
COLOR VISION DEFECT AND TOOTH SHADE SELECTION AMONG NIGERIAN DENTAL PRACTITIONERS

Defeito de visão e seleção de cores dentárias entre cirurgiões-dentistas Nigerianos

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Abstract

OBJECTIVES: The aim of this work is to assess the prevalence of color defect and the mode of tooth shade selection among dental practitioners. **MATERIAL AND METHODS:** Two hundred self administered questionnaires were sent to all the dentists in the six dental schools in Nigeria. The color vision status of the respondents was assessed using Ishihara test. The investigators were calibrated for examining the numbers in the plates by comparing the results of Ishihara test administered to them and were adjudged not to be color blind. Data was analyzed using SPSS version 11. Analysis used included frequencies cross tabulation, chi-square analysis and Fisher's exact tests. **RESULTS:** The prevalence of color blindness among Nigerian dentists working in teaching hospitals was found to be 6.3%. The prevalence was higher in males (8.4%) than in the females (3.9%) giving a male female ratio of 2.2:1. Color vision defect was highest among Pedodontists (33.3%), followed by Oral surgeon (8.3%) and general dental practice (6.5%). None in Conservative dentistry and Prosthodontics have color vision defect. Majority of those with color vision defect usually select color with concurrence from other dentist. **CONCLUSION:** The prevalence of color defect among dentists in Nigeria is high compared to other studies. Dentists should be screened for color vision defect before they choose their specialty.

Keywords: Color vision defect; Dental practitioners; Ishihara test.

Resumo

OBJETIVOS: Os objetivos deste trabalho são investigar a prevalência de dificuldade de visão e o modo de seleção de cores dentárias entre cirurgiões-dentistas Nigerianos. **MATERIAL E MÉTODOS:** Duzentos questionários autoaplicáveis foram enviados para todos os dentistas nas 6 faculdades de Odontologia da Nigéria. As condições de visão de cores dos profissionais que responderam o questionário foram avaliadas pelo uso do teste de Ishihara. Os investigadores foram calibrados para exame dos números nas lâminas pela comparação dos resultados do teste administrado a eles mesmos, não sendo os próprios cegos para cores. Os dados foram analisados usando SPSS versão 11. As análises incluíram tabulação cruzada de frequência, chi quadrado e teste exato de Fisher. **RESULTADOS:** A prevalência de cegueira para cores entre dentistas Nigerianos, trabalhando em hospitais de ensino, foi de 6,3 %. A prevalência foi maior em homens (8,4%) do que em mulheres (3,9%), proporção masculino/feminino de 2.2:1. Os defeitos de visão foram mais comuns entre os Odontopediatras (33.3%), seguidos pelos Cirurgiões Buciais (8,3%) e Clínicos Gerais (6,5%). Nenhum dos profissionais de Odontologia Restauradora e Prótese apresentaram defeitos de visão de cores. A maioria apresentou defeitos visuais para cores geralmente selecionam a cor de dentes com auxílio de outro dentista. **CONCLUSÃO:** A prevalência de defeitos de percepção de cores entre dentistas Nigerianos é alta, em comparação a outros estudos. Os dentistas deveriam ser avaliados para detectar defeitos de percepção de cores e os resultados deveriam ser levados em consideração na escolha da especialidade.

Palavras-chave: Defeitos de visão de cores; Profissionais de odontologia; Teste de Ishihara.

INTRODUCTION

People vary in their ability to detect small differences in color between two objects (1-3). Color perception also might differ for the same person under varying conditions (3). Moreover, once observers detect a color difference between two objects, their opinions might differ considerably in regard to the degree of this difference (4). Instrumental color measurement in dentistry assists in shade selection via intra oral optical electronic determination of a target color during fabrication of a restoration (5). However, application of technology that quantifies color and color difference is not yet a common practice in dental clinics. Previous research has not shown a positive correlation between instrumental and visual assessment of color differences in regard to matching crown pairs in all dimensions of color space (5).

Acceptability thresholds were found to depend on chromaticity. Observers were more critical of crowns in which color differed in redness as opposed to crowns that differed to the same extent in yellow color (1).

Many factors affect the process of shade matching, including the light source, the patient's clothing and makeup, inherent inconsistencies of commercial shade guides and vague orders on the laboratory prescription form (6). Research also has demonstrated that dental personnel who have impaired color vision make significantly more errors in the process of shade matching (7). Therefore, some authors have suggested that dentists consult an assistant for a second opinion during the shade selection process (8-10). Mollon (11) conducted a study and reported that women generally are more capable than men in the shade selection and color matching process. This may be because more deficiencies in color vision are recorded for men than for women (12).

Color vision deficiencies are a group of conditions that affect the perception of color (13). They can be inherited or acquired. Acquired color vision defects are caused by toxins, inflammation or detachment of the retina, macular degeneration, optic nerve diseases, ageing and many other causes (14). The problem usually occurs in all the cones and the central pathways

from the eye to the brain. Usually the color defect is red-green confusion or blue-yellow confusion. This type of color vision defect can affect one or both eyes, and can have a different degree of color defect in either eye (13), whereas congenital or inherited defects are genetic disorder. It usually affects only one type of cone, but can affect two or even all three of the cone types. The type of color defect depends on which cones are affected. This affects both eyes, so the degree of color defect in each eye is identical (14).

Color vision defects generally cause a range of changes in color vision, from mild difficulty with distinguishing shades to a total inability to detect color. These conditions are divided into three major categories: red-green color vision defects, blue-yellow color vision defects, and a complete absence of color vision (15-21).

Red-green color vision defects are the most common form of color vision deficiency. Among Caucasians, about 8% of males and 0.5% of females have red-green color vision defects, and 15% of females are heterozygous carriers. Red-green color vision defects are significantly less frequent among males of African (3%-4%) or Asian (3%) origin, largely because of the presence of more deuteranomalous individuals among Caucasians (5%) (22, 23).

Affected individuals have trouble distinguishing between shades of red and green. They see these colors differently than most people and may have trouble naming different hues.

Blue-yellow color vision defects affect males and females equally. This condition occurs in fewer than 1 in 10,000 people worldwide (24, 25). Blue-yellow color vision defects, cause problems with differentiating shades of blue and green. These two forms of color vision deficiency disrupt color perception but do not affect the sharpness of vision (visual acuity). An absence of color vision, called achromatopsia, is uncommon. People with complete achromatopsia cannot perceive any colors. They see only black, white, and shades of gray (26). A milder form of this condition, incomplete achromatopsia, may allow some color discrimination. People with achromatopsia almost always have additional problems with vision including reduced visual acuity, increased sensitivity to light (photophobia), and small involuntary eye movements called nystagmus (26).

Consequently, selecting the proper porcelain shade and matching restorations to the natural dentition continue to be challenges for the restorative dentist. The process of shade selection is an art in which the dentist and patient should collaborate. Dentists may consider changing a restoration because they believe the color does not match that of the adjacent teeth, even though the color difference might not be noticeable to the patient. Involving the patient in the shade selection process likely will improve his or her satisfaction with the final outcome.

To date, patient satisfaction with shade matching or patient input into the shade selection process has not been appraised carefully in the dental literature.

MATERIAL AND METHOD

Two hundred self administered questionnaires were sent to the six dental schools in Nigeria. The first part of the questionnaire consists of the dentist's biodata including area of specialization, the years of practice, and his /her mode of tooth shade selection procedure and whether he/she has been previously diagnosed as having color vision defect.

The second part consist of the Ishihara color blind Tests. The respondents were asked to correctly identify the numbers written in plates labeled A to G and to write it down in a space provided in the questionnaire without asking for any other person's opinion.

The investigators were calibrated for examining the numbers in the plates by comparing the results of Ishihara test administered to them and were adjudged not to be color blind. Data was analyzed using SPSS version 11. Analysis used included frequencies cross tabulation and odds ratio.

RESULTS

A total of 160 dentists, eight three (51.9%) males and 77(48.1%) females, aged 21 to 57 years (mean age being 32.7+ 6.64 years) who consented to the study and returned correctly filled questionnaire were recruited into the study given a response rate of 80% (Table 1).

TABLE 1 - Age group distribution of dentists according to color vision status

Age group	COLORVISION STATUS			
	NORMAL		COLORVISION DEFECT	
	No	%	No	%
21-29	57	96.6	2	3.4
30-39	73	93.6	5	6.4
40-49	18	90.0	2	10.0
50-59	2	66.7	1	33.3
Total	150	93.8	10	6.3

The majority of them (57.5%) including house officers, work in the general outpatient clinics of these hospitals, while specialists in Oral Medicine constitute the least (0.6%) (Figure 1).

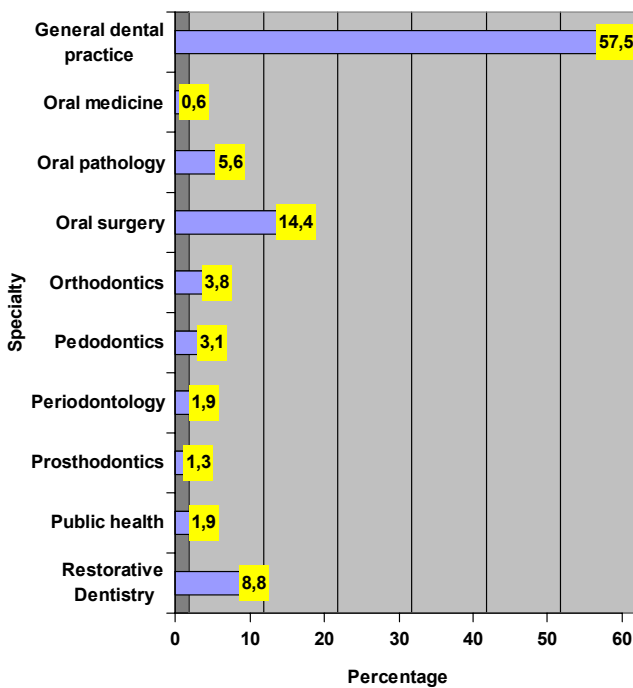


FIGURE 1 - Distribution according to specialty

Table 1 also shows that the prevalence of color vision defect increase among Nigerian dentists as the age increases. The prevalence was 3.4% in age group 20-29 years while it was 33.3% in age group 50-57 years.

There was a higher prevalence of color vision defect in males (8.4%) than in the females (3.9%) giving a male female ratio of 2.2:1 (OR=2.272, 95% CI=0.613-8.363).

Out of the 160 dentist that returned and correctly filled their questionnaire, 10 have color vision defect giving a total prevalence of color blindness among Nigerian dentists working in teaching hospitals to be 6.3% (Table 2).

TABLE 2 - Distribution of dentists according to color vision status by gender

STATUS	GENDER				TOTAL	
	Male		Female		No	%
	No	%	No	%	No	%
NORMAL VISION	76	91.6	74	96.1	150	93.8
COLOR DEFECT	7	8.4	3	3.9	10	6.3
TOTAL	83	100.0	77		160	100

Odds Ratio (OR=2.272,95% Confidence Interval (CI) = 0.613 - 8.363

Table 3 shows the prevalence of color blindness among various specialists in Nigerian teaching hospitals. Color vision defect was highest among Pedodontists (33.3%), followed by Oral surgeon (8.3%) and general dental practice (6.5%). None in Conservative dentistry and Prosthodontics have color vision defect.

TABLE 3 - Distribution of dentists according to color vision status by speciality

SPECIALITY	COLOR VISION STATUS				Total	
	NORMAL		VISION DEFECT		No	%
	No	%	No	%		
GeneralDentalpractice	86	93.5	6	6.5	92	57.5
Oralmedicine	1	100.0	0	0	1	0.6
Oralpathology	9	100.0	0	0	9	5.6
Oralsurgery	22	91.7	2	8.3	24	15
Orthodontics	6	100.0	0	0	6	3.8
Paedodontics	4	66.7	2	33.3	6	3.8
Periodontology	3	100.0	0	0	3	1.9
Prosthodontics	2	100.0	0	0	2	1.3
Publichealth	3	100.0	0	0	3	1.9
RestorativeDentistry	14	100.0	0	0	14	8.8
Total	150	93.8	10	6.3	160	100.0

One hundred and seven, (66.9%) out of 160 dentists usually select tooth shade with other dentists and patients. There is a lesser odd that those without color blindness will choose tooth shade alone when compared with those with color vision defect (OR=0.83, 95% CI =0.225-

3.099). Ninety nine (66%) dentists with normal color vision select tooth shade with other dentists and patients while 51(34%) dentists do not. Also, out of 10 dentists with color vision defect, 7 (70%) usually select tooth shade with concurrence from others while only 3 (30%) do not. (Table 4).

TABLE 4 - Color vision defects and mode of teeth selection

MODE OF SELECTING TEETH	COLOR VISION STATUS				Total	
	NORMAL		DEFECT		No	%
	No	%	No	%		
ALONE	51	34	3	30	53	33.1
WITH OTHERS	99	66	7	70	107	66.9
TOTAL	150	100	10	100	160	100.0

All the dentists that participated in this study were not aware of their color vision status nor have been tested for color vision defect before.

DISCUSSION

The ability to match the shade of a porcelain-fused-to-metal, partial denture and implant retained restoration to that of the natural

teeth is an important goal of the restorative dentist. Ideally, when placed in the mouth, the restoration should match the color and shape of the patient's natural dentition (20).

Color vision deficiency (CVD) has a high prevalence and is often a handicap in everyday life. Those who have CVD will be better able to adapt and make more informed career choices, if they know about their deficiency. The facts that from 20 to 30 per cent of adults with abnormal

color vision do not know they have CVD suggest that color vision is not tested as often as it should be. This may be because of practitioner uncertainty about which tests to use, how to interpret them and the advice that should be given to patients on the basis of the results. The purpose of this paper is to recommend tests for primary care assessment of color vision and provide guidance on the advice that can be given to patients with CVD (21).

Standardized shade guides have been developed to assist in the process of shade selection and to help practitioners communicate effectively with the dental technician. However, the successful use of these shade guides depends on the accuracy of the color assessment by the individual choosing the shade, as well as effective communication with the dental laboratory fabricating the restoration (20).

In this study, a prevalence of color vision defect of 6.3% was found among the practicing Nigerian dentists studied. Although the prevalence found among the Nigerian dentists in this study is higher than most populations studied (19), our findings cannot be said to be a reflection of color vision defect among Nigerians generally since there is no existing national data on color vision defect. However the importance of selecting tooth shade with other colleagues and patients must be emphasized in the dental curriculum in view of the high prevalence noted in this study as this would reduce the incidence of dissatisfaction with prostheses and restorations.

The prevalence was higher among male dentists (8.4 %) compared with their female counterparts (3.9%). (Table 1) This is similar to the results of other studies (12, 17, 19) and has been attributed to the fact that, like hemophilia, the defective gene is carried on the X chromosome.

This study also showed that the older the dentist and the more the number of years of practice the more the likelihood of color vision defect. Color vision defects could be acquired, as a result of disease, side effects of certain medications, or through normal aging processes, and these deficiencies may affect parts of the eye other than the photoreceptors. Aging could result in degenerative changes characterized by the yellowing and darkening of the crystalline lens and cornea, accompanied by shrinking

in the size of the pupil. With yellowing of the lens and cornea, shorter wavelengths of visible light are absorbed, so that blue hues appear darker. As a consequence, elderly individuals often experience difficulty in discriminating between colors that differ primarily in their blue content, such as blue and gray or red and purple. Hence older dentist may need to seek help from time to time before arriving at appropriate tooth shade.

All dentists in the other specialties had normal color vision, however 33.3% of the paedodontists, 8.3% of oral surgeons and 6.5% general dental practitioners have color vision defects. There are no global data available to compare this result with. While the oral surgeons may not be expected to routinely choose color, the general dental practitioners and the paedodontists are expected to routinely select shade during restorative procedures.

It is generally agreed that tooth shade selection should be done in conjunction with other colleagues and the patients under natural light before arriving at an acceptable tooth shade. In this study about 67% of the dentists believed that tooth shade should not be selected by the attending dentist alone.

Seven (70%) dentists with color vision defect in this study select tooth shade with others. This may not be unconnected with the fact that they might have experienced a lot of displeasure by their patients with tooth shade selected for them by these dentists. However none of the dentist said he or she has been diagnosed as having color vision defect.

Also the practice of tooth shade selection is still not good among the dentists interviewed when viewed from the background of the high prevalence obtained from this study. Research done by Davison and Myslinski (7) and Yorty et al. (18) showed that dental personnel with deficiencies in color perception made significantly more errors in hue and chroma selection than did personnel whose vision was normal. Unfortunately about a third of conservative dentists do not consult others before selecting shade for their patients. This could lead to patients' dissatisfaction with their restorations which in turn could lead to loss of revenue, time and materials. It may further weaken the level of confidence in dentists by patients in general.

CONCLUSION

The prevalence of color vision defect is high among male dentists in Nigeria when compared with most data from other parts of the world. Proper mode of selection of teeth should be emphasized in the dental curriculum and continuing education program to prevent waste as a result of patients' dissatisfaction with their restoration.

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