

A Blessing for Geriatric Beverage Enthusiast - Mechanical and Chemical Resin Cleaner

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Abstract

Introduction: This in vitro study evaluates and compares three denture cleansing methods in the removal of tea, coffee stains from conventional and high impact polymethylmethacrylate heat cured denture base acrylic resin.

Materials & Method: Two types of denture base acrylic resins were polymerized into 360 specimens, 30x8x2mm dimension each. Samples were treated with 300ml artificial saliva and distilled water and air dried. Beverage decoction was prepared for sample staining using distilled water under controlled conditions. Each stained samples are subdivided into three groups of 30 specimens for each kind of cleansing method, tablet (Secure Denture Tablet Group Pharma Pvt Ltd),ultrasonic cleaning (Confident) & both tablet & ultrasonic method. The values of spectrophotometer are obtained from the samples before, after staining & after

cleaning. The results averaged & mean derived. Stains on each of the denture base resin were analyzed (using ANOVA test) for cleaning. Comparison of each stain for denture base resins was done by ‘Z –Test’.

Result: Tablet and ultrasonic cleaner showed a maximum cleaning ability, while tablet performance as a cleanser was better considering ultrasonic. The tablet cleanser is better because of sodium perborate monohydrate, releasing nascent oxygen with better cleaning effect.

Conclusion: Routine cleansing of dentures by denture brushes’ and detergents can remove only surface stains and not deeper level stains. The present study promotes usage of chemical method only or chemical & mechanical method for better maintenance of the dentures.

Keywords: Ultrasonic Cleaning, Denture base resin, Acrylic resins

Introduction

The color and appearance of artificial dentures is an important optical property in the present day lifestyle¹. Staining of acrylic resins can lead to poor esthetics. A denture should have a smooth and glassy surface & be capable of matching the natural appearance of soft tissues². Discoloration of the denture base polymers may be caused by intrinsic and extrinsic factors, intrinsic factors involve chemical changes of the material. The cause of such chemical discoloration has been attributed to the oxidation of the amine accelerator, after exposure to various energy sources and immersion in water for a long period.

Extrinsic factors for discoloration is the result of sorption property exhibited by resins & thus as a result of contamination from exogenous sources, eg, coffee and tea, nicotine, beverages, and colored solutions. One or more of these factors may contribute to visibly detectable or esthetically unacceptable color changes of the prosthesis³.

The use of teeth with more natural contours, and the trends towards stippled surfaces on denture bases, tends to provide more recessed areas for the accumulation of stains and debris and consequently, increase the patient's cleaning problems².

A plethora of cleansers are available for purchase over the counter for patients, with claims for their various efficacies. Some cleansers are marketed as having superior stain – removal properties. The color stability of denture base acrylic resins and hard direct relined acrylic resins, when exposed to food colorants, has been widely reported. However, little information is available on the efficacy of stain removal from denture base resin by a denture cleanser⁴.

The present study evaluates the extent of removal of tea and coffee stains on high impact and conventional

denture base acrylic resin by using different denture cleansing methods.

Materials

This in vitro study was conducted in Department of Prosthodontics, Crown Bridge and Implantology, Sri Siddhartha Dental College & Hospital, Tumkur, Karnataka and Siddganga College of Pharmacy Tumkur, Karnataka, with the objective of evaluating the effective use of three different denture cleansing methods on tea & coffee stain removal from conventional and high impact polymethylmethacrylate denture base acrylic resin.

List of Equipments Used

1. Spectrophotometer, brand name- UV-VIS Spectrophotometer 3000 +, manufacturer- Labindia Analytical Ltd.



Fig. 1: Spectrophotometer

2. Digital acrylicising unit, brand name-CONFIDENTC.73, manufacturer-Confident Dental Equipment Ltd

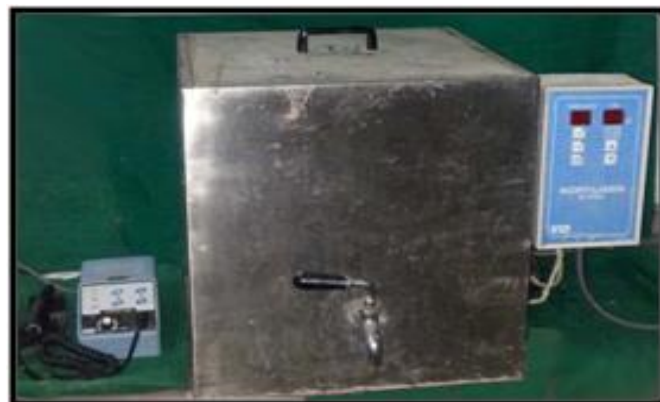


Fig. 2: Digital Acrylicising Unit

3. Ultrasonic Cleanser, brand name- C-80-M, manufacturer- Confident Dental Equipment Ltd



Fig. 3: Denture Cleaning Agents, Ultrasonic cleanser and Tablet

4. Induction Cooker, brand name- BUTTERFLY POWER HOB 3P 101 PLUS, manufacturer- LLM Appliances Ltd



Fig. 4: Induction Cooker with Miscellaneous Armamentarium

5. Hand trimmer, brand name - Supreme lobo Hand trimer, manufacturer- Confident Dental Equipment Ltd

List of Materials Used

1. Heatcure denture base resin, Brand name - TREVALON, manufacturer-Dentsply India Pvt Ltd



Fig 5: Heat Cure Denture Base Resins and Separating Medium

2. Heat cure denture base resin, brand name-DPI Heat Cure, manufacturer-The Bombay BurmahTrading Corporation Ltd
3. Dental Stone, brand name-KALSTONE, manufacturer-Kalabhai Karson Pvt Ltd



Fig. 6: Dental Stone, Dental Plaster

4. Dental Plaster, brand name-PLASTER OF PARIS FOR DENTAL USE, manufacturer-Kalabhai Karson Pvt Ltd
5. SeparatingMedia, brand name-DPI Heat Cure, manufacturer- The Bombay Burmah Trading Corporation Ltd

6. Artificial Saliva, brand name-WET MOUTH, manufacturer- ICPA Health Product Limited
7. Tea, brand name-THREE ROSES, manufacturer- Hindustan Unilever Pvt Ltd
8. Coffee, brand name-NESCAFE, manufacturer- Nestle India Limited



Fig. 7: Materials Used For Staining of Samples

- 9 Tablet Form Denture Cleanser, brand name- SECURE DENTURE TABLET, manufacturer- Group Pharma Pvt Ltd
- 10 Round bur ,brand name- ZSS WHITE HP-6, manufacturer- SS WHITE

Miscellaneous Armamentarium

1. Metal mould.
2. Rubber mixing bowl
3. Acrylic mixing jar
4. Petroleum jelly –Vaseline



Fig. 8: Miscellaneous Armamentarium

5. Bench press

6. Metal flask/clamp

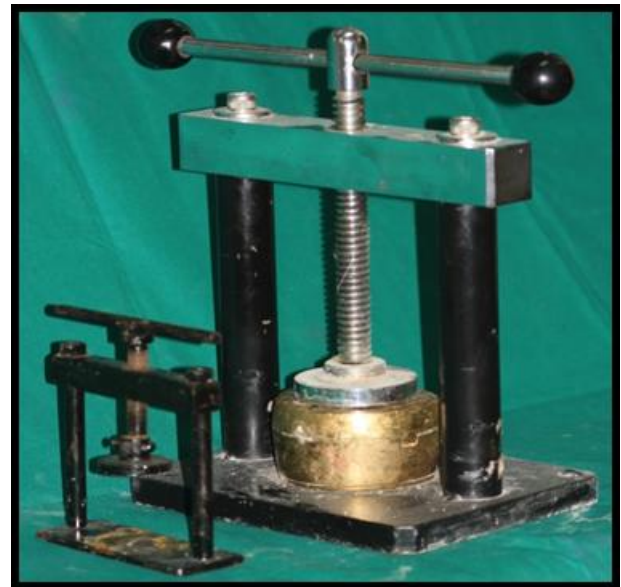


Fig. 9: Bench Press Along with Flask and Clamp

7. Stainless steel straight plaster spatula
8. Lecrons carver
9. Distilled water
10. Stainless steel container ,lid & spoon
11. Glass beakers
12. Measuring cylinder
13. Sieve
14. Enamel tray
15. Custom made sample orientation guide
16. Tweezers
17. Zip lock pouches
18. Cotton
19. Camlin painting brush
20. Faber-castell-marker pen

Method

In this study the effective use of three different denture cleansing method's on tea and coffee stain removal from conventional and high impact polymethylmethacrylate denture base acrylic resin was observed. Polymethylmethacrylate denture base acrylic resin was polymerized into rectangular shaped specimen of 360 in number, with dimension of 30x8x2mm each. These

specimens were prepared using a metal mold with the assembly of three metal plates.(fig 10)

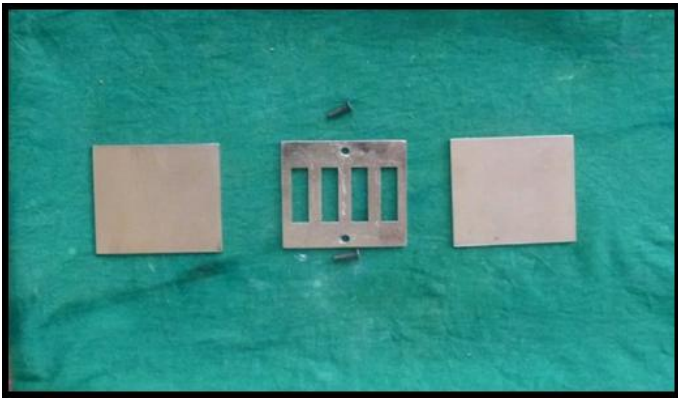


Fig. 10: Constituents Of Metal Mould

The metal mould consists of a unit of three metal plates, with a highly polished mirror finish, so as to replicate similar surface in the resultant samples. In the middle plate four slots are present with the dimension of 30 x 8 x 2mm and the remaining right and left margins of the plates have a screw hole with screw threads (fig 10) The other two plates, upper and lower, have flat plane surfaces. Specimens were prepared using metal mould. The unit of three plates is flaked using three pour technique and a uniform layer of separating medium was applied with Camlin painting brush on it for easy separation of second pour.

After initial setting of the Gypsum, the counter part of the flask is separated. As shown in fig 12. The middle plate present apart, either in base or counter part of the flask. Petroleum jelly was applied to the inner surface of the slot & the surfaces of the upper & lower metal plates facing the middle plate. Heat cure denture base resin is taken in a mixing jar with accepted polymer-to-monomer ratio of 3:1 by volume. When the resultant mass attains dough stage it is packed in the slot place present in the middle plate of the metal mold (fig 13).



Fig. 11: Flasking with Metal Mould

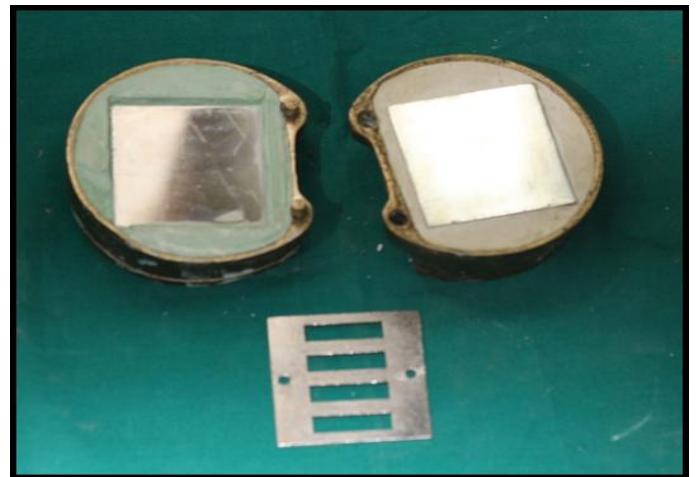


Fig. 12: After Separating The Base And Counter Part Of The Flask

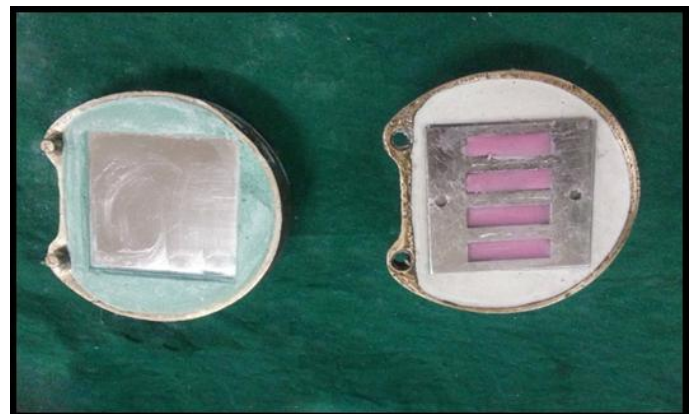


Fig. 13: Packing With Heat Cure Acrylic

The flask along with the base and counter part is reassembled and kept inside the bench press, and pressure is applied incrementally. Curing procedure was

carried according to manufactures instructions for conventional and high impact resin respectively. The flask was disassembled, screws were placed in the screw slots present on the margin of the middle plate & the middle plate is easily separated from lower plate (fig 14). Then samples were separated from the middle plate by slowly tapping.

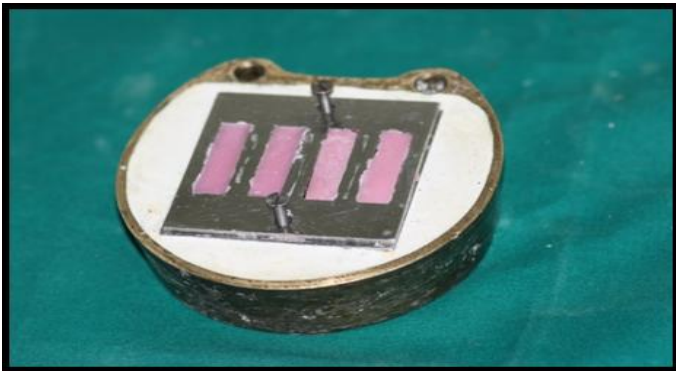


Fig. 14: Screw placed in the middle plate to separate it from the lower plate after acrylisation

The samples so obtained were trimmed off the flash. Thus 240 samples were similarly fabricated using this procedure. An orientation groove was made on one of the surface of the samples using the round bur, 1mm away from the finishing edge, for guidance during placement in the beaker (fig15).



Fig. 15: A Sample after removal from the middle plate along with the orientation groove

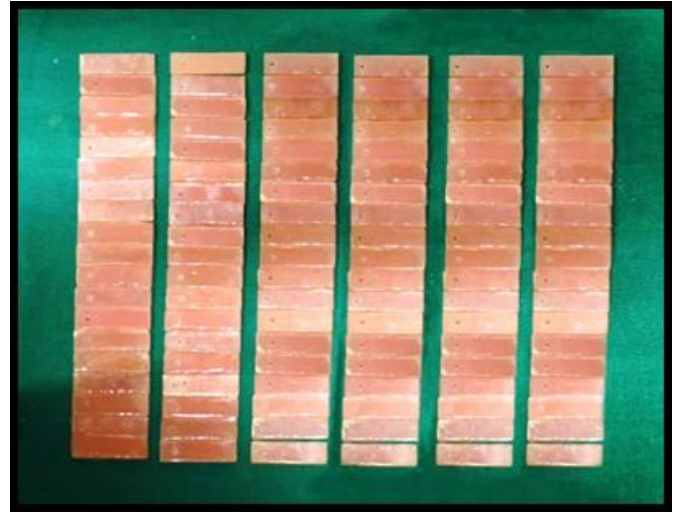


Fig. 16: Samples Obtained After Acrylization

These samples so obtained were placed in different zip lock pouches & these samples are numbered on the pouches using marker pen for maintaining the further records of the values .The amount of UV light spectrum absorbed by these specimens were determined using uv spectrophotometer. In a glass beaker 300ml artificial saliva was taken, below this glass beaker orientation guide was kept (fig17)



Fig. 18: Custom made samples guide placed beneath the beaker

Samples so obtained were placed with the help of tweezers in this beaker of saliva along the orientation guide (fig19) for 2 min with the help of stopwatch. The samples were carefully removed from the glass beaker with the help of tweezers holding the margin. These were

further treated with distilled water and left in the enamel tray for air drying, unless all the water droplet present on the samples dry.



Fig. 19: Samples Placed in Artificial Saliva

A stainless steel vessel was taken and water is boiled in it, till it reaches its boiling temperature as show in the digital display of the induction cooker. In this boiling water 8gms each of brook bond tea (3 roses) and Nescafe (classic) respectively is placed, and timer is set in the automatic timer of the induction cooker for 2 min. The boiling liquid is stirred in between with the stirrer. At the end of two minutes as the induction cooker stops, the stainless steel vessel is removed from the induction cooker. Later the precipitate so obtained after boiling is filtrated through a sieve. This decoction so obtained is left for cooling.

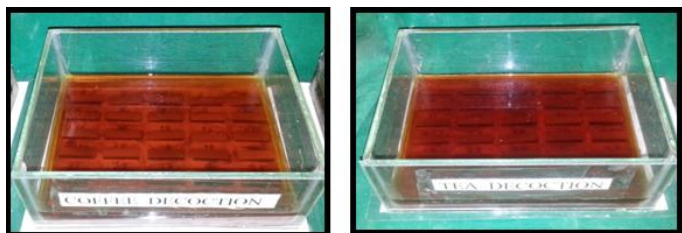


Fig. 20: Samples Placed in Coffee & Tea Decoctions

Each, conventional and high impact denture base resin is placed in two groups of 90 specimens each. Individual specimen was immersed in 300ml of two prepared decoction of tea and coffee, respectively for one hour,

after treating them with saliva. These samples were oriented in glass beaker at equal distance of 1.2 x 7mm between each sample & the orientation groove facing the beaker bottom, with the help of custom made sample guide, held just below the glass beaker (fig20). These samples will be left in these decoctions for a period of one hour. Specimens are removed from the decoction carefully. The samples are then treated with distilled water & left in the enamel tray for air drying, so as to facilitate recording values from spectrophotometer. These samples are then placed in zip lock pouches & further the amount of uv light spectrum absorbed by these specimen is determined using spectrophotometer.

Cleansing of the sample

Each of the stained samples present in two groups i.e. tea, coffee, and are further subdivided into three subgroups of 30 specimens for each kind of cleansing method, the tablet form secure tablet (Secure Denture Tablet Group Pharma Pvt Ltd), ultrasonic cleaning (Confident, with 3.5ltr capacity) & both tablet & ultrasonic denture cleansing method. In a glass beaker 300ml of distilled water is taken, in this stained samples are immersed along with the secure denture cleansing tablets, and these samples are left in the beaker for overnight cleaning i.e. 8 hours (fig 22). The sample are then removed from the beaker with the help of tweezers and treated with distilled water & air dried. In the ultrasonic cleaner 300ml of distilled water is taken an each sample is immersed in the cleaner and ultrasonic cleaning is performed for a period of 10 min using the automatic timer present in the cleaner (fig21).



Fig. 21: Samples Placed in Ultrasonic Denture Cleanser



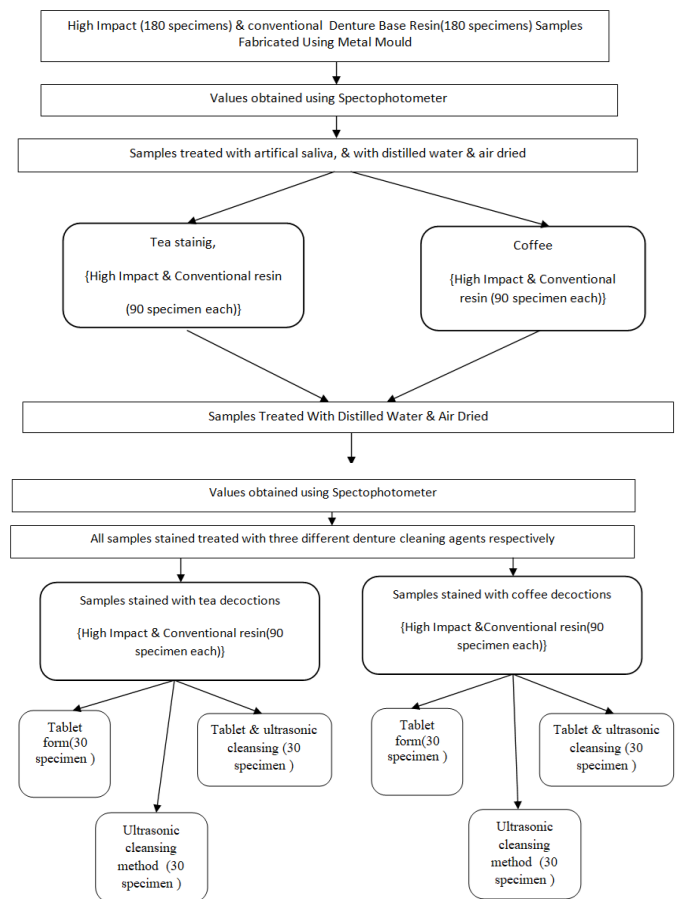
Fig. 22: Samples placed in tablet form of denture cleanser

The sample is then removed from the cleaner with the help of tweezers and treated with distilled water and air dried. In using the tablet & ultrasonic cleaning method first the samples are overnight cleaned with the tablet form then they are place in the ultrasonic cleaner respectively. All samples after cleaning are placed in zip lock pouches and further the amount of uv light spectrum absorbed by these specimen is determined using spectrophotometer

Evaluating the values from the spectrophotometer -

The values are obtained from the samples before treating them with the stains, after staining as well as after cleaning. First the amount of staining is been calculated

by subtracting the before staining and after staining values. Then the values are obtained for the amount of cleaning by subtracting the amount of cleaning from the stained amount. To know the exact amount of cleaning ability of the cleanser the percentage values of the amount of cleaning is been calculated, and further the mean and standard deviations of these are considered. Following are the schematic presentations of methodology:



Results

An in vitro study was conducted in Department of Prosthodontics, Crown Bridge & Implantology, Sri Siddhartha Dental College and Hospital, Tumkur, Karnataka and Siddaganga College of Pharmacy Tumkur, Karnataka, in the year 2011-2012 with the objective of evaluating the effective use of three different denture cleansing method's on tea, coffee and pan stain removal

from conventional and high impact polymethylmethacrylate denture base acrylic resin.

Statistical analysis

The following method of statistical analysis has been used in this study. The data collected was entered in Microsoft excel sheet and statistical analysis was performed using Microsoft SPSS (version 17) software. The results were averaged & mean derived (mean ± standard deviation) for each parameter & presented in the following tables and graph's. Tea, coffee & pan stains on each of the denture base resin was analysed (using ANOVA test) for effective cleaning by three different cleaning method i.e. tablet, ultrasonic & tablet & ultrasonic cleaning method. Comparison of each tea, coffee and pan stain of two denture base resin was done by using 'Z -Test'.

Table 1: High impact denture base resin: Tea

Denture Cleaning Agent	Mean ± SD	F statistic	p value
Tablet	71.5 ± 22.5	48.31	< 0.0001
Ultrasonic	28.5 ± 22.6		
Tablet & Ultrasonic	82.1 ± 11.7		

Table 1 represents the mean, standard deviation, 'p' value and 'f' value of the percentage of amount of cleaning shown by three different denture cleaning agents i.e. tablet, ultrasonic and tablet and ultrasonic cleaning method on high impact denture base resin stained with tea stain. Table shows that the highest percentage of cleaning, mean 82.1 ± 11.7 for high impact denture base resin is with tablet & ultrasonic form of denture cleanser for tea stain. Comparing individual cleaning methods, tablet is showing higher amount of percentage of cleaning, mean 71.5 ± 22.5, rather than ultrasonic form of denture cleanser, mean 28.5 ± 22.6. In this table ANOVA test shows highly significant difference (p <0.05)

between percentage of cleaning among tablet, Ultrasonic and Tablet and Ultrasonic form of denture cleanser.

Graph 1: High impact denture base resin: Tea

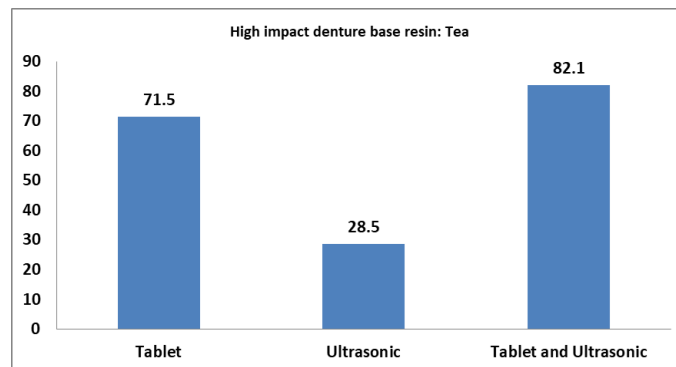
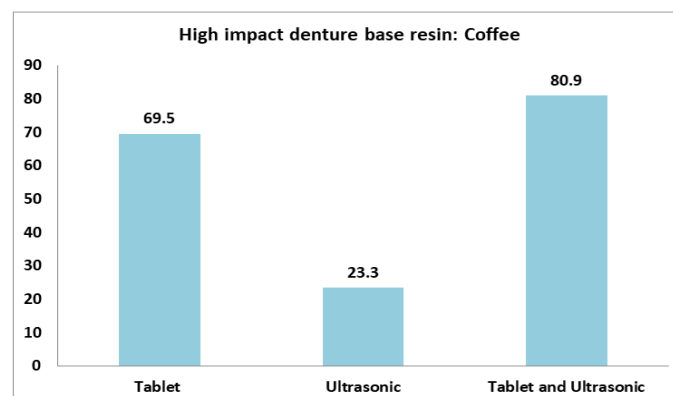


Table 2: High impact denture base resin: Coffee

Represents the mean, standard deviations, 'p' value and 'f' value of the percentage of amount of cleaning shown by three different denture cleaning agents i.e. tablet, ultrasonic and tablet and ultrasonic cleaning method on high impact denture base resin stained with coffee stain. Table shows that the highest percentage of cleaning, mean 80.9 ± 10.3 for high impact denture base resin is with tablet and ultrasonic form of denture cleanser for coffee stain.

Denture Cleaning Agent	Mean ± SD	F statistic	p value
Tablet	69.5 ± 23.7	99.86	< 0.0001
Ultrasonic	23.3 ± 23.9		
Tablet & Ultrasonic	80.9 ± 10.3		

Graph 2: High impact denture base resin: Coffee



Comparing individual cleaning methods, tablet is showing higher amount of percentage of cleaning, mean

69.5 ± 23.7, rather than ultrasonic form of denture cleanser, mean 23.3 ± 23.9. In this table ANOVA test shows highly significant difference (p <0.05) between percentage of cleaning among tablet, Ultrasonic and Tablet and Ultrasonic form of denture cleanser.

Table 3: High impact denture base resin

Represents the mean, standard deviation, 'p' value and 'f' value of the percentage of amount of cleaning done by tablet form of denture cleaning method on tea, coffee stain in high impact denture base resin. Table shows that the highest percentage of cleaning, mean 71.5 ± 22.5 is by the tablet form of denture cleaning method with tea stain.

		Decoctions		ANOVA	
Denture Cleaning Agent	Groups	Tea	Coffee	F	p value
	Tablet	71.5 ± 22.5	69.5 ± 23.7	0.441	0.644
	Ultrasonic	28.5 ± 22.6	23.3 ± 23.9	0.801	0.451
	Tablet & Ultrasonic	82.1 ± 11.7	80.9 ± 10.3	4	0.02
ANOVA	F	48.31	99.86		
	p value	< 0.0001	< 0.0001		

Comparing other stains cleaned with tablet, higher amount of percentage of cleaning, mean 69.5 ± 23.7 is shown with coffee, than pan stain, mean 66.9 ± 22.4. In this table ANOVA test shows no significant difference (p >0.05) between percentage of cleaning among tea, coffee and pan stain.

Graph 3: High impact denture base resin

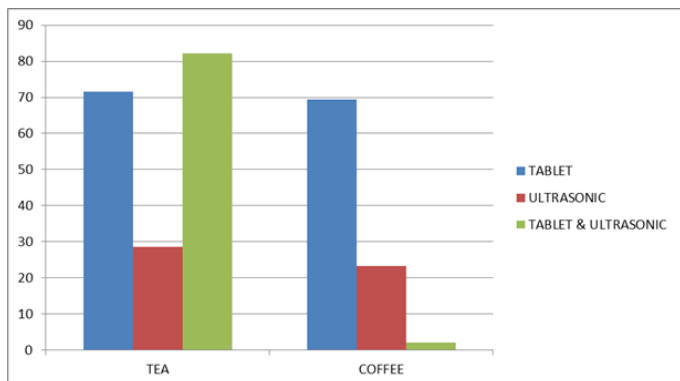


Table 4: Conventional denture base resin:

Tea Represents the mean, standard deviation. 'p' value and 'f' value of the percentage of amount of cleaning shown by three different denture cleaning agents i.e. tablet, ultrasonic and tablet and ultrasonic cleaning method on conventional denture base resin stained with tea stain. Table shows that the highest percentage of cleaning, mean 82.6 ± 9.36, for conventional denture base resin is with tablet and ultrasonic form of denture cleanser for tea stain. Comparing individual cleaning methods, tablet is showing higher amount of percentage of cleaning, mean 72.6 ± 15.83, rather than ultrasonic form of denture cleanser, mean 31.1 ± 21.53. In this table ANOVA test shows highly significant difference (p <0.05) between percentage of cleaning among tablet, Ultrasonic and Tablet and Ultrasonic form of denture cleanser.

Denture Cleaning Agent	Tea	F statistic	p value
Tablet	72.6 ± 15.83	93.48	<0.0001
Ultrasonic	31.1 ± 21.53		
Tablet & Ultrasonic	82.6 ± 9.36		

Graph 4: Conventional denture base resin-Tea

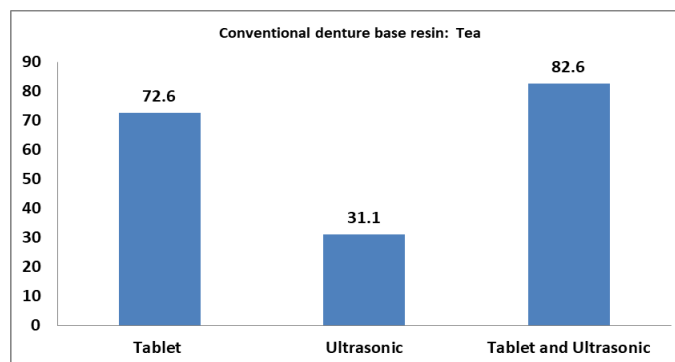


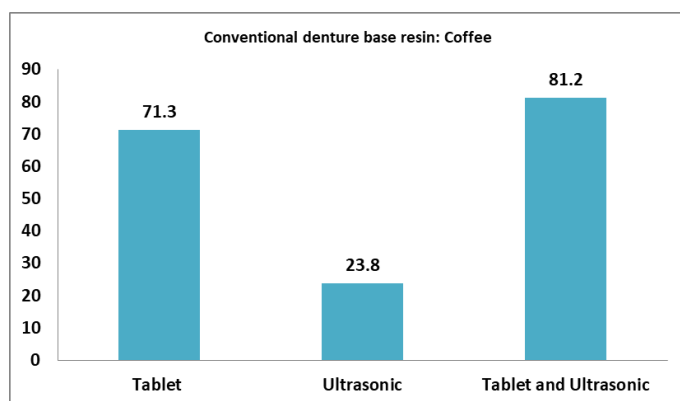
Table 5: Conventional denture base resin: Coffee

Represents the mean, standard deviation, 'p' value and 'f' value of the percentage of amount of cleaning shown by three different denture cleaning agents i.e. tablet, ultrasonic & tablet & ultrasonic cleaning method on conventional denture base resin stained with coffee stain. Table shows that the highest percentage of cleaning

,mean 81.2 ± 10.5 for conventional denture base resin treated is with tablet & ultrasonic form of denture cleanser for coffee stain . Comparing individual cleaning methods, tablet is showing higher amount of percentage of cleaning, mean 71.3 ± 19.92 , rather than ultrasonic form of denture cleanser, mean 23.8 ± 19.95 .

Denture Cleaning Agent	Coffee	F statistic	p value
Tablet	71.3 ± 19.92	83.91	<0.0001
Ultrasonic	23.8 ± 19.95		
Tablet & Ultrasonic	81.2 ± 10.5		

Graph 5: Conventional denture base resin: Coffee



In this table ANOVA test shows highly significant difference ($p < 0.05$) between percentage of cleaning among tablet, Ultrasonic and Tablet and Ultrasonic form of denture cleanser

Table 6: Conventional denture base resin

Represents all the mean, standard deviation, ‘p’ value and ‘f’ value of the amount of cleaning shown by three different denture cleaning agents i.e. tablet, ultrasonic and tablet and ultrasonic cleaning method on tea ,coffee stains on conventional denture base resin. This table summarizes all the values obtained with three different stains and three different denture cleaning agents.

Denture Cleaning Agent	Groups	Decoctions		ANOVA	
		Tea	Coffee	F	p value
Denture Cleaning Agent	Tablet	72.6 ± 15.83	71.3 ± 19.92	0.703	0.929
	Ultrasonic	31.1 ± 21.53	23.8 ± 19.95	1.64	0.199
	Tablet & Ultrasonic	82.6 ± 9.36	81.2 ± 10.5	1.702	0.188
ANOVA	F	93.48	83.91		

Graph 6: Conventional denture base resin

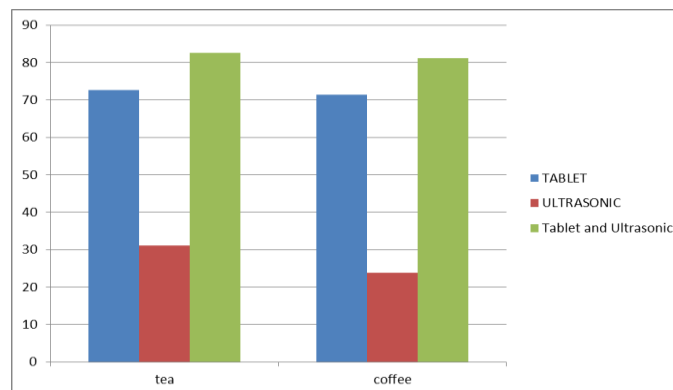
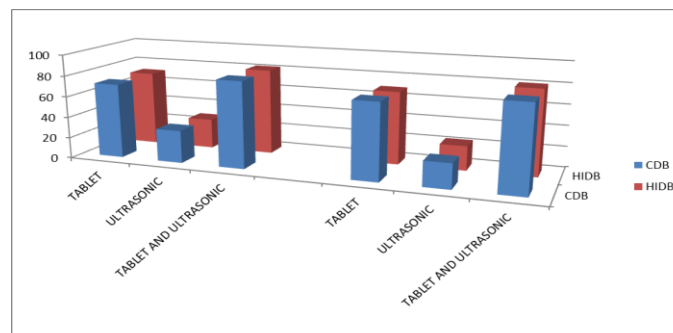


Table 7: Comparison between CDB and HIDB - Represents Comparison between all the mean, standard deviation, and ‘p’ value of the amount of cleaning shown by three different denture cleaning agents i.e. tablet, ultrasonic and tablet and ultrasonic cleaning method on tea ,coffee stains of conventional denture base resin and high impact denture base resin

		CDB	HIDB	p value
Tea	Tablet	71.3 ± 19.92	71.5 ± 22.5	0.036
	Ultrasonic	31.1 ± 21.53	28.5 ± 22.6	0.93
	Tablet & Ultrasonic	82.6 ± 9.36	82.1 ± 11.7	0.86
Cofee	Tablet	72.6 ± 15.83	69.5 ± 23.7	0.5
	Ultrasonic	23.8 ± 19.95	23.3 ± 23.9	0.059
	Tablet & Ultrasoni	81.2 ± 10.5	80.9 ± 10.3	0.55

Graph 7: Comparison between CDB and HIDB



Discussion

Almost all complete dentures are fabricated by using an acrylic resin, a low cost material that requires relatively easy manipulation and construction methods. However, it is not the ideal material in every respect. Discoloration of acrylic resin results in esthetic problems, and a denture base polymer should have good esthetics with a smooth and glassy surface and be capable of matching the natural appearance of the soft tissues. For the best esthetic effect, the material should be translucent. Color and translucency should be maintained during processing, and these resins should not get stained or change color in clinical use. Dentures are fabricated keeping in mind these increasing demands of esthetic, and these demands are most of the times efficiently fulfilled by the dentist during fabrication. But the real hindrance for esthetic comes in play as and when the patients start using the dentures. Deposition, plaque, stains and many other factors contribute and the real attempt to restore a pleasing smile goes in vain.

“Need is the mother of invention”; as this is rightly said, denture cleanser were invented as a ray of hope to permanently curtail this esthetic problems of dentures during patient usage. Many studies were done to show the usage of denture cleansers but very few could prove its ability. This is because of the vague contributors of the esthetic problems in denture wearing patients.

Materials used for prosthetic treatment are subject to sorption, a process of absorption and adsorption of liquid dependent upon environmental conditions. The materials absorb liquid slowly over a period of time. The absorption is undoubtedly due primarily to the polar properties of the resin molecules. Because of this property, these materials are known to undergo staining from the intake of fluid & food. Polymethyl methacrylate exhibit tendency to absorb water by a process of

imbibitions. Its noncrystalline structure possesses high internal energy. Thus molecular diffusion can occur in the resin, because less activation energy is required. Furthermore the polar carboxyl group, even though esterified, can form a hydrogen bridge to a limited extent with water.³⁶

It is found that Polymethylmethacrylate polymer has a hydrophilic nature due to its chemistry and polymerization linkage. Monomer commonly used as cross-linking agents and their resultant polymers are not considered extremely hydrophilic but may absorb water to a potentially damaging extent. It has been stated that there is a relationship between staining of resin-based materials and water sorption as well as hydrophobicity / hydrophilicity of these materials. Hydrophobic materials are stained by hydrophobic solutions in oil, and hydrophilic materials with high water absorption are stained by hydrophilic colorant in aqueous solutions.²

The solvent diffuse into the polymer network chains, creating an expansion; however the polymer network contains porosity between chains, especially in the region near cross-links, which permits the water sorption to occur without any polymer expansion. If the denture base acrylic resin can absorb water, then it is also able to absorb other fluids, along with dissolved stain's which results in its color change.²

It was thought that food colorant are also one of the reason for discoloration in denture base resin. So, Nur Hersek et al²⁵ conducted a study evaluating the color stability of denture against three different food colorants. They considered the commonly used dyes present in food, i.e. erythrosine, tartrazine, and sunsetyellow and 5 different brands of acrylic resin, 2 conventional, 3 high impact denture base resin

The results of this study indicated that the adhesive that exhibited noticeable color change on specimens were

Lucitone, which exhibited the greatest chromatic change in erythrosine solution, and in the descending order, Lucitone and QC-20 in tartrazine solution, and QC-20 in sunset yellow solution. As already known discoloration and loss of esthetics is multifactorial and beverages do contribute to such discoloration. Along with food colorants, beverages should also be consider to evaluate the discolorations contributed by them.

A study was conducted by Sebnem Buyukyilmaz et al¹⁹ to know the color stability of denture base polymer. This in vitro study was to evaluate quantitatively the discoloration of one light-polymerized, three heat-polymerized, and three autopolymerized denture base materials after exposure to tea, coffee, distilled water in the dark, as well as artificial sunlight and water in accelerated tests.

This study concluded that Coffee and tea stained the denture base materials superficially. Long-term exposure did not increase this staining. Brushing with toothpaste as well reduced the discoloration to an acceptable level both for short-term and long term staining with actual coffee and tea. This study effectively proved that the beverages do affect the color stability of denture cleanser, but failed to evaluate the percentage amount of cleaning done by the denture cleanser.

Considering these factors, this present study was conducted to efficiently asses the cleaning ability of denture cleansers against stains and presents the percentage amount of actual cleaning.

A similar study is conducted by Daryll Cjagger et al³ to assess the effectiveness of a range of denture cleansers on tea stain removal from acrylic resin. Perspex acrylic resin sheets were used in this study and two set of specimens were fabricated, one with smooth surface and other uniformly roughened. Seven denture cleansers were used. Stains were established on the denture base resin after

treating them with saliva. The samples were immersed in the denture cleanser solution. The two paste cleansers which were used were not brushed on the surface of the specimens, but used only in soaking mode. The study concluded that the same range of denture cleansers showed worse results on roughened acrylic resin surfaces than on smooth surfaces. All denture cleansing products tested were statistically significantly more efficient in cleaning smooth surfaces than roughened surfaces. The major shortcoming of this study is Perspex acrylic resin sheets were used in sample fabrication so as to mimic the acrylic resin; on the other hand, denture base acrylic resin is different to perspex resin. It cannot be denied that both commercial Perspex sheet and denture base resin both belong to same family of denture base resin, but Polymethyl methacrylate (PMMA) with a small quantity of cross-linking comonomers is the most widely used denture base material. So along with the chemical difference there might be structural difference also. Therefore acceptance & reference of these obtained results of perspex sheet to denture base resin is doubtful. It is referred here on the basis of the effect of, a mechanical mean of denture cleanser i.e. paste form is mentioned but it is used in a soaking mode.

The present study was visualized with a very practical approach & two of the most common and popular beverages present in India i.e. tea and coffee were used.

The discoloring agents present in the respective stains for the present study are as follows.

Sr No.	Stain	Chemical content causing discoloration
1.	Tea	Teaflavins
2.	Coffee	Caffeic acid / Tannic acid - yellow colorant

Tea leaves contain a considerable amount of flavonoids, which gives tea its functional properties and flavor; however teaflavins in tea leaves are reported to be the

cause of discoloration of resin's¹ Different studies have shown that coffee shows higher staining compared to tea in denture base resin. The stainability of the polymer by coffee is attributed to the presence of yellow colorants with different polarities¹. Tannic acid have proved to be especially responsible for the staining of this beverage. The main alkaloid, arecoline, gives a red colour to the denture base resin.

The degree of stain produced was determined with the help of a spectrophotometer. This method of analysis appears to have some advantages in, particular; a quantitative measurement of staining can be obtained. This method is far more accurate than the subjective assessment of color & shade. This study employed a method that was easily standardized.³

Denture cleaning can be performed by different methods, which are divided into two main groups – mechanical and chemical cleansers. Brushing is the mechanical mean of cleaning dentures. Ultrasonic agitation is also considered to be one of the mechanical mean of cleanser. Immersion- type of denture cleanser form the chemical denture cleanser.⁴

A comparative study was conducted by Mohssen Ghalichebaf et al⁵ to asses four commercial immersion type denture cleansers.

Prior to start of this study, samples were subjected to ultrasonic cleanser and then further to plaque accumulation and cleansing using the chemical cleanser. The study concluded that the amount of wear on dentures has been related primarily to brushing and to powder and pastes containing soluble or insoluble ingredients. It was seen ultrasonic agitation is not an efficient method by itself to remove denture plaque, both physical action and chemical dissolution are necessary for plaque removal.

Keeping in mind these inferences, the denture cleansers used in this present study was one chemical cleanser

(tablet form of denture cleanser; Secure denture tablet: Group pharma), one mechanical cleanser (ultrasonic cleanser, Confident C-80-M) and the combination of both of these.

The polymethymethacrylate samples were fabricated using the dimension specificity as dictated by spectrophotometer (UV-VIS SPECTROPHOTOMETER 3000 +). The samples were also subjected to artificial saliva (WET MOUTH) for initial pellicle layer formation; later the samples were subjected to stain and spectrophotometric interpretation.

The sample were evaluated, average and mean was derived and was subjected to ANOVA test, as shown in table 1-15. These test revealed a highly significant difference ($p < 0.05$) in between the individual cleaning methods i.e. tablet, ultrasonic and also among the combined cleanser i.e. tablet and ultrasonic for the two stains i.e. tea and coffee stains. As shown in the result tables of this study the chemical soak in type and ultrasonic agitation go hand in hand and prove a highest efficient denture cleanser compared to individual one.

While considering high impact denture base resin, in case of tea stain the ultrasonic and tablet combined cleanser has particularly shown the highest cleaning ability of 82.1% of the stained amount, however tablet individually has shown a comparatively higher amount of cleaning ability of 72.2 %, compared to ultrasonic cleanser which is 28.5%. Similarly with the same denture base resin for coffee stain as well the highest cleaning ability is shown by ultrasonic and tablet combined cleanser of 80.9 %, followed by tablet individually cleaning ability of 69.5%, & comparatively less of ultrasonic cleanser of 23.3%. Not much variations are present in the conventional denture base resins. The descending sequence of cleaning ability has been followed in conventional denture base resin also. In case of tea stain

the ultrasonic and tablet combined cleanser has particularly shown the highest cleaning ability of 82.6% of the stained amount, however tablet individually has shown a comparatively higher amount of cleaning ability of 72.6 %, compared to ultrasonic cleanser which is 31.1%. Similarly with the same denture base resin for coffee stain as well the highest cleaning ability is shown by ultrasonic and tablet combined cleanser of 81.2 %, followed by tablet individually cleaning ability of 71.3%, and comparatively less of ultrasonic cleanser of 23.8%. A comparison between the two denture base resin for cleansing methods was done and was subjected to ANOVA test. This test revealed no (p < 0.05) significant difference.

Researchers reported that denture base resin subjected to tea and coffee stain shows higher staining value with coffee than tea. It was seen that discoloration by tea can be easily removed depending on the adsorption of the colorant from tea at the surface of the materials. In contrast, with coffee, the discoloration is probably due to both surface adsorption and absorption of colorants is because of compatibility of the polymer phase with the yellow colorant of coffee. Moreover, as an aqueous solution, it might be expected that polymer had adsorbed water molecule of this beverage.¹

Similar phenomena was seen in the present study as well, tea stains were quite efficiently removed with the highest percentage of stain removing capacity as considering all the three employed method comparing coffee & pan.

The probable reason for the efficient denture cleaning shown by the tablet form is attributed to the content of the tablet that is sodium perborate monohydrate.⁴ So when it is combined with the mechanical mode as well, it shows higher percentage, as following the mathematical law of one on to one gives two as result . Thus, tablet and ultrasonic combined shows better results. The samples in

this study have been treated with this combined effect of ultrasonic cleanser and tablet form, where so both of it has consequently lead to show a better results. According to Ejvind Budtz-Jorgensen⁴, ultrasonic agitation along with the disinfectant solutions increases the disinfectant's effectiveness and does not deteriorate the polished denture surface.

An ultrasonic cleaner is simply a metal tank [stainless steel] that has pizeo ceramic transducers bonded to the bottom or side. These transducers have a unique property of changing size almost instantly when excited by an electrical signal. When excited the transducer increases in size and causes the tank bottom or side to move. This creates a compression wave in the liquid of the tank.

By using an electrical generator that puts out a high frequency signal transducer rapidly induces compression and rarefaction waves in the liquid. During the rarefaction cycle the liquid is torn apart. This creates a vacuum cavity within the liquid. These cavities will grow larger and smaller as the compression waves are continued. When the cavity reaches a certain size [based on the frequency and the wattage of the signal] the cavity can no longer retain its shape. The cavity collapses violently and a jet of plasma that impacts against whatever object is in the tank. There are millions of these bubbles created and collapsing every second in an ultrasonic tank. It is these collapses that clean the part. The jet will explode the dirt or any other material off the surface of the part. By adding soap or other chemical to the water in an ultrasonic tank, you can increase the effectiveness of the cleaning operation.

Tablet i.e. secure denture cleaning tablet contains sodium perborate monohydrate. It is classified under chemical mean of denture cleanser. Sodium perborate monohydrate are alkaline peroxides. According to Ejvind Budtz-Jorgensen⁴ these peroxides are the most commonly

used denture cleansers. They include powder or tablets which become alkaline solution of hydrogen peroxide when dissolved in water. This type of cleanser usually combines alkaline detergents, to reduce surface tension, and agents (sodium perborate or percarbonate) which release oxygen from solution. The oxygen bubbles are supposed to exert mechanical cleansing effect as stated by Elvid Budtz. It is also stated that, peroxides cleansers are effective stain removing products but are no more effective than brushing with soap. There are no serious disadvantages to the use of peroxide cleansers.

According to recent electron microscopic studies, prolonged immersion of heat -or chemically-cured acrylic resin in peroxide cleansers did not affect the surface of the acrylic resins. However, there is evidence that peroxide cleansers when used for routine denture cleansing may cause bleaching of acrylic resin.⁴

Ultrasonic cleanser mechanically cleanses the surface debris & is inefficient in cleaning the deep stains present in the polymer chain. Moreover as mentioned by Elvid budtz ultrasonic agitation is not an efficient method for the removal of denture plaque, since ultrasonic agitation per se does not cause a significant reduction of the number of microorganism that can be cultured from dentures.⁴

According to the results of this study, it shows that the tablet form (i.e. soaking with chemical) is more effective, than only mechanical form of ultrasonic cleaning. Further investigation has to be undertaken to the factor of adherence of the stains to the resins and their energy transfer. In order for the stains to break free from the polymer chains the energy transfer has to be reversed and may need enormous effort either chemically or mechanically than, effort needed by the stain to adhere to the resin. By going in this argument, the ultrasonic vibration has shown less effective due to its only factor

of vibration, the forces of which may not be enough to release the stains from the polymer chains. The reduced cleaning effort of vibration's may be limited to the molecules of stain's present in between the polymer chain's, than to be able to disengage the stain's present that are adhered to the polymer chain. Whereas, the tablet or chemical form has shown better results, may be due to the effect of the chemical to penetrate between and with in the chain by the produce of the nascent oxygen and its effervescence action to liberate the particle of stain from the polymer irrespective of coffee, tea or pan.

Ultrasonic vibration may not be effective for the detachment of stain from the polymer chain deep within the resin and travel to the surface. If so studies may be required only on the effect of ultrasonic cleanser's and time duration for the cycles to remove all the stains. Since in this study the tablet (chemical form) has shown better results, means it has a better penetration power, to act at the molecular level to engage in disengagement of the stains from the resin.

From the cleansing method employed in the present study we can observe that a slightly better result's has been seen with the use of combined method .i.e but chemical and mechanical than using individual. This reason for the combined method to be effective may be as described in the above discussion that, the chemical may release the surface, as well as the stain's between the polymer chain's and stain's adhered to the chain's, this when combined with ultrasonic vibration, it may help in transportation of the disengaged stain by the chemical method to the surface and eventually increasing the cleaning effect.

The stain causing tannic acid & the arecoline alkaloid along with tannin has got deeply rooted into the closely netted polymer chain due to the hydrophilic nature of chain. The best cleaning ability of the chemical soaking

type has also failed to enter this chain. Therefore, the results of this study too fall short of showing a 100% of cleaning ability by tablet & the combined tablet and ultrasonic. As it is stated by Skinner Philips³⁶, this polymer chain can be successfully dismantled by only alcoholic & phenolic groups. The results of this alcoholic and phenolic groups on the strength and other physical property of denture base resin is doubtful but yes, implying this stain removal can be obtained.

since the study shows a marginal difference between only chemical and chemical with ultrasonic, patient who can afford to equipment for better cleaning of their denture's can buy an ultrasonic cleanser along with chemical cleanser's. People of lower socioeconomic strata can do with only chemical method combined with better food habits.

Conclusion

When put into conclusion, we can understand that mere routine cleansing of dentures by denture brushes' and detergents can remove only surface stain's and not deeper level stain's. Therefore according to the present study & the reflection of the result's, promotion of chemical method only or chemical & mechanical method may help in better maintenance of the denture's in the long run, for not only esthetic's but even as a hygiene point of view.

Summary

An in vitro study was conducted in department of Prosthodontics, Crown Bridge & Implantology, Sri Siddhartha Dental College & Hospital, Tumkur, karnataka with the assistance of Siddganga College of Pharmacy Tumkur, Karnataka for evaluating the effective use of three different denture cleansing method's on tea & coffee stain removal from conventional and high impact polymethylmethacrylate denture base acrylic resin.

Conventional(DPI heat cure, DPI) and high impact type (TREVALON, DENTSPLY) Polymethyl methacrylate denture base resin were heat polymerized into Rectangular shaped specimens of 540 in number, with dimensions of 30 x 8 x 2 mm each, so as to fit into the specimen chamber of the spectrophotometer . They were then placed in artificial saliva for two minutes, so as to form an initial pellicle layer and facilitate the uptake of the stain and further washed with distilled water.

TEA and COFFEE decoction was prepared using 8gms each of brook bond tea (3 Roses) and Nescafe coffee (classic), placed in boiling distilled water and left for two minutes, followed by filtration through a sieve. Specimens will be immersed in 300ml of three prepared decoction of tea, coffee respectively for one hour, after treating them with saliva. Specimens will be removed from the solution & washed with distilled water and allowed to air dry. The optical densities of the specimens will be determined using spectrophotometer and a mean value is obtained.

Each, conventional and high impact denture base acrylic resin was divided into three groups. Each group consisting of 90 specimens. Each individual specimen was immersed in three prepared decoctions of tea & coffee respectively for one hour, collectively making into six groups .Each of the six groups was further subdivided into three subgroups of 30 specimens for each kind of cleansing method, totaling 18 subgroups . Each subgroup of 30 specimens subjected for a particular stain was cleaned with three cleansing methods, the tablet form (secure tablet, for overnight immersion i.e. eight hours) , ultrasonic cleaning (CONFIDENT , with 3.5 ltr capacity, for ten minutes) using distilled water as the liquid, and both tablet and ultrasonic denture cleansing method. After cleansing the specimens with three

respective methods, their optical density will be again determined and the mean values was obtained.

Tablet and ultrasonic cleaner showed a maximum cleaning ability, while tablet performance as an individual cleanser was remarkably better considering ultrasonic. The credit of tablet cleanser is because of its content of sodium perborate monohydrate, releasing nascent oxygen and leading to better cleaning effect.

Master Chart shows basic values obtained from the spectrophotometer along with the amount of staining, cleaning and percentage of stain removed from sample.

Key to Master chart

1. AS = After staining
2. AC = After cleaning
3. AS-BS = Amount of staining
4. AS-AC = Amount of cleaning
5. AC*100/ AS = Percentage of amount of cleaning
6. BS = Before staining
7. CDB = Conventional denture base resin.
8. HIDB = High impact denture base resin

High impact denture base resin stained with tea, coffee stain & cleaned with tablet form of denture cleanser

Tea Stain Cleaned With tablet Form Of Denture Cleaner						Coffee Stain Cleaned With tablet Form Of Denture Cleaner							
Sr. no	BEFORE STAINING	AFTER STAINING	AFTER CLEANING	AMT OF STAINING	AMT OF CLEANING	Sr. no	BEFORE STAINING	AFTER STAINING	AFTER CLEANING	AMT OF STAINING	AMT OF CLEANING		
	BS	AS	AC	AS-BS	AS-AC		BS	AS	AC	AS-BS	AS-AC		
1	0.071	0.076	0.074	0.005	0.002	40.0	1	0.091	0.101	0.092	0.010	0.009	90.0
2	0.069	0.075	0.072	0.006	0.003	50.0	2	0.093	0.102	0.094	0.009	0.008	88.9
3	0.071	0.078	0.073	0.007	0.005	71.4	3	0.099	0.107	0.099	0.008	0.008	100.0
4	0.061	0.070	0.065	0.009	0.005	55.6	4	0.100	0.111	0.101	0.011	0.010	90.9
5	0.050	0.061	0.054	0.011	0.007	63.6	5	0.080	0.089	0.081	0.009	0.008	88.9
6	0.049	0.056	0.053	0.007	0.003	42.9	6	0.072	0.082	0.073	0.010	0.009	90.0
7	0.050	0.060	0.054	0.010	0.006	60.0	7	0.081	0.087	0.082	0.006	0.005	83.3
8	0.051	0.062	0.055	0.011	0.007	63.6	8	0.067	0.073	0.068	0.006	0.005	83.3
9	0.071	0.077	0.075	0.006	0.002	39.3	9	0.069	0.075	0.070	0.006	0.005	83.3
10	0.072	0.074	0.066	0.004	0.004	66.7	10	0.080	0.087	0.081	0.007	0.006	85.7
11	0.069	0.076	0.073	0.007	0.003	42.9	11	0.080	0.088	0.081	0.008	0.007	87.5
12	0.071	0.079	0.072	0.008	0.007	87.5	12	0.080	0.089	0.081	0.009	0.008	88.9
13	0.073	0.081	0.076	0.008	0.005	62.5	13	0.083	0.090	0.085	0.007	0.005	71.4
14	0.071	0.084	0.072	0.013	0.012	92.3	14	0.081	0.091	0.083	0.010	0.008	80.0
15	0.076	0.081	0.077	0.005	0.004	80.0	15	0.090	0.098	0.091	0.008	0.007	87.5
16	0.077	0.087	0.078	0.010	0.009	90.0	16	0.097	0.103	0.098	0.006	0.005	83.3
17	0.075	0.081	0.076	0.006	0.005	83.3	17	0.098	0.107	0.101	0.009	0.006	66.7
18	0.071	0.082	0.072	0.011	0.010	90.9	18	0.101	0.109	0.104	0.008	0.005	62.5
19	0.079	0.085	0.080	0.006	0.005	83.3	19	0.092	0.102	0.096	0.010	0.006	60.0
20	0.080	0.088	0.081	0.008	0.007	87.5	20	0.081	0.090	0.083	0.009	0.007	77.8
21	0.081	0.090	0.082	0.009	0.008	88.9	21	0.081	0.091	0.089	0.010	0.002	20.0
22	0.087	0.093	0.088	0.006	0.005	83.3	22	0.091	0.097	0.094	0.006	0.003	50.0
23	0.089	0.096	0.090	0.007	0.006	85.7	23	0.083	0.090	0.089	0.007	0.001	14.3
24	0.091	0.098	0.092	0.007	0.006	85.7	24	0.082	0.087	0.086	0.005	0.001	20.0
25	0.089	0.099	0.090	0.010	0.009	90.0	25	0.084	0.086	0.085	0.002	0.001	50.0
26	0.092	0.100	0.097	0.008	0.003	37.5	26	0.085	0.088	0.087	0.003	0.001	33.3
27	0.094	0.101	0.096	0.007	0.005	71.4	27	0.071	0.083	0.075	0.012	0.008	66.7
28	0.096	0.104	0.098	0.008	0.006	75.0	28	0.072	0.082	0.078	0.010	0.004	40.0
29	0.089	0.097	0.089	0.008	0.008	100.0	29	0.069	0.076	0.071	0.007	0.005	71.4
30	0.085	0.090	0.085	0.005	0.005	100.0	30	0.067	0.077	0.070	0.010	0.007	70.0

High impact denture base resin stained with tea, coffee stain and cleaned with ultrasonic form of denture cleanser

Tea Stain Cleaned With ultrasonic Form Of Denture Cleaner						Coffee Stain Cleaned With ultrasonic Form Of Denture Cleaner							
Sr. no	BEFORE STAINING	AFTER STAINING	AFTER CLEANING	AMT OF STAINING	AMT OF CLEANING	Sr. no	BEFORE STAINING	AFTER STAINING	AFTER CLEANING	AMT OF STAINING	AMT OF CLEANING		
	BS	AS	AC	AS-BS	AS-AC		BS	AS	AC	AS-BS	AS-AC		
31	0.069	0.078	0.072	0.009	0.006	66.7	31	0.080	0.088	0.087	0.008	0.001	12.5
32	0.069	0.075	0.073	0.006	0.002	33.3	32	0.081	0.085	0.084	0.004	0.001	25.0
33	0.073	0.081	0.080	0.008	0.008	100.0	33	0.079	0.087	0.086	0.008	0.001	12.5
34	0.071	0.080	0.079	0.009	0.001	11.1	34	0.078	0.088	0.087	0.010	0.001	10.0
35	0.070	0.077	0.075	0.007	0.002	28.6	35	0.080	0.090	0.089	0.010	0.001	10.0
36	0.069	0.076	0.075	0.007	0.001	14.3	36	0.087	0.093	0.090	0.006	0.003	50.0
37	0.070	0.079	0.076	0.009	0.003	33.3	37	0.089	0.095	0.094	0.006	0.001	16.7
38	0.071	0.084	0.082	0.013	0.002	15.4	38	0.089	0.094	0.093	0.005	0.001	20.0
39	0.070	0.089	0.087	0.019	0.002	10.5	39	0.081	0.091	0.089	0.010	0.002	20.0
40	0.081	0.090	0.089	0.009	0.001	11.1	40	0.079	0.086	0.086	0.007	0.000	0.0
41	0.073	0.081	0.079	0.008	0.002	25.0	41	0.079	0.085	0.084	0.006	0.001	16.7
42	0.074	0.083	0.082	0.009	0.001	11.1	42	0.083	0.093	0.089	0.010	0.004	40.0
43	0.087	0.090	0.087	0.003	0.003	100.0	43	0.091	0.098	0.096	0.007	0.002	28.6
44	0.084	0.091	0.090	0.007	0.001	14.3	44	0.089	0.099	0.096	0.010	0.003	30.0
45	0.089	0.095	0.094	0.006	0.001	16.7	45	0.091	0.100	0.094	0.009	0.006	66.7
46	0.087	0.093	0.092	0.006	0.001	16.7	46	0.092	0.102	0.097	0.010	0.005	50.0
47	0.080	0.088	0.087	0.008	0.001	12.5	47	0.089	0.097	0.096	0.008	0.001	12.5
48	0.069	0.073	0.072	0.004	0.001	25.0	48	0.083	0.090	0.089	0.007	0.001	14.3
49	0.070	0.074	0.073	0.004	0.001	25.0	49	0.079	0.085	0.084	0.006	0.001	16.7
50	0.063	0.072	0.071	0.009	0.001	11.1	50	0.080	0.087	0.085	0.007	0.002	28.6
51	0.066	0.071	0.070	0.005	0.001	20.0	51	0.071	0.080	0.077	0.009	0.003	33.3
52	0.071	0.081	0.080	0.010	0.001	10.0	52	0.069	0.076	0.075	0.007	0.001	14.3
53	0.061	0.070	0.069	0.009	0.001	11.1	53	0.065	0.075	0.072	0.010	0.003	30.0
54	0.050	0.068	0.067	0.015	0.001	5.6	54	0.061	0.071	0.070	0.010	0.001	10.0
55	0.057	0.065	0.064	0.008	0.001	12.5	55	0.079	0.086	0.085	0.007	0.001	14.3
56	0.060	0.069	0.068	0.009	0.001	11.1	56	0.080	0.088	0.087	0.008	0.001	12.5
57	0.061	0.062	0.061	0.001	0.001	100.0	57	0.083	0.090	0.089	0.007	0.001	14.3
58	0.049	0.059	0.058	0.010	0.001	10.0	58	0.087	0.094	0.093	0.007	0.001	14.3
59	0.070	0.079	0.078	0.009	0.001	11.1	59	0.090	0.097	0.095	0.007	0.002	28.6
60	0.073	0.080	0.079	0.007	0.001	14.3	60	0.089	0.100	0.099	0.011	0.001	9.1

High impact denture base resin stained with tea, coffee & pan stain and cleaned with tablet & ultrasonic form of denture cleanser

Tea Stain Cleaned With ultrasonic & Tablet Form Of Denture Cleaner						Coffee Stain Cleaned With ultrasonic & Tablet Form Of Denture Cleaner							
Sr. no	BEFORE STAINING	AFTER STAINING	AFTER CLEANING	AMT OF STAINING	AMT OF CLEANING	Sr. no	BEFORE STAINING	AFTER STAINING	AFTER CLEANING	AMT OF STAINING	AMT OF CLEANING		
	BS	AS	AC	AS-BS	AS-AC		BS	AS	AC	AS-BS	AS-AC		
61	0.070	0.078	0.071	0.008	0.007	87.5	61	0.078	0.085	0.079	0.007	0.006	85.7
62	0.069	0.077	0.072	0.008	0.005	62.5	62	0.081	0.090	0.082	0.009	0.008	88.89
63	0.068	0.076	0.069	0.008	0.007	87.5	63	0.079	0.087	0.080	0.008	0.007	87.50
64	0.071	0.080	0.072	0.009	0.008	88.9	64	0.078	0.086	0.081	0.008	0.005	62.50
65	0.072	0.081	0.073	0.009	0.008	88.9	65	0.080	0.089	0.082	0.009	0.007	77.78
66	0.070	0.085	0.071	0.015	0.014	93.3	66	0.079	0.088	0.083	0.009	0.005	55.56
67	0.079	0.088	0.081	0.009	0.007	77.8	67	0.069	0.075	0.070	0.006	0.005	83.33
68	0.081	0.090	0.084	0.009	0.006	66.7	68	0.067	0.072	0.069	0.005	0.003	60.00
69	0.083	0.091	0.085	0.008	0.006	75.0	69	0.059	0.068	0.060	0.009	0.008	88.89
70	0.079	0.087	0.081	0.008	0.006	75.0	70	0.060	0.069	0.061	0.009	0.008	88.89
71	0.077	0.082											

Tea Stain Cleaned With tablet Form Of Denture Cleaner						Coffee Stain Cleaned With tablet Form Of Denture Cleaner					
Sr. no	BEFORE STAINING	AFTER STAINING	AFTER CLEANING	AMT OF STAINING	AMT OF CLEANING	Sr. no	BEFORE STAINING	AFTER STAINING	AFTER CLEANING	AMT OF STAINING	AMT OF CLEANING
	BS	AS	AC	AS-BS	AS-AC		BS	AS	AC	AS-BS	AS-AC
1	0.105	0.111	0.106	0.006	0.005	1	0.110	0.117	0.111	0.007	0.006
2	0.089	0.097	0.090	0.008	0.007	2	0.113	0.121	0.114	0.008	0.007
3	0.090	0.096	0.096	0.006	0.002	3	0.111	0.118	0.112	0.007	0.006
4	0.080	0.087	0.081	0.007	0.006	4	0.113	0.120	0.114	0.007	0.006
5	0.079	0.084	0.080	0.005	0.004	5	0.112	0.117	0.115	0.005	0.002
6	0.099	0.106	0.099	0.007	0.007	6	0.111	0.120	0.114	0.009	0.006
7	0.101	0.111	0.107	0.010	0.004	7	0.113	0.121	0.114	0.008	0.007
8	0.105	0.112	0.109	0.007	0.003	8	0.100	0.109	0.102	0.009	0.007
9	0.099	0.107	0.101	0.008	0.006	9	0.101	0.110	0.102	0.009	0.008
10	0.100	0.108	0.105	0.008	0.003	10	0.095	0.102	0.097	0.007	0.005
11	0.079	0.083	0.080	0.004	0.003	11	0.093	0.100	0.094	0.007	0.006
12	0.069	0.076	0.070	0.007	0.006	12	0.083	0.089	0.084	0.006	0.005
13	0.066	0.070	0.067	0.004	0.003	13	0.087	0.092	0.088	0.005	0.004
14	0.099	0.108	0.103	0.009	0.005	14	0.112	0.119	0.113	0.007	0.006
15	0.100	0.109	0.102	0.009	0.007	15	0.111	0.121	0.112	0.010	0.009
16	0.098	0.105	0.099	0.007	0.006	16	0.113	0.117	0.115	0.004	0.002
17	0.097	0.106	0.098	0.009	0.008	17	0.114	0.121	0.117	0.007	0.004
18	0.101	0.108	0.102	0.007	0.006	18	0.112	0.120	0.113	0.008	0.007
19	0.101	0.107	0.102	0.006	0.005	19	0.109	0.117	0.113	0.008	0.004
20	0.059	0.067	0.060	0.008	0.007	20	0.110	0.118	0.112	0.008	0.006
21	0.058	0.064	0.060	0.006	0.004	21	0.111	0.119	0.113	0.008	0.006
22	0.054	0.061	0.056	0.007	0.005	22	0.109	0.116	0.112	0.007	0.004
23	0.053	0.058	0.054	0.005	0.004	23	0.111	0.117	0.113	0.006	0.004
24	0.050	0.057	0.053	0.007	0.004	24	0.113	0.120	0.116	0.007	0.004
25	0.103	0.109	0.103	0.006	0.006	25	0.111	0.117	0.112	0.006	0.005
26	0.107	0.111	0.108	0.004	0.003	26	0.109	0.116	0.113	0.007	0.003
27	0.099	0.107	0.104	0.008	0.003	27	0.115	0.121	0.118	0.006	0.003
28	0.099	0.105	0.101	0.006	0.004	28	0.110	0.117	0.111	0.007	0.006
29	0.100	0.106	0.101	0.006	0.005	29	0.110	0.119	0.114	0.009	0.005
30	0.105	0.112	0.109	0.007	0.003	30	0.112	0.118	0.113	0.006	0.005

Tea Stain Cleaned With Tablet & ultrasonic Form Of Denture Cleaner						Coffee Stain Cleaned With Tablet & ultrasonic Form Of Denture Cleaner					
Sr. no	BEFORE STAINING	AFTER STAINING	AFTER CLEANING	AMT OF STAINING	AMT OF CLEANING	Sr. no	BEFORE STAINING	AFTER STAINING	AFTER CLEANING	AMT OF STAINING	AMT OF CLEANING
	BS	AS	AC	AS-BS	AS-AC		BS	AS	AC	AS-BS	AS-AC
61	0.108	0.116	0.110	0.008	0.006	75.0	61	0.111	0.118	0.112	0.007
62	0.100	0.109	0.101	0.009	0.008	88.9	62	0.112	0.119	0.113	0.007
63	0.102	0.107	0.102	0.006	0.005	100.0	63	0.113	0.120	0.114	0.007
64	0.101	0.108	0.102	0.007	0.006	85.7	64	0.115	0.121	0.116	0.006
65	0.105	0.112	0.107	0.007	0.005	71.4	65	0.113	0.119	0.114	0.006
66	0.099	0.106	0.101	0.007	0.005	71.4	66	0.110	0.118	0.111	0.008
67	0.100	0.107	0.101	0.007	0.006	85.7	67	0.109	0.117	0.109	0.008
68	0.104	0.108	0.105	0.007	0.006	75.0	68	0.111	0.116	0.111	0.005
69	0.101	0.109	0.103	0.008	0.006	75.0	69	0.110	0.119	0.111	0.009
70	0.102	0.110	0.103	0.008	0.007	87.5	70	0.109	0.118	0.110	0.009
71	0.104	0.111	0.107	0.007	0.004	57.1	71	0.110	0.117	0.111	0.007
72	0.107	0.112	0.108	0.005	0.004	80.0	72	0.113	0.118	0.114	0.005
73	0.103	0.106	0.104	0.003	0.002	66.7	73	0.112	0.120	0.113	0.008
74	0.099	0.108	0.100	0.009	0.008	88.9	74	0.110	0.119	0.111	0.009
75	0.100	0.109	0.101	0.009	0.008	88.9	75	0.112	0.118	0.113	0.006
76	0.106	0.112	0.107	0.006	0.005	83.3	76	0.111	0.119	0.112	0.008
77	0.107	0.118	0.111	0.011	0.007	63.6	77	0.114	0.117	0.115	0.003
78	0.102	0.112	0.103	0.010	0.009	90.0	78	0.116	0.121	0.117	0.005
79	0.099	0.106	0.100	0.007	0.006	85.7	79	0.110	0.118	0.111	0.008
80	0.100	0.107	0.101	0.007	0.006	85.7	80	0.110	0.117	0.112	0.007
81	0.101	0.108	0.102	0.007	0.006	85.7	81	0.111	0.116	0.112	0.005
82	0.100	0.109	0.101	0.009	0.008	88.9	82	0.112	0.120	0.113	0.008
83	0.107	0.112	0.109	0.005	0.003	60.0	83	0.111	0.117	0.112	0.006
84	0.109	0.119	0.110	0.010	0.009	90.0	84	0.111	0.118	0.113	0.007
85	0.100	0.109	0.101	0.009	0.008	88.9	85	0.110	0.119	0.113	0.009
86	0.100	0.106	0.101	0.006	0.005	83.3	86	0.111	0.117	0.112	0.006
87	0.099	0.105	0.101	0.006	0.004	66.7	87	0.113	0.120	0.114	0.007
88	0.098	0.107	0.099	0.009	0.008	88.9	88	0.110	0.119	0.114	0.009
89	0.099	0.109	0.100	0.010	0.009	90.0	89	0.111	0.118	0.112	0.007
90	0.100	0.108	0.101	0.008	0.007	87.5	90	0.109	0.116	0.111	0.007

Conventional Denture Base Resin Stained With Tea, Coffee Stain and Cleaned with Ultrasonic Form Of Denture Cleanser

Tea Stain Cleaned With ultrasonic Form Of Denture Cleaner						Coffee Stain Cleaned With ultrasonic Form Of Denture Cleaner					
Sr. no	BEFORE STAINING	AFTER STAINING	AFTER CLEANING	AMT OF STAINING	AMT OF CLEANING	Sr. no	BEFORE STAINING	AFTER STAINING	AFTER CLEANING	AMT OF STAINING	AMT OF CLEANING
	BS	AS	AC	AS-BS	AS-AC		BS	AS	AC	AS-BS	AS-AC
31	0.090	0.099	0.097	0.009	0.002	22.2	31	0.099	0.107	0.106	0.008
32	0.091	0.097	0.096	0.006	0.001	16.7	32	0.101	0.110	0.107	0.009
33	0.089	0.093	0.093	0.004	0.000	0.0	33	0.090	0.098	0.097	0.008
34	0.083	0.098	0.097	0.015	0.001	6.7	34	0.091	0.099	0.098	0.008
35	0.105	0.111	0.110	0.006	0.001	16.7	35	0.111	0.119	0.113	0.008
36	0.099	0.106	0.104	0.007	0.002	28.6	36	0.117	0.121	0.119	0.004
37	0.101	0.109	0.108	0.008	0.001	12.5	37	0.110	0.116	0.115	0.006
38	0.101	0.108	0.106	0.007	0.002	28.6	38	0.113	0.117	0.115	0.004
39	0.106	0.111	0.109	0.005	0.002	40.0	39	0.117	0.121	0.119	0.004
40	0.087	0.093	0.092	0.006	0.001	16.7	40	0.076	0.087	0.083	0.011
41	0.079	0.087	0.086	0.008	0.001	12.5	41	0.077	0.083	0.082	0.006
42	0.078	0.088	0.085	0.010	0.003	30.0	42	0.078	0.088	0.087	0.010
43	0.079	0.084	0.084	0.005	0.000	0.0	43	0.063	0.074	0.073	0.011
44	0.060	0.079	0.078	0.019	0.001	5.3	44	0.065	0.073	0.072	0.008
45	0.067	0.074	0.073	0.007	0.001	14.3	45	0.067	0.072	0.071	0.005
46	0.059	0.069	0.067	0.010	0.002	20.0	46	0.064	0.071	0.070	0.007
47	0.056	0.063	0.061	0.007	0.002	28.6	47	0.057	0.063	0.062	0.006
48	0.058	0.067	0.066	0.009	0.001	11.1	48	0.050	0.058	0.057	0.008
49	0.068	0.077	0.074	0.009	0.003	33.3	49	0.049	0.057	0.055	0.008
50	0.070	0.085	0.084	0.015	0.001	6.7	50	0.055	0.062	0.059	0.007
51	0.100	0.107	0.106	0.007	0.001	14.3	51	0.109	0.118	0.111	0.009
52	0.099	0.108	0.107	0.009	0.001	11.1	52	0.109	0.116	0.114	0.007
53	0.100	0.109	0.107	0.009	0.002	22.2	53	0.109	0.117	0.115	0.008
54	0.101	0.105	0.105	0.004	0.000	0.0	54	0.109	0.119	0.110	0.010
55	0.100	0.107	0.102	0.007	0.005	71.4	55	0.114	0.121	0.118	0.007
56	0.108	0.111	0.110	0.003							

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