

# VISUAL ACUITY and PUPIL TESTING

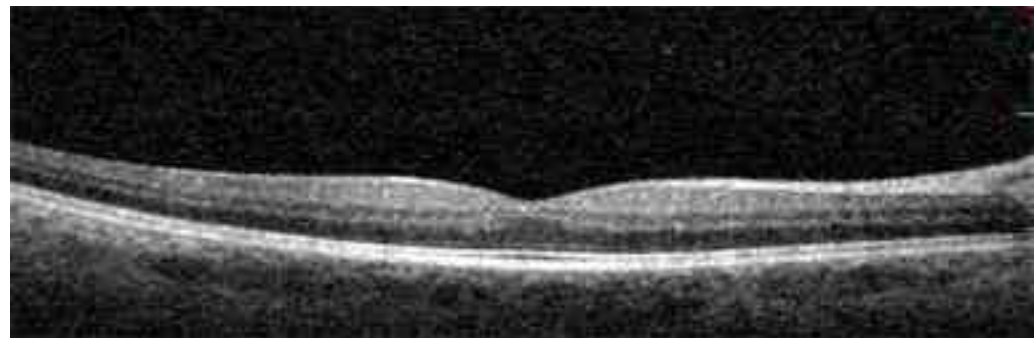
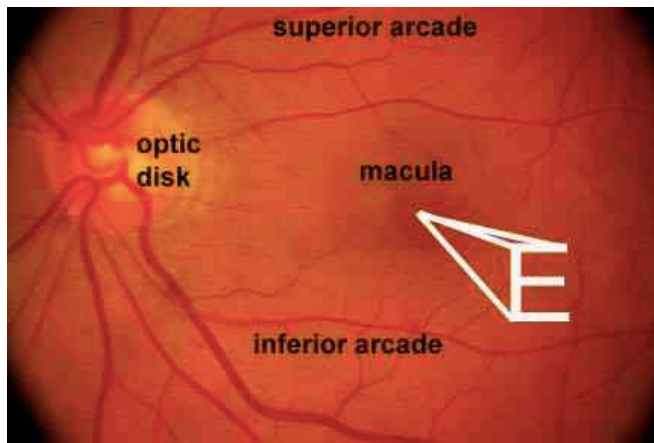
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# Importance of Checking Visual Acuity (VA)

- Visual acuity is a very basic and a very important measure of how the visual system functions.
- not the complete story
- In order to see 20/20, the ocular media must be relatively clear, the fovea (central vision) must be healthy, the neural pathway to the brain must be operating well, and the visual cortex of the brain (perception) must be functioning.
- If the eye does not see 20/20, then it is the doctor's job to figure out why not, and to offer possible remedies.

# Anatomy of Vision

- Retinal photo receptors called cones are packed into the fovea, creating the only area of the retina that has sharp vision. The optical system of the eye focus light to a pinpoint in this area.
- Below is a spectral domain OCT image of the foveal depression, the area of the retina that gives us 20/20 vision.



# Anatomy of Vision

- Studying normal eyes
  - visual acuity drops off rapidly as an acuity stimulus is moved away from the fovea.
- The macular area immediately surrounding the fovea has an acuity of 20/70. Moving outward from the macula, visual acuity drops to 20/400



# four types of va

- Minimum visible, a.k.a. *detection*
- Minimum separable, a.k.a. *resolution*
- Hyperacuity, a.k.a. Vernier
- Recognition



# purposes of measurement

- Quantification for comparison and referral
- Qualification for assistance, licensing, or legal purposes
- Indication of level of functional vision
- Calculation of Just Noticeable Difference
- Estimation of magnification needed for task
  - *telescope* for distance
  - *equivalent add power* for near

# Levels of VA

- NLP (no light perception):
  - **Total blindness** or the complete lack of light perception and form perception
- LP (light perception):
  - the ability to perceive the difference between light and dark, or daylight and nighttime.
- Lproj (light projection):
  - If the eye can tell what direction the light is coming from
- HM (hand motion):
  - wave your hand in front of the eye and if the patient can see your hand move

# levels of va

- Quantified VA
  - Legal blindness
    - 20/200 or worse with standard chart
    - 20/125 or worse with logMAR chart
    - VF 20 deg or less
  - Functionally visually impaired
    - 20/70 or worse



# Recording VA

- The results of visual acuity tests are usually noted with a large "V", "VA", or "Va".
- The result for the right eye is identified with "OD", which is an abbreviation for the Latin term "oculus dexter" (right eye). The result for the left eye is identified with "OS" (oculus sinister).
- Distance visual acuity can be tested "CC" (with correction), or "SC" (without correction).
  - If the correction is a contact lens, "CL" is often used as the identifier
  - Near vision may be identified by a large "V" with the word "near", or perhaps with a large "N"
- VA CC OD 20/20 OS 20/30

# Recording VA

- The Snellen notation, e.g. 20/20, should not be thought of as a fraction.
- The first number means the testing distance the chart is at.
- The second number means that a "normal" eye can see this size letter at the indicated distance.
  - For example, a visual acuity of 20/80 means that the eye tested has to be 20 feet away to see a 20/80 sized letter. A normal eye can see a 20/80 size letter at a distance of 80 feet.

# methods of recording & reporting va

- Snellen Acuity
  - Standard Distance, e.g., 20 ft, 6 m
  - Snellen Equivalent
    - Conversion to 20-ft or 6-m when room is a different length



# methods of recording & reporting VA

- **AVOID** Finger Counting!



# TARGET PARAMETERS

- Optotypes (a.k.a. characters)
  - Grating
  - Tumbling E
  - Landolt C
  - Pictures, Shapes, Symbols
  - Numbers
  - Letters

# target parameters

- Target Presentations
  - Single Character
  - Line of Random Characters
  - Multiple Lines of Characters
  - Single Words
  - Continuous Text

LIGHTHOUSE "GAME" CARD  
FOR NEAR VISION  
LINE INCREMENTS IN LogMAR UNITS

	SHELLN EQUIV. ALENT SIZE	METRIC PRINT SIZE
game	20/400	8.0M
smile	20/320	6.4M
watch	20/250	5.0M
bird melt	20/200	4.0M
four rock	20/160	3.2M
next cake	20/125	2.5M
left soup	20/100	2.0M (18%)
chair print	20/80	1.6M
order seven	20/60	1.25M (15%)
baker first	20/50	1.0M
train plate	20/40	.8M
write month	20/30	.6M (8%)
road	20/25	.5M
...	20/20	.4M

THIS CARD IS CALIBRATED FOR USE AT 40 CM (16 IN.)  
WITH CUSTOMARY READING CORRECTION IF NEEDED.

LIGHTHOUSE INTERNATIONAL  
111 E. 59th St., NYC, NY 10022-1201 1-800-829-0500 CAT. NO. C197

LIGHTHOUSE "NUMBER" CARD  
FOR NEAR VISION  
LINE INCREMENTS IN LogMAR UNITS

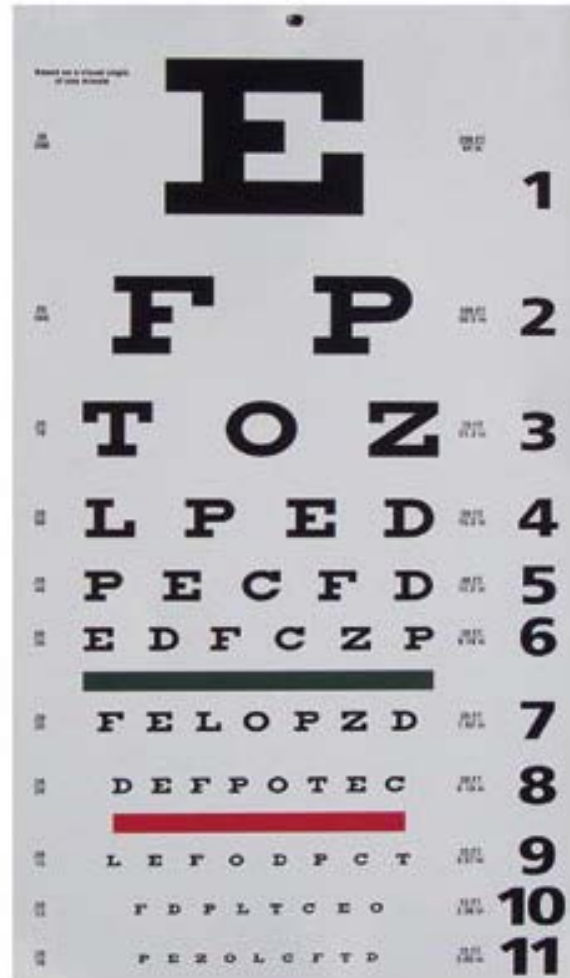
	SHELLN EQUIV. ALENT SIZE	METRIC PRINT SIZE
826	20/400	8.0M
473	20/320	6.4M
952	20/250	5.0M
687 495	20/200	4.0M
359 872	20/160	3.2M
428 637	20/125	2.5M
765 924	20/100	2.0M (18%)
529 583	20/80	1.6M
374 295	20/60	1.25M (15%)
586 473	20/50	1.0M
942 429	20/40	.8M
611 112	20/30	.6M (8%)
...	20/25	.5M
...	20/20	.4M

THIS CARD IS CALIBRATED FOR USE AT 40 CM (16 IN.)  
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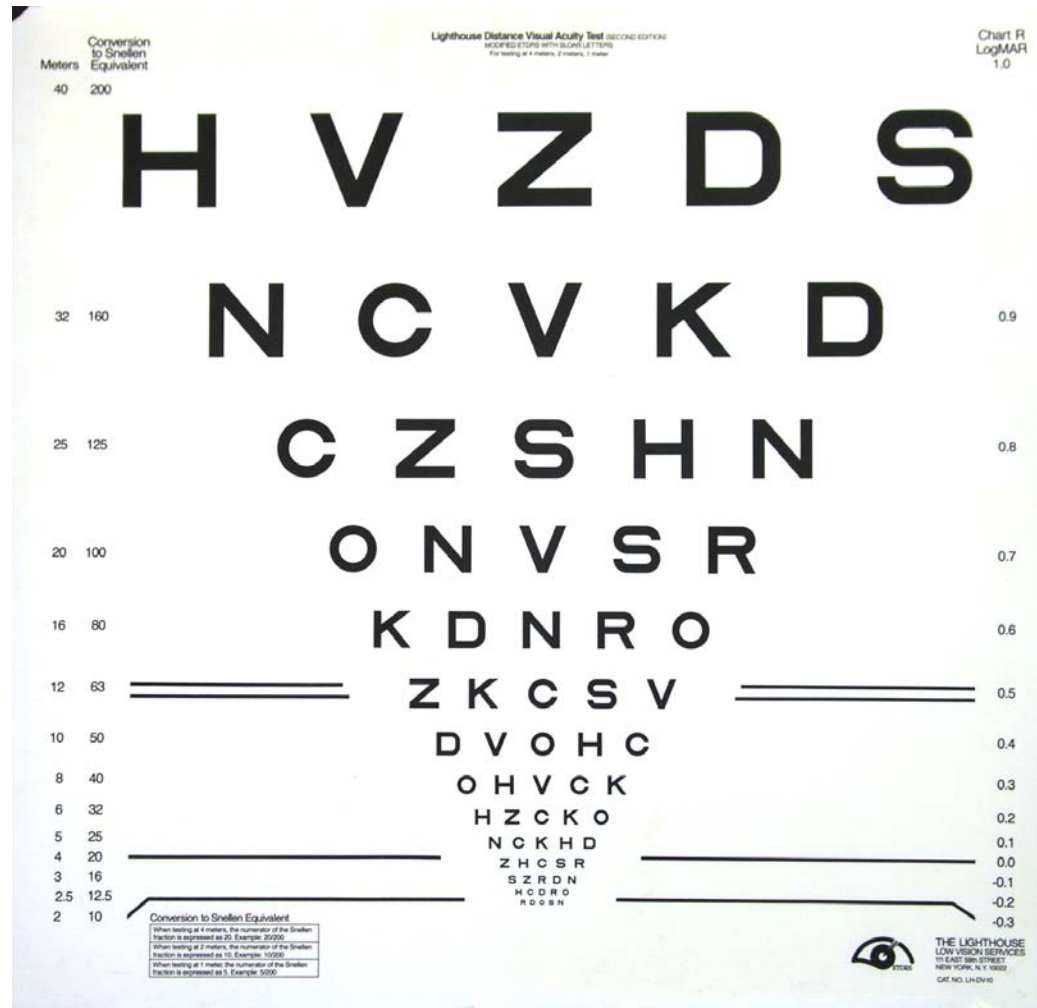
# Chart configurations

- Snellen



# Chart configurations

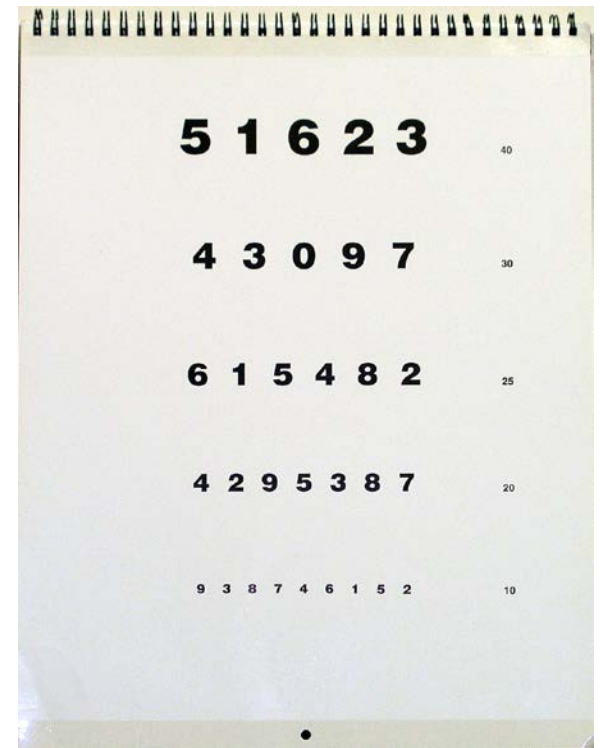
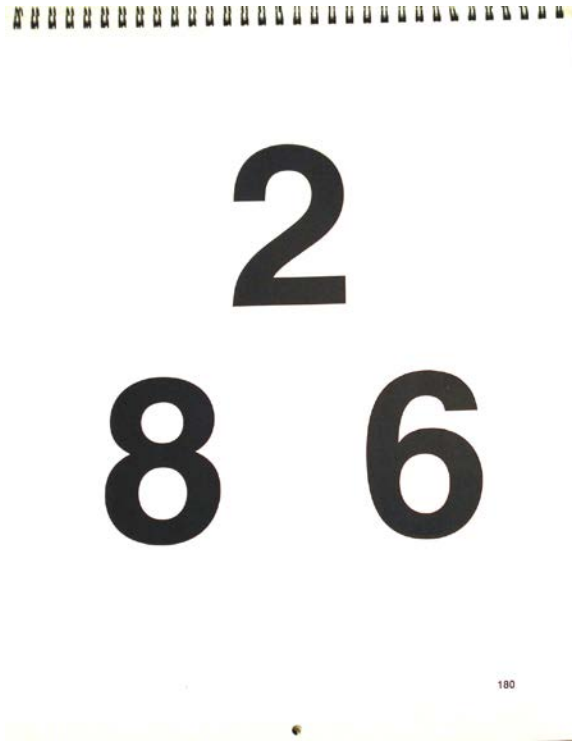
- logMAR





# chart configurations

- Feinbloom



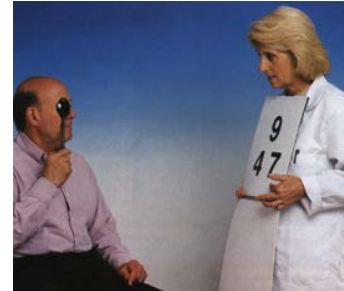


# chart options

- Printed
- Projected on a screen
- Displayed
- Projected directly on the retina

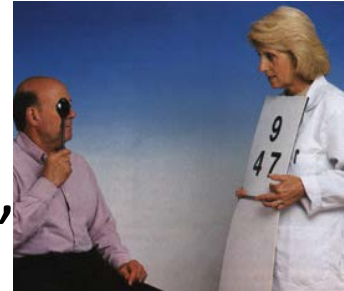
# Measurement Protocol

- Your office will have its own protocols
- In general:
  - Corrected distance vision:
    - If patient has glasses or CL you will always check their corrected acuities
  - Uncorrected (unaided) distance vision:
    - Obvious if patient doesn't wear glasses or CL
    - All first time patients should have uncorrected VA recorded in the chart but may not be needed for subsequent visits
    - Drivers License reporting forms require an uncorrected visual acuity so important that this is recorded in the chart

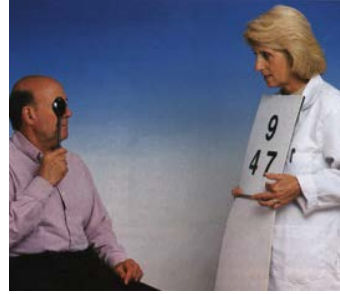


# Measurement Protocol

- Near vision with correction:
  - If the exam is a complete eye examination, then this measurement is important. Your doctor may not require this measurement for follow-up and post-op exams.
- Near vision without correction:
  - If the patient needs glasses for reading, then your doctor likely will not need this measurement. The exception is the patient who says he can read better without his reading correction.

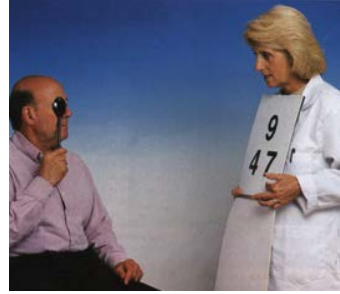


# Measurement Protocol



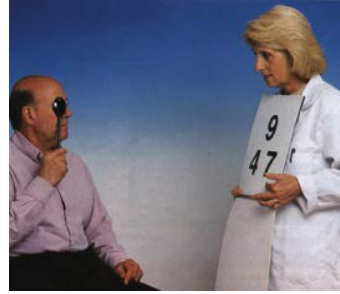
- If the acuity chart is an actual chart that hangs on a wall, then the room light will need to be on for testing.
- If the acuity chart is projected, then the room light may be off, on, or dimmed somewhere in between.
  - Your procedure in this regard will be up to your doctor. It is best to be consistent.
- Some eyes will see better with the light dimmed. A common example is an eye with a significant cataract.
- The level of light within the room will affect contrast, which does have an effect on visual acuity.
- The light level will also affect pupil size, which can also have an effect on visual acuity.

# Measurement Protocol



- The visual acuity projector will have controls that allow you to isolate a line of letters or even a single letter at a time.
  - Letters should not be isolated for acuity testing, they should be presented as a whole chart or as a single line
  - particularly important when testing children. An eye with amblyopia will have better vision when tested with single letters. With a line of letters, the amblyopic eye experiences the so called "crowding phenomenon", which decreases visual acuity.

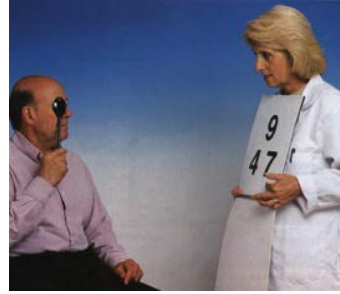
# Measurement Protocol



- If you have an idea of what the end result will be, you can skip lines on the chart and start testing near your acuity estimate. For example, when checking a young person with no visual complaints, you can probably start with the 20/25 or 20/30 line.
- Encourage the patient to guess, even if she protests that the letters are blurry.
- Have the patient continue reading lines and letters until more than half of the letters are named incorrectly.
- The final visual acuity is the smallest line of letters for which more than half of the letter are named correctly. It is good practice to note how many letters are read correctly.



# Measurement Protocol

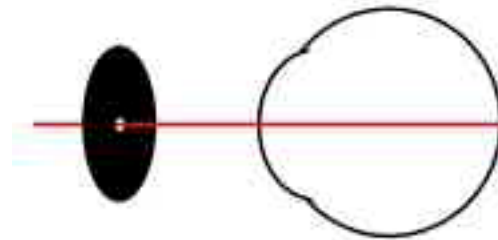
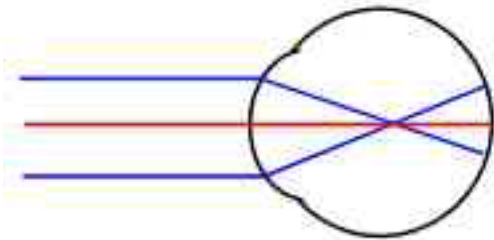


- 20/30 +2 means that all of letter on the 20/30 line were read correctly and 2 letters on the 20/25 line wereread correctly.
- 20/60 -1 means that all the letter on the 20/60 line were read correctly, except for one.



# Pinhole Acuity

- The pinhole works by eliminating all rays of light going to the macula except for the central rays, which are not refracted by the optics of the eye.





# Pinhole Acuity

- Good pinhole acuity tells you that blurry vision is due to a refractive problem.
- Poor pinhole acuity does not necessarily tell you that blurry vision is not due to a refractive problem.
- Poor pinhole acuity may be due to the patient not executing the measurement properly.
- Generally want to check pinhole acuity for any patient who presents with 20/40 or worse vision (uncorrected and doesn't wear correction or with correction on)

# Best Corrected VA (BCVA)

- One goal of a complete eye examination is to determine the best corrected visual acuity, abbreviated BCVA.
- Normal visual acuity is generally accepted as 20/20, although many people can see 20/15, and a few can see 20/10.
- If the eye cannot see 20/20 with a glasses or contact lens correction, then a refraction is required to determine the BCVA.

# Choosing your Acuity chart for Children

❑ Sloan/Snellen

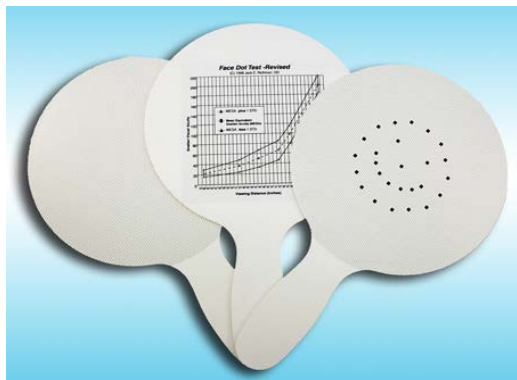
❑ 10 Feet (3m)

❑ Lea Symbols

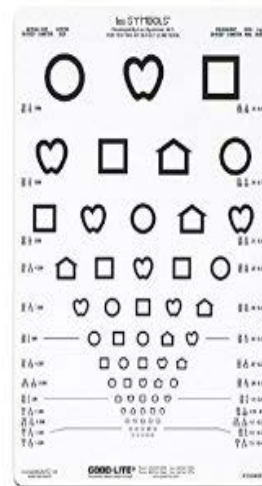
❑ 10 Feet (3m)

❑ Face Dot paddles

❑ 20/40 @ 5 Ft (1.5m)



1 20/200  
2 20/100  
3 20/70  
4 20/50  
5 20/40  
6 20/30  
7 20/25  
8 20/20  
9  
10  
11



# Visual Acuity Charts

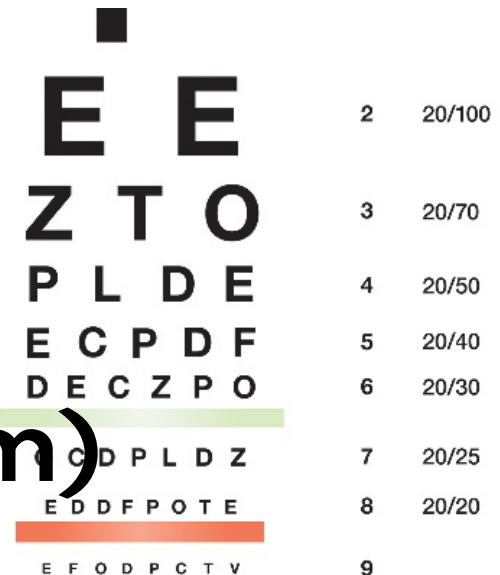
## Sloan

- ❑ GOLD STANDARD
- ❑ Equal difficulty / sizing



## Snellen

- ❑ 1862-Original chart
- ❑ Not standardized



**10 FEET (3m)**

# Visual Acuity Charts

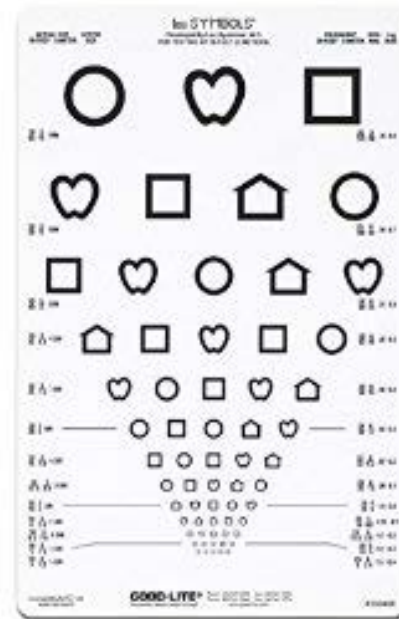
- Lea Symbols

- Ages 5 and under

- HEAD START

- Illiterate

- Non - Verbal



**10 FEET (3m)**

# Visual Acuity Charts

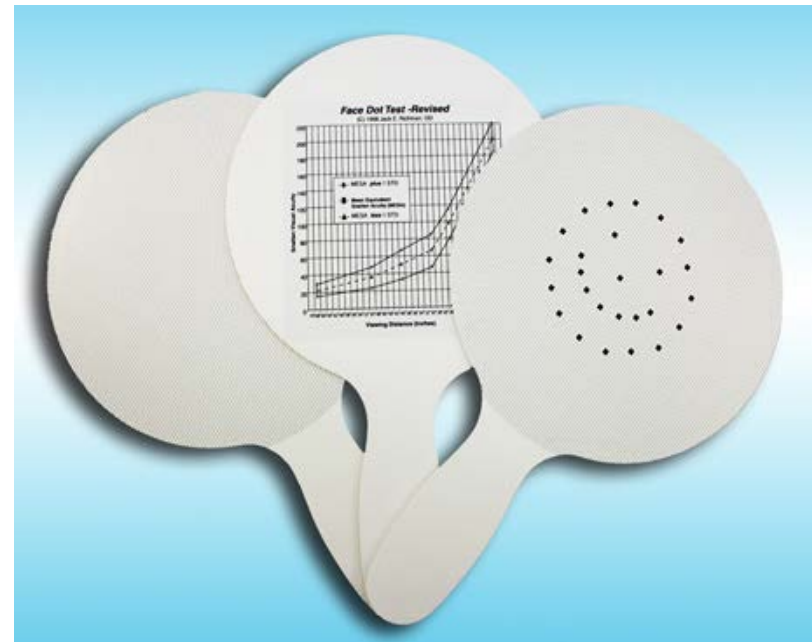
## □ Face Dot Paddles: **TRY LEA FIRST**

■ Preferential Looking

■ **RESERVED FOR DIFFICULT CASES**

■ **4 y/o and younger**

5 feet (1.5m) = 20/40

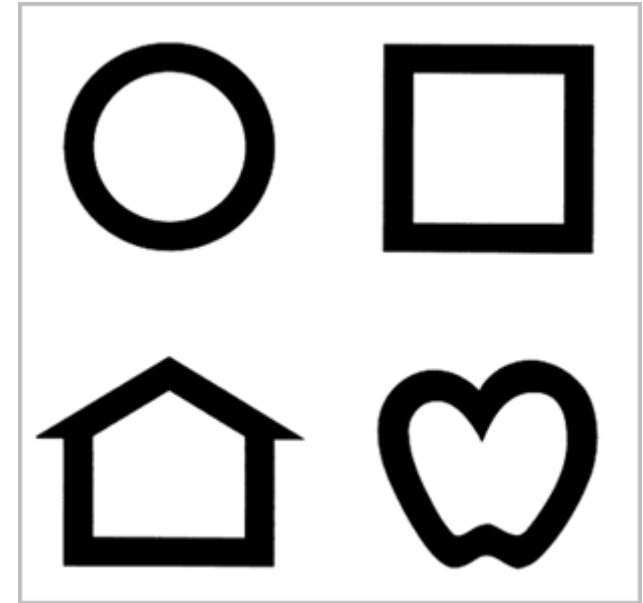




# Accurate VA Measurement and Recording

- Identify Images
  - Circle, Ball, Moon

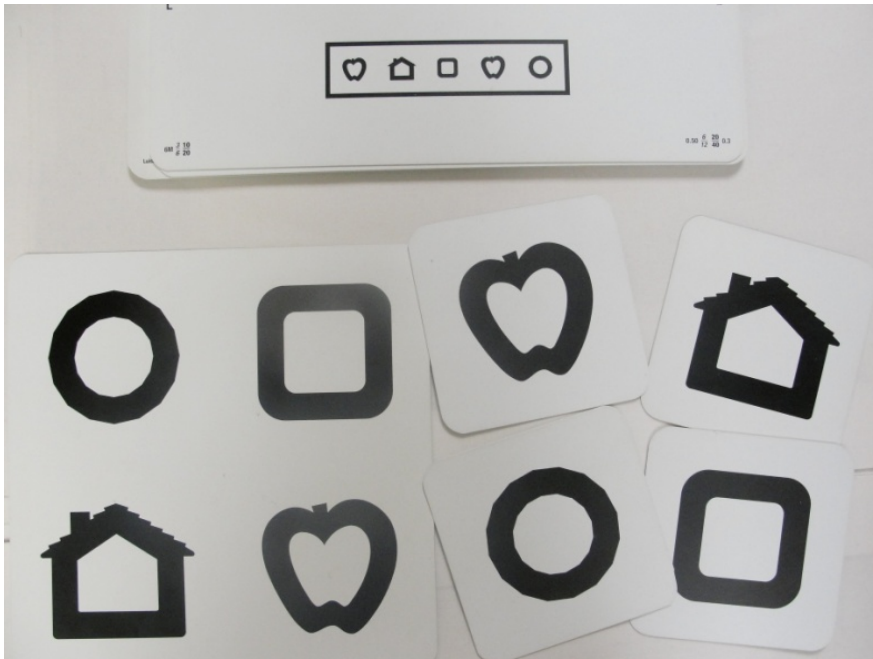
- Match Shapes



- Record VA at **10 Feet (3m)**

# Matching Lea Shapes

ISOLATE SHAPE: REDUCE CROWDING EFFECT



# Measuring Distance Visual Acuity

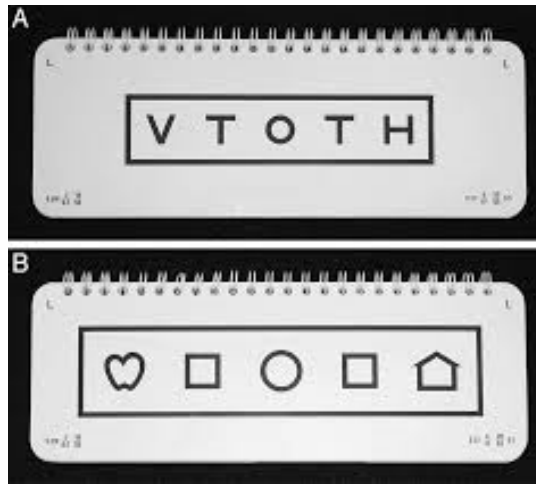
Majority of the line correct

■ **3 images correct out of 5**

Show smaller letters/shapes

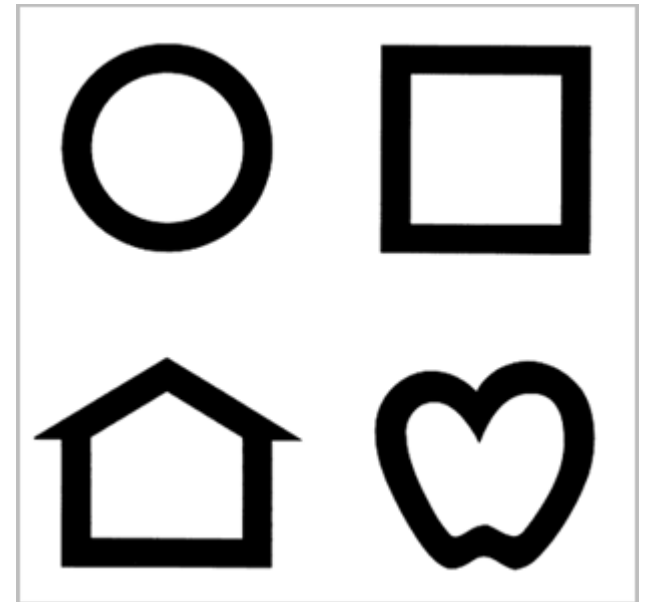
■ **Miss 3 letters/shapes**

Show larger letters/shapes



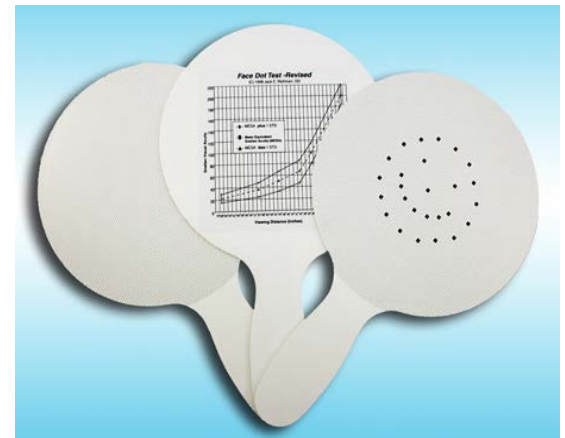
# Measuring Distance Visual Acuities

- Be creative and encouraging
- Utilize the Matching Lea card
- Confirm one eye is occluded
- Accurately Record BEST VA
  - OD: 20/20
  - OS: 20/40



# Face Dot Paddles

- **Forced choice PREFERENTIAL LOOKING**
  - Presented two choices
- Blank Paddle vs. Face Dot Paddle
  - High Contrast Pre test Paddle
- Observe which paddle the child looks at
- **MONOCULAR ACUITY**
  - **OCCLUDE ONE EYE!**
  - **20/40 is at 5 feet (3m)**
  - **3 out of 5 correct**



# Face Dot Paddles



# Face Dot Paddles

- **Second method of checking vision**
  - Try Lea symbols first
  - Reserved for difficult cases
  - Nonverbal
- **The critical factor that determines visual acuity is the distance between the child and the examiner**
  - 20/40 at 5 feet (3m)

# Distance Visual Acuities

- **Check vision with habitual GLASSES**
  - Record vision was measured with glasses
  - cc – With Correction
  - sc – Without Correction
- “Owns glasses but not with”
  - Home, broken, backpack, grandma’s house

**VISUAL ACUITY**    is wearing glasses    has no correction    owns glasses but not with

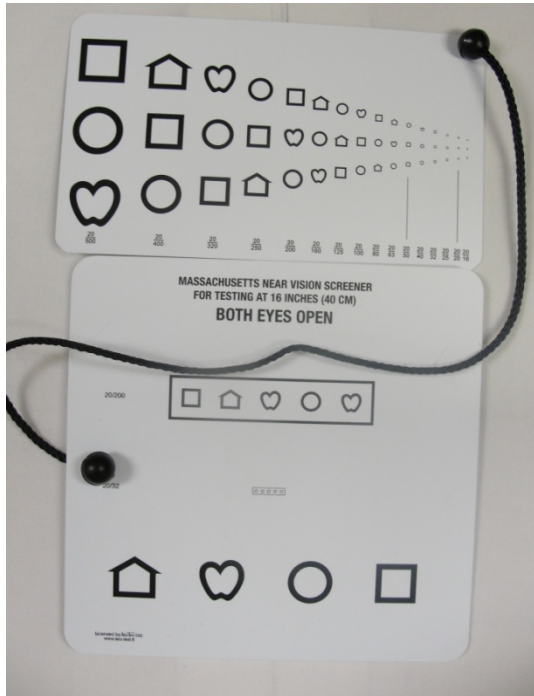
Snellen   distance

Lea   right eye   20/\_\_\_

Face Dot   left eye   20/\_\_\_



# Near Visual Acuities



**Performed Binocularly for Screening purposes**

# Near Visual Acuities

- Not a reading proficiency test
- Chose appropriate acuity chart
- Indicates possible astigmatism if DVA and NVA are reduced.
- Expected to be reduced in patients 40 y/o and older

# Near Vision Acuities

Symbols/letters per line	Allowed misses
1-3 symbols/letters	1 miss
4-7 symbols/letters	<b>2 misses</b>
8-11 symbols/letters	3 misses

**VISUAL ACUITY**    is wearing glasses    has no correction    owns glasses but not with

Snellen    Lea    E's    Face Dot

right eye   left eye

near   OU 20/\_\_\_

# Pupil Testing

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Pacific University College of  
Optometry

# Why Check Pupils?

- Pupillary assessment is an important part of neurological assessment because changes in the size, equality and reactivity of the pupils can provide vital diagnostic information

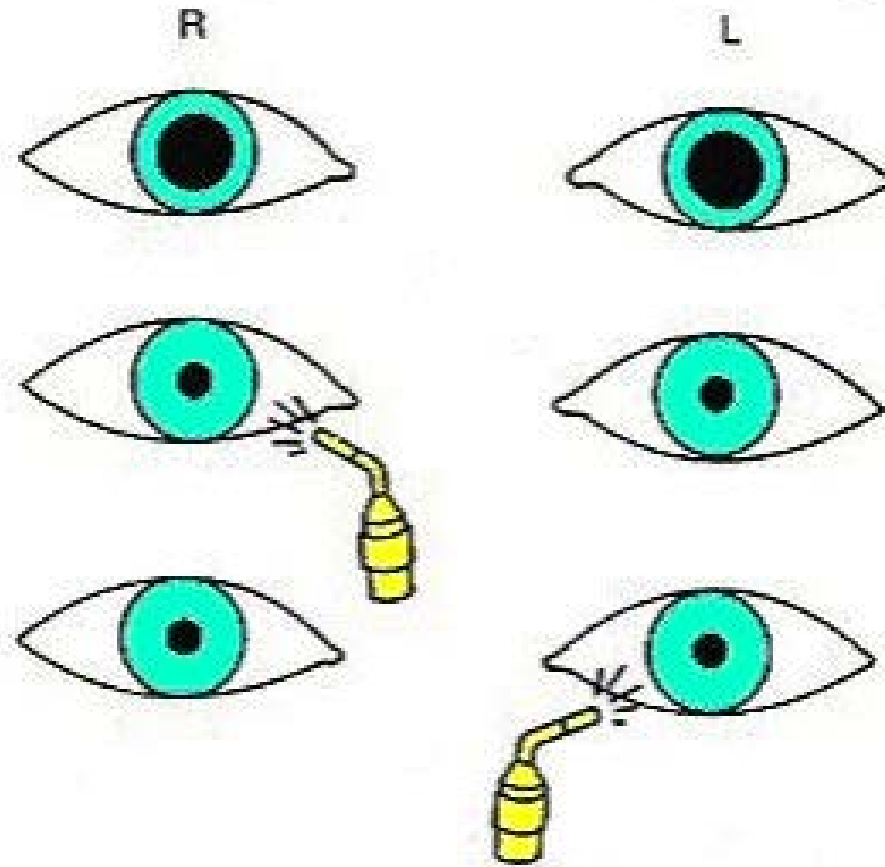
# Pupils

- The pupil is the 'black hole' in the center of the iris
- Relaxation and contraction of the muscles of the iris causes it to dilate (in darkness) or constrict (in bright light)
- pupillary reaction is effectively an assessment of the third cranial nerve (oculomotor nerve), which controls constriction of the pupil

# Pupil Function

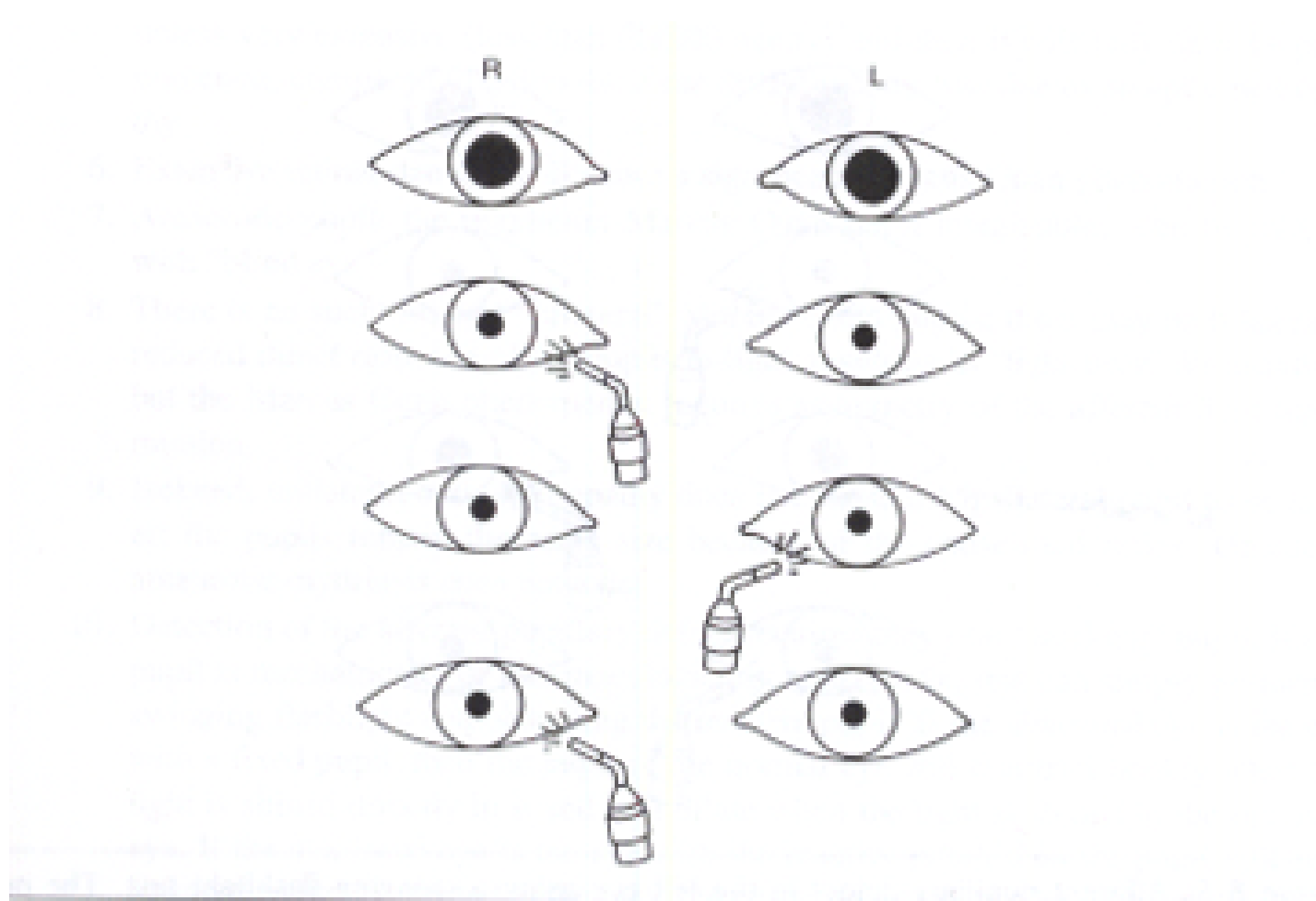
- Pupil reaction to light should be brisk and after removal of the light source, the pupil should return to its original size.
- There should also be a consensual reaction to the light source, that is the opposite pupil also constricts when the light source is applied to one eye

# Normal Pupil Function

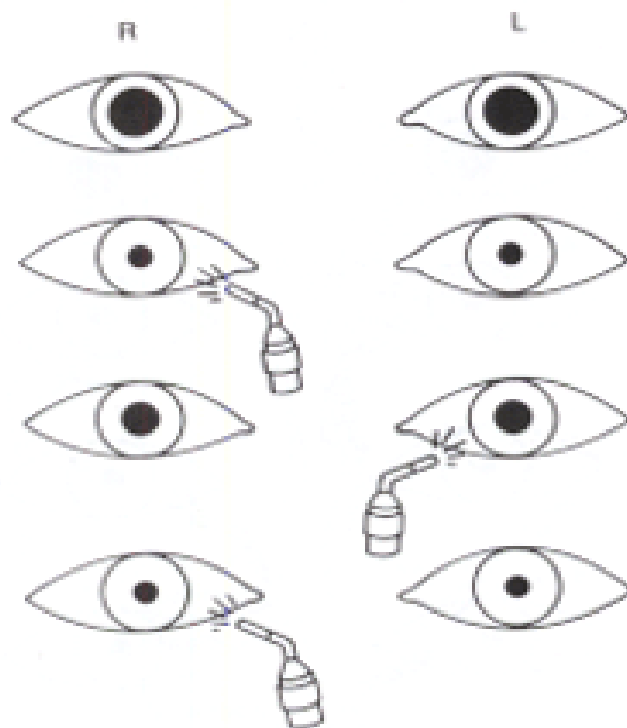




# Normal swinging flashlight test



# Left APD



# Causes of Pupil Abnormalities

- Physiological anisocoria. Up to 25% of the population. May switch sides and may be transient. Fairly consistent across light levels
- Structural abnormalities and sphincter tears
- Age / ischemia
- Pharmacological agents
- Benign Episodic Pupillary Mydriasis (women who suffer migraines: lasts minutes to one week but usually about 12 hours. May or may not react to light)

# Pharmacology

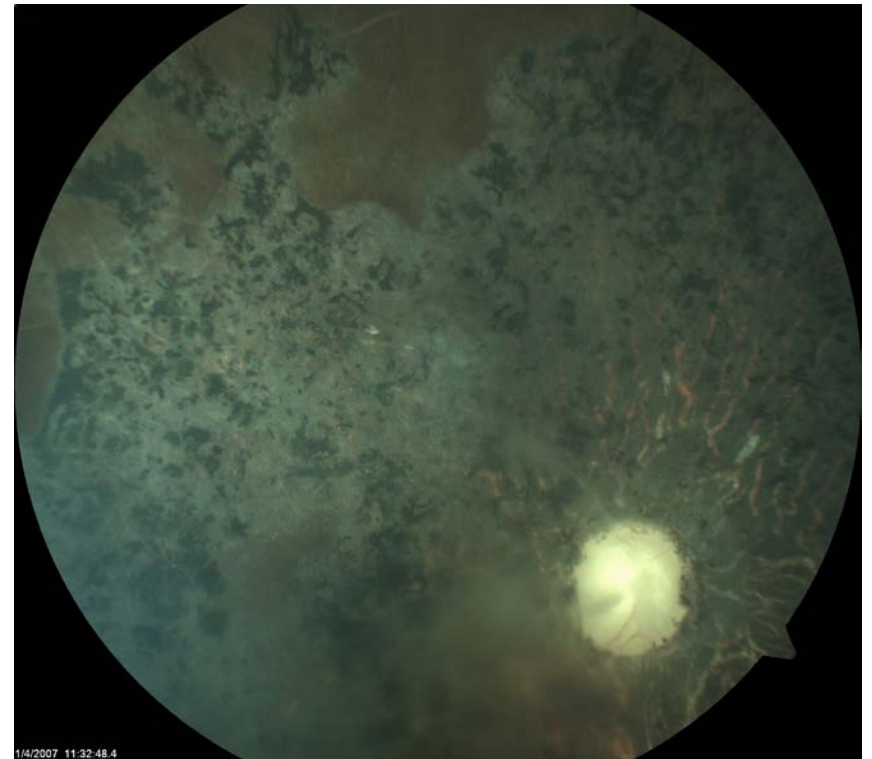
- Topical drugs ( Visine )
- Systemic drugs. Heroin , morphine , codeine lead to miosis. Dramamine , cocaine , levodopa , and antihistamines lead to mydriasis. Belladonna and jimson
- Angel's Trumpet (Datura)
- Preparation H!!!!!!! (2.5% phenyl)
- Scopolamine motion sickness patches
- Flea / tick control products
- 1% pilocarpine test. Will constrict a compressive or tonic pupil but not a pharmacological one

# Pathology / Syndromes

- Argyll - Robertson
- Adie's Tonic
- Midbrain lesions
- Horner's
- Third nerve palsy

# Argyll - Robertson

- Bilateral, asymmetrically miotic pupils which are irregular
- Poor dilation with poor response to light but brisk near response
- Hallmark of tertiary neurosyphilis.



# Argyll-Robertson pupil



**Dark**



**Light**



**Near**

# Adie's Tonic( Holmes-Adie )

- Affected pupil larger originally but becomes smaller with time. Originally unilateral but may become bilateral
- Benign lesion of ciliary ganglion resulting in neuronal loss and aberrant regeneration. Affects mostly women in their 20's and 30's
- Often decreased deep tendon reflexes (achilles most common)
- Tendon reflex loss originally on same side as pupil problem-later bilateral. ? Viral etiology



# Adie's Tonic

- Light reaction poor or absent while accommodation is slow and tonic. Can mimic A-R when bilateral
- Poor re-dilation after accommodation and vermiform movements are common
- Light / near dissociation possible after some regeneration has occurred (8 weeks)
- Test with 1/8 % pilocarpine. Will constrict while normal pupil will not (studies show that pilocarpine must be diluted to .0625% before there is absolutely no constriction of normal)

# Adie's tonic pupil (OD)



**Dark**



**Light**

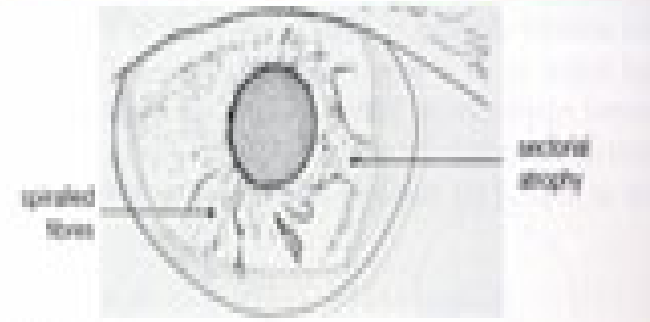
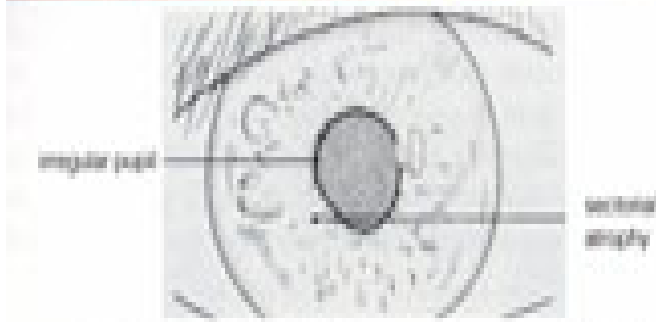


**Near**



**Pilocarpine 0.12%**

# Adie's tonic pupil



# Horner's

- Miosis with normal reaction to light
- Ptosis and upside down ptosis ( loss of muscle tone )
- Heterochromia if congenital and anhidrosis if the lesion is below the SC ganglion but before the carotid bifurcation
- Hypotony
- Can occasionally get partial involvement with ptosis only (no miosis)

# Horner's

- Testing ; 4% cocaine will dilate a normal pupil by blocking the re-uptake of epinephrine but will not dilate the Horner's pupil. Shelf life of only six months if preserved and cost of \$90
- More practical: 1% Iopidine will dilate a Horner's pupil after 30-45 minutes but will not dilate a normal pupil. 0.5% works also
- 1% hydroxyamphetamine will dilate a first or second order Horner's but not a third by releasing NE from postganglionic synapses. Must wait one hour to check and need 72 hour washout if cocaine was used
- Ptosis only patients will get lid elevation with Naphazoline. Little pupillary mydriasis.

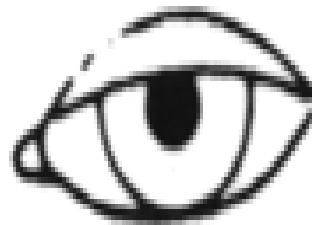
# Horner's Causes

- First order : Neoplasms , Wallenberg's syndrome , trauma , vertebral - basilar insufficiency
- Second order : Pancoast or thyroid tumor , neck trauma or surgery
- Third order : Cluster headaches , cavernous sinus lesion , dissecting carotid aneurysm
- Testing: MRI , MRA , and chest X-ray

# Horner's pupil (OS)



**Dark**



**Light**





# Horner's pupil



# Third Nerve Palsy

- Partial vs. Complete. Complete will show fixed , dilated pupil with ptosis and restricted motility. Eye will be down and out and patient will complain of diplopia
- May actually involve only the pupil where fibers are superficial

# Pupil sparing / Pupil involving

- Rule of thumb : Pupil sparing third nerve palsies tend to be ischemic while those involving the pupil tend to be due to aneurysms or tumors
- Not a firm rule
- Pupil sparing may become pupil involving so follow very closely
- May get pupil involvement only in rare cases such as basilar artery aneurysms

# Third Nerve Management

- Immediate MRI if any question of aneurysmal involvement. Patient may complain of a severe headache and will often have other neurological signs
- If patient is diabetic or hypertensive and the pupil is not involved they can be followed closely without imaging studies

# Third Nerve Management

- Patient education and reassurance a must
- Diplopia relief with patching
- Most ischemic palsies resolve over several months

# Third nerve palsy

- Right third nerve palsy



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