PREVALENCE OF COLOR VISION DEFICIENCY AMONG DENTAL STUDENTS IN ALEXANDRIA, EGYPT

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ABSTRACT

Introduction: The key objective of esthetics in dentistry is to create natural blending, with well-proportioned teeth considering the parameters of surface form, translucency and color. Tooth color is determined either instrumentally or visually. Instrumental color determination of teeth is not error proof. Visual color determination, though subjective, is the most commonly applied method. Consequently, color vision deficiency would fundamentally influence this method.

Objectives: The aim of this study was to detect the prevalence of color vision deficiency among dental students in Alexandria, Egypt.

Methodology: Four hundred dental students were randomly selected [200 males and 200 females] to participate in this study. An informed consent was obtained and brief instructions were given. To facilitate the scoring and analysis of the results, a key answer sheet was used.

Results: The results showed that 4.5% of the males had color vision deficiency; meanwhile none of the females had color vision deficiency. Among the discovered color vision deficient males, 66% were not aware of their condition.

KEYWORDS: Shade Matching, Color Vision, Color Vision Deficiency, Ishihara Test.

INTRODUCTION

A smile has been reported to be one of the most important interactive communication skills of a person.[1] The key objective of esthetics in dentistry is to create a "beautiful" smile, with well-proportioned teeth that are pleasantly arranged with the surrounding structures (gingiva, lips and face).[2] In addition, the esthetics of any restoration needs to consider the parameters of surface form, translucency and color.[2-5]

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Many methods are currently used to assess tooth color. These range from visual subjective comparisons using paper, colored porcelain or acrylic resin shade guides to instrumental objective measurements using spectrophotometers, colorimeters and image analysis techniques. Visual color determination, by comparison of the tooth with standard color tooth shade guides, is the most regularly applied method in dentistry. This method is subjective whereby the tooth and the shade guide are observed simultaneously under the same lighting conditions. General variables [such as external light conditions, experience, age, and fatigue of the human eye] and physiological variables [such as color blindness] may lead to inconsistencies and bias.[6-8]

Instrumental color determination of teeth is not error proof. Therefore relying exclusively on the instrumental method is not a guarantee for success. Henceforth, visual assessment is of crucial importance. Despite its limitations; the human eye is capable of detecting even small differences of color between two objects.[9, 10]

"Color blindness" is a misnomer as only a small percentage of people are truly unable to see any color. Hence the term can be replaced by color vision deficiency [CVD].[6] CVD is either acquired or inherited. Acquired CVD can be a result of eye diseases or normal aging or even as a side effect of some medications. Inherited CVD is one of the common genetic disorders which is a sex linked recessive trait.[6] Dentists having defective color vision may be unaware of their defect, or may have problems in perceiving color as dentists with normal vision. This lack of knowledge of their condition may lead to inaccurate shade determination resulting in inappropriate "natural blending" and hence repeating their restorations.[11]

The science of color vision testing has advanced since its beginning in the late 1700s. Among the used methods in clinical practice at present are isochromatic plates. The Ishihara test is the most widely used screening test.[12, 13]

This study has not been conducted before among the universities of Egypt. This study; by screening the future dentists [in the Alexandria metropolitan area] for the presence of defective color perception, could help them in modifying their method of shade determination, hence improving their chances of achieving highly esthetic restorations.

The aim of this study was to detect the prevalence of CVD among dental students in Alexandria, Egypt.

MATERIALS AND METHOD

Sample selection

A sample size of 400 dental students from Alexandria was randomly selected for the study. The sample size included 200 males and 200 females with age ranges from 18 to 25 years. Non-Egyptian dental students were excluded, as well as students younger than 18 years old, or older than 25 years old.

Pseudo-isochromatic plates [Ishihara test concise edition]

It is an individual test consisting of several plates each 4x4 inches. The original test is an ingenious adaptation by Ishihara, professor of ophthalmology in the Imperial University of Tokyo.[14-16]

The concise edition used in this study consists of 14 plates. The plates are made up of colored circles of varying dimensions and chroma, against a background of other circles in which hue, in addition to dimensions and chroma may vary. [Figure 1]

Ishihara fashioned the test in such style that the design, through color contrast, may present one digit to the normal eye, and somewhat another to the color-weak or color-deficient eye. This is attained through the blending of a portion of the outline with the background circles of color [i.e. may either wipe out a digit, or alter and incorporate it into another].[14-16]
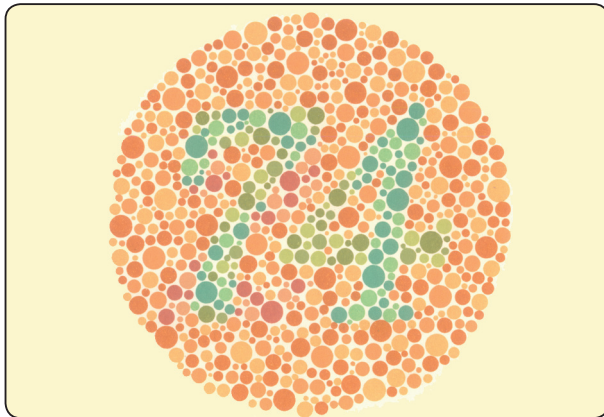
Fig. (1) Ishihara Plate V

Method:

Approval was obtained from the Committee of Ethics and Protection of Human Subjects. Four hundred dental students in Alexandria participated in this study. The participants were enrolled in the two universities in Alexandria, i.e. Alexandria University and Pharos University.

The tests were carried under controlled lighting. An informed consent was obtained from all participants. Brief instructions were given. The instructions contained information on the Ishihara plates; and the importance of screening for CVD. The participants were given 3 seconds to identify each plate placed in front of them. The scoring and analysis of their results were facilitated using a key answer sheet [table 1] that denotes the usual response for the normal color vision and those made by the different types of CVD persons.

TABLE (1) Answer sheet for Ishihara plates used in this study

Plate Number	Normal Person	Person with Red-Green Deficiencies				Person with Total Color Blindness
I	12	12				12
II	8	3				--
III	5	2				--
IV	29	70				--
V	74	21				--
VI	7	--				--
VII	45	--				--
VIII	2	--				--
IX	--	2				--
X	16	--				--
XI	Traceable	--				--
		Protan		Duetan		
		Mild	Strong	Mild		
XII	35	5	(3) 5	3	(3) 5	
XIII	96	6	(9) 6	9	(9) 6	
XIV	Can trace 2 lines	Purple	Purple (red)	Red	Purple (red)	--

The mark -- shows that the plate can't be read

Participants who were found to have CVD were given the test again to confirm their answers. They were informed discretely about their condition. They were given advice on how to deal with it in relation to dental procedures which are affected by their condition.

Variables that would affect the study [as the source of light, the room for the study, and time the test was held] were kept constant for all the participants.

Data was analyzed using IBM SPSS software package version 20.0. Qualitative data was described using number and percent. Significance of the obtained results was judged at the 5% level. Chi-square test and Fisher's Exact test were used.

RESULTS

After exclusion of those who did not meet the selection criteria, the total number of participants was 400. Two hundred were males [50%] and two hundred were females [50%]. The mean age [$\bar{x}$] was 21.89 years and the standard deviation [SD] was 1.51.

Dental students who participated in the test from Alexandria University accounted for 50.5%, whereas participants from Pharos University accounted for 49.5%. According to the test guide manual of the Ishihara test, if 4 plates or more were not identified correctly, the participant was considered as having CVD.

Table 2 shows the relation of gender to CVD. As for the male participants, 4.5 % were found to have CVD while none of the female participants showed to have CVD. Significance of the obtained results was judged at the 5% level. Chi-square test and Fisher's Exact test were used. Fisher's Exact was used for correction of Chi-square as expected frequency fell below 5. This test involved the calculation of the P value directly, without the use of particular test statistic.

TABLE (2) Relation of gender to CVD

	Male (n= 200)		Female (n= 200)		c^2	FEp
	No.	%	No.	%		
Normal color vision	191	95.5	200	100.0	9.207*	0.004*
Color vision deficiency	9	4.5	0	0.0		

c^2: Chi square test   FE: Fisher Exact test

*Statistically significant at p ≤ 0.05

Among the CVD positive candidates, 66% were found to be unaware of their condition.

DISCUSSION

Working with color is an important part of clinical dentistry. Whether restoring one tooth or several teeth, color matching with other teeth is needed to achieve harmonious restorations. Although color matching techniques have advanced over the years, frustration with color has been a problem in the past, is a problem now, and most probably will be a problem in the future.[17]

The dentist's perception of color is among the chief factors that has an effect on the shade selection process. This perception would be fundamentally affected should the dentist suffer from any form of CVD.[18]

CVD is one of the common genetic disorders which is reported to be a sex linked recessive trait.[11] It has a prevalence of 8% in males and up to 2% in females.[11, 19, 20] People with CVD frequently do not recognize its extent and consequences. Some react by denial. Others do not even recognize that they have a CVD.

It has been established that the ability to see color declines with age because of changes in the absorption of light by the ocular media such as the lens, retinal specialized cells (cones) as well as a reduction in pupil size.[21]

In order to minimize the aging effect on the eye, dental students belonging to the same age group were chosen to participate in this present study. In addition to their same age range, they have minimum or no familiarity with color matching, or color science in general. Furthermore, they are likely to have fewer systemic conditions that might affect color vision.[22, 23]

In this present study, the Ishihara plates [concise edition] were used to screen the participants. This test was chosen because it is considered the "Gold Standard" for quick diagnosis of congenital CVD as reported by Dain, Lee and Honson, and Birch.[12, 15, 24]

The percentage of males with CVD in this study was found to be 4.5%, whereas the percentage of females with CVD was 0%. These findings are lower than the global general population percentages [8% for males and up to 2% for females].[11, 19, 20]

In addition, these results are also lower than that reported by various studies performed on dental personnel. Studies performed by Barna et al[25], Moser et al[26], Preston and Bergen[27] McMaugh[28] and Davison and Myslinski[29] found the percentages of CVD to be 14%, 9.9%, 8%, 8.2%, and 7.8% respectively. The difference may be due to different age or racial backgrounds of the participants or the type of tests used for screening or even different conditions in which the tests were performed.

However, the results of this present study are in favor with the findings of Naik and Pai[11], and Curd et al[19] who found the percentages of CVD to be 5%, and 6% respectively.

In this present study, it was also found that 66% of the participants diagnosed with CVD, did not know of their condition. This result is very significant. Moreover, it agrees with the findings of Rigby et al[30], Steward and Cole[31], and Spalding[32].

It is noteworthy to mention the limitations of the present study. The number of students who participated is one of the downsides of the present study. This resulted in a comparatively limited number who were found to have CVD, which limited the statistical analysis of this group.

CONCLUSIONS

Within the limitation of this present study, it could be concluded that:

i. 4.5% of the male participants had CVD.

ii. None of the female participants had CVD.

iii. 66% of the participants with CVD were not aware of their condition.

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