PUPILLARY RESPONSES

by Samuel Pesner, O.D., F.C.S.O.

I. Definition - *Pupillary Response* - the reaction of the pupil(s) to a stimulus.

II. Basic Syntonics Testing

A. Pupillary responses are traditionally tested by optometrists to detect departures from normal which may be indicative of pathology (Table 1).

B. A pupillary response of particular interest in Syntonic Optometry is the "Alpha Omega pupil" because of the opportunity it affords to discover imbalances within the autonomic nervous system, i.e., between the sympathetic and parasympathetic nervous systems (see "Pupillary Nerve Pathways") and to monitor the restoration of syntony during Optometric Phototherapy.

C. *Rogoff Sign* - "Another finding of patients with hypoadrenia concerns the Rogoff sign. In the Rogoff sign test, light is beamed on the eye's pupil. If the light fails to constrict the pupils and maintain a constant constriction for 38-45 seconds, the adrenals are weak or underactive. The physiological mechanism behind this abnormal reaction is related to the adrenals' inability to maintain electrolyte balance (balance between sodium and potassium ions) and secrete adrenaline (which constricts blood vessels). Likewise, if the pupil fluctuates between dilation and constriction, the test is indicative of poor adrenal activity. If the pupil maintains constant constriction for 35 seconds (without any dilation), the adrenal activity is considered normal. Also, when observing these pupil changes, be aware that patients with hypoadrenia have a certain vague staring and a vacantness in their eyes that is similar to someone who takes drugs or had too much to drink[1]."

D. *Alpha Omega Pupil* - "The 'Alpha Omega pupil' is a term unique to Syntonic Optometry. It is used to define a pupil which does not respond normally to light. When a penlight is directed at the eye continuously from the front, an 'alpha omega pupil' may fail to constrict, or may constrict but fail to hold the constriction. The pupillary response is an indication of the size of the functional field, i.e., the faster the dilation (in the presence of the light source) the smaller the field. The response of one eye may differ from that of the other eye. Alpha + omega ($\alpha\omega$) is the combination frequency recommended to alleviate the faulty pupil function, hence the origin of the term[2]."

III. Instrumentation

A. A penlight, muscle light, spot retinoscope or ophthalmoscope will suffice.

IV. When to Perform Pupillary Response Testing

A. In *every* Syntonic Optometry basic examination and progress examination.

B. In *every* comprehensive eye examination.

[1] Yanick, Jr., Paul (Ph.D.), *Manual of Hormonal Regulation*, Biological Energetic Press, Colebrook, NH (?), 1992

[2] Butts, C. "The Alpha Omega Pupil" CSOJ, Mar 1990, pg 7

Table One

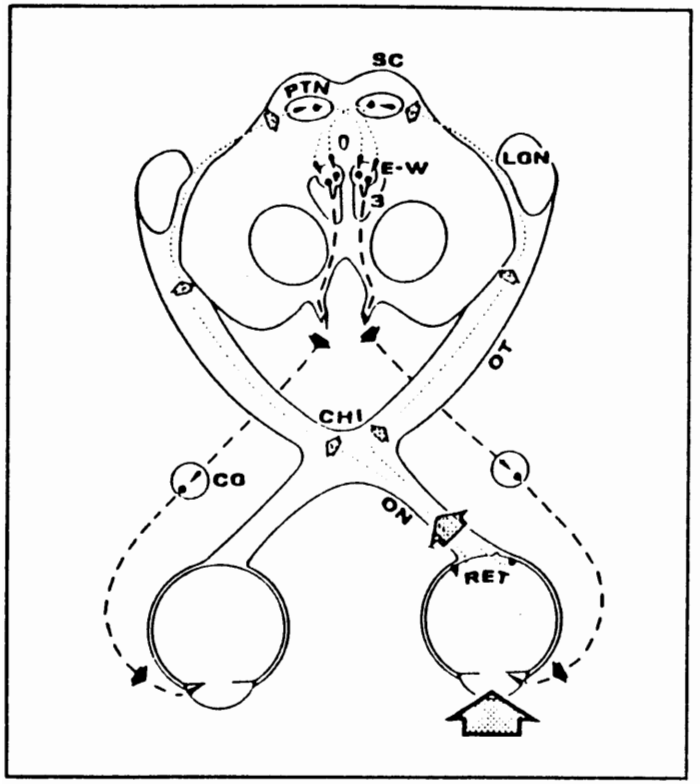
	General Characteristics	Responses to Light and Near Stimuli	Room Condition in which Anisocoria is Greater	Response to Mydriatics	Response to Miotics	Response to Pharmacologic Agents
Essential anisocoria	Round, regular	Both brisk	No change	Dilates	Constricts	Normal and rarely needed
Horner's syndrome	Small, round, unilateral	Both brisk	Darkness	Dilates	Constricts	Cocaine 4%, poor dilation Paredrine 1%, no dilation if third-order neuron damage
Tonic pupil syndrome (Holmes-Adie syndrome)	Usually larger* in bright light; sector pupil palsy, vermiform movement Unilateral or, less often, bilateral	Absent to light, tonic to near; tonic redilation	Light	Dilates	Constricts	Pilocarpine 0.1% or 0.125% constricts; Mecholyl 2.5% constricts
Argyll Robertson pupils	Small, irregular, bilateral	Poor to light, better to near	No change	Poor	Constricts	
Midbrain pupils	Mid-dilated; may be oval; bilateral	Poor to light, better to near (or fixed to both)	No change	Dilates	Constricts	
Pharmacologically dilated pupils	Very large†, round, unilateral	Fixed‡	Light		No‡	Pilocarpine 1% will not constrict
Oculomotor palsy (nonvascular)	Mid-dilated (6 mm–7 mm), unilateral (rarely bilateral)	Fixed	Light	Dilates	Constricts	

* Tonic pupil may appear smaller following prolonged near-effort or in dim illumination; affected pupil is initially large, but with passing time gradually becomes smaller.
† Atropinized pupils have diameters of 8mm to 9 mm. No tonic, midbrain, or oculomotor palsy pupil ever is this large.
‡ Pupils may be weakly reactive, depending on interim after instillation.

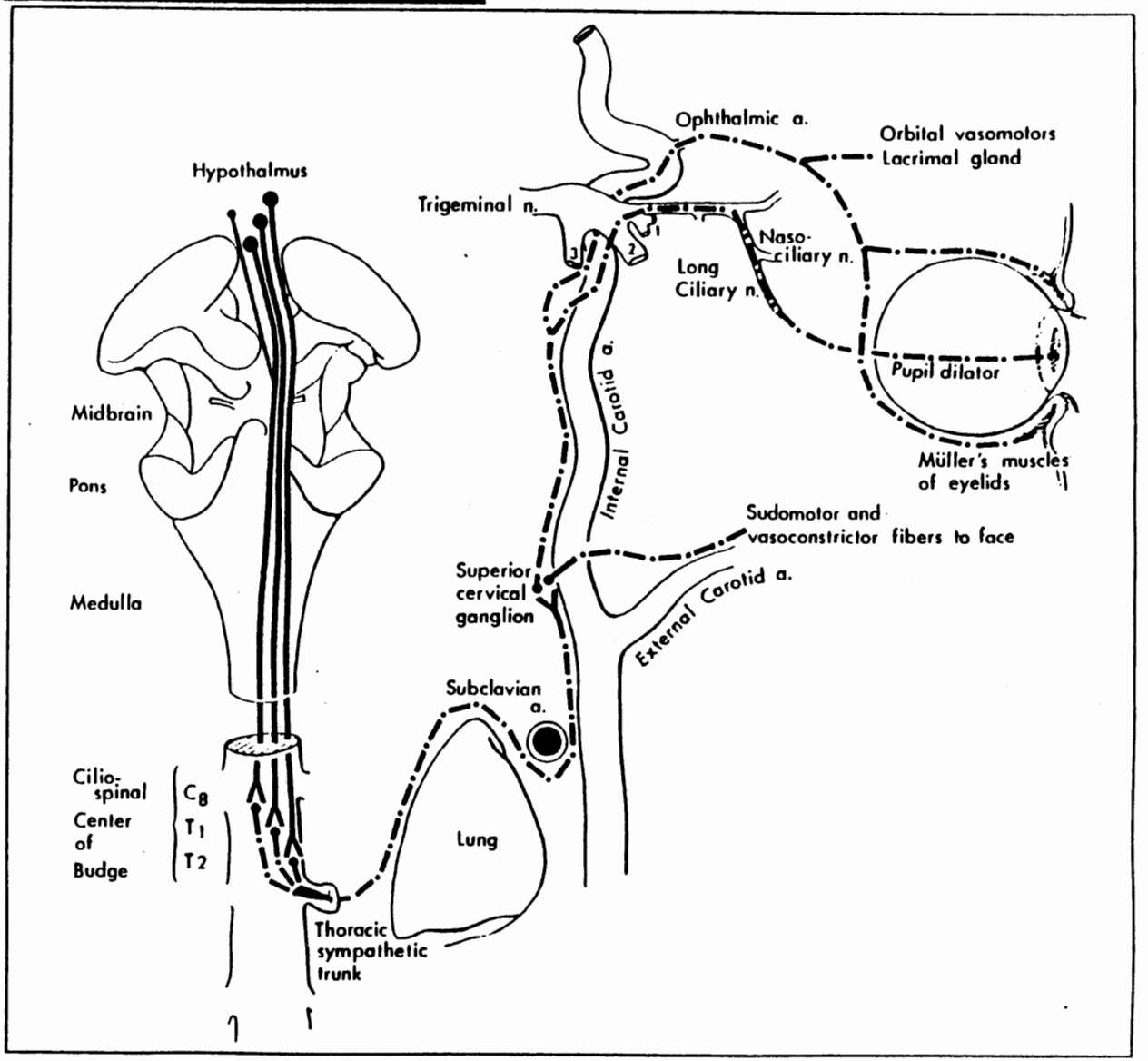
Characteristics of Pupils Encountered in Neuro-ophthalmology

Figure adapted from Duane's Ophthalmology

Pupillary Nerve Pathways



Pupillary Light Reflex. Light in left eye (dotted arrow) stimulates retina (RET), whose afferent axons (fine dashed lines) ascend optic nerve (ON), decussate at chiasm (CHI) and terminate in pretectal nuclear complex (PTN). Lateral geniculate nucleus (LGN) is bypassed by these pupillomotor fibers. The PTN is connected by crossed and uncrossed intercalated neurons to both Edinger-Westphal parasympathetic motor nuclei (E-W), which comprise the dorsal aspect of the oculomotor nuclear complex (3). Preganglionic parasympathetic fibers (heavy dashed lines) leave ventral aspect of the midbrain in the substance of the third cranial nerves. After synapsing in the ciliary ganglia (CG), the postganglionic fibers innervate the pupillary sphincter muscles. Note that the uniocular light stimulus evokes bilateral and symmetric pupillary constriction. Brain stem diagram represents section through level rostral to superior colliculi (SC).



Ocular Sympathetic Pathways. Hypothalamic sympathetic fibers comprise a polysynaptic (?) system as they descend to the ciliospinal center. This intra-axial tract is functionally considered the "first-order neuron." The second-order neuron takes a circuitous course through the posterosuperior aspect of the chest and ascends in the neck in relationship to the carotid system. Third-order neurons originate in the superior cervical ganglion and are distributed to the face with branches of the external carotid artery and to the orbit via the ophthalmic artery and ophthalmic division (1) of the trigeminal nerve.

Figures adapted from Duane's Ophthalmology