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A clinical study of contrast sensitivity and visual acuity in patients following retinal photocoagulation for diabetic retinopathy

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ABSTRACT

Aims: This study is aimed to assess the effect of retinal photocoagulation on contrast sensitivity and visual acuity.**Materials and Methods:** In this prospective observational study, patients with diabetic retinopathy in either one or both eyes requiring retinal photocoagulation were included in the study. Eyes which were subjected to treatment for diabetic retinopathy were divided into 3 groups. Group 1 included eye which were subjected to pan retinal photocoagulation (PRP) alone, Group 2 included eyes which were subjected to PRP and macular laser (ML) and Group 3 included eyes which were subjected to ML alone. Assessment of visual acuity and contrast sensitivity were done before and three months post retinal photocoagulation. Descriptive statistics were used and where required, paired t test, One-way, ANOVA, Post HOC tests, Tukey HSD tests were used. The sample size was calculated to be 64 eyes.**Results:** Total of 64 eyes of 37 patients, underwent retinal photocoagulation for diabetic retinopathy. Out of the 37 patients, only 16 patients (29 eyes) came for follow up at the end of 3 months of laser photocoagulation. Number of eyes requiring PRP was more when compared to PRP with ML and ML alone. Pre-laser and post-laser visual acuity following PRP, remained unchanged. Improvement in visual acuity was seen in eyes that underwent ML alone. There was worsening of visual acuity in eyes that underwent combination of PRP and ML. However, p value was not significant. Pre-laser and post-laser contrast sensitivity, improved in eyes that underwent only PRP and macular laser alone. There was a reduction in CS when both forms of treatment were combined, though p value was not significant**Conclusions:** Eyes which underwent PRP alone, showed improvement in contrast sensitivity without any change in visual acuity. While reduction in visual acuity and contrast sensitivity was observed in eyes which underwent combination treatment (PRP and ML), there was improvement in visual acuity and contrast sensitivity in eyes which underwent macular laser alone.**Key Messages:** Contrast sensitivity is necessary component of visual function. Abnormal contrast sensitivity can affect day to day activities. Hence it is important to counsel patients about the possibility of contrast sensitivity being affected to some extent following laser treatment for diabetic retinopathy.This is an Open Access (OA) journal, and articles are distributed under the terms of the [Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License](https://creativecommons.org/licenses/by-nc-sa/4.0/), which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.For reprints contact: reprint@ipinnovative.com

1. Introduction

India is set to emerge as the diabetic capital of the world. According to the WHO, 31.7 million people were affected by diabetes mellitus (DM) in India in the

year 2000.^{1,2} The Chennai Urban Rural Epidemiology Study (CURES) reported the prevalence of DR in urban Chennai to be 17.6% in diabetic population, and the Aravind Comprehensive Eye Study reported the prevalence of DR (in self-reported subjects with diabetes) in rural South India to be 10.5%.³ The conventional treatment for Proliferative diabetic retinopathy and macular edema

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pan retinal photocoagulation (PRP) and macular laser (ML) respectively.⁴ Laser photocoagulation may also cause losses in high spatial frequency contrast sensitivity. Contrast sensitivity (CS) is a more sensitive measurement of visual acuity than the Snellen chart for monitoring foveal integrity in patients undergoing PRP.⁵ Measuring CS is one of the ways of assessing the impact of the disease on the quality of life.^{6,7} Hence, there is a need for studying the effect of retinal photocoagulation on these on these two aspects of visual perception. This study is aimed to assess the effect of laser photocoagulation on contrast sensitivity and visual acuity.

2. Materials and Methods

This is a observational study design, conducted in the Ophthalmology department of the Medical College Hospital in South Indian coastal town over a period of 16 months from January 2016 to May 2017. The study was started after obtaining approval from the Institutional Ethics Committee and in accordance with the Declaration of Helsinki. During the specified study period, patients with diabetic retinopathy in either one or both eyes requiring retinal photocoagulation attending the eye out patient department and fulfilling the inclusion criteria, were considered for participation in the study. Written informed consent from the patients was obtained before enrolment. Detailed medical and ophthalmic history was followed by baseline ophthalmologic examination. This included visual acuity, contrast sensitivity, anterior segment evaluation, intraocular pressure and fundus examination.

Distant visual acuity was assessed by self-illuminated Snellen acuity chart, placed at a distance of 6m (20 ft) from the patient with illumination of 100 lux. One eye at a time was tested with the fellow eye occluded. Near vision was assessed by reduced Snellen's chart.

Contrast sensitivity was measured using I chart (Appasamy Associates) LCD type 15" SXGA LCD with a resolution of 1280 x 720 @75 Hz, chart window size- 452 x 254 mm and brightness- 230 + 30 Cd /m². Testing was carried out at a distance of 3 meter (10 feet) with the patient wearing appropriate spectacle correction one eye was tested with the other eye occluded in ambient light conditions. The same conditions were maintained for each patient throughout the study. In the I Chart CS ranges from 100% (poor contrast sensitivity) to 4% (normal contrast sensitivity) with; 80%, 60%, 40%, 20%, 10%, 5% in between.

Based on the clinical findings the eyes were subjected to PRP for PDR or severe NPDR and Macular photocoagulation for macular edema (focal or modified grid). PRP was performed using double frequency Nd YAG laser (IRIS Medical Oculight SL 810nm infrared laser, Iris Medical Inc, Mountain view, CA) which is a diode pumped solid state laser with wave length of 532nm. Laser was

delivered either with slit lamp using 165 wide field lens, with spot size of 500um aiming for mild white reaction. Indirect laser delivery system was used to deliver the laser in patients who was unable to sit for a long time. The laser was aimed at achieving mild white reaction. PRP was completed in 3 or more sittings depending on the patients tolerance to the procedure.

Macular photocoagulation (ML) was performed using slit lamp laser delivery system. The procedure was performed after dilating the pupil with tropicacyl plus. The spot size of 100µm was selected and laser was delivered to the area of thickening and/ of focal to aneurysm, aiming for just visible retinal reaction.

In eyes which required combined treatment (PRP and ML) then macular laser was performed first followed by PRP.

Eyes which were subjected to treatment for Diabetic retinopathy were divided into 3 groups. Group 1 included eye which were subjected to PRP alone, Group 2 included eyes which were subjected to PRP and ML and Group 3 included eyes which were subjected to ML alone. Assessment of visual acuity and contrast sensitivity were done before and three months post retinal photocoagulation.

Eyes requiring laser as a treatment for PDR and/or macular edema were included in the study. Eyes with vision of < 6/36, vitreous hemorrhage, received intravitreal anti VEGF and underwent cataract surgery were excluded from the study.

2.1. Statistical analysis

The data were entered in an MS excel sheet for analysis. Descriptive statistics were used and where required. paired t test, One- way, ANOVA, Post HOC tests, Tukey HSD tests were used. To detect an average decrease in Contrast Sensitivity of 0.110 with a two-sided test (paired t test) at 5% level of significance and 80% power of study, after laser with standard deviation of change at 0.232, the sample size was calculated to be 64 eyes.

3. Results

Total of 64 eyes of 37 patients, underwent retinal photocoagulation for diabetic retinopathy, during the study period and fulfilling the inclusion criteria, were recruited in the study. Out of the 37 patients, only 16 patients (29 eyes) came for follow up at the end of 3 months of laser photocoagulation. Of these 16 patients, 14 were males and two were females. The data of these eyes was analyzed further. Table 1 shows the number of eyes in each group. Tables 2 and 3 shows BCVA and CS before and after laser treatment in each group. Figures 1 and 2 depicts comparison of BCVA and CS pre and post laser in each group.

In PRP group, BCVA improved in 33.33% and CS improved in 52.38%. In PRP and ML group, BCVA and CS

Table 1: Number of eyes in each group

Lasers	Number of eyes
PRP (Group1)	21(72.41%)
PRP+ ML(Group 2)	3(10.34%)
ML(Group 3)	5(17.24%)
Total	29

Table 2: BCVA in eyes pre and post laser treatment in each group.

	Visual acuity Snellens LogMAR	MEAN + SD	Visual acuitysnellens LogMAR	Mean + SD	P value
PRP (21 eyes)	6/6 – 6/36	0.00 – 0.80	6/6-6/24	0.309+0.16	0.903
PRP+ ML (3eyes)	6/9 – 6/36	0.20 – 0.80	6/9-6/60	0.57+0.40	0.423
ML (5 eyes)	6/6 – 6/36	0.00 – 0.80	6/6-6/24	0.22+ 0.30	0.208

Table 3: CS in eyes pre and post laser treatment in each group at 3 months follow up.

	Contrast sensitivity	Mean+ SD	Contrast sensitivity	MEAN (%)	P value
PRP (21 eyes)	5%-80%	28.33 + 20.99	5% - 60%	21.42 + 16.84	0.021
PRP+ML (3 eyes)	10%-100%	5.00 + 45.83	10% - 100 %	56.66 + 45.09	0.423
ML (5 eyes)	10%-80%	34+33.62	5% - 60%	24.00 + 24.90	0.117

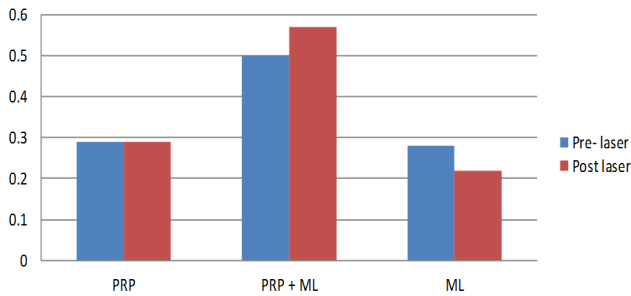


Fig. 1: Depicts comparison of BCVA, pre and post laser treatment in each group

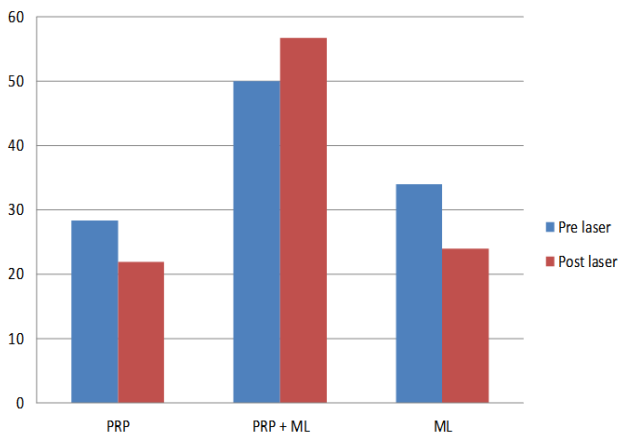


Fig. 2: Depicts CS, pre and post laser treatment in each group.

improved in 66.66%. In ML group, BCVA and CS improved in 60% and 80 % of the eyes respectively.

4. Discussion

Global prevalence of proliferative diabetic retinopathy and diabetic macular edema reported was 7.0% and 8.0 % respectively.^{8,9} In the current study the number of eyes requiring PRP was more when compared to PRP with ML and ML alone. In our study there was higher frequency of PDR when compared to macular edema. We observed, pre-laser and post-laser visual acuity following PRP, remained unchanged. Improvement in visual acuity was seen in eyes that underwent ML alone. There was worsening of visual acuity in eyes that underwent combination of PRP and ML. However, p value was not significant (Table 2 and Figure 1).

On comparing the pre-laser and post-laser contrast sensitivity, the contrast sensitivity improved in eyes that underwent PRP alone and macular laser alone. However, there was a reduction in CS when both forms of treatment were combined, though p value was not significant (Table 3 and Figure 2). In eyes that underwent PRP though contrast sensitivity improved, visual acuity remained stable. This observation was different from the study done by Perwaz et al,¹⁰ where significant improvement in CS and visual acuity 3 months following PRP was observed.

Mukhtar et al¹¹ found that visual acuity showed improvement following PRP in contrary to our observation. Maia et al¹² concluded that the visual acuity stabilized after pan retinal argon laser photocoagulation indicating the need for treatment in early stages of diabetic retinopathy in order to preserve the visual function. Mc Donald et al¹² observed

decrease in visual acuity in 25% of the eyes following PRP due to chronic macular edema, vitreous haemorrhage, tractional retinal detachment, epiretinal membrane, macular ischemia, cataract and neovascular glaucoma. Shairin Jahan et al¹³ concluded that retinal photocoagulation causes statistically significant improvement in contrast sensitivity after a period of 6 weeks post laser in patients of diabetic retinopathy. This was attributed to the resolution of vitreous and retinal hemorrhages in patients of diabetic retinopathy. Also that PRP when done in multiple sessions reduces the side effects of laser including exacerbation of macular edema which is one of the most important cause of reduction in contrast sensitivity following laser photocoagulation.

We observed, that patients who were subjected to macular laser alone, showed improvement in visual acuity and CS in contrast to a study done by Mohammed et al where there was a stabilization of visual acuity and improvement in contrast following macular photocoagulation. Shah et al¹⁴ in their study found that despite the fact that focal laser has its maximum effect on the cones at macula, CS improved the most, after focal laser due to the resolution of macular edema following treatment. Olk¹⁵ in a randomized clinical trial in patients with diffuse diabetic maculopathy, reported an improvement in the BCVA in 45% of the eyes and a stable vision in another 45% of eyes, showing a positive effect of macula laser photocoagulation in patients with DME. Talwar et al,¹⁶ in his study found that focal laser helps in improving contrast sensitivity and stabilized visual acuity. In our study patients who underwent combined treatment with PRP and macular laser showed reduction in visual acuity as well as contrast sensitivity at 3 months follow up. Suchi et al,¹⁴ found that, there was improvement in visual acuity in all 3 types of laser and the mean improvement in CS was maximum in patients who had undergone focal laser, which they attributed to the resolution of macular edema. Lovestem et al¹⁷ reported reduction in CS after PRP which they attributed to old age. Our observation shows that eyes requiring either PRP or ML alone showed improvement in terms of visual acuity and contrast sensitivity. Eyes requiring combination treatment (PRP and macular laser) did not perform well probably because of worsening of pre-existing macular edema due to PRP itself.

Improvement in contrast and visual acuity was seen when subjected to macular laser alone. Keeping in view the small sample size this needs to be evaluated further. Laser photocoagulation has an important role in stabilizing and improving visual acuity and contrast sensitivity in patients with diabetic retinopathy. Improvement in vision acuity and contrast sensitivity did not go hand in hand. The two are different variables hence necessitating the need to test both visual acuity and contrast sensitivity while evaluating the vision, in all patients with diabetic retinopathy undergoing laser photocoagulation.

5. Conclusion

Our study was conducted to assess the effect of retinal photocoagulation on visual acuity and contrast sensitivity 3 months following laser. We observed that eyes which underwent PRP alone, showed improvement in contrast sensitivity without any change in visual acuity. While reduction in visual acuity and contrast sensitivity was observed in eyes which underwent combination treatment (PRP and ML). Improvement in visual acuity and contrast sensitivity in observed in eyes which underwent macular laser alone.

6. Acknowledgement

None.

7. Conflict of Interest

The authors declare that there are no conflicts of interest in this paper.

8. Source of Funding

None.

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