ISSN: 2581-5989
PubMed - National Library of Medicine - ID: 101738774

International Journal of Dental Science and Innovative Research (IJDSIR)
IJDSIR : Dental Publication Service
Available Online at: www.ijdsir.com
Volume – 4, Issue – 2, March - 2021, Page No. : 417 - 425

Effect of various mouth rinses at different time interval on color stability of different provisional restorative materials: An in vitro study

[1]Dr Rupal J Shah, [1]Dr Sanjay Lagdive, [1]Dr Urvashi Rai, [2]Dr Bhavisha Gadhiya, [2]Dr Anchal Kapoor, [3]Dr Kalaiarasi Periyanan

[1,2,3]Department of Prosthodontics and Crown & Bridge, Government Dental College and Hospital, Ahmedabad, Gujarat University, Ahmedabad, India.

Corresponding Author: Dr Urvashi Rai, Department of Prosthodontics and Crown & Bridge, Government Dental College and Hospital, Ahmedabad, Gujarat University, Ahmedabad, India

Citation of this Article: Dr Rupal J Shah, Dr Sanjay Lagdive, Dr Urvashi Rai, Dr Bhavisha Gadhiya, Dr Anchal Kapoor, Dr Kalaiarasi Periyanan, "Effect of various mouth rinses at different time interval on color stability of different provisional restorative materials: An in vitro study, IJDSIR- March - 2021, Vol. – 4, Issue - 2, P. No. 417 – 425.

Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

Background: One of the important factors affecting treatment outcome of fixed prosthesis is esthetics. Whether a definitive prosthesis or a provisional restoration, maintenance of esthetics is of prime concern along with rehabilitation of function.

Aim: This study was aimed at determining colour stability of two commercially available provisional fixed partial denture materials: an acrylic resin based material and a bis-acryl composite material when immersed in commonly used mouth rinses with saliva as control at various time intervals.

Materials and Methods: Two different provisional restorative materials (self-cure tooth molding powder-pyrax and bis-acryl composite resin- trantemp) and two mouthrinses (chlorhexidine and herbal mouth wash) were used. 80 specimens (40 of each material) were prepared in the form of discs of size 15 mm diameter and 2 mm thickness using a brass template and spectrophotometer was used to evaluate and compare colour stability of provisional fixed partial denture materials.

Result: Analysis of variance or ANOVA was used for statistical testing. Based on the mean spectrophotometric values obtained on 7days and 14 days, comparing the two mouth rinses, synthetic saliva + herbal mouthwash has a less potential to stain when compared to synthetic saliva + chlorhexidine.

Conclusion: The results indicate that there is a significant difference in the color stability of both materials in two different mouth rinses at different time intervals. Bis-acryl composite resin-trantemp was found to be the most colour stable material and herbal mouth wash had the least staining potential at varying time intervals.

Keywords: provisional restorative materials, color stability, mouth rinses.

Introduction

Fixed prosthodontic treatment commonly involves indirect fabrication of definitive prosthesis in the dental laboratory.[1] During this time span of fabrication of definitive prosthesis, which on an average takes about 7-10 days, prepared tooth needs to be protected and its spatial relationship has to be maintained. To fulfil this provisional restorations are fabricated for the time being and by the process called Temporization / Provisionalisation. [2] Provisional restorations otherwise called interim fixed restoration must satisfy many interrelated factors, which can be classified as biological, mechanical, and esthetics. They include pulpal protection, maintenance of periodontal health, occlusal relationship and position of the abutment tooth and also aids in deciding the shade, shape and contour of the final restoration, especially for rehabilitating in aesthetic regions.[3] Various materials such as autopolymerizing polymethyl methacrylate, polyethylene methacrylate, polyvinyl methacrylate, urethane methacrylate, , bis-acryl composites, and microfilled resin have been used for making provisional restorations. The choice of material should be with regards to properties of a given material relative to the clinical requirements for specific treatment. Thermoplastic acrylic resins such as polymethyl methacrylate ,methyl methacrylate, ethyl methacrylate have been well established as provisional materials of choice and have, to a certain degree, met many of requirements such as high strength, durability, good marginal adaptation, capable of repair and high polish, and relatively inexpensive. The more recent bis-acryl composite provisional materials, have become a well accepted alternative, due to their enhanced properties such as ease of handling, low exothermic reaction thus causing minimal pulpal irritation, good wear resistance as compared to acrylic resins.[4-8] An essential requirement of prosthodontic treatment is that material color matches and remains stable intraorally. Thus color stability is a prime factor for selection of provisional material when they are to be give for an extended period of time . The color stability of provisional materials and its ability to accumulate stains is still disputable.[4-8]The degree of colour change can be affected by various factors like incomplete polymerization, water sorption, diet of the patient and oral hygiene measures followed. Water sorption leads to change in the optical property of the provisional restorative material by chemical degradation process such as oxidation and hydrolysis. Mouth rinses have been routinely used for maintaining oral hygiene and to inhibit bacterial colonization. Literature has insufficient evidence on the effect of mouth rinses on the colour stability of provisional crowns. Thus, this study was aimed at determining colour stability of two commercially available provisional fixed partial denture materials: an acrylic resin based material and a bis-acryl composite material when immersed in commonly used mouth rinses with saliva as control at various time intervals.

Materials and method

Two different provisional restorative materials (self cure tooth moulding powder- Pyrax and bis-acyrl composite resin- Trantemp) and two mouthrinses (chlorhexidine and herbal mouth wash) were used.[Figure 1] 80 specimens (40 of each material) were prepared in the form of discs of size 15 mm diameter and 2 mm thickness using a brass template.

A. Provisional restorative materials

- Self cure tooth moulding powder (SC-10, Pyrax, Uttarakhand, India)
- Bis-acryl composite resin (Trantemp, Nexobio co., Ltd, Korea)

B. Storage solutions

Three storage solutions were used:

-0.2% chlorhexidine (Hexidine, ICPA ,Ahmedabad, India)

- Herbal mouth wash (HiOra, Himachal Pradesh, India)

- Artificial saliva (Wet Mouth, ICPA, Ahmedabad, India)

C. Other Equipment

- Glass Jar

- Micromotor and hand piece, acrylic stone

- Brass template

- Glass slabs

-Reflectance spectrophotometer

Figure 1: Materials used in the study

Methodology

i) Fabrication of the template: A brass template was constructed using precise milling instrument to cut off circular portions of 15 mm diameter and 2 mm thickness for the preparation of samples.[Figure 2]

Figure 2: Brass template

ii) Fabrication of the Specimen: The samples were fabricated utilising the brass template. A total number of 40 samples were prepared from each material. The acrylic resin was manipulated manually according to the manufacturer's instructions, while the bis-acrylic composite was dispensed using automixing guns into the brass template. After this, the materials were allowed to polymerise. Once the disks were fabricated, they were ground with the acrylic burs to remove any superficial layer of set material and polished to high gloss. [Figure 3 & 4] All the disks were rinsed thoroughly to remove debris.

Figure 3: Self cure tooth moulding Powder (Pyrax): Group I

Figure 4: Bis- acryl resin (Trantemp): Group II

iii) Sample grouping and preparation of storage solution

40 samples, each of self cure tooth moulding powder- Pyrax(GROUP I) and bis acryl resin- Trantemp

(GROUP II) were then divided into four categories:

- A: Untreated specimens,
- B: Artificial saliva,
- C: Artificial saliva + Chlorhexidine
- D: Artificial saliva + Herbal mouth wash

After finishing and polishing, the disks were rinsed with distilled water at room temperature and immersed in staining solutions. [Figure 5] Untreated group specimens were used as a control. Specimens of the required dimensions which were highly polished with smooth, flat and glossy surface were included in the study. And, specimens with surface irregularities, visible cracks or porosities were excluded from the study.

Figure 5: Specimens in testing solutions

The staining solutions were prepared in the ratio 3:1 (mouth rinse: artificial saliva). Colour intensity was evaluated after 1 week and 2 week using a reflectance spectrophotometer. All the test specimens were immersed in their respective solutions and all the solutions were diluted with artificial saliva with the main purpose of simulating the oral conditions.

iv) Assessment of Color Change: Baseline color measurement of all specimens was measured using reflectance spectrophotometer. For baseline color measurement each specimen was placed on the measuring head of spectrophotometer which was covered with the black cover. Before each measurement session the spectrophotometer was calibrated according to the manufacturer recommendations using the supplied white calibration standard. The spectrophotometer automatically calculated the mean color measurement of 10 specimens of each material. This measurement was taken as the baseline measurement for the corresponding material to evaluate the color change after immersion in different storage solutions. The color measurement was done at baseline and at time intervals of 7 days (1 week) and 14 days (2 week).

Color characteristics of all the samples were evaluated by using the CIELAB system.

1. Δ L-Change in lightness/ darkness
2. Δ a- Change in redness- greenness
3. Δ b- Change in yellowness- blueness

Color changes were calculated by using the formula: Change in Color is

Δ E = (ΔL2 + Δa2 + Δb2) 2

Observation and result

Analysis of variance or ANOVA was used for statistical testing. ANOVA is useful in comparing two or more means and finding if the difference is statistically significant**.**

The results of the present study indicate that for self cure tooth moulding material, there is a significant difference between the staining variables at 1 week and 2 week with p values less than 0.05(0.048 and 0.006 respectively ,Table 1)

For Trantemp, the p value at 1 week was 0.115 which was statistically insignificant, whereas the p value at 2 week was statistically significant at the range of 0.017 (Table 2)

At 1 week, for self cure tooth moulding powder, artificial saliva has the least staining potential, followed by artificial saliva + herbal mouth wash and artificial saliva + hexidine. For Trantemp, at 1 week artificial saliva + herbal mouthwash stains least followed by artificial saliva and artificial saliva + hexidine.

At 2 week, for self cure tooth moulding powder, artificial saliva has the least staining potential, followed by artificial saliva + herbal mouthwash and artificial saliva + hexidine. For Trantemp, the maximum stain is caused by artificial saliva+ hexidine followed by artificial saliva + Herbal mouthwash and least staining was seen with artificial saliva.

Results of the present study depict that at 1 week, based on the mean spectrophotometric values, artificial saliva stains the least for self cure tooth moulding material and artificial saliva + herbal mouthwash stains least for bis-acryl resin. But comparing the two mouth rinses, artificial saliva + herbal mouthwash has a less potential to stain when compared to artificial saliva + hexidine (Graph 1). After 2 weeks, artificial saliva stains the least and when the two mouth rinses are compared, the staining caused by artificial saliva + herbal mouth wash is less than artificial saliva +hexidine (Graph 2)

Graphs 1 and 2 show the change in stain taken up by each material in various staining solutions at 1 week and 2 week respectively and does not depict the comparison of stain taken up by different materials with each other as this depends on the composition and property of the material and hence cannot be compared. Color taken up by each material is compared with the untreated specimen (control group).

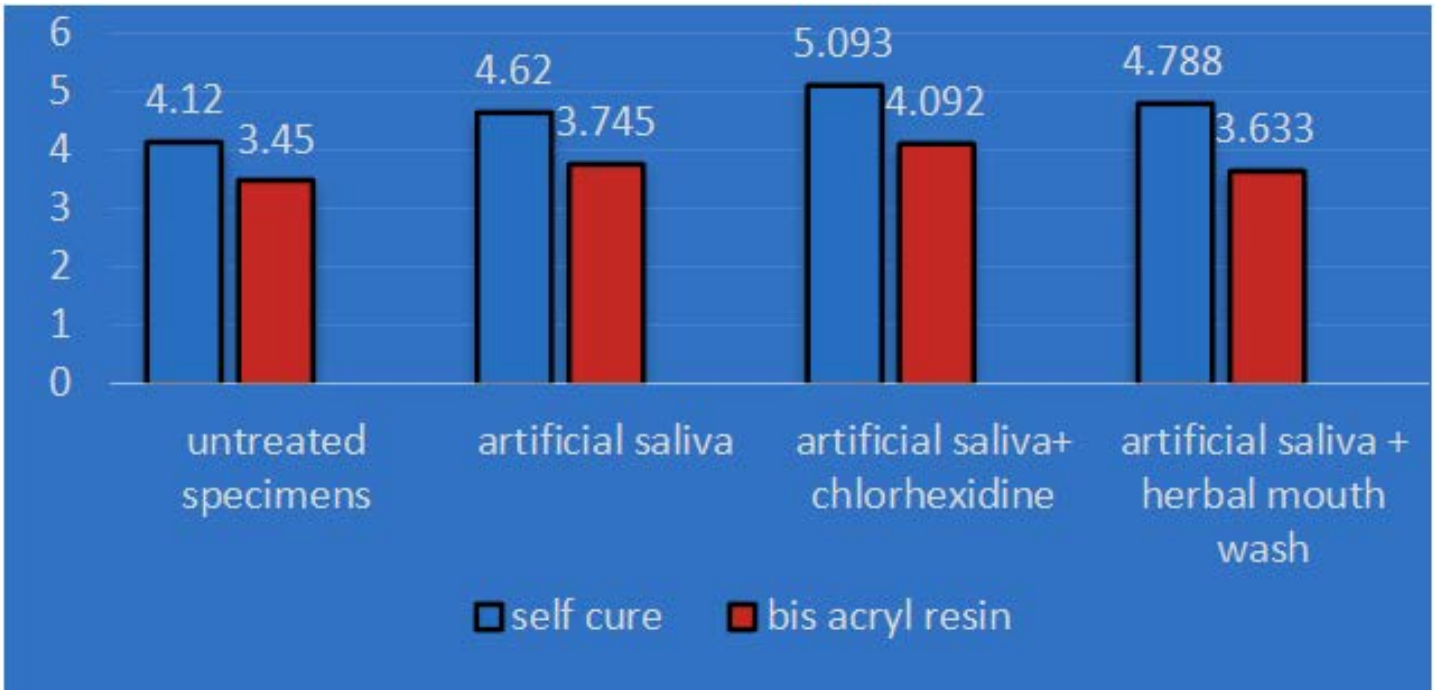
Table 1: Comparison of colour variation of self cure tooth moulding material at two separate time intervals

Time	Material	N	MEAN	SD	P Value
1 week	Untreated specimens	10	4.12	0.216	0.048
	Artificial saliva	10	4.62	0.268	
	Artificial saliva + chlorhexidine	10	5.093	0.128	
	Artificial saliva+ herbal mouthwash	10	4.788	0.111	
2 week	Untreated specimens	10	4.33	0.126	0.006
	Artificial saliva	10	4.97	0.228	
	Artificial saliva + chlorhexidine	10	5.55	0.116	
	Artificial saliva+ herbal mouthwash	10	5.159	0.098	

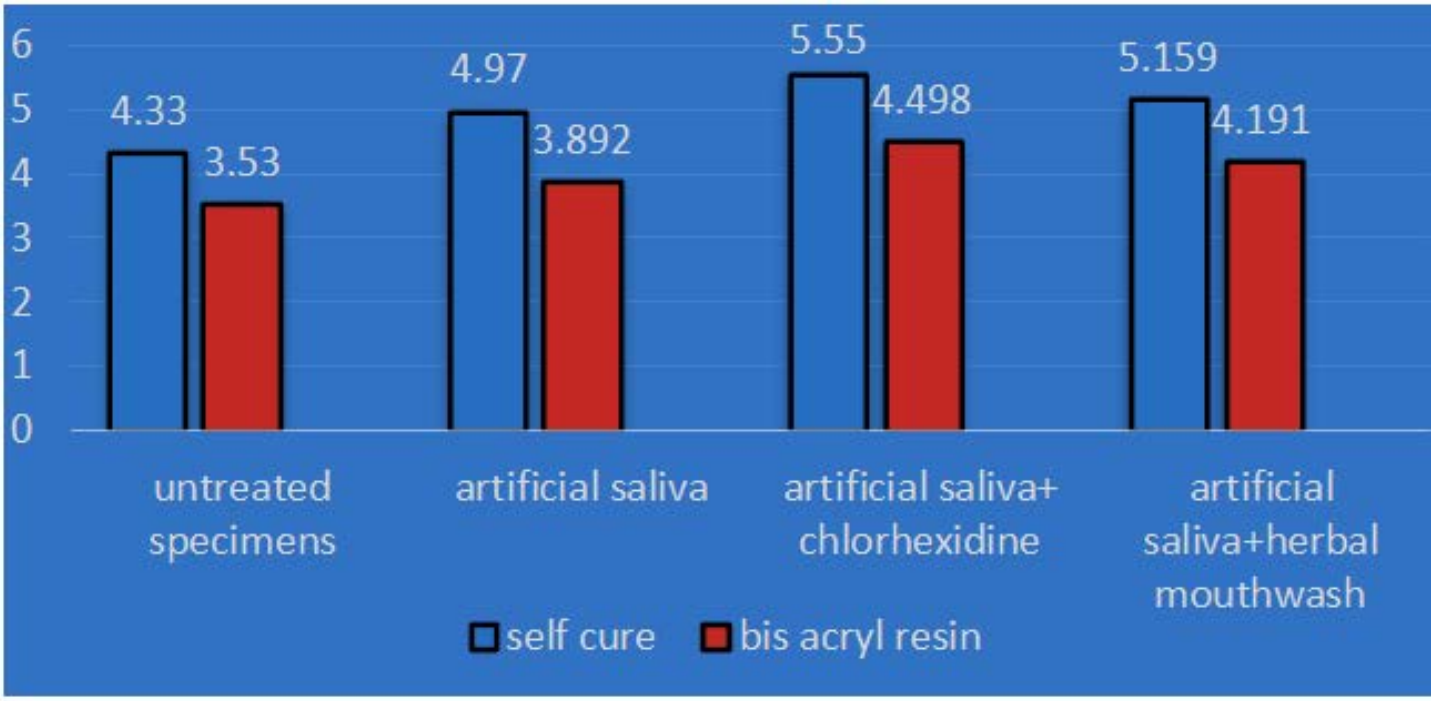
Table 2: Comparison of colour variation of bis- acryl resin (Tran temp) at two separate time intervals

Time	**Material**	**N**	**Mean**	**SD**	**P Value**
1 week	Untreated specimens	10	3.45	0.260	0.115
	Artificial saliva	10	3.745	0.172	
	Artificial saliva + chlorhexidine	10	4.092	0.227	
	Artificial saliva+ herbal mouthwash	10	3.633	0.273	
2 week	Untreated specimens	10	3.53	0.115	0.017
	Artificial saliva	10	3.892	0.131	
	Artificial saliva + chlorhexidine	10	4.498	0.113	
	Artificial saliva+ herbal mouthwash	10	4.191	0.337	

Graph 1: Stain taken up by each material in different staining solutions after 1 week



Graph 2: Stain taken up by each material in different staining solutions after 2 week



Discussion

Esthetics and function are the main concerns for any restorative procedure. Provisional restorations are planned for the period between tooth preparation and before the fit and insertion of the final prosthesis. These restoration are expected to fulfil the requirements of biologic, mechanical and esthetics. Color stability of these provisional restorative materials becomes an important consideration during prosthodontic rehabilitation when involving an esthetic zone or when long term of use is anticipated. Often, provisional crowns are custom made from methyl or bisacrylate resins, each of them differ in composition

and properties to a certain extent. Nevertheless, dental polymers do deteriorate in their color stability due to, water sorption, adsorption of the liquids such as mouth rinses, food colorants from the surrounding environment, incomplete polymerization, chemical reactivity and softening on the surface of temporary prosthesis. During the period of provisionalisation , adjuvants such as mouth rinses are commonly prescribed to patients to maintain the periodontal health and in turn the longevity of the prosthesis. Polymethyl methacrylate resin (Self cure tooth moulding) materials have acceptable mechanical properties , but they tend to discolor on prolonged use . In a study conducted by Koumjian J and Firtell D,[19] bis-acryl composite (Protemp) was more color stable than an autopolymerizing methylmethacrylate resin (cold pack) whereas Protemp was less color stable than the two other autopolymerizing methylmethacrylates (Truekit and Duralay). The polymethyl methacrylate-based resin exhibit higher resin content [20] and higher porosity [21] over bis-acryl composites due to which they are comparatively less color stable. Braden M et al,[12] explained that composites based on difunctional methacrylates exhibit lower diffusion coefficient of water , for the reason that they are highly cross-linked in nature , leading to low water sorption . According to Turker SB et al,[22] acrylic resins being more porous than resin composites take up fluid pigment from food and beverages .Sham et al,[17] put forward that oxidation of unreacted double bonds or oxidation of the polymer matrix in the residual monomers was the reason for chemical discoloration of dental polymers. Composite is manipulated by a dispenser gun instead of hand manipulation thereby reducing the amount of air entrapped and porosity leading to better color stability.[13] Most bis-acryl polymers being polar than PMMA polymers are attracted towards water and other polar liquids. This explains for some degree of color change in the bis-acryl when compared to PMMA resins. Bis-acryl resins exhibit heterogeneous mixture of very fine particle size with powders of various sizes that allow a very dense packing of the polymer particles, this enhances the surface smoothness of the resin.(10) These differences may explain why bis-acryl resins exhibit better colour stability than PMMA resins. Instrument measurements preclude the subjective interpretation of visual-color comparison. Spectrophotometers and colorimeters[17] have been used to measure color changes in dental materials. Spectrophotometeric values are more accurate in measuring the color change than colorimetric values. Based on the spectrophotometric values obtained in this study, at 1 week and 2 weeks, synthetic saliva + hexidine had a greater staining potential when compared to synthetic saliva alone or synthetic saliva + herbal mouth wash, irrespective of the material being used. At 2 week, self cure tooth moulding material was found to be less colour stable than bis-acryl which is in agreement to the results obtained by Gupta and Gupta [11] and Sham et al [23] Colour change exhibited by self cure tooth moulding material in comparison to bis-acryl groups may be due to higher water sorption , resulting in discoloration. Alcohol present in mouth washes caused the polymer resin matrix to soften that resulted in the degradation of the filler-matrix interface, which decreased the hardness values[14,15] of the materials and may have contributed to the colour change. But Gurgan et al. [16] proved that hardness of resin restorative material is affected by mouth rinses irrespective of its alcohol concentrations.

Conclusion

Within the limitations of this study, the following conclusions could be drawn:

1. Among the two provisional restorative materials, bis acryl resin (trantemp) was found to be the most colour stable material at varying time intervals.
2. Evaluation of the staining ability of the mouth rinses revealed that hexidine had more staining potential compared to herbal mouth wash.
3. According to the results of the present study, it can be concluded that self-cure tooth moulding material showed significant staining and least stain was taken up by bis-acryl resin.
4. According to the results of the present study, herbal mouth wash had the least staining potential.

References

1. Burns DR, Beck DA, Nelson SK. A review of selected dental literature on contemporary provisional fixed prosthodontic treatment: Report of the Committee on research in Fixed Prosthodontics of the American Academy of Fixed Prosthodontics. J Prosthet Dent. 2003; 90:474-97.
2. Schillenburg HT, Hobo S, Whitsett LD, Bracklett SE. Fundamentals of fixed prosthosdontics. 3rd ed. Chicago: Qiuntessence, 1997, 225-56.
3. Rosenstiel F, Land F, Fujimoto J (2006): Contemporary fixed prosthodontics. Fourth edition, 467:504-15.
4. Christensen GJ. Provisional restorations for fixed prosthodontics. J Dent Assoc. 1996; 127:249-52.
5. Christensen GJ. Tooth preparation and pulp degeneration. J Am Dent Assoc. 1997; 128:353-4
6. Kaiser DA, Cavazos E. Jr. Temporization techniques in fixed prosthodontics. Dent Clin North Am. 1985; 29:40312.
7. Wang RL, Moore BK, Goodacre CJ, Swartz ML, Andres CJ. A comparison of resins for fabricating provisional fixed restorations. Int J Prosthodont. 1989; 2:173-84.
8. Wang X, Powers JM, Connelly ME. Color stability of heat-activated and chemically activated fluid resin acrylics. J Prosthodont. 1996; 5:266-9.
9. Seghi RR, Gritz MD, Kim J (1990) Colorimetric changes in composites resulting from visible-light-initiated polymerization. Dent Mater 6(2):133–137
10. Stober T, Gilde H, Lenz P (2001) Color stability of highly filled composite resin. Dent Mater 17(1):87–9
11. Gupta G, Gupta T (2011) Evaluation of the effect of various beverages and food material on the color stability of provisional materials: an in vitro study. J Conserv Dent 14(3):287–292
12. Braden M, Causton EE, Clarke RL (1976) Diffusion of water in composite filling material. J Dent Res 55:730–732
13. Yannikakis SA, Zissis AJ, Polyzois GL, Caroni C (1998) Color stability of provisional resin restorative materials. J Prosthet Dent 80(5):533–53
14. Soderholm K (1982) Relationship between compressive yield strength and filler fractions of PMMA composites. Acta OdontolScand 40(3):145–150
15. Soderholm K, Robert MJ (1990) Influence of water exposure on tensile strength of composites. J Dent Res 69:1812–1816
16. Gurgan S, Onen A, Koprulu H (1997) In vitro effects of alcoholcontaining and alcohol-free mouth rinses on microhardness of some restorative materials. J Oral Rehabil 24(3):244–246
17. Okubo SR, Kanawati A, Richards MW, Childress S. Evaluation of visual and instrument shade matching. J Prosthet Dent 1998;80:642-8
18. Gujjari AK, Bhatnagar VM, Basavaraju RM. Color stability and flexural strength of poly (methyl

methacrylate) and bis-acrylic composite based provisional crown and bridge auto-polymerizing resins exposed to beverages and food dye: an in vitro study. Indian J Dent Res. 2013 Mar-Apr;24(2):172-7.

19. Koumjian JH, Firtell DN, Nimmo A. Color stability of provisional materials *in vivo*. J Prosthet Dent. 1991;65:740–2
20. Inokoshi S, Burrow MF, Kataumi M, Yamada T, Takatsu T. Opacity and color changes of tooth colored restorative materials. Oper Dent. 1996;21:73–80.
21. Arima T, Murata H, Hamanda T. The effects of crosslinking agents on the water sorption and solubility characteristics of denture base resins. J Oral Rehabil. 1996;23:476–80.
22. Turker SB, Kocak A, Aktepe E. Effect of five staining solutions on the colour stability of two acrylics and three composite resins based provisional restorations. Eur J ProsthodontRestor Dent. 2006;14:121–5.
23. Sham AS, Chu FC, Chai J, Chow TW. Color stability of provisional prosthodontic materials. J Prosthet Dent. 2004;91:447–52.