Color Stability of Provisional Restorative Materials - A Tabular Review

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Abstracts: Temporary prosthodontic materials used for temporization for crown and bridges to protect the vital tooth or teeth from hypersensitivity. Most commonly used temporization materials are Polymethylmethacrylate (PMMA), Bis-acryl composite resin, Light polymerized composite resin, and CAD/CAM provisional restorative material. In this review we have made an attempt to discuss the advantages and disadvantages of temporary prosthetic materials in a tabular format.

Keywords: Temporary Dental Prosthesis, Color, Stability, Crowns, Fixed Partial Denture

1. INTRODUCTION

Provisional or temporary crowns and fixed partial dentures are a very significant part of prosthodontic treatment. [1] A temporary or Provisional restoration should protect the prepared teeth, provide comfort, function, color stable and be esthetically acceptable. [2] Multiple areas of concern have been identified with provisional restorations, including periodontal health, maxillomandibular relationships and continued evaluation of fixed prosthodontic treatment plans. [3] Provisional restorations protect vital prepared teeth from hypersensitivity and pulp irritation. Moreover, they constitute an important step to assess functional and aesthetic outcomes. [4-6]

Provisional restorations must resemble the form and function of the definitive treatment. Provisional restorations sometimes serve as a diagnostic aid in treatment assessment, and in cases of temporomandibular joint or periodontal disorders, treatment plans require long-term provisionalization until the definitive prostheses have been fabricated. Therefore, the esthetics of the temporary restoration become a primary concern, particularly when it is in the esthetic zone during these processes. [7]

Temporary restoration must remain color-stable during the length of treatment In aesthetically critical areas, which can last an extended period of time. [8] Temporary restorations show color changes over time, jeopardizing the success of any type of cosmetic treatment. [5,9]. Materials used for Provisional restoration should possess color stability and resistance to discoloration in the oral cavity as far as diverse drinks and teeth-cleansing solutions are concerned. [10,11] Devices like Spectrophotometers and colorimeters have been used to assess the color changes of the restorations and color measurement of dental materials. [4,12] Materials used for provisional or temporary restorations are, methyl methacrylate, polymethyl methacrylate (PMMA), polyvinyl siloxane, bis-acrylic resins and

resin composites, polymerized by means of chemical processes, light, or even dual polymerization. [13] Recently, computer-aided design and computer-aided manufacturing (CAD-CAM) technology have been utilized to fabricate provisional restorations. [14]

2. MATERIALS AND METHOD

A review was performed to evaluate the in vitro studies on the color stability of provisional crown and bridge materials. An Internet based search was done using PUBMED, Google scholar databases and Google search engine. The keywords used for the search are listed in (Table 1). The end search date was 23rd July 2019 across the databases. Full text articles in English language were considered eligible for the review. The selection process was conducted in two phases. In first phase, titles and abstracts from the selected electronic databases were reviewed by 2 authors. Articles not full filling the inclusion criteria were excluded from the review. In phase 2, the full text articles obtained after filtering in phase 1 were evaluated by the same reviewers. In case of a disagreement in the selection process between the two reviewers a third author was called in to reach a consensus. Details regarding authors, year of publication, results, and conclusion were evaluated. In case of any relevant missing information the authors of the paper were contacted using email and the information was obtained.

3. RESULTS

After evaluation of the full articles fourteen articles were obtained for final review. **[Table 1]** The earliest article was in the year 2011 and the most recent one in the year 2018. [14-24] The publishing trend reveals the growing interest in this specific area of research. Among the 10 full text articles, authors from Brazil and Saudi Arabia contributed three articles each. Two papers from Indian researchers were found eligible for the final review. Authors from Iran and Turkey contributed one article each. **Table 2** provides an overview of research conducted by various authors and outlines the methods they employed to reach their findings.

Table 1- list of key words used for database search.

Database	Key words used
Pubmed	Temporary Dental prosthesis, acrylic resin, color, hue, shade, stability, crowns, fixed partial denture, CAD-CAM.
Google Scholar	Temporary Dental prosthesis, acrylic resin, color, hue, shade, stability, crowns, fixed partial denture, CAD-CAM.

Table 2- list of key words used for database search.

Author	Evaluation based on	Immersion Time	Provisional Restorative materials Used	Immersion Solutions used	Conclusion
Gaurav G et al 2011[15]	Spectrophotometer	2, 5,7,10 and 15 days.	Polymethylmethacrylate (DPI) Bis-acryl composite resin (Protemp™ II, 3M ESPE) Bis-acryl composite resin (Systemp® c and b, IVOCLAR Light polymerized composite resin (Revotek LC–GC)	Tea (Brooke Bond), Coffee (Nescafe), Pepsi, Turmeric.	Authors concluded that Revotek LC provisional restorative material was most color stable followed by Protemp, Systemp and DPI. Maximum staining potential was reported in turmeric solution preceded by coffee, tea and pepsi.
Hamid J et al 2012[16]	Spectrophotometer.	2 and 4 weeks.	Duralay, Tempron, Acropars TRP	Artificial saliva. Artificial saliva + tea.	Authors recommended Tempron due to its color stability in compression with methyl methacrylate and butyl methacrylates
Silame FDJ et al 2013[17]	Accelerated Aging System (AAA).	40 hours.	Polymethyl methacrylate (Duralay) Bis-methyl acrylate (Luxatemp)]	UV-B light sources.	Authors reported colour variation above the clinically acceptable limit in all materials. Based on thickness Luxatemp

					showed the lowest color alteration and Duralay showed the greatest alteration with 0.5mm.
Jose VQM et al 2015[18]	Spectrophotometer	2, 5,7 and 15 days.	Dencor / Classico Protemp 4/3M ESPE Structur 2 SC/Voco Luxatemp AM Plus/DMG	Artificial saliva Saliva + cola type soda. Saliva + coffee.	Authors reported that acrylic resin exhibited higher color stability in comparison with bis-acrylic resins. Coffee lead to immense color change, and immersion time was crucial in color stability.
Pinar C et al 2016[19]	Spectrophotometer	1 week and 4 weeks.	Bis-acryl composite Methyl methacrylate	Distilled water, Coffee, Tea and Cola.	Authors reported that bis-acryl resin composite material was found to be more stable than methyl methacrylate resin. They concluded that color stability is affected by both material types and beverages, coffee and tea showed more staining after 1 and 4 weeks of immersion in comparison with other solutions.
Omar A et al 2017[20]	Spectrophotometer	2 days, 1, 2 weeks, and 1 month.	Bis-acryl Composite (System C&B – IvoclairVivadent) Bis-acryl Composite (ProTemp IV – 3M ESPE) Bis-acryl Composite (Success CD – Promedica) Polymethyl Methacrylate (Trim II – Bosworth) Light-cure Polymethyl Methacrylate (UniFast TRAD)	Coffee + artificial saliva. Tea + artificial saliva. Cola + artificial saliva., Apple juice + artificial saliva. Saline + artificial saliva.	Authors concluded that Bis-acryl revealed the better color stable succeeded by Polymethyl Methacrylate. Non-polished Light-cured Polymethyl methacrylate showed significant color change compared with polished group. Coffee showed the highest color change followed by tea, cola and apple juice respectively.
Marwa I E et al 2017[21]	Spectrophotometer	7 days	TrimPLUS, CeramillTEMP, Success CD, TempSpan	Lipton	Authors reported that PMMA materials were more color stable compared to bis-acryl resin composite materials. CAD-CAM PMMA material exhibited the best color stability.
Italo Alisson da FC et al 2018[22]	Spectrophotometer	7 days	Acrylic Bis-acrylic resins	Distilled water. Cola flavored soft drink. Wine, Coffee.	Authors reported that coffee and wine promoted larger color changes. They concluded that acrylic resins showed more color stability than the bis-acrylic resins.
Divya S et al 2018[23]	Spectrophotometer	10 days	Protemp 4 3M ESPE, Luxatemp Fluorescence DMG, Cooltemp ColteneWhaledent	Coffee powder-Nescafe Distilled water	Authors reported that colour stability of Luxatemp was highest followed by Protemp IV and Cooltemp. The

					difference in colour changes of all the three materials however was not statistically significant.
Thamer A et al 2018[24]	CIELAB system and colorimeter	1, 2, 3 and 4 weeks	Systemp C&B, 3M Protemp 4, and Telio CA	Pepsi, coffee, tea, and distilled water	Authors reported that CAD/CAM provisional restorative material (Telio CAD) showed better color stability compared to conventional materials. They suggested CAD/CAM provisional materials for long-term temporization procedures.

4. DISCUSSION

A provisional restoration in fixed prosthodontics helps to improve esthetics, stabilize occlusion, shields pulp chamber and aids in masticatory function for limited duration of time. It is substituted by a permanent prosthesis in a prearranged method. [23] The color stability of a temporary prosthesis is very important especially in esthetically critical areas. The literature on this specific property of resins used for temporary restorations is limited. [25,26]

Temporary restorations are usually made of polymethyl methacrylate (PMMA). PMMA possess certain aesthetic qualities and it is easy to repair or manipulate, thus making it one of the most popular temporary prosthetic materials in dentistry for over 70 years. [27] however PMMA possess inferior clinical properties such as low impact and fracture resistance and poor color stability over time. [27]

However other materials like bis-methyl acrylate (Bis-Ac) have also been used for temporary restorations which exhibit good color stability over a period of time. [28,29] Most provisional prosthetic materials undergo a phenomenon called sorption, which leads to absorption and adsorption of liquids present in environmental conditions. [30,31] the phenomenon is very evident when provisional prosthodontic materials come in contact with pigmented solutions such as coffee or tea. [32] Factors like Porosity, surface quality of provisional restorations, oral hygiene habits, degree of polymerization and chemical reactivity define the nature of color stability. [33]

Contamination from exogenous sources causes color change with staining by colorant adsorption or absorption.[34] Furthermore, extrinsic factors like coffee, tea, nicotine and beverages causes staining of restorations. [34,35] Coffee showed higher discoloration effect due to adsorption and absorption of colorants particles.[36] Whereas change in color is due to adsorption only. Study shows that tannic acid present in both tea and coffee causes more discoloration. [37]

On analysis of the eligible manuscripts, it was found that a wide variety of temporary restorative materials were subjected to color stability tests. Poly methyl methacrylate and bis acrylic resins were the most common tested materials. [15-23]. However, in one study conducted by Thamar A et al in 2018 CAD/CAM technique was used. [24] They concluded that CAD/CAM provisional material offered better color stability when compared to conventional materials. The researchers also recommended CAD/CAM provisional materials for long-term temporization procedures because of certain factors like pre-polymerization, higher monomer conversion, and reduced preparation errors with CAD/CAM materials.[24] The number of temporary restorative materials being analyzed for their color stability also varied from study to study. Most of the studies compared two to four different temporary restorative materials. Whereas only one study eligible for the systematic review compared five different materials.[20] Omar A et al observed that Bis-acryl composites showed the highest color stability values, followed by Polymethyl Methacrylate and light cured polymethyl methacrylate. [20]

Conclusion

CAD/CAM based temporary prosthetic materials seems to be more color stable and can be used in situation where extended duration of coverage is required. However, the cost factor is the only barrier that exists for CAD/CAM gaining popularity in prosthodontic practice. Currently other temporary materials like PMMA and Bis-acrylic are popular materials especially suited for short term coverage for temporization procedures.

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DOI: https://doi.org/10.15379/ijmst.v10i1.2756