A COMPARATIVE EVALUATION OF COLOR STABILITY AND SURFACE ROUGHNESS OF POLY METHYL METHACRYLATE RESIN AND POLYETHERETHERKETONE POLYMER AFTER STAINING AND EXPOSURE TO CLEANSING AGENTS – AN IN-VITRO STUDY

By

Dr. JASMIN CYRIL

Dissertation submitted to the
Kerala University of Health Sciences, Thrissur
Inpartial fulfillment of the requirement for the degree of

MASTER OF DENTAL SURGERY

IN
BRANCH 1
PROSTHODONTICS, CROWN & BRIDGE

Under the guidance of

Prof. Dr. GEORGE FRANCIS

Dept of Prosthodontics, Crown &
Bridge St .Gregorios Dental College,
Chelad, Kothamangalam

2020-2023

DECLARATION BY THE CANDIDATE

I hereby declare that this dissertation entitled "**A comparative evaluation of color stability and surface roughness of polymethylmethacrylate resin and polyetheretherketone polymer after staining and exposure to cleansing agents – an in-vitro study**" is a bonafide and genuine research work carried out by me under the guidance of **Prof. Dr. George Francis,** Department of Prosthodontics and Crown & Bridge, St Gregorios Dental College, Chelad, Kothamangalam.

Date: 27/01/2023

Dr. JASMIN CYRIL

St. Gregorios Dental College * Chelad - 686 681 *

CERTIFICATE BY THE GUIDE

This is to certify that the dissertation entitled "**A comparative evaluation of color stability and surface roughness of polymethylmethacrylate resin and polyetheretherketone polymer after staining and exposure to cleansing agents – an in-vitro study**" is a bonafide research work done by Dr. Jasmin Cyril, in partial fulfillment of the requirement for the degree of Master of Dental Surgery.

Signature of the Guide

Prof. Dr. George Francis

Professor & HOD

Dept.of Prosthodontics and Crown &Bridge

Date: 27-01-2023

Kothamangalam

H.O.D.
Dept. of Prosthodontics
St. Gregorios Dental College
Chelad

St. Gregorios Dental College ★ Chelad - 686 681 ★

ENDORSEMENT BY THE HOD AND PRINCIPAL OF THE INSTITUTION

This is to certify that the Dissertation entitled "**A comparative evaluation of color stability and surface roughness of poly methylmethacrylate resin and polyetheretherketone polymer after staining and exposure to cleansing agents" – an in-vitro study** is a bonafide research work done by Dr. Jasmin Cyril under the guidance of Prof. Dr.George Francis, Department of Prosthodontics and Crown & Bridge, St Gregorios Dental College, Chelad, Kothamangalam.

Seal& Signature of HOD

H.O.D.
Dept. of Prosthodontics
St. Gregorios Dental College
Chelad

Prof. Dr. GEORGE FRANCIS
Prof and HOD

Date: 27-01-2023
Kothamangalam

Seal & Signature of Principal

PRINCIPAL
St. Gregorios Dental College
Chelad, Kerala - 686 681

Prof. Dr. JAIN MATHEW
Prof and HOD

Date: 27-01-2023
Kothamangalam

COPYRIGHT

Declaration by the Candidate

I hereby declare that the Kerala University of Health Sciences, Thrissur shall have the rights to preserve, use and disseminate this Dissertation in print or electronic format for academic/ research purposes.

Jasmin

Date: 27-01-2023

Dr. JASMIN CYRIL

Kothamangalam

St. Gregorios Dental College ★ 689691 ★ Chelad - 686 689

ACKNOWLEDGEMENT

I owe my first expression of deepest gratitude to the God Almighty in whose name I started the journey and who has always been on my side in all my work showering His favours upon me.

I am extremely indebted to my mentor and guide, **Prof. Dr George Francis** , Professor and Head of the Department of Prosthodontics, Crown and Bridge, St. Gregorios Dental College, Chelad, for his flawless guidance and instinct encouragement. His experienced guidance and perfect supervision at each level of work helped me to complete my research work successfully.

I express my heartfelt gratitude and indebtness to, **Prof. Dr.Mathew M. Alani**, Professor, Department of Prosthodontics for patiently guiding and motivating me. His sense of humour and positivity has always helped me work at ease and inspires me to create a constructive work environment.

I would also like to thank our esteemed Principal **Dr. Jain Mathew** for his encouragement and support.

I profusely thank **Dr. Reba P B**, who left us to join Government Dental College, Kottayam, for her assistance, guidance, critical evaluation and valuable suggestions during the entire course of my research work.

I would like to take this opportunity to thank my beloved teachers, **Dr. Paul Kariyatty** for his timely support and advices; **Dr. Arun K Joy**, for his assistance in the selection of the study, timely support and advices and for consistently propelling me to arrive at the completion; **Dr. Joyce Thomas**, for the support and assistance; **Dr. Merin K Joseph**, for the support, affection and timely advices throughout my post graduate course; **Dr.Silpa Abraham**, for devoting her time for correcting and perfecting the flaws that were present in the study and for sharing her knowledge; **Dr.Reshma Raju**, for sharing the study material and last minute guidance.

Words would not suffice to express my indebtedness to, **Dr. M.R.Radhakrishnan Panicker**, Head of the division, Department of Mechanical Engineering, CUSAT; **Dr. Biju. N**, Professor, Department of Mechanical Engineering, CUSAT; **Mr. Jibi**, Guest lecturer, Department of Mechanical Engineering, CUSAT, Eranakulam; **Dr. P. P. Lizymol**, Senior Scientist, Division of Dental Products, Biomedical wing, SCT, Trivandrum and **Dr. Ananthakumar S**, Chief Scientist, Material and Mineral Division, CSIR-NIIST, Trivandrum for their support and guidance in completion of my study.

I gratefully acknowledge the help of **Dr.Abdul Saheer,** Associate Professor and HOD, Department of Public Health Dentistry, Malabar Dental College, for helping me prepare the statistical analysis of the study.

I would like to take this opportunity to convey my sincere thanks to **Dr. Eapen Cherian**, for his endless cooperation throughout the course.

I express my heartfelt thanks to my colleagues **Dr. Jinson James** and **Dr Arya Aravind** as well as my juniors **Dr. Aishwarya, Dr. Divya, Dr. Mebil, Dr. Aiswarya, Dr. Gopika** and **Dr. Tintu** for being very supportive.

Also, I thank all my senior post graduates, **Dr. Ann, Dr. Amrutha, Dr. Hari, Dr. Jerin, Dr. Kiran, Dr.Raisa, Dr. Merlin** and **Dr. Godwin** for offering help and for being my constant pillars of support during the entire post-graduation period.

I am extremely thankful to all non-teaching staff members in my department for their endless cooperation throughout my research work.

Words may fail to express the gratitude I have for the sacrifices of my parents, **Mr.Kuruvilla, Mrs. Mary Kuruvilla**, in unison with the prayers of **my loving siblings.**

Words are inadequate to express my gratitude to my **Religious Congregation and my dear Sisters** for their unconditional love, prayer and support. Their faith in me helped me think in the right direction. They have never let me down in times of distress all throughout the course and constantly supported me.

I cannot do away with the selfless and timely help given by my dear friends, **Dr. Jimmy, Dr. Sarjin, Dr. Shreenath, Dr. Ann, and Dr. Lissy** throughout the study.

I also appreciate the contribution of all the people who have helped me in one or other way for the successful completion of the study

Date: 27-01-2023

Kothamangalam

Jasmin

Dr. JASMIN CYRIL

TABLE OF CONTENTS

ABSTRACT

Background and objectives: Denture cleansers are widely used to prevent microbial colonization and prevent denture plaque formation. It has been established that daily use of denture cleansers can affect the physical and mechanical properties of the denture base materials. The existing literature gives very scarce information about the effect of denture cleansers on surface roughness and colour stability of Polyetheretherketone (PEEK). Therefore, the objective of this study is to evaluate the colour stability and surface roughness of PEEK and compare it with that of PMMA, after staining and exposure to denture cleansing agents.

Methods: A total number of 42 specimens (21 specimens of PMMA and PEEK each) were used in the study. After the analysis for baseline values of colorimetry and surface roughness, all the specimens were immersed in coffee (staining solution) for 12 hours and rinsed with distilled water, then according to the cleansing media to be used, each material samples were subdivided into 3 subgroups(n=7) of 7 samples each (2 test groups for Fittydent & Polident and 1control group for distilled water).Each of the specimen was immersed in the cleansing media and distilled water for 12 hours according to the subgroups. This procedure was repeated every 24 hours with fresh staining solution and cleansing media for next 30 days. The colour stability and surface roughness values were measured on 1^{st}, 7^{th} and 30^{th} day by using spectrophotometer and profilometer respectively. Inferential statistics to find out the difference between the groups was done using, one way Anova and within the group by Repeated measure's of Anova followed by Tukey's HSD Post hoc analysis to find out the difference between two groups.

Results and discussion: From the analysis, it was found that PEEK in Polident exhibited least colour change than Fittydent.; similar result was found in the case of PMMA, thus suggesting that the favorable cleansing media for maximum color stability for both the materials is Polident. Simultaneously, for the

property of surface roughness; the results for PEEK showed similar trend as that for color stability where Polident exhibits minimum change in surface roughness of the PEEK material, whereas for PMMA, Fittydent exhibited least change in surface roughness. In addition to this, comparative analysis between the groups shows that, with the use of cleansing media, PEEK material demonstrates better properties than PMMA.

Conclusion: Within the limitations of the above study, it is concluded that PEEK material is able to sustain the property of colour stability and surface roughness better than PMMA even after immersing it in the cleansing agents. According to this study Polident is better cleansing agent than Fittydent.

Keywords – Polymethylmethacrylate, Polyetheretherketone, Denture Cleansers, Surface Roughness, Colour stability.

LIST OF TABLES

LIST OF FIGURES

LIST OF GRAPHS

INTRODUCTION

INTRODUCTION

According to GPT 9, Denture base is the part of a denture that rests on the foundation tissues and to which teeth are attached. Over the years, several types of denture base materials have been used for denture fabrication. The aim has always been to replace or restore the lost or damaged tooth structure to satisfy both the aesthetics and functional requirements. Thus, an ideal denture base material must have sufficient strength and rigidity, be biocompatible, have good aesthetics, be easy to handle and allow minimal release of residual compounds in order to serve for a reasonable length of time [1].

Since 700 BC various materials such as wood, bone, ivory, porcelain, gold, vulcanite, tortoise shell, gutta-percha, cheoplastic, aluminium, celluloid, bakelite, stainless steel, base metal alloys and vinyl resin had been used as denture base material. The introduction of a more satisfactory plastic denture base material occurred in 1937, when Dr. Walter Wright described the results of his clinical evaluation of methyl methacrylate resin[2]. Other commonly used denture base materials included polyamide and PEEK.

PMMA is the most popular material in dentistry especially as a denture base material since 1937[3].It has some advantages like ease of manipulation, repair and polish, low cost and acceptable esthetic properties. However, polymerization shrinkage, poor wear resistance, inadequate mechanical properties, and residual monomer content are the main limitations of the material. Polyamide (nylon) denture base material that has been described in 1950, is an alternative to the acrylic resins in special situations such as repeated denture fracture and allergies.[4]

Polyamide thermoplastic resin is more flexible than the more widely used acrylic resins, providing patients with comfortable long-term use. Therefore, it is often recommended for geriatric and disabled denture wearers.[5]

PEEK is a thermoplastic resin that has been employed in the field of industry and medicine for several years. It is a semi-crystalline high performance composite that offers a unique combination of outstanding physical properties, stability at high temperatures and excellent resistance to chemical damage.[6] The most crucial property being the modulus of

elasticity of the PEEK that lies in the range of 4000MPa, which is almost close to the elasticity of human bone, thereby providing a cushioning effect to the occlusal forces. This elasticity which lies within the range of bone makes it a more suitable prosthetic material as it is able to compensate for the torsion of bone. This outstanding nature of the material enables the use of PEEK as implant abutments and as a framework material for removable and fixed dental prosthesis. In addition to this, when compared to other materials, PEEK exhibits properties of bio-inertness, non- toxicity, good chemical resistance, radiolucency and MRI compatibility which allows the use of PEEK as an implant superstructure material in dentistry. The polishing properties of PEEK are of significant importance, which counteract plaque deposits and discoloration even in exposed surfaces and framework structures.[7]

Denture care is indispensable for general health, especially in elderly patients who cannot adequately brush their dentures because of disease, dementia and poor dexterity. Home care instructions provided to patients during the denture placement appointment help in maintaining healthy oral mucosa[8]. Denture cleaning methods include mechanical and chemical cleaning. Mechanical cleaning implies the removal of plaque using a brush or ultrasonic cleaning. Effective plaque removal requires a degree of manual dexterity that is often lacking especially among elderly patients.

The use of chemical denture cleaning agents produces more effective results, especially in geriatric patients and in people who have problems with wearing dentures. A variety of chemical denture cleansing products are commercially available and these can be divided into five groups: alkaline peroxides, alkaline hypochlorite, diluted organic and inorganic acids, disinfectants and enzymes.[9] Immersion-type denture cleansers marketed mainly in the form of tablets or powder are used most commonly due to their easy application. The alkaline peroxides and sodium hypochlorite are the most used agents and their clinical effectiveness has been tested by microbiological and stained biofilm quantifications. The alkaline peroxide solutions are widely indicated for controlling of biofilm; however the efficacy of such agents is still inconclusive. Some studies show ineffectiveness on biofilm removal while others demonstrate that these solutions can incorporate a cleaning action in the hygiene procedure and may be useful as an adjunct method of denture cleansing; however, the concentration is a factor that should be

considered to prevent any adverse effects on the materials of the prosthetic devices. Considering the limitations of both the methods when used individually, greater interest has been shown in combination of both.

Despite the advantages, daily use of denture cleansers can affect the physical and mechanical properties of denture base material. Properties that are mainly affected by denture cleansers are color, surface roughness, and hardness, and these are very important for long-term success of any prosthesis. While choosing a disinfectant for a dental prosthesis, consideration should be given to its compatibility with the type of material to be disinfected to avoid adverse effects.[10]

Change in physical properties of the denture base acrylic resin after immersion in denture cleansers has been extensively reported. The findings indicated that denture cleansers significantly increase the surface roughness, decrease the surface hardness and remarkably alter the colour of the denture base resins. Nevertheless the effect of using denture cleansers on the PEEK material is not yet established much in literature. Hence the purpose of this study is to evaluate the effect of two different denture cleansers on the color stability and surface roughness of PEEK and compare it with PMMA.

BACKGROUND AND REVIEW OF LITERATURE

BACKGROUND AND REVIEW OF LITERATURE

Anthony DH and Gibbons P (1957)[11]conducted a study to evaluate the nature and behavior of denture cleansers (Cholrex, Soda, Salt and Listerine). Results showed that denture cleansers appear to be harmless to dentures. Similarly sodium hypochlorite acts as an efficient disinfectant. He also concluded that substances which contain appreciable quantities of alcohol are not indicated as denture cleansers.

Cannor et al. in1977[12]did an in vivo study to evaluate the enzyme denture cleanser. Twelve edentulous individuals were randomly selected to participate in the study for the purpose of intentionally forming plaque specimens on their dentures. Results of this study indicate that the incorporation of enzymes in a denture cleanser enhances the effectiveness of the cleanser in removing plaque. In view of the potentially harmful effects of plaque accumulations on dentures, further research should be conducted to find the most appropriate enzymes to optimize plaque removal.

Jorgensen EB. (1979)[13] conducted a study to evaluate the various materials and methods recommended for cleaning dentures. Alkaline peroxides are the most commonly used denture cleansers. However there is evidence that peroxide cleansers when used for routine denture cleansing may cause bleaching of acrylic resin, which in turn may decrease the transverse strength. Also alkaline hypochlorites are effective because they are fungicidal and bactericidal. However the significant disadvantage of hypochlorite is it's tarnishing and corroding of metal components and bleaching acrylic resins, which can affect transverse strength.

Augsburger R. H, Elahi J M (1982)[14]The purpose of this study was to evaluate the efficacy of seven proprietary denture cleansers. They have used the following denture cleansers for their study: Denalan, Mersene, old Efferdent and new Efferdent, Polident tablets, and old Kleenite and new Kleenite. Results showed, a marginally significant baseline score difference was focused primarily in the buccal surfaces, where as "no differences were found in the tissue contact surface. They concluded that a 10minute soaking in a denture cleanser alone did not prove to be particularly effective in plaque

removal. Therefore a longer soaking period, in addition to mechanical brushing is recommended.

Mohssen Ghalichebaf et al. in 1982[15]did a study to compare the effectiveness of four commercial immersion-type cleansers.Four immersion type cleansers were used are Mersene, Polident, Efferdentand Calgon. The active ingredient in Clorox is sodium hypochlorite (5.25%). Result showed that Mersene was most effective in removing plaque from the denture's tissue surface in 15 minutes. The second most effective cleansing material was Calgon with Clorox, but there was no statistically significant difference between Mersene and Calgon.

Moore T.C, Smith D.E, Kenny G.E (1984)[16]Conducted a study to test efficacy of denture cleaners to kill and remove microorganisms on dentures currently worn by patients. They have used the following denture cleansers Mersene, Polident, Efferdent, Miller's Kleenite, and Clorox and Calgon. Based on the results of this study, authors have concluded that,

1. Millers and Kleenite were the most effective sanitizing agents.

2. Brushing the denture with soap and water and soaking the denture in the cleaner Mersene were effective to a lesser degree.

3. In the past, the function of denture cleaners has been to remove deposits and stains from dentures. With the present knowledge of the role of microorganisms in the etiology of denture stomatitis, more emphasis should be placed on the ability of denture cleansers to sanitize dentures.

Robert W. Rudd et al. in 1984[17]did study to evaluate the bactericidal action of 5.25% sodium hypochlorite (undiluted Clorox) for the sterilization of complete dentures and to determine the optimum immersion time required to achieve this effect. Result showed that the dentures coated with the organisms and then immersed in Clorox for 1 and 3 minutes showed evidence of growth, whereas the dentures immersed for 5 minutes were sterile. Subcultures of the broth after 1 and 3 minutes immersion showed viable organisms, but after 5 minutes immersion there was no growth. It was concluded that a 5-minute

immersion of dentures in undiluted Clorox accomplished sterilization against a variety of microorganisms, including a spore-forming bacteria and C. albicans.

Mitsuhiro Tamamoto et al. in 1985[18] did study to evaluate the ability of several enzymes to remove C. albicans from an acrylic resin surface. Ten high-power fields (1.1 mm^2)were counted and totalled. Five plates were used for each enzyme (Amylase,Dextranase, Yeast lytic enzyme, Proteolytic enzyme) and compared with the control, so that the percent of cells removed could be calculated. Result showed that yeastlytic enzymes and proteolytic enzymes were effective for removing C. albicans, while other types of enzymes were not. It was concluded that yeast lytic and proteolyticenzyme are potentially useful denture cleansers.

Carol-Anne Crawford, C. H. Lloyd, J. P. Newton and R. Yemm. (1986)[19] in this study the cleaning procedures used by patients presenting with bleached or whitened dentures have been carried out on specimen strips of acrylic denture base material. The results show that it is possible to produce, on correctly cured acrylic strips, this bleached or whitened appearance, but only in those samples subjected to very hot water, with or without the denture cleaning agent. In these samples, changes in the physical properties were indicated by a breakdown of the surface layer, a reduction in light transmission and a reduction in transverse bend strength. The conclusion from this study is that the bleaching of the denture-base material is, in reality, a surface opacification effect produced by the use of boiling water, irrespective of the presence of the proprietary denture cleaning agent.

Robinson JG, Mc Code J F, Storer R (1987)[20]A study was conducted to evaluate the effect of various treatments on clarity strength and structure of three denture base resin were chosen as being representative of common heat and cold curing commercial resins. Results showed that both heat cured specimens that had been whitened by tests involving acetone and those involving hypochlorite solutions had suffered a reduction in transverse strength, where as chemically activated resin exhibited increased strength when subjected to hot water, hot alkaline and hypochlorite. This was possibly caused by the increase in degree of cure brought about by high temperature offsetting the weakening effect seen in other resins.

Dills S.S, Olshan A.M, Goldner S and Brogdon C (1988)[21]have done study to compare the anti-microbial capability of an abrasive paste and chemical soak denture cleansers. Dentu crème abrasive denture paste and Efferdent alkaline peroxide denture cleanser soak were selected for study. Based on the results of two studies following similar double blind cross over designs, authors have concluded that soaking with the denture cleanser caused a significantly greater reduction of microorganisms than did brushing with the denture paste. Further, combining brushing with the soak did not reduce the level of removable microorganisms significantly more than soaking alone. Overall, brushing alone did not consistently remove more microorganisms than were observed in the no treatment group.

P.Hornez LSD et al (1989)[22] The study was to determine the effect of 3 processing cycles on some physical and chemical properties of heat cure acrylic resin and to compare the impact strength and Brinell hardness of that denture base resin. The results showed that the samples processed by following the recommended cycles showed statistically significant differences in regard to impact strength and Brinell hardness. Residual monomer ratio was higher when the boiling point was not reached, which seems to confirm the plasticizing effect of residual monomer. Samples were less brittle and less hard. Violent boiling caused increase in porosity and lessened impact strength.

Nakamoto K, PharmSci M, Tamamoto M & Hamada T (1991)[23]study to compare the cleansing efficiency of four denture cleansers with enzymes and one cleanser without enzymes (alkaline peroxide type) under the same conditions to assess the cleansing efficiency resulting from the enzymes. Five commercially available denture cleansers were used in this study. Four denture cleansers contained enzymes (Pika, Liodent, Dr. Health, Polident) and one denture cleanser does not contain enzyme (Polident former type). Results of this study showed that, three cleansers with proteolytic enzymes showed little yeast lytic ability, while one cleanser with yeast lytic and proteolytic enzymes and one cleanser without enzymes showed slight yeast lytic ability. They have concluded that the activity of denture cleansers depended on alkaline peroxide rather than on enzymes.

Kenneth B. May(1992)[24] conducted a study to evaluated the color stability of five denture base acrylic resins and one denture base repair resin. The study concluded that:

1. Use of an accelerated aging chamber and a colorimeter were effective in quantitatively evaluating the color stability of denture base resins.

2. Lucitone Hy-pro and Triad (VLAR) denture base resin were the materials least affected by conditions of accelerated aging.

3. Compak-20 was the least color-stable of the materials tested.

Per A. Odman in 1992[25] did an in vivo study to test the effectiveness of an enzyme-containing denture cleanser. During a 3-week period, 13 patients used Enzydent only for soaking the denture: during another 3-week period, the patients were instructed first to soak and then to brush their denture. The effectiveness of the cleanser was measured by microbiologic procedures. The results showed that soaking the denture in the enzyme containing cleanser alone was as effective as the patients' previous regimen of denture hygiene, but when soaking was used in combination with brushing, the denture became significantly cleaner.

Drake et al. in 1992[26] did an in vitro study to evaluate the efficacy of denture cleansing agents in an in vitro bacteria-yeast colonization model. Super-Strength Polident (Block Drug Co, Inc, Jersey City, NJ) and Professional-Strength Efferdent (Warner-Lambert, Morris Plains, NJ) were the denture cleansing agents evaluated. Results were showed that both Efferdent and Super-Strength Polident were able to substantially reduce or eliminate colonizing S mutans. In sharp contrast, however, no significant decreases in adherent C albicans were observed with either denture soaking agent.

Hiroki Nikawa et al in 1995[27] described a simple method to measure Candidal bio film activity using pH change of Stomastat was developed and used to evaluate the efficacy of 11 commercial denture cleansers on Candida albicans biofilm. The initial number of yeasts inoculated correlated with the pH value of Stomastat after both 24- and 30- hour incubation periods ($r= 0.992$; $r= 0.988$, respectively; $P<.01$], which supported the method's validity. The ability of the cleansing agents to decrease fungal biofilm activity varied

depending upon the components of the agents. In general, peroxide denture cleansers, a disinfectant, and one enzyme cleanser were more efficacious than the other types tested in this study.

Keng et al.1996[28]did a study to determine the distribution of plaque on dentures. The plaque material was disclosed with a dye solution and measured with a modified Quigiey-Hein scale. A photographic method was used to determine the distribution of plaque on the dentures of a grotip of complete-denture wearers. The effectiveness of aperborate soak-type cleanser was also measured by studying the precleaned and post cleaned states of the denture. Denture plaque was more evident on the fitting surfaces of the dentures than on areas of the flange, teeth, and palate. The use of the soak-type cleanser atone may not be completely effective for the control of heavy plaque.

Aysun Unlu, O.Tugrul Altay, Sevil Sahmali (1996)[29] conducted a study to evaluate the effect of chemical denture cleansers on heat-activated and auto polymerizing acrylic denture resins. Three types of heat-polymerizing and three types of auto polymerizing acrylic resins were selected, and four different types of chemical denture cleansers were tesled. The results were evaluated using a two-way analysis of variance and Tukey's Significant Difference Method, Corega had a significant whitening effect on the acrylic resins as compared to the other cleansing agents tested. The weakest effect was shown by Polident (F value = 250,366; P<D01), There was a significant difference between the acrylic resin materials used in this study. Whitening was greatest with the orthodontic auto polymerizing acrylic resin, and the least for QC- 20, the heat-poiymerized acrylic resin (F value = 76,420; P<, 001), Significant differences were found between the cleansing agents and acrylic resins (F value = 2,561; P<002).

Gregory L Polyzois, Stavros A.Yannikakis, Alkibiades J.Zissis, Pyrros P.Demetriou (1997)[30]conducted a Study evaluated the effects of chemical disinfectants on the color of denture base materials. Materials tested included Paladon 65, Triad VLC and ProBase Cold. The disinfectants were Klinex, Gidex-7, Hibitane, and Cabadol. It was concluded that if there commended disinfecting times are followed, no observable color changes should be anticipated for the denture materials tested. Even the long-term (7-day) immersion caused observable color changes only with Cabadol, a phenol based

disinfectant, and Pro Base and Triad denture materials.

Hiroki Nikawa et al in 1999[31] was reviewed summarizes the methods employed to evaluate denture cleansers and makes some suggestions on the methodology of evaluation. More than 20 articles evaluating the efficacy of denture cleansers were compared, and the advantages and disadvantages of each method were evaluated. The result showed that efficacy of denture cleansers was variable depending on the methods used to evaluate the particularly among in vitro and in vivo assays. In addition, it is pointed out that chemical denture cleansers are not as efficacious in clinical use as in the in vitro assay. The uncertainty over efficacy may be caused by non standardized methodology and reports of conflicting results. It was concluded that standardization of the methodology is needed.

Sheen R.S, Harrison A (2000)[32] conducted a study to assess the plaque prevention on dentures using an experimental cleanser. They have used a new method for assessing plaque levels on dentures by using digital imaging and to use this methodology, together with a validated visual scoring method, to evaluate plaque buildup on dentures. The new denture cleanser used in this study contained a silicone polymer that has been developed recently, which inhibits plaque formation on acrylic resin denture surfaces by using a novel "plaque block" technology. Results showed that, new cleanser is more effective in reducing mean visual plaque of 51% at 2 day and 42% at 14th day compared with water. Similar results were seen with digital imaging. They have concluded that the new denture cleanser (Fixodent, Procter and Gamble Technical Centres Ltd, Rusham Park, Egham, U.K.) Proved to be effective at preventing plaque accumulation on dentures. The analysis of digital images gave similar results as the visual scoring method.

Y. Kulak-Ozkan, E. Kazazoglu & A. Arikan. (2002)[33] study was to determine oral hygiene habits, denture cleanliness, presence of yeasts and denture stomatitis in elderly people. Seventy complete denture wearers were investigated clinically and mycologically. Subjects were evaluated according to, presence of denture stomatitis, presence of yeasts, denture cleanliness, frequency of denture brushing and denture cleaning methods. Swabs were taken from the palate investigated mycologically in order to identify the yeast colonies. No statistical relationship was found between denture stomatitis and frequency of denture brushing and denture cleaning methods. However, there was a statistically

significant relationship between denture stomatitis, yeasts' presence and denture cleanliness.

Filiz Keyf (2002)[34]conducted a study to determine the gloss changes resulting from the testing process in four different beverages in one heat polymerized denture base resin and one cold-polymerized denture base repair resin. The results of this study revealed that gloss changes occurred after testing in heat-polymerized denture base resin and cold-polymerized denture base repair resin. The significance of the gloss changes exhibited by each sample, kept for different lengths of time in the same solution, was compared using the Wilcoxon test. The results were statistically significant. According to the Kruskal–Wallis analysis of variance, the difference between measurements for angles of illumination was statistically significant.

Also according to the Mann–Whitney U-test, the difference between two polished surfaces or two unpolished surfaces was statistically insignificant, but the difference between smooth polished and rough unpolished surfaces was statistically significant.

Renata C, Garcia R, Leon BL, Oliveira VMB, Cury A (2003)[35] Conducted a study to evaluate the effect of denture cleanser (Polydent, tap water) on weight, surface roughness and tensile bond strength of two resilient denture liners. Roughness was evaluated by the use of a profilometer. Weight changes were recorded in milligrams and expressed as the percentage of weight difference between the periods of evaluation. Tensile bond strength was determined with universal testing machine. He found that specimens immersed in Polydent demonstrated increased weight changes of resilient liner as compared to tap water, but surface roughness and tensile bond strength were unaffected.

Garcia R, De Souza JA, Rached RN, Cury A (2004)[36]A study was conducted to evaluate the effect of denture cleansers on the surface hardness and surface roughness of the denture base resin, Co-Cr and Ti-6Al- 4V alloys. He concluded that cleanser manipulated using sodium perborate increased the surface roughness and hardness of Co-Cr alloys and Ti-6Al-4V alloys as well as denture base resins due to its incapacity to remove the pellicle formed on the acrylic resin and dental alloys.

Harrison Z, Johnson A, Douglas CWI (2004)[37]Conducted a study to evaluate the effect of limited range of denture cleansers on surface roughness and removal of Candida albicans from conventional heat cured acrylic resin materials. Results showed that immersion type of cleanser was found to be the most suitable cleaner of the denture base material due to its low abrasive and effective removal of organic debris. Paste type cleansers were found to be significantly roughen the denture base material.

Sato S, Cavalcante M R S, Orsi I A, Paranhos H F O, Zaniqeilli O (2005)[38] The purpose of this study was to assess the flexural strength and color alteration of acrylic resin, immersed in denture cleansers for different periods of time. Results show that there were significant difference among the resins Lucitone, Triplex and QC-20. No significant differences were found either among the denture cleansers (Bony Plus; Corega Tabs; Efferdent Plus and control) or between the soaking periods throughout the soaking cycles simulating 30 days of use. No color alterations were identified by visual examination.

Yasemin Kulak-Ozkan, Akkan Akkaya, Buket Akalın, Ender Kazazoglu (2005)[39] The aim of this study was to evaluate the effects of disinfectants on the colour stability of 3 different denture base materials. After 28 days, Meliodent was found to have the best colour stability ($\Delta E^* = 1.12$). The greatest colour change was noted for Impact ($\Delta E^* = 2.4$).All materials tested showed clinically acceptable colour changes after 28 days of exposure to the disinfectants tested.

E.M.C.X.Lima et al.2006[40]did study to evaluate the effect of denture cleansers on surface roughness of acrylic resin and on biofilm accumulation. It was conducted a crossover study of three phases of 4 days each and 13 volunteers wore palatal appliances containing four specimens of acrylic resin of known surface roughness which were extra-orally submitted once a day to three groups of separated treatments: (i) negative control, (ii) enzymatic commercial solution (Ortoform) or (iii) 0.5% sodium hypochlorite (NaOCl).The roughness of the resin increased after the treatments ($P < 0.05$) but the difference among the cleansers was not statistically significant (P ¼ 0.85). The lowest amount of biofilm formed on acrylic resin specimens was found for the treatment with NaOCl ($P < 0.05$) but the enzymatic product did not differ from the negative control group ($P > 0.05$). The data

suggest that the roughness of acrylic resin was not changed by the cleansers, but the ability to reduce biofilm accumulation depended on the product used.

H. F. O. Paranhos et.al.in 2007[41]did study to quantify biofilm on the internal surface of upper complete dentures following six possible cleansing methods. Thirty-six edentulous subjects were submitted to a time-series trial and dentures were cleansed according to six methods: (i) rinsing with water; (ii) soaking in an alkaline peroxide solution (Bonyplus);(iii) brushing with dentifrice (Dentu-Creme) and soft Johnson and Johnson's toothbrush; (iv) combination between soaking and brushing according to methods 2 and 3; (v) brushing with dentifrice (Dentu-Creme) and soft Oral B toothbrush; (vi) combination between soaking and brushing according to methods 2 and 5.. Result showed that the most efficacious approach was 6. It was concluded that brushing alone was more effective than the chemical method employed. The best results were obtained by a combination of methods.

Sarag D, Sarag Y, Kurt M, Yuzbasioglu E (2007)[42]Conducted a study to investigate the color stability of soft denture liners and the effectiveness of denture cleansers on soft denture liners colored by food colorants in different time periods. They have used a plasticized acrylic resin soft liner (Viscogel) and a silicone based soft liner (Mollosil). Results showed that there were no significant differences between soft liners and cleansers in terms of color change. Viscogel exhibited slightly greater color changes than Mollosil and the results showed significant differences. They concluded that, silicone based soft denture lining materials seems to be more resistant to staining. With respect to denture cleansers, Fittydent was more effective than Curadent in this trial.

Francine Cristina da Silva et al. in 2008[43]did study to evaluate the effectiveness of disinfectant solutions (1% sodium hypochlorite, 2% chlorhexidine digluconate, 2% glutaraldehyde, 100% vinegar, tabs of sodium perborate based denture cleanser, and 3.8% sodium perborate) in the disinfection of acrylic resin specimens (n = 10/group) contaminated in vitro by Candida albicans, Streptococcus mutans, S. aureus, Escherichia coli, or Bacillus subtilis as measured by residual colony-forming unit .The results showed that 1% sodium hypochlorite, 2% gluteraldehyde, and 2% chlorhexidine digluconate were most effective against the analyzed microorganisms, followed by 100% vinegar, 3.8%

sodium perborate, and tabs of sodium perborate based denture cleanser. Superficial roughness of the specimens was higher after disinfection cycles with 3.8% sodium perborate and lower after the cycles with 2% chlorhexidine digluconate. It was concluded that within the limits of this experiment, 1% sodium hypochlorite, 2% gluteraldehyde, 2% chlorhexidine, 100% vinegar, and 3.8% sodium perborate are valid alternatives for the disinfection of acrylic resin.

Hong G, Murata H, Li Y, Sadamori S, Hamada T (2009)[44]Conducted a study to determine the influence of denture cleansers on the color stability of 3 different types of acrylic resin. They have used one heat polymerized acrylic denture base resin (Acron), one auto polymerized chair side direct reline acrylic resin (Denture Liner), and one visible light polymerized hard direct reline acrylic resin (Tokuso Lite – Rebase) for evaluation. Results showed significant differences among the acrylic resins and denture cleansers in terms of color change (ΔE) produced after 365 days. The ΔE values of all denture base acrylic resins increased with time. The ΔE value of the auto polymerizing acrylic resin was larger than that of other acrylic resins. The least discoloration was found with acid type denture cleanser. The influence of alkaline peroxide denture cleanser on the color stability of heat polymerized acrylic resin and auto polymerized acrylic resin was significantly greater than that of the other cleansers. They have concluded that, the color stability of denture base acrylic resins is influenced by polymerization type and the type of denture cleanser used.

Pervin Imirzalioglu, DDS, PhD, Ozgul Karacaer, DDS, PhD, Burak Yilmaz, DDS, PhD, & Ilknur Ozmen, MSc (2009)[45] conducted a study to investigate the effect of four solutions [saliva(control group), saliva + tea, saliva + coffee, saliva +nicotine] on the color of different denture base acrylic resins (heat-polymerized, injection-molded, auto polymerized) and a soft denture liner, and the study concluded that the effect of staining solutions on the color of each test material in each session was perceivable by the human eye (E >1); however, the color shifts of all test materials were clinically acceptable (E <3.7) except for soft liner in nicotine, which was not clinically acceptable over time. Therefore, minimizing drinking of such beverages and use of tobacco, particularly when soft liner is applied, may be advantageous for denture wearers for long-term color stability.

Davi LR, Peracini A, Ribeiro Nde Q, Soares RB, da Silva CH, Paranhos Hde F, deSouza RF (2010)[46] conducted a study to evaluated color stability, surface roughness and flexural strength of microwave-polymerized acrylic resin after overnight immersion in sodium hypochlorite, simulating 180 days use. Forty discshaped(15 mm × 4 mm) and 40 rectangular specimens (65 mm × 10 mm × 3 mm)were prepared from microwave-polymerised acrylic resin. Author was concluded that immersion in 1% sodium hypochlorite solutions for 8 hr does influence the colour stability and flexural strength of microwave-polymerized acrylic resin, during the simulated period of 180 days.

Dr. Chethan M D, Dr. N. S. Azhagarasan, Dr. Saket miglani, Dr. Mohammed. H, Dr. A. Hari Prasad (2011)[47]The purpose of this study was conducted to compare and evaluate the efficacy of four chemically different immersion types of commercially available denture cleansers on recently fabricated complete dentures in healthy patients, using microbiological quantification method. Chemical denture cleansers used were divided into four groups; Group I – Sodium hypochlorite solution 0.02% Group II – Trisodiumphosphate , Group III – Sodium perborate and Group IV – Chlorhexidine gluconate 0.2%. For all the groups the difference of means was statistically significant. The percentage reduction in streptococcus species count in log units for Groups I, II, III, and IV was found to be 28%, 16%, 10%, and 9% respectively. Cleansing agents were found to be effective in the following order, Sodium hypochlorite solution (0.02%), Trisodium phosphate, Sodium perborate and Chlorhexidine gluconate (0.2%). Treatment of dentures with denture cleansers significantly decreases the amount of subsequently formed plaque.

Helena de Freitas Oliveira Paranhos, Amanda Peracini, Marina Xavier Pisani, Viviane de Cássia Oliveira, Raphael Freitas de Souza, Cláudia Helena Silva-Lovato (2013)[48]study to evaluate color stability, surface roughness and flexural strength of acrylic resin specimens after immersion in alkaline peroxide and alkaline hypochlorite, simulating a period of one and a half year of use of overnight immersion Properties were evaluated at baseline and after the immersion. Color data were also calculated according the National Bureau of Standards (NBS). Results were analyzed statistically by ANOVA and Tukey's HSD test (α=0.05). In conclusion, overnight immersion in denture cleansing solutions simulating a year and a half of use did not alter the flexural strength of acrylic resin but caused noticeable color alterations, higher for alkaline peroxide.

Anil K Gujjari, Vishrut M Bhatnagar, Ravi M Basavaraju (2013)[49] To evaluate the color stability and flexural strength of poly (methyl methacrylate) (PMMA)and bis-acrylic composite based provisional crown and bridge auto-polymerizing resins exposed to tea, coffee, cola, and food dye. The findings of the study showed that for materials used in the study, PMMA was more color stable than bis-acrylic composite based resin. Also, material based on PMMA was more resistant to damage from dietary beverages as compared to bis-acrylic composite based provisional crown and bridge resin.

Vrinda R. Shah, Darshana Nilesh Shah, Chirag J. Chauhan, Paras J. Doshi, Ashish Kumar(2015)[50]Conducted a study aimed at evaluating the colour stability and flexural strength of flexible denture base materials (Valplast) and Polymethyl methacrylate (PMMA) denture base material (Meliodent) processed bytwo different methods (Injection moulding and compression moulding) after immersing them in threedifferent denture cleansers with acidic, basic and neutral PH.The study was concluded that maximum effect on colour stability was noted with Clinsodent followed by Valclean. Least color changes were observed after immersion in Polident. Colour difference was increased significantly as the immersion time increased. For both Meliodent and Nylon resins, statistically significant change in flexural strength occurred with immersion in all denture cleansers. Clinsodent has greater effect as compared to Valclean and Polident. Polident and Valclean can be safely used as denture cleanser for both nylon and acrylic resin denture base materials as far as colour stability and flexural strength both are concerned.

Karthigeyan Jeyapalan(2015)[51]this study was to evaluate and compare the effects of three chemically different commercially available denture cleansing agents on the surface topography of two different denture base materials. All three denture cleanser solutions showed no statistically significant surface changes on the acrylic resin portions at 56 hr, 120 hr, and 240 hr of immersion. However, on the alloy portion changes were significant at the end of 120 hr and 240 hr. Of the three denture cleansers used in the study, none produced significant changes on the two denture base materials for the short duration of immersion, whereas changes were seen as the immersion periods were increased.

Scott Hollis et al (2015)[52] conducted a study for evaluating the color stability of different denture base materials like light polymerized resin, heat polymerized resin and auto polymerized resin after subjecting them various staining agents and denture cleansers. The study concluded that the light polymerized resin displayed greater color changes than heat polymerized and auto polymerised resins. Regardless of the cleansers used color changes in all the three resins were clinically perceivable.

Anja Liebermann et al (2015)[53]study was to assess effects of different aging regimens/duration son roughness, solubility, water absorption, Martens hardness (HM), and in dentation modulus/EIT on different computer-aided design and computer-aided manufacturing (CAD/CAM)polymers. Storage media had no effect on surface roughness and water absorption. Physiological saliva revealed the highest significant impact on solubility followed by artificial saliva, sodiumchloride, and distilled water. Water absorption increased significantly with storage duration. PEEK showed the lowest solubility and water absorption values. The highest solubility was observed for the conventional polymer CG, and the highest water absorption was found for the composite LU. PMMA-based TC, ZP, CG, and AT showed the lowest HM and indentation modulus, followed by CT, and PEEK. The highest values were observed for the hybrid material EN, followed by LU and EX. The hardness parameters of PEEK were comparable with those of PMMA-based materials.

Sina Heimer et al (2016)[54] this study was to determine the effects of laboratory and chair side polishing methods on the surface roughness (SR) and surface free energy (SFE) of PEEK, an auto polymerizing poly(methyl methacrylate), and a veneering composite resin. The polishing protocol exerted the highest influence on SR and SFE values (P<.001; SR: partial eta squared hP2=.970; SFE: hP2=.450), followed by material group (P<.001, SR: hP2=.319; SFE:hP2=.429). The interaction effect of the binary combinations of the 2 independent parameters (polishing protocol and material group) was also significant (P<.001, SR: hP2=.681; SFE: hP 2=.365). Chairside methods presented lower SR values than laboratory methods, and specimens polished using the 2-body mode showed higher SR than did specimens polished using the 3-body mode.

Köroğlu et al in 2016[55]did study to investigate the effect of denture cleansers on the surface roughness and Candida albicans adherence of surface sealant agent coupled denture base resins. One hundred and twenty specimens were fabricated from 2 polymethyl methacrylate (PMMA) (Meliodent; Acron MC) and 1 polyamide (Deflex) denture base materials, coated with a sealant agent (Palaseal) and divided into 4 groups (n=10) according to overnight cleaning procedures: distilled water (control), 5% sodium hypochlorite (NaOCl) and two different sodium perborate (Corega; Rapident). The surface roughness values were measured with a profilometer before (Ra0) and after 90 days immersion in denture cleaners (Ra1).

Specimens were incubated with Candida albicans suspension and Candida colony- forming units (CFU) (Cfu/mm) were counted. Significant differences were found, between the Ra0 and a values of 5% NaOCl applied Acron MC, Deflex and also Rapident applied Deflex groups ($p<0.05$). Denture cleaning procedures had no significant effects on the quantitiy of Candida albicans.

Aysegul Kurtet al in 2016[56]did study to evaluate the antimicrobial efficiency of three cleaning solutions and their effect on the physical properties of a denture base material. A heat-cured polymethyl- methacrylate (PMMA) denture base material (Meliodent)and three cleaning solutions (alkaline-peroxide, 30 minutes; 1% sodium-hypochlorite,10minutes; and 0.1% polymeric-guanidine solution, 5 minutes) were used. The surface roughness and Vickers hardness of the specimens were consecutively measured after 48 hours of water storage at 37 ± 2°C (t0), two disinfection cycles (t1), and 7 days of storage (t2) in one of the solutions. Finally, all 40 rectangular specimens were subjected to flexural strength test.It was concluded that the use of polymeric guanidine disinfectant solution could be an alternative method for cleaning PMMA denture base materials.

Anand Porwal et al (2017)[57] conducted a study to evaluate the effect of different denture cleansers on the color stability, surface roughness and surface hardness of different denture base resins-conventional heat cure resin, high impact resin, and polyamide denture base resin. The study concluded that the color changes in polyamide resin were significantly greater than those of heat cure acrylic resin and high impact heat cure acrylic

resin. Color change of polyamide denture base resin was more in sodium perborate denture cleanser as compared to sodium hypochlorite denture cleanser. Surface roughness change in conventional heat cure resin was significantly greater than high impact resin. Change in hardness of conventional heat cure resin was significantly greater than those of high impact and polyamide acrylic resin.

Fouad Salama(2017)[58] The objective of this investigation was to assess the effects of different denture cleansers and distilled water on color stability of self-polymerized (SP) and heat polymerized (HP) acrylic denture base materials. No significant color change in HP acrylic base material immersed in denture cleansers compared to the control group. However, a significant change in the color was found in SP resins. A significant increase in color change for SP resins immersed in Corega and Polident compared with the control group.

A statistically significant lower color change was recorded after immersion in Stain Away Plus compared to Corega and Polident ($P<0.05$). There was a significant increase in (ΔE) for SP resins immersed in Corega and Polident compared to HP resins ($P<0.05$). Short-term immersion of acrylic denture base materials in denture cleansers showed significant color change of self-polymerized compared to heat polymerized acrylic resins. Immersion of self-cure acrylic reins in Polident and Corega denture cleansers produced appreciable color changes compared to a slight change after immersion in StainAway Plus.

Inas T. Motawea(2017)[59] This study was to evaluate the effect of denture cleanserson the flexural strength, color stability and surface roughness of flexible denturebase resin as well as micro wave cured denture base resin. it was concluded that the tested denture cleansers had no effecton the surface roughness of flexible and microwave cured acrylic resin, however,significantly influenced their flexural strength. Moreover, denture base polymers aresusceptible to color change on immersion in Corega Tabs.

Ahmad M. Al-Thobity (2017)[60] conduct a study to evaluate the effect of several denture cleansing solutions on the color stability, surface roughness, and flexural strength of three denture base materials. It was concluded that Corega has a significantly greater negative impact than distilled water on the flexural strength of HP resin base materials.

Renew significantly increased the surface roughness of AP and HP, while Corega increased the surface roughness of all resin materials.

Cagatay Dayan, Melahat Celik Guven, Burc Gencel, Canan Bural(2019)[61]A Color Stability Comparison of Conventional and CAD/CAM Polymethyl Methacrylate Denture Base Materials.This study concluded that the color stability of CAD-CAM denturebase resins is better than any of the other kind of denture base resins. The color change valuesof all groups except Eclypse stored in red wine had clinically detectable values.

Maha Nagy Mohamed Kamal (2020)[62]Purpose of this study was compare the color stability of Polyetheretherketone (PEEK), Acetal resin (polyoxymethylene POM) and Acrylic resin (Polymethylmethacrylate PMMA) denture base material discs milled by CAD/CAM and stored in different storage media. It was found that, all materials revealed statistically significant color changes after stored for 7 days in different storage media. In all storage media, Group III (Acrylic resin) recorded the highest statistically significant color changes mean values, followed by Group I (PEEK) mean values, while the lowest color changes mean values were for Group II (Acetal resin). It was also found that coffee stained subgroups recorded higher color changes mean values than ginger stained subgroups. The CAD/CAM milled acetal resin denture base material demonstrated the highest color stability while Acrylic resin denture base material demonstrated the least color stable material. It was also found that coffee demonstrated the highest color changing storage media.

Ahmed Ziada andMarwa Beleidy (2020)[63]conducted a study for verify the effect of thermo cycling and different mouth rinses on color stability of CAD/CAM composite versus conventional nanohybrid composite veneered PEEK crowns. The study showed that all specimens showed visually unperceptible color differences after thermo cycling and immersing in mouth rinses. Based on material, C group showed statistically significant higher color change values than H group. ANOVA test revealed that the highest color change was for Hexitol followed by Listerine then Distilled Water ($p=<0.0001<0.05$). Tukey's post-hoc test showed a non-significant difference between Hexitol and Listerine. The interaction between the effect of mouth rinses and type of veneering composite

materials was statistically non-significant for C group that the highest color change was for Hexitol followed by Listerine then Distilled Water (p=<0.0001<0.05). Although visually non perceptible, HIPC or nanohybrid composite veneered PEEK crowns showed a color difference after thermo cycling and immersion in different mouth rinses.

Fathima Banu et al(2020)[64] this study was to determine the color stability of three different denture base materials upon staining with beverages and denture cleansing using commercially available denture cleansers. On descriptive statistical analysis, polymethyl methacrylate (PMMA) had higher ΔE values at 12 hrs after immersion in coffee and cola; after 24 hrs, high impact PMMA had higher ΔE values in coffee and PMMA in cola. Two-way analysis of variance (ANOVA) analysis showed no statistically significant difference for the samples immersed in coffee, whereas samples immersed in cola at the end of 24 hrs showed a significant statistical difference. Thermoplastic resin was the least staining denture base material when compared to conventional PMMA and high-impact PMMA when immersed in coffee and cola. There was no significant difference in the cleanability of all three-denture base materials.

Kawkb Mohamed Eltamimi* *and* Sara Zaky Mohamed (2021)[65]The purpose of this in vitro study was to investigate the effect of four solutions sterile water (control group), tea, coffee, cola on the color stability of different denture base materials (short cycle heat-polymerized PMMA, long cycle heat-polymerized PMMA, thermo plastic monomer free microcrystalline polymer and 3d printed PEEK).Result showed significant difference between groups before and after immersion in different beverages except for Cola solution in the PEEK at P-value 0.05, control grouphadno change in color before and after immersion in sterile water. Tea and colashowed the highest change in color with thermo plastic monomer free microcrystalline polymer.

Rana Saleh Alsilani, Rana Mahmoud Sherif and Noha Adel Elkhodary (2022)[66]The study was evaluate the colour stability and surface roughness of 3 different CAD/CAM materials(IPS e.max, Vita Enamic, and PEEK) after immersion in two beverage solutions (Coffee, Coca-Cola). There was a significant colour change between the materials. Vita Enamic and PEEK samples showed the highest colour change value with coffee immersion respectively. While IPS e.max.CAD revealed the lowest colour change

value following coffee immersion with a statistically significant difference in between. After immersion indifferent media, there was a significant difference in surface roughness between the materials. Vita Enamic and PEEK showed colour change beyond the clinically acceptable level, while IPS e.max CAD was the most stable material in colour and surface roughness.

AIMS AND OBJECTIVES

AIMS AND OBJECTIVES

AIM

To analyse the color stability and surface roughness of PEEK and compare it with that of PMMA, after staining and exposure to denture cleansing agents.

OBJECTIVES

1. To evaluate the baseline value of surface roughness and colour stability of PMMA (Group1) prior to staining the samples.
2. To evaluate the baseline values of surface roughness and colour stability of PEEK (Group2) prior to staining the samples.
3. To evaluate the value of surface roughness and colour stability of **PEEK**, after staining followed by immersion in **Polident** (PK-P), for a time period of 1, 7, 30 days.
4. To evaluate the value of surface roughness and colour stability of **PEEK**, after staining followed by immersion in **Fittydent** (PK-F), for a time period of 1, 7, 30 days.
5. To evaluate the value of surface roughness and colour stability of **PEEK**, after staining followed by immersion in **distilled water** (PK-D), for a time period of 1, 7, 30 days .
6. To evaluate the value of surface roughness and colour stability of **PMMA**, after staining followed by immersion in **Polident** (PM-P), for a time period of 1, 7, 30 days.
7. To evaluate the value of surface roughness and colour stability of **PMMA**, after staining followed by immersion in **Fittydent** (PM-F), for a time period of 1, 7, 30 days.
8. To evaluate the value of surface roughness and colour stability of **PMMA**, after staining followed by immersion in **distilled water** (PM-D), for a time period of 1, 7, 30 days.

9. Comparative evaluation of surface roughness and colour stability between PM-F and PM-D as well as PM-P and PM-D.
10. Comparative evaluation of surface roughness and colour stability between PK-F and PK-D as well as PK-P and PK-D.
11. To compare the result of group 1 to group 2 to determine the material that can maintain its physical properties in cleansing media.

RELEVANCE OF THE STUDY

RELEVANCE OF THE STUDY

Over the years, a variety of materials have been used for the fabrication of the denture bases. PMMA is the most commonly used denture base material as they are less costly, easy to manipulate, easy to fabricate and easy to repair when compared to the other available materials. The PEEK is a synthetically produced polymeric material belonging to the polyacryletherketone family. Because of its excellent chemical, thermal, and mechanical properties and its excellent biocompatibility, it is widely used in dentistry[67]. No matter what kind of denture base material is used, the material must match the color and appearance of the oral tissues to provide satisfying esthetic results.

Color stability and surface roughness are two important physical properties of the denture base materials. The roughness of the denture base surfaces is important, as the adhesion of microorganisms to a surface, is a prerequisite for the colonization of that surface. Colour stability is an important physical property of all denture base materials. Several factors may contribute to the discoloration of denture base material after long term use. The factors include stain accumulation, water sorption, dissolution of the ingredients, degradation of intrinsic pigments and surface roughness[68].

Dentures can be cleaned by mechanical methods, chemical methods, or a combination of both. Denture cleansers are the most preferred chemical cleansing methods, which have been +suggested for the disinfection of the prosthesis. An ideal cleanser should be simple to use, effectively remove organic and inorganic matter from denture surface, have bactericidal and fungicidal properties and should cause least amount of change to the denture base[69]. But, it is a well known fact that, the long term use of cleansing agents can compromise some of the properties of denture base materials like PMMA. PEEK is a denture base material which has superior properties than the other denture base materials. The effect of using denture cleansers on this material is not yet established in literature. Therefore, this study evaluates the impact of two different denture cleansers on the property of colour stability and surface roughness of PEEK, to demonstrate if PEEK can be a better denture base material to be used in cases where denture cleansers are indicated.

METHODOLOGY

MATERIALS AND METHODS:

Table 1: List of Materials used for the study

Sl No.	Materials used	Brand Name and Company
1	Polymethyl methacrylate resin (PMMA)	DPI Mumbai
2	Polyetheretherketone polymer (PEEK).	Dent Care, Muvattupuzha
3	Fitty dent cleanser agents	Dr.Reddy's
4	Polident cleanser agents	GSK Consumer Health Care
5	Dental stone type 3	DPI Mumbai
6	Distilled Water	SM chemicals, Kerala
7	Coffee (staining agent)	Nescafe classic
8	Cold mould seal	Coltene

Table 2: List of Equipments used for the study

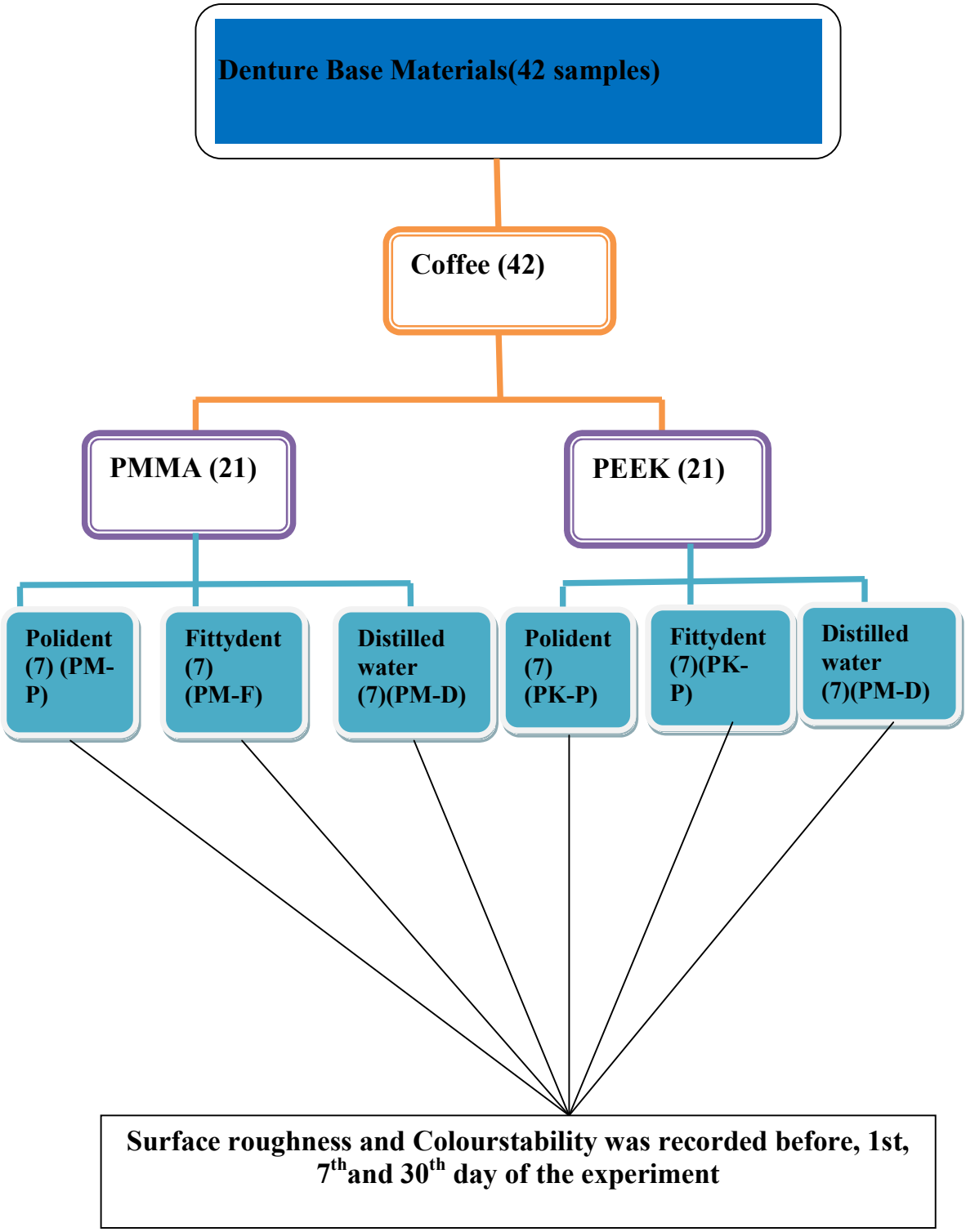
Sl No.	Equipments used	Specifications
1	Acryliser unit	Confident, India
2	Profilometer	Surfcom Flex 50A
3	Spectrophotometer	Perkin .Lamda 36/5

Table 3: List of armamentarium used for the study

SL No	Armamentarium used	Specifications
1	Stainless steel metal mould	Local dealer
2	Dental flask and clamp	Jabbar and company
3	Porcelain jar	Local dealer
4	Hydraulic press	Sirino dental division
5	Lathe	Jaypee dental lathe India
6	Silicon carbide polishing paper	Warrior plus

Table 4: Description of sample groups

Group	Description
PM-F	Polymethylmethacrylate Resin in Fittydent Cleanser agent
PM-P	Polymethylmethacrylate Resin in Polident Cleanser agent
PM-D	Polymethylmethacrylate Resin in Distilled water (Control)
PK-F	Polyetheretherketone Polymer in Fittydent Cleanser agent
PK-P	Polyetheretherketone Polymer in Polident Cleanser agent
PK-D	Polyetheretherketone Polymer in Distilled water (Control)


Denture Base Materials(42 samples)
Coffee (42)
PMMA (21)
PEEK (21)
Polident (7) (PM-P)
Fittydent (7) (PM-F)
Distilled water (7)(PM-D)
Polident (7) (PK-P)
Fittydent (7)(PK-P)
Distilled water (7)(PM-D)
Surface roughness and Colourstability was recorded before, 1st, 7th and 30th day of the experiment

METHODOLOGY

This in-vitro study was conducted in the Department of Prosthodontics, Crown and Bridge and Implantology, St. Gregorios Dental College, Chelad, Kothamangalam, Kerala. Testing of the samples for color stability was carried out in the Bio Medical Technology Wing, Sree Chitra Thirunal Institute of Technology, Trivandrum, Kerala. And measuring surface roughness was done at CUSAT, Kochi.

SAMPLING

a) Sample size

Sample size was calculated by using G*POWER software version

3.1.9.2

Effect size f = 0.6

α err prob = 0.05

Power (1-β err prob) = 0.8

Number of groups = 6

Minimum sample size per group = 7

Total sample size = 42

b) Inclusion criteria

Not applicable

c) Exclusion criteria

Not applicable

SAMPLE PREPARATION

PMMA:

Standardization

To attain the standard dimensions, 7 smooth polished stainless steel metal disc of dimension 10*2 mm were fabricated with laser cutting technique.

Preparation

For the preparation of samples, compression moulding technique was used in this study.

The 7 metal discs were invested in dental flasks in dental stone(type 3 gypsum product) in the first pour. Once the material is set, the surface was coated with a thin layer of petroleum jelly. The second pour was done after placing the upper part of the flask. The flask is closed and clamped tightly till metal to metal contact of the flask was attained.

Once the stone was set, the flask was opened and the metal discs were retrieved .The mould space was then painted with one coat of cold mould seal and allowed to dry.

Polymer is mixed with the liquid monomer in a ratio of 2:1 by weight for the fabrication of all the samples.

Once it reaches the dough stage, the heat cure acrylic resin is packed into the mould space and the flask is closed. The flask is loaded inside the hydraulic press for 5 minutes under 14 MPa pressure followed by bench curing for 30 minutes. Acrylization was done using long curing cycle at 74^0 C for 8 hours, which was raised to 100^0C and then maintained for another one hour and allowed to bench cool at room temperature.

The specimens were de flasked and excess were trimmed using tungsten carbide bur and finished with 150,180,220 sand papers. Subsequently water proofs and paper with grits (400, 600, and 1200) was used until a uniform surface was obtained[70]. Final polishing was done with a combination of water with pumice on a cotton cloth wheel, dry buff with denture polishing cake and air drying.

PEEK

Sample preparation:

PEEK denture base specimens were prepared by CAD-CAM milling. The measurements (10x2mm) was given on 3D builder software(object creating software) and converted to HDL file. This HDL file was uploaded to the milling machine and 21 such specimen was prepared using this.

PREPARATION OF STAIN:

7.5gm of instant Nescafe packet coffee powder (Nescafe Classic) was mixed in 500 ml of boiling distilled water to produce staining agent – Coffee[67].

PREPARATION OF CLEANSING AGENTS

Drop one Polident cleanser tablet (GSK Consumer Health Care) into 100ml of warm water. Similarly one Fittydent (Dr.Reddy's) into 100ml of warm water.

PROCEDURE :(flowchart 1)

21 samples each of PEEK(**Fig 8)** and PMMA (**Fig 7)** were used for analysis. Base line values of colour stability and surface roughness ,of all the 42 samples were measured, by using spectrophotometer and profilometer respectively(fig.12 and fig.9) followed by staining for 12hours. After staining, all the specimens were rinsed with distilled water.

The specimens of PEEK and PMMA were then subdivided into 2 test groups (Polident and Fittydent) and 1 control group (distilled water) with 7 specimens(n=7), according to the cleansing media to be used; (PM-F,PM-P,PM-D,PK-F,PK-P,PK-D)(flowchart1 &fig19,21,17,20,22,18.)

The specimens in the test groups were immersed in the cleansing media for 12 hours at room temperature and the specimens in the control group was immersed in distilled water. After every immersion, the staining agent and cleanser were replenished. This procedure was repeated every 24 hours for a period of 30 days. Color stability and surface roughness

values was measured on the 1st, 7th and 30thday using a spectrophotometer (Perkin .Lamda 36/5) **(Fig 12)** and a profilometer (Surfcom Flex 50A)**(Fig 9)** respectively.

Fig 1:Heat cure denture base resin

Fig 2: Dental stone

Fig 3: Separating media

Fig 4: Hydraulic Press

Figure 5: Lathe

Figure 6 : Acrylic polisher

Fig 7: PMMA – 7 Samples

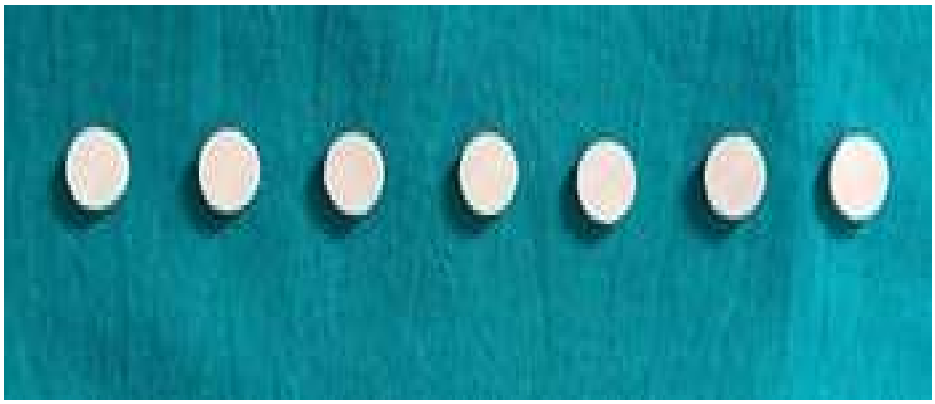


Fig 8: PEEK – 7 samples

Fig 9: Profilo meter

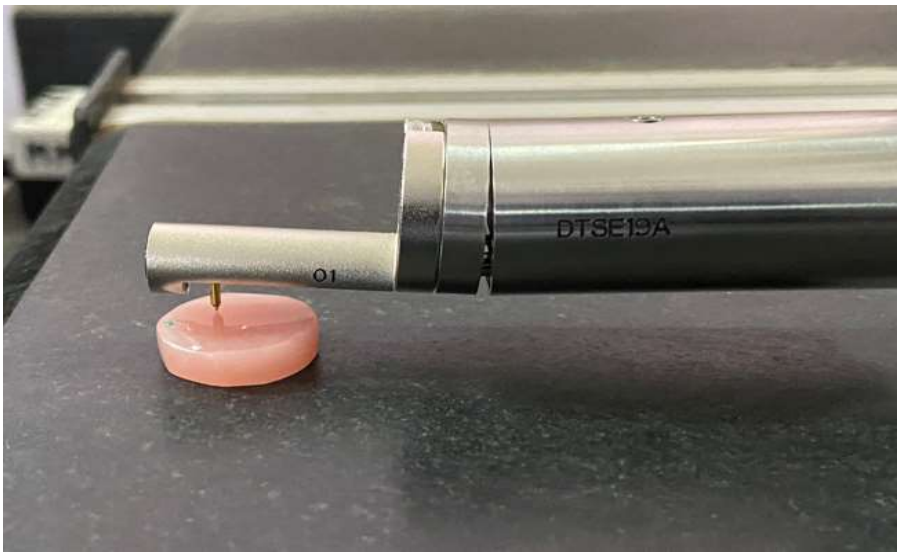


Fig 10: PMMA sample in Profilometer

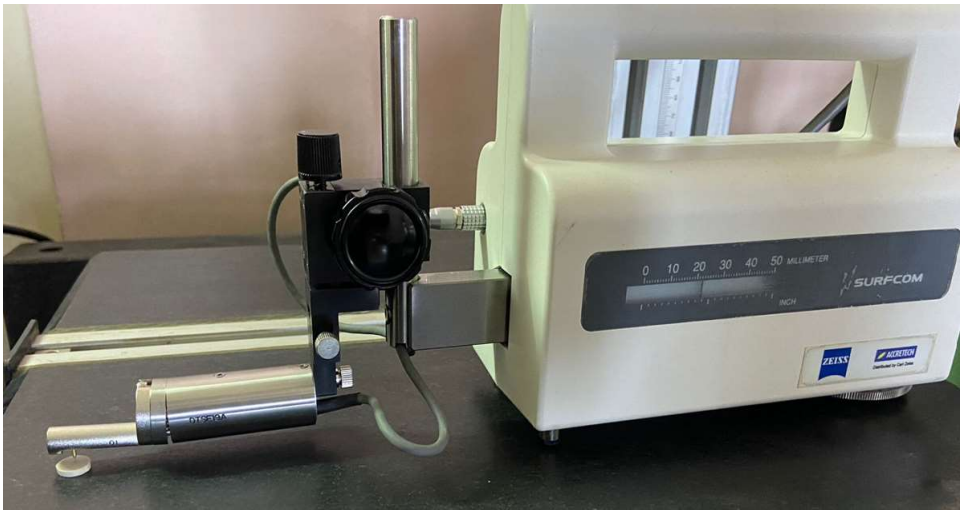


Fig 11: PEEK sample in Profilometer

Fig 12: Spectrophotometer

Fig 13:Fittydent- Denture cleanser tablets

Fig 14: Polident- Denture cleanser tablets

Fig.15: PMMA in coffee

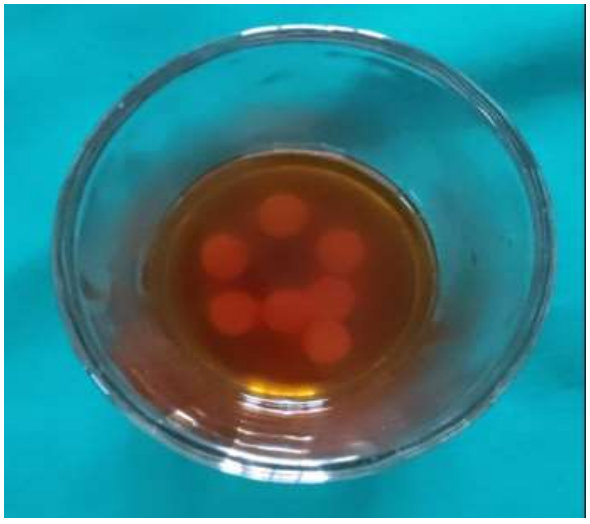


Fig.16: PEEK in coffee

Fig.17: PMMA in distilled water

Fig.18: PEEK in distilled water

Fig.19: PMMA in Fittydent

Fig.20: PEEK in Fittydent

Fig.21: PMMA in Polident

Fig.22: -PEEK in Polident

RESULTS

RESULTS

Table: 5 Colour stability values of specimens of PM- P, before, first, 7th, and 30th day.

Before			First day			7th day			30th day		
L*	a*	b*	L*	a*	b*	L*	a*	b*	L*	a*	b*
53.9	20.10	6.64	53.90	20.11	6.64	56.11	24.08	10.78	62.21	30.04	17.80
52.8	20.30	6.49	52.81	20.30	6.50	56.14	23.58	10.91	61.80	30.24	17.40
53.1	20.15	6.58	53.10	20.31	6.59	57.10	23.31	10.59	63.02	30.60	17.41
52.7	20.20	6.50	52.71	20.20	6.50	56.24	23.48	10.80	63.20	30.28	17.38
54.11	20.16	6.54	54.11	20.16	6.54	58.10	23.26	10.58	64.11	30.60	17.58
53.09	20.13	6.39	53.10	20.13	6.40	56.30	23.23	10.39	63.34	30.54	17.30
54.1	20.13	6.48	54.10	20.14	6.48	58.08	23.50	10.54	64.20	30.30	17.70

Table: 6 Colour stability values of specimens of PM- F before, first, 7th, and 30th day

Before			First day			7th day			30th day		
L*	a*	b*	L*	a*	b*	L*	a*	b*	L*	a*	b*
53.90	20.11	6.12	53.90	20.11	6.12	57.60	24.14	10.15	62.10	31.18	18.98
53.70	20.09	6.14	53.71	20.10	6.14	56.71	24.15	10.18	61.80	32.23	19.06
52.15	20.18	6.51	52.15	20.19	6.51	55.90	23.96	10.25	61.10	31.86	19.11
52.68	20.15	6.47	52.68	20.15	6.47	56.07	24.18	10.21	60.11	31.90	18.94
54.10	20.13	6.53	54.10	20.14	6.54	58.08	24.16	10.20	62.09	32.18	18.98
53.12	20.16	6.42	53.12	20.17	6.42	57.20	24.20	10.24	60.23	32.11	19.04
54.09	20.07	6.46	54.09	20.07	6.46	57.34	24.10	10.15	61.36	32.06	19.06

Table: 7 Colour stability values of specimens of PM-D before, first, 7th, and 30th day.

Before			First day			7th day			30th day		
L*	a*	b*	L*	a*	b*	L*	a*	b*	L*	a*	b*
53.90	20.10	6.65	53.90	20.11	6.65	64.28	21.65	14.84	69.21	29.16	28.29
53.10	20.09	6.44	53.10	20.09	6.44	65.03	21.84	14.45	68.18	29.28	28.19
52.98	20.24	6.49	52.97	20.24	6.49	63.90	21.75	14.78	67.90	29.60	28.20
52.96	20.30	6.50	52.96	20.31	6.50	64.02	21.65	14.64	70.16	29.54	28.24
53.06	20.22	6.54	53.07	20.22	6.54	64.08	21.73	14.58	69.44	29.30	28.30
53.08	20.14	6.40	53.08	20.15	6.41	63.18	21.85	14.44	70.02	29.54	28.38
53.24	20.19	5.47	53.24	20.20	6.47	64.25	21.73	14.68	68.60	29.25	28.41

Table: 8 Colour stability values of specimens of PK-P before, first, 7th, and 30th day.

Before			First day			7th day			30th day		
L*	a*	b*	L*	a*	b*	L*	a*	b*	L*	a*	b*
53.90	20.10	6.65	53.90	20.11	6.65	64.28	21.65	14.84	69.21	29.16	28.29
53.10	20.09	6.44	53.10	20.09	6.44	65.03	21.84	14.45	68.18	29.28	28.19
52.98	20.24	6.49	52.97	20.24	6.49	63.90	21.75	14.78	67.90	29.60	28.20
52.96	20.30	6.50	52.96	20.31	6.50	64.02	21.65	14.64	70.16	29.54	28.24
53.06	20.22	6.54	53.07	20.22	6.54	64.08	21.73	14.58	69.44	29.30	28.30
53.08	20.14	6.40	53.08	20.15	6.41	63.18	21.85	14.44	70.02	29.54	28.38
53.24	20.19	5.47	53.24	20.20	6.47	64.25	21.73	14.68	68.60	29.25	28.41

Table: 9 Colour stability values of specimens of PK –F before, first, 7th, and 30th day.

Before			First day			7th day			30th day		
L*	a*	b*	L*	a*	b*	L*	a*	b*	L*	a*	b*
72.73	1.16	7.51	72.73	1.16	7.51	71.08	0.42	7.13	68.06	0.17	7.03
72.54	1.43	7.8	72.55	1.4	7.79	71.06	0.57	7.06	68	0.23	7.01
72.03	1.88	7.98	72.07	1.8	7.98	70.98	0.83	7.08	67.96	0.34	7.02
72.6	1.21	7.48	72.6	1.18	7.48	69.81	0.48	7.12	64.41	0.21	7.05
72.49	1.38	7.29	72.48	1.35	7.28	70.01	0.61	7.13	65.3	0.24	7.04
72.4	1.7	7.76	72.38	1.69	7.76	69.93	0.8	7.45	63.8	0.34	7.12
72.57	1.8	7.5	72.56	1.8	7.5	69.96	0.85	7.4	61.08	0.38	7.1

Table: 10 Colour stability values of specimens of PK-D before, first, 7th, and 30th day.

Before			First day			7th day			30th day		
L*	a*	b*	L*	a*	b*	L*	a*	b*	L*	a*	b*
72.73	1.17	7.52	72.73	1.17	7.52	70.45	0.66	7.50	64.43	0.30	7.46
72.54	1.43	7.84	72.54	1.43	7.85	70.52	0.59	7.41	64.50	0.25	7.20
72.01	1.88	8.00	72.02	1.88	8.00	70.10	0.99	7.96	64.13	0.40	7.43
72.70	1.18	7.50	72.70	1.18	7.50	70.68	0.68	7.49	64.63	0.25	7.22
72.50	1.40	7.48	72.50	1.41	7.48	72.47	0.61	7.45	64.47	0.28	7.11
72.30	1.54	7.30	72.31	1.55	7.31	70.27	0.70	7.28	64.26	0.30	7.09
72.44	1.44	7.68	72.48	1.44	7.68	70.46	0.60	7.64	64.45	0.15	7.06

SURFACE ROUGHNESS

Table: 11 Surface roughness values of samples of PM-P before, first, 7th, and 30th day.

Before	First day	7th day	30th day
0.077	0.077	0.083	0.094
0.093	0.094	0.096	0.102
0.083	0.083	0.086	0.146
0.081	0.082	0.086	0.094
0.089	0.089	0.093	0.093
0.073	0.074	0.077	0.084
0.076	0.076	0.080	0.085

Table: 12 Surface roughness values of samples of PM-F before, first, 7th, and 30th day.

before	First day	7 th day	30th day
0.077	0.077	0.080	0.090
0.083	0.084	0.088	0.096
0.092	0.092	0.098	0.104
0.074	0.075	0.080	0.088
0.080	0.081	0.086	0.098
0.086	0.086	0.090	0.098
0.089	0.089	0.093	0.099

Table: 13 Surface roughness values of samples of PM-D before, first, 7th, and 30th day.

before	First day	7th day	30th day
0.074	0.075	0.112	0.120
0.078	0.078	0.101	0.110
0.082	0.084	0.106	0.114
0.088	0.088	0.103	0.111
0.077	0.079	0.109	0.116
0.083	0.084	0.111	0.118
0.085	0.085	0.111	0.121

Table: 14 Surface roughness values of samples of PK-P before, first, 7th, and 30th day.

before	First day	7 th day	30 th day
0.034	0.034	0.036	0.041
0.033	0.034	0.038	0.042
0.038	0.038	0.040	0.044
0.040	0.041	0.044	0.048
0.035	0.035	0.039	0.043
0.041	0.041	0.044	0.049
0.040	0.041	0.042	0.046

Table: 15 Surface roughness values of samples of PK-F before, first, 7th, and 30th day.

before	First day	7 th day	30 th day
0.033	0.034	0.038	0.039
0.035	0.035	0.038	0.040
0.040	0.041	0.046	0.050
0.037	0.037	0.042	0.048
0.036	0.036	0.044	0.048
0.039	0.039	0.044	0.049
0.032	0.032	0.038	0.043

Table: 16 Surface roughness values of samples of PK-D before, first, 7th, and 30th day.

before	First day	7 th day	30 th day
0.038	0.039	0.043	0.049
0.036	0.036	0.042	0.049
0.034	0.035	0.043	0.050
0.035	0.035	0.042	0.051
0.036	0.037	0.042	0.052
0.034	0.035	0.041	0.051
0.036	0.036	0.040	0.049

STATISTICAL ANALYSIS

Data was analyzed using the statistical package **SPSS 26.0** (SPSS Inc., Chicago, IL) and the level of significance was set at **p<0.05**. **Descriptive statistics** were performed to assess the mean and standard deviation of the respective groups. Normality of the data was assessed using **Shapiro Wilkinson test**. Since the data was following Normal distribution and parametric test were used for the data analysis. **Inferential statistics** to find out the difference between the groups was done using, **One way Anova and within the group by Repeated measures's of Anova followed by Tukey's HSD Post hoc analysis** to find out the difference between these two groups.

DESCRIPTIVE ANALYSIS

COLOUR STABILITY

PMMA

Polident:

From the analysis, it was found that PMMA showed gradual rise in the value of colour changes from baseline to 30th day. The value for color change of baseline, 1st day, 7th day and 30th day are 57.45±0.52, 57.41±0.63, 62.44±0.71 and 72.21±0.77 respectively. Tukey's HSD test was done(Table.17) for the comparative analysis among the different time periods and the results shows that there was a significant change(p value- 0.0001) in the property of color stability between each time period, except for the time period of 1 day(p value-0.93).

Fittydent:

In Fittydent, the value of colour changes for PMMA from baseline to 30th day are 57.41±0.63, 57.41±0.63, 62.70±0.67 and 71.65±0.64 are respectively. Tukey's HSD test shows that there was significant change (p value- 0.0001) in color stability between each time period except for the first day(p value-0.99).(Table.17)

Distilled water

In distilled water, the value for color changes from baseline, 1st day, 7th day and 30th day are 57.24±0.25, 57.26±0.25, 69.26±0.67 and 80.21±0.67 respectively. Tukey's HSD test shows that there was significant change(p value- 0.0001) in the color stability between each time period, except for the time period of 1 day(p value-0.96).

Comparison of action of cleansing agents with control group

Tukey's HSD Post hoc analysis was performed for comparison of Polident and Fittydent cleansing agents with control group (distilled water). It was found that,both the cleansing agents on 7th, and 30th day exhibited change in color stability and the comparative analysis shows that Polident exhibits more change in the property than Fittydent and the difference was statistically significant(P value is 0.0001*).(Table18)

PEEK

Polident:

From the test analysis, it was found that PEEK material showed a progressive rise in the colour changes from baseline to 30th day. The value of color changes for baseline, 1st day, 7th day and 30th day are 72.84±0.20, 72.84±0.20, 70.66±0.37 and 67.96 ±0.77 respectively. Tukey's HSD test was done for the comparative analysis among the different time periods and the results shows that there was significant change (p value- 0.0001) in the color stability between each time period, except for first 24 hours(0.99).(Table.19)

Fittydent

In Fittydent, similar trend was found, where the value for color change for baseline, 1st day, 7th day and 30th day are 72.85±0.18, 72.86±0.17, 70.77±0.54 and 65.89 ±2.44 respectively (Table.19). Tukey's HSD test was done and the results show that there was significant change (p value- 0.0001) in color stability between each time period except for the first day (p value-0.99).

Distilled water

Similar to the findings in cleansing agents, PEEK in distilled water exhibited an increase in the value of colour changes and the values from baseline to 30th day are 72.66±0.20, 72.88±0.20, 71.11±0.72 and 64.81±0.14 respectively. Tukey's HSD test shows that there was significant change (p value- 0.0001) in the color stability between each time period, except for the time period of oneday.(Table.19)

Comparison between cleansing agents and control group.

Tukey's HSD Post hoc analysis was performed for comparison of Polident and Fittydent with Distilled water, it was found that Polident & Fittydentvs. Distilled water on 7^{th}, and 30 th day exhibited significant difference(P value is 0.0001).(Table20).

Comparison between PMMA and PEEK

Independent T test were done for comparing the two groups in 3 cleansing solutions (Table.21, 22, 23). The results show that PEEK denture base material exhibited least colour changes than PMMA in both the cleansing agents as well as in distilled water. The result was found to be statistically significant.

SURFACE ROUGHNESS

PMMA:

Polident

From the analysis, it was found that the property of surface roughness has no change up to 7^{th} day, but there was a slight increase by 30^{th} day. The values of surface roughness for baseline to 30th day are 0.08±0.006, 0.08±0.006, 0.08±0.006, 0.09±0.004 respectively. Comparative analysis using Tukey's HSD test shows that there was a no significant change in the property for 7days (p value-0.99), whereas the change that occurred by 30^{th} day was statistically significant (p value- 0.01).(Table.24)

Fittydent

Fittydent shows same pattern as Polident, where the surface roughness value did not change till 7th day but, there was a slight increase by 30th day. The value of surface roughness for baseline, 1st day, 7th day and 30th day are 0.08±0.006, 0.08±0.006, 0.08±0.006, 0.09±0.005 respectively. The comparative analysis shows that there was no significant change in the surface roughness by 7days (p value-0.99), but by 30th day, there was significant change in surface roughness (p value- 0.0001) (Table.24)

Distilled water

PMMA in distilled water shows a gradual increase of surface roughness value from 1st day to 30th day of the experiment. The values from base line to 30th day are 0.08±0.004, 0.08±0.006, 0.10±0.003 and 0.11±0.003 respectively. Tukey's HSD test for Comparative analysis shows that there was no significant change in the property for 7days (p value-0.99), whereas the change that occurred by 30th day was statistically significant (p value-0.02).(Table.24)

Comparison between cleansing agents and control group

Comparison of Polident and Fittydent with Distilled water done by using Tukey's HSD Post hoc analysis, it was found that Polident and Fittydent vs.Distilled water on 7th, and 30 th day exhibit significant surface roughness difference(P value is 0.0001).(Table.25)

PEEK

Polident

From the experiment analysis, it was found that the surface roughness value of PEEK material remained the same upto 24 hours, which was followed by a gradual rise by 30th day. The values for baseline, 1st day, 7th day and 30th day are 0.03±0.003, 0.03±0.003, 0.04±0.002, 0.04±0.002 respectively. The results of Tukey's HSD test for the comparative analysis; suggests that there was statistically significant change (p value- 0.0001) in the surface roughness between 7th and 30thday (Table.26).

Fittydent

PEEK in Fittydent exhibited no variation in the surface roughness upto 7th day of the experiment and a slight increase was noted from 7th to 30th day. The values for baseline to 30th day are 0.03±0.002, 0.03±0.00, 0.04±0.003, 0.04±0.004 respectively. Tukey's HSD test shows significant changes (p value- 0.0001) in the surface roughness on the 7th, and 30th day. (Table.26).

Distilled water

From the analysis, it was found that there was a gradual increase of surface roughness value from the 1st day to 30th day of the experiment. The values of surface roughness from baseline to 30th day are 0.03±0.001, 0.03±0.00, 0.04±0.0001, 0.05±0.001 respectively (Table.26).

Tukey's HSD test done for the comparative analysis among the different time periods is indicative of statistically significant change (p value- 0.0001) in the surface roughness between each time period, except for the first 24 hours.

Comparison between cleansing agents with control group

Tukey's HSD Post hoc analysis was performed for comparison of different cleansing agents with distilled water, it was found that Polident and Fittydentvs. Distilled on 30 th day exhibit significant surface roughness difference(P value is 0.001)(Table.27).

Comparison between PEEK and PMMA.

Independent T test were done for comparing the surface roughness of the two groups in 3 cleansing solutions. It was found that the variation in the property of surface roughness was lower in PEEK material than PMMA, for all the time periods, in both the cleansing agents as well as in distilled water. This result was found to be statistically significant (Table.28,29,30).

TABLE 17- COMPARISON OF DELTA E- WITHIN THE PMMA GROUP

DELTA E	Before	57.45±0.52	57.41±0.63	57.24±0.25
	1st day	**57.41±0.63**	**57.41±0.63**	**57.26±0.25**
	7th day	**62.44±0.71**	**62.70±0.67**	**69.26±0.67**
	30th day	**72.21±0.77**	**71.65±0.64**	**80.21±0.67**
P VALUE (Repeated measures of anova TEST)		**0.0001***	**0.0001***	**0.0001***
P VALUE (TUKEY'S HSD TEST)	**Before vs. day 1**	0.93	0.99	0.96
	Before vs. 7th day	**0.0001***	**0.0001***	**0.0001***
	Before vs. 30th day	**0.0001***	**0.0001***	**0.0001***
	Day 1 vs. 7th day	**0.0001***	**0.0001***	**0.0001***
	Day 1 vs. 30th day	**0.0001***	**0.0001***	**0.0001***
	Day 7th vs. 30th day	**0.0001***	**0.0001***	**0.0001***

***P<0.05 is statistically significant**

Within group Statistical analysis of DELTA E value by Repeated Measures of Anova test reported statistically significant result within all the 3 study groups.

TABLE 18 - COMPARISON OF DELTA E- BETWEEN THE PMMA GROUP

		Polident	Fittydent	Dist.water	P one way anova	POSTHOC TEST	
DELTA E	**Before**	**57.45±0.52**	**57.41±0.63**	**57.24±0.25**	**0.93**	**P vs. F**	**0.91**
						P vs. D	**0.90**
						F vs. D	**0.89**
	1st day	**57.41±0.63**	**57.41±0.63**	**57.26±0.25**	**0.94**	**P vs. F**	**0.91**
						P vs. D	**0.93**
						F vs. D	**0.92**
	7th day	**62.44±0.71**	**62.70±0.67**	**69.26±0.67**	**0.0001***	**P vs. F**	**0.85**
						P vs. D	**0.0001***
						F vs. D	**0.0001***
	30th day	**72.21±0.77**	**71.65±0.64**	**80.21±0.67**	**0.0001***	**P vs. F**	**0.75**
						P vs. D	**0.0001***
						F vs. D	**0.0001***

***P<0.05 is statistically significant**

Between groups Statistical analysis of DELTA E value was done by one way Anova test and reported statistically significant result between the 3 study groups at 7th day and 30th day.

TABLE 19 - COMPARISON OF DELTA E- PEEK-WITHIN THE GROUP

		Polident-Peek	Fittydent - Peek	Dist.water Peek
DELTA E	**Before**	**72.84±0.20**	**72.85±0.18**	**72.66±0.20**
	1st day	**72.84±0.20**	**72.86±0.17**	**72.88±0.20**
	7th day	**70.66±0.37**	**70.77±0.54**	**71.11±0.72**
	30th day	**67.96±0.77**	**65.89±2.44**	**64.81±0.14**
P VALUE (Repeated measures of Anova TEST)		**0.0001***	**0.0001***	**0.0001***
P VALUE (TUKEY'S HSD TEST)	**Before vs. day 1**	**0.99**	**0.99**	**0.99**
	Before vs. 7th day	**0.0001***	**0.02***	**0.0001***
	Before vs. 30th day	**0.02***	**0.0001***	**0.93**
	Day 1 vs. 7th day	**0.0001***	**0.02***	**0.0001***
	Day 1 vs. 30th day	**0.02***	**0.0001***	**0.93**
	Day 7th vs. 30th day	**0.0001***	**0.0001***	**0.88**

***P<0.05 is statistically significant**

Within group Statistical analysis of DELTA E (PPEK) value by Repeated Measures of Anova test reported statistically significant result within all the 3 study groups.

TABLE 20 -COMPARISON OF DELTA E- PEEK-BETWEEN THE GROUP

		Polident-Peek	Fittydent - Peek	Dist.water Peek	P VALUE-one way anova	POSTHOC TEST	
DELTA E	**Before**	**72.84±0.20**	**72.85±0.18**	**72.66±0.20**	**0.95**	**P vs. F**	**0.92**
						P vs. D	**0.97**
						F vs. D	**0.93**
	1st day	**72.84±0.20**	**72.86±0.17**	**72.88±0.20**	**0.89**	**P vs. F**	**0.91**
						P vs. D	**0.89**
						F vs. D	**0.88**
	7th day	**70.66±0.37**	**70.77±0.54**	**71.11±0.72**	**0.0009***	**P vs. F**	**0.53**
						P vs. D	**0.0001***
						F vs. D	**0.0001***
	30th day	**67.96±0.77**	**65.89±2.44**	**64.81±0.14**	**0.002***	**P vs. F**	**0.03***
						P vs. D	**0.001***
						F vs. D	**0.34**

***P<0.05 is statistically significant**

Between group Statistical analysis of DELTA E (PEEK) value was done by One way Anova test and reported statistically significant result between the 3 study groups at 7th day and 30th day.

TABLE 21 - COMPARISON OF DELTA E-POLIDENT BETWEEN PMMA &PEEK

		Polident-PMMA	Polident- PEEK	P Value(Ttest)
DELATA E	**Before**	**57.45±0.52**	**72.84±0.20**	**0.0001***
	1st day	**57.41±0.63**	**72.84±0.20**	**0.0001***
	7th day	**62.44±0.71**	**70.66±0.37**	**0.0001***
	30th day	**72.21±0.77**	**67.96±0.77**	**0.0001***

***P<0.05 is statistically significant**

Independent T test reported statistically significant result regarding DELTA E (POLIDENT)value at all the time intervals.(P<0.05)

TABLE 22 - COMPARISON OF DELTA E-FITTYDENT BETWEEN PMMA &PEEK

		Fittydent-PMMA	Fittydent- PEEK	P Value(Ttest)
DELTA E	**Before**	**57.41±0.63**	**72.85±0.18**	**0.0001***
	1st day	**57.41±0.63**	**72.86±0.17**	**0.0001***
	7th day	**62.70±0.67**	**70.77±0.54**	**0.0001***
	30th day	**71.65±0.64**	**65.89±2.44**	**0.0001***

***P<0.05 is statistically significant**

Independent T test reported statistically significant result regarding DELTA E (FITTYDENT)value at all the time intervals.(P<0.05)

TABLE 23 - COMPARISON OF DELTA E-DISTILLED WATER

		Dist –water-PMMA	Dist water- PEEK	P Value(Ttest)
DELTA E	**Before**	**57.24±0.25**	**72.66±0.20**	**0.0001***
	1st day	**57.26±0.25**	**72.88±0.20**	**0.0001***
	7th day	**69.26±0.67**	**71.11±0.72**	**0.0001***
	30th day	**80.21±0.67**	**64.81±0.14**	**0.0001***

***P<0.05 is statistically significant**

Independent T test reported statistically significant result regarding DELTA E (DISTILLED WATER)value at all the time intervals.(P<0.0

TABLE 24 - COMPARISON OF SURFACE ROUGHNESS-PMMA- WITHIN GROUP

		Polident	Fittydent	Dist.water
SURFACE ROUGHNESS-	**Before**	**0.08±0.006**	**0.08±0.006**	**0.08±0.004**
	1st day	**0.08±0.006**	**0.08±0.006**	**0.08±0.006**
	7th day	**0.08±0.006**	**0.08±0.006**	**0.10±0.003**
	30th day	**0.09±0.004**	**0.09±0.005**	**0.11±0.003**
P VALUE (Repeated measures of anova TEST)		**0.005***	**0.006***	**0.008***
P VALUE (TUKEY'S HSD TEST)	**Before vs day 1**	**0.99**	**0.99**	**0.99**
	Before vs 7th day	**0.99**	**0.99**	**0.99**
	Before vs 30th day	**0.02***	**0.01***	**0.02***
	Day 1 vs 7th day	**0.99**	**0.99**	**0.99**
	Day 1 vs 30th day	**0.01***	**0.01***	**0.02***
	Day 7th vs 30th day	**0.01***	**0.01***	**0.02***

***P<0.05 is statistically significant**

Within group Statistical analysis of SURFACE ROUGHNESS value by Repeated Measures of Anova test reported statistically significant result within all the three groups(p<0.05)

TABLE 25 - COMPARISON OF SURFACE ROUGHNESS-PMMA- BETWEEN GROUP

		Polident	Fittydent	Dist.water	P VALUE- one way anova	POSTHOC TEST	
SURFACE ROUGHNESS-	**Before**	**0.08±0.006**	**0.08±0.006**	**0.08±0.004**	**0.94**	**P vs. F**	**0.94**
						P vs. D	**0.95**
						F vs. D	**0.90**
	1st day	**0.08±0.006**	**0.08±0.006**	**0.08±0.006**	**0.91**	**P vs. F**	**0.88**
						P vs. D	**0.86**
						F vs. D	**0.89**
	7th day	**0.08±0.006**	**0.08±0.006**	**0.10±0.003**	**0.0001***	**P vs. F**	**0.93**
						P vs. D	**0.0001***
						F vs. D	**0.0001***
	30th day	**0.09±0.004**	**0.09±0.005**	**0.11±0.003**	**0.0001***	**P vs. F**	**0.94**
						P vs. D	**0.0001***
						F vs. D	**0.0001***

***P<0.05 is statistically significant**

Between group Statistical analysis of SURFACE ROUGHNESS value was done by One way Anova test and reported statistically significant result between the 3 study groups at 7th day and 30th day.

TABLE 26 - COMPARISON OF SURFACE ROUGHNESS- PEEK-WITHIN GROUP

		Polident	Fittydent	Dist.water
SURFACE ROUGHNESS-	**Before**	**0.03±0.003**	**0.03±0.002**	**0.03±0.001**
	1st day	**0.03±0.003**	**0.03±0.00**	**0.03±0.00**
	7th day	**0.04±0.002**	**0.04±0.003**	**0.04±0.0001**
	30th day	**0.04±0.002**	**0.04±0.004**	**0.05±0.001**
P VALUE (Repeated measures of anova TEST)		**0.0001***	**0.0001***	**0.0001***
P VALUE (TUKEY'S HSD TEST)	**Before vs day 1**	**0.99**	**0.96**	**0.95**
	Before vs 7th day	**0.0001***	**0.0001***	**0.0001***
	Before vs 30th day	**0.0001***	**0.0001***	**0.0001***
	Day 1 vs 7th day	**0.0001***	**0.0001***	**0.0001***
	Day 1 vs 30th day	**0.0001***	**0.0001***	**0.0001***
	Day 7th vs 30th day	**0.99**	**0.93**	**0.0001***

***P<0.05 is statistically significant**

Within group Statistical analysis of SURFACE ROUGHNESS (PEEK) value by Repeated Measures of Anova test reported statistically significant result within all the three groups(p<0.05)

TABLE 27 - COMPARISON OF SURFACE ROUGHNESS- PEEK-BETWEEN GROUP

		Polident-peek	Fittydent-peek	Dist.water-peek	P VALUE-one way anova	POSTHOC TEST	
SURFACE ROUGHNESS-	**Before**	**0.03±0.003**	**0.03±0.002**	**0.03±0.001**	**0.98**	**P vs F**	**0.97**
						P vs D	**0.95**
						F vs D	**0.97**
	1st day	**0.03±0.003**	**0.03±0.00**	**0.03±0.00**	**0.99**	**P vs F**	**0.97**
						P vs D	**0.95**
						F vs D	**0.97**
	7th day	**0.04±0.002**	**0.04±0.003**	**0.04±0.0001**	**0.92**	**P vs F**	**0.91**
						P vs D	**0.98**
						F vs D	**0.94**
	30th day	**0.04±0.002**	**0.04±0.004**	**0.05±0.001**	**0.001***	**P vs F**	**0.95**
						P vs D	**0.001***
						F vs D	**0.001***

***P<0.05 is statistically significant**

Between group Statistical analysis of DELTA E value was done by One way Anova test and reported statistically significant result between the 3 study groups at 30th day only.

TABLE 28 - COMPARISON OF SURFACE ROUGHNESS-POLIDENT

		Polident	Polident- Peek	P Value(T TEST)
SURFACE ROUGHNESS-	**Before**	**0.08±0.006**	**0.03±0.003**	**0.0001***
	1st day	**0.08±0.006**	**0.03±0.003**	**0.0001***
	7th day	**0.08±0.006**	**0.04±0.002**	**0.0001***
	30th day	**0.09±0.019**	**0.04±0.002**	**0.0001***

***P<0.05 is statistically significant**

Independent T test reported statistically significant result regarding SURFACE ROUGHNESS (POLIDENT)value at all the time intervals.(P<0.05)

TABLE 29 - COMPARISON OF SURFACE ROUGHNESS-FITTYDENT

		Fittydent	Fittydent- Peek	P Value(T TEST)
DELTA E	**Before**	**0.08±0.006**	**0.03±0.002**	**0.0001***
	1st day	**0.08±0.006**	**0.03±0.00**	**0.0001***
	7th day	**0.08±0.006**	**0.04±0.003**	**0.0001***
	30th day	**0.09±0.005**	**0.04±0.004**	**0.0001***

***P<0.05 is statistically significant**

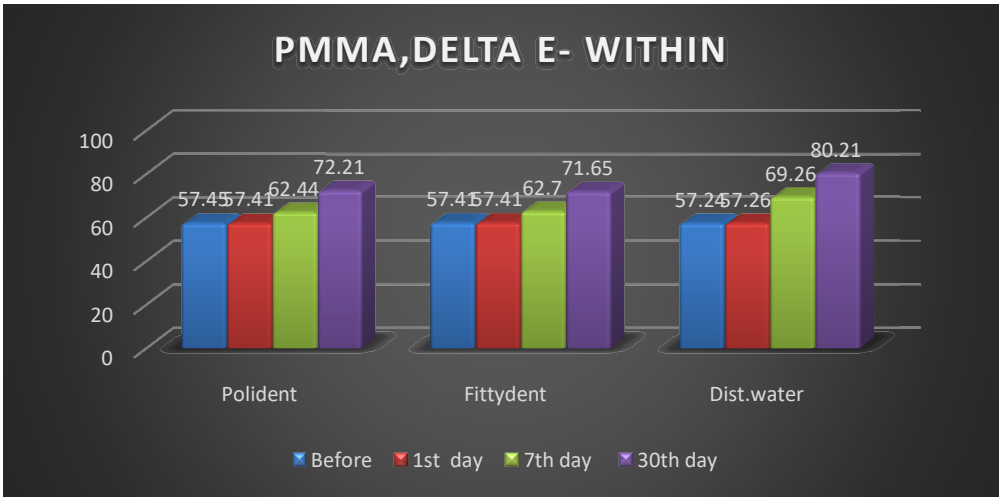
Independent T test reported statistically significant result regarding SURFACE ROUGHNESS (FITTYDENT)value at all the time intervals.(P<0.05)

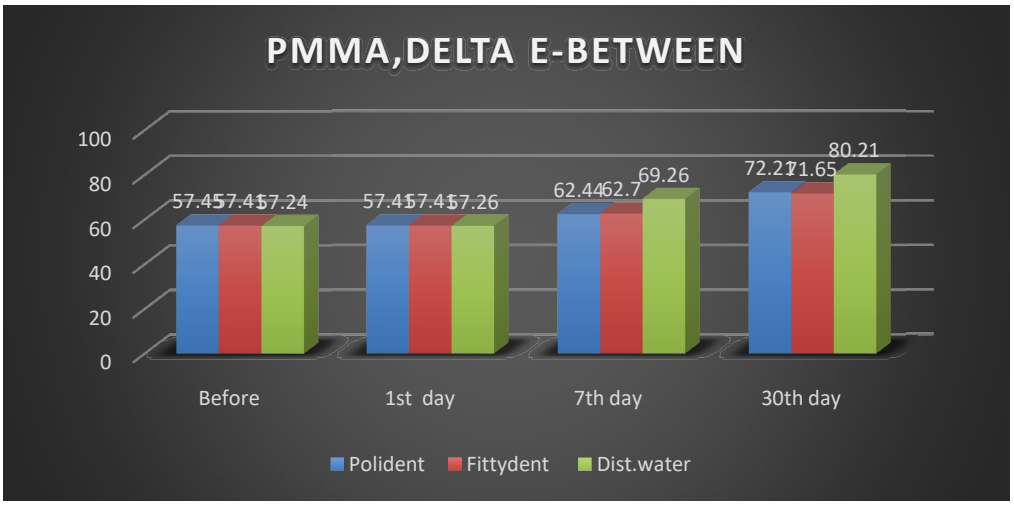
TABLE 30 - COMPARISON OF SURFACE ROUGHNESS-DISTILLED WATER

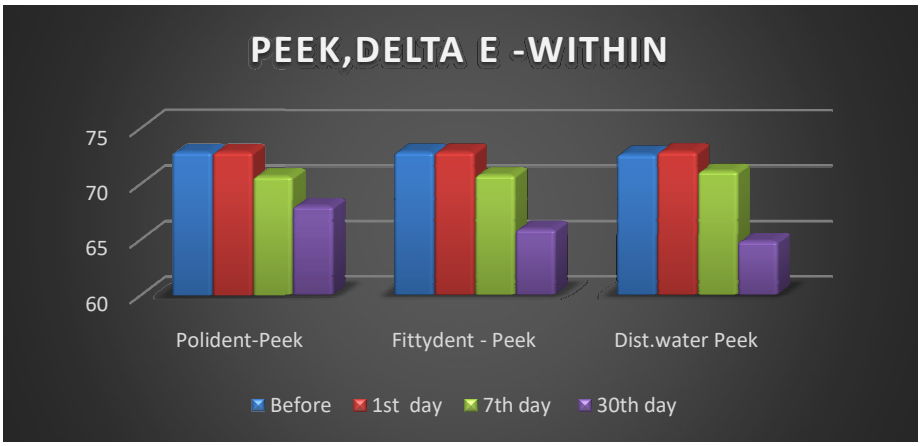
		Dist -water	Dist water- Peek	P Value(T TEST)
DELTA E	**Before**	**0.08±0.004**	**0.03±0.001**	**0.0001***
	1st day	**0.08±0.006**	**0.03±0.00**	**0.0001***
	7th day	**0.10±0.003**	**0.04±0.0001**	**0.0001***
	30th day	**0.11±0.003**	**0.05±0.001**	**0.0001***

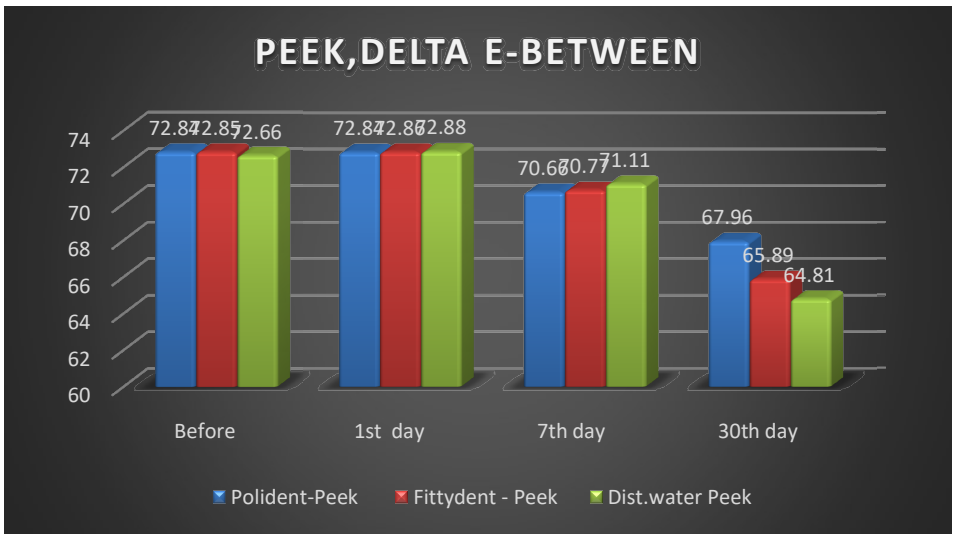
***P<0.05 is statistically significant**

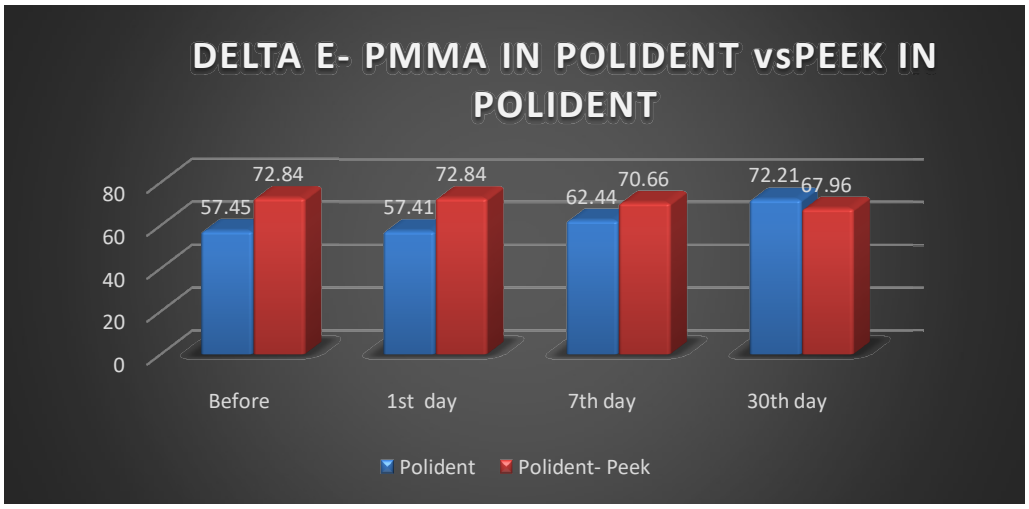
Independent T test reported statistically significant result regarding SURFACE ROUGHNESS (DISTILLED WATER)value at all the time intervals.(P<0.05)

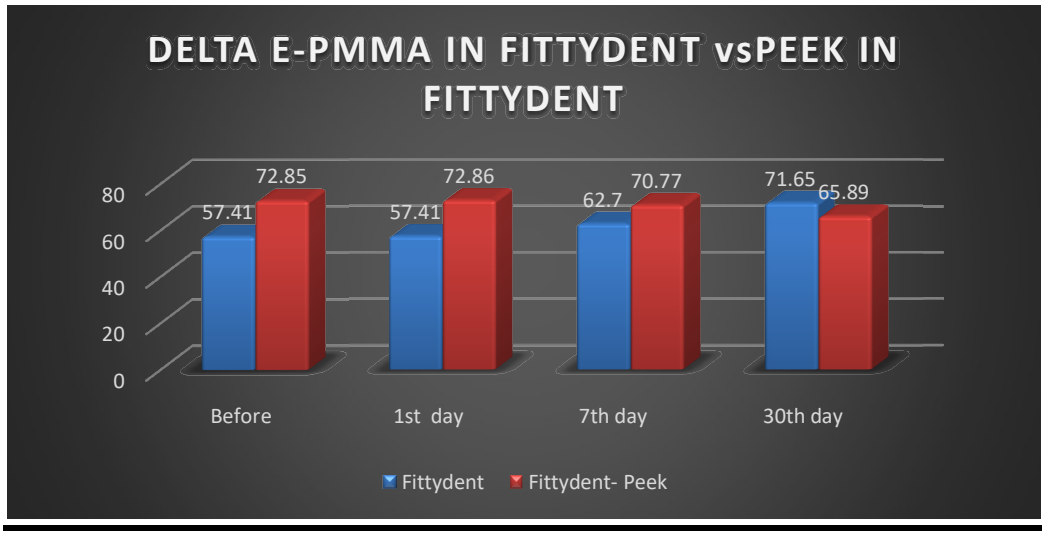

PMMA,DELTA E- WITHIN
100
80
60
40
20
0
57.45
57.41
62.44
72.21
57.41
57.41
62.7
71.65
57.24
57.26
69.26
80.21
Polident
Fittydent
Dist.water
Before
1st day
7th day
30th day

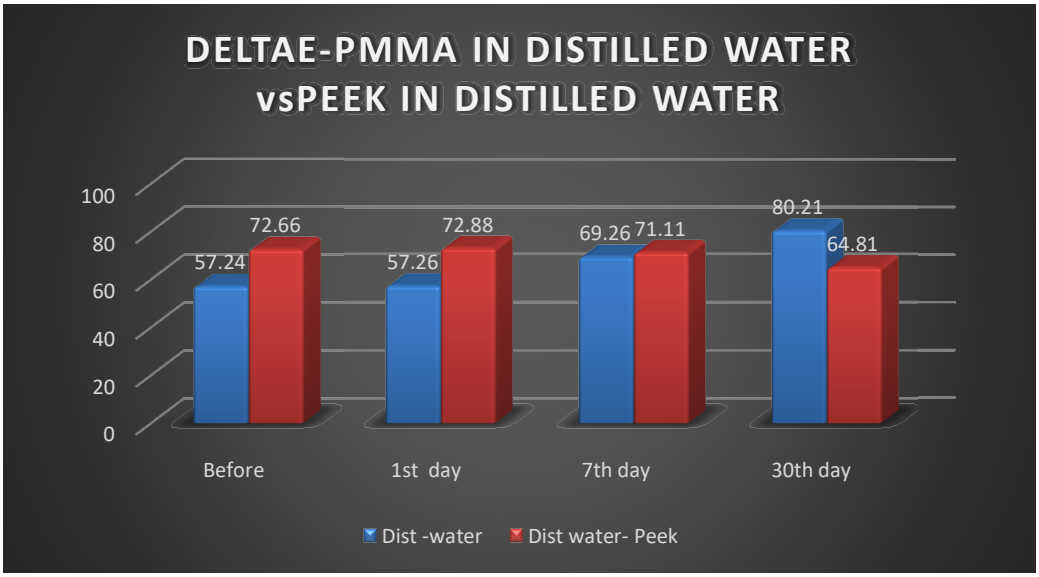

PMMA,DELTA E-BETWEEN
100
80
60
40
20
0
57.45
57.41
57.24
57.41
57.41
57.26
62.44
62.7
69.26
72.21
71.65
80.21
Before
1st day
7th day
30th day
Polident
Fittydent
Dist.water

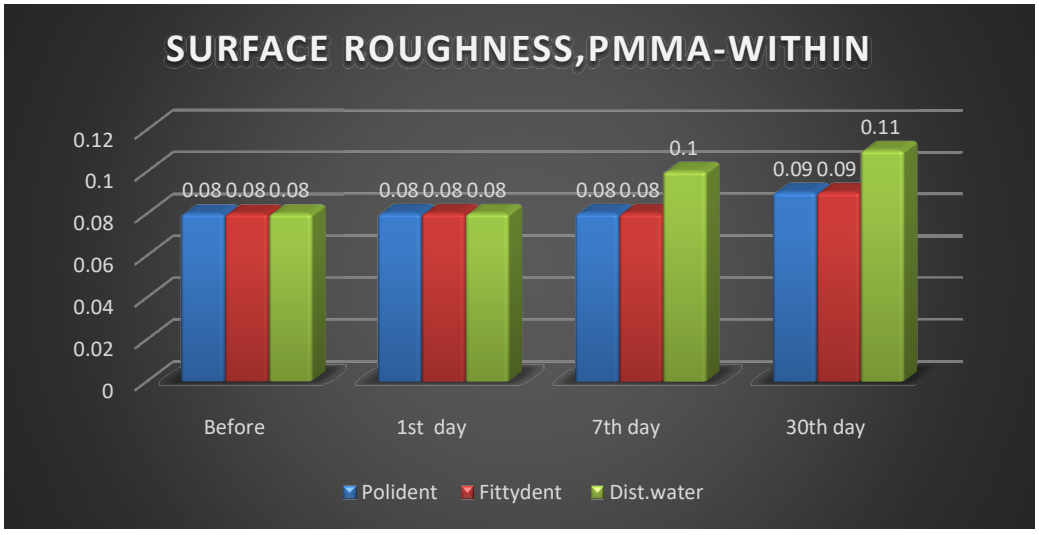

PEEK,DELTA E -WITHIN
75
70
65
60
Polident-Peek
Fittydent - Peek
Dist.water Peek
Before
1st day
7th day
30th day

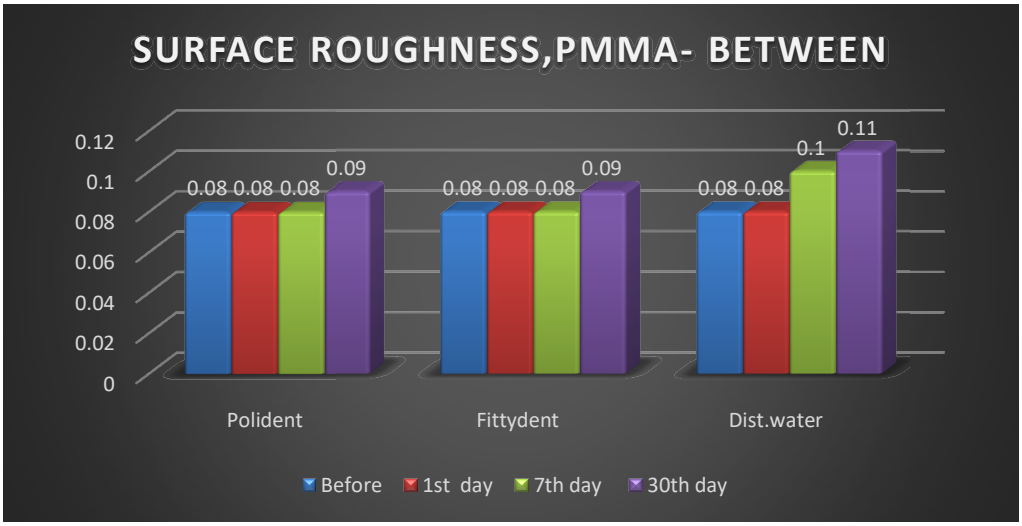

PEEK,DELTA E-BETWEEN
74
72
70
68
66
64
62
60
72.84
72.85
72.66
72.84
72.86
72.88
70.63
70.77
71.11
67.96
65.89
64.81
Before
1st day
7th day
30th day
Polident-Peek
Fittydent - Peek
Dist.water Peek

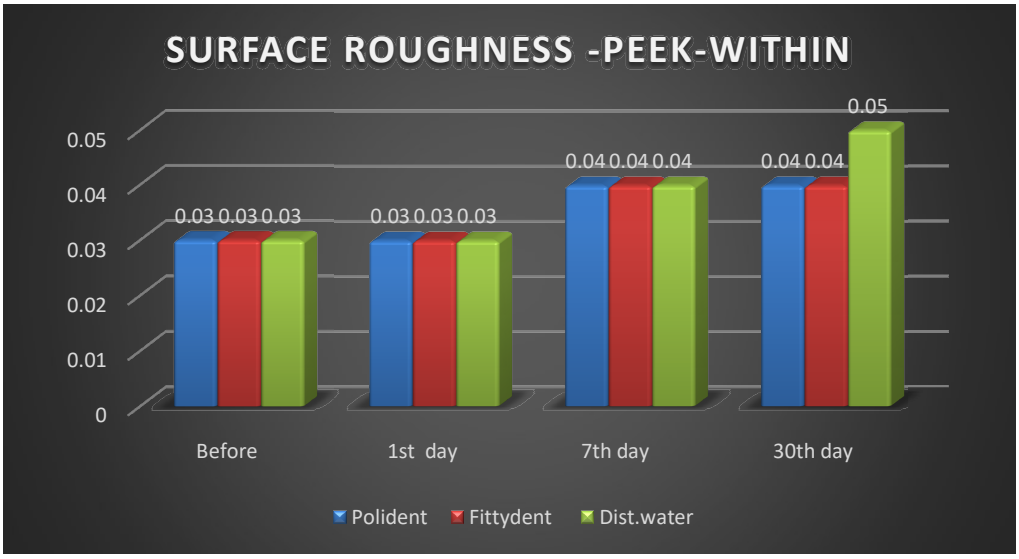

DELTA E- PMMA IN POLIDENT vsPEEK IN POLIDENT
80
60
40
20
0
57.45
72.84
57.41
72.84
62.44
70.66
72.21
67.96
Before
1st day
7th day
30th day
Polident
Polident- Peek

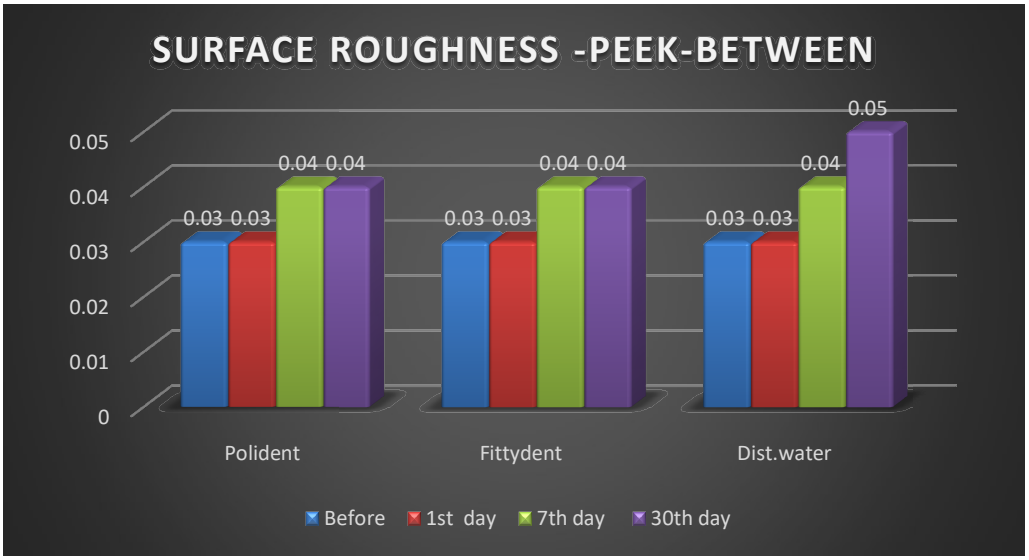

DELTA E-PMMA IN FITTYDENT vsPEEK IN FITTYDENT
80
60
40
20
0
57.41
72.85
57.41
72.86
62.7
70.77
71.65
65.89
Before
1st day
7th day
30th day
Fittydent
Fittydent- Peek

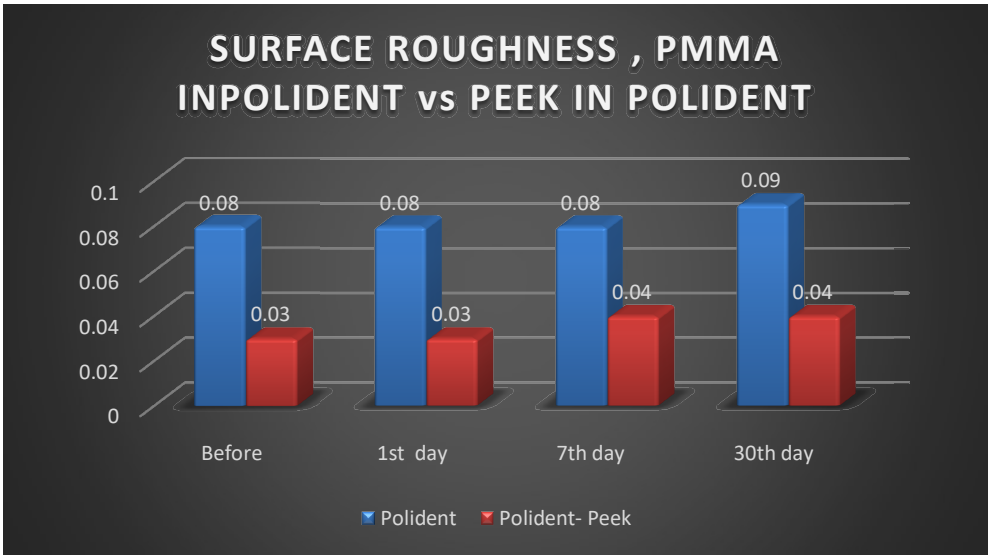

DELTAE-PMMA IN DISTILLED WATER
vsPEEK IN DISTILLED WATER
100
80
60
40
20
0
57.24
72.66
57.26
72.88
69.26
71.11
80.21
64.81
Before
1st day
7th day
30th day
Dist -water
Dist water- Peek

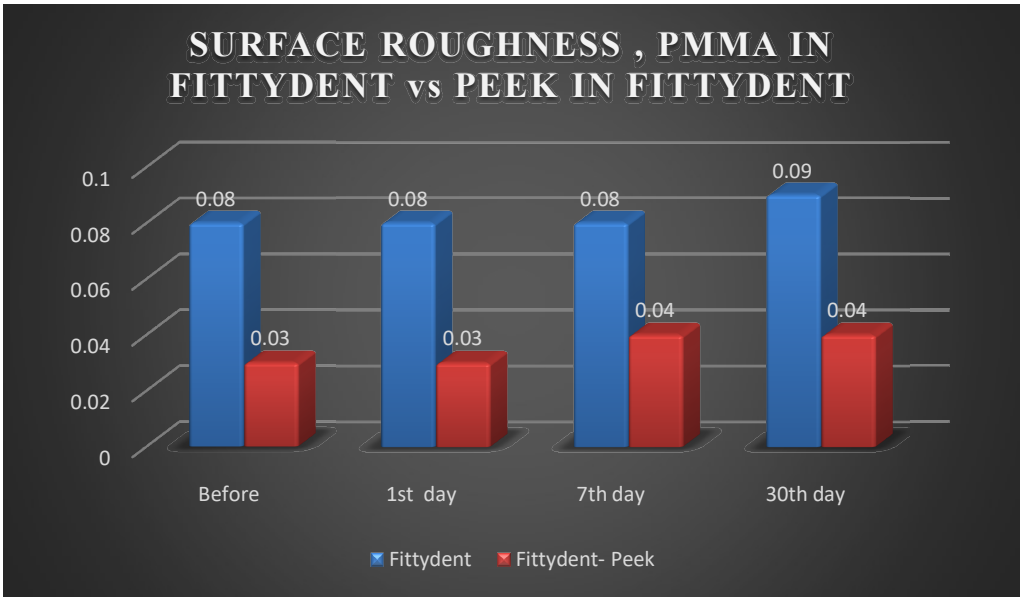

SURFACE ROUGHNESS,PMMA-WITHIN
0.12
0.1
0.08
0.06
0.04
0.02
0
0.08 0.08 0.08
0.08 0.08 0.08
0.08 0.08
0.1
0.09 0.09
0.11
Before
1st day
7th day
30th day
Polident
Fittydent
Dist.water

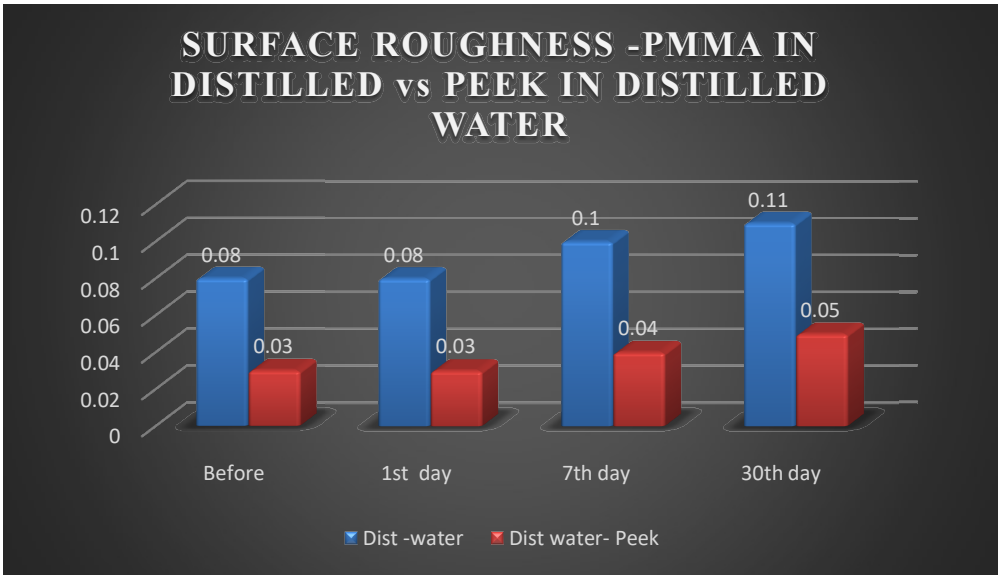

SURFACE ROUGHNESS,PMMA- BETWEEN
0.12
0.1
0.08
0.06
0.04
0.02
0
0.08 0.08 0.08 0.09
0.08 0.08 0.08 0.09
0.08 0.08 0.1 0.11
Polident
Fittydent
Dist.water
Before
1st day
7th day
30th day


SURFACE ROUGHNESS -PEEK-WITHIN
0.05
0.04
0.03
0.02
0.01
0
0.03 0.03 0.03
0.03 0.03 0.03
0.04 0.04 0.04
0.04 0.04 0.05
Before
1st day
7th day
30th day
Polident
Fittydent
Dist.water


SURFACE ROUGHNESS -PEEK-BETWEEN
0.05
0.04
0.03
0.02
0.01
0
0.03 0.03
0.04 0.04
0.03 0.03
0.04 0.04
0.03 0.03
0.04
0.05
Polident
Fittydent
Dist.water
Before
1st day
7th day
30th day


SURFACE ROUGHNESS , PMMA INPOLIDENT vs PEEK IN POLIDENT
0.1
0.08
0.06
0.04
0.02
0
0.08
0.03
0.08
0.03
0.08
0.04
0.09
0.04
Before
1st day
7th day
30th day
Polident
Polident- Peek


SURFACE ROUGHNESS , PMMA IN FITTYDENT vs PEEK IN FITTYDENT
0.1
0.08
0.06
0.04
0.02
0
0.08
0.03
0.08
0.03
0.08
0.04
0.09
0.04
Before
1st day
7th day
30th day
Fittydent
Fittydent- Peek


SURFACE ROUGHNESS -PMMA IN DISTILLED vs PEEK IN DISTILLED WATER
0.12
0.1
0.08
0.06
0.04
0.02
0
0.08
0.03
0.08
0.03
0.1
0.04
0.11
0.05
Before
1st day
7th day
30th day
Dist -water
Dist water- Peek

DISCUSSION

DISCUSSION

This in vitro study was performed to evaluate the effects of Polident and Fittydent denture cleansing agents on the physical properties of PMMA, and PEEK denture base materials.

Dentistry as a specialty is believed to have begun about 3000 BC in Egypt. As civilization progressed there has been continued refinement of both the quantity and quality of useful materials making it biologically simple to manipulate and technically controlled to develop a prosthesis that is functionally effective and pleasing in appearance. The transition from naturally occurring materials to the application of synthetic resins in denture construction indicates the extent of development taking place[71]. As aptly said that for a strong building there is a need for a sound foundation, similarly for fabricating long lasting, esthetically and biologically acceptable dentures, there is a need fora favorable denture base.

Polymethyl methacrylate (PMMA), since its introduction in 1937, is still the most commonly used material for denture fabrication due to its easy processing, accurate fit, adequate strength, superior aesthetics, low water sorption, low toxicity and stability in the oral environment. Nonetheless, drawbacks such as polymerization shrinkage, residual monomer allergy, weak flexural strength, low impact strength and low fatigue resistance[72] demands another material which could overcome these limitations and have better properties.

Polyether ether ketone (PEEK) was introduced in dentistry as a revolutionary material of choice for fixed and removable prostheses due to its promising mechanical and biological behaviors. PEEK has good mechanical properties, excellent chemical-resistance, high-temperature stability and it is also non-cytotoxic, tissue-compatible, electrically non-conductive, and bio-inert and thermally insulating. Other advantages of PEEK that makes it suitable for dentistry are the poor electrical and thermal conductivity.

Denture base material used for the fabrication of dentures, areused in an environment having variations in oral temperature, the pH of saliva, and their component and must be in contact with several foods, drinks and beverages, taken at various temperatures rendering them susceptible to changes in their physical structure and appearance, due to the absorption of different contaminants.

Relevant parameters for evaluating the clinical longevity of dental restorations include water absorption, polymerization shrinkage, dimension stability, and polishing ability. PEEK has been shown to absorb less water than PMMA, even after an immersion period of 10 days at 121^0C.Although PMMA showspolymerization shrinkage of approximately 2% to 4%, PEEK does not shrink during the polymerization process and remains chemically inert.Furthermore, PEEK offers high stability with regard to hardness, rigidity, and strength, at a wide range of temperatures; thus resulting in lessdeformation than other thermoplastic materials[54].

Improper prosthesis maintenance may contribute to the formation of plaque biofilm and pathogen colonization on the surface of the prosthesis. *Candida albicans* is the most common fungal pathogen on denture surfaces, and it causes denture stomatitis. Patient education regarding prosthesis hygiene and maintenance is one of the main criteria for successful dental treatment. Daily disinfection of the prosthesis usually reduces the progression of biofilm formation on denture surfaces. Different denture disinfection maintenance protocols havebeen proposed. Common mechanical cleaning methods include brushing the prosthesis with dentifrices and ultrasonic cleansing. The prosthesis may also be immersed in chemical cleansers, alone or in conjunction with brushing techniques. Several studies have reported the efficacy of chemical cleansers on the removal of plaque biofilm[74].

There are several types of chemical cleansers for removable prostheses, including acids, enzymes, disinfecting agents, and alkaline peroxides. The main drawback of denture cleansers is their detrimental effect on the physical properties of denture base materials; in particular, these agents increase surface roughness. An increase in the surface roughness of the denture base increases the accumulation of microbial plaque and hinders plaque removal. Polychronakis et al[73] reported that the surface roughness of Heat polymerized (HP) acrylic resin increased after exposure to cleansing agent. Peracini et al[75] evaluated the effects of denture cleansers on the physical properties of HP acrylic resin and concluded that the cleansers significantly increase surface roughness and also negatively affect color stability.

Several studies have examined the effects of denture cleansers on acrylic resin; however, the effects of denture cleansers on PEEK denture resins have not been thoroughly investigated. Therefore, this study evaluated the effects of two denture cleansing agents on

the color stability and surface roughness of PEEK and compares it with PMMA denture base material, the most commonly used one.

In this study denture cleansers used are Polident and Fittydent. These cleansers were selected as they are generally available in the market and most of the denture wearers are using the same[54]. The staining agent used in the study iscoffee. There are studies which shows coffee has more chromogenic discoloration than tea[69]. Both surface absorption and adsorption of colorants are responsible for the discoloration of coffee. Small coffee particles are deposited into denture base materials pits. Less polar colorants and water soluble poly-phenols in coffee for example tannin, caffeine and caffeic acid may have penetrated deep into the material, probably because such colorants would be more compatible with polymer matrices[76].

The specimens of each group were immersed in the cleansing solutions for 12 hours. This approximately simulated the overnight immersion of a denture in cleanser medium. The time period of this study was 30 days, in view of the fact that, in most in vitro studies the final period is typically four weeks or more, in order to achieve a cumulative staining effect and obtain distinct results[77].

When color alteration is being assessed, visual examination may be considered as an individual psychological, physiological and emotional process while using the spectrophotometer device for determination of color alteration not only eliminates personal explanations but also allows recognition of minor color changes can't be seen by naked eye. A color system named "The Commission Internationale de l'Eclairage (CIE)" where; L*a*b is a constant color scale that includes all the colors visible to the human eye was used in the present study. To evaluate color stability, color differences (ΔE) and color variables (ΔL*, Δa*, Δb*) were calculated relative to the baseline measurements using the following equation: $\Delta E^* = [(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2]1/2$[78] .

Color is considered as an important criterion of any denture material, consequently, its stability during material's entire time of survival is considered as a major factor for the success or failure ofprosthesis. Polishing ability and material structure are the parameters providing color stability for a longer period of time. Moreover, types of food intake are also a key factor[79].The surface roughness (*R*a) of a material used for prosthetic rehabilitation is

important and it directly or indirectly affects the resistance to staining, plaque accumulation, the health of oral tissues, and patient comfort[80]. Surface roughness is associated with increased initial biofilm adhesion. Previous studies have confirmed that surfaces with low roughness and free energy show less bacterial growth and plaque accumulation and a smoother and brighter appearance[81].

The surface roughness of dental materials may be evaluated using many types of devices, such as conventional profilometer, laser-tipped profilometer, atomic force microscopes, and scanning electron microscopy (SEM). It has been reported in related studies that contact profilometer devices are effective to detect the surface roughness, caused by polishing techniques. In this study surface roughness was evaluated using contact profilometer[82].

Result of this study showsthat with the increase in immersion time, the property of colour stability and surface roughness has varied significantly**.** PEEK specimens showed the least color instability when immersed into staining agents which was earlier stated by Mohammed S and Eltamimi K in their studies.They also stated that PEEK has least water absorption and solubility values as compared to PMMA hence contributing to the better colour stability[65] .Heimer also claimed that PEEK material showed the significantly lowest color changes after one week immersion in the different staining agents[54].

The greater discoloration of PMMA was probably due to its rougher surface after polishing. Acrylic resins are susceptible to sorption owing to the method of absorption and adsorption of various colors. Several literatures in the past years have shown the difference in color stability between different brands of heat-cured resins. Acrylic resin is an organic material and its translucency and color are likely to deteriorate due to the adhesion of colorants to the surface pellicle layer forming on the denture base material when they come into contactwith different compounds in food products and beverages[83].

This study also revealed that PEEK is structurally stable with minimum surface roughness after immersion into different cleansing agents (Fittydent and Polident), which is in agreement with Benli et al[84]who confirmed lowest surface roughness value in PEEK specimens.

PEEK

This feature may be due to the structural uniqueness of PEEK having aromatic backbone molecular chain with combinations of ketone and ether functional groups between aryl rings. This gives PEEK its exceptional chemical and mechanical properties that are retained even at higher temperatures. PEEK is one of the most inert material because it is homopolymer having a single monomer making it highly resistant to chemical and radiation damage[85].

Cleansing agents mainly prevent the formation of biofilm which later leads to colour change as well as surface deterioration. Ozyilmaz et al.[86] investigated the effect of surface cleaning agents on the properties of three different denture and detected that all agents reduced the surface roughness.In this study Polident has proved to cause minimum colour change as well as surface roughness on PEEK, in accordance with Hayran et al stating that, usage of Polident as cleansing agents prevented biofilm formation as well as caused minimum roughness on denture material[87].

This is probably contributed mainly by its composition which includes Sodium Bicarbonate, Citric Acid, Potassium Caroate (Potassium Monopersulfate),Sodium Carbonate, where all these are buffering solutions.Polident achieveschemical cleaning by using the release of oxygen froma neutral enzymatic peroxide solution.Murata, et al.reported that the influence of neutral enzymaticdenture cleanser on the surface properties was lessthan that of alkaline peroxide denture cleanser dueto the neutral enzymatic denture cleanser containingless peroxide[88].

The limitations of this study are the absence of oral environmental factors, such as masticatory forces, saliva, and biofilm that may affect the results. This study also did not examine the effects of temperature changes. In addition, the specimens were immersed in the two denture cleansing agents to simulate 30 days of use, evenhough this short immersion period revealed no clinically significant findings.

Within the limitations of this invitro study, the following conclusions could be drawn: The color stability and surface roughness of PEEK denture base resins is better than that of PMMA when immersed in cleansing agents.

CONCLUSION

CONCLUSION

1. PEEK and PMMA denture base specimens immersed in Polident, Fittydent and Distilled water showed gradual colour change with time.
2. With the comparison of the two materials it was ascertain the PEEK is more colour stable than PMMA.
3. Within the limitation of the study Polident emerges as a better cleansing agent.
4. Comparing the two groups it came to lime light that PMMA showed a positive change in surface roughness while being immersed in all cleansing solutions than PEEK.

BIBLIOGRAPHY

BIBLIOGRAPHY

1. Gantait s, Bhattacharyya j, das s, Biswas s, ghati a, Ghosh s, et al: Comparative assessment of the effectiveness of different cleaning methods on the growth of Candida albicans over acrylic surface. Contempt clin dent 2016; 7:336-42.
2. S. K. Khindria, Sanjeev mittal, Uradhi sukhija. Evolution of denture base Materials. The journal of Indian prosthodontic society April 2009; 9(2):64-69.
3. Köroğlu,r şahİn1, dede, denİz,karacan sever and özkan et al.Efficacy of denture cleaners on the surface roughness and candida albicans adherence of sealant agent coupled denture base materials.dental materials. Journal 2016; 35(5): 810–816.
4. Frederico silva de freitas Fernandes, tatiana Pereira-cenci, Wander Jose da silva,Antonio pedro ricomini filho, Fabiana gouveia straioto and Altair antoninha delbel cury. Efficacy of denture cleansers on candida spp. Biofilm formed onpolyamide and polymethyl methacrylate resins. J prosthet dent 2010; 105: 51-58.
5. Mohamed S, Eltamimi K. Effect of different beverags on colour stability of different denture base materials (a comparativespectrometric study). Egyptian Dental Journal. 2021 Apr 1; 67(2):1549-56.
6. Alsilani RS, Sherif RM, Elkhodary NA. Evaluation of colour stability and surface roughness of three CAD/CAM materials (IPS e. max, Vita Enamic, and PEEK) after immersion in two beverage solutions: an in vitro study. Int J Appl Dent Sci. 2022; 8:439-49.
7. Linda gendreau,& zvi g. Loewy, et al. Epidemiology and etiology of denturestomatitis. Journal of prosthodontics 20 (2011) 251–260 c 2011.

8. Ufuk is¸ eri, altay Uludamar and Yasemin kulak ozkan et al.Effectiveness ofdifferent cleaning agents on the adherence of candida albicans to acrylic denturebase resin.Gerodontology 2011; 28: 271–276.

9. Mohssen ghalichebaf.The efficacy of denture-cleansing agents, the journal of prosthetic dentistry, november 1982 vol 4 number5:515-520.

10. Porwal A, Khandelwal M, Punia V, Sharma V. Effect of denture cleansers on color stability, surface roughness, and hardness of different denture base resins. The Journal of the Indian Prosthodontic Society. 2017 Jan; 17(1):61.

11. Anthony DH, Gibbons P. The nature and behavior of denture cleansers. Journal of Prosthetic Dentistry. 1958 Sep 1; 8(5):796-810.

12. Jorgensen EB. Materials and methods for cleaning dentures. J Prosthet Dent 1979;42:619-623.

13. Connor, schoenfeld, and 'Taylor.An evaluation of an enzyme denture cleanser.J. Prosthet. Dent.february, 197; 37(2):147-157.

14. Augsburger R. H, Elahi J M. Evaluation of seven proprietary denture cleansers. J Prosthet Dent 1982; 47: 356-58.

15. Mohssen ghalichebaf.The efficacy of denture-cleansing agents, the journal of prosthetic dentistry, november 1982 vol 4 number5:515-520.

16. Moore T.C, Smith D.E, Kenny G.E. Sanitization of dentures by several denture hygiene methods. J Prosthet Dent 1984; 52:158 – 63. 2

17. Robert w. Rudd, e. Steve senia, ferne k. Mccleskey, and Ernest d.adams. Sterilization of complete dentures with sodium hypchlorite. The journal of prosthetic dentistry1984; 51(3):318-321.

18. Mitsuhiro tamamoto, taizo hamada, yoichiro miyake, and hidekazu suginaka. Ability of enzymes to remove candida. Journal of prosthetic dentistry 1985; 53(2):214-216.

19. Crawford CA, Lloyd CH, Newton JP, Yemm R. Denture bleaching: a laboratory simulation of patients' cleaning procedures. Journal of dentistry. 1986 Dec 1; 14(6):258-61.

20. Robinson JG, Mc Code J F, Storer R. Denture base: The effect of various treatments on clarity, strength and structure. J Dent 1987; 15:159-165.

21. Dills S.S, Olshan A.M, Goldner S and Brogdon C. Comparison of theantimicrobial capability of an abrasive paste and chemical soak denturecleaners. J Prosthet Dent 1988; 60:467 -70.

22. P.Hornez LSD et al. The effect of three processes cycle on some physicaland chemical properties of a heat-cured acrylic resin. J Prosthet Dent1989; 61:510-517.

23. Nakamoto K, PharmSci M, Tamamoto M & Hamada T. Evaluation ofdenture cleansers with and without enzymes against Candida albicans. JProsthet Dent 1991; 66:792-5.

24. Kenneth Shay. Denture hygiene: A review and update. J of contemporarydental practice; 2000;1:2.

25. Per a. Odman. The effectiveness of an enzyme-containing denturecleanser. Quintessence lnt 1992; 23:187-190.

26. David drake. efficacy of denture cleansing agents in an in vitro bacteria-yeastColonization model.Int i prosthodont 1992,5:214-220.

27. Hiroki nikawa.Commercial denture cleansers—cleansing efficacy against candidaalbicans biofilm and compatibility with soft denture-lining materials. Int Jprosthodont 1995:8:434-444.

28. Keng SB, Lim M. Denture plaque distribution and the effectiveness of a perborate-containing denture cleanser. Quintessence international. 1996 May 1; 27(5).

29. Ünlü A, Altay OT, Sahmali S. The role of denture cleansers on the whitening of acrylic resins. International Journal of Prosthodontics. 1996 May 1; 9(3).

30. Polyzois GL, Yannikakis SA, Zissis AB, Demetriou PP. Color changes of denture base materials after disinfection and sterilization immersion. International Journal of Prosthodontics. 1997 Jan 1; 10:83-9.

31. Hiroki nikawa, Taizo mamada, Hirofumi yamasiiiro, Hiroshi kumagai. A Reviewof in vitro and in vivo methods to evaluate the efficacy of Denture cleansers. Int jprosthodont 1999; 12:153-159.

32. Sheen R.S, Harrison A. Assessment of plaque prevention on dentures usingan experimental cleanser. J Prosthet Dent 2000; 84:594-601.

33. Ozkan Y.K, Kazazoglu E, Arikan A. Oral hygiene habits, denturecleanliness, presence of yeasts and stomatitis in elderly people. J of OralRehabilitation 2002; 29:300-304.

34. Keyf F, Etikan İ. Evaluation of gloss changes of two denture acrylic resin materials in four different beverages. Dental materials. 2004 Mar 1; 20(3):244-51.

35. Renata C, Garcia R, Leon BL, Oliveira VMB, Cury A. Effect of denturecleanser on weight, surface roughness and tensile bond strength of twodenture liners. J Prosthet Dent 2003; 89:489-94.

36. Garcia R, De Souza JA, Rached RN, Cury A. Effect of denture cleansers onthe surface roughness and hardness of a microwave cured acrylic resin anddental alloys.J Prosthodont 2004 ;13:173-78.

37. Harrison Z, Johnson A, Douglas CWI. A vitro study into the effect of alimited range of denture cleaners on surface roughnes and the removal ofcandida albicans from conventional heat cure acrylic resin denture basematerial. J Oral Rehab 2004; 31:460 67.

38. Sato S, Cavalcante M R S, Orsi I A, Paranhos H F O,Zaniqeilli O.Assesment of flexural strength colour alteration of heat polymerized acrylicresin after simulated use of denture cleansera. Braz Dent J 2005; 16(2):124-8.

39. Kulak Y, Arikan A, Albak S, Okar I, Kazazoğlu E.Scanning electron microscopicexamination of different cleaners: surface contaminant removal from dentures. JOral Rehabil 1997; 24:209-215.

40. E. M. C. X. Lima. Effect of enzymatic and naocl treatments on acrylic Roughnessand on biofilm accumulation. journal of oral rehabilitation 2006 33; 356–362.

41. H. F. O. Paranhos, c. H. Silva-lovato, r. F. Souza, p. C. Cruz, k. M. Freitas & a.Peracini. Effects of mechanical and chemical methods on Denture biofilmaccumulation. Journal of oral rehabilitation 2007; 34: 606–612.

42. Sarag D, Sarag Y, Kurt M, Yuzbasioglu E. The effectiveness of denturecleansers on soft denture liners colored by food colorant solutions. JProsthodont 2007; 16: 185 -91.

43. Francine cristina da silva, estevao tomomitsu kimpara, maria nadir Gasparottomancini, ivan balducci, antonio olavo cardoso jorge, cristiane Yumi

koga-ito.Effectiveness of six different disinfectants on removing five microbial speciesand effects on the topographic characteristics of Acrylic resin. Journal ofprosthodontics 2008; 17:627–633.

44. Hong G, Murata H, Li Y, Sadamori S, Hamada T . Influence of denturecleansers on the color stability of three types of denture base acrylic resin. JProsthet Dent 2009; 101:205-13.

45. Imirzalioglu P, Karacaer O, Yilmaz B, Ozmen MSc I. Color stability of denture acrylic resins and a soft lining material against tea, coffee, and nicotine. Journal of Prosthodontics: Implant, Esthetic and Reconstructive Dentistry. 2010 Feb; 19(2):118-24.

46. Davi LR, Peracini A, Ribeiro Nde Q, Soares RB, da Silva CH, ParanhosHde F, deSouza RF. Effect of the physical properties of acrylic resin ofovernight immersion in sodium hypochlorite solution. Gerodontology. 2010;27(4):297-302.

47. Chethan M. D, Azhagarasan N.S, Miglani S, Mohammed H.S, Prasad A.H.Microbiological evalution of the effectiveness of commercially availabledenture cleansing agents.Int.J.Drug Dev. & Res.,2011;3(3):159-172.

48. Paranhos HD, Peracini A, Pisani MX, Oliveira VD, Souza RF, Silva-Lovato CH. Color stability, surface roughness and flexural strength of an acrylic resin submitted to simulated overnight immersion in denture cleansers. Brazilian dental journal. 2013 Mar; 24:152-6.

49. 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 Journal of Dental Research. 2013 Mar 1; 24(2):172.

50. Shah VR, Shah DN, Chauhan CJ, Doshi PJ, Kumar A. Evaluation of flexural strength and color stability of different denture base materials including flexible material after using different denture cleansers. The Journal of the Indian Prosthodontic Society. 2015 Oct; 15(4):367.

51. Jeyapalan K, Kumar JK, Azhagarasan NS. Comparative evaluation of the effect of denture cleansers on the surface topography of denture base materials: An in-vitro study. Journal of pharmacy & bioallied sciences. 2015 Aug; 7(Suppl 2):S548.

52. Hollis S, Eisenbeisz E, Versluis A. Color stability of denture resins after staining and exposure to cleansing agents. The Journal of prosthetic dentistry. 2015 Nov 1; 114(5):709-14.

53. Awad D, Stawarczyk B, Liebermann A, Ilie N. Translucency of esthetic dental restorative CAD/CAM materials and composite resins with respect to thickness and surface roughness. The Journal of prosthetic dentistry. 2015 Jun 1; 113(6):534-40.

54. Heimer S, Schmidlin PR, Stawarczyk B. Discoloration of PMMA, composite, and PEEK. Clinical oral investigations. 2017 May; 21(4):1191-200.

55. Köroğlu A, Sahin O, Dede DÖ, Yilmaz B. Effect of different surface treatment methods on the surface roughness and color stability of interim prosthodontic materials. The Journal of prosthetic dentistry. 2016 Apr 1;115(4):447-55.

56. Kurt A, Erkose-Genc G, Uzun M, Sarı T, Isik-Ozkol G. The effect of cleaning solutions on a denture base material: elimination of Candida albicans and alteration of physical properties. Journal of Prosthodontics. 2018 Jul; 27(6):577-83.

57. Porwal A, Khandelwal M, Punia V, Sharma V. Effect of denture cleansers on color stability, surface roughness, and hardness of different denture base resins. The Journal of the Indian Prosthodontic Society. 2017 Jan; 17(1):61.

58. Salama F, Al-khunaini N, Al-Rashed S, Abou-Obaid AA, Elsharawy M. Effect of different denture cleansers on surface roughness of acrylic denture base materials. International Journal of Contemporary Research and Review. 2017;8(11).

59. Gadallah AF, Motawea IT, Bayoumi RE. Evaluation of the effect of saliva contamination and cleaning methods on the surface free energy and shear bond strength of resin cements to zirconia ceramics. Al-Azhar Dental Journal for Girls. 2018 Oct 1;5(4):385-98.

60. Alnassar T, Vohra F, Abualsaud H, Al-Thobity AM, Flinton R. Efficacy of novel cleansing agent for the decontamination of lithium disilicate ceramics: a shear bond strength study. Journal of adhesion science and Technology. 2017 Jan 17; 31(2):202-10.

61. Dayan C, Guven MC, Gencel B, Bural C. A comparison of the color stability of conventional and CAD/CAM polymethyl methacrylate denture base materials. Acta StomatologicaCroatica. 2019 Jun; 53(2):158.

62. Kamal MN. Comparative evaluation of color stability between three different CAD/CAM milled denture base materials: An In vitro study. Journal of International Dental and Medical Research. 2020 Sep 1; 13(3):854-60.

63. Beleidy M, Ziada A. Marginal accuracy and fracture resistance of posterior crowns fabricated from CAD/CAM PEEK cores veneered with HIPC or nanohybrid conventional composite. Egyptian Dental Journal. 2020 Oct 1; 66(4-

October (Fixed Prosthodontics, Removable Prosthodontics and Dental Materials)):2541-52.

64. Banu F, Jeyapalan K, Modi K. Comparison of Colour Stability Between Various Denture Base Resins on Staining and Denture Cleansing Using Commercially Available Denture Cleansers. Cureus. 2020 Jan 19; 12(1).

65. Mohamed S, Eltamimi K. Effect of different beverags on colour stability of different denture base materials (a comparativespectrometric study). Egyptian Dental Journal. 2021 Apr 1; 67(2):1549-56.

66. Alsilani RS, Sherif RM, Elkhodary NA. Evaluation of colour stability and surface roughness of three CAD/CAM materials (IPS e. max, Vita Enamic, and PEEK) after immersion in two beverage solutions: an in vitro study. Int J Appl Dent Sci. 2022; 8:439-49.

67. Erdağ ÜH, Sahin O, Köroğlu A, Özdemir T, Dede DÖ. Performance of polyether ether ketone (peek) for dental applications: surface roughness and color stability. Polymer Bulletin. 2022 Jul 29:1-6.

68. Ahuja RS, Prakash P, Sandhu HS, Bhandari SK. Comparison of color stability of two types of denture base resins in various food colorant solutions: An in vitro study. IP Annals of Prosthodontics and Restorative Dentistry. 2020 Dec 15;6(4):204-10.

69. Nikawa H, Hamada T, Yamashiro H, Kumagai H. A review of in vitro and in vivo methods to evaluate the efficacy of denture cleansers. International Journal of Prosthodontics. 1999 Mar 1; 12(2).

70. Srivastava S, Singh T, Lahori M. The relevance of polishing acrylic dentures. Guident. 2021 Jun 1;14(7).

71. Sheejith M, Swapna C, George Roshy SN. Evolution of denture base material: from past to new era. IOSR J Dent Medic Sci. 2018;17(11):23-7.

72. Kumar MA, Ali S. Denture Base Resins From Past to New Era. European Journal of Molecular & Clinical Medicine.7 (06):2020.

73. Ziada A, Beleidy M. Effect of artificially accelerated ageing and different mouth rinses on color stability of veneered PEEK crowns. Egyptian Dental Journal. 2021 Jan 1;67(1-January (Fixed Prosthodontics, Removable Prosthodontics and Dental Materials)):497-507.

74. Al-Thobity AM, Gad M, ArRejaie A, Alnassar T, Al-Khalifa KS. Impact of denture cleansing solution immersion on some properties of different denture base materials: an in vitro study. Journal of Prosthodontics. 2019 Oct;28(8):913-9.

75. Peracini A, Davi LR, de Queiroz Ribeiro N, de Souza RF, da Silva CH, Paranhos HD. Effect of denture cleansers on physical properties of heat-polymerized acrylic resin. Journal of prosthodontic research. 2010 Apr 1; 54(2):78-83.

76. Cooley RL, Barkmeier WW, Matis BA, Siok JF. Staining of posterior resin restorative materials. Quintessence International (Berlin, Germany: 1985). 1987 Dec 1; 18(12):823-7.

77. Koksal T, Dikbas I. Color stability of different denture teeth materials against various staining agents. Dental materials journal. 2008; 27(1):139-44.

78. Daniela nair borges felipucci.Effect of different cleansers on the surface of removable partial denture. Braz dent j (2011) 22(5): 392-397.

79. Nikawa H, Hamada T, Yamashiro H, Kumagai H. A review of in vitro and in vivo methods to evaluate the efficacy of denture cleansers. International Journal of Prosthodontics. 1999 Mar 1; 12(2).

80. Banu F, Jeyapalan K, Kumar AV, et al. Comparison of Colour Stability Between Various Denture Base Resins on Staining and Denture Cleansing Using Commercially Available Denture Cleansers. Cureus 2020; 12(1): 2-12.

81. Alp G, Johnston WM, Yilmaz B. Optical properties and surface roughness of prepolymerized poly (methyl methacrylate) denture base materials. J Prosthet Dent. 2019; 121(2): 347-52.

82. Berger JC, Driscoll CF, Romberg E, et al: Surface roughness of denture base acrylic resins after processing and after polishing. J Prosthodont 2006;15**:**180-186

83. Polychronakis N, Lagouvardos P, Polyzois G, Sykaras N, Zoidis P. Color changes of polyetheretherketone (PEEK) and polyoxymethelene (POM) denture resins on single and combined staining/cleansing action by CIELab and CIEDE2000 formulas. journal of prosthodontic research. 2020;64(2):159-66.

84. Benli M, Eker Gümüş B, Kahraman Y, Gökçen-Rohlig B, Evlioğlu G, Huck O, Özcan M. Surface roughness and wear behavior of occlusal splint materials made of contemporary and high-performance polymers. Odontology. 2020 Apr; 108(2):240-50.

85. Polychronakis N, Lagouvardos P, Polyzois G, Sykaras N, Zoidis P. Color changes of polyetheretherketone (PEEK) and polyoxymethelene (POM) denture resins on single and combined staining/cleansing action by CIELab and CIEDE2000 formulas. journal of prosthodontic research. 2020; 64(2):159-66.

86. Ozyilmaz OY, Akin C. Effect of cleansers on denture base resins' structural properties. Journal of applied biomaterials & functional materials. 2019 Feb; 17(1):2280800019827797.

87. Hayran Y, Sarikaya I, Aydin A, Tekin YH. Determination of the effective anticandidal concentration of denture cleanser tablets on some denture base resins. Journal of Applied Oral Science. 2018 Jan 18; 26.

88. Murata H, Li Y, Sadamori S, Hamada T. Influence of denture cleansers on the color stability of three types of denture base acrylic resin. The Journal of prosthetic dentistry. 2009 Mar 1; 101(3):205-13.

ANNEXURES

ST. GREGORIOS DENTAL COLLEGE

UNDER THE MANAGEMENT OF MJSCE TRUST, PUTHENCRUZ
CHELAD , KOTHAMANGALAM, ERNAKULAM DIST, KERALA - 686681

ETHICAL CLEARANCE CERTIFICATE

17/02/2021

To, SGDC/152/2021/1012

Dr. Jasmin Cyril
St. Gregorios Dental College
Chelad, Kothamangalam

Dear Dr. Jasmin Cyril

Subject: Ethics Committee Clearance-reg

Protocol: A comparative evaluation of colour stability and surface roughness of poly methyl methacrylate resin and polyetheretherketone polymer after staining and exposure to cleansing agents: An In -Vitro Study.

At the Institutional Ethics Committee (IEC) held on 15th of January 2021, this study was examined and discussed. After consideration, the committee has decided to approve and grant clearance for the aforementioned study.

The members who attended the meeting at which the protocol was discussed were:

1) Dr .C.K.K Nair - Former BARC Scientist
2) Dr.Cinu Thomas A - Scientist, Vice Principal, Caritas College of Pharmacy
3) Dr. Lissy Jose – Former member of Women's welfare Association.
4) Adv. Jose Aranjani – Advocate.
5) Dr. Sauganth Paul – Reader, Department of Biochemistry, St. Gregorios Dental College.
6) Dr. Eapen Cherian – Secretary, Professor, St. Gregorios Dental College
7) Dr. Jain Mathew – Principal and Head of the Department, Department of Conservative Dentistry and Endodontics.
8) Dr. George Francis – Head of the Department, Department of Prosthodontics and Crown and Bridge.
9) Dr. Binoy Kurian – Head of the Department, Department of Orthodontics and Dentofacial Orthopaedics.

St. Gregorios Dental College Chelad - 686 681

Dr. C.K.K Nair
Chairman Institutional Ethics Committee
St Gregorios Dental College, Chelad

Dr. Eapen Cherian
Secretary

Phone : 0485-2572529, 530, 531, 2571429, Fax : 0485-2572530,
Email : sgdc@rediffmail.com, Web : sgdc.ac.in

LIST OF ABBREVIATIONS USED

GPT	Glossary of Prosthodontic Terms
PEEK	Polyetheretherketone
PMMA	Polymethylmethacrylate acrylic resin
Ra	Surface roughness
%	Percentage
mm	Millimetre
hr	Hour
P value	Probability value
ºC	Degree Celsius
gm	Gram
ml	Millilitre
fig.	Figure
vs.	Versus