(e) ISSN Online: 2321-9599

(p) ISSN Print: 2348-6805

ORIGINAL ARTICLE

The Effect of repeated firing on the Color of Ceramic System with two Different Veneering Porcelain Shades

K.Rohan Kumar[1] , R. Sukumar[2], L Prashanth Reddy[3], T.V Pavan[4] , G. Satya Kiran[5], R. Raga Navya[6]

[1,3]Department of Prosthodontics ,Crown And Bridge, Government Dental College Osmania ,Hyderabad,[2] Department of Prosthodontics Crown And Bridge, Meghna Istitute Of Dental Sciences [4] Department of Orthodontics, Army College Of Dental Sciences ,Hyderabad, [5]Department of Oral Pathology, Krishna Devaraya College Of Dental Sciences, Bangalore, [6]Department of Endodontics And Conservative Dentistry, College Of Dental Sciences , Davangere

ABSTRACT:
Statement of problem: Shade matching is an important property in fixed prosthodontics for achieving optimal esthetics. However, there is a lack of information on how color is affected by fabrication procedure. **Purpose:** To evaluate and to compare the color changes observed after repeated firing (3rd, 5th and 7th) of Pressable ceramic system veneering with two different veneering porcelain shades using spectrophotometer. **Materials and methods:** Twenty disc-shaped ceramic specimens (10 mm in diameter, with a core thickness of 1 mm), with 2 different veneering porcelain shades (A1, B2), were fabricated from an Pressable ceramic system. Repeated firings (3, 5, and 7 firings) were performed. Color differences (ΔE) and changes in color parameters (ΔL, Δa, Δb) were determined using a spectrophotometer. The statistical analysis was done using Repeated-measures ANOVA. Unpaired 't' and 'Tukey HSD Post hoc test' were used for multiple comparison. **Results:** The results denote that perceptible color changes (ΔE>1) were observed after repeated firing
Keywords: Color Change, Repeated Firing, Pressable Ceramic.

Corresponding author: Dr. K. Rohan Kumar, Department of Prosthodontics, Crown And Bridge, Government Dental College Osmania, Hyderabad

This article may be cited as: Kumar KR, Sukumar R, Reddy L P, Pavan T V, Satya K G, Navya RR. The Effect of Repeated Firing on The Color of Ceramic System With Two Different Veneering Porcelain Shades. J Adv Med Dent Scie Res 2017;5(9):78-81.

Access this article online	
Quick Response Code	Website: www.jamdsr.com
	DOI: 10.21276/jamdsr.2017.5.9.18

INTRODUCTION

Shade matching is one of the crucial determinants for success of a prosthodontic restoration[1]. Metal ceramic system, first developed in 1962, are used to fabricate 70-80% of fixed prosthesis due to their higher fracture resistant[2]. However the metal substructure of metal ceramic restoration has negative esthetic effect due to increased light reflectivity, particularly when they are used in esthetic zone.

The use of a ceramic rather than a metal core permits greater light transmission within a crown, thereby improving the color and translucency of a restoration. The shade of Layered ceramic restoration are influenced by many factors which include the opacity and shade of the ceramic, core thickness, veneer thickness, firing temperature, number of firing cycles and by their interaction[3].

The number of firing cycles required for the fabrication of all-ceramic restoration is 3 firings i,e. dentin (1st firing), enamel (2nd firing), glaze (3rd firing). Additional firing is required when there is any occlusal correction clinically and any errors during laboratory procedure. An additional increase in the number of firing cycles may lead to change translucency and shade of final prosthesis which may results in poor esthetics.

The Commission Internationale de I'Eclairage (CIE) color system is generally used to identify color changes All colors in the CIE L*a*b* system represent the relative mixture of primary colors of blue, green and red. The values of blue, red, and green are converted mathematically to the CIE L*a*b* scale and the color distance is calculated.[4]

There is disagreement in the literature with respect to the limit for the human eye to appreciate differences in color. Instrumental color analysis offers a potential advantage over

visual color determination, as instrumental readings are objective, quantifiable, and more rapidly obtainable.
The purpose of this in-vitro study was to evaluate the effects of two different veneering porcelain shades (A1, B2) and number of firings (3, 5 & 7) on the color of e-max pressable all-ceramic system.

AIMS
To evaluate the color changes observed after repeated firing (3^{rd}, 5^{th} and 7^{th}) of Pressable (IPS e-max) ceramic system veneering with two different veneering porcelain shades. They are: A1 shade and B2 shade. Study also aimed to compare the color changes observed after repeated firing.

MATERIALS AND METHOD
Preparation of ceramic sample
A 20 disc shaped samples with dimensions of 10mm in diameter and 1mm thickness were fabricated from ceramic ingots (fig 1). The thickness of each sample were measured using metal caliper (fig 2). The samples were divided into 2 groups. Each group contains 10 samples (n =10). Group-I samples veneered with A1 shade and Group-II veneered with B2 shade (fig 3).

Figure 1: IPS e-max pressable ceramic (ingots)

Figure 2: Standardization of ceramic sample

Firing of each sample
Each sample were fired in were fired in vaccum furnace (CERAMO-3, DENTSPLY)by layering technique adding dentin, enamel (with temperature increase rate 50^0C/min, holding temperature 750^0C, holding time 1min) and glazing (with temperature increase rate 60^0C/min, holding temperature 725^0C, holding time 1min). After glazing the samples the thickness of each sample were measured using caliper (final thickess-2mm). After 3^{rd} firing color of each sample were measured using spectrophotometer
Repeated firing (5^{th} & 7^{th}) of Group-I done using enamel firing temperature and the color of each specimen measured after 5^{th} and 7^{th} firing using spectrophotometer

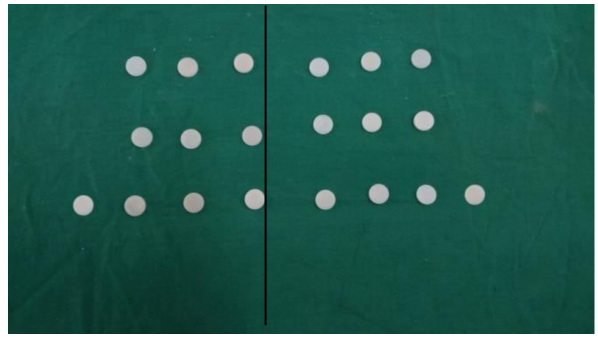


Figure 3: GROUP I (A1 shade) GROUP II (B2 Shade)

Figure 4: Ceramic furnace (ceramo-3, dentsply)

Figure 5: Spectrophotometric evaluation

Spectrophotometric evaluation
The color of each specimen was measured with a spectrophotometer (DATA COLOR, SPECTRUM 650) (fig 5). This system captures the color coordinates using a D65 illuminant and a viewing angle of 10 degrees. Before the evaluation session, the spectrophotometer was calibrated against white and black working standard and then served as the standard backgrounds for the different samples discs.

Each disc was placed with glazed surface facing in front of the aperture, perpendicular to the beam of the spectrophotometer. The readings of the disc were recorded in CIELAB system in the form of L* a* b* values. A total of three readings were taken and a mean value was obtained for each ceramic disc. Change in color was obtained by calculating Δ E by the formula: ΔE* = ([Δ L*]2+ [Δ a*]2+ [Δ b*]2) 1/2 where Δ E* is the change in color and Δ L*, Δ a*, Δ b* represent the difference in L*, a*, b* values of the ceramic discs.

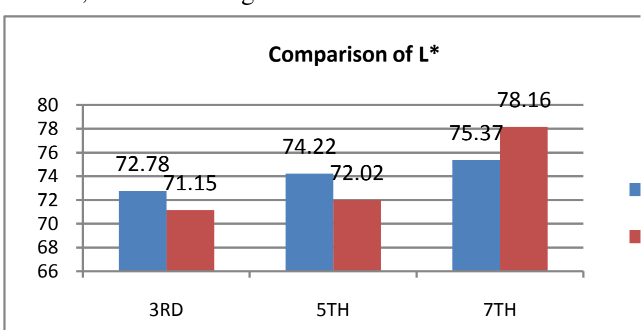
Figure 6: Aperture for evaluation of ceramic sample

RESULTS

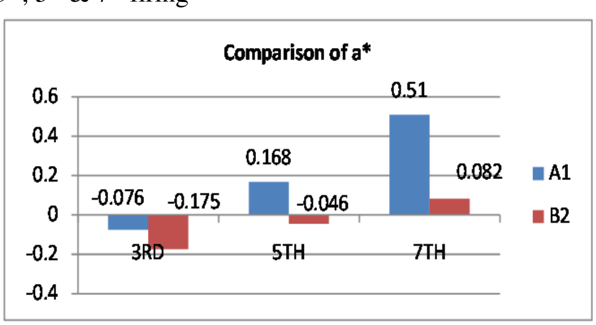
The statistical analysis of results showed that:

- The L*a*b* values of the ceramic system were affected by the number of firings (3, 5, 7, firings) and veneering porcelain shade.
- Statistically significant interactions were present between the number of firings and the veneering porcelain shade forL*,a*, and b*values.

Graph 1: Comparison of L* Values of A1 &B2 shade after 3rd , 5th & 7th firing



Graph 2: Comparison of a* Value of A1 and B2 shade after 3rd, 5th & 7th firing



Graph 3: Comparison of b* Value of A1 and B2 shade after 3rd, 5th & 7th firing.

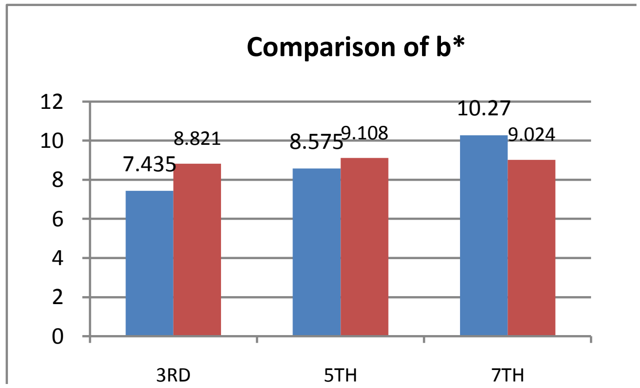


Table 1: Mean ΔE values of 2 different shades of ceramic samples after repeated firings

No of firings	ΔE (A1)	ΔE (B2)
3-5	1.89	0.93
3-7	1.93	3.03
5-7	1.18	2.14

DISCUSSION

Some metals used as a restorative materials in dentistry may contribute a problem which include, allergies, gum staining, and release of metallic ions into gingival sulcus. These drawbacks, as well as the search for more esthetic materials by patient and dentist, have lead to the development of all ceramic restoration.[5]

Primary difference between ceramic systems lies in the color and translucency of the substructure or core material. The substructure material has an appreciable effect on the shade of the artificial crown. Therefore, selection criteria can be largely based on the various esthetic characteristic of the substructure material.[6]

Based on the composition of ceramic they are classified into Feldspathic porcelain, Leucite–reinforced feldspathic porcelain, aluminous porcelain, glass infiltrated composites, glass–ceramics, leucite-reinforced glass ceramics, lithium disilicate –reinforced glass ceramics, zirconia oxide ceramics etc. Most of the ceramic system composed of two different phases 1)the glassy phase and 2)crystalline phase. Glassy phase is often responsible for esthetic behavior (translucency), while the crystalline phase is associated with mechanical strength.[5]

Possible sources of processing variables in porcelain firing include thickness and color of the opaque; thickness, color, and translucency of the body and enamel layers; firing temperature and number of firings.

It was previously reported that an increase in the number of firings resulted in a decrease in L* and an increase in a* and b* color values of In-Ceram. Results of another study investigating the color changes of a zirconia ceramic system with 2 different veneering porcelain shades after repeated firings indicated an increase in the L* value and a decrease in the a* value for both A1 and A3 veneering porcelain shades, resulting in lighter and greener specimens. However, the b* value was not influenced by the number of firings for the A1 veneering veneering porcelain shade and increased for the A3 veneering porcelain shade, resulting in more yellowish specimens. The differences between these 2 previous

studies and the current study may be attributed to the optical properties of different core materials, as a zirconia ceramic system was found to be the least translucent ceramic system and more opaque than a glass-infiltrated alumina ceramic system or the IPS Empress system.[7]

Heffernan et al stated that an additional firing resulted in a significant difference in translucency rankings of ceramic systems and a decrease in the opacity of all veneered materials, except the completely opaque zirconia and metal ceramic specimens.

In the current study, two veneering porcelain shades were selected (A1 and B2), and measured the color changes after repeated firing. The results were shown that, for A1 and B2 shade samples there is an increase in L* value as the number of firings were increased, which indicates lighter specimens. There also increase in a* an b* values after repeated firing which represents, which indicates yellowish and reddish specimen.

In the current study, mean color differences caused by the repeated firing (3, 5& 7) of 2 different veneering porcelain shades were > 1 ΔE units, which is indicated as a perceptible color change.

The results of this study support the hypothesis that color differences would occur relative to the number of firings and veneering porcelain shades. There is a significant change in shade of ceramic system tested with 2 different veneering porcelain shade after repeated firing (3, 5& 7). So it is important factor should be taken into consideration while fabrication of ceramic restoration.

CONCLUSION

Within the limitations of this in vitro study, the following conclusions were drawn:

1) Hue, Value, Chroma of the ceramic systems were affected by the increase in number of firing cycles (5 & 7).
2) An increase in the number of firing cycle resulted in increased Value of A1 and B2 shade resulted in lighter shade because of increased translucency.
3) Hue and chroma is also increased resulting in redness of A1 shade sample and yellowish of B2 shade sample.

The results denote that the number of firing cycle for all-ceramic restoration is 2-3. More than that results in improper shade matching which consequently results in poor esthetics. Hence it is an important for a clinician to do necessary occlusal adjustment during the clinical procedure before final glazing so as to avoid extra firing cycles.

REFERENCES

1. Neelam Pande, Maithili S. Kolarkar. Spectrophotometric evaluation of shade reproduction of pressable all ceramic system on unstained and stained tooth: J Indian Prosthodontic Soc 2016;16(1)
2. Stephen F. Rosenstiel, and William M. Johnston, The effects of manipulative variables on the color of ceramic metal restorations. Journal of prosthet Dent:1988:60:3.297-303
3. I.E Ruyter, K.Nilner, B.Moller color stability of dental composite resin materials for crown and bridge veneers . Dent Mater.1987:3:246-251
4. Ozge Ozturk, Bulent Uludag, Aslihan Usumez,Volkan Sahin, and Gozde Celik, The effect of ceramic thickness and number of firings on the color of two all-ceramic systems. J Prosthet Dent 2008;100:99-106
5. W.M.Johnston and E.C. Kao Assessment of Appearance Match by Visual Observation and Clinical Colorimetry. J Dent Res 1989:68(5):819-822.
6. Evans DB et al The influence of condensation method on porosity and shade of body porcelain. J Prosthet Dent 1990
7. V. Sahin, B. Uludag, A. Usumez, and S. E. Ozkir. The effect of repeated firings on the color of an alumina ceramic system with two different veneering porcelain shades. J Prosthet Dent 2010;104:372-378
8. Kerem Yılmaz, Fehmi Gonuldas, Caner Ozturk**.** The effect of repeated firings on the color change of dental ceramics using different glazing methods. J Adv Prosthodont 2014;6:427-33

Source of support: Nil **Conflict of interest:** None declared