern?

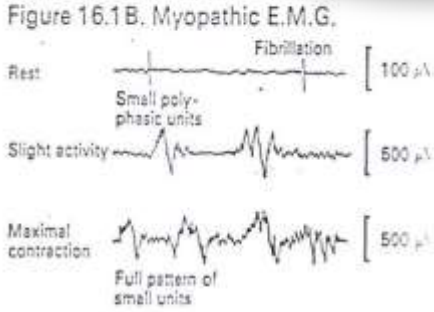
Due to some motor units are not activated

Myopathic EMG changes

Full interference pattern



Small amplitude and short duration



Positive sharp waves

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

SPONTANEOUS ACTIVITY

The skeletal muscle is silent at rest, hence spontaneous activity is absent.

FIBRILLATION POTENTIALS

These are seen in cases of neuropathy. They are generated from the single muscle fiber of a denervated muscle, possibly due to denervation hypersensitivity to acetylcholine.

NERVE CONDUCTION STUDIES

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

CALCULATION OF MNCV

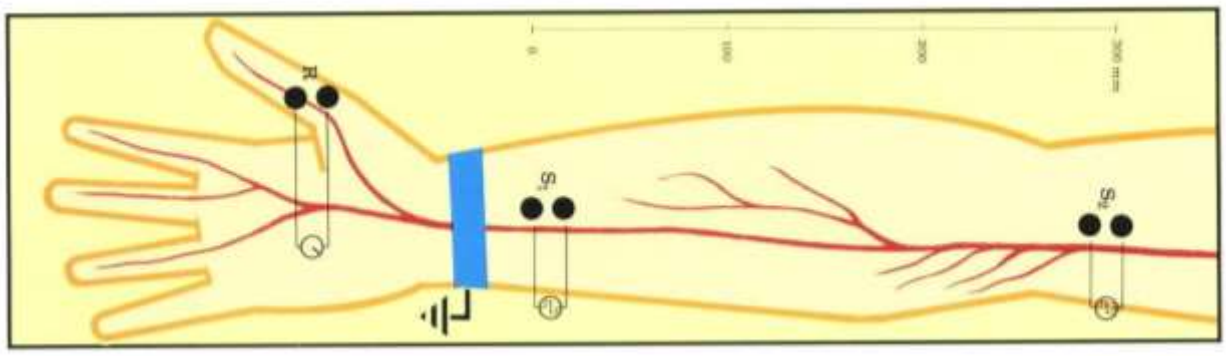
It can also be calculated by formula: $\text{MNCV} = \frac{\text{Distance}}{\text{L1 – L2}}$

It should be calculated in m/sec. (L_1 = latency at elbow. L_2 = latency at wrist)

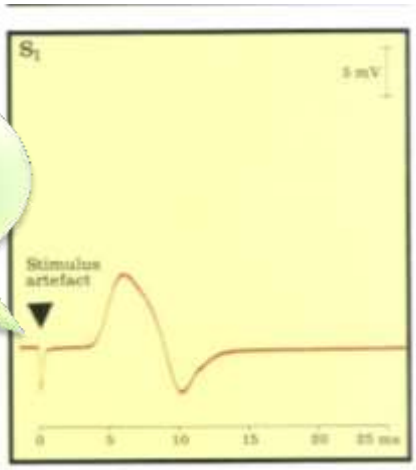
NORMAL VALUES FOR CONDUCTION VELOCITY

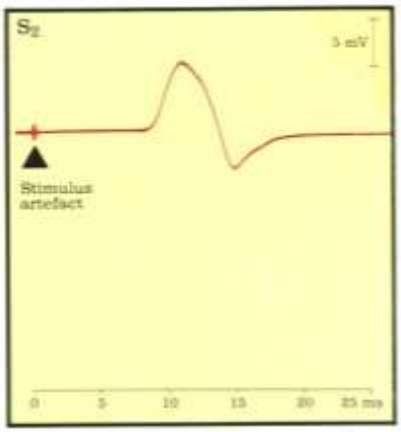
- ✓ In arm 50 – 70 m / sec.
- ✓ In leg 40 – 60 m / sec.

Lower values are important
Ignore the other value



For L2: because it is shorter, you can measure it from 0 to the beginning of the elevation





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.

If it less than normal, it will indicate either axonal degeneration or segmental demyelination

IMPORTANT NOTES (Summary)

VISUAL ACUITY

- **What is the definition of visual aquity?**
  Is the shortest distance by which two lines can be separated and still perceived as two lines.

- **What does it depend on?**
  - The refractive ability of the (Cornea and lens).
  - Density of the photoreceptors.

- **What is the name of the chart do we use to test visual aquity?**
  Snellen's chart.

- **What type of lenses do the patient with myopia need?**
  Biconcave lenses.

- **What is myopia?**
  Is refractive error in which close objects are seen clearly, but far objects appear blurred (also called nearsightedness).

- **What is the name of the chart do we use to test hypermetropia?**
  Jaeger's chart

- **What type of lenses do the patient with hypermetropia need?**
  Biconvex lenses

- **What is the name of the chart do we use to test astigmatism?**
  Astigmatism chart

- **What type of lenses do the patient with astigmatism need?**
  Cylindrical lenses

- **Where is the blind spot? Where is it located & why we do not feel it?**
  - Also known as a scotoma, is the place in the visual field where an object can't be seen keeping one eye closed.
  - Lateral of the visual field, because the optic disc is in the medial side
  - We can't feel it because we have 2 eyes are supporting each other.

- **What is the meaning of near point?**
  The nearest possible distance at which the near object can be clearly seen. We use any common pin to test it

- **We use purkinje-sanson images to test for accommodation.**
  - The 3rd image from posterior surface of lens will be inverted.
  - The 2nd image from anterior surface of lens is the biggest.

- **PROTANOPIA >> (RED BLINDNESS)**
- **DEUTERANOPIA >> (GREEN BLINDNESS)**
- **TRITANOPIA >> (BLUE BLINDNESS)**

- **PROTANOMALY >> defective perception of red due to less sensitivity of red cones**
- **DEUTERANOMALY >> the green cones have decreased sensitivity, mildly affecting red–green hue discrimination.**
- **TRITANOMALY >> blue cones have decreased sensitivity, affecting blue–yellow hue discrimination.**

Hearing Tests

- **Air conduction is better than bone conduction (normally), because the sound waves are transmitted by the three ossicles and get amplified (22 times).**
- **Rinne's Test: to compare between the air conduction and the bone conduction**
- **Weber's Test: to distinguish between conductive and sensorineural deafness.**

ELECTROMYOGRAPHY (EMG)

- **A motor unit is defined as one motor neuron and all of the muscle fibers it innervates.**
- **Fibrillation potentials appears in neuropathic EMG due to denervation hypersensitivity to acetylcholine.**
- **Based on the nature of conduction abnormalities two principal types of peripheral nerve lesions can be identified: Axonal degeneration and segmental demyelination. (Produce slow conduction)**

$$\text{MNCV} = \frac{\text{Distance}}{\text{L1} - \text{L2}}$$

- **Normal Values:**
  - **In arm 50 – 70 m / sec.**
  - **In leg 40 – 60 m / sec**
- **If it less than normal, it will indicate either axonal degeneration or segmental demyelination**

GOOD LUCK

Done By:

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