

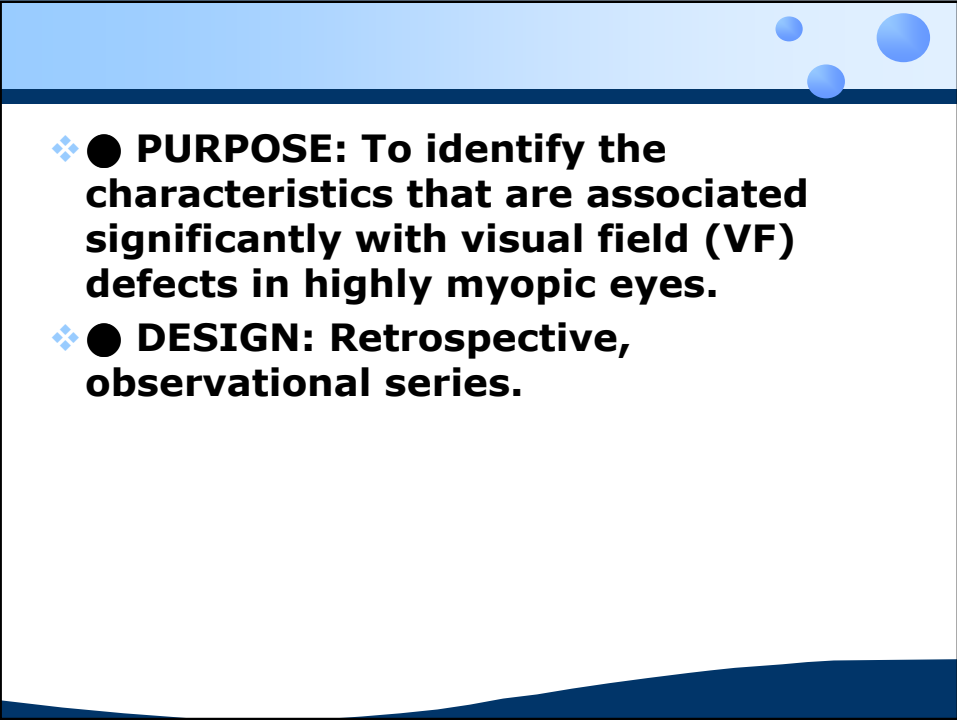


Long-term Development of Significant Visual Field
Defects in Highly Myopic Eyes

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- ❖ ● **PURPOSE:** To identify the characteristics that are associated significantly with visual field (VF) defects in highly myopic eyes.
 - ❖ ● **DESIGN:** Retrospective, observational series.

Intro

- ❖ **VF defects in high myopia can be divided into 2 types:**
 - 1. the result of the chorioretinal lesions
 - 2. no identifiable cause → **glaucoma** related?.
- ❖ **recent studies have suggested that primary open-angle glaucoma can develop in myopic eyes**
 - positive association between the degree of myopia and the prevalence of open-angle glaucoma for a specific age and gender group.
- ❖ **In the UK, the relative risk of glaucoma in eyes (n= 953) with myopia (spherical equivalent refractive error ≥ 5 diopters [D]) was **3.1****

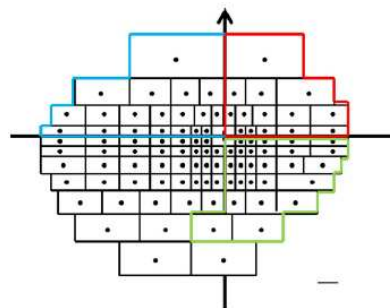
- ❖ **A PubMed search identified only 2 studies that examined the prevalence of glaucoma in highly myopic eyes.**
 - Curtin : the incidence of primary open-angle glaucoma was
 - **3%** in myopes with an axial length > 26.5 mm
 - **28%** in those with an axial length > 33.5 mm.
 - In the second study, Xu and associates examined 122 eyes with myopic refractive errors of more than 8 D in the Beijing Eye Study and showed that 10 eyes (**8.2%**) had **optic disc glaucoma**, and 7 eyes (**5.7%**) had **perimetric glaucoma**,
- ❖ **However, the appearance of disc is abnormal in highly myopic nonglaucomatous eyes.**
- ❖ **It then would be difficult to diagnose glaucoma based on the presence of visual field defects in highly myopic eyes.**

METHODS

❖ The exclusion criteria were:

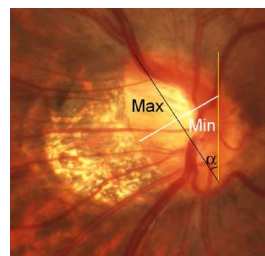
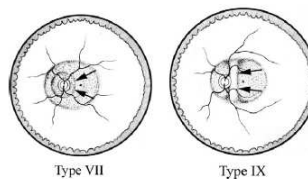
- peak intraocular pressure (IOP) of more than 21 mm Hg,
- use of antiglaucoma medication at the initial examination,
- history of optic neuritis or other neuro-ophthalmologic diseases,
- any type of myopic macular or peripheral lesions;
- choroidal neovascularization;
- peripheral chorioretinal lesions;
- history of vitreoretinal surgery, glaucoma laser surgery, or glaucoma incisional or filtration surgery;
- follow-up period of less than 5 years after the initial visit.

❖ The **Goldmann visual fields** were quantified using a grid system similar to that used by Kwon and associates. A **grid template** was adapted from the visual field scoring system originally described by Esterman. This grid consisted of 100 sectors that lay within the V4 isopter.



- ❖ **significant visual field defects : loss in more than 10 of the sectors or more than 10% of the dots in each field**
- ❖ **The IOP measurements : 2:00 pm to 5:00 pm in all pt**
- ❖ **The axial length of the eye was measured by A-scan ultrasonography**

- ❖ **Staphyloma->**
- ❖ **Oval: Mx/Mn ratio > 1.5,**
- ❖ **Round: Mx/Mn ratio < 1.5**
 - vertically oval: < 10
 - horizontally oval 70-90
 - obliquely 11-69 degrees.



RESULTS

- ❖ In the end, 492 eyes of 308 patients with high myopia met our inclusion criteria.
- ❖ There were 122 men (204 eyes) and 186 women (288 eyes).
- ❖ The mean age \pm SD was 40.6 ± 16.6 years (8 to 78 years).

- ❖ The mean refractive error \pm SD was -13.4 ± 4.1 D (-8.25 to -30.0 D), and the mean axial length \pm SD was 28.6 ± 1.7 mm (26.6 to 33.0 mm).
- ❖ The mean IOP \pm SD at entry was 14.7 ± 2.4 mm Hg (8 to 21 mm Hg).
- ❖ Among the 492 eyes, in 65 eyes (13.2%) of 44 patients, significant visual field defects developed: loss of sensitivity in 10% or more of the sectors in 1 or more quadrants, during a mean follow-up \pm SD of 11.6 ± 5.5 years (6 to 30 years).

- ❖ All received antiglaucoma medication after VF defect
- ❖ The average number of medications \pm SD during the follow-up was 1.2 ± 0.4 (1 to 3).

TABLE 1. Relationship between Optic Disc Shape and Visual Field Defects in Highly Myopic Eyes

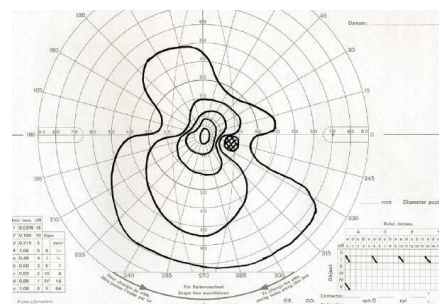
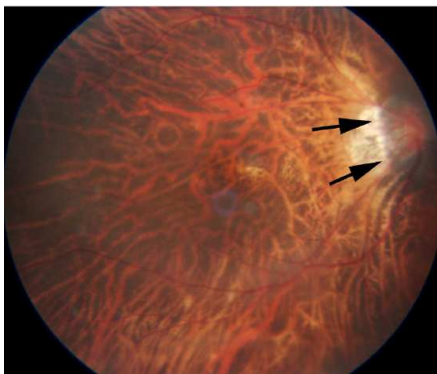
| Optic Disc Shape | Significant Visual Field Defects | |
|--------------------|----------------------------------|-------------------|
| | Absent (427 Eyes) | Present (65 Eyes) |
| Round | 296 eyes (69.3%) | 26 eyes (40.0%) |
| Oval | 131 eyes (30.7%) | 39 eyes (60.0%) |
| Horizontal (oval) | 8 eyes (1.9%) | 0 eyes (0%) |
| Vertical (oval) | 64 eyes (15.0%) | 20 eyes (30.8%) |
| Cyclotorted (oval) | 59 eyes (13.8%) | 19 eyes (29.2%) |

TABLE 2. Prevalence and Area of Visual Field Defect According to the Optic Disc Shape in Highly Myopic Eyes

| | Optic Disc Shape | | |
|--|------------------|-------------------------|------------------------|
| | Round (322 Eyes) | Vertical Oval (84 Eyes) | Oblique Oval (78 Eyes) |
| Prevalence of significant visual field defects | 26 eyes (8.8%) | 20 eyes (23.8%) | 19 eyes (24.4%) |
| Area of significant visual field defects | | | |
| Nasal only | 10 eyes (38.5%) | 5 eyes (25.0%) | 6 eyes (31.6%) |
| Temporal only | 2 eyes (7.7%) | 2 eyes (10.0%) | 3 eyes (15.8%) |
| Both nasal and temporal | 14 eyes (53.8%) | 13 eyes (65.0%) | 10 eyes (52.6%) |

example

Vertical ridge



Gourd-shape VF defect

51yrd M, -14.5D, 30.6mm, IX staphyloma,
Vertically oval

TABLE 3. Correlation of Various Factors with Significant Visual Field Defects in Highly Myopic Eyes with Oval Disc Shape

| Factors at the Development of Visual Field Defects | Without Visual Field Defect (123 Eyes) | With Visual Field Defect (39 Eyes) | P Value |
|---|---|---------------------------------------|---------------------|
| Age (years) | 43.7 ± 15.3 | 52.7 ± 14.9 | .006 ^a |
| Refractive error (D) | -14.9 ± 4.8 | -14.5 ± 4.5 | NS |
| Axial length (mm) | 29.1 ± 1.9 | 29.1 ± 1.5 | NS |
| Intraocular pressure (mm Hg) | 14.4 ± 2.5 | 15.7 ± 2.4 | .006 ^a |
| Ratio of maximum to minimum diameter of the optic disc | 1.6 ± 0.4 (1.2 to 3.0) | 2.0 ± 0.5 (1.5 to 4.0) | < .001 ^a |
| Sudden change of scleral curvature temporal to optic disc | 19/123 | 14/39 | .01 ^b |

D = diopters, NS = not significant.
 Data are presented as mean ± standard deviation (range) or number/total.
^aMann-Whitney U test.
^bChi-square test.

TABLE 4. Multiple Regression Analysis of Factors That Correlate with Significant Visual Field Defects in Highly Myopic Eyes with Oval Disc Shape

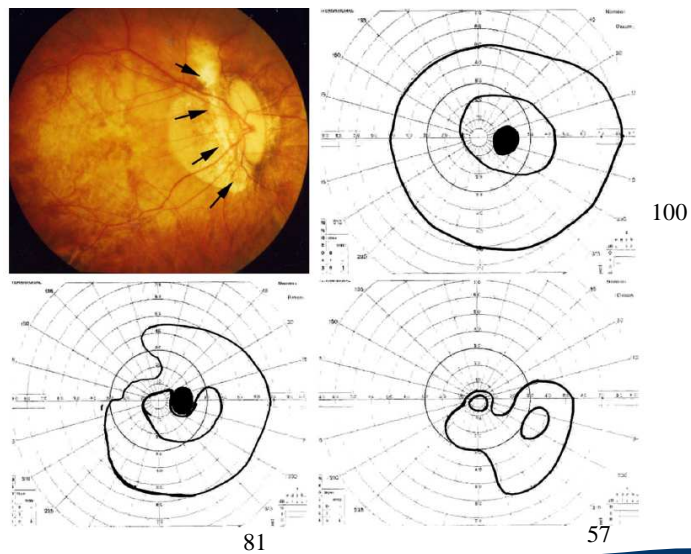
| Variable | Regression Coefficient | P Value |
|---|------------------------|---------|
| Age (years) | 0.18 | .02 |
| Refractive error (D) | 0.06 | .86 |
| Axial length (mm) | -0.55 | .54 |
| Intraocular pressure (mm Hg) | 1.46 | .005 |
| Ratio of maximum to minimum diameter of the optic disc | 5.74 | .027 |
| Sudden change of scleral curvature temporal to optic disc | 9.54 | .0028 |

D = diopter.

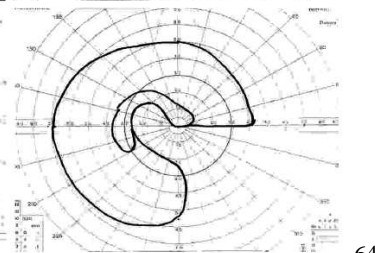
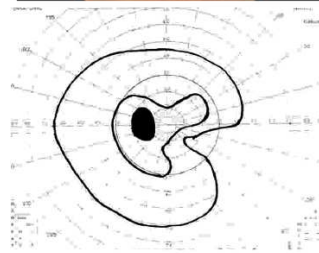
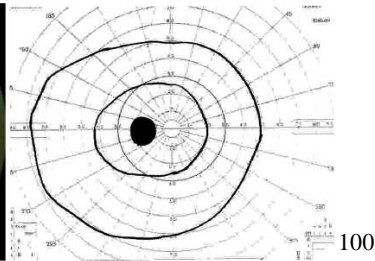
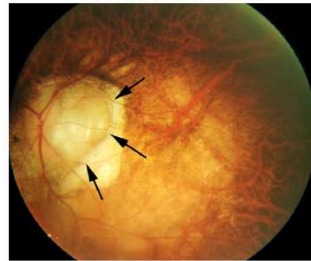
TABLE 5. Multiple Regression Analysis of Factors That Correlate with the Progression of Visual Field Defect in Highly Myopic Eyes

| Variables | Regression Coefficient | P Value |
|---|------------------------|---------|
| Age at the initial examination | 0.32 | NS |
| Age at the last examination | -0.33 | NS |
| Axial length (mm) | 0.31 | NS |
| IOP at the initial examination (mm Hg) | -0.06 | NS |
| Mean IOP during follow-up (mm Hg) | 0.28 | NS |
| Ratio of maximum to minimum diameter of the optic disc | 0.27 | NS |
| Sudden change of scleral curvature temporal to optic disc | 0.59 | .0025 |

Pt 1 -28D, 31.6mm,Mx/Mn2.75,IX



Pt 2 -17.5D, 32.1mm,Mx/Mn2.20,VII



DISCUSSION

- ❖ **SIGNIFICANT VF defects developed in 13.2% of highly myopic eyes.**
- ❖ **visual field defects were found in the temporal quadrant**
 - in 61.5% of the eyes with round optic discs,
 - in 75.0% of the eyes with vertically oval discs,
 - in 68.2% of the eyes with obliquely oval discsThese differences were **not significant**.

- ❖ **During a mean follow-up period of 10.2 years after the development of a significant visual field defect, 73.8% of the eyes showed a progression of the visual field defects with a mean progression of 1.5% sectors per year.**
- ❖ **Multiple regression analyses :**
 - **an abrupt change in the scleral curvature** was the only factor that was associated significantly with the progression of the VF defects.

Discussion


- ❖ **These findings indicate that visual field defects develop and progress in highly myopic eyes.**
- ❖ **However, the sites of the visual field defects did **not** correspond to those found in glaucomatous eyes.**
- ❖ **Possible mechanism that caused the visual field defects?**
 - normal-tension glaucoma or high-tension glaucoma (less likely)
 - tilted disc syndrome (progressive, round or tilted disc)
 - by **a mechanical tension and distortion** of the optic nerve fibers caused by an elongation of the axial length of the eye, by a progression of the posterior staphyloma, or both

❖ **Why does the bending in the nerve fibers lead to their damage and consequently the visual field defects?**

- the elongation of the axial length and a progression of the staphyloma **stretches the nerve fibers**, while the abrupt change in the curvature distorts the nerve fibers.
- an abrupt change of scleral curvature temporal to the optic disc could increase the mechanical **tension on the optic disc**, leading to a deformation of the optic disc.

❖ **Our findings suggest that a combination of stretching and bending may be the cause of the damage to the nerve fibers leading to the VF defects.**

❖ **In addition, the thinning of the lamina cribrosa may play some role in the development of visual field defects in highly myopic eyes.**

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- ❖ Thus, we propose that this condition is better termed **myopic optic neuropathy**, although glaucoma or tilted-disc syndrome in highly myopic eyes may overlap.
 - ❖ Because of the high incidence of visual field defects and the progression of the visual field defects, we suggest that **high myopia** be considered a high-risk group of visual field defects and should be monitored at least **yearly**.



Thank you



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