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Comparative Analysis Of Abrasion Resistance In Relation To Different Temporary Acrylic Crown Material Using Toothbrush Simulator- An In vitro Study

Research Article

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Abstract

Objective: The aim of this study is to compare the abrasion resistance of different temporary acrylic crown materials using a toothbrush simulator.
Materials And Methods: This study was conducted using four different groups of temporization materials such as pro temp, tooth color acrylic material., heat cure acrylic material, Computer aided design and computer aided manufacturing (CAD-CAM) acrylic material. They were kept in a toothbrush simulator which stimulates 3-dimensional brushing. Before and after the intensity of abrasion was measured using a profilometer. The results were analyzed using SPSS statistical analysis.
Results :By analyzing the range of abrasion it can be said that heat cure acrylic material and Computer aided design and computer aided manufacturing (CAD-CAM) acrylic material has better abrasion resistance compared to pro temp and tooth color acrylic material. There are significant differences in the group ($P<0.05$).
Conclusion: Heat cure acrylic material and Computer aided design and computer aided manufacturing (CAD-CAM) acrylic material has better abrasion resistance.

Keywords: Abrasion Resistance; Temporization Material; Toothbrush Simulator; Profilometer; Restoration.

Introduction

Wearing happens when a hard rough surface slides across a softer surface, typically the adhesive material, causing the undesired removal of material from the surface [1]. Wear plays an important role in the oral cavity. Tooth wear occurs not only because of dental caries. It can also be due to abrasion, attrition, etc and it increases with age [2]. Abrasion resistance refers to the capability of an adhesive to resist carrying due to contact with another surface [3]. Abrasion occurs mainly due to improper brushing movements, vigorous brushing, and using their tooth as a tool. Abrasion mostly affects the canines and premolars along the cervical margin [4].

Temporary crowns or interim crowns is a short term crown used in dentistry. The main function of temporary crowns is maintaining the esthetic, maintaining the tooth's function, preventing dentine hypersensitivity and preventing coronal leakage [5]. Toothpaste also varies in their level of abrasiveness while abrasives that remove the stain also contribute to tooth wear [6]. Those who are concerned about tooth wear should seek a less abrasive fluoride toothPaste. Fluoride toothpaste helps to combat tooth wear especially erosive tooth wear as the availability of fluoride promotes the formation of calcium fluoride layer [7].

Temporization materials are important for the practice of dentistry. The capability to briefly bond restorations, crowns, or bridges lets in dentists the time they need to create greater everlasting restorations without sacrificing affected person consolation and dental function [8]. There are different types of temporization

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material. They can be stainless steel, metal-based, resin-based, ceramic-based, etc [9].

Restorations play an important role in prosthetic therapy procedures. The demand for tooth colored restorations has expanded significantly in recent years because of improved strategies, and additionally patient demand for esthetic restorations [10]. Therefore, the use of numerous modern-day restorative substances which have acceptable mechanical properties, are critical for both temporary and definitive restorations [11]. Temporary restoration is a critical part of prosthetic remedy processes with constant prostheses (i.e, crowns and bridges). It can be used as an intermediate until the tooth preparation of definitive indirect restoration is fitted [12]. Accurate temporary restorations are important and serve diverse features, along with protection of the pulpal tissues, preventing bacterial contamination and preservation of the periodontal tissues [13]. Therefore, well fabricated temporary restorations must offer a preview of the prosthesis and the health of the abutments and periodontium [14]. Polymethyl methacrylate (PMMA) resins and composite-based resins (CBR) are the maximum common substances used to fabricate temporary restorations [15]. These are indicated for long term anterior esthetics. The main aim of my study is to compare the abrasion resistance of different temporization materials.

Materials And Methods

This study was done by using four different temporization materials. Group 1 was pro temp (3M), group 2 was tooth color acrylic material (DPI), group 3 was heat cure acrylic material (DPI) and group 4 was CAD-CAM (CERAMILL) Acrylic PMMA (Poly methyl methacrylate) material. Six samples were made for each material totaling 24 specimens. All the 4 materials were drawn into rectangular slabs of thickness 2mm (Figure 1). Each material was mounted on the mold in a one mm increment and it was removed from the mold carefully. The excess was trimmed and it was polished using an automatic polishing machine.For the abrasive wear test, a custom-made toothbrush simulator was used equipped with eight stations of replaceable brush heads (Oral B Flat end) (Figure 2). Tooth brushing load of 1.5 N was set. All the materials were placed and Dabur lal toothpaste was used. The materials were exposed to 21,000 cycles. The toothbrush simulator simulates various brushing movements on the surfaces of teeth and takes a look at the portion .Up to a maximum of 8 specimens are concurrently exposed to abrasion within the tooth brushing system. The specimen chambers are separated from each other so that each specimen can be operated with its personal liquid (e.g. Toothpaste-water mix), and for cleaning. All the brushes are controlled with the aid of a relevant pressure device, and the chosen type of motion is, therefore, equal for all specimens used in the trial. The motion series (teeth cleansing approach) can be freely decided on from an aggregate of forwards, backward and circular actions.Readings of the samples were taken before and after exposing to the tooth brush simulator. After exposing to 21,000 cycles the abrasion of the material was measured using a profilometer (Figure 3). The results were analysed using SPSS statistical analysis software.

Results And Discussion

The values obtained before and after exposing to the tooth brush simulator was analysed using SPSS software. One way ANOVA test was done to compare the abrasion among four samples (Table 1, Figure 4). The mean value of heat cure acrylic material and CAD CAM acrylic material is 0.001mm and 0.165 respectively followed by protemp which is 0.266mm and tooth color acrylic material which is 0.428mm. Therefore it can be said that heat cure acrylic material and CAD CAM material is more resistant to abrasion compared to protemp and tooth color acrylic material.The P value of all the four samples is 0.001 (<0.05) which is statistically significant. Post Hoc Tukey test was done for pairwise comparison of abrasion resistance among four samples (Table 2). Protemp and tooth color acrylic material was compared and their mean difference was 0.031mm where protemp showed less abrasion compared to tooth color acrylic material. The difference between sample 1 and sample 2 was statistically significant as p value is 0.001 (<0.05).Protemp and heat cure acrylic material was compared and their mean difference was 0.051mm where heat

Figure 1. Temporization material samples and mounted on green stone.

Figure 2. Toothbrush simulation of temporization material using Dabur lal toothpaste.

Figure 3. A denotes pre abrasion, B denotes the post abrasion for Protemp, Tooth color acrylic material (cold cure), Heat cure acrylic material, CAD CAM acrylic material.

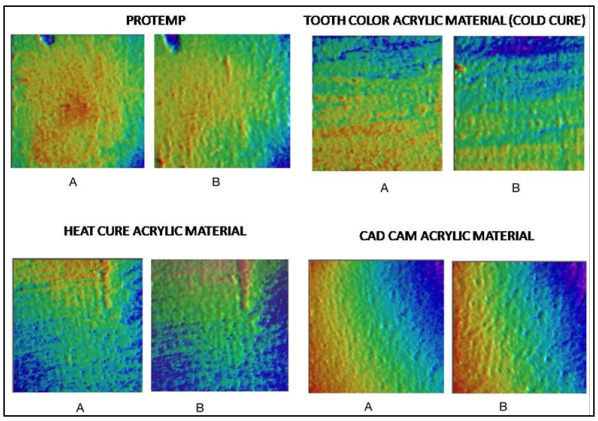

Figure 4. Mean plot is showing Comparison of abrasion after tooth brushing (21000 cycles) among four groups (protemp, tooth colour acrylic cold cure, CAD CAM acrylic material) based on mean value. X axis indicate groups and Y axis indicate abrasion. Tooth colour cold cure acrylic is showing maximum abrasion, heat cure and CAD CAM acrylic is showing minimum abrasion.

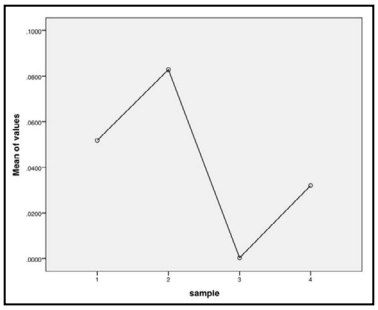

Table 1. Comparison Of Abrasion After Tooth Brushing (21000 Cycles) Among Four Groups (Protemp, Tooth Colour Acrylic Cold Cure, CAD CAM Acrylic Material).

GROUP	N	MEAN	FVALUE	P VALUE
Protemp	6	0.266	3063.75	0.001*
Tooth color acrylic material	6	0.428	3063.75	0.001*
Heat cure acrylic material	6	0.001	3063.75	0.001*
CAD CAM acrylic material	6	0.165	3063.75	0.001*

P Value derived from one way ANOVA test
*Significant at P< 0.05

Table 2: Pair Wise Comparison Of Abrasion After Tooth Brushing (21000 Cycles) In Between Groups (Protemp, Tooth Colour Acrylic Cold Cure, CAD CAM Acrylic Material).

GROUP	MD	SE	p
Protemp Vs tooth color acrylic material	-0.031	0.008	0.0001*
Protemp Vs heat cure acrylic material	0.051	0.008	0.0001*
Tooth color acrylic materialVs heat cure acrylic material	-0.082	0.008	0.0001*
Protemp Vs CAD CAM acrylic material	0.019	0.008	0.0001*
Tooth color acrylic material Vs CAD CAM acrylic material	0.050	0.008	0.0001*
Heat cure acrylic treatment Vs CAD CAM acrylic material	-0.031	0.008	0.0001*

P value derived from Tukey HSD post hoc test
*Significant at P < 0.05

cure acrylic material showed less abrasion compared to protemp. The difference between sample 1 and sample 3 was statistically significant as P value is 0.001 (<0.05). Tooth color acrylic material and heat cure acrylic material was compared and their mean difference was 0.082mm where heat cure acrylic material showed less abrasion compared to tooth color acrylic material.The difference between sample 2 and sample 3 was statistically significant as p value is 0.001 (<0.05). Protemp and CAD CAM acrylic material was compared and their mean difference was found to be 0.019mm where CAD CAM material showed less abrasion compared to protemp. The difference between sample 1 and sample 4 was statistically significant as p value is 0.001 (<0.05). Tooth color acrylic material and CAD CAM acrylic material was compared and their mean difference was 0.050mm where CAD CAM material showed less abrasion compared to tooth color acrylic material. The difference between sample 2 and sample 4 was statistically significant as P value is 0.001 (<0.05). Heat cure acrylic material and CAD CAM acrylic material was compared and their mean difference was 0.031mm where heat cure acrylic material showed less abrasion compared to CAD CAM acrylic material. The difference between sample 3 and sample 4 was statistically significant as p value is 0.001 (<0.05).

In recent years, there are vast improvements in the dental composites, however, one composite nonetheless stays a situation [12]. In this element, the surface properties of restorative fabric play a main function in the long term recovery. In the oral hollow space, by tearing away of the natural matrix, removal of inorganic content, and lack of smaller filler particles due to chewing and due to toothbrushing in our day by day life . This surface roughness results in the lack of esthetics and additionally ends in growth in the accumulation of dental plaque.In this study, four different temporization materials were chosen. Sample 1 was pro temp sample 2 was tooth color acrylic material sample 3 ways heat cure acrylic material and sample 4 was CAD-CAM acrylic material. All the four materials are a base of Poly Methyl Methacrylate (PMMA). These materials are due to free radical polymerization which is initiated chemically. Protemp is a composite material used for bridges, veneers, crowns, etc and it is generally recommended for long term restoration [16]. Acrylic is a plastic that is widely used in dentistry for various purposes. An acrylic veneer is a plastic layer placed over the surface of the teeth. Heat cure acrylic resins are the most commonly used denture base materials. The important limitation is they may act as reservoirs of microorganisms [17].CAD-CAM acrylic material also plays an important role in dentistry. They are designed to produce efficient restoration. They are available in block form also [17].

The materials were polished and kept in a toothbrush stimulator but before that post abrasion test was taken. The intensity of abrasion was measured using a profilometer. After exposing the material to 21, 000 cycles the intensity of abrasion was measured again. Pre and post abrasion test was compared. So here the intensity varies from red, orange, yellow, green, blue, and pink.In sample 1 (Protemp) [figure 3] we can see before keeping the sample in a toothbrush simulator it was more red-orange and yellow but after we can see that it's more green and blue which indicates that pro temp has undergone abrasion. The intensity of the abrasion depends on the color changes which is indicated in the profilometer.The more the changes the more abrasion has occurred. Abrasion is due to vigorous brushing movements, pH of saliva.In sample 2 (tooth color acrylic material) [figure 4] also it was more yellow and orange which turned into green and blue. In sample 3 (heat cure acrylic material) [figure 5] and sample 4 (CAD CAM cure material) [figure 6] there is not much difference. Clinically, toothbrushing may additionally affect the abrasive relying on hardness of bristles and abrasiveness of dentifrices. The variations and complexity of oral surroundings may affect the damage behaviors and clinical performance of restorative substances.

In the study conducted by Maleeha Nayyer etal it has been concluded that dyract which is a compomer has undergone highest loss of smooth surface [18]. In the study done by Wang et al it has been found that bis acryl resins had more wear resistance than methyl methacrylate resins [19]. Omid et al conducted study on evaluation of hardness of interim restorative materials. Pro temp has less wear rates compared to other materials such as Temp Span and Revotek in dry conditions but revotek showed much lesser wear rate after conditioning in artificial saliva. This occurred because Revotek is a light polymerised composite resin material [20]. Therefore by analyzing the abrasion-resistance, we can conclude that sample 3 and sample 4 that is heat cure material and CAD-CAM material has better abrasion resistance compared to sample 1and 2 that is pro temp and tooth color acrylic material. This study was constrained to abrasive wear. The abrasion of each material was calculated using a profilometer. The temporary restoration materials play an important role in dentistry. Abrasion wear resistance is an important property of dental materials.

Conclusion

Abrasion plays an important role. It is very necessary to check the abrasion resistance of temporary crown materials. From this study, we came to know that heat cure acrylic material and CAD CAM acrylic material has better abrasion resistance. The shape and composition of composites and compomer substances, especially, the matrix traits, kind of filler, and filler-particle size significantly affect the damage resistance. Further studies can also be done to analyze the abrasion resistance of different temporary materials which would provide great comfort to the patient.

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