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Evaluate the Effect of using Chromagen Lens upon Color vision deficiency

Muhammad Lafi Alosimi[1*], Naif BaniJ Alharbi[2], Yosefdaifallah Alzahrani[3]

[1] Senior optometrist at Prince Sultan Military Medical City, Riyadh KSA

[2] Senior Dietitian at Prince Sultan Military Medical City, Riyadh KSA

[3] Healthcare administration at Prince Sultan Military Medical City, Riyadh KSA

Abstract -

Purpose: This study investigated the efficacy of theChromagen lens in CVD subjects, and Evaluate the effects of using Chromagen Lens with CVD.

Methods: Color vision tests by ishihara before and after chormagen lens filter to measure the improvement and the city university 3rd edition color vision test for determine the type of CVD.

Results: Chromagen lenses improved color vision perception in deutan and protan subjects with the Ishihara test.The average of improvement in ishiharaplates by± 60% SD responses after wearing the chromagen lens in all subjects was observed.all the identified CVD subjects reported improved color vision perception with the chromagen lens.

Conclusion: The chromagen filter improve general color perception, make colors brighter and clearer, allow shades of color, previously unseen, to be observed and discriminated and improve color naming, improve performance on color vision tests. Can use the chromagen lens in jobsrequire excellent color perception for example Soldiers, pilots, engineers and designers and use these lenses with good illumination and after finishing work can be removed.

Keywords - Chromagen filter, Chormagen lens, Color vision deficiency

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INTRODUCTION

Color vision deficiency (CVD), is building blocks of the argument byDiggles (2014), who stated that color blindness is among the most common disorders of vision. Besides, the increasing intensity of studies directed towards color vision deficiency proves the need for increased awareness on this form of invisible disability in order to provide a greater role in assistance and advocacy.

Therefore, this study analyses the effect that chromagen lenses have on patients with color blindness. Moreover, it provides the diagnostic measures required to establish the presence of color blindness, as well as categorize the diagnosed color vision deficiency based on the different types of color blindness discussed.This study is primarily intended to emphasize the vulnerability and sensitivity of the human eye. Furthermore, draws significant insight for optometry and ophthalmologystudents and professionals, as well as people involved in wide ranges of occupations in healthcare delivery.

Within the retina are two cells, the rod cells and cone cells, which react differently to light.Rod cells are extremely sensitive to light and are designed to react even to the faintest lights such as that from the star (American Academy of Ophthalmology, 2017). However, the rod cells do not see colors, but enable people to see objects a night only in shades of black, white and grey. On the other hand, cone cells are designed to react to brighter light and enable people see the detail in objects. These cells are responsible for picking up colors. The types of colors they pick, predominantly red, blue and green, categorize cone

cells. The color that people see, therefore, is a combination of the messages that brain retrieves form each definite set of cone cells. Color blindness, therefore, accrues from either the lack of one or more of the different types of cone cells or the inability of these cone cells to function optimally.

The definition of color is relevant in color deficiency as it depicts the mechanics behind reality of the inability of people to sense or see the detailed physical spectral differences of objects despite them having the normal vision. In developing a suitable definition therefore, Fomins and Ozolinsh (2011) emphasized on the significance of overlooking the basic myths and assumptions developed by people with regard to color blindness.Therefore, color blindness is the inability to perceive differences between some colors that other people can distinguish. Color blindness manifests at the back of the human eye, the retina, which is responsible for picking up the light that comes into the eye.

Types of color blindness

In a study conducted to analyze the scope of color blindness, Hasrod and Rubin (2016) identified two typesof color vision deficiency, which theylabeled as congenital (hereditary) and acquired. In making these establishments, Hasrod and Rubin (2016) observed that color blindness in all its various forms accrues from anomalies in one or more of the cone cells wavelengths, which cause different sensitivities. Consequently, the authors validated their study by linking the roleof color differentiation to the neural processes in the retina and the brain, which result from the comparison of activities of the cone receptors. Whereas the normal color vision is characterized by the ability to perceive hundreds of thousands of variations in color, both the hereditary and acquired forms of color blindness subject the person to less than 100 color variations.

According to Sasaki and Vorauer (2013), majority of the color blindness disorders are hereditary. This means that such disorders manifest as a result of genetic defects in the cone cell genes that have instructionsmakingthephoto pigments. Whereas other defects can change the sensitivity of the photo pigment to color, others can result in total loss of the photopigment. However, the categorization of the types of color blindness depends on the type of defect on the red, green or blue cone cells.

Red-Green Color Blindness

This type of color blindness, which Randolph (2013) claimed to be the most common, is hereditary. It is caused by the limited function or total loss of the photopigments of the red cone (protan) or green cone (deutran). There are several types of red-green color blindness. Theyinclude Deuteranomaly, Deuteranopia, Protanopiaand Protanomaly, which are all linked with genetic disorders of the X(female) gene.

Protanopiais the color vision disorder that accrues from having no working red cells, which subjects the person into viewing shades of green, yellow and orange as predominantly yellow, while red appears as black. On the other hand, Deuteranopiais the equivalent of Protanopia, only that there are no working green cells. Green objects are seen as beige, while red objects are seen as brownish or yellow. Both Deuteranopia and Protanopiaaffect 1% of males.

Protanomaly,on the other hand, manifests due to abnormalities in the red cone pigment. This color blindness limits the ability of the person to brightly view red, yellow and orange colors, as they appear greener. Protanopiais the color vision deficiency linked with anomalies in the green cone photo pigment. A person having this anomaly often views green and yellow objects as redder, and experiences difficulties in differentiating blue from violet. Both conditions caused by anomalies in the red and green cones are considered mild, and do not affect the daily living of the colorblind patient. However, the latter is the most prevalent form or red-green color blindness, as it affects nearly 5% of the males. The other forms of red-green color blindness affect an average of 1% males.

Blue-Yellow Color Blindness:

This form of color blindness is rarer than the red-green color blindness (American Academy of Ophthalmology, 2017). This color vision deficiency is primarily linked with the limited functioning or total failure of blue cones (tritans). Besides, other people with this form of color blindness have no blue cones. There are two predominant types of blue-yellow color blindness. Tritanomalyis a color blindness type linked with functionally limited blue cones. When having this disorder, blue appears greener, and the person experiences difficulties in telling red and yellow from pink. However, Konstantakopoulou, Rodriguez-Carmona and Barbur (2012) explain that this form of disorder is very rare, though studies indicate that it affects females and males equally, hence is autosomally dominant. Just like Tritanomaly, Tritanopiais a rare recessive disorder, but arises from lack of blue cone cells in the retina. People with this disorder often perceive blue objects

as green, whereas yellow objects appear light grey or violet.

Completecolor blindness

Themain feature of complete color blindness is the inability to experience color in totality. In other cases, complete color blindness, also referred to as monochromacy, and may affect the clarity of vision, hence subjecting a person to lack of visual acuity. Hasrod and Rubin (2015) identified two types of complete color blindness, Cone monochromacy and Rod monochromacy**.** The first type of complete color blindness often accrues from the failure of two or three cone cell photo pigments. Withthisform of color blindness, the brain receives different signal from the different cones, which makes it difficult to perceive color. Therefore, for a person to have Cone monochromacy, theyhaveto be diagnosed with a failure in at least two cone cells.Failures in blue cone celloften present additional visual risks such asvisual dullness, uncontrollable eye movements and short-sightedness.

On the other hand, Rod monochromacyis defined as the most severe type of color blindness, which is present at birth. This color blindness disorder occurs when all the cone cells have functional errors, hence subjecting the person to lack of cone vision. Such people often view colors as gray, black and white. Similarly, the deficiency affects the rod cells, hence making the person uncomfortable in environments with bright lights. This disorder affects males and females equally.

Acquired color blindness

In the above discussion, the hereditary forms of color blindness have been discussed. However, Simunovic (2016)asserted that the risks of color vision deficiency do not end with the congenital types of color blindness. In making this argument, the author posted that acquired color vision deficiency can occur due to eye diseases or lesions elsewhere in the visual processes and pathways. Acquiredcolor vision deficiency can occur at any age, though its prevalence is higher among the older populations that report greater incidences of eye disease (Colourblindawareness.org 2017). One distinguishing feature between the acquired and congenital types of color blindness is the monocular occurrence of the former. In addition, there are diseases, medications and accidents that can subject a person to the risks of acquired color vision deficiency.

Prevalence of color blindness

From the type of color blindness discussed above, it is evident that the most prevalent types of color blindness are those that affect the men. AccordingtoKonstantakopoulou, Rodriguez-Carmona and Barbur (2012), nearly 2.7 million people in the UK have deficiencies related to color blindness. In Australia, nearly 8% of the male population is color blind, as compared to 0.4% of the color blind females. In this study, it was established that the prevalence of color blindness is higher in isolated communities that have limited genetic pooling. This statement is validated by the observation of Diggles (2014), who listed countries such as Hungary and Finland as those with high prevalence of the color blindness.Besides, the author observed that one in every ten men in Caucasian societies suffer from color blindness, as opposed to one in every 100 Eskimos. However, no proof exists to depict the spread in the prevalence of color blindness on social characteristics, as most of these disorders are hereditary.

In the year 2015, estimate from the report byNational Eye Institute indicated that nearly 7% of the male population had difficulties in perceiving the red and green colors, against the 0.4% female population. In the report, it was established that nearly 95% of the total color vision deficiencies involved the red-green color blindness disorder, with approximately 4% suffering from the blue colorblindness. Therefore, the prevalence of color blindness is higher in males than it is in female. Randolph (2013) attributed to this trend to the fact that majority of the common color blindness defects are inherited and passed through the X chromosome, which is common in men who have only one X chromosome, as opposed to women who have two X chromosomes.

Table 1: Type ,causes and prevalence of CVD

Type of color blind	L-con Red	M-con Green	S-con Blue	Genetic	Males	Female
Mono chromacy	Absent	Absent	Absent	Yes	Extremely rare	Extremely rare
Protanopia	Absent			Yes	1%	<1%
Deuteranopia		Absent		Yes	1%	<1%
Trianopia			Absent	Yes	Very rare	Very rare
Protanomaly	Weak			Yes	1%	<1%
Deuternamaly		Weak		Yes	5-6%	<1%
Tritanomaly			Weak	Yes	Very rare	Very rare

Causes and etiology of color blindness

Majority of the color vision deficiencies are genetically acquired, and are present at birth.

Colorblindness is an inherited disorder that is on the X chromosome, which is the structure that carries the genes. Upon conception, a part of each chromosome is passed from the parent through the sperm cells and the egg. The sex chromosomes (X and Y) determine the gender of a person, with females bearing the (XX) and males bearing the (XY). The X chromosome is acquired from the mother, and is dominant in the children. The color blindness gene in linked with the inheritance of the X chromosome, which passes 50% of the mutated genes to the child (Konstantakopoulou, Rodriguez-Carmona and Barbur, 2012). Females have two X chromosomes, making it possible for them to compensate for genetic losses in the other functional X chromosome. This explains why males are at higher risk of acquiring the X-linked disorders such as color blindness. Inherited color blindness can be present at birth or can begin in childhood. In other instances, inherited color vision deficiency may not appear until in adulthood.

Color blindness is not only linked with the genetic inheritance, as the American Academy of Ophthalmology (2017) reports. Majority of the color vision disorders that occur later in life are as a result of disease. Most of the acquired color blindness from diseasesis less understood, as opposed to the congenital forms of color blindness. There are certain chronic illnesses that can lead to color blindness such as glaucoma, Alzheimer's disease, macular degeneration, Parkinson's disease, chronic alcoholism, sickle cell anemia, diabetes mellitus, liver disease, retinitis pigmentosa, leukemia and multiple sclerosis.

Besides, there are medications that have been linked with causing color blindness. National Eye Institute (2015) reports that such medications cause color blindness in the long-term, as they subject the body to substance intoxication that may affect the eye. Such medications include high blood pressure medications, antibiotics, anti-depressants, anti-tuberculosis drugs, barbiturate and medications used in managing disorders of the nervous system. In addition, the continuous usage of dietary supplements and non-prescribed medications has been found to cause color blindness. Similarly, continuous exposure to chemical solvents in industrial and environmental spheres can cause color blindness. Such chemicals as carbon monoxide, lead and carbon disulphide can cause color blindness.

Furthermore, traumas coming from accidents that inflict head and eye injuries were listed by as Hood, Mollon, Purves and Jordan (2006) among the factors that cause acquired color blindness. The impact of such accidents, therefore, should not be underestimated, as the damages they inflict on the retina and certainpartsof the brain have the potential of causing not only color blindness but also total blindness. To strengthen this argument, Simunovic (2016) followed up by listing the neurological effects of accidents on the optical nerves, including retinopathy, lesions, optic neuritis, ganglion cells and neuropathy. Asearlier mentioned, the prevalence of color blindness is higher among the elderly. This supports the basis of the inclusion of age as a causative factor of color blindness.

Diagnosis of color blindness

There are several measures that can be taken to establish the presence of color vision disorder. In one test, aperson is required to look at a set of colored dots and establish a pattern in these dots, such as anumber of a letter. These colors enable the optician to understand the colors that pose aproblem to the patient. In a separate test, the opticians may arrange colored chips in accordance with the order of the similarity in the colors. Thereafter, the optician will dismantle the chips and ask the patient to arrange the colored chips in an order similar to the previous. The presence of a color vision defect limits the ability of the person to arrange the colored chips correctly.

As Fomins and Ozolinsh (2011) asserts, disorders in color vision can have ranging impacts on the life of a person. Therefore, the authors used this assertion to illustrate the significance of early detection of the problem, more so among the children who are at highrisk of inheriting the disorder from the parents. Besides, Randolph (2013) noted that in children, color vision defects greatly affect the learning abilities, which may stretch further to affect the development of reading and writing skills. Many of the tasks that people undertake in their daily routines rely on their ability to separate things using their characteristics, with color being among the characteristics used in specifying objects, according to Hood, Mollon, Purves and Jordan (2006). Color blindness may present difficulties for people to rely on color as the core differentiating feature of objects. Color blindness, moreover, increases the risk of accidents, as people use traffic lights to navigate their daily activities.

There are certain symptoms that guide the diagnosis of color blindness based on the criterion of severity. The mild symptoms of color blindness are the most common, with many people unaware of their color vision deficiencies. Parents need to observe their children and distinguish their behaviors with those of

other children, as this helps in noticing the color deficiency problems of the child. The most common symptoms of color blindness include trouble seeing colors and their brightness in the usual way, and difficulties in distinguishing between shades of the same and similar colors. According toJhanji and Xu (2011),expertrecommendations point to the need for eye exams for children aged between three and five years, coupled with a mandatory screening of the vision of all children, and periodicallyfor those enlisted as at high risk of color inherited color blindness,

Management and treatment of colorblindness

Chromagen lenses

First devised by optician David Harris, the chromagen therapy was developed at the research and development center of the Corneal Laser Center in Clatter Bridge (Hasrod and Rubin, 2015). Soon after it was developed, the chromagen therapy was bought and licensed by the Ultralase Clinic in Chester, with the ownership and distribution rights transferring lately to Cantor and Nissel. The chromagen therapy uses lenses, which since its inception, has been assisting patients with color vision deficiencies. In recent years, the developer of the therapy published areport in which he validated the use of the Chromagen contact lenses for patients with dyslexia, besides using it for reducing the severity and frequency of migraine.

Thechromagen therapy is a lens system that consists of contact lenses and tinted spectacles. Each of these lenses or spectacles has a specific color wavelength filter that controls the spectrum of light entering the eye. Several studies have been conducted to ascertain the mechanism that the chromagen lenses uses in enhancing the color perception of individuals with abnormal color vision.

Today, chromagen fitters come in spectacle form, which are supplied mostly for people categorized as having Specific Learning Difficulties (SLD). According to Harris, the decision to switch from the original production of chromagen contact lenses to spectacle is driven by the young age of the people with SLD. Besides, such filters are only required when the patient is studying or reading.

The chromagen lenses work using the color vision therapy, which contends that there are no two color vision defectives that are exactly the same. This therapy is established on the reality that every person has a unique perception of color, though majority of the color deficient patients have red-green color blindness. On the other hand, patients with a macula problem are almost totally monochromatic. Similarly, the color vision therapy observes the prevalence of color blindness, taking into consideration the high occurrence (8%) in the males as opposed to females (0.4%).

The chromagen lenses are placed over the non-dominant eye while the patient observes a color screen. Whereas the dominant eye sees the colors as is required, the non-dominant eye has adramatic change in the color perception, regardless of whether the eye is amblyopic or divergent. The chromagen lens filters are colored dark blues, yellow, violet, and magenta, orange, amber, light blue, purple and green (Oriowo and Alotaibi, 2011). Through trial and error, the optician finds the best filter that brings out the colors on the screen. However, the optician has to balance the process, as there may be two or three colors that have an effect of enlarging the color range, thus making other colors fluoresce.

The establishment of the optimum filter then leads to the installation of the appropriate soft contact lenses of a similar color in the eye. The developers of this therapy created three intensities from which the optician can make a choice, with the tint diameters variable as well, ranging between 5 and 7mm. As Wong (2011) explains, a full eye examination is necessary before fitting any contact lenses. After the chromagen lenses are fitted, the patient is subjected to numerous periodical tests that help in ascertaining the general perception of color that the patient has acquired with the lenses.

The above processes are often preliminary stages of the treatment procedures as required by the color vision therapy. However, asFomins and Ozolinsh (2011) posit, majority of the patients, ratio 3:1, report improvement at this early stage of treatment using the chromagen lens therapy. Thereafter, final contact lens is offered, with an option of making a tint in the spectacles. Some of lenses often are mirrored or semi-mirrored, and resemble fashionable glasses. These usually hide the spectacle tint. These spectacles are widely used for outdoor purposes, while the contact lenses are recommended for use at any time.

Thechromagen lens therapy works by changing the levels of each color that goesinto the non-dominant eye during the course of the color vision therapy. The variations of red, green and blue may be different in the dominant eye, but predominantly low in the non-dominant eye with the chromagen lenses filter over it. Thechromagenlenses subject the

patient's brain to two different sets of signals, hence causing confusion that that then enables the brain to differentiate between colors that previously looked the same. As a result, the color range perceived by the color defective eye is increased twice or thrice. Prior to the color vision therapy, a normal person has the ability to see over 10,000 different colors, as opposed to the color deficient person, whose maximum color rage perception does not exceed 100. However, after the chromagen lens therapy, the color defective patient has the ability to recognize over 6,000 colors, an observation strengthened in the study byOriowo and Alotaibi (2011).

The chromagen lens therapy, however, does not completely treat the patient with color blindness. Despite its inability to provide the patient with the perfect color perception, the chromagen lenses enable the patient to perceive more colors. This increases the ability of the color vision deficient patients to see the color differences that they previously had no ability to differentiate. Forcolor vision children patients, and adults alike, the chromagen lens therapy enables them to develop more accurate color naming, which may positively influence their learning and career outcomes. In developing this therapy, David Harris observed that the patients who recorded satisfaction of the therapeutic outcomes felt more normal, and frequently exhibited excitement of their new-found ability to perceive and subsequently differentiate between colors.

In this introduction, color blindness has been discussed in earnest, as a defect that affects the ability of a person to perceive colors as others do. Color blindness, furthermore, has been discussed in light of its causative factors, with the types of this defect largely linked with hereditary genetic disorders. The other type of color blindness discussed herein is acquired color blindness. Across the study, the diagnostic measures of color vision impairments have been dissected, with a detailed look at the Ishihara Test 24 Plate and City University Color Test 3rd Edition. However, the study reveals that the main treatment method of this defect, the chromagen lens therapy relies on trial and error basis in making its judgment. In conclusion, this study cements the need for more research to develop a more comprehensive method for managing and treating color blindness.

The aim of the study is to analyses the effect that chromagen lenses have on patients with color blindness. Moreover, it provides the diagnostic measures required to establish the presence of color blindness, as well as measures the improvement in patients with color vision deficiency based on the different types of chromagenlens. This study is primarily intended to emphasize the vulnerability and sensitivity of the human eye. furthermore, draws significant insight for optometry and ophthalmology students and professionals, as well as people involved in wide ranges of occupations in healthcare delivery.

MATERIAL AND METHOD

A total number of patients were 500 male examined by Ishihara tests in cross sectional study. Only 35 of Subjects were diagnosed having color vision deficiency CVD all subjects from al Riyadh were Aged between (12 and 50) years from king Saud university students, high school students, staff and teacher and all subjects had non ocular history Diseasesor general history of disease, Subjects with any history of ocular diseases were excluded. The Study was approval from king Saud University college of Applied Medical Science Research Committee. All procedures were conducted in accordance with the Declaration of Helsinki and with the approval of the institutional review board.

The patient after inclusion in our study they will be given a consent form describing the study. And take approval from the patient to participate in the study. At the beginning we take background information ofsubject's personal information (such as name, gender, ocular history).

Instruments

Ishihara Test 24 Plate Diagnostic Tool:

Named after its designer, Dr. Shinobu Ishihara, the Ishihara test 24 plate is a test that is conducted to ascertain the color perception and color vision deficiencies among perceived color blind patients. In designing the test, Ishihara envisioned a process that could provide an accurate and speedy assessment of color vision deficiency for people having the congenital types of color blindness. Besides, the designer noted that this is the most common form of color vision disorder, hence prioritizing the test's design to envision the red-green deficiencies. The plates used in this test are a simplified method of establishing the diagnosis of the congenital cases of color vision deficiency, and distinguishing them from the total color weakness that subject's other patients of color blindness to abnormalities in visual functions. However, there are certain forms of color blindness that the developer of the Ishihara test 24 plate referred to as rare. These include the total color blindness that subjects the patient to the total failure to make color variations.

This diagnostic test was not designed to diagnose such extreme cases.

The 24 plates used in the Ishihara test are referred to as pseudo-isochromatic plates (Hasrod and Rubin, 2015). These plates were designed to be appreciated correctly in rooms adequately lit by daylight. The differences in the appearances of the shades of color were the main reasons behind the stipulation that these plates be used in a room, rather than in direct sunlight or electric light that may produce shade-altering discrepancies on the readings. However, the designer revised the instructions to enable the use of electrical light that is adjusted to resemble the effect of natural daylight.

The optician holds these plates 75cm from the subject and tilts the plates to a right angle with the line of the subject's vision. The correct positions of each plate are printed at the back of the plate, with the numerical 1-17 seen on the pates. The subject is required to provide an answer within a period not exceeding three seconds. The inability of the subject to read the numerical on the plates then obligates the optician to introduce pates 18-24. The winding lines between two X's are traced with the brush, and a time limit of ten seconds provided for the completion of each tracing.

The Ishihara test 24 plates are designed to merely separate the color defectives from those with normal color perception. Therefore, it is deemed unnecessary to use all the plates in the series if the subject completes the first 15 assessments successfully within the stipulated timeline. The designer of the tool also provided for the alteration of the order of the plates if it is suspected that there is deliberate deception on the part of the subject.

The assessment of the readings of plates 1 to 15 determines the normality or degree of defectiveness of color vision as portrayed by the subject. The criterion for analysis of the results dictates that a subject is regarded as normal if 13 or more plates are read normally. The subject is regarded as deficient if only 9 or less than 9 plates are read normally. Subjects who read numerals 5 and 45 on plates 14 and 15 easier than they do on plates 9 and 10 are regarded as abnormal. The test also admits that it is rare to find a person whose recordings of normal answers are between 14 and 15 plates. In such instances, color vision tests such as the anomaloscope are recommended. The color appreciation by short method is allowed by using six plates, with a normal recording of all plates being adequate proof of normal color vision. These plates, according to Ishihara should be stored well in closed places, as the continuous exposure to sunlight may cause fading of the plates. Color vision was tested by using the Ishihara 24 plate (kaneharashuppan Co., Ltd Tokyo japan 1980 edition)

City University Color Test 3rd Edition:

The City University Color Test 3rd Edition is a two-part test whose results are recorded on a customized sheet that is provided by the test. The first part of the test involves a screening aid for detecting defective vision of color, while the second part identifies the type and severity of the defect (Wong, 2011). Part one of the City University Color Test 3rd Edition is made up of four charts used in indicating any color vision defect. This is conducted in 30 seconds. Each chart has four vertical columns with three colored spots that the subject must identify. The second part displays a central color and four other colors at the periphery. The subject then selects a peripheral color that resembles the central color, within a time limit of 40 seconds.

In the first test, normal subjects detect a total of 9 or 10 spots in each chart (Fomins and Ozolinsh, 2011). However, deutans and protons score a total of between 4 and 5 missing spots, while tritansscore 7. In the second test, the degree of defect is acquired from the number of errors, with a mild defect depicted by few errors, as opposed to extreme defects that are depicted through maximum number of errors. Whereas the first part of this test performs its function through the number of correct choices made, the second part of the test differentiates the severity of the color deficiency based on the error rates between the three major types of color defect. Despite its accuracy, more research should be conducted to ascertain the need for a subject to undertake the second test after successfully completing the first test.the city university 3rd edition from (KeelerLtd., U.K 1998).

PROCEDURE

The procedure of study was as follows:

- Use Ishihara 24 plats test to find CVD subjects.
- Subjects can read more than 4 plats Excluded from the study.
- The CVD subjects examined by all 24 plats of Ishihara test and calculate the number of pages before the filter.
- Use the city university 3rd edition to determine type of color blindness (deutan or protan).central color and four other colors at the periphery. The subject then selects a

peripheral color that resembles the central color, within a time limit of 40 seconds.
- Use Ishihara plate NO.16/17 to determine type and severity of color blindness.

According to Ishihara 24 plat instructionthe normal subject read them as 26 (No.16) and 42 (No.17). In protanopia and strong protanomalia subject only 6 (No. 16) and 2 (No.17) are read, and in case of mild protanomalia both numerals on each plate are read but the 6 (No.16) and 2 (No.17) are cleared than the other numerals.

- Use four lenses for every CVD subjects test by Ishihara 24 plate and calculate the improvement of plats for every lens (pink, orange, magenta and violet).

Uses only sever CVD subjects because in the filter more affect in strong CVD subjects(OriowoandAlotaibi 2011).

All the tests were conducted under binocular viewing conditions. After finishing with subjects, we tell the subject about his condition and the type of color blindness he has, and best lens he improve with it. Many patients were not aware of the disease.And the risks to which they may beexposed

RESULTS

The study conducted 32 subjects with color vision deficiency, 24 subjects with deutan and 8 subjects with protan. The average plats of deutan before the chromagen lens was 2.75 with 0.989 Stander deviations.

Table one shows the result after apply chromagen lens as follow:

Table 2: Duetan with chromagen lens

Deutan	Mean	SD	percentage of the improvement	P value
Pink	17.083	2.9476	70%	0.000
Orange	2.250	3.3912	10%	0.570
Magenta	11.875	3.4680	49.45%	0.000
Violet	11.0417	3.5932	46%	0.000

Table onepresentedthe average of the deutan subjects before the chromagen lens was 2.75 plates and the average of them after use pink chromagen lens was 17.083 plats. Therefore, the total improvement in pink filter was 70% of ishihara plates. The orange filter shows low improvement around only 2.25 of ishihara plates, which is about 10% improvement.

The average of the improvement with the magenta filter was about 11.875 plates approximately 49.45%. Furthermore, by violet filter the improvement about 11.0417 plates, which equal 46%. The deutansubjects shows significant improvement with three types of chromagen filter the pink, magenta and violet. However, the orange filter shows no significant improvement results. The average plats of protan before the chromagen lens was 2.00 with 0.0 Stander deviations. Table two show the result after apply chromagen lens as follow:

Table 3: Protan with chromagen lens

Protan	Mean	SD	Percentage of the improvement	P value
Pink	17.50	4.840	72.91%	0.000
Orange	0.500	0.926	2%	0.429
Magenta	12.250	5.651	51%.	0.000
Violet	12.00	3.742	50%	0.000

Table twopresented the average of the protan subjects before the chromagen lens was only 2 plates and the average of them after use pink chromagenlens was 17.50 plates. Therefore, the total improvement in pink filter was 72.91% of ishihara plates. The orange filter shows low improvement around 0.50 of ishiharaplates which is about 2% improvement. The average of the improvement with the magenta filter was about 12.25 plates approximately 51%. Additionally, by violet filter the improvement about 12 plates which equivalent 50%. The protansubjects shows significant improvement with three types of chromagen filter the pink, magenta and violet. however, the orange filter shows no significant improvement results.

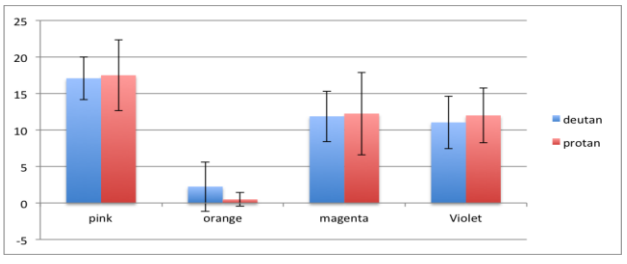

Figure 1 improvement in plates after chromagen lens

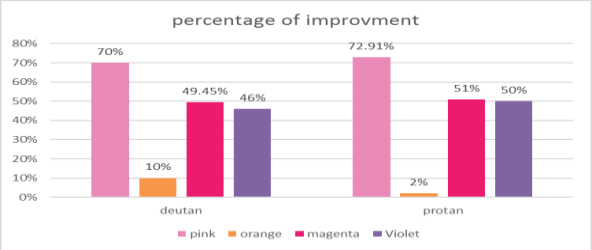

Figure 2 percentage of the improvement

In figure one show the average of improvement and the pars show the stander deviation of the improvement after use chromgen lens. Figuretwo show the percentage of improvement after use chromagenlens,bothfigure one and two displaysdeutan and protan subjects show nearly similar results of improvement byishihara plates after use the chormagen lens (pink, magenta and violet) and have significant improvement but by the orange filter show no significant improvement.

DISCUSSION

The study uses four lens of chormagen (pink, orange magenta and violet)on two type of CVD which isdeutan and protan by use Ishihara 24 plate test and calculate the plates before and after the use of chromagenfilter.The four lenses are long wavelengths lenses, the most effective of chromagen lens was the pink lens, it is found that about 70% improvement with ishihara test when subjects with deutan and protan use it.According to David Harristhe reason is that the wavelength of the pink is able to improve the perception of colors in the retina.

in addition, the wavelength of violet and magenta lens also haveenhancedthe color perception with deutan and protan subjects. Butthe wavelength oforangelens has less improvement among the others lenses and only 4 subjects of deutan were improvement with orange lens and there was no improvement in protan after using the orange lens.

The percentage of total improvementin this study is comparable to Dr. Harris' research and it is about ± 60% after use chromagen lens in deutan and protan subjects.

In developing a befitting definition of color vision deficiency, Wong (2011) began by defining color not as a physical attribute of objects but as light that is carried as specific wavelengths that are absorbed by the eye and converted into messages by the mind. Therefore, color scientifically refers to the sensory characteristic that is produced by different spectral dispersions. As Simunovic (2016) notes, people in reality never see the full scope of the spectral composition of an object, despite the seemingly lively and bright color perceptions of people. This explains why colors cannot be seen at night, as the perception of color is dependent on the surface reflection of light.

According to Dr. Harris the creator of chromagenlens,clarifies that the wavelength of chromagen lens have the most significant and able to improve the perception of colors more than other color wavelength on patients with red and greencolorsdeficiency. And the chromagenlensstillin the process of study and development to improve the efficacy ofthese lens.

Thechromagen lens can be benefits for some careers that require fine color perception such as electricians, electronic and chemical engineers, graphic artists, police officers, textile workers, photographers and others.

Subjects of the study were furthermore questioned as to their intentions for continuing Chromagenlens wears after completion of the study. Some of subject is stating that, they were too much bother because the background like lens color. Most others expressed interest when see the color lose it, the lenses wearing on an occasional basis. The effects of chromagen lens wear on vision, particularly difficult to use it in dim light and at night. Additionally, in this study apply the test of chromagen binocularly because thesubjects might experience some difficulties with judgement of distance and motion due to effect in monocular lens wear or with lenses of two different tint densities, also interference with stereopsis.

Colored lenses may realistically be expected to doimprove general colorperception,makecolors brighter and clearer,allow shades of color, previously unseen, to be observed and discriminated and improve colornaming,improve performance on color vision tests and general improvement in jobs and tasks that need color discrimination but expectations are not realistic because cure color vision deficiencies, immediate ability to name colors and ability to pass all color vision tests.

CONCLUSION

The results in this study showed that wearing the chromagen lens filter, provided remarkable color vision enhancement, particularly as obtained with the Ishihara test in bothsubjectsdeutanand the protantocorrect responses before wearing the chromagen filter and improved to correct responses

after wearing the filter. These include airline pilots (although the use of chromagen lenses are restricted for some commercial licenses), fashion designers, photographers, electricians and electronic engineers. The chromagen lens filter can used in those jobs after finish the job can be removed also have limit use in dark place because the lens is tint. There is no medical treatment exists that can cure color vision defects, except in some rare cases in which the color vision defect was acquired, and the underlying pathology was successfully treated (OriowoandAlotaibi 2011).Therefore,thechromagen lenses (UK) and other color correction lenses such as ColorMax (USA), ColorView (USA), and Colorlite (Hungary). However, it should be noted that there are some drawbacks with colored or tinted filter lenses, such as visual experience difficulties in dim light or at night when wearing tinted lenses to improve color perception, thus the optometrist or ophthalmologist should be consulted for professional care.

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Corresponding Author

Muhammad Lafi Alosimi*

Senior optometrist at Prince Sultan Military Medical City, Riyadh KSA