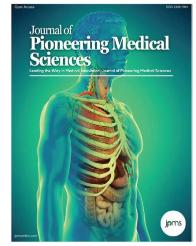
Journal of Pioneering Medical Sciences
Received: February 22, 2025 | Accepted: March 25, 2025 | Published: July 05, 2025
Volume 14, Issue 06, Pages 189-194

DOI https://doi.org/10.47310/jpms2025140625



Measurement of Photo stress Recovery Duration with Various Tools in a Tertiary Eye Care Hospital

Syeda Sadiya Ikram[1*] and Sanjeev Kumar Puri[2]

[1]Department of Optometry, College of Applied Medical Sciences, Qassim University, Saudi Arabia

[2]Department of Ophthalmology, Saveetha Institute of Medical and Technical Sciences, Chennai, Tamil Nadu, India

Author Designation: [1]Assistant Professor, [2]Professor

*Corresponding author: Syeda Sadiya Ikram (sadiyaikram20@gmail.com).

Abstract **Background**: Photostress test can be employed to differentiate between retinal (macular) and post-retinal disease, which affect the optic nerve. Finding a suitable tool is crucial to the test since recovery time impacts on the brightness of the instrument used to measure it. This study aims to find an effective and user-friendly tool for estimating photostress recovery time and to define standardized photostress applications for incorporation into clinical practice. **Methods:** The participants visual acuity, color vision, and contrast sensitivity were assessed. A total of 96 participants (48 for emmetrope and 48 for refractive error) were analysed. The 48 refractive error participants were divided in to 3 groups for evaluation using 3 different tools (Penlight, ophthalmoscope, and smartphone camera light). **Results:** The gender distribution showed homogeneity. Colour vision and contrast sensitivity were normal for everyone. Evaluation with penlight method, the recovery 1 and recovery 2 of emmetrope and refractive error groups showed (P = 0.103) and (P = 0.207). With smart phone light, recovery 1 and recovery 2 of emmetrope and refractive error groups showed (P = 0.211) and (P = 0.735). With ophthalmoscope, recovery 1 and recovery 2 were (P = 0.107) and (P = 0.415). Result from recovery 1 and recovery 2 of all the diagnostic tools were not statistically significant, showing all are acceptable. **Conclusion:** According to this study, the three tools' recovery times differ relatively little from one another. Consequently, all three of these instruments can be used to measure PSRT in a clinical setting.

Key Words Ophthalmoscope, Mobile Phone Light, Emmetropia, Refractive Error

INTRODUCTION

The process of measuring photostress recovery time (PSRT) is called a photostress test. A straightforward clinical technique entitled a photostress test can be employed to differentiate between retinal (macular) and post-retinal disease, which affect the optic nerve. Finding a suitable tool is crucial to the test since recovery time impacts on the brightness of the instrument used to measure it. The brightness level utilised should neither overestimate nor underestimate the individual's recovery time, as this could cause unnecessary confusion. An ophthalmoscope is used to evaluate the macula clinically, however PSRT is a rapid and easy test to diagnose macular disease.

The subjective method proposed by Bailliart is a practical and helpful approach that involves shining the macula with an ophthalmoscope and monitoring the return of central vision [1]. Light bleaches the pigments in the retina, resulting in a brief deterioration of retinal sensitivity which the individual perceives as a scotoma. The ability of the photoreceptors to resynthesize visual pigment is essential for vision recovery[2]. Two basic well-known tests of macular function, Amslergrid testing and Snellen visual acuity, do not assess the disease process's pathophysiologic components. It is suggested that performing the macular photostress test is a quick and easy procedure that can be carried out in an outpatient setting, for clinical evaluation of macular function [3].

The test entails shining a bright light source—such as an ophthalmoscope, pen torch, or smartphone camera light—on the eye and monitoring how long it requires for the individual's recovery of visual acuity to normal (one level above BCVA). The macula in normal people creates a central scotoma that gradually fades away in ten to fifty seconds. Recuperation time more than sixty seconds are regarded as pathological.

Photo stress testing has three requirements: a sensitive measure of retinal function, a bright standardized adaptive light, and a timed mechanism. For the first fifteen seconds after exposure, the impacts of intense photic stimulation on the retina are neural; however, after that, they rely on the presence or resynthesis of retinal photochemical [4].

After exposure to intense illumination, photopigment depletion is the main cause of sensitivity loss, and recovery relies on the speed at which photopigment regenerates. It has been shown more recently that glaucoma, an inner retinal disease, also results in a little elevation of PSRT. Increased PSRT has also been linked to a number of systemic medications, including alcohol, chloroquine, oxyazepam, and the tranquillizer Melperon [5]. In clinics, it is a useful screening tool because prompt diagnosis is crucial for effective therapy. Finding the most effective and user-friendly tool for estimating photostress recovery time is the primary goal.

METHODS

Objective

The study's objective is to find the accurate, effective, and user-friendly tool for estimating photo stress recovery time. A quasi-experiment research study is non randomised; were purposive sampling and prospective research design was adopted.

Study Period

The six-month duration of this investigation was from February to July 2024. 96 individuals participated in the study (48 emmetrope and 48 refractive error). The sample size was estimated assuming 15 % difference among the essential parameters between the instrument measurements with 20 % of standard deviation, 90 % power and 5% significance level. The estimated sample size was 48 for each group. SigmaPlot 14.5 version (Systat Software Inc., San Jose, USA) was used for the sample size calculation.

Statistical Method

The data on recovery 1 and recovery 2 were represented by mean, standard deviation (SD) and standard error (SE). The means of normal and refractive error groups were analysed by Student's 't' test. A probability of 0.05 and less was taken as statistically significant. The analysis and plotting of graphs were carried out by SigmaPlot 14.5 version (Systat Software Inc., San Jose, USA).

Inclusion and Exclusion Criteria

Participants with age group range from 18 to 30. People with moderate refractive errors corrected to a 6/6 visual acuity, emmetropes with a 6/6 visual acuity with good general health were taken into consideration. Participants with systemic illness, ocular pathologies, or any history of medicine intake were not considered. Those whose VA does not improve to 6/6 with refractive error are excluded from the research.

Data Collection Technique and Tools

A full medical and ocular history was taken prior to the evaluation. Color vision, Contrast sensitivity, and VA assessment were all part of a thorough initial examination. Using the Snellen chart for distance, the individuals' best corrected visual corrected visual acuity was assessed (BCVA). The Ishihara chart is used to measure color vision, and the Pelli-Robson chart is used to evaluate contrast sensitivity. The eye's anterior and posterior portions were examined to look for any potential issues.

For this study, a total of 100 individuals who attend a tertiary eye care center were recruited to measure the recovery time from photo stress testing. Out of this, 48 individuals with normal eyesight (emmetrope) and 48 individuals with visual impairments were selected. The 48 participants were split into three groups of sixteen each. To analyze the three groups, three different tools and methods are employed. Recovery times are measured with an ophthalmoscope, penlight, and smartphone light. The non-testing eye is occluded before the testing process begins. To measure the PSRT, participants were instructed to gaze directly at the light source of the instrument. A timer was used to record the duration of the exposure. After the exposure, the person must read at least three letters from the Snellen visual chart (one line prior to BCVA). To read the letters on the chart, the participant must put on glasses as soon as possible after being exposed to light. The amount of time taken to read the letters is calculated using a stop clock. To track any changes in the recovery period, the individual underwent examination twice in a span of two weeks.

Tools

The tools used were (a) Smart phone light Samsung M51(display: Super AMOLED Plus), Size 6.7 inches, resolution 1080 × 2400 pixels, ratio 20:9, density 393 ppi; GPU; Adreno 618, OS, Android 10. (b) Penlight long 14cm, Battery 2*AAA, Lamp bulb 2.2 V (yellow light). (c) Ophthalmoscope WelchAllyen 3.5 V 620mAh (2.2Wh).

Ethical Considerations

The Institutional Ethics Committee of Saveetha College of Allied Health Sciences gave its approval to the study's methodology and consent form (SCAHS/ISRB/2024/MARCH/581) and follows the guidelines proposed by the declaration of Helsinki and Indian Council of Medical Research. The oral and written consent were obtained from the participants. The informed consent form was translated into Tamil. The confidentiality of the information and rights to withdraw from the study were explained. The data collection was done from March 2024 to June 2024.

RESULT AND DISCUSSION

The gender distribution was not significant Table 1. The visual acuity of emmetropic group was 6/6 in the Snellen

Table 1: Comparison of Normal and Refractive Error on Recovery 1 and Recovery2 Among Gender.

S. No.	Parameter	Gender	Groups	Mean	SE
1	Recovery 1	Male	Normal	11.1	1.3
		Male	Refractive error	8.9	1.2
		Female	Normal	12.1	0.6
		Female	Refractive error	10.2	0.6
	Statistical analysis				
	Group		-	F = 4.585;	P = 0.035
	Gender		-	F = 1.362;	P = 0.246
	Group X Gender interaction		-	F = 0.0264;	P = 0.871
2	Recovery 2	Male	Normal	9.0	1.0
		Male	Refractive error	9.2	0.9
		Female	Normal	10.9	0.4
		Female	Refractive error	10.0	0.5
	Statistical analysis				
	Group		-	F = 0.171;	P = 0.680
	Gender		-	F = 3.123;	P = 0.080
	Group X Gender interaction		-	F = 0.500;	P = 0.481

The 'F' and 'P' values are two-way ANOVA with Bonferroni 't' test for multiplecomparisons. n = 96

Table 2: General Parameters

Number of participants	Emmetrope	16
Color vision	Refractive error	16
Contrast sensitivity	25/25	100%
Spectacle power	2.0	100%
-	-2.00 and less	35.4%
-	-2 to -1D	43.8%
-	-1 D to 0	20.8%

Table 3: Comparison of normal and refractive error on recovery 1 using different tools

S.No.	Tool	Groups	Mean	SD	SE	Statistics
1	Pen light	Normal	11.8	3.5	0.9	t = 1.681
		Refractive error	9.6	3.8	1.0	P = 0.103
2	Mobile light	Normal	12.0	3.3	0.8	t = 1.279
		Refractive error	10.3	4.4	1.1	P = 0.211
3	Ophthalmoscope	Normal	12.0	3.2	0.8	t = 1.664
		Refractive error	9.9	3.8	1.0	P = 0.107

n = 16 each, The 't' and 'P' values are by Student's 't' test

Table 4: Comparison of normal and refractive error on recovery 2 using different tools

S.No.	Tool	Groups	Mean	SD	SE	Statistics
1	Pen light	Normal	9.9	2.0	0.5	t = 1.290
		Refractive error	8.9	2.1	0.5	P = 0.207
2	Mobile light	Normal	11.7	3.6	0.9	t = 0.341
		Refractive error	11.3	3.6	0.9	P = 0.735
3	Ophthalmoscope	Normal	10.1	2.4	0.6	t = 0.827
		Refractive error	9.4	2.3	0.6	P = 0.415

n = 16 each, The 't' and 'P' values are by Student's 't' test

chart and the acuity of refractive error group was 6/6 with their spectacles. Both groups' general parameters, such as color vision and contrast sensitivity, were 100%, respectively. Both recovery 1 and recovery 2 of the refractive error group have distributions that resemble those of the emmetropic group. This shows that it was not statistically significant (Table 3-4).

Table 1 shows that the gender distribution was not significant. The data on recovery 1 and recovery 2 using 3 different tools for male and female were represented by mean and SE. In general, the male showed lesser recovery time than the female. The emmetrope and refractive error showed more or less similar recovery.

Table 2 illustrates the total number of participants in the study: 16 for each method used in the study, 16 for the emmetrope and 16 for the refractive error group. The subjects had a color vision of 25/25, equal 100%. All study subjects had a normal contrast sensitivity of 2.0 (100%) in a similar manner. With a spectacle power of -2.00D, the participants in the refractive error group are (35.4%), -2 to -1 D (43.8%), and -1 D to 0 (20.8%).

Table 3 demonstrates the mean, SD and SE of recovery 1 of pen light, smart phone light and ophthalmoscope. In the penlight method, the mean of recovery 1 in emmetrope and refractive error groups were 11.8 and 9.6 (sec), and SEM of 0.881 and 0.957 respectively. Analysed by students' 't' test. It was not statistically significant (P = 0.103). This shows that the refractive error group showed similar recovery 1, like the emmetropic group. In the Smart phone light, the mean of recovery 1 in emmetrope and refractive error groups were 9.6 and 12.0(sec), and SEM of 0.822 and 1.094 respectively. It was not statistically significant (P = 0.211).

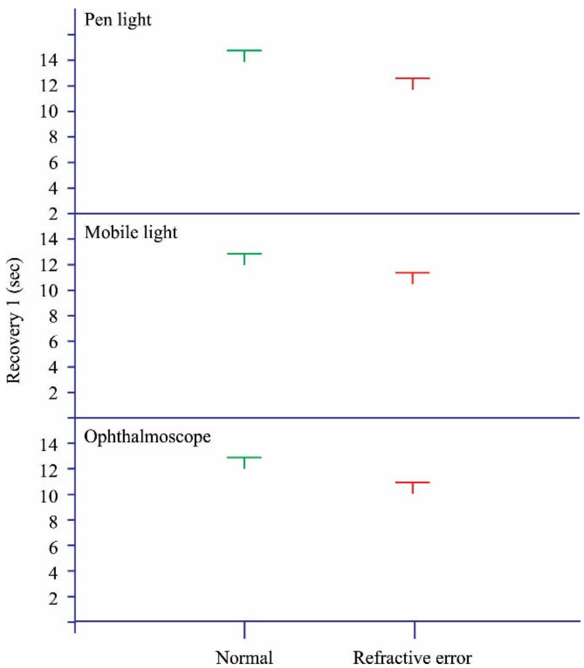


Figure 1: Comparison Of Normal and Refractive Error Using Different Tools on Recovery 1. The Values Are Mean ± Se (N = 16 Each). The Data Was Analysed by Student's 'T' Test.

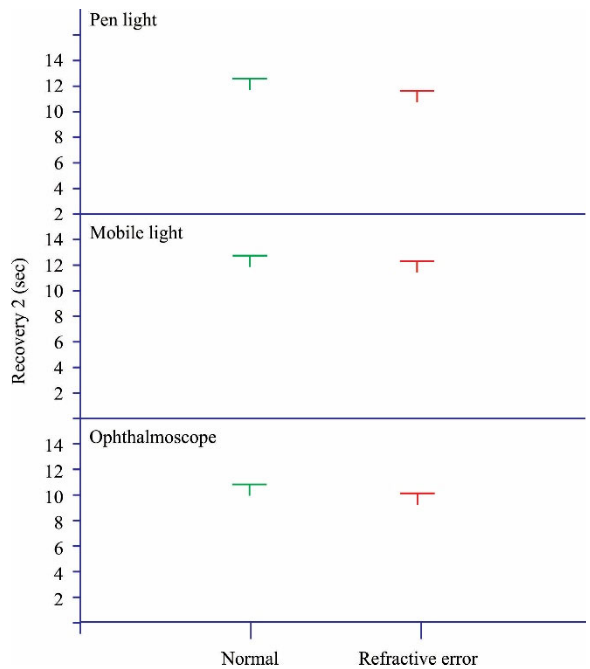


Figure 2: Comparison Of Normal and Refractive Error Using Different Tools on Recovery 2. The Values Are Mean ± Se (N = 16 Each). The Data Was Analysed by Student's 'T' Test.

This shows that the refractive error group showed similar recovery 1, like the emmetropic group. In ophthalmoscope method, the mean of recovery 1 in emmetrope and refractive error groups were 12.0 and 9.9 (sec), and SEM of 0.791 and 0.955 respectively. It was not statistically significant (P=0.107). This shows that the refractive error group showed similar recovery 1, like the emmetropic group.

Table 4 demonstrates the mean, SD and SE of recovery 2 of pen light, smart phone light and ophthalmoscope. In the pen light method, the mean of recovery 2 in emmetrope and refractive error groups were 9.9 and 8.9 (sec), and SEM of 0.491 and 0.536 respectively. It was not statistically significant (P = 0.207). This shows that the refractive error group showed similar recovery 2, like emmetropic group. In Smart phone light, the mean of recovery 2 in emmetrope and refractive error groups were 11.7 and 11.3 (sec), and SEM of 0.907 and 0.906 respectively. It was not statistically significant (P = 0.735). This shows that the refractive error group showed similar recovery 2, like emmetropic group. In ophthalmoscope method, the mean of recovery 2 in emmetrope and refractive error groups were 10.1 and 9.4 (sec), and SEM of 0.612 and 0.563 respectively. It was not statistically significant (P = 0.415). This shows that the refractive error group showed similar recovery 2 like emmetropic group.

Figure 1 illustrates that the normal and refractive error groups recover in almost similarly using different tools on recovery 1.

Figure 2 indicates that the normal and refractive error groups recover in almost similarly using different tools on recovery 2. In this research, the PSRT in eyes with emmetrope and refractive error group was evaluated using three different methods. Depending on the light source used for the bleaching process, various tools frequently produce varying degrees of bleaching photopigments. The process includes:

- Retinal bleaching
- Scotoma After a picture is produced
- The process of visual pigment resynthesis

Despite being a simple and fast method, photostress is not commonly utilized in clinical settings to identify macular defects at an early stage. Additionally, several researchers measured PSRT using various instruments [6-12].

This investigation demonstrates that there is no statistically significant variation among the refractive errorand emmetropic group. This demonstrates that the group with refractive errors recovered similarly to the emmetropic individuals. Prior to the study's execution, the anticipated outcomes suggested that there would be a statistically significant difference between the PSRT, and tools used by individuals with refractive error and emmetropic group. Expected outcomes include shorter recovery times for emmetropic people than the people with refractive error, and shorter recovery times for tools such as ophthalmoscope compared to penlight and smart phone light. We predicted that the recovery period of a smart phone light would be longer than that of an ophthalmoscope or penlight.

People with refractive error may experience some alterations in their vision as compared to emmetropic individuals. However, no such alterations were seen in this study, which could have been due to the age group of the young adults who participated in it; they were between the ages of 18 and 30, and their BCVA with spectacles was 6/6. Since the refractive error group people in this case used to wear their glasses on a regular basis, that may also have contributed to their comparable recovery to that of emmetropic individuals.

A smartphone-based photostress recovery test was conducted and found statistically significant differences between diseases. For a normal eye, the recovery took 39 seconds. ophthalmology might adjust to recent advancements in digital technology, which agrees with the present research [13]. It is claimed that the most effective results come from extended exposure (30 seconds) under the ophthalmoscope and that there is no correlation between acuity and PSRT, both of which go opposite to the present findings 5. The study's findings revealed that although the MDD-2 offers repeatable PSRT measurements in both normal and diabetic subjects—with or without nonproliferative DR—it may not be sensitive to diabetes [14]. A xenon flash source was used to measure recovery time and found that recovery time from photostress statistically significantly rise after the age of 55 [15].

A study that used a smartphone application to assess the macula's reaction to photostress also suggested that it may be used as a self-monitoring tool to identify changes that signal a worsening of the underlying disease early [13].

A similar study proposes PSRT as a quantitative predictive biomarker for incident age related macular disorder, making it potentially useful for clinical management [16].

This research indicates that there is practically little variation in recovery time across the three tools. Therefore, PSRT can be measured in a clinical context using all three of these tools. If the patient's vision does not improve to a 6/6 in a camp or optical setting, and there are no lens changes in the slit lamp, a photostress test can be performed to see whether the patient is experiencing any changes to their retina or macular structure. Effective therapy requires an early diagnosis, which can be achieved with PSRT. Early changes can be identified, and the patient can be referred to the hospital for further examination. In a clinic, optical shop, or camping circumstance, if the practitioner fails to bring an ophthalmoscope or penlight, a photostress test can be performed using the smartphone light.

Limitation

The study's limitations include the possibility of conducting large-scale, long- term exposure research and the inclusion of individuals with pathological conditions that might improve understanding.

In conclusion, the study's findings suggest that neither the two groups nor the instruments used in the investigation differ significantly from one another. According to these findings, all the instruments can be used in a clinical context with individuals between the ages of 18 and 30 because the differences between them were almost the same. To further investigate and establish if acuity and PSRT are related, more research with bigger sample sizes and longer exposure times may be conducted.

Acknowledgement

The authors would like to thank all the participants who took part in the study and for the support provided by Saveetha Medical College and Hospitals.

Conflicts of Interest

The authors declare that this study is an original work, and they have no conflict of interests related to it.

REFERENCES

[1] Chilaris, George A. "Recovery time after macular illumination: as a diagnostic and prognostic test." American Journal of Ophthalmology, vol. 53, no. 2, February 1962, pp. 311-314. https://www.sciencedirect.com/science/article/pii/0002939462911819.

[2] Glaser, Joel S. et al "The photostress recovery test in the clinical assessment of visual function." American Journal of Ophthalmology, vol. 83, no. 2, February 1977, pp. 255-260. https://europepmc.org/article /med/836667.

[3] Wu, Gloria et al "The macular photostress test in diabetic retinopathy and age-related macular degeneration." Archives of Ophthalmology, vol. 108, no. 11, 1990, pp. 1556-1558. https://jamanetwork. com/journals/jamaophthalmology/article-abstract/638748.

[4] Sloan, Philip G. "Clinical application of the photostress test." Optometry and Vision Science, vol. 45, no. 9, September 1968, pp. 617-623. https://journals.lww.com/optvissci/abstract/1968/09000/clinical_application_of_the_photostress_test_.7.aspx.

[5] Margrain, Tom H., and David Thomson. "Sources of variability in the clinical photostress test." Ophthalmic and Physiological Optics, vol. 22, no. 1, January 2002, pp. 61-67. https://onlinelibrary.wiley.com/doi/abs/10. 1046/j.1475-1313.2002.00005.x.

[6] Horiguchi, Masayuki et al "Extrafoveal photostress recovery test in glaucoma and idiopathic central serous chorioretinopathy." British Journal of Ophthalmology, vol. 82, no. 9, 1998, pp. 1007-1012. https://bjo.bmj.com/content/82/9/1007.short.

[7] Severin, Sanford L. et al "Photostress test for the evaluation of macular function." Archives of Ophthalmology, vol. 70, no. 5, 1963, pp. 593-597. https://jamanetwork.com/journals/jamaophthalmology/article-abstract/627366.

[8] Elliott, David B., and David Whitaker. "Changes in macular function throughout adulthood." Documenta Ophthalmologica, vol. 76, September 1990, pp. 251-259. https://link.springer.com/article/10.1007/BF00 142684.

[9] Omokhua, P., and O. George. "Photostress recovery time among Nigerians." Journal of the Nigerian Optometric Association, vol. 16, 2010, pp. 16-20. https://www.ajol.info/index.php/jnoa/article/view/56627.

[10] Sandberg, Michael A., and Alexander R. Gaudio. "Slow photostress recovery and disease severity in age-related macular degeneration." Retina, vol. 15, no. 5, 1995, pp. 407-412. https://journals.lww .com/retinajournal/abstract/1995/15050/Slow_Photostress_Recovery_and_Disease_Severity_in.6.aspx.

[11] Loughman, James et al "Clinical applicability of the Macular Degeneration Detection Device (MDD-2): a novel photostress recovery measurement device." Clinical and Experimental Optometry, vol. 96, no. 3, April 2021, pp. 272-277. https://www.tandfonline. com/doi/abs/10.1111/j.1444-0938.2012.00813.x.

[12] Zingirian, Mario et al "The macular recovery test after photostress in normal and diabetic subjects." Acta Diabetologia Latina, vol. 22, April 1985, pp. 169-172. https://link.springer.com/article/10.1007/BF02590791.

[13] Karampatakis, Vasileios et al "Design of a novel smartphone-based photostress recovery time test for detecting abnormalities in the macula. A cross-sectional study." Annals of Medicine and Surgery, vol. 77, May 2022. https://www.sciencedirect.com/science /article/pii/S2049080122004599.

[14] Loughman, James et al "Suitability and repeatability of a photostress recovery test device, the macular degeneration detector (MDD-2), for diabetes and diabetic retinopathy assessment." Retina, vol. 34, no. 5, May 2014, pp. 1006-1013. https://journals.lww. com/retinajournal/FullText/2014/05000/SUITABILITY_AND_REPEATABILITY_OF_A_PHOTOSTRESS.23.aspx.

[15] Newsome, David A., and Manny Negreiro. "Reproducible measurement of macular light flash recovery time using a novel device can indicate the presence and worsening of macular diseases." Current Eye Research, vol. 34, no. 2, July 2009, pp. 162-170. https://www.tandfonline.com/doi/abs/10.1080/02713680802647654.

[16] Brandl, Caroline et al "Photostress recovery time as a potential predictive biomarker for age-related macular degeneration." Translational Vision Science & Technology, vol. 12, no. 2, February 2023. https://tvst.arvojournals.org/article.aspx?articleid=2785359.Reference Two