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Effect of Cataract Surgery on the Progression of Diabetic Retinopathy

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Abstract: ***Introduction: Diabetic retinopathy is one of the most common causes of vision loss in a patient in the middle aged group population. There are many factors associated with worsening of diabetic retinopathy such as anaemia, smoking, high cholesterol levels, hypertension, etc. Cataract surgery being the most common procedure for cataract extraction, it is postulated to cause alterations in blood retinal barrier and blood aqueous barrier and produce changes in the retinal vasculature which can fasten the progression rate. Since cataract surgery is an unavoidable procedure for cataract removal, they are other necessary precautions that should be taken such as good glycaemic control, cessation of smoking, strict annual fundus examination, lipid control measures and healthy lifestyle. Aim: . To study the effect of cataract extraction surgery on progression of diabetic retinopathy. Methods: This prospective comparative study was done on 29 patients, who were known case of diabetes mellitus who underwent cataract surgery in the department of ophthalmology at Justice K S Hegde Charitable Hospital between 1ST October 2022 – 30th April 2024 was done. Subjects were divided into case (operated eye) and control (unoperated eye) and then monitored for 2 months in the post operative period to observe the progression of DR post cataract surgery and also compared the progression of operated eye to unoperated eye. Results: Categorical variables were expressed as frequency and percentage. For the comparison of pre - and post data within each group, Wilcoxon's signed rank test was used. Categorical variables were analyzed using Chi square test. The case group showed more progression of diabetic retinopathy after cataract surgery with respect to microaneurysms, haemorrhages, cotton wool spots and diabetic macular oedema. Study also showed that there is more progression of diabetic retinopathy when compared to the control group with respect to cotton wool spots and diabetic macular oedema. It was observed that there is more progression with longer duration of diabetes. HbA1C levels were not statistically significant with progression of diabetic retinopathy. Conclusion: Cataract surgery causes detrimental effect on the progression of diabetic retinopathy. We also observed that the progression of retinopathy was also faster in the subjects with longer the duration of diabetes.***

Keywords: Diabetic retinopathy, Cataract surgery, non-proliferative diabetic retinopathy, Proliferative diabetic retinopathy.

1. Introduction

The diabetes capital of the world is shortly predicted to be established in India.

According to WHO, in India, 31.7 million people had diabetes mellitus (DM) in 2000. By 2030, this number is anticipated to increase to 79.4 million, making it the highest in any country in the world. Over time, diabetic retinopathy (DR) is anticipated to develop in about two - thirds of Type 2 and nearly all Type 1 diabetics.[1]

The most common reason for vision loss in adults between the ages of 20 and 74 is diabetic retinopathy (DR). DR ranks as the fifth most frequent cause of avoidable blindness from 1990 to 2020 and the fifth most frequent cause of moderate to severe visual impairment. Over one - third of the 340 million people with diabetes who are estimated to be living in the world in 2020 have DR symptoms, and one - third of these individuals have vision threatening diabetic retinopathy [2]

Literature have also identified several risk factors associated with DR, including many systemic and lifestyle factors, nephropathy, obesity, alcohol consumption, haematological markers of anaemia, hypothyroidism, inflammation, endothelial dysfunction, hyperglycaemia, hypertension, dyslipidaemia, diabetes duration, ethnic origin, pregnancy, and puberty.[3]

Although extraction is the standard treatment option for cataracts, it has also reported to have worsen the existing cases of diabetic retinopathy, a micro vascular complication leading to further vision loss.[2]

It was also postulated that cataract extraction may lead to break in blood retinal barrier and blood aqueous barrier that may lead to increase in intra ocular inflammatory response, which can also worsen the existing diabetic retinopathy.3 Even though diabetic retinopathy frequently cannot be entirely avoided, you can lower your risk of it developing or worsening. Keeping your blood sugar under control delays the onset of retinopathy and stops it from worsening. Additionally, it decreases the requirement for laser surgery or other treatments for severe retinopathy.[4]

The literature by Chung et al, demonstrates indications of a potential deterioration of diabetic retinopathy after cataract surgery in patients with preoperative macular oedema and impaired renal function.5

Study by shuh bin liao et al, documented that the postoperative progression of DR was not significantly affected by phacoemulsification surgery. Individuals with preoperative NPDR were more likely to exhibit progressive postoperative DR.6

In a prospective study by Katharina krepler et al, stated that there appears to be no relationship between the advancement of diabetic retinopathy and contemporary cataract surgery. Most NPDR patients see an improvement in their vision,

however those who develop macular oedema show worse visual outcomes.7

Thus, this study is under taken to compare the progression of DR, among diabetic patients undergoing cataract surgery.

Objectives

1) To determine the effect of cataract extraction surgery on diabetic retinopathy progression in the operated eye.
2) To compare the progression of diabetic retinopathy in the operated eye with the contralateral non operated.

2. Materials and Methods

Study Design and Settings

Study Design: Prospective comparative study (time bound study)

Study Setting: Department of ophthalmology, Justice K. S Hegde charitable hospital attached to K. S. Hegde Medical Academy, a unit of NITTE (deemed to be university), Mangaluru - 575018.

Study Period: 1ST OCT 2022 – 30TH APRIL 2024

Sampling Method – purposive sampling.

Sample Size Calculation: Since the study is a time bound study conducted during the given time period, all patients meeting all the exclusive and inclusive criteria will be taken into the study.

Selection of Study Materials

All type 2 diabetes mellitus patients diagnosed to be having cataract and undergoing cataract extraction surgery meeting all inclusion and exclusion criteria from the department of Ophthalmology, K. S Hegde Hospital, Deralakatte, Mangalore, after obtaining an informed consent will be recruited under study.

Inclusion Criterion

1) All Patients more than 48 years of age having history of physicians diagnosis of type 2 diabetes or newly diagnosed diabetes
2) Patients with and without retinopathy of any stage
3) Patients with Similar and different stage of diabetic retinopathy in two eyes
4) Patients who need cataract surgery having senile cataract with visible fundus in both the eyes (If the fundus of the operated eye is not visible, then the fundus is examined within 1 week of post operative period and Will be taken as pre - operative grade of diabetic retinopathy)

Exclusion Criterion

1) Patients with previous H/O posterior segment intraocular surgery.
2) Patients with intra operative complications from cataract surgery like PC rent, zonular dialysis, iridodialysis
3) Patients in need of any treatment modality for existing diabetic retinopathy at or within one week of post operative period
4) Patients among which the fundus is not visible in the control eye within the 2 months follow up period.
5) Patients with previous H/0 cataract surgery in the control eye.

Diagnostic Criterion

Basic History & Past Medical History

Routine ophthalmological examination – Visual acuity testing, retinoscopy refraction, best corrected visual acuity, slit lamp biomicroscopic examination and fundus examination.

Diabetic retinopathy grading -

- **No DR -** No microvasculature abnormalities
- **Mild NPDR -** Microaneurysms only
- **Moderate NPDR -** Microaneurysms with other signs (dot and blot
- haemorrhages, hard exudates, cotton wool spots).
- **Severe NPDR -** Intraretinal haemorrhages (20 or more in each of 4 quadrants), definite venous beading (in at least 1 quadrant), but not PDR.
- **PDR -** Neovascularisation of optic disc or elsewhere, preretinal haemorrhage, or vitreous haemorrhage
- **DME -** Retinal thickening in the macula.

Progression grading

Evaluation of progression was done between temporal arcades, macula and optic disc and 1.5 disc diameter beyond them. Existing DR was graded according to the ETDRS and progression was graded as following. If the existing lesions exceed more than 20 in number, then others signs were given preference to evaluate the progression of diabetic retinopathy.

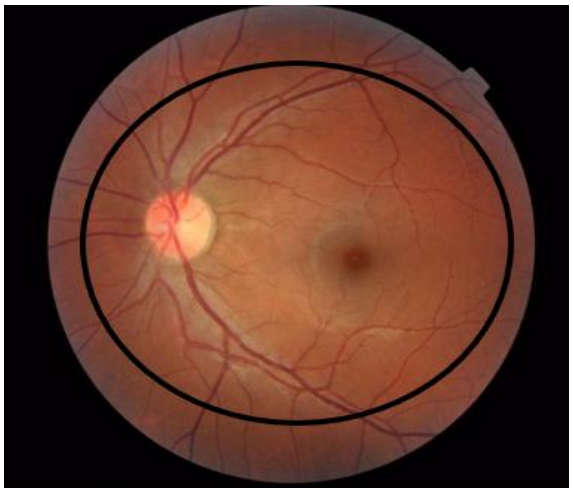

Figure 17: Representing the area of evaluation

Grade	Increase in Number of Microaneurysms	Increase in Number of Hemorrhages	Increase in Number of Hard Exudates
No progression	0	0	0
Mild progression	Upto 5	Upto 5	Upto 5
Moderate progression	6-10	6- 10	6- 10
Severe progression	>10	>10	>10

Grade	Increase in Number of Soft Exudates
No progression	0
Mild progression	Upto 2
Moderate progression	3-5
Severe progression	>5

Grade	Increase in Number of Venous Changes (beading, sausaging, looping)	IRMA
No progression	0	0
Mild progression	1	1
Moderate progression	2	2
Severe progression	3 or >3	3 or >3

Grade	Increase in Number of Quadrants
No progression	0
Mild progression	1
Moderate progression	2
Severe progression	3 or >3

If 2 or more quadrants are involved preoperatively other signs were taken for grading classification

Severe progression – NPDR progressing to PDR and if NPDR/PDR without maculopathy progressing to NPDR/PDR with maculopathy.

(If progression grade differs for different signs, sign with worser grade was used for final grading of progression).

3. Results

The statistical analysis of the data was conducted using SPSS 23.0. Categorical variables were expressed as frequency and percentage. For the comparison of pre - and post data within each group, Wilcoxon's signed rank test was used. Categorical variables were analyzed using Chi square test A significance level of $p < 0.05$ was considered statistically significant.

- Predominance of 51.7% of the individuals were present in the age group of 50 - 59 years.
- In terms of gender, male predominance is noted with 62.1%.
- Regarding the operated eye, 55.2% of cases were in the left eye, and 44.8% were in the right eye.

Table 1: Cross tabulation of duration of diabetes and progression of DR

		Progression		Total	Chi square	p value
		Yes	No			
Duration	Newly diagnosed	2	4	6	2.146	0.543
		14.30%	26.70%	20.70%		
	<1 year	1	3	4		
		7.10%	20.00%	13.80%		
	1- 5 year	5	4	9		
		35.70%	26.70%	31.00%		
	More than 5 years	6	4	10		
		42.90%	26.70%	34.50%		
Total		14	15	29		
		100.00%	100.00%	100.00%		

Among 29 subjects, 14 subjects which showed progression and 15 showed no progression. In subjects who showed progression, 14.3% were seen in newly diagnosed group, 7.1% in less 1 year group, 35.7% in 1 - 5 year group and 42.9% in more than 5 years of duration of diabetes group. Out of 6 subjects in newly diagnosed 33% showed progression, out of 4 subjects in <1 year 25% showed progression, out of 9 subjects in 1 - 5 years of duration 55.5% showed progression, and out of 10 in >5 years of duration 60% showed progression.

Table 2: Comparison of HbA1C based on progression.

Progression		Mean	Std. Deviation	t value	p value
HBA1C	Yes	6.207	.690	1.501	0.145
	No	6.700	1.031		

For the progression group, the mean HbA1c level is 6.207 ± 0.690, while for the no progression group, it is 6.700 ± 1.031.

Table 3: Pre and post comparison in operated eye

		Mean	Std. Deviation	Z value	p value
Microaneurysms	Pre	3.862	4.24	3.193	0.001
	Post	5.414	5.144		
Haemorrhage	Pre	0.966	1.861	2.232	0.025
	Post	1.517	2.654		
Hard Exudates	Pre	0.414	1.547	1.633	0.102
	Post	0.931	2.828		
Cotton wool spots	Pre	0	0	1.342	0.179
	Post	0.103	0.409		
IRMA	Pre	0	0		
	Post	0	0		
Venous Changes	Pre	0	0		
	Post	0	0		
PDR	Pre	0	0		
	Post	0	0		
DME	Pre	0	0	1	0.317
	Post	0.034	0.186		

For microaneurysms, the mean count increased from 3.862±4.240 pre- intervention to 5.414±5.144 post - intervention, with a statistically significant Z value of 3.193 (p = 0.001). Haemorrhages also increased from 0.966±1.861 to 1.517±2.654, showing a significant Z value of 2.232 (p = 0.025). However, no statistically significance was noted in hard exudates, cotton wool spots, DME.

No changes were seen in IRMA, venous changes and PDR.

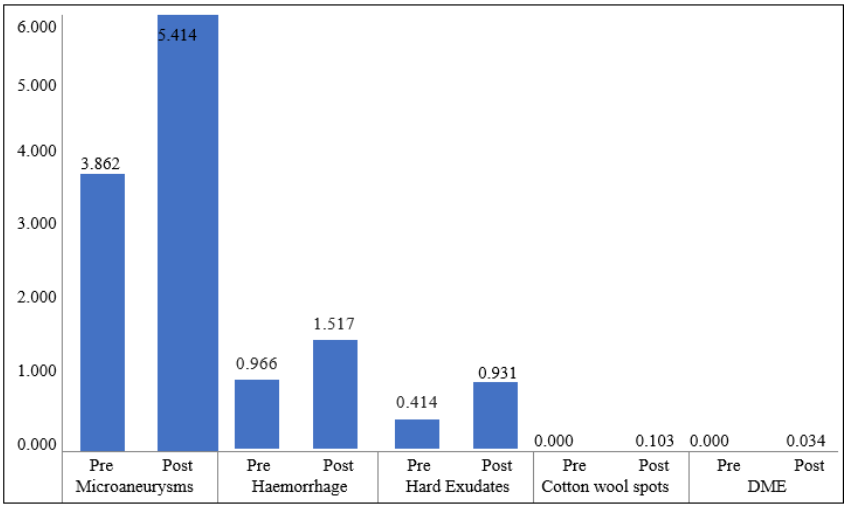

Figure 1: Pre and post comparison in operated

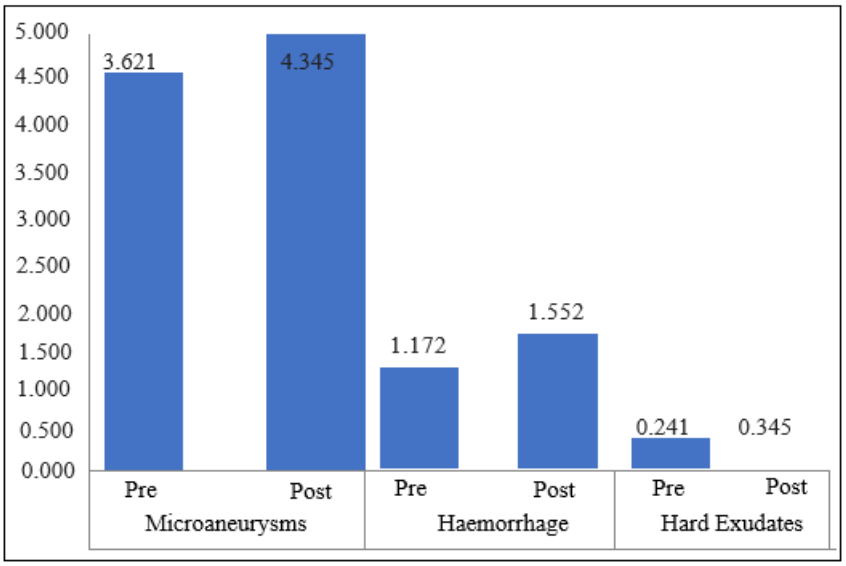

Figure 2: Pre - post comparison in non operated eye

Microaneurysms increased from 3.621±3.774 pre - intervention to 4.345±3.985 post - intervention, with a significant Z value of 2.070 (p = 0.038). However, haemorrhages and hard exudates showed progression but is not statistically significant. No changes were seen in cotton wool spots, IRMA, venous changes, PDR and DME

Pictures showing progression of DR, pre - operative versus post operative -

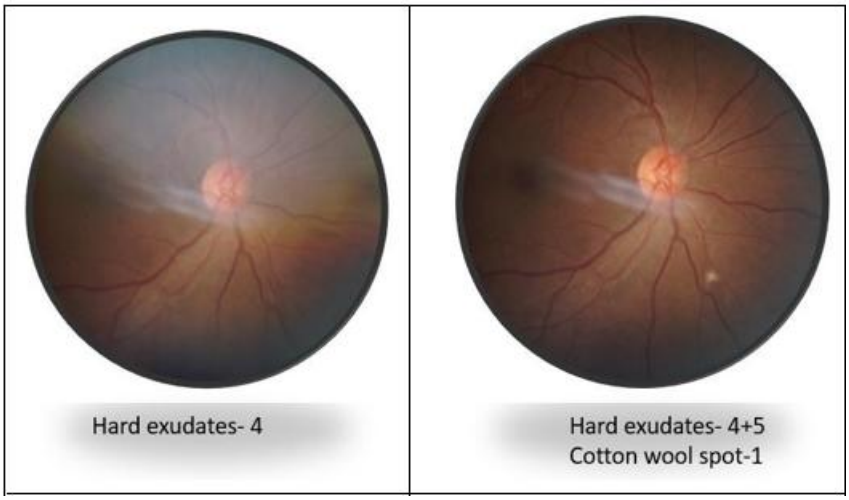

Figure 3: Showing progression of haemorrhages from 3 to 5 (mild progression)

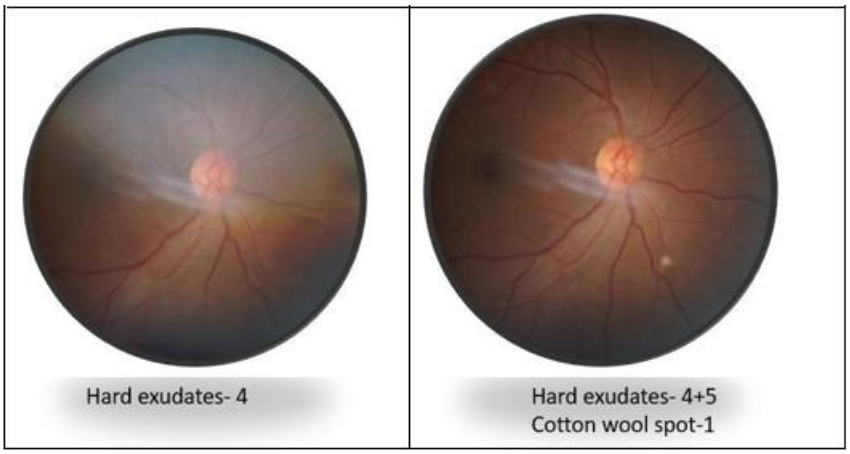

Figure 4 - showing progression in hard exudates from 4 to 9 and cotton wool spots from nil to 1 (mild progression).

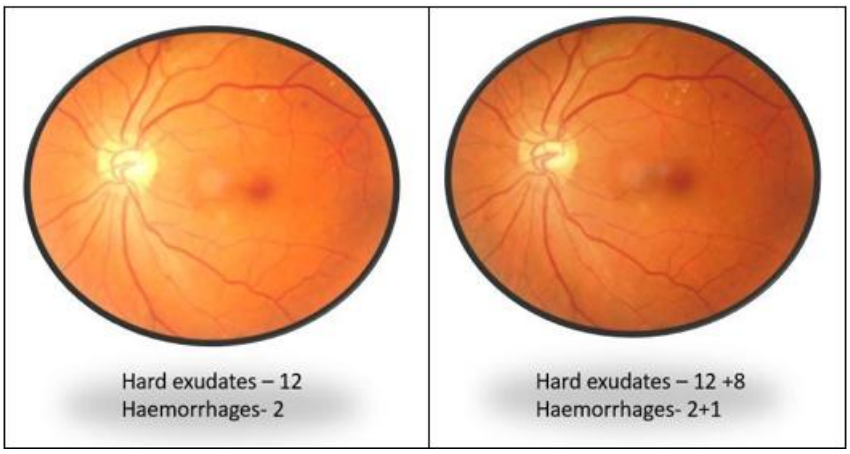

Figure 5: showing progression in hard exudates from 12 to 20 (moderate progression) and haemorrhages from 2 to 3 (mild progression).

4. Discussion

Diabetic retinopathy is one of the most common conditions associated in patients with diabetes mellitus. Patients with DR changes need active follow up with fundus examination on every visit to elicit the progression of DR.4. Cataract surgery is the most common procedure for cataract extraction and this itself can produce abnormalities in the blood retinal barrier (BRB) and cause changes in the retinal vasculature which can worsen the retinopathy. Hence, this study is undertaken to

determine the effect of cataract surgery on the progression of diabetic retinopathy.

Since we had only 2 months of follow up period after cataract surgery in our clinical setting, we followed a customised grading of different signs of DR to detect the worsening of retinopathy.

In our study, progression of DR in relation to HbA1C was statistically not significant which is contradiction to many other studies.8, 9, 10. As we operate diabetic patients with cataract after good glycaemic control, our subjects were operated after getting HbA1C value near to normal levels. So, HbA1C value in our study subjects do not reflect how long the retinal vasculature was exposed to higher HbA1C levels in previous years. This is similar to the findings of a study done by **Nagasree, D. V. C. et al** which concluded that HbA1C levels does not correlate with the severity of the retinopathy.[11] as they included patients with chronic kidney disease in relation to HbA1C.

Like in many other studies [12, 13, 14] we observed that progression of DR was seen more in subjects that the longer duration of diabetes, which is also similar to the findings in a study by **seyed ahmad rasoulinejad et al** which was a retrospective cohort study included a total of 1, 125 patients who underwent cataract surgery divided into three groups, patients with no DR, patients with NPDR, patients with PDR concluded that patients with retinopathy had significantly higher progression in longer duration of diabetes compared with those without retinopathy.[15,,] which is also similarly seen in a study by **Shuh - Bin Liao** showed that when comparing the eyes with progression of retinopathy with the eyes without progression of retinopathy, duration of diabetes was significantly longer.

Out of 29 subjects, majority of the patients were above 50 years of age (51.7%), and males (62.1%) predominance is noted.

In our study, more progression in the operated eye was seen with respect to microaneurysms, haemorrhages, hard exudates, cotton wool spots and DME, which are similar to findings in a study done by **Dr. Krishna Kuldeep et al**[16] concluded that progression of the retinopathy in diabetic eyes occurred in the follow - up period. Out of 22 eyes, 12 eyes with mild NPDR progressed to moderate NPDR and 8 eyes without retinopathy developed mild non - proliferative diabetic retinopathy and 2 eyes of moderate NPDR progressed to severe NPDR. Worsening of retinopathy was more in eyes with preexisting DR, in the operated eye. Our study showed similar findings to a study done by **yih - chung tham et al**[17]**,** showing the progression is more after cataract surgery in the operated eye. In a study conducted by **Thomas Hong et al** [18] a clinic based cohort study, which had a follow up to 12 months post operatively, discovered that pseudophakic eyes has twice more the chance of progression of DR compared to phakic eyes, which developed NPDR to PDR. In our study major changes in DR after cataract surgery were not observed due to short duration of follow up period. A study by **S. Vijayan et al** [19] concluded that maximum progression was seen at 12 months of follow up only.

In a prospective study by **Katharina krepler et al** [7] which was studied for 18 months post - operatively, concluded that cataract surgery have no influence on the progression of diabetic retinopathy to cause visual impairment in the majority of patients with NPDR. But poorer visual outcome was observed in patients developing macular oedema following the cataract surgery. Though our follow up period was only for 2 months, one subject in our study developed DME with poor vision.

A study by **Krishna Kuldeep et al,** discovered that harder cataracts and more phaco time also might effect the progression of DR. As our study included both manual SICS and phacoemulsification surgery, we did not specifically look into this aspect. [16]

In a study by **S. A sadiq et al**, which is a case series study of 7 cases monitored in the post - operative period, showed rapid progression of the proliferative changes leading to rubeosis iridis and neovascular glaucoma within a few months of surgery (range 1 - 18 months), even with good glycaemic control. As our study did not have pre - operative advanced DR changes due to multiple inclusion and exclusion criteria, we were not able to opine on the same. But one subject showed DME changes during 2 months of follow up period with HbA1C level of 9.

In our prospective comparative study monitoring the progression of DR after cataract surgery revealed that there is more progression of diabetic retinopathy in the operated eye when compared to non - operated eye in parameters of microaneurysms, cotton wool spots and DME.

Our study concludes that the cataract surgery can have a detrimental effect on faster progression of DR in the patients and with longer duration of diabetes mellitus. Therefore, it gives good research basis for further studies on factors causing progression and preventing measures to progression of DR after cataract surgery.

5. Conclusion

In our study we had found that in case group (operated eye), there is worsening of the diabetic retinopathy (DR) more than compared to the control group (non operated eye). The worsening was more seen in respect to microaneurysms, haemorrhages, hard exudates, cotton wool spots and diabetic macular oedema. We also observed that the progression of retinopathy was also faster in the subjects with longer the duration of diabetes. There was no statistically significant difference seen in terms of HbA1C levels in relation to the progression of diabetic retinopathy**.**

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