DOI: 10.7860/JCDR/2026/85436.23221

Original Article

Ophthalmology Section

Impact of Diabetes Duration on Stage of Retinopathy and Visual Outcome Post-laser Photocoagulation: A Prospective Interventional Study

HETAJ SHETH[1], KSHAMA POPAT[2]

ABSTRACT

Introduction: The chronicity of Diabetes Mellitus (DM) plays a pivotal role in the onset and progression of Diabetic Retinopathy (DR). Early intervention can mitigate vision loss, but clinical outcomes post-treatment often vary with the duration of diabetes.

Aim: To evaluate the association between duration of diabetes and severity of DR, and to assess its influence on visual outcomes following Pan-retinal Photocoagulation (PRP).

Materials and Methods: A prospective interventional study was conducted at the Department of Ophthalmology, GT Sheth Ophthalmological Hospital, P.D.U. Government Medical College, Rajkot, Gujarat, India from November 2012 to September 2014 on 80 eyes of 44 diabetic patients who underwent PRP. Patients were categorised based on diabetes duration: Group A- <5 years, Group B- 6-10 years, and Group C- >10 years. DR was classified per Early Treatment Diabetic Retinopathy Study (ETDRS) guidelines, and all patients underwent PRP. Best Corrected Visual Acuity (BCVA) was assessed at baseline and over a 6-month follow-up. Chi-square was applied to find the association between the duration of DM and severity of DR. Paired t-test and Analysis of Variance (ANOVA) test were applied to compare visual improvement post-laser PRP with severity of DR.

Results: Severity of DR increased with diabetic duration (p-value=0.0247). Proliferative Diabetic Retinopathy (PDR) was observed in 47.1% (16/34 eyes) of patients with <5 years' duration, 59.1% (26/44 eyes) in 6-10 years, and 100% (2/2 eyes) in >10 years. Visual improvement post-PRP was seen in 28 eyes (82.3%), 35 eyes (79.5%) and 1 eye (50%) of patients across the three groups, respectively. Visual deterioration was observed only in patients with diabetes duration of ≥6 years.

Conclusion: Duration of diabetes is directly related to disease severity and inversely related to improvement in vision after laser treatment. Early screening and timely PRP can significantly enhance the prognosis for patients with DR.

Keywords: Diabetics, Diabetic retinopathy, Laser, Pan-retinal photocoagulation, Type II diabetes, Vision

INTRODUCTION

The DR remains one of the most common causes of blindness in India and the world. Diabetes progressively damages every system of the body. The nerves, retina and kidneys are the main organs affected by glucotoxicity, as entry of glucose in these organs is insulin independent [1]. DR is a progressive microvascular complication of DM. Mechanism of DR includes loss of pericytes, thickening of basement membrane leading to micro aneurysms and breakdown of blood retinal barrier further leading to oedema, hard exudates, dot and blot haemorrhages. Also, there is non perfusion of the retina due to aggregation of platelets in the capillaries. Chronic hyperglycaemia induces retinal ischemia, prompting the release of Vascular Endothelial Growth Factor (VEGF) and consequent neovascularisation. Macular oedema and Vitreous Haemorrhage (VH), if present, can lead to visual impairment [2,3]. The risk and severity of DR are known to increase with the duration of diabetes. PRP has been established as a mainstay treatment to halt disease progression by ablating ischemic retinal areas and curbing VEGF production.

The present study investigated the role of diabetes duration in influencing the stage of DR and visual outcome post-PRP, aiming to emphasise the need for timely intervention.

MATERIALS AND METHODS

A prospective interventional study was conducted at the Department of Ophthalmology, GT Sheth Ophthalmological Hospital, P.D.U. Government Medical College, Rajkot, Gujarat, India between November 2012 and September 2014 after obtaining Institutional Ethical Committee Approval (PDUMCR/IEC/25141/2012).

Sample size calculation: Based on the expected change in BCVA following laser photocoagulation, assuming a standard deviation of 0.35 logMAR and a minimum clinically significant difference of 0.11 logMAR, with 5% level of significance and 80% power, the required sample size was calculated using the formula

$$n = (Z\alpha + Z\beta)^2 \sigma^2/d^2.$$

The minimum sample size thus obtained was 79.37, which was rounded off to 80 patients.

Inclusion and Exclusion criteria: Total of 80 eyes of 44 diabetic patients aged 40-81 years were included. Patients with other ocular co-morbidities, prior laser treatment, or advanced diabetic eye disease like Tractional Retinal Detachment (TRD) were excluded.

Patients were categorised based on diabetes duration:

1. **Group A:** Duration <5 years (n=34 eyes) (42.5%)
2. **Group B:** Duration 6-10 years (n=44 eyes) (55%)
3. **Group C:** Duration >10 years (n=2 eyes) (2.5%)

Study Procedure

Detailed ocular and systemic history was recorded, with emphasis on diabetic duration and control status {using Fasting Blood Sugar (FBS), Post Prandial Blood Sugar (PPBS) and glycated Haemoglobin (HbA1C)}. Also, other systemic co-morbidities, such as hypertension and cardiac diseases, were asked about. However, they were not excluded since most of the diabetic

patients will have these co-morbidities. Uncorrected Visual Acuity (UCVA) and BCVA were assessed for each eye using Snellen's chart and the assessor doing the assessment was unaware of diabetic status and treatment timing of the patient. Detailed anterior segment examination was done with slit lamp biomicroscopy and fundus examination was done with +90 D lens and slit lamp and also with indirect ophthalmoscope. All patients underwent Fundus Fluorescein Angiography (FFA) and were categorised as having Non Proliferative Diabetic Retinopathy (NPDR) or PDR per ETDRS classification [4]. PRP was administered using Nd:YAG 532 nm laser in three sessions. Laser parameters are mentioned in [Table/Fig-1].

Laser parameters	Spot size (µm)	Duration (ms)	Power (mW)	Count (no.)
PRP	100-200	100-300	100-600	1200-2000
Grid	100	100	100-300	70-100
Focal	50-100	100	100-150	20-50

[Table/Fig-1]: Details of laser parameters.

BCVA was evaluated using Snellen's chart at baseline and at one week, one month, three months, and six months post-treatment. Visual acuity was defined as 'Improved' when BCVA improved by two lines or more and 'Decreased' when BCVA decreased by two lines or more and 'Stable' if neither of the above [5].

Outcome measures: Primary outcomes included changes in BCVA and distribution of DR severity by diabetes duration.

STATISTICAL ANALYSIS

Statistical analysis was done using men and medicine software. Chi-square test was applied to find the association between duration of DM and severity of DR. Paired t-test and ANOVA analysis were used to compare visual improvement post-laser PRP along with severity of DR. A p-value less than 0.05 was considered statistically significant.

RESULTS

This is a prospective interventional case study carried out on 80 eyes of 44 patients of age group from 40-81 years. This study involved 45 eyes of 23 males and 35 eyes of 21 females. None of the patients were lost to follow-up in the study in this duration.

The proportion of patients with PDR increased with disease duration. Group A showed 47.1% (16/34 eyes) had PDR, and 52.9% (18/34 eyes) had NPDR. Group B showed 59.1% (26/44 eyes) had PDR, and 40.9% (18/44 eyes) had NPDR and in group C, 100% (2/2 eyes) had PDR [Table/Fig-2].

Duration of diabetes	NPDR (Number of eyes)	PDR (Number of eyes)	Total
<5 years	18 (52.9%)	16 (47.1%)	34 (100%)
6-10 years	18 (40.9%)	26 (59.1%)	44 (100%)
>10 years	0	2 (100%)	2 (100%)
Total	36	44	80

[Table/Fig-2]: Distribution of Diabetic Retinopathy (DR) severity by duration of diabetes values are expressed in n (%).
Although Chi-square analysis showed statistical significance (p=0.0247), interpretation should be made cautiously due to small sample size in Group C, potentially violating test assumptions

Patients with co-existing hypertension and cardiovascular illness are shown [Table/Fig-3]. A total of 28 out of 44 patients had co-existing hypertension, and 24 out of 44 patients had cardiovascular disease. Patients with macular oedema and their visual outcome after PRP are shown in [Table/Fig-4]. Although visual improvement was more frequent in eyes without macular oedema, the association was not statistically significant (p-value=0.299), possibly due to limited sample size and short follow-up.

Groups	Co-existing hypertension 28/44 patients (41 out of 80 eyes)	Co-existing cardiovascular disease 24/44 patients (44 out of 80 eyes)
A	11/28 patients (11/41 eyes)	10/24 patients (18/44 eyes)
B	15/28 patients (26/41 eyes)	12/24 patients (22/44 eyes)
C	2/28 patients (4/41 eyes)	2/24 patients (4/44 eyes)

[Table/Fig-3]: Patients with co-existing hypertension and cardiovascular illness.

Macular oedema	Total eyes (n=80)	Visual improvement	Stable vision	Visual deterioration
Present	37	29	6	2
Absent	43	35	8	0
Total	80	64	14	2

[Table/Fig-4]: Patients with macular oedema and their visual outcome after PRP.

Visual Acuity Outcomes after Laser Photocoagulation

Visual outcomes were assessed via changes in BCVA measured at six months post-PRP. Its correlation with duration of DM is shown in [Table/Fig-5]. Most visual improvements ranged from a gain of 2 Snellen lines. No patient in group A experienced visual loss, whereas one eye each in groups B and C showed deterioration of 2 Snellen lines.

Groups	Eyes (n)	Improved vision	Stable vision	Deteriorated vision
A (<5 y)	34	28 (82.3%)	6 (17.7%)	0
B (6-10 y)	44	35 (79.5%)	8 (18.2%)	1 (2.3%)
C (>10 y)	2	1 (50%)	0	1 (50%)

[Table/Fig-5]: Visual outcome after PRP and its correlation with duration of DM.

The mean baseline BCVA was 0.6989 logMAR, which improved to 0.5440 logMAR at six months following PRP. This improvement was statistically significant on paired t-test analysis (p-value <0.01) [Table/Fig-6].

Baseline Mean BCVA (logMAR)	Post-PRP BCVA (logMAR)
0.6989±0.123	0.5440±0.117

[Table/Fig-6]: Comparison of mean BCVA at baseline and six months post-PRP in logMAR.

Group-wise analysis revealed improvement in mean BCVA following PRP in groups A and B. Group A showed the greatest mean visual gain (0.2126 logMAR), followed by group B (0.1614 logMAR). In contrast, group C showed no change in mean BCVA. Intergroup comparison using One-way ANOVA showed a significant difference (p=0.0039); post-hoc comparison confirmed group A had significantly greater improvement than group C [Table/Fig-7].

Groups	Baseline mean BCVA (logMAR)	Post-PRP BCVA (logMAR)	Mean visual gain* (logMAR)
Group A	0.7132±0.124	0.5006±0.116	0.2126±0.008
Group B	0.6842±0.148	0.5228±0.137	0.1614±0.011
Group C	0.3010±0.165	0.3010±0.165	0

[Table/Fig-7]: Shows groupwise BCVA at baseline and post-PRP in logMAR.
*p-value=0.0039 for one-way ANOVA comparing mean visual gain

At baseline, majority of eyes were in the moderate to severe visual impairment (3/60 to 6/18) category. At six months following PRP, a shift towards better visual acuity categories was observed. The proportion of eyes with BCVA ≥6/18 increased, while those with severe visual impairment and blindness decreased, indicating functional visual improvement following laser treatment. Eyes in group A (<5 years diabetes duration) showed a greater shift towards the ≥6/18 category compared to groups B and C. This is shown in [Table/Fig-8].

Best corrected visual acuity	Baseline BCVA (n=80 eyes)	6 months Post-PRP BCVA (n=80 eyes)
Group A		
≥6/18	8	20
<6/18-6/60	25	13
<6/60-3/60	1	1
<3/60	0	0
Group B		
≥6/18	15	28
<6/18-6/60	26	16
<6/60-3/60	1	0
<3/60	2	0
Group C		
≥6/18	0	0
<6/18-6/60	0	1
<6/60-3/60	1	1
<3/60	1	0

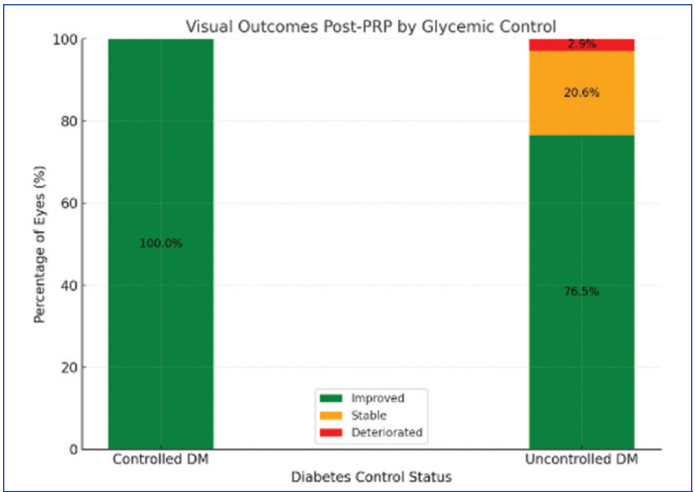
[Table/Fig-8]: Stratification of Best Corrected Visual Acuity (BCVA). The analysis demonstrated improvement in visual acuity category from baseline to six months post-PRP in groups A and B. The change in group C was not significant, likely due to the small sample size

Association of Visual Outcome with Diabetic Control and Stage of DR

Further subgroup analysis revealed:

1. Among patients with controlled diabetes (n=12), 100% showed improvement in BCVA.
2. Among those with uncontrolled diabetes (n=68), 52 eyes (76.5%) improved, 14 eyes (20.6%) were static, and two eyes (2.9%) worsened.

This is shown in [Table/Fig-9].



[Table/Fig-9]: Correlation of visual outcome with diabetes control.

Similarly, visual outcomes were better in NPDR patients:

1. NPDR group (n=36 eyes): 91.7% (n=33) showed improvement; three were stable and none worsened.
2. PDR group (n=44 eyes): 70.5% (n=31) improved; 25% (n=11) were stable and 4.5% (n=2) worsened.

DISCUSSION

The present study reinforces the well-established association between the duration of DM and the severity of DR, while also highlighting its influence on visual outcomes following PRP. The data show a clear trend, as the duration of diabetes increases, the proportion of patients presenting with PDR rises significantly. Notably, all patients with more than 10 years' duration of diabetes had progressed to PDR, a finding consistent with previous epidemiological studies from India and worldwide [6,7].

The inverse relationship between diabetes duration and visual improvement post-PRP suggests that the window for optimal intervention narrows with increasing chronicity of disease. Patients with a diabetes duration of less than five years demonstrated the highest rate of visual improvement and no visual deterioration, whereas those with longer duration showed less favourable outcomes. This may be attributed to chronic, irreversible retinal ischemic damage, macular involvement and optic nerve compromise that limit visual recovery despite adequate laser therapy [8,9].

Although PRP is effective in halting neovascular progression, it is primarily a stabilising rather than vision-enhancing procedure. Importantly, long-term visual outcomes following PRP may worsen due to late-onset complications such as post-laser macular oedema, progressive capillary non perfusion, recurrent VH and TRD [4,10]. These complications may manifest months to years after treatment and could not be fully assessed in the present study due to the relatively short follow-up period of six months. Consequently, the visual outcomes reported here may represent early post-treatment results, and long-term prognosis- particularly in patients with longstanding diabetes- may be less favourable.

The study also highlights the influence of systemic metabolic control on treatment response. All patients with well-controlled diabetes demonstrated improvement in BCVA, whereas poorer outcomes were observed in those with uncontrolled glycaemia. This finding aligns with landmark trials such as the Diabetes Control and Complications Trial (DCCT), which established tight glycaemic control as a key modifiable factor in reducing the progression and severity of DR [11,12].

Visual outcomes were also significantly better in eyes with NPDR compared to proliferative disease. Early intervention in NPDR may preserve retinal function by preventing macular involvement and extensive ischemic damage. The ETDRS demonstrated that timely laser treatment before the onset of advanced neovascular complications yields better long-term visual stability [13,14].

From a public health and economic perspective, delayed presentation and advanced DR substantially increase the burden on healthcare systems. Patients with PDR often require repeated laser sessions, intravitreal anti-VEGF injections and vitreoretinal surgeries, significantly escalating treatment costs. In contrast, early detection through screening programmes and timely PRP in less advanced stages represent cost-effective strategies that reduce the need for complex interventions and minimise vision-related disability [15,16].

In low- and middle-income countries like India, vision loss due to advanced DR has profound socioeconomic implications, including reduced productivity, increased dependency and long-term financial strain on patients and healthcare infrastructure. Strengthening DR screening, improving patient awareness and ensuring early referral are therefore crucial not only for better visual outcomes but also for reducing the economic burden associated with advanced disease management [17].

Overall, the findings emphasise the importance of early retinal screening, strict glycaemic control and timely laser intervention to improve both clinical outcomes and cost-effectiveness of DR care.

Limitation(s)

The present study contains only two patients in Group C (> 10 years duration of DM) which is very small sample size and the comparison of results might not be very accurate. Another limitation is duration of follow-up- six months is relatively short follow-up period as late complications like post-laser macular oedema and delayed VH may develop after six months. One more limitation is that we have not compared the results of anti-VEGF treatment with laser PRP as the study was done in government set up where anti VEGF are not available. Also, co-existing nephropathy has not been studied which can be a limiting factor as nephropathy is directly related to severity of retinopathy. Moreover, co-existing hypertension and

cardiovascular disease can be confounding factors which is another limitation.

Future studies should focus on long-term prospective evaluation of visual outcomes following laser photocoagulation, with larger sample sizes and extended follow-up to better assess disease progression. Incorporation of advanced retinal imaging modalities such as optical coherence tomography angiography may improve early detection of microvascular changes and help refine treatment timing. Additionally, integrating systemic metabolic control parameters and exploring combination therapies with newer pharmacological agents may contribute to more individualised management strategies for DR.

CONCLUSION(S)

The duration of DM plays a pivotal role in determining both the severity of DR and the visual outcomes following PRP. The present study demonstrates that patients with a shorter duration of diabetes (<5 years) not only present with less severe forms of DR but also experience significantly better visual outcomes post-PRP. In contrast, prolonged disease duration correlates with advanced retinopathy and reduced visual improvement, underscoring the limited reversibility of late-stage retinal damage. These findings highlight the critical importance of early detection and timely intervention. Integrating routine ophthalmologic screening into the standard care of diabetic patients-ideally beginning at diagnosis or within the first five years- can substantially mitigate the risk of vision-threatening complications. Strengthening DR surveillance and ensuring prompt laser treatment when indicated should remain central to comprehensive diabetes management strategies aimed at preserving vision and improving patient quality of life.

REFERENCES

[1] Gupta V, Gupta A, Dogra MR, Singh R. Diabetic retinopathy – Atlas and Text. 1st edition. Jaypee; 2007. p. 1-2.

[2] Wang W, Lo ACY. Diabetic retinopathy: Pathophysiology and treatments. Int J Mol Sci. 2018;19(6):1816. Doi: 10.3390/ijms19061816. PMID: 29925789; PMCID: PMC6032159.

[3] Boyer DS, Hopkins JJ, Sorof J, Ehrlich JS. Anti-vascular endothelial growth factor therapy for diabetic macular edema. Ther Adv Endocrinol Metab. 2013;4(6):151-69. Doi: 10.1177/2042018813512360. PMID: 24324855; PMCID: PMC3855829.

[4] Photocoagulation for diabetic macular edema. Early Treatment Diabetic Retinopathy Study report number 1. Early Treatment Diabetic Retinopathy Study Research Group. Arch Ophthalmol. 1985;103(12):1796-806. PMID: 2866759.

[5] Fenwick E, Man R, Ong PG, Sabanayagam C, Gupta P, Cheng CY, et al. Association of changes in visual acuity with vision-specific functioning in the Singapore Malay Eye Study. JAMA Ophthalmol. 2016;134(11):1299-305.

[6] Rema M, Pradeepa R. Diabetic retinopathy: An Indian perspective. Indian J Med Res. 2007;125(3):297-310.

[7] Klein R, Klein BEK, Moss SE. The Wisconsin Epidemiologic Study of Diabetic Retinopathy: A review. Diabetes Metab Rev. 1989;5(7):559-70.

[8] Aiello LP, Gardner TW, King GL, Blankenship G, Cavallerano JD, Ferris FL, et al. Diabetic retinopathy. Diabetes Care. 1998;21(1):143-56.

[9] Kohner EM, Aldington SJ, Stratton IM, Manley SE, Holman RR, Matthews DR, et al. United Kingdom Prospective Diabetes Study 30: Diabetic retinopathy at diagnosis of non–insulin-dependent diabetes mellitus and associated risk factors. Arch Ophthalmol. 1998;116(3):297-303.

[10] Early photocoagulation for diabetic retinopathy. ETDRS report number 9. Early Treatment Diabetic Retinopathy Study Research Group. Ophthalmology. 1991;98(5 Suppl):766-85. PMID: 2062512.

[11] The Diabetes Control and Complications Trial Research Group; Nathan DM, Genuth S, Lachin J, Cleary P, Crofford O, Davis M, et al. The effect of intensive treatment of diabetes on the development and progression of long-term complications in insulin-dependent diabetes mellitus. N Engl J Med. 1993;329(14):977-86.

[12] Stratton IM, Adler AI, Neil HAW, Matthews DR, Manley SE, Cull CA, et al. Association of glycaemia with macrovascular and microvascular complications of type 2 diabetes (UKPDS 35). BMJ. 2000;321(7258):405-12.

[13] Ferris FL 3rd, Davis MD, Aiello LM. Treatment of diabetic retinopathy. N Engl J Med. 1999;341(9):667-78.

[14] Chew EY, Ferris FL, Csaky KG, Murphy RP, Agrón E, Thompson DJS, et al. The long-term effects of laser photocoagulation treatment in patients with diabetic retinopathy - The early treatment diabetic retinopathy follow-up study. Ophthalmology. 2003;110(9):1683-89.

[15] Narayan KMV, Zhang P, Kanaya AM, Williams DE, Engelgau MM, Imperatore G, et al. Diabetes: The pandemic and potential solutions. Dis Prim Care. 2006;24(1):01-14.

[16] Ting DSW, Cheung GCM, Wong TY. Diabetic retinopathy: Global prevalence, major risk factors, screening practices and public health challenges. Clin Exp Ophthalmol. 2016;44(4):260-77.

[17] Gadkari SS, Maskati QB, Nayak BK. Prevalence of diabetic retinopathy in India: The All India Ophthalmological Society Diabetic Retinopathy Eye Screening Study 2014. Indian J Ophthalmol. 2016;64(1):38-44.

PARTICULARS OF CONTRIBUTORS:

1. Assistant Professor, Department of Ophthalmology, Smt. B. K. Shah Medical College, Dhiraj Hospital, Sumandeep Vidyapeeth Deemed to be University (SVDU), Vadodara, Gujarat, India.
2. Consultant, Department of Cornea and Anterior Segment, Thakorbhai V. Patel Eye Institute, Vadodara, Gujarat, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:

Hetaj Sheth,
A-302, Everest Experia Apartment, Vasna Bhayli Road, Opp. Bright Play Centre, Vadodara-391410, Gujarat, India.
E-mail: hetaj85@gmail.com

PLAGIARISM CHECKING METHODS: [Jain H et al.]

- Plagiarism X-checker: Nov 19, 2025
- Manual Googling: Feb 23, 2026
- iThenticate Software: Feb 27, 2026 (4%)

ETYMOLOGY: Author Origin

EMENDATIONS: 8

AUTHOR DECLARATION:

- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. NA

Date of Submission: **Nov 18, 2025**
Date of Peer Review: **Nov 30, 2025**
Date of Acceptance: **Mar 03, 2026**
Date of Publishing: **May 01, 2026**