

## **Abstract**

### **Optic Disc May Be Sinking In Chronic Glaucoma**

**Objective:** The term 'glaucomatous cupping', given 150 years ago, implies gradual enlargement of the physiological cup in response to raised intraocular pressure. This presentation is designed to determine whether the physiological cup is truly enlarging or not.

**Methods:** This presentation will discuss three unresolved puzzling questions in glaucoma: (1) Why some ocular hypertension subjects (OHT) having high intraocular pressure (IOP) such as 30 mmHg never develop glaucoma whereas normal-tension glaucoma subjects (NTG) develop glaucoma even at a normal range IOP (10-21 mm Hg)?; (2) Why are the arcuate and peripheral nerve fibers destroyed in the early stages, whereas the macular fibers last until the end-stage of glaucoma?; and (3) Why can't glaucoma be halted despite maximally lowering of IOP? The answers to these questions will be discussed based on deductive reasoning, morphology, imaging devices and histology of the glaucomatous disc.

**Discussion:** Question 1. Medical history of hundreds of glaucoma patients revealed that pure high-tension glaucoma subjects (HTG) were usually in good health whereas normal-tension (NTG) subjects had cardio-pulmonary and circulatory problems. These findings suggest that HTG may be an ocular disease whereas NTG a systemic disease and thus glaucoma construed as a multifactorial disease in which the raised IOP is just one of the risk factor. The more risk factors present in a particular subject, the more the likelihood of developing glaucoma. Glaucoma being a multifactorial disease may be the answer to Q 1.

Question 2. Why are the peripheral and arcuate fibers destroyed first in glaucoma? It is not possible that raised IOP or in fact any pathology including a neurodegenerative disease could selectively and specifically destroy only the peripheral and arcuate fibers first either in retina or in the optic disc in the early stages of glaucoma. Thus, having ruled out the optic disc and retina as a primary site of injury, we are left with border tissue of Elschnig (BT) which lies between the scleral edge and the optic disc. Border tissue is exclusively supplied by low-pressure ciliary circulation which can be easily compromised either directly by high IOP or due to poor systemic circulatory problems. Poor perfusion of BT will result in chronic ischemia and its atrophy. Due to atrophy of the BT the optic disc becomes loose and starts sinking in the scleral canal. Sinking of the disc will result in stretching and severing of the nerve fibers at the scleral edge.

Returning to our question 2. Can sinking of the optic disc result in the loss of peripheral and arcuate fibers first, in glaucoma? Very likely: Since the peripheral

fibers lie deeper (closer to sclera) therefore they would be axotomized first if sinking of the disc occurs. As the optic disc sinks temporally, all the temporal fibers (macular and sup/inf arcuate) will be severed simultaneously. However, the arcuate fibers being fewer in number compared to macular fibers, would be depleted earlier giving rise to arcuate/ring field defects. This may answer question number 2.

Question 3. Why glaucoma can't be halted despite maximally lowering of IOP? In addition to BT, the 360 degrees of the retinal nerve fibers also provide anchorage to the disc as roots anchor a tree. Loss of anchorage of the disc due to the severance of the nerve fibers results in further loosening and sinking of the disc. The cascade of sinking of the disc and severing of the nerve fibers will become self-propagated and unstoppable until all the nerve fibers are axotomized at the scleral edge. This may be answer to Q 3.

**Conclusion:** The optic disc may be sinking in glaucoma resulting in stretching and severing of the prelaminar fibers at the scleral edge. The optic disc may not be truly enlarging but de-cupping due to the severance of the nerve fibers. The phenomenon of 'cupping' appears to have been mistakenly given 150 years ago. Axotomy of the nerve fibers results in excavation and wallerian degeneration causing death of the ganglion cells and also of the neurons in the lateral geniculate nucleus. Excavation, progressive thinning of RNFL and end-stage glaucomatous disc being an empty 'bean pot' suggest that nerve fibers are being severed, not atrophied in glaucoma. Glaucoma may not be an optic disc neuropathy, but optic disc axotomy- a paradigm shift.