Effect of Various Commercially Available Mouthwashes on Color Stability of IPS Empress Ceramic Restoration: An In-vitro Study

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Abstract

Objective: This study aims to compare the color stability of IPS EMPRESS direct (Ivoclar Vivadent) ceramic restorations after exposure to two commercially available mouth rinses.

Method: Thirty disc-shaped specimens (10x4 mm) of IPS IMPRESS direct (Ivoclar Vivadent) ceramic restoration was prepared. The specimens were separated into three groups (n=10) randomly. Commonly used mouthwashes, chlorhexidine0.2 %, and Listerine were used as experimental groups. Distilled water was used as the control group. Specimens were immersed in 10 ml of each, for 20 minutes every day for 30 consecutive days. The color values of each were measured before and after immersion by the NIX color sensor according to the CIELAB color scale. Their color change value was calculated. Data were analyzed and interpreted using IBM SPSS version 22. A two-way analysis of variance at a significance level of .05 was used for further evaluation of the collected data.

Results: There was a significant difference in the color change of restorative material following immersion in mouthwashes.

Conclusions: Following immersion in mouth rinses, ceramic restorative materials revealed a color difference.

Keywords: IPS EMPRESS ceramic, color stability, chlorhexidine0.2%, listerine, esthetic failure, NIX color sensor.

How to cite: *Alkhudair L, Nawabi S, Saleem A, Jabeen N, Khan AE, Fatima SR. Effect of Various Commercially Available Mouthwashes on Color Stability of IPS Empress Ceramic Restoration: An In-vitro Studys. Esculapio - JSIMS 2022;18(03):336-339*

DOI: https://doi.org/10.51273/esc22.2518319

Introduction

Esthetics has played a fundamental role in the field of prosthetic dentistry and the demand for esthetics has always been challenging and inescapable for dental professionals in their routine dental practice.[1] Modern materials have been created to restore teeth to their most natural state.[2] Dental ceramic is one of them. They are increasingly being used in clinical settings due to their close appearance to natural teeth.[3] They also have several other desirable characteristics, including low thermal conductivity, biocompatibility, abrasion resistance, and low bacterial adhesion. Over the last few years, ceramics have become the most dominant material used in the fabrication of fixed prosthesis.[4] The systematic review of clinical data shows a comparatively higher clinical survival rate for metal-ceramic restoration (94.4 %) as compared to all-ceramic restoration (88.6%) over five years. However, the latter is more desirable among patients. This is mainly attributed to the excellent esthetics of the all-ceramic restorations.[5]

However, all these properties of dental ceramics are desired to be preserved throughout their functional lifetime in an oral environment, where they may interact with different plaque-controlling agents to reduce periodontal diseases and dental caries. For any crown, bridge, and veneering material,[6] color constancy is an essential physical quality.[7] The ability of a mate-rial to retain its

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Submission Date: 09-06-2022
1st Revision Date: 29-06-2022
Acceptance Date: 19-08-2022

color over some time in a particular environment is termed color stability.[8] In 2019, Gresnigt et al reported that the majority of patients complain regarding restorations attributed to discoloration of restoration and accounts for the failure of esthetic restoration.[9] Several conditions, both intrinsic and extrinsic, might induce discoloration of restorative materials.[10] The material's discoloration is one of the intrinsic characteristics.[11] Staining by adsorption or absorption of colorants from exogenous sources such as coffee, tea, nicotine, drinks, and mouthwashes are examples of extrinsic causes.[12] This study aims to evaluate the effects of different commercially available mouthwashes on the color sta-bility and strength of IPS EMPRESS ceramic restora-tions. In this study, the null hypothesis was that daily mouthwash use impacts the color stability and strength of ceramic restorative materials.

Materials and Methods

A total of 30 ceramic discs of IPS IMPRESS Direct (10mm in diameter and 4mm in thickness) were constructed in a standardized manner.[13] Samples were divided into three main groups (n=10). All specimens were fabricated using a CNC milling machine and electric Iso Met micro saw 4000.[14] They were seated in a central motor machine CNC Jr. Tabletop Mill XD series vertical CNC milling machine which fabricates restorations utilizing subtraction manufacturing technology.[15] All specimens were cut into discs of 4mm thickness using a diamond saw disc at the speed of 2500 rpm under water coolant. A digital caliper was used to verify the dimensions. Standardized immersion solutions were prepared for all groups. All disc samples were tested twice before and after immersion in the solutions. The baseline shade of the ceramic samples (N=30) was measured using a NIX color sensor before immersion in the solutions. Group 1:0.2% Chlorhexidine gluconate mouthwash. Group 2: Listerine® mouthwash, and Group 3: distilled water which is control. To evaluate color stability, the specimens were immersed in mouthwash agents and distilled water (control) at 37◦C, daily for 18 consecutive days. Immersion lasted for 20 minutes every day. This time interval is equivalent to 2 min of mouthwash per day for six months. Each specimen was then washed for 120 sec with tap water and then air-dried. The shade of the samples was measured again using a NIX color system.

Results

Statistical analysis was done using IPM SPSS 22 version. Mean and Standard deviation was calculated before and after immersion (Table1, Table2). Paired T-test was carried out to determine if there was any significant difference between the measurements before and after the immersion (Table 3). One way ANOVA test was also applied to analyze the difference between groups at a 0.05 significant level (Figure 1). The paired t-test determined that there is a significant (p=.043) difference in the groups before and after immersion (Table 3). Therefore, the first part of the null hypothesis "The mouth-rinse will affect the color stability of restoration" is accepted.

A significant difference is observed through one way ANOVA test between chlorhexidine and Listerine groups (p= 0.299) regarding the discoloration of resto-rative material (Figure 1).

Table 1: *Standard Deviation of groups before immersion*

Groups	Mean	Standard deviation	N
1	100	0	30
2	100	0	30
3	100	0	30

Table 2: *Standard deviation of groups after immersion*

Groups	Mean	Standard deviation	N
1	120	41.404	30
2	106.67	25.820	30
3	113.33	34.575	30

Table 3: *Paired t-test for analysis of difference before and after immersion*

	Mean	Standard deviation	Standard error mean	95% confidence interval of the difference		Significance
Pair before - after	-13.333	34.575	6.312	Lower -26.244	Upper -4.23	0.43

Fig 1 **ANOVA**

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	1333.333	1	1333.333	1.120	.299
Within Groups	3333.333	28	1190.476		
Total	34666.667	29			

Figure 1: *One way ANOVA test for analysis of the difference between groups at a 0.05 significant level*

Discussion

The growing accessibility of media and online information has increased the demand for superior dental aesthetics.[16] The success of an aesthetic restoration is based on the replication of tooth shape and shade. It is also vital that the selected shade is maintained in the harsh oral environment throughout the functional life of the prosthesis.[17] Keeping this in view, dental ceramics are the material of choice and they have widely been used to replace missing teeth due to their superior optical properties of color translucency, opalescence, sound biocompatibility, and good wear resistance.[18] An extremely homogenous leucite-based ceramic is used to form IPS EMPRESS Ceramic. It is capable of scattering light like natural enamel and therefore, it blends well with its surroundings. Apart from this highly desirable property, its mechanical properties and strength have made it the material of choice for permanent restoration.[19] However, both dentists and patients need to be educated about the gradual discoloration of ceramics that occurs when these materials are exposed to different conditions and various oral hygiene products.[20] In 2014, Sarikaya I studied the effects of various surface treatments on different types of dental porcelains. He reported that glazed porcelain is much more likely to retain its color in the oral environment than polished porcelain[21]. In 2015, Tekce N et al studied the effects that different drinks have on the color stability of different restorative materials and reported the subsequent change in their shades.[22] In 2017, Van den Breemeret et al conducted a retro perspective case study to assess the clinical performance of monolithic lithium disilicate posterior restorations and discussed in detail, the changes observed after one year, two years, and five years.[23] The present study observed the effects of two commercial mouth rinses on the color stability of IPS EMPRESS ceramic restoration. Mouthwashes are of paramount importance where prevention and reduction of periodontal diseases and dental caries is concerned. However, these mouthwashes may cause discoloration of the restorative materials.[24] In this study, a statistically significant difference is observed between the groups after immersion in mouthwashes.[25]

Conclusion

Although mouthwashes are important in the reduction of periodontal diseases and dental caries, they may result in discoloration of the restorative materials as a side effect. However, follow-up at regular intervals and clinical studies are required to evaluate their effects on color stability.

Conflict of Interest *None*

Funding Source *None*

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Authors Contribution

LA: Conceptualization of Project
SN: Data Collection
AS: Literature Search
AS: Statistical Analysis
AE: Drafting, Revision
SRF: Writing of Manuscript