ISSN: 2754-4990

Journal of Ophthalmology Research Reviews & Reports

Research Article

Open Access

Comparison Subjective and Objective Chromoretinoscopy

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ABSTRACT

Subjective duochrome (chromoretinoscopy) is a method of analyzing the refraction of light in the eye using a small, hand-held device called a duochrome. The device consists of a light source and two filters; one red and other is green. The light is shone into the eye, and the filters are used to measure the amount of light that is absorbed or scattered by the eye. It relies on the observations and interpretation of the person performing the test. The results of the test can be influenced by factors such as the skill and experience of the person performing the test, as well as the patient's cooperation and willingness to follow instructions.

Objective duochrome (chromoretinoscopy) is a method of analyzing the refraction of light in the eye using an automated device. The device uses a light source and two filters, similar to the subjective duochrome, but it also includes a computerized system for measuring and analyzing the results. It relies on the automated measurement and analysis of the results, rather than on the observations and interpretation of the person performing the test. As a result, it is generally considered to be more accurate and reliable than subjective duochrome chromoretinoscopy.

To compare retinoscopy using colored filters (chromo-retinoscopy) with the conventional subjective duochrome method. All people between the ages of 16-35 years are included in this study whose responses are reliably taken in the subjective part of this study. Emmetropic, any kind of ametropic people have included in the study. The people were excluded with variable or unreliable responses, having any ocular pathology, and tired and irritated people. The difference between subjective and objective duochrome tests is 0.006 diopters. Statistically, this is not a significant difference. The objective duochrome technique (chromoretinoscopy) yields highly correlating values to subjective duochrome values. Thus, this technique can be relied on and can be added as a part of regular workup in clinics.

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Received: June 02, 2024; **Accepted:** July 27, 2024; **Published:** July 31, 2024

Keywords: Retinoscopy, Chromo Retinoscopy, Optometric Examination, Defogging Procedure, Regular Workup

Introduction

Chromoretinoscopy is a diagnostic technique used to evaluate the retina and Retinal Pigment Epithelium (RPE). It can be performed subjectively or objectively. Subjective chromoretinoscopy involves the use of a hand held instrument called a duochrome to measure the color and intensity of light reflected from the retina. The patient is asked to fixate on a target, and the clinician moves the duochrome across the retina, observing the color and intensity of the reflected light. This technique allows the clinician to identify abnormalities in the RPE and retina, such as pigmentary changes or inflammatory lesions.

Objective chromoretinoscopy involves the use of a machine called a fundus reflectometer to measure the color and intensity of light reflected from the retina. The patient's eye is illuminated with a specific wavelength of light, and the reflectometer measures the amount of light that is reflected back. This technique is often used to measure the thickness of the RPE, which can help diagnose and monitor conditions such as age-related macular degeneration.

Both subjective and objective chromoretinoscopy are useful diagnostic tools that can help clinicians assess the health of the retina and RPE. Subjective refers to something that is based on personal opinions, feelings, or judgment, rather than on facts or evidence. In the context of chromoretinoscopy, subjective refers to the use of a handheld instrument called a duochrome to measure the color and intensity of light reflected from the retina. The clinician observes the reflected light and makes a judgment about the health of the retina based on their interpretation of the colors and intensities.

Subjective chromoretinoscopy has the advantage of allowing the clinician to directly observe the retina and identify subtle changes that may not be detectable with objective techniques. However, it can be more time-consuming and subjective, as it relies on the clinician's interpretation of the reflected light. In comparison, objective chromoretinoscopy uses a machine to measure the amount of light reflected from the retina, which can be more objective and faster to perform. However, it may not be as sensitive as subjective chromoretinoscopy in detecting subtle changes in the retina. Both subjective and objective chromoretinoscopy have their own strengths and limitations, and they can be used in combination to provide a more comprehensive assessment of the retina and retinal pigment epithelium.

Determination of endpoint of refraction subjectively or objectively is the most essential, critical, and challenging part of the clinical optometric examination. The subjective method may be an integrated element in the point determination. It may still not correct the patient to qualifying standards at a distance or near. The level of negative and positive responses of the patient may be misleading. To avoid such discrepancies, objective methods of chromoretinoscopy can be used. This technique can prove to give unbiased and true values of endpoint more quickly than the subjective methods. The significance of objective refraction procedures is evident with illiterate patients, children, or others who cannot subjectively respond. It is also much faster than a strictly subjective procedure. Keeping in view the above response, we undertook the study to find the usefulness and reliability of the two techniques in refining the endpoint of our subjective refraction.

Retinoscopy (Objective Refraction)
Retinoscopy is a method to find out refractive error, and the retinal reflex is "neutralized" by the examiner using suitable lens power in front of the patient eyes.

Chromoretinoscopy
Chromoretinoscopy is used to find out the portion of chromatic aberration interval in focus while fixating at far or near. Transmittance filter with chosen dominant wavelength when placed in the light path between the light origin of a retinoscope, and the eye, make manageable a clinical measurement of chromatic aberration of an eye. This also determines the estimate in focus in the retinal plane when an eye fixating a target at various distances. Transmittance filters with selected dominant wavelengths, red and green. This when placed in the light path between the light source of a retinoscope and the retinoscopist's eye, makes possible a clinical measurement of the chromatic aberration of an eye, and this is chromoretinoscopy.

Subjective Refraction
After the objective refraction with retinoscopy, a fine-tuning of the lens is made, based on the patient's choice of the lens power. This refinement is done with each eye separately and then both together.

The duochrome or bichromatic test is based on a monocular refraction in which each eye is tested individually. It is a purely subjective test that requires the patient response to better the spherical correction. The Chromatic aberration is the foundation of the test; the various wavelengths of light are bent to a different stage, the longer wavelength (red) is refracted less than the shorter (green). If the letters on the red side look clearer more, add minus power; if the letters on the green side look clearer more, add plus power. Neutrality is reached, when the letters on both the chart backgrounds appear as equally clear. Initially, the vision was slightly fogged in +0.25D until letters on the red side appeared to be distinct for the patient. This was followed by a defogging procedure in 0.12D steps until the next reduction of –0.25 or –0.12D enables the letters on the green background to appear more distinct.

Justification
Subjective refraction always has an edge above objective refraction because the patient's responses are considered and he or she is corrected to his or her satisfaction. But the patient's response is not always quick and prompt. It takes a lot of time and patience in the clinical setup to go with the patient's responses till the best visual outcome is achieved. Many times even after following a good subjective technique the required standard visual outcome is not achieved. Such occurrences are more obvious in illiterate, non-responding, angry, very young, and patients with variable responses.

Objective Chromoretinoscopy is such a technique, which does not depend on the patient's responses. It is a quicker and objective technique. This technique is not being used in regular clinics. This may be because of poor familiarity with the procedure or the need for very good refraction. The specific requirement of this technique "filters" are readily available in the regularly used trial boxes in clinics. Thus, I have undertaken this project to familiarize and prove the technique of chromoretinoscopy that it correlates to the values we get for spherical endpoint in subjective duochrome balancing.

Objectives
- To exclude the subjective part of refraction from regular clinics.
- To prove that subjective and objective duochrome tests produce the same results.
- To provide the best possible optical correction to uncooperative patients.
- To avoid the hit and trial method of prescribing glasses that the patient accepts.
- To save time in the busy clinic which is always overloaded with patients.

Materials and Method
Students of DEPARTMENT OF OPTOMETRY, GALGOTIAS UNIVERSITY, have been the subjects for this project. The required materials for this, visual acuity charts, retinoscope, red and green filters, the trial box have been taken from the PRE CLINICS LAB.

Inclusion and exclusion criteria described below
Inclusion Criteria
- Best-corrected visual acuity 20/20.
- Age between 15-30 years.
- Promptly responding to subjects.
- Subjects with no ocular pathology.

Exclusion Criteria
- Subjects with ocular pathology.
- Irritated subjects.
- Variable responses.
- Subjects not able to appreciate equality of red and
- Green in duochrome balance

Refraction
All the subjects have undergone Retinoscopy. Taking the retinoscopic values as a starting point the subject was fogged 2.00D above the value. Defogging was done in 0.25D steps till minimum minus or maximum plus power for 6/6 visual acuity was achieved.

Duochrome Balance
With the above lens power in the trial frame, the standard duochrome chart was shown to the subject. The lenses were changed accordingly till the subject reported equality of sharpness of letters on both the backgrounds red and green without any bias. These values were recorded as the subjective endpoint of refraction.

Chromoretinoscopy
This technique is the same as retinoscopy accept the use of specific filters. The retinoscope is kept at the highest illumination and surrounding illuminations are kept at a minimum. Keeping a red filter just in front of the peephole of the retinoscope regular retinoscopy was done on the subjects. The dioptric power for neutrality was obtained and recorded as a red filter value.

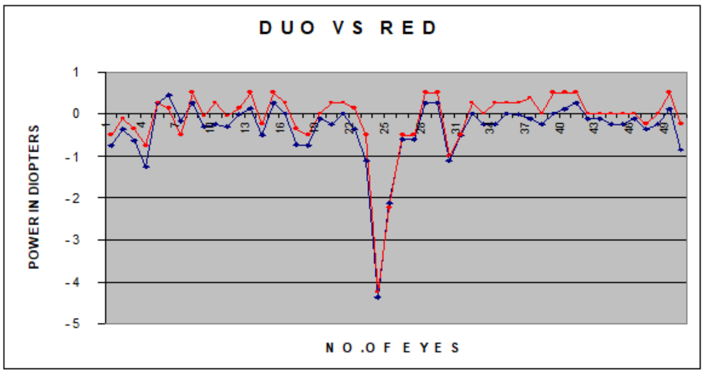
Maintaining the same working distance, retinoscope illumination, surrounding illumination, the retinoscopy was repeated for the subjects using a green filter in front of the peephole of the retinoscope. The dioptric power for neutrality was obtained and recorded as a green filter value. The values obtained above were recorded. The average of the two values was considered the chromoretinoscopic value. This value was compared to the values obtained on duochrome balancing and assessed for correlation.

Analysis and Results

A pilot study was done for this project before the actual data collection. On the basis of this study, the sample size was calculated. The sample size calculated is-50 eyes. On the basis of the inclusion and exclusion criteria subjects were chosen. Various parameters studied their analysis and their results are enlisted in the tables below.

Table 1: Comparison of the Spherical Equivalent of Subjective Duochrome Balance Results to the Values of the Spherical Equivalent of Objective Chromoretinoscopy using a Red Filter.

SE(Duochrome)	SE(Red filter)	SE(Duochrome)	SE(Red filter)
-0.75	-0.5	-0.62	-0.5
-0.375	-0.125	-0.62	-0.5
-0.625	-0.375	0.25	0.5
-1.25	-0.75	0.25	0.5
0.255	0.25	-1.12	-1
0.44	0.125	-0.5	-0.5
-0.18	-0.5	0	0.25
0.25	0.5	-0.25	0
-0.31	-0.06	-0.245	0.245
-0.25	0.25	0	0.25
-0.31	-0.06	-0.005	0.245
-0.005	0.125	-0.125	0.375
0.125	0.495	-0.25	0
-0.5	-0.25	0	0.5
0.25	0.5	0.12	0.5
0	0.25	0.25	0.5
-0.745	-0.375	-0.12	0
-0.75	-0.505	-0.12	0
-0.12	0	-0.25	0
-0.25	0.25	-0.25	0
0	0.25	-0.12	0
-0.375	0.125	-0.37	-0.25
-1.12	-0.5	-0.25	0
-4.37	-4.25	0.12	0.5
-2.12	-2.25	-0.87	-0.25



Analysis

Duochrome vs red filter: not significant at the .05 level. t-statistic is -(-1. 61).
Degrees of freedom-98
P (1-tailed)-(0.0553)
P (2-tailed)-(0.1106)

DOI: doi.org/10.47363/JORRR/2024(5)177

Result

The mean difference between the values of duo-chrome balance and values obtained on chromoretinoscopy using the red filter is (-0.2433). Thus we can get values almost equal to that of duo-chrome balance by adding a factor of (-0.2433) to the objective chromoretinoscopy values.

Table 2: Comparison of the Spherical Equivalent of Subjective Duochrome Balance Results to the Values of the Spherical Equivalent of Objective Chromoretinoscopy Using a Green Filter.

SE(Duochrome)	SE(Green filter)	SE(Duochrome)	SE(Green filter)
-0.75	-1	-0.62	-1
-0.375	-0.625	-0.62	-1
-0.625	-1.125	0.25	0
-1.25	-1.37	0.25	0.25
0.255	-0.25	-1.12	-1.5
0.44	-0.375	-0.5	-0.87
-0.18	-0.625	0	-0.25
0.25	0	-0.25	-0.5
-0.31	-0.56	-0.245	-0.245
-0.25	-0.12	0	0
-0.31	-0.56	-0.005	-0.005
-0.005	-0.125	-0.125	-0.125
0.125	0.125	-0.25	-0.37
-0.5	-0.75	0	0
0.25	0	0.12	0
0	-0.25	0.25	0
-0.745	-0.875	-0.12	-0.25
-0.75	-0.875	-0.12	-0.5
-0.12	-0.5	-0.25	-0.5
-0.25	-0.25	-0.25	-0.5
0	-0.25	-0.12	-0.5
-0.375	-0.375	-0.37	-0.75
-1.12	-1.5	-0.25	-0.5
-4.37	-4.75	0.12	0
-2.12	-2.75	-0.87	-0.88

Analysis

Duochrome v/s green filter:not significant at the .05 level. t-statistic is 1.50.
Degrees of freedom-98
P (1-tailed)-(0.0684)
P (2-tailed)-(0.1368)

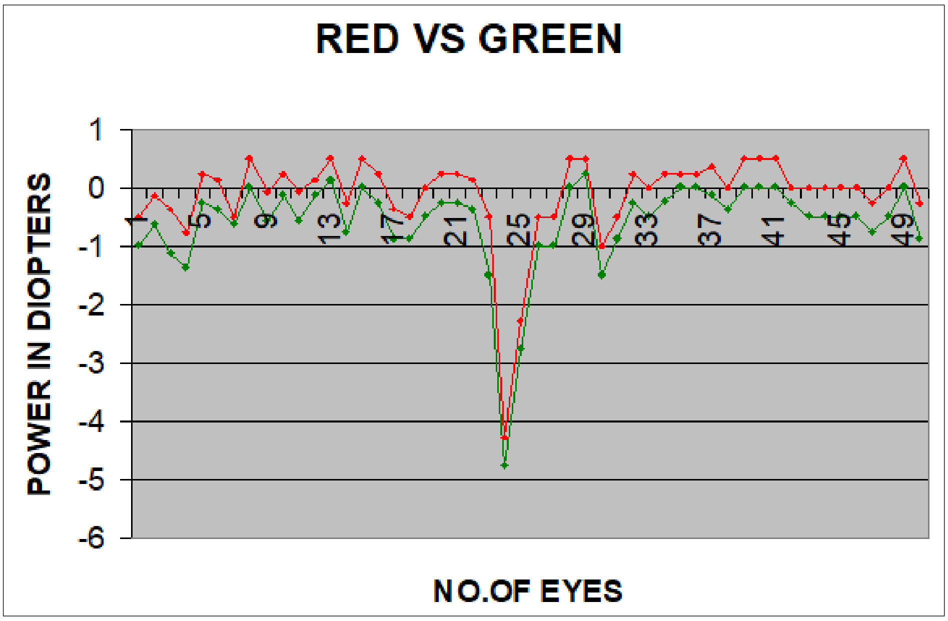
Result

The mean difference between the values of duo-chrome balance and values obtained on chromoretinoscopy using a green filter is 0.2310. Thus, we can get values almost equal to that of duo-chrome balance by adding a factor of 0.2310 to the objective chromoretinoscopy values.

Table 3: Comparison of the Spherical Equivalent of Chromoretinoscopy using a Red Filter to the Values of the Spherical Equivalent of Chromoretinoscopy using a Green Filter

SE(red filter)	SE(green filter)	SE(red filter)	SE(green filter)
-0.5	-1	-0.5	-1
-0.125	-0.625	-0.5	-1
-0.375	-1.125	0.5	0
-0.75	-1.37	0.5	0.25
0.25	-0.25	-1	-1.5

0.125	-0.375	-0.5	-0.87
-0.5	-0.625	0.25	-0.25
0.5	0	0	-0.5
-0.06	-0.56	0.245	-0.245
0.25	-0.12	0.25	0
-0.06	-0.56	0.245	-0.005
0.125	-0.125	0.375	-0.125
0.495	0.125	0	-0.37
-0.25	-0.75	0.5	0
0.5	0	0.5	0
0.25	-0.25	0.5	0
-0.375	-0.875	0	-0.25
-0.505	-0.875	0	-0.5
0	-0.5	0	-0.5
0.25	-0.25	0	-0.5
0.25	-0.25	0	-0.5
0.125	-0.375	-0.25	-0.75
-0.5	-1.5	0	-0.5
-4.25	-4.75	0.5	0
-2.25	-2.75	-0.25	-0.88



Analysis
Red filter vs green filter: significant at the .05 level. t-statistic is –(3.02).
Degrees of freedom-98
P (1-tailed)-(0.0016)
P (2-tailed)-(0.0032)

Result
The mean dioptric difference between the values of the red and green filters is (0.4743).

DOI: doi.org/10.47363/JORRR/2024(5)177

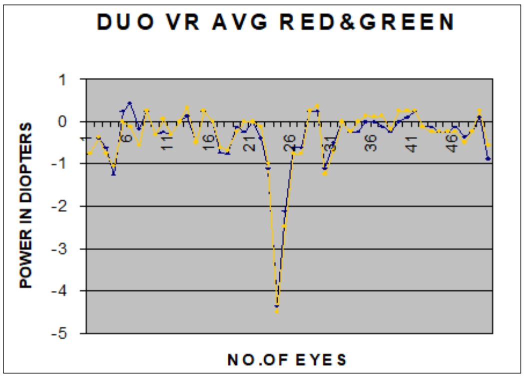
Table 4: Comparison of an Average of Spherical Equivalent of Chromoretinoscopy using Red Filter & Green Filter to the Value of Duo-Chrome Balance

AVGE red & green	SE(Duochrome)	AVGE red&green	SE(Duochrome)
-0.75	-0.75	-0.75	-0.62
-0.375	-0.375	-0.75	-0.62
-0.75	-0.625	0.25	0.25
-1.06	-1.25	0.375	0.25
0	0.255	-1.25	-1.12
-0.125	0.44	-0.685	-0.5
-0.5625	-0.18	0	0
0.25	0.25	-0.25	-0.25
-0.31	-0.31	0	-0.245
0.065	-0.25	0.125	0
-0.31	-0.31	0.12	-0.005
0	-0.005	0.125	-0.125
0.31	0.125	-0.185	-0.25
-0.5	-0.5	0.25	0
0.25	0.25	0.25	0.12
0	0	0.25	0.25
-0.625	-0.745	-0.125	-0.12
-0.69	-0.75	-0.25	-0.12
-0.25	-0.12	-0.25	-0.25
0	-0.25	-0.25	-0.25
0	0	-0.25	-0.12
-0.125	-0.375	-0.5	-0.37
-1	-1.12	-0.25	-0.25
-4.5	-4.37	0.25	0.12
-2.5	-2.12	-0.565	-0.87

Analysis
Average red-green vs duochrome: Not significant at the .05 level. t-statistic is (-0.04).
Degrees of freedom-98
P (1-tailed)-(0.4841)
P (2-tailed)-(0.9682)

Result
The mean difference between the average values of red & green filter and duo-chrome balance is (0.00615) diopters.

Discussion
This study proves the hypothesis of this project that the results obtained from the subjective duochrome balancing technique and objective duochrome is almost the same. The minimal dioptric difference between the two values in this study is only 0.006D for which the patient is not sensitive. Such highly correlating values can be substituted in place of each other [1-5].



The other interesting observations done in this study gave various factors and specific numerical values. We can achieve the values equal to duochrome balancing by adding a factor of -0.2433 to the value of chromoretinoscopy using a red filter.

Similarly, for chromoretinoscopy using a green filter an addition of a factor of 0.2310 will give values equal to duochrome balancing. The mean difference between the values of the two chromoretinoscopies is 0.4743. This value correlates to the dioptric difference between the wavelengths of red and green, which according to the standard texts is 0.50 diopters. The yellow wave band having a wavelength of 570nm is preferred to be focused on the retina because it forms the least circle of confusion on the retina. The green light of wavelength 535nm tends to focus 0.20 diopters in front of the retina according to standard text. This study calculates this value as 0.2310. The figure for red according to the text is 0.24 diopters and in this study is (0.2433) behind the retina. These differences could be due to the manufacturing and standardization of duochrome test chart, which can be ignored in this study because the difference is very minor. This study mostly includes emmetropes. Such a criterion has been chosen because they are more sensitive to duochrome testing and can appreciate a difference of even 0.12 diopters, which has been proved by the pilot study done which makes them change their preferences from red to green or vice-versa. The statistical data and the analysis done has proved the supposition that subjective and objective duochrome test give correlating values. So this objective assessment of endpoint of refraction may have clinical value [5-10].

Summary and Conclusion

The study successfully proves the hypothesis of the study that subjective and objective duochrome values are the same. Thus, the traditional technique of subjective duochrome balancing, which can often be tedious and time-consuming can be replaced with chromoretinoscopy using a red and green filter. This technique necessarily demands proper refraction by the refraction. This can particularly be used when the patient is very young or patients who cannot promptly respond.

Limitations in the Study

The optimum room illumination conditions required for chromoretinoscopy have sometimes not been fulfilled due to various reasons. But as the results are correlating well with the assumption made, we could still rely on this.

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