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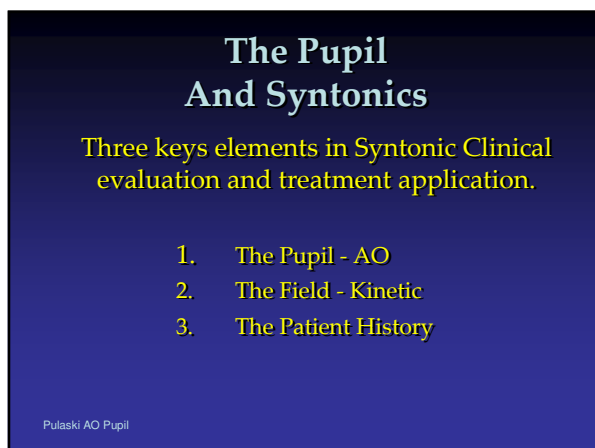
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## The Pupil

One of the most sensitive measures of ANS activity.

- ANS/Brainstem function
- “Eyes are the window to the Soul”  
The Pupils are the window.
- Portal of Energy Reception and Projection. Portal through which we interact with our world
- Non-verbal Communication and strong emotional indicator.
- Reception of “nutrition” - LIGHT



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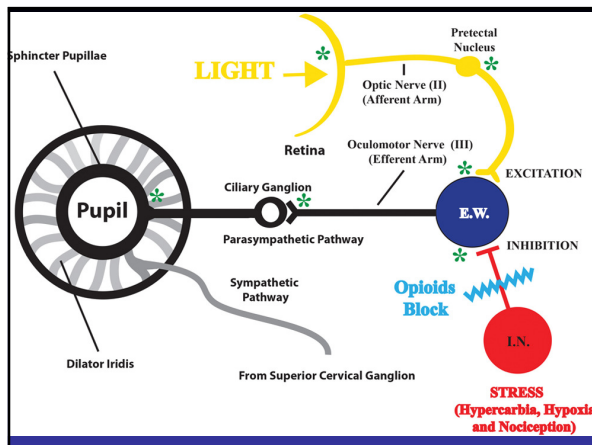
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## The Pupil

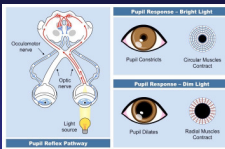
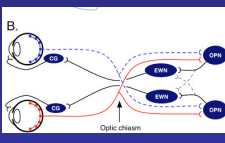
### Neurological Pathways

**Parasympathetic - Constriction**

- The Pupillary Light Reflex (PLR)
- Influence on Iris Sphincter
- Light-Inhibited Sympathetic Path
- Trigeminal Nerve – sensory stimulation to eye/iris

**Sympathetic – Dilation**

- Direct stimulation of Iris Dilator through 3 neuron arc
- Inhibition of EW nucleus

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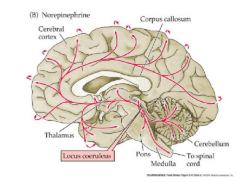
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## The Pupil

### Neurological Pathways

**Pathway of Dilation**

- **Direct Stimulatory - Iris dilator**
  - Hypothalamus
  - Nucleus Coeruleus
  - Superior Colliculus
  - Frontal Eye Fields
- **Inhibitory – EW nucleus**
  - Nucleus Coeruleus
  - Superior Colliculus
  - Supernuclear Inhibition from the Reticular Activating Formation in brainstem



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## The Pupil

### In Syntonics

In Syntonics we are interested in the pupil as an indication of the state of the ANS. The two major reactions observed are:

- Alpha Omega Pupil
- Pupillary Light Reflex



Pulaski AO Pupil

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## The Pupil

### Reactions

### Alpha Omega Pupil

- An Alpha Omega Pupil is the abnormal re-dilation of the pupil during direct, constant light stimulation.
- Unique to the practice of Syntonics
- First suggested as a term by Dr. Paul Johnson in 1934.
- The abnormality is brought to normalcy with phototherapy treatment
- There is an inverse relation between the size of the functional visual field and the degree of the AO Pupil.



Pulaski AO Pupil

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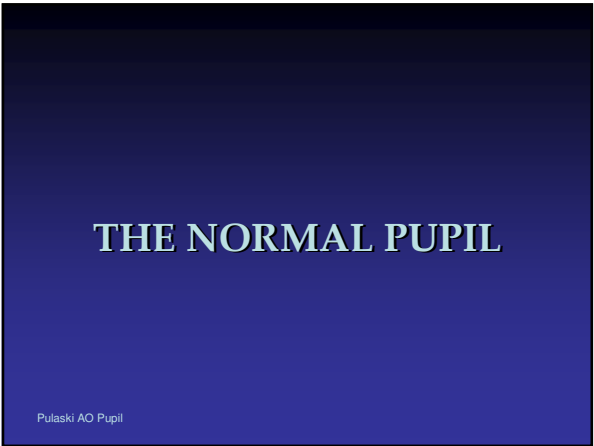
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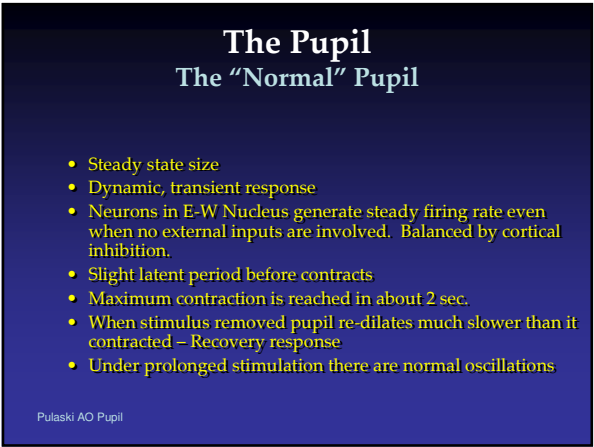
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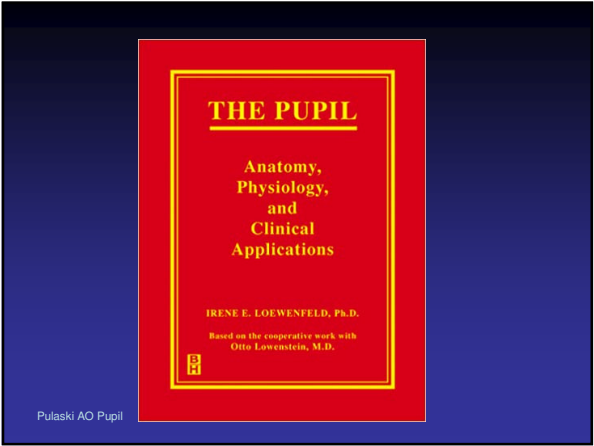
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Figure 10-1. Spontaneous pupillary movements in a healthy 24-year-old man. The pupilligrams of the right eye are shown. A and C were original records. In B, the time axis of the graph was compressed in the following manner: the pupillary diameter at the beginning of each successive second was taken from the original record, and was plotted as a single measurement (small rectangles); sixty such measurements thus show the pupillary movements

that occurred within each minute. A: Normal light reflex; B: Diameter during the fifth to ninth minute in darkness. The pupil was large and quiet. The subject was not tired, and was able to continue the test for more than 2 hours without remarkable changes in pupillary behavior. C: Slow (a) and (b) pupillary oscillations of small extent (see text). (From O. Loewenfeld, R. Feinberg, and I.E. Loewenfeld, *Invert. Ophthalmol.*, 2 [1963]:138)

Figure 10-1. Spontaneous pupillary movements in a healthy 24-year-old man. The pupillograms of the right eye are shown. A and C were original records. In B, the time axis of the graph was compressed in the following manner: the pupillary diameter at the beginning of each successive second was taken from the original record, and was plotted as a single measurement (small rectangles); sixty such measurements thus show the pupillary movements

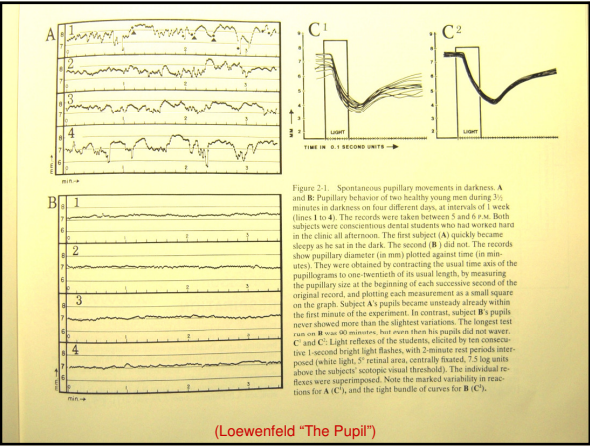
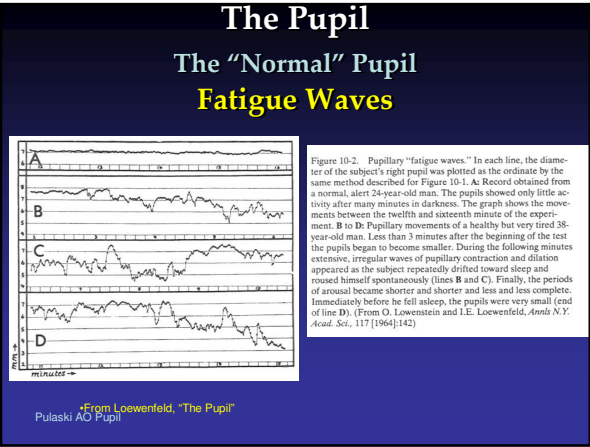
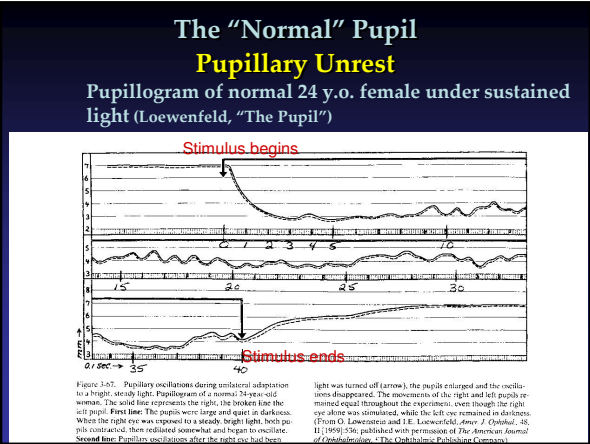
that occurred within each minute. **A:** Normal light reflex; **B:** Diameter during the fifth to ninth minute in darkness. The pupil was large and quiet. The subject was not tired, and was able to continue the test for more than 2 hours without remarkable changes in pupillary behavior. **C:** Slow (**a**) and fast (**b**) pupillary oscillations of small extent (see text). (From O. Lowenstein, R. Feinberg, and I.E. Loewenfeld, *Invest. Ophthalmol.*, 2 [1963]:138)

- Pupillary Unrest
- Pupillary Fatigue
- Pupillary Escape

Pulaski AO Pupil

- Defined by Lowenfeld as “normal pupillary oscillations brought on by steady light and absent in darkness.”
- They are continuous, constant rippling and pumping, rapid and irregular movements of the pupil in a lighted environment that cease when the light is turned off.
- Can vary from one individual to another but the pattern is the same for that individual over time. Postulated that it is unique due to our genetic make-up.
- Their cause remains unknown although it is Lowenfeld's opinion that they originate in the neurons of the midbrain.

Pulaski AG: 48011



## The Pupil Reactions Pupillary Escape



- Re-dilation of the pupil after exposure to a moderate light source.
- Stated that the re-dilation is due to retinal adaptation
- Pupillary "Unrest" follows
- The Alpha Omega pupil might be considered as a form of pupillary escape by non-light therapists

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## The Pupil Reactions Pupillary Escape



- Duke-Elder,<sup>1</sup> in 1959 discussing the clinical picture of optic neuritis, mentions "a peculiar pupillary reaction common to all forms of conduction interference, wherein, although both the direct and consensual reactions are present the contraction is not maintained under bright illumination so that the pupil slowly dilates again while the light is still kept upon the eye."
- "Pupillary escape" is an abnormal **pupillary** response to a bright light, in which the **pupil** initially constricts to light and then slowly redilates to its original size. **Pupillary escape** can occur on the side of a diseased optic nerve or retina, most often in patients with a central field defect.

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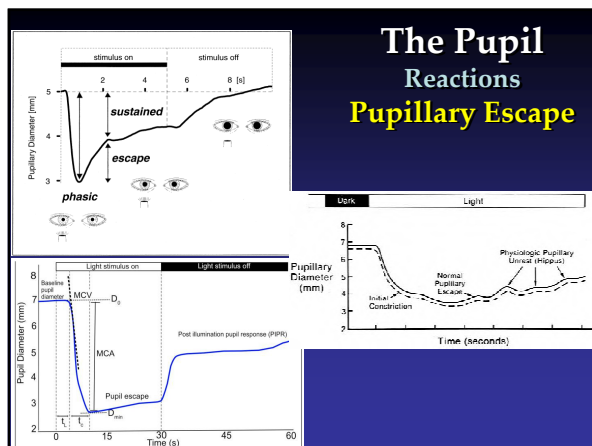
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# The Pupil

## Reactions

### Alpha Omega Pupil



- An Alpha Omega Pupil is the abnormal re-dilation of the pupil during direct, constant light stimulation.
- An Alpha Omega Pupil differs from Pupillary Unrest in that its occurrence happens before 8-9 seconds have elapsed. Its amplitude is greater than 1 mm in many cases.
- It's measurement or recording can be effected by the influence of "Fatigue Waves" in a very tired person and effect the variability of response during testing.
- It can be considered a form of pupillary "escape" but without pathology that is reversible with treatment. There are also differences in frequency and amplitude.
- Conclusion – The pupil reaction is extremely complex.

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# The Pupil

## Sympathetic

### Influences on Pupillary Reflex Dilation

#### The Normal Pupillary Reflex Dilation

Any sensory, emotional, or mental stimulus elicits reflex dilation. Any sound, touch or pain, fear, joy or anger or spontaneous thoughts and intentional efforts all dilate the pupils.

The amplitude of reaction depends on the degree of arousal caused by the stimulus and the subject's physical and mental state at the time of stimulation.

Loewenfeld

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# The Pupil

## Influences on Pupillary Reflex Dilation

Increased Dilation	Increased Constriction
Increased attention	Mind wandering/Distraction
Orienting Reflex	Introspection
Increased mental effort	Poor task performance
Mental arithmetic	Disgust
Memory formation	Images of the sun
Pleasant sounds	High level scene processing
Perception of odors	Memory retrieval
Sexual arousal	
Dishonesty, Lying	
Enjoy/Dislike what is seen	

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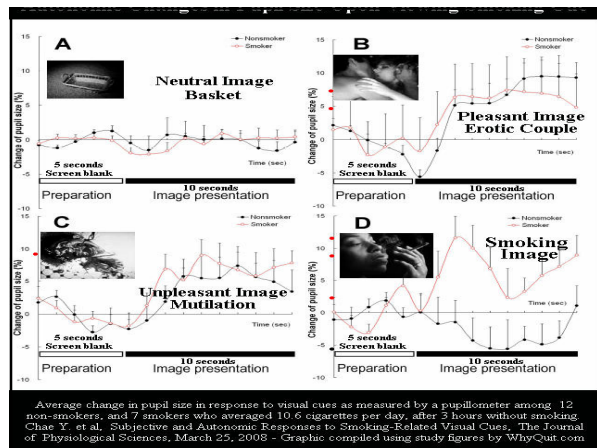
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## The Pupil

# REACTIONS

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## The Pupil Reactions

- Alpha Omega
- Hippus
- Afferent Pupillary Defect
- Pupillary Light Response (PLR)
- Near Reflex

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# The Pupil

## Reactions

### Alpha Omega Pupil



- Why is it not Hippus?
- Why is it not an APD defect?
- How do other reactions relate?
- How does the field relate?

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# The Pupil

## Reactions

### Alpha Omega Pupil



- An Alpha Omega Pupil is the abnormal re-dilation of the pupil during direct, constant light stimulation.
- It is related to imbalances within the ANS. Hypothalamus and Adrenal activity are important.
- The reaction reveals many aspects of the vitality of the human being.
- Rian Shah, N.D. states that oscillations are due to severe sodium depletion secondary to decreased adrenal function, specifically diminished aldosterone. Also called "rebound" pupil.

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# The Pupil

## Testing Standards in Measurement

### Alpha Omega Pupil

Pulaski, 2006

### Observation and Recording of AO Pupil

1. Quickness of initial stimulation – PLR
2. Time to release
3. Amplitude of release
4. Reactions after initial release – fluctuations
5. Change in response with repeated stimulation
6. Sensory reactions – tearing, pain, etc

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## The Pupil

### Grading Standardization

### Alpha Omega Pupil

Alpha Omega Grading Standard  
(Pulaski 2010)

Grade	Release Time	Fluctuations	Amplitude
Normal	≥ 9 seconds	Trace	Trace
1+ AO	4 – 6 sec	Moderate	Mild
2+ AO	2 – 3 sec	Marked	Mild-Moderate
3+ AO	1 – 2 sec	Mild-Moderate	Moderate
4+ AO	< 1 sec	Mild	Large

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## The Pupil

### Grading Summary

**OD**

0 1 2 3 4  
0 1 2 3 4

PLR  
Near Reflex

Yes No  
Yes No

Normal Direct  
Normal Consensual

Pupillary Diameter  
Time of Release  
Amplitude of Release

0 1 2 3 4  
0 1 2 3 4

Fluctuations  
AO Pupil

Change in repeated stimulation  
Sensory reactions

**OS**

0 1 2 3 4  
0 1 2 3 4

PLR  
Near Reflex

Yes No  
Yes No

Normal Direct  
Normal Consensual

Pupillary Diameter  
Time of Release  
Amplitude of Release

0 1 2 3 4  
0 1 2 3 4

Fluctuations  
AO Pupil

Change in repeated stimulation  
Sensory reactions

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### Field / Progress Evaluation

DATE     /    /     NAME                      Filter AO/MD MU UO/MU       
 Copay      Total Weeks      Since Last OV     

HX Compliance + -      Changes in Health/Medication None

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**Field Testing** Tested by KL JP Reliability 1 2 3 4     

VA      cc      OD 20      Pupils Size SS/Lt      PLR      αΩ      APD Near      NPC     /      
 OS 20      OD     /     mm 1 2 3 4+ 0 1 2 3 4+ - + + -  
 OS     /     mm 1 2 3 4+ 0 1 2 3 4+ - + + -  
 Photophobia None 1 2 3 4+ Other     

**Fields** White Green Red Blue BS EOM's Pursuits Saccades Hypo/Hyperm  
 OD     %     %     %     % SAFE 1 2 3 4+     % Rt 1 2 3 4+       
 OS     %     %     %     % SAFE 1 2 3 4+     % Lt 1 2 3 4+       
 Jerky 1 2 3 4+ Fixation Loss 1 2 3 4+ Sac Int      +

**Dynamic** OD      Impression ☐ Visual Field Contraction ☐ Plan ☐ Continue Current Filters  
 OS      ☐ Improving W C ☐ Same W C ☐ FLUp      Weeks  
☐ Worse OD OS ☐ Asymmetric  
☐ Pursuit / Saccadic Dysfunction ☐ Change Tx       
☐ Pupillary Abnormality       
☐ Convergence Insufficiency       
 Signed                     

**Externals** OD      OS       
 Lid/Lash       
 Conjunctiva     

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## The Pupil Reactions

### Hippus

Per Lowenfeld it is a very confusing term

- Nystagmus in ancient times
- Lid fluttering
- 18<sup>th</sup> Century – wave-like pupillary movements
- Nine categories (see addendum – pupillary oscillations)
- Loewenfeld suggests that the name be dropped or defined as “vigorous pupil oscillations of various types”
- Of interest are
  - » Pupillary Unrest
  - » Fatigue Waves
  - » Pupillary Escape Waves

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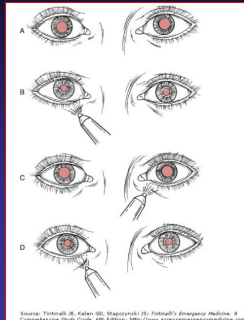
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## The Pupil Afferent Pupillary Defect

1. Confusion with Alpha Omega
2. RAPD due to Unilateral Optic Nerve Neuropathy. Indication of retinal disease or optic nerve pathology
2. Re-dilation referred to in literature as “Pupillary Escape”
3. Normal consensual with subnormal direct. Decreased PLR. Anisocoria at times
4. Swinging Flashlight Test
5. Characteristic observation is “release” or re-dilation of both pupils when the light is moved from the normal to the affected eye.



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## Afferent Pupillary Defect vs. Normal (Loewenfeld “The Pupil”)

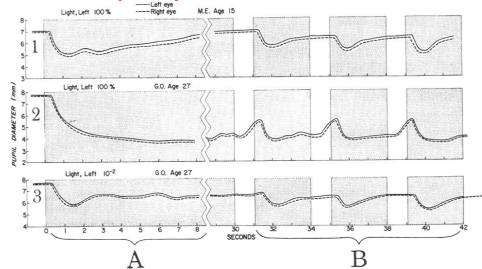


Figure 17-4. Pupilary “escape” in a patient with afferent impairment (line 1), compared with a normal subject (lines 2 and 3). The patient was an obese 15-year-old girl who complained of severe headaches. She was found to have bilateral papilloedema and increased intracranial pressure. Extensive diagnostic investigation failed to reveal the cause of her trouble. During the next months the working diagnosis was pseudotumor cerebri. She was treated with steroids and the papilloedema receded. About 2 months later her headache recurred and her vision was reduced to light perception. One month later a craniotomy was done for decompression, and the cortex and meninges were found to be studded with nodules of metastatic melanoma. The patient died about 2 months later, and since only the brain was examined, the location of the primary tumor

the patient’s reactions to bright light (A) and to darkness (B). Line 2 shows a normal person’s reactions under the same conditions. In line 3 light of reduced intensity was used in the normal person (attenuated by neutral grey filter of 10% density). Note the “escape” of the patient’s light reflex, compared to the firm, extensive contraction of the normal subject’s pupils. With 2 log units of neutral grey filter interposed between the normal eye and the light the same pupillary “escape” was produced in the normal subject as in the patient with bright light. In the darkness reflexes the normal pupil dilated well to one-second interruptions of the light (white bars); and they recontraction quickly when the light was readmitted. In contrast, both the patient’s eye and the normal eye with attenuated light had “low intensity” darkness reflexes: the dark dilations were missing and the recontractions were shallow and short-lasting. (From 17, 4.)

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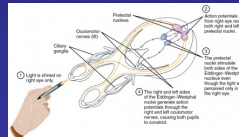
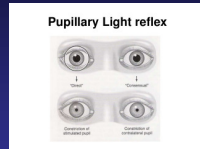
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## The Pupil Reactions

### Pupillary Light Reflex

- 10-20% of RGC axons relate to PLR
- 1% of ipRGC's
- Speed/Strength of contraction
- Coma, TBI, Stroke
- Excited Patient
- Relation to ANS



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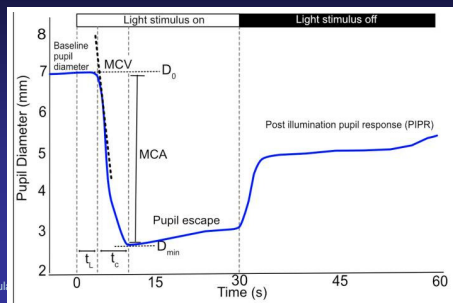
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## The Pupil Reactions

### Pupillary Light Reflex



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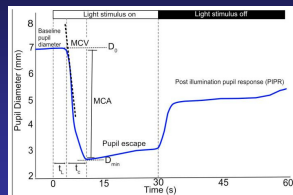
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## The Pupil Reactions

### Pupillary Light Reflex

MCA, MCV predictors for

- Alzheimer's
- Parkinson's
- ABI/TBI
- Autism
- Drugs/Alcohol
- Infection



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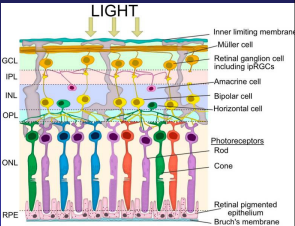
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# The Pupil Reactions

## Pupillary Light Reflex

- ipRGC's very important in recovery phase (PIPR)
- Are both inhibited and activated by different wavelength sensitive cones
- Important in sustained constriction



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# The Pupil Reactions

## Near Reflex

1. Observed reaction of Pupil when the patient looks from a distance to near object.
2. Record strength of constriction from 0 – 4+ for each eye.
3. Is a different pathway and can react even if no PLR

Pulaski AO Pupil

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# The Pupil

# TESTING

Pulaski AO Pupil

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# The Pupil TESTING

Conventional

Automated Pupillometry

Pulaski AO Pupil

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# The Pupil Testing Standards in Measurement

Observation and Recording

General Observations and Questions (Loewenfeld "The Pupil")

1. Size - too large/small for age, illumination, etc.
2. Direct and Consensual responses.
3. Are reactions to light and to near equally extensive
4. Are they equal in size
5. If unequal is difference greater in dim or bright
6. Do both constrict to light
7. Do both redilate as light removed
8. Is reflex to sensory stimuli intact on both sides
9. Are there other motor or sensory defects relating to the pupillary syndrome

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# The Pupil Testing Constants in Measurement Rigid Test Protocol

- Room Illumination
- Patient Fixation
- Light Source
- Distance and Location
- Duration

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## The Pupil

### Testing Constants in Measurement

#### Room Illumination

- Dimly lit room in dark adapted state

#### Patient Fixation

- At distance (non-accommodative to avoid near reflex)
- Non-descript target – no cognition

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## The Pupil

### Testing Constants in Measurement

#### Light Source

- Small, bright, concise, with ability to adjust the light intensity



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## The Pupil

### Testing Constants in Measurement

#### Distance and Location

- Approximately 6-8" from eye
- Light source turned on and below or temporal to eye being tested
- Light should be swung directly to a location straight into the line of sight
- Lag of 2-3 seconds between eyes



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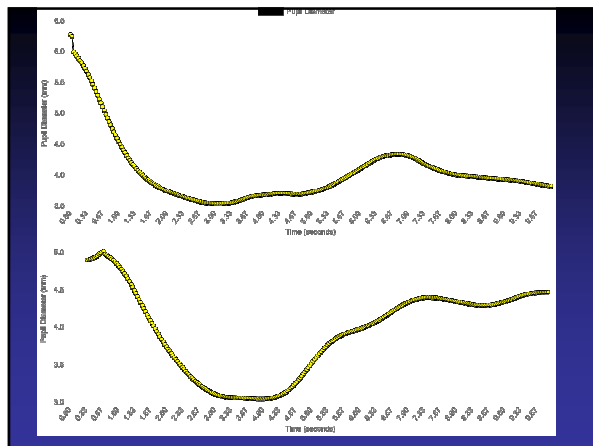
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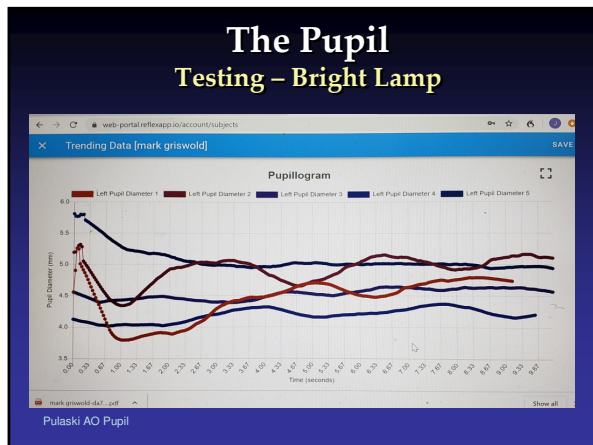
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### The Pupil

#### Testing – Bright Lamp

#### Pupil Parameter Normal Ranges

• Avg. Constriction Speed	0.45 - 1.159 mm/sec
• Avg. Diameter	3.169 - 3.816 mm
• Avg. Dilation Velocity	0.888 - 2.699 mm/sec
• Constriction Time	1.178 - 2.217 sec
• Latency	0.138 - 0.279 sec
• Max. Constriction Speed	4.013 - 9.136 mm/sec
• Max. Diameter	3.662 - 5.186 mm
• Min. Diameter	2.861 - 3.317 mm
• 75% Recovery Time	3.945 - 4.54 sec

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**Questions or Comments?**  
Matthew Southern  
Marketing Director  
[msouthern@brightlamp.org](mailto:msouthern@brightlamp.org)  
Phone: (317) 763-0786

 **reflex**

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**The Pupil**

**REACTIONS OF PUPIL  
RELATE TO SIZE OF FIELD**

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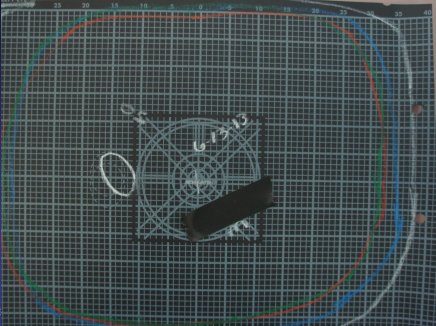
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**The Kinetic Visual Field**  
**The Normal Visual Field**



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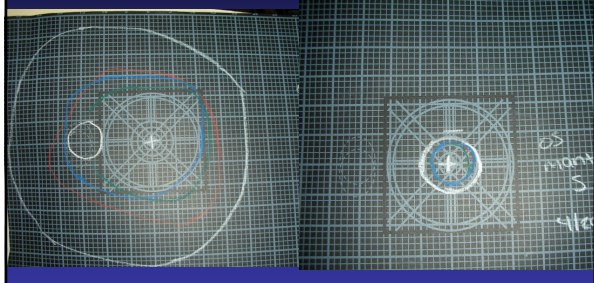
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## Kinectic (Functional) Visual Fields

**Abnormal**



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