Vol: 08, Issue 01
OPHTHALMOLOGY PAKISTAN

Original Article

Applicability of Worth four dot test in patients with red green color vision defect visiting Mayo Hospital Lahore

Author's Affiliation

Shumaila Bashir

Muhammad Suhail Sarwar

Correspondence Author:

Correspondence to:
Dr Suhail Sarwar
College of Ophthalmology & Allied Vision Sciences (COAVS)/K.E.M.U Lahore.

Objectives: Primary aim of this study was to identify the validity of worth four dot test (W4DT) in patients with red green (R-G) color vision defect (CVD) to evaluate their binocular sensory status.

Method: Forty five individuals with R-G CVD went through W4DT. The type of R-G CVD was determined through D15 Farnsworth color test. W4DT was used to assess binocular sensory dissociation. Results were recorded according to the difference noted in case of amblyopia and squint. Prior approval was sought from ethical review board of College of Ophthalmology and Allied Vision Sciences to conduct this study.

Results: Total number of subjects was 45. Both males and females were included in the study. 25 individuals had protanopia while 18 individuals had deuteranopia and remaining 2 subjects had deuteranomaly. They performed W4DT at near and distance. Twenty out of 25 showed fusion and five had suppression. Among deuteranopia, 16 had fusion while one showed diplopia and remaining one had suppression. Out of 2 individuals one had diplopia and one showed fusion. Result showed that W4DT is significant in red green color vision patients where p=0.02. This result showed that patients with red green color vision defect can successfully perform the W4DT and their sensory status can be checked through this test.

Conclusion: It concludes that patients with R-G CVD can effectively perform the W4DT

Introduction

Color blindness is abnormal condition in which person is unable to differentiate between different colors of spectrum. Normal human color vision is mixture of three colors (red, green and blue) i.e., trichromatic.[1] Genes responsible for red green color vision defect are present on the long arm of X-chromosome within Xq28band.[2,3,4]

There is neither specific etiology of color vision defect or color blindness nor there is any treatment for color-blindness. The term "Color blind" describes that there is no actual blindness but there is abnormality in the development of one or more groups of retinal cones that are sensitive for color vision in light and then transfers that information to the optic nerve. It is a sex-linked disorder. Color blindness is more common in males than in females this is because the genes that create photopigments are present on the X chromosome. If some of them are absent or there is some abnormality then males are more affected because males only have one X chromosome. In females, a normal gene carries two X chromosomes which is enough to produce the needed photo pigments.[5]

Worth four dot test (W4DT) uses red and green colored glasses to assess binocular dissociation.[6] W4DT is of less importance when used in evaluation of longstanding and acquired strabismus in adults and in managing complex diplopia.[7]

Clinically depending upon the deficiency or absence of cone pigments, color vision defect is classified into protan (red), deutan (green) and tritan (blue-yellow) types. It is genetically governed by X-linked recessive inheritance and thus occurs in males but is carried out through female and about 8.0% of all women are its carrier.[8] Persons with deficiency of the red or green pigment are protanopes (P) or deuteranopes (D), respectively, and are known as dichromats. They have two colors of pigments instead of three normal pigments (red, green, and blue).

WFDT is performed using 1 red, 2 green and 1 white flashlight dots.[14] Binocular sensory status is investigated by W4DT.[9] This is very simple and common method. Coordination of both eyes is essential for the achievement of binocular single vision, so that separate images of both eyes are appreciated as a single image. There are four lights in W4DT that gives a diamond shape appearance with two green lights at the left and right sides, a red light at the top and a white light at the bottom. The patients wear their own refractive correction while the test is conducted. While performing the test, patient is asked that how many dots he can see and what color they were. The patient has to wear red-green glasses with a green lens over the left eye and a red lens over the right eye. The patient's right eye wearing the red filter blocks green light in this eye so he sees only the top red and bottom white lights. Whereas, his left eye wearing the green lens blocks red light at top so that he can see only the green lights at sides and white light at the bottom. Both eyes are able to see the bottom light if the patient has normal binocular vision. He will appreciate four lights with a sparkling R-G light and this occurs because of binocular contention. Therefore, one is supposed to have either usual binocular fusional reaction with no manifest strabismus, when a patient sees all four dots in WFDT or a harmonious anomalous retinal correspondence (HARC) if he has manifest misalignment.[10] On the other side, a patient may see two or three dots with repression of either eye if he has strabismus along with abnormal binocularity and/or amblyopia, five dots in case of diplopia, or he sees four dots in case of harmonious anomalous retinal correspondence.[11]

Materials and Methods

This is cross sectional study involving the use of structured proforma and informed consent signed from patient to evaluate the validity of worth four dot test in patients with red green color vision defect. Prior approval was sought from ethical review board of College of Ophthalmology and Allied Vision Sciences to conduct this study.

The study was conducted on 45 patients having red green color vision defect. Type of color vision defect was checked by D15 Farnsworth test. Worth four dot test was performed at near and distance. Data was entered and analysed using the SPSS 20.0 software.

Results

Table No. 1
W4DT at near vs type of red green color defect.

Count		Type of red green color defect			Total
		Protanopia	Deuteranopia	deuteranomaly	
W4DT at near	Suppression	5	1	0	6
	Fusion	20	16	1	37
	Diplopia	0	1	1	2
Total		25	18	2	45

Results showed that patients with red green color vision defect can successfully perform the worth four dot test at near. Majority of individuals showed fusion in W4DT results. This result showed that W4DT is of significant importance in red green color vision patients where p=0.017 (Chi-square test).

Table 2
W4DT at distance vs type of red green color defect.

Count		Type of red green color defect			Total
		Protanopia	Deuteranopia	Deuteranomaly	
W4DT at distance	Suppression	4	1	0	5
	Fusion	21	16	1	38
	Diplopia	0	1	1	2
Total		25	18	2	45

Results showed that patients with red green color vision defect can successfully perform the worth four dot test at distance. Majority of individuals showed fusion in W4DT results. This result showed that W4DT is of significant importance in red green color vision patients where p=0.02 (Chi-square test).

Discussion

There is one previous study present that is conducted on the patients that had R-G color vision defect (CVD). They went through the W4DT. In this test green and red lights are used so this is considered that individuals that have R-G CVD cannot accurately perform the W4DT.[8] So in this study persons that had R-G CVD underwent through W4DT. The W4DT was conducted on 45 individuals. They wore R-G glasses in which right eye was covered with red filter while left eye was under the green filter. The W4DT has four lights one red light at top, two green lights at each side and one white light at bottom.

In the results of W4DT performed at (near) 45 patients, 6 individuals had suppression and out of 6, one had deuteranopia and five had amblyopia. Whereas 37 individuals had fusion in which twenty had protanopia and 16 individuals had deuteranopia and remaining one showed deuteranomaly. While 2 patients had diplopia in which one was suffering from deuteranomaly and other from deuteranopia. So out of forty five patients 18 individuals showed deuteranopia while 25 had protanopia and rest of 2 persons had deuteranomaly. Out of total 45 patients, 5 individuals had suppression. Whereas 38 individuals showed fusion in which four had squint and 34 individuals were normal and remaining two individuals had diplopia which included one normal person and one was suffering from amblyopia. So out of total forty five, four individuals had strabismus while 6 had amblyopia and 35 persons showed that they were normal. Out of total 45 patients, 5 individuals had suppression. Out of these five, one had deuteranopia and four had protanopia. Whereas 38 individuals had fusion in which one had deuteranomaly, 16 patients showed deuteranopia and 21 individuals were suffering from protanopia and remaining two persons displayed diplopia which included one deuteranomalous person and one had deuteranopia. So out of total 45 subjects two individuals had deuteranomalous vision, 18 persons had deuteranopia and 25 showed protanopia.

However, all of these patients with normal vision and ocular alignment showed a binocular fusional response with the W4DT. Therefore, this does not alter our qualitative conclusions that patients with different types and degrees of R-G color vision defect showed reliable responses with the W4DT. In conclusion, this can be the primary study to demonstrate the validity of the W4DT on patients with R-G CVD.

In the end we acknowledge that our study had some restrictions. First, low sample size was used in a single hospital in a restricted time period. Secondly, there were few individuals with abnormality or visual disorder. Any studies with a larger range of patients are necessary to work out whether or not patients with variable R-G trichromacy defect and abnormal binocular sensory dissociation resulting from abnormality or visual disorder can show predictable results with the W4DT. Lastly, apart from R-G CVD, different severe types of trichromacy defects like achromatopsia, and other diseases related trichromacy defect like cone dystrophy or cerebral achromatopsia were not included.

Conclusion

It concludes that patients with R-G CVD can effectively perform the W4DT. They displayed good results and their sensory status can be checked by the W4DT. This shows that W4DT is applicable for red green color vision patients.

References

1. Karim KJ, Saleem MA. Prevalence of congenital red-green color vision defect among various ethnic groups of students in Erbil City. Jordan J Biol Sci. 2013;6(3):235-38.
2. Deeb SS, Kohl S. Genetics of color vision deficiencies. Dev Ophthalmol. 2003;37(1):170-87.
3. Filosa S, Calabro V, Lania G, Vulliamy TJ, Brancati C, Tagarelli A, et al. G6PD haplotypes spanning Xq28 from F 8 C to red/green colour vision. Genomics. 1993;17(1):6-14.
4. Norn M. Prevalence of congenital colour blindness among Inuit in East Greenland. Acta Ophthalmol.1997;75(1):206-09.
5. Holroyd E, Hall DM. A re-appraisal of screening for color vision impairments. Child Care Health Dev. 1997; 23(1):391– 8.
6. Ahsana SH, Hussain R, Fareed M, Afzal M. Prevalence of red-green color vision defects among Muslim males and females of Manipur, India. Iran J Public Health. 2013;42(1):16-.
7. Roper-Hall G. The "worth" of the worth four dot test. Am

Orthopt J. 2004;54(1):112-9.
8. Bak E, Yang HK, Hwang JM. Validity of the worth 4 dot test in patients with red-green color vision defect. Optom Vis Sci. 2017;94(5):626-29.
9. Pokorny J. Congenital color defects. Congenital and acquired color vision defects. 1979:183-241.
10. Poole CJ, Hill DJ, Christie JL, Birch J. Deficient colour vision and interpretation of histopathology slides: Cross sectional study. BMJ. 1997;315(7118):1279-81.
11. Oriowo OM, Alotaibi AZ. Colour vision screening among Saudi Arabian children. South African Optometrist. 2008;67(2):56-61.