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Long-Term Visual Outcome in Proliferative Diabetic Retinopathy Patients After Panretinal Photocoagulation

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Background: There is the need for a long-term study on the visual outcome of panretinal photocoagulation (PRP) for proliferative diabetic retinopathy (PDR) patients.

Cases: We retrospectively reviewed the clinical course and visual results in 66 eyes of 59 patients with PDR who were followed-up for at least 10 years after argon or krypton laser PRP.

Observations: Thirty-nine eyes had stage B-II, whereas 8 eyes had stage B-III retinopathy. Stage B-IV and B-V retinopathy were seen in 15 and 4 eyes, respectively. Although active stages of diabetic retinopathy were encountered after 5 years, complete regression could be successfully attained after 10 years. Long-term visual prospects were promising for eyes with stage B-II DR; 28.2% still enjoyed 20/40 or better visual acuity by 5 years. Most cases had maintained the same visual acuity at 10 years. Eyes with stage B-III DR did not attain 20/40 vision by 10 years. Panretinal photocoagulation in cases with neovascularization of the optic nerve head was seen to be beneficial but limited, suggesting that such cases might benefit from maximal initial and supplemental PRP followed by vitrectomy and intraoperative endophotocoagulation when necessary. Although 20% of the eyes with stage B-IV and 25% of the eyes with stage B-V DR had 20/40 or better visual acuity, analyses of the visual change revealed that about half the eyes with stage B-IV and all eyes with stage B-V DR experienced a visual loss of two lines or more.

Conclusions: Progression of lens opacities, chronic macular edema, vitreous hemorrhage, macular traction, and neovascular glaucoma were the main causes of visual loss in this series. Panretinal photocoagulation for PDR provides good anatomical and visual outcome for 10 years or longer. **Jpn J Ophthalmol 1999;43:217–224**

Key Words: Panretinal photocoagulation, proliferative diabetic retinopathy, visual prognosis, vitrectomy, vitreous hemorrhage.

Introduction

Photocoagulation is a well-established treatment for proliferative diabetic retinopathy (PDR) that has been shown to induce regression of neovascularization and arrest of progression of diabetic retinopathy.[1] Randomized multicenter collaborative clinical trials have shown that not only is laser treatment preferable to no treatment, but a timely applied treatment is more effective as far as visual prognosis is concerned.[2,3] However, photocoagulation may not eliminate the possibility of visual loss in "high-risk" eyes, as described by the Diabetic Retinopathy Study.[2,4] Although many clinical trials have provided very valuable information about the visual prospects of PDR following panretinal photocoagulation (PRP), there have been only a few studies providing clinical and visual data for a period longer than 10 years.[5–7] Moreover, there is no study showing the relationship

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between the long-term visual outcome of PDR following PRP and the stage of retinopathy. Therefore, we retrospectively reviewed the clinical course and visual results of patients with PDR who were followed-up for at least 10 years.

Materials and Methods

The records of 59 patients (66 eyes) treated with argon or krypton laser PRP for PDR at the Diabetes Outpatient Clinic of Kobe University Hospital, Department of Ophthalmology, were surveyed in this study. The presence of diabetes in all patients had been confirmed by the corresponding Internal Medicine Department; data on HbA_{1c} and fasting blood-glucose levels were also available. Patients with a fasting blood-glucose level of less than 140 mg/dL and a HbA_{1c} of less than 8% were accepted as having good control of their diabetes. Only those patients having a prelaser ocular examination, fundus photography, and fluorescein angiography performed within a week prior to treatment and the same procedures performed at least 3 months after treatment were included. Patients had stage B-II–B-V PDR, as defined by the Fukuda Classification of Diabetic Retinopathy.[8]

All patients were treated with argon green or krypton red laser photocoagulation using 500-μm spots, lasting 0.5 seconds and of sufficient energy to produce a low–moderate intensity lesion. Treatment was given in three divided sessions, in most cases by the same laser surgeon. The sessions were seperated by an interval of 1–3 weeks. The number of photocoagulation spots did not exceed 1000 shots in any patient.

Thirteen eyes in this study also received extracapsular cataract surgery. Patients who underwent vitreous surgery during follow-up were excluded from the study.

All patients had over 10 years of follow-up after the initial treatment. Landolt visual acuities were recorded at each visit. The causes of visual loss were determined on the basis of ophthalmoscopic findings, fundus photography, and fluorescein angiography.

Kruskall-Wallis and Mann-Whitney *U* tests were performed for the analysis of nonparametric data. A probability level of 5% was set for statistical significance.

Results

Diabetic Status

There were 20 female and 39 male patients whose ages ranged from 28–74 years (mean = 56 years). Three patients had insulin-dependent and 56 cases had non–insulin-dependent diabetes mellitus. The duration of diabetes varied from 14–40 years (mean = 12.4 ± 7.6 years) and the patients were followed up between 10 and 13 years (mean = 11.6 ± 1.4 years). Diabetes was under good control in 17 patients before the use of photocoagulation therapy.

Course of Diabetic Retinopathy

Thirty-nine eyes had stage B-II, whereas 8 eyes had stage B-III retinopathy. Stages B-IV and B-V retinopathy were encountered in 15 and 4 eyes, respectively. There were no significant age or sex differences or any difference in relation to the control of diabetes between patients in each stage of retinopathy. Although eyes with stage B-II or B-III retinopathy displayed active diabetic retinopathy (DR) at the 5-year follow-up, all eyes had stabilized to stage A-III–A-V retinopathy at the 10-year visit (Figures 1A and 2A). Eyes with stages B-IV and V DR also showed active DR at the 5th year. There was complete regression into stage A-III–A-V DR by 10 years (Figures 3A and 4A).

Visual Outcome

At 5 years, 28.2% of the eyes with stage B-II DR had 20/40 vision or better, whereas 7.7% had a visual acuity of 20/200 or worse. The final visual acuity was above 20/40 in 23.1% of the eyes with stage B-II DR. Of these eyes, 12.8% had a visual acuity worse than 20/200 at 10 years (Figure 1B). At 5 years, 12.5% of stage B-III eyes had 20/40 or better visual acuity, whereas the visual acuity in 50% of these eyes was 20/200 or worse. There were no eyes with a visual acuity of 20/40 or better in the stage B-III DR group, where the visual acuity was worse than 20/200 in 27.5% of these eyes at the 10-year follow-up (Figure 2B). Of the stage B-IV DR eyes, 26.7% achieved 20/40 or better vision and 40% had 20/200 or worse acuity by 5 years. A visual acuity of 20/40 or better was observed in 20%, and 33% had a visual acuity worse than 20/200 at 10 years (Figure 3B). At the 5-year follow-up, 25% of the eyes with stage B-V DR had a Landolt visual acuity of 20/40 or better and 25% of these eyes had 20/200 visual acuity or worse. The same percentages of 20/40 or better and 20/200 or worse visual acuity were obtained at 10 years (Figure 4B). The analyses of visual change after photocoagulation therapy revealed that 73% of the eyes with stage B-II DR had stable vision or improvement by 2 or more lines at the last follow-up visit. The figures were 62% and 52% for eyes with stages B-III and

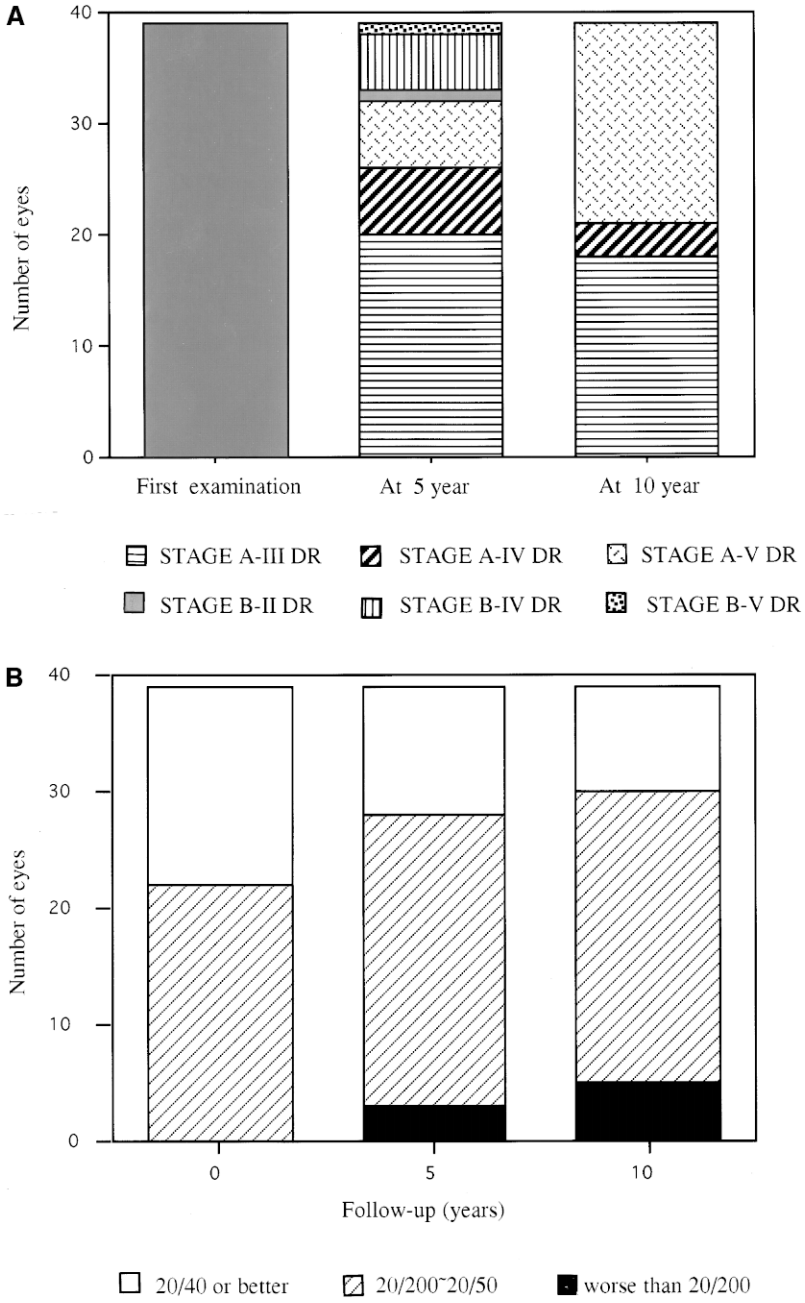

Figure 1. Visual prognosis and course of retinopathy in eyes with stage B-2 retinopathy. (**A**) Course of retinopathy (Bars show different stages of diabetic retinopathy and change of diabetic status at 5 and 10 years). (**B**) Visual outcome (Bars delineate three levels of visual acuity and changes at 5 and 10 years).

B-IV retinopathy, respectively. However, all eyes with stage B-V DR showed a decline in visual acuity by at least 2 lines at the final visit (Table 1).

Causes of Visual Loss

Thirteen eyes with stage B-II, 3 eyes with stage B-III, 6 eyes with stage B-IV, and all 4 eyes with stage B-V DR had lost 2 or more lines of visual acuity at the last follow-up. Of the eyes with stage B-II DR 25.6% had visual deterioration due to progression of lenticular opacities. Seven eyes with stage B-II DR underwent uneventful extracapsular cataract surgery. Severe visual loss in 7.7% of stage B-II eyes was due to chronic macular edema. The main cause of severe visual impairment was vitreous hemorrhage in 25% of eyes with stage B-III DR, and recurrence of vitreous bleeding in 40% of eyes with stage

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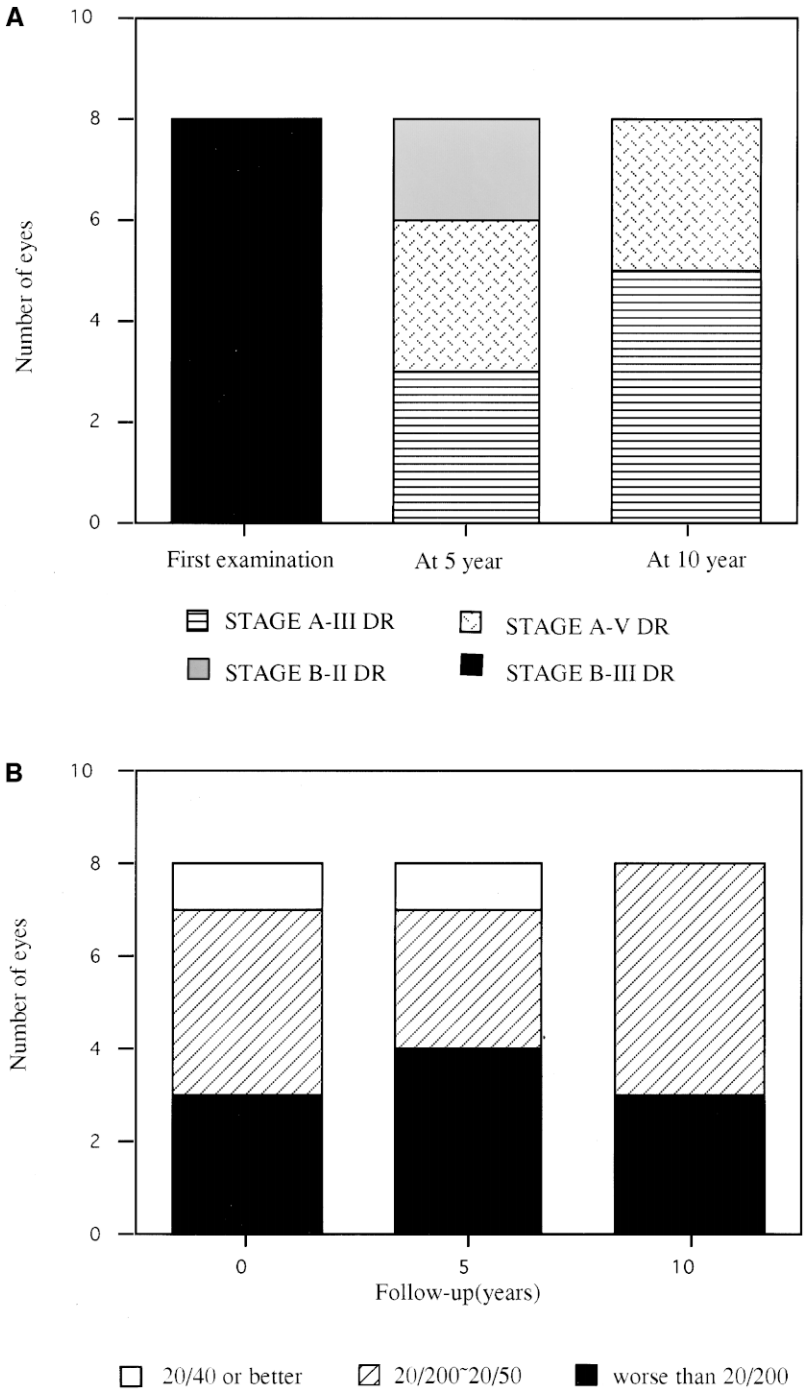

Figure 2. Visual prognosis and course of retinopathy in eyes with stage B-3 retinopathy. (**A**) Course of retinopathy. (**B**) Visual outcome.

B-IV retinopathy. Macular traction and neovascular glaucoma resulted in visual acuity of worse than 5/200 in 50% of the eyes with stage B-V DR.

Discussion

Panretinal photocoagulation has already been shown by multicenter clinical trials to be effective in reducing the incidence of visual loss and preventing subsequent neovascularization in patients with PDR.[1–4,9] Little[5] reported that 60% of the 66 cases in his series treated with argon laser PRP had 20/50 or better and 75% had 20/100 or better acuity at the 5 to 12-year follow-up visits. Likewise, the visual results from the Bascom Palmer Diabetic Retinopathy Study at 15 years were similar to those at 10 years,

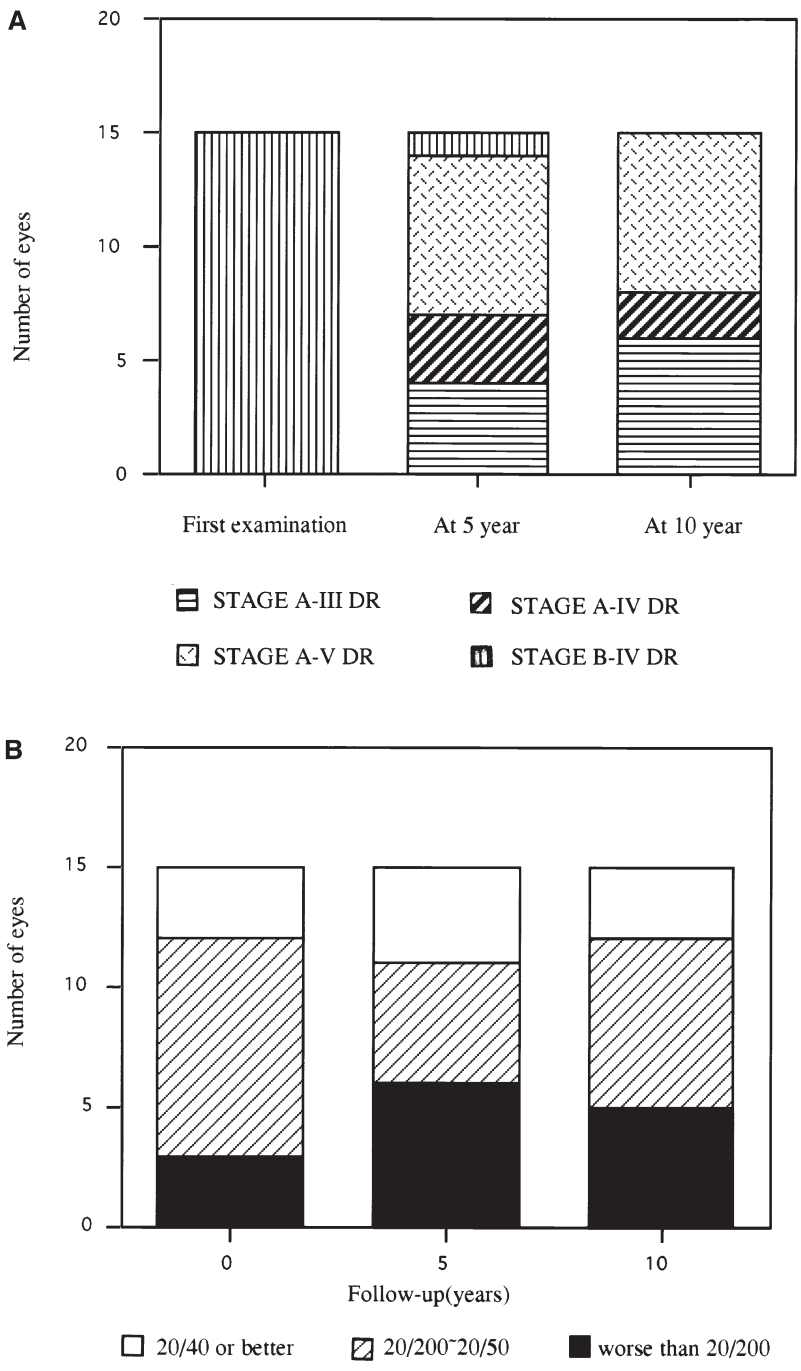

Figure 3. Visual prognosis and course of retinopathy in eyes with stage B-4 retinopathy. (**A**) Course of retinopathy. (**B**) Visual outcome.

with 58% of the eyes attaining 20/40 or better vision where 5% of the eyes had 20/200 or worse visual acuity.[7] On the other hand, 31% of the patients in Gerke and Reuber's[6] series achieved a visual acuity of 20/40 or better 20 years after laser treatment.

In this study, we reviewed the clinical and visual outcome in different stages of PDR. The long-term visual prospects were promising for eyes with stage B-II DR, where 28.2% still enjoyed 20/40 or better visual acuity by 5 years. Most cases have maintained the same visual acuity by 10 years; 23.1% of these eyes had 20/40 or better visual acuity, similar to Gerke and Reuber's[6] report. The number of eyes with 20/200 or worse vision was significantly lower compared to the other three groups. On the other hand, eyes with stage B-III DR did not attain better

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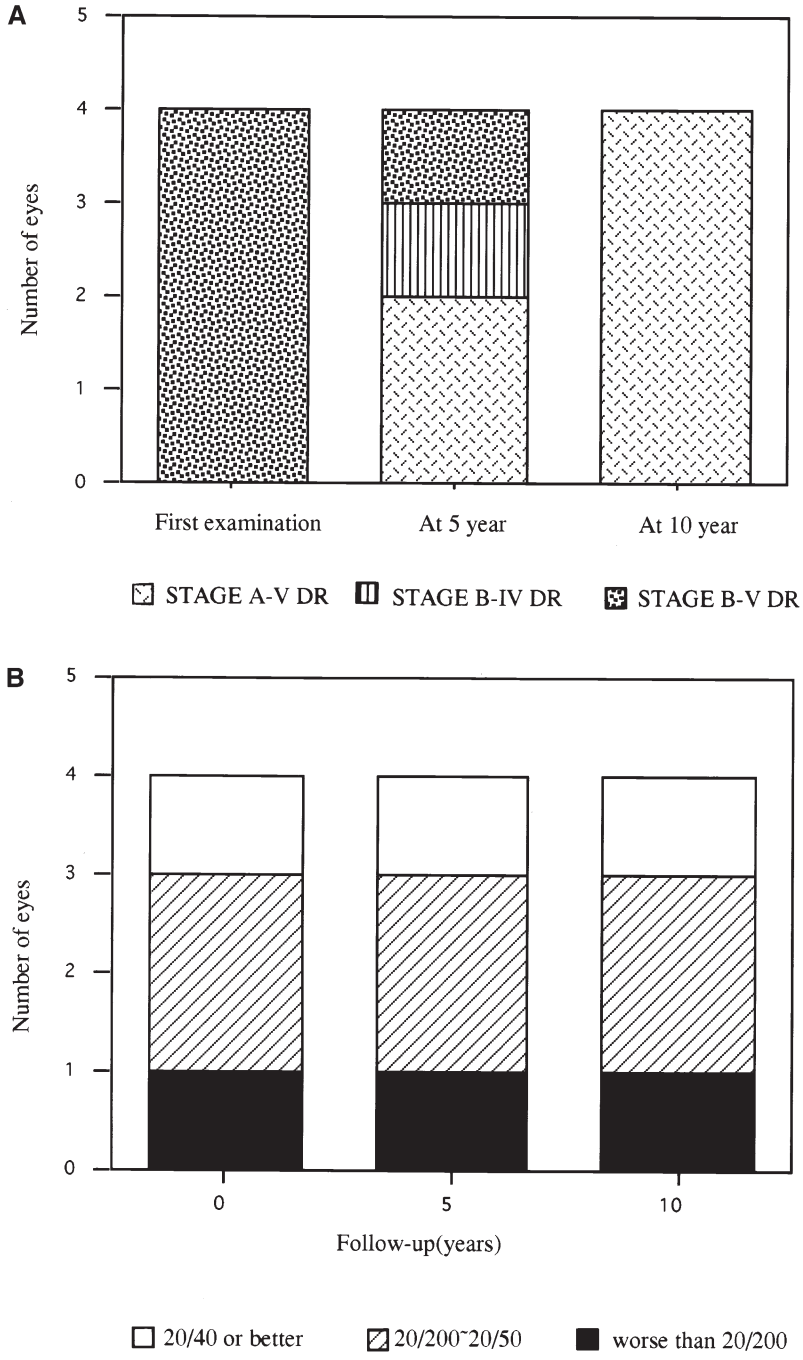

Figure 4. Visual prognosis and course of retinopathy in eyes with stage B-5 retinopathy. (**A**) Course of retinopathy. (**B**) Visual outcome.

than 20/40 vision by 10 years. The beneficial effects and importance of PRP in such cases as far as long-term visual prospects are concerned have already been reported.[5,10–11] We also stress the importance of maximal initial and supplemental PRP in cases with stage B-III DR. Moreover, vitrectomy and intraoperative endophotocoagulation are also effective in reducing the risk of recurrent neovascularization and vitreous bleeding. Although 20% of the eyes with stage B-IV and 25% of the eyes with stage B-V DR had 20/40 or better visual acuity, analyses of the visual change revealed that about half the eyes with stage B-IV and all eyes with stage B-V DR experienced a visual acuity loss of two lines or more. Severe recurrent vitreous hemorrhage, which peaked around 5 years after photocoagulation, was the major cause

Table 1. Visual Acuity Change After Panretinal Photocoagulation

	Number of Eyes				
Visual Status	Stage B-II	Stage B-III	Stage B-IV	Stage B-V	Total
Improvement[a]	9 (23%)	2 (25%)	4 (26.6%)	0	23.8%
No Change	20 (50%)	3 (37.5%)	4 (26.6%)	0	11.9%
Decline[a]	10 (27%)	3 (37.5%)	7 (46.8%)	4 (100%)	64.3%

[a]Denotes change of 2 lines or more.

of visual loss in eyes with stage B-IV DR. Macular traction and neovascular glaucoma were responsible for the severe visual loss in eyes with stage B-V DR. Overall, more eyes with stages B-IV and B-V DR had a visual acuity of 20/200 or worse compared to those with stage B-II. These results suggest that especially eyes with stages B-IV and B-V DR might have benefited from vitreous surgery, which could not be performed in these cases because of poor general health or refusal for further treatment by the patients. Indeed, the Diabetic Retinopathy Vitrectomy Study confirmed that eyes with extensive neovascular or fibrovascular proliferation had an increased and sustained chance of achieving 10/20 vision or better at both 2- and 4-year follow-up visits.[12–15]

We believe that maximal PRP should first be applied to patients when the retina shows very severe neovascular and fibrovascular disease. It has been our experience that although active stages of DR can be encountered after 5 years, complete regression can be successfully attained after 10 years. Likewise, Namba et al[16] reported that 25 of 29 eyes with PDR had stable retinopathy 10 years following PRP; only 2 eyes underwent vitrectomy. Moreover, it is suggested that patients with a longer duration of diabetes, young onset diabetes, diabetic nephropathy, and cases in whom initial PRP did not evoke a sufficient response, should be treated more aggressively with PRP than recommended by the Diabetic Retinopathy Study.[17,18] If no significant regression or if rapid progressive traction, especially involving the macula, is seen and if dense preretinal or vitreous hemorrhage coexists, early vitrectomy with removal of fibrovascular membranes should be performed.[10,19] Routinely, we think that all patients about to undergo laser treatment or vitreous surgery for PDR should receive a full explanation about the potential benefits of the treatment as well as the possibility of visual loss, which can result even after treatment, despite regression of retinopathy, because of the relentless nature of this disease.

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