# *Is the Optic Disc 'Sinking' or 'Cupping' in Glaucoma?*

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In 1851, the introduction of the ophthalmoscope by Von Helmholtz revolutionized ophthalmology. With the ophthalmoscope, Von Graefe and others at the time were the first to visualize the optic disc of blind patients in whom the eyeballs were firm but non-congested. They classified this condition as simple glaucoma and labeled the appearance of the optic disc as 'cupped'. Since then, the term 'cupping' became synonymous with chronic glaucoma. This article will present why the terms 'cupping' and cup/disc ratio of the optic disc may be incorrectly associated with glaucoma.

Isolated scotomas in the paracentral region, which later coalesce to form single or double arcuate scotomas, are the earliest sign of glaucoma due to the destruction of arcuate fibers also known as the nerve fiber bundle[1]. Although Landesberg (1869) became aware of the sectorial defects in glaucoma on the perimeter, credit goes to Jannik Bjerrum for discovering reproducible comet (arcuate) defects in glaucoma (1889), fllowed by his pupil Ronne. This arcuate defect ending at horizontal raphe became known as Ronne's nasal step (1909). The arcuate field defect resulting from destruction of arcuate fibers is perhaps the only lead we have in the pathogenesis of glaucoma and is also the foundation for the perimetry in the early detection of glaucoma.

**The question arises: Can the arcuate fibers be selectively destroyed if the optic disc is cupping?** Not likely. How is it possible that cupping, which implies that the pathology starts within the optic disc, could selectively destroy only the arcuate fibers among the million or so densely packed nerve fibers in the optic disc, and leave others unscathed in the early stages of glaucoma?

If we give credence to high intraocular pressure directly damaging the optic disc or lamina which is embedded in the scleral opening, selective destruction of the arcuate fibers cannot be explained. Furthermore, if the pathology started concentrically from the central part of the optic disc, there would be destruction of 360-degrees of the nerve fiber simultaneously resulting in immediate blindness, instead of arcuate field defects according to the arrangement of the nerve fibers in the optic disc[2]. In my opinion, there is no known biological mechanism which could *selectively* destroy only the arcuate fibers either at the level of the optic disc or at the retina. Similarly, the ganglion cells of the retina serving the arcuate fibers cannot be *selectively* destroyed by any biological mechanism.

Therefore, if the optic disc is not 'cupping', then what may be occurring? The optic disc is firmly anchored in the scleral canal by the circular border tissue and the retinal nerve fibers themselves – just as roots anchor a tree. If the ciliary circulation supplying the border tissue is compromised in high tension glaucoma or systemically reduced in normal tension glaucoma, then the border tissue will atrophy and weaken resulting in sinking of the optic disc. The sinking will begin temporally due to the anatomically tilted insertion of the optic nerve to the globe. Once the optic disc begins sinking, mechanical factors would come into play. As a result of the sinking of the optic disc, the temporal part of the optic disc containing the superior and inferior arcuate and the centrally located macula fibers will be stretched (one end is still attached to the retina and the other end to the sinking disc). In addition to stretching, the sinking of the disc would lead to compression, kinking and destruction of the nerve fibers at the rim of the scleral opening.

The arcuate fibers, which arch above and below the macula fibers being scant in number, will be depleted first, giving rise to the double arcuate field defect. The centrally located macula fibers, on the other hand, will last until the end due to their abundance.

Due to the destruction of the nerve fibers, the optic disc would become further loosened and sink due to the loss of anchorage from the nerve fibers. This cascade of sinking and loosening of the optic disc would continue until all the nerve fibers are cut at the scleral edge and the whole disc is perished[3]. At the end stage of glaucoma, the optic disc area is an empty crater due to the total loss of the optic disc. Why describe it as a 100% cupped disc when the optic disc is not present anymore?

In summary, the sinking (dropping) of the optic disc starting at the temporal edge would result in the destruction of the nerve fibers at the scleral rim. This may explain the early single or double arcuate field defects and sloping, kinking, of the blood vessels which are observed at the edge of the optic disc with the ophthalmoscope. The resolution whether the optic disc is 'cupping' or 'sinking' is of paramount importance in the research of glaucoma. The 'cupping' implies that the pathology starts from the center to the edge whereas the 'sinking' vice versa. If studies determine that the optic disc is in fact 'sinking', then it would lead us to more accurate etiology and treatment, especially in normal tension glaucoma. Most importantly, the grading of the optic disc in glaucoma progression will then be based on the sinking instead of the cupping[3].

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### *References*

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