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# Comparison of Pain Intensity after Pan Retinal Photocoagulation Performed with Yellow versus Green Laser in Patients with Proliferative Diabetic Retinopathy

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## ABSTRACT

***Objective:*** To compare the patient's perceived pain during yellow versus green laser Pan Retinal Photocoagulation (PRP) using standardized 10 points on Visual Analogue Scale.
***Study Design:*** Prospective, single center, Quasi-experimental study.
***Place and Duration of Study:*** Armed Forces Institute of Ophthalmology Rawalpindi, Pakistan from Aug 2021 to Jan 2022.
***Methodology:*** Study included a total of 56 eyes of 56 individuals diagnosed as cases of Proliferative Diabetic Retinopathy, referred by a consultant ophthalmologist for Pan Retinal Photocoagulation (PRP). Patients were assigned to one of the two groups for choice of laser (Group-A received yellow and Group-B received conventional green laser).
***Results:*** Lasers were applied to right eyes of 26(46.4%) patients while left eye of 30 patients (53.6%). Twenty-seven (48.2%) of them underwent conventional green laser while 29(51.8%) underwent yellow laser panretinal photocoagulation. Mean of total number of laser burns applied was 1582.7±359.6, ranging from 730 to 2100 burns. Duration of session ranged from 2 minutes to 29 minutes, with mean duration of 18.7±4.5 minutes. Overall, mean score of patient's perceived pain remained 4.04±1.57 (out of 10 on Visual Analogue Scale).
***Conclusion:*** The patient-perceived pain was significantly less by the use of yellow retinal laser for PRP as compared to green laser. The number of burns required for PRP was more by using yellow laser. However, no significant difference was noted in duration of lasers with both lasers.

**Keywords:** Diabetic Retinopathy, Proliferative Diabetic Retinopathy, Green Laser, Yellow Laser, Pan Retinal Photocoagulation.

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## INTRODUCTION

Diabetic retinopathy study outlines all the working definitions and standard treatment protocols for diabetic retinopathy.[1] Proliferative diabetic retinopathy (PDR) being the sight threatening condition is extensively studied and pan retinal photocoagulation (PRP) still remains the main stay of treatment in most of the advanced centers in the world.[2] A recent protocol, protocol S of DRS, concluded that intravitreal ranibizumab is as effective as PRP in the treatment of high-risk PDR at 5 years.[3]

Furthermore, CLARITY study revealed that intravitreal aflibercept is as effective as PRP in the treatment of PDR at 1 year.[4] However, in developing countries lasers are considered cost-effective as compared to intravitreal anti-VEGF injections and are considered in majority of patients with PDR and the outcomes are comparable.[5] Conventionally, single spot green retinal lasers (532 nm) were the main stay for lasers. However, recently, yellow lasers (577 nm) are being used more frequently in advanced centers.[6-7] Outcomes of both lasers in terms of adequate PRP are comparable however, other parameters are less studied.[8]

Thus, the objective of our study was to compare the patient's perceived pain by using visual analogue scale (10-point scale) during yellow versus green laser PRP procedure.

## METHODOLOGY

This Quasi-experimental study was carried out at the Armed Forces Institute of Ophthalmology (AFIO) Rawalpindi, Pakistan, from August 2021 to January 2022, after approval from the Institutional Ethical Review Board (vide letter no.2020/ERC/AFIO).

**Inclusion Criteria:** Patients of either gender between 20 to 80 years of age having proliferative diabetic retinopathy were included.

**Exclusion Criteria:** Patients with previous history of pan retinal photocoagulation within past 6 weeks,

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intravitreal injections, vitreo-retinal surgery, previous retinal detachment, advanced diabetic eye disease and media opacities were excluded.

Sample size was calculated using OpenEpi calculator, which came to 56 eyes.[9] Patients were assigned to each of the two groups by convenience sampling method for the choice of laser: the 29 patients assigned to Group-A had yellow laser, while the 27 patients assigned to Group-B had conventional green laser (Figure-1).

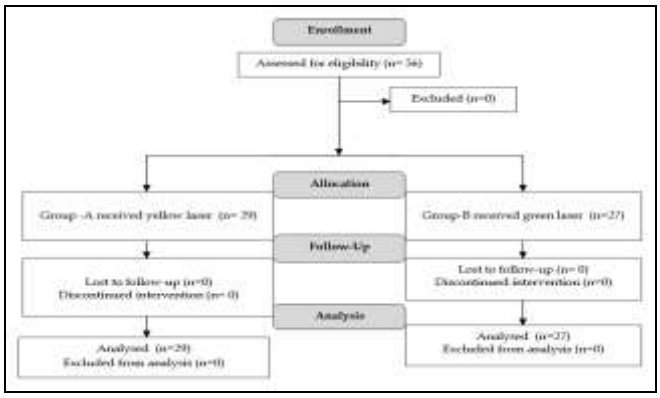


**Figure-1: Patient Flow Diagram (n= 56)**

Data regarding baseline demographics including age, gender, known comorbidities, status of cataract surgery were recorded, along with details of procedure, like laterality, choice of laser, duration of laser, number of burns, patient's pain response according to visual analogue score and reason to stop PRP were documented for each patient separately.

Only one eye of each patient (56 eyes of 56 patients) was studied. Pre-procedure mydriasis was achieved using Tropicamide 1% 1 drop thrice at 10 minutes interval each and a topical anaesthesia Proparacaine 0.5% (1 x drop twice at 5 minutes interval). Detailed procedure was explained to the patient to gain maximum patient's cooperation. Patient was asked to rest his/her chin on slit lamp's chin rest and made comfortable. A Super Quad 160 contact Lens by Volk® Optical was used along with a coupling agent (Visol gel®) for both sort of lasers. Enrolled patients in the study underwent PRP with a Green laser of 532 nm wavelength (NIDEK GYC-500 green laser photocoagulator by NIDEK® CO. LTD Japan) and yellow laser of 577 nm wavelength (TOPCON PASCAL 577 by TOPCON® Medical Laser Systems, USA). Green laser was a single spot laser and a spot size of 200 um for the duration of 50 microseconds (ms) was chosen for PRP. The power for green laser intensity of burn was titrated from minimum to maximum until a gray white blanching retinal reaction of ETDRS +2/+3 severity was observed. Each burn was kept at almost 1 to 1.5 burns apart. While yellow laser was a pattern laser and a single spot size of 200 um for the duration of 20 ms was chosen for PRP. The power for yellow laser intensity of burn was titrated from minimum to maximum until a gray white blanching retinal reaction of ETDRS +2/+3 severity was observed. Each burn was kept at 1-1.5 burn apart with a pattern of 5x5 spots. During this study as much as PRP was done as required in upper half of retina taking care of the Macula by demarking the temporal Macular area with two crescent shaped rows of burns. Treatment at 9 and 3 clock hours of retina was not done in both laser types as to avoid the neurovascular bundles at these points. PRP was stopped once adequate PRP is done, the patient had unbearable pain, got fatigued or the laser treatment exceeds the recommended duration.

Data was analyzed using Statistical Package for Social Sciences (SPSS) version 22. Quantitative data was represented using Mean±SD and qualitative data was represented by using percentage and frequency. Independent samples t-test was applied and *p*-value of ≤ 0.05 was considered as statistically significant.

## RESULTS

A total of 56 individuals participated in our study, all were males. Age of the participants ranged from 43 to 76 (59.39±8.14) years. Proliferative diabetic retinopathy was the main indication of pan retinal photocoagulation in our study sample, 9(16.1 %) of the patients had high risk PDR while rest of them had mild to moderate PDR (n=47, 83.9%). Out of 56 patients, 30(53.6%) had a history of previous cataract surgery. Hypertension was the commonest co-morbid condition, seen in 40(71.4%) patients followed by ischemic heart disease in 16(28.5%) patients.

Lasers were applied to right eyes of 26(46.4%) patients while left eye of 30 patients (53.6%) and 27(48.2%) of them underwent conventional green laser while 29(51.8%) underwent yellow laser pan retinal photocoagulation (PRP). Mean of total number of laser burns applied was 1582.7±359.6, ranging from 730 to 2100 burns. Duration of session ranged from 2 minutes to 29 minutes, with mean duration of 18.7±4.5 minutes. Overall mean of patient perceived score remained 4.04±1.57 (out of 10 on Visual Analogue scale). Demographic and clinical characteristics of study participants are shown in Table-I.

The mean pain score was significantly higher in Group-B (4.8±0.5) compared with Group-A (3.3±0.3), and this difference was statistically significant ($p$=0.002). The mean treatment time was 19.04±3.4 minutes in the Group-B and 18.45±2.17 minutes in Group-A; however, this difference was not statistically significant ($p$=0.30). Moreover, the mean number of treatment shots was significantly lower in Group-B (1323.25±43.23) compared to Group-A (1824.14±42.10), with a statistically highly significant difference ($p$<0.001), shown in Table-II.

**Table-I: Demographic and Clinical Characteristics of Study Participants (n = 56)**

| Variable | Values |
|---|---|
| **Gender** | |
| Male | 56 (100%) |
| **Age (years)** | |
| Range | 43 – 76 |
| Mean ± SD | 59.39 ± 8.14 |
| Indication for PRP | |
| High-risk proliferative diabetic retinopathy | 9(16.1%) |
| Mild to moderate proliferative diabetic retinopathy | 47(83.9%) |
| **History of Cataract Surgery** | |
| Yes | 30(53.6%) |
| No | 26(46.4%) |
| **Comorbid Conditions** | |
| Hypertension | 40(71.4%) |
| Ischemic heart disease | 16(28.5%) |
| Eye Treated | |
| Right eye | 26(46.4%) |
| Left eye | 30(53.6%) |
| **Type of Laser Used** | |
| Conventional green laser PRP | 27(48.2%) |
| Yellow laser PRP | 29(51.8%) |
| **Laser Treatment Parameters** | |
| Total laser burns (Mean±SD) | 1582.70±359.60 |
| Range of laser burns | 730–2100 |
| Duration of session (minutes), mean ± SD | 18.70±4.50 |
| Range of session duration (minutes) | 2–29 |
| Patient-Perceived Pain Score (VAS, 0–10) | |
| Mean±SD | 4.04 ± 1.57 |

## DISCUSSION

With the recent advancement in laser delivery systems and vast availability of lasers, PRP has been annotated as standard of care for patients with proliferative diabetic retinopathy.[9] Lasers, being a non-invasive intervention, under topical anaesthesia in an OPD setting are preferred over intravitreal injections (IVAs) by the treating surgeons and patients alike.[10]

There are comparable results with IVAs but severe sight threatening complications like endophthalmitis cannot be ruled out.[11] Recently, subthreshold retinal lasers have been introduced for PRP to improve patient compliance and reduced patient discomfort.[12] Previously, use of red krypton laser was associated with severe patient pain and use of retro-bulbar anesthesia was common in patient preparation.[13] Patients often required post-procedure topical and oral non-steroidal anti-inflammatory drugs (NSAIDS).[14]

**Table-II: Comparison of Mean Pain Score, Duration of Laser Treatment and Number of Retinal Burns across Groups (n=56)**

| | Group-A (n=29) Mean±SD | Group-B (n=27) Mean±SD | $p$-value |
|---|---|---|---|
| Pain Score (out of 10) | 3.30±0.300 | 4.80±0.500 | 0.002 |
| Treatment Time (mins) | 18.45±2.17 | 19.04±3.40 | 0.300 |
| Treatment Shots (n) | 1824.14±42.10 | 1323.25±43.23 | < 0.001 |

Our current study found a statistically non-significant difference between treatment times of the two lasers i.e. yellow requiring lesser time than green laser. Furthermore, the mean number of burns for yellow laser (1824.14±42.1) was much more as compared to green laser (1323.25±43.23). The results are both clinically and statistically significant, and one possible explanation was increased wavelength for yellow laser and thus, lesser energy delivered to the retina contrary to the previous studies.[15-18] The mean pain scores for green laser were 4.8±0.5 while, mean pain score for yellow laser was 3.3±0.3 and results were statistically significant.

## LIMITATIONS OF STUDY

Limitations of our study included that two eyes of the patient are not compared with different lasers. Furthermore, the sample size was small in each group and it was a single center study. The absence of female study participants may also contribute to bias.

## CONCLUSION

In conclusion the patient perceived pain was significantly less by the use of yellow retinal laser for pan retinal photocoagulation (PRP), as compared to green laser. The number of burns required for PRP was more by using yellow laser. However, no significant difference was noted in duration of lasers with both lasers.

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**Authors Contribution**

Following authors have made substantial contributions to the manuscript as under:

MUG & MAM: Conception, study design, drafting the manuscript, approval of the final version to be published.

TAK & TAJ: Data acquisition, data analysis, data interpretation, critical review, approval of the final version to be published.

UI & WY: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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