Scanning laser polarimetry in normal subjects and patients with myopia

Sengül C Özdek, Meriğ Önol, Gökhan Gürelik, Berati Hasanreisoglu

Abstract

Aims—To examine the changes in the retinal nerve fibre layer (NFL) thickness with age and myopia in normal subjects and in patients with myopia.

Methods—Retinal nerve fibre layer thickness was measured with a scanning laser polarimeter (NFA-I) in 180 normal subjects of varying age (range 7–83 years) and in 110 eyes of 85 patients with myopia of varying degrees (range −1.00 to −15.00D).

Results—The mean superior NFL ratio was 2.96 and the mean inferior NFL ratio was 2.93 in normal subjects. There was a gradual decrease in NFL ratio with increasing age (simple regression analysis, p<0.05). The mean S/I ratio was 1.01 with a large variation. In patients with myopia, the mean superior NFL ratio was 2.60 and the mean inferior NFL ratio was 2.72. Superior and inferior NFL retardations, and S/I ratio in myopic patients were significantly (15.5%, 10.8%, and 4.9% respectively) lower than that of age matched normals (t test, p<0.05). There was also a gradual decrease in NFL thickness with increasing degree of myopia (simple regression analysis, p<0.05).

Conclusions—Nomograms we obtained for retinal NFL thickness may serve as reference points for the assessment of normal Anatolian people and myopic patients in future studies. NFL thicknesses gradually decreased with increasing age. Patients with myopia had significantly lower NFL thicknesses than normal subjects and, although weakened by wide age range of myopic group, there is a linear relation between severity of myopia and NFL thickness in myopic patients.

Scanning laser polarimeter (Nerve Fibre Analyser I (NFA-I); Laser Diagnostic Technologies Ltd, San Diego, CA, USA) is one of the first clinical devices for quantitative assessment of the retinal nerve fibre layer (NFL) thickness in the living human eye. It measures the amount of retardation that is caused by the specific arrangement of the microtubules of the retinal ganglion cells. When a polarised light beam passes through the microtubules in the retinal NFL, the light is shifted from phase. The amount of phase shift is called retardation and is correlated linearly with the thickness of the retinal NFL.1,2 Each degree of retardation was found to correspond with an NFL thickness of approximately 7.4 µm in two enucleated monkey eyes.

Weinreb and associates found significant differences in retardation between normal and glaucomatous eyes in the superior and inferior arcuate regions in their first studies with this instrument.3 Previous studies on the reproducibility of measurements with the scanning laser polarimeter suggest that it provides reproducible measurements especially if performed by the same operator.4,5 The specificity and sensitivity for detection of glaucoma have been reported to be 93% and 96% respectively with the NFA-I.6 A new study by Choplin et al, using the newest version of the instrument, the NFA-GDx, suggested that there was a clear delineation between normal subjects and glaucoma patients with no overlap between the 95% confidence intervals using some variables like the superior maxima.7 The NFA was suggested to be used for glaucoma screening studies.7,8

Nomograms for retinal NFL thickness of different ages, ethnic groups, and different refractive stages are needed to define the normals. Many studies have been done on variation of NFL thickness measurements with age and ethnicity by scanning laser polarimetry,9–12 but the effect of refractive changes on NFL thickness measurements with the scanning laser polarimeter is still not clear. It is widely known that primary open angle glaucoma, pigmentary glaucoma, and low tension glaucoma are more prevalent in highly myopic patients than in others.13,14 The occurrence of a defect in retinal NFL in severe myopia (8%) was also shown to be greater than that in either emmetropia or hyperopia (1%).15 NFL retardation in myopes may therefore be different from that in emmetropes.

In the present study, we aimed to obtain nomograms for the retinal NFL thickness of different ages in healthy Anatolian people and of patients with different degrees of myopia by using scanning laser polarimetry.

Patients and methods

Polarimetric measurements were obtained in randomly selected eyes in each of 180 healthy volunteers and in 110 eyes of 85 myopic patients during a 7 month period. Only one eye of the myopic subjects was included in the study when the refractive errors were same in both eyes. The subjects in the study groups comprised hospital personnel, students in the medical faculty, and volunteers who applied for
Scanning laser polarimetry in normal subjects and patients with myopia

The recorded NFL thickness in each randomly chosen eye of the 180 normal subjects is presented as a function of age in Figure 1. On average, the superior NFL ratio was 2.96, with a 95% confidence interval (CI) of between 2.87 and 3.06 (range 1.54–4.63). Similarly, the mean inferior NFL ratio was 2.93, with a 95% CI of between 2.86 and 3.01 (range 1.60–4.08).

To assess any asymmetries between the superior and inferior NFL, we determined the S/I NFL ratio for each eye. The S/I NFL ratio averaged 1.01 with a slightly wider range of 0.80 to 1.60. To test the effect of age and myopia on NFL ratios, and the Student’s t test was used for the comparison of NFL ratios of age matched normal subjects with those of myopic patients.

Results

The recorded NFL thickness in each randomly chosen eye of the 180 normal subjects is presented as a function of age in Figure 1. On average, the superior NFL ratio was 2.96, with a 95% confidence interval (CI) of between 2.87 and 3.06 (range 1.54–4.63). Similarly, the mean inferior NFL ratio was 2.93, with a 95% CI of between 2.86 and 3.01 (range 1.60–4.08).

To assess any asymmetries between the superior and inferior NFL, we determined the S/I NFL ratio for each eye. The S/I NFL ratio averaged 1.01 with a slightly wider range of 0.80 to 1.60. To test the effect of age and myopia on NFL ratios, and the Student’s t test was used for the comparison of NFL ratios of age matched normal subjects with those of myopic patients.

Results

The recorded NFL thickness in each randomly chosen eye of the 180 normal subjects is presented as a function of age in Figure 1. On average, the superior NFL ratio was 2.96, with a 95% confidence interval (CI) of between 2.87 and 3.06 (range 1.54–4.63). Similarly, the mean inferior NFL ratio was 2.93, with a 95% CI of between 2.86 and 3.01 (range 1.60–4.08).
The equation for the regression line of the inferior NFL was inferior NFL = 3.142 − 0.092 × refraction (D) (R² = 0.306) (p<0.0001). This finding is supported by some other studies.14 15 17–19

Chihara et al described severe myopia as a risk factor for progressive visual field loss in primary open angle glaucoma.20 They also reported higher prevalence of focal NFL defects in high myopes with oblique insertion of the optic disc.21 Glaucoma patients, on the other hand, have a longer axial length than people without glaucoma, and visual field defects are more pronounced in glaucoma patients with long axial lengths than in those with short axial lengths. Some have even hypothesised that it is the intraocular pressure, combined with biomechanically weak sclera, that causes elongation in the progressive myopia.20 The present study also supports a relation between glaucoma and high myopia.

This study has shown a significant linear relation between the degree of myopia and the NFL thickness. This linear relation, however, is weakened by the large age range of myopic group in the study. We could more reliably check the effect of the degree of myopia on NFL thickness if we could study on different degrees of myopic patients of the same age group.

Myopic eyes have some special features which may contribute to their difference in nerve fibre layer thickness. The axial length is greater in myopic eyes, and the optic discs are frequently abnormal in shape; they are mostly much larger than normal,21 horizontally oval, have cyclotorsion, or are obliquely inserted.22 A large disc size, tilted disc, or thin and abnormal collagen fibres may be predisposing factors for abnormal nerve fibre layer defects. All these factors also add to the difficulties in measurements with NFA, in locating the band concentrically with a disc margin with indistinct borders.

Myopic patients had a mean S/I ratio of 1.01 indicates a good symmetry between superior and inferior poles, there was a large range (0.66 to 1.91) and variability (95% CI, 0.98 to 1.03).
may suggest that NFL thinning in myopia is more evident in the superior half and inferior part is better preserved, which is contrary to previous reports in which inferior temporal thinning of the neuroretinal rim was reported to occur first as an early finding in primary open angle glaucoma. This controversy may be explained by the birefringence of the visible sclera caused by the inferior parapapillary chorioretinal atrophy, which causes increased retardation measurement mimicking thick retinal NFL. This topic needs further study.

In conclusion, NFL thickness in healthy Anatolian people gradually decreased with increasing age. Patients with myopia had a significantly lower NFL thickness than normal subjects and NFL thickness in myopic patients decreased with increasing degree of myopia. This linear relation between severity of myopia and RNFL thickness, however, is weakened by the wide age range of myopic subjects in the study. The nomograms we obtained for retinal NFL thickness may serve as reference points for the assessment of normal subjects and myopic patients in future studies.

Scanning laser polarimetry in normal subjects and patients with myopia

Sengül C Özdek, Merih Önl, Gökhan Gürelık and Berati Hasanreisoglu

*Br J Ophthalmol* 2000 84: 264-267
doi: 10.1136/bjo.84.3.264

Updated information and services can be found at:
http://bjo.bmj.com/content/84/3/264

These include:

**References**
This article cites 21 articles, 1 of which you can access for free at:
http://bjo.bmj.com/content/84/3/264#BIBL

**Email alerting service**
Receive free email alerts when new articles cite this article. Sign up in the box at the top right corner of the online article.

**Topic Collections**
Articles on similar topics can be found in the following collections

- Optic nerve (713)
- Optics and refraction (508)

**Notes**

To request permissions go to:
http://group.bmj.com/group/rights-licensing/permissions

To order reprints go to:
http://journals.bmj.com/cgi/reprintform

To subscribe to BMJ go to:
http://group.bmj.com/subscribe/