Peripapillary Retinal Nerve Fiber Layer Thickness Change After Panretinal Photocoagulation in Patients With Diabetic Retinopathy

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Purpose: To examine the effect of panretinal photocoagulation (PRP) on the retinal nerve fiber layer (RNFL) thickness in patients with diabetic retinopathy.

Methods: Subjects included 118 eyes for a treatment group and 164 eyes for a control group. The peripapillary RNFL thickness was measured before and 6 months after PRP in treatment group. In control group, the peripapillary RNFL thickness was measured at baseline and 6 months later. The relationships between changes in RNFL thickness and the number of laser burns, duration of diabetes, HbA1c level, and vision change were analyzed.

Results: After 6 months, the RNFL thickness decreased an average of 2.12 µm and 0.93 µm in the treatment and control groups. However, the changes between the two groups were not statistically significant. The relationship between the number of laser burns and changes in RNFL thickness was not significant. No differences were found between changes in the RNFL thickness and the duration of diabetes in either group. However, in the treatment group a higher HbA1c level was correlated with a greater decrease in post-PRP RNFL thickness. This relationship was not observed in the control group. The difference in the change of the RNFL thickness between the two groups was statistically significant. Vision increased an average of 0.02 and 0.01 after 6 months in the treatment and control groups, respectively. However, this difference was not statistically significant.

Conclusions: Although a decrease in peripapillary RNFL thickness was observed in the treatment group after 6 months, it was not statistically significant compared to control group. However, the decrease was greater when the blood HbA1c level was higher.

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Key Words: Diabetic retinopathy, Glycosylated hemoglobin, Panretinal photocoagulation, Optical coherence tomography, Peripapillary retinal nerve fiber layer

Panretinal photocoagulation (PRP) reduces the risk of severe visual loss by 50% in patients with diabetic retinopathy. Most physicians agree that the intensity of a laser is enough to stimulate the outer retinal layer. If the laser intensity is too strong and destroys the entire retinal layer, it will cause a sequential decrease in the peripapillary retinal nerve fiber layer (RNFL) thickness. Also, it is reasonable to hypothesize that the peripapillary RNFL thickness should decrease in proportion to the frequency of the laser burns. Most physicians perform PRP as a first line strategy in the treatment of diabetic retinopathy; however, no reports have investigated peripapillary RNFL thickness change following PRP.

The goal of this study is to evaluate the peripapillary RNFL thickness after PRP in patients with diabetic retinopathy. We also examined possible relationships between changes in peripapillary RNFL thickness and 1) HbA1c level, 2) diabetes duration, and 3) interval visual acuity.

Materials and Methods

The medical records of patients with diabetic retinopathy were reviewed retrospectively. The subjects were divided into a treatment group and a control group. The treatment group included patients who had received PRP. All patients in the treatment group had at least severe non-proliferative diabetic retinopathy and received PRP treatment. All patients received a moderate degree of laser burns from an argon laser photocoagulator (Coherent Ultima 2000, CA, USA). A laser...
Table 1. Baseline data of the treatment group and the control group

|                      | Treatment group | Control group | p     |
|----------------------|-----------------|---------------|-------|
| Number of eyes       | 118             | 164           |       |
| Age (mean, years)    | 59.2±10.1       | 56.1±9.8      | 0.853 |
| Duration of diabetes (mean, years) | 12.6±6.2       | 6.8±4.2       | <0.001* |
| BCVA                 | 0.34±0.12       | 0.86±0.14     | <0.001* |

BCVA=best corrected visual acuity.

*p<0.05, t-test was performed between the treatment group and the control group

Table 2. Interval changes of peripapillary RNFL thickness in the treatment and control groups

|                      | Number of eyes | Number of laser burns | RNFL thickness at baseline (µm) | RNFL thickness at 6 months (µm) | RNFL thickness difference* (µm) | p     | p‡  |
|----------------------|----------------|-----------------------|---------------------------------|---------------------------------|---------------------------------|-------|-----|
| Treatment group      | 118            | 1576.5±415.7          | 348.5±48.1                      | 346.4±53.4                      | 2.12±7.34                       | <0.001† | 0.31|
| Control group        | 164            | no                    | 364.2±54.2                      | 363.3±58.1                      | 0.93±4.24                       | 0.127 |     |

RNFL= retinal nerve fiber layer; PRP=panretinal photocoagulation.

*RNFL thickness at 6 months – RNFL thickness at baseline
†p<0.05, t-test was performed between baseline and 6 months
‡p value, ANOVA was performed between the treatment group and the control group

Table 3. Interval changes of visual acuity in the treatment group and the control group

|                      | Number of eyes | Number of laser burns | BCVA at baseline, mean | BCVA at 6 months, mean | Interval difference of BCVA* | p     | p‡  |
|----------------------|----------------|-----------------------|------------------------|------------------------|-----------------------------|-------|-----|
| Treatment group      | 118            | 1576.5±415.7          | 0.34±0.12              | 0.36±0.25              | 0.02±0.10                   | <0.001† | 0.357|
| Control group        | 164            | no                    | 0.86±0.14              | 0.85±0.23              | 0.01±0.12                   | 0.248 |     |

PRP=panretinal photocoagulation; BCVA=best corrected visual acuity.

* BCVA at 6 months – BCVA at baseline
†p<0.05, t-test was performed between baseline and 6 months
‡p value, ANOVA was performed between the treatment group and the control group

Results

Table 1 shows the demographic data of the 118 eyes from the 59 PRP-treated subjects and the 164 eyes of the 82 control subjects. There were no differences in age or gender between the two groups. However, in the treatment group the duration of diabetes was longer and the best corrected visual acuity was lower than in the control group. These differences were statistically significant (p<0.001).

In the treatment group the post-PRP peripapillary RNFL thickness decreased an average of 2.12 µm (348.5±48.1 µm at baseline to 346.4±53.4 µm 6 months later, p<0.001), while an average decrease of 0.93 µm (364.2±54.2 µm at baseline to 363.3±58.1 µm 6 months later p=0.127) was observed in the control group (Table 2). However, the changes were not statistically different between the two groups (p=0.31, Table 2). In addition, there was no significant relationship between the number of laser burns and changes in the peripapillary RNFL thickness in the treatment group (p=0.511, ANOVA).

In the treatment group the post-PRP visual acuity increased an average of 0.02 (0.34±0.12 at baseline to 0.36±0.25 6 months later, p<0.001, Table 3). Despite a significant increase in visual acuity, there was no significant relationship between the number of laser burns and changes in visual acuity (p=0.873, ANOVA). In the control group, visual acuity at 6 months had
patients with DR. Laser photocoagulation does not alter retinal function in the treatment group. This indicates that an adequate intensity of retinal nerve fiber layer thickness change in the treatment of follow-up.

However, the results are limited to 6 months because of sample differences. Many researchers, such as Lopes et al. and Takahashi et al., have suggested a relationship between diabetes and retinal nerve fiber loss. Ozdek et al. also suggested a strong relationship between diabetic retinopathy and retinal nerve fiber loss.

Chihara suggested that risk factors for RNFL defects in eyes with diabetes mellitus included a higher level of DR, systemic hypertension, and advanced age. However, visual acuity, disc size, axial length, and HBA1c level at the time of examination did not correlate with RNFL defects. In our study, the decrease in peripapillary RNFL thickness was more prominent when the blood HbA1c level was higher. In patients with diabetes, a high blood HbA1c suggests poor blood sugar control. When the blood sugar level is high there is an increased vulnerability to tissue viability, this in turn makes the retinal nerve fiber layer vulnerable to external insults, such as a laser.

In the treatment group, there was no relationship between changes in peripapillary RNFL thickness and changes in vision. The laser does not directly treat the fovea; therefore it is logical that the visual acuity was not affected.

PRP, which is used to treat diabetic retinopathy, lead to a decrease in peripapillary RNFL thickness in the treatment group. However, this decrease was not statistically significant when compared to the control group. The decrease was greater when the blood HbA1c level was higher. Based on this result, we suggest that the appropriate timing of PRP treatment may be determined after properly reducing the blood HbA1c level if other conditions are tolerable.

One limitation of this study is that we only focused on 6 months of follow-up. Future studies should examine long-term results to determine if a similar pattern exists with longer follow-up.

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