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Original Research Article

Evaluating the effect on tensile bond strength between commonly used acrylic denture base material lined with two variety of soft liners after using three varieties of denture cleansers-an *in vitro* study

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ABSTRACT

Background: Long-term use of denture causes significant changes in its supporting structures and can lead to constant pain and discomfort. Soft lining material extensively used in field of prosthodontics to improve fit of conventional acrylic resin denture for restoring optimal health of abused oral tissue showing degenerative change.
Method: Specially designed metal mould used for fabrication of 80 acrylic resin blocks. Applying soft liner between 2 acrylic sample using metal mould and grouping these samples for immersion in solution of denture cleansers. These acrylic samples were then divided into 2 groups of 40 samples each for applying 2 variety of soft liner for each group (L1 and L2). Keeping specimen in solution of denture cleanser per day for 8 h keeping each specimen 3 times a day=equals to 3 days treatment. Thus, keeping the specimen for 30 days×3 exposure=amount to 90 days (3 months) exposure and then tensile bond strength measured using universal testing machine (Instron). ANOVA test is applied.
Results: Tensile bond strength of Viscogel soft liner with acrylic based is decreased with more Polident denture cleanser followed by Efferdent, Clinsodent and least affected by water which is statistically significant.
Conclusions: The clinician should choose denture cleanser by considering the microbiologic properties of cleansers and material aspects such as the compatibility of denture cleanser with soft liners.

Keywords: Tensile bond strength, Soft liner, Denture cleansers

INTRODUCTION

One of the major concerns in geriatric dentistry is accuracy of fit for the retention and functional performance of complete denture as a replacement of natural teeth.[1] Over the years, a variety of materials has been used for the fabrication of the denture bases. Polymethylmethacrylate (PMMA) is the most commonly used denture base resin as they have less cost, easy manipulation, easy construction method and easiness of repair as compared to other materials available for fabrication of denture.[2] Long-term use of denture causes significant changes in its supporting structures and can lead to constant pain and discomfort especially in the mandibular region of patients. Additionally, resorption of the edentulous alveolar ridge leads to the formation of a sharp and thin alveolar ridge crest bearing too much pressure that causes severe problems for the patient and necessitates the need for improvement of denture quality and comfort.[3] The soft lining material are extensively used in the field of prosthodontics to improve the fit of the conventional acrylic resin denture and also the maxillofacial prosthesis they are also used as a treatment modality, in the form of tissue conditioner for restoring the optimal health of the abused oral tissue an acting as cushion for the abused oral tissue showing degenerative change.[4] However, the loss of surface integrity and surface smoothness of tissue conditioner may begin

within 3-4 days after its application.[5] Need for soft lining material for denture has been recognized since many years and numerous materials have been used by assessing their suitability for the said purpose.[6,7] Various relining material and procedure have been used in dentistry with varied degree of success. The term reline is defined as: to resurface the tissue side ofa denture with new denture base material to make it fit more accurately.[8]

Soft liners have extensive applications in patients who cannot tolerate conventional hard bases. Soft lining materials have remarkable capabilities in healing the inflamed tissues, distributing and spreading the functional loads exerted on denture areas, improving denture fit and retention between tissue and denture base and cushioning functional forces.[9-11] Soft lining material have introduced in dentistry as a solution for certain clinical problems. These materials may provide an even distribution of functional load on the bearing area and avoid load stress concentration. They are widely used as a cushion on the intaglio surface of denture in management of traumatized oral mucosa, ridge atrophy, bony undercut, bruxism, xerostomia, edentulous arches opposing natural dentition, congenital oral defect requiring obturation and for improving retention of dentures by engaging undercut.[12]

Resilient liner material includes acrylic resin based and silicone based and are available in auto polymerized and heat-polymerized forms.[1] These resilient liners when immersed in water undergo leaching of plasticizers along with other soluble material into the water and also undergo absorption of water by polymer. The loss of plasticizer can alter the bonding surfaces or the viscoelastic properties of resilient material, which become brittle changing their bond strength properties.[13,14] Tensile bond strength is a measurement of the force required to pull something to the point where it break, and to measure the tensile bond strength universal testing machine is used in the study.

Bond failure creates potential surface for bacterial growth, plaque accumulation and calculus formation. Any favorable properties of denture liner are rendered useless in the absence of good bond to the denture base material. Acrylic denture with resilient liners when outside the oral cavity to be kept in water/cleanser which has effect over it. Therefore, assessing, tensile bond strength is of utmost significance because it determines durable bond of resilient liner to their denture base.[15]

As the time advance, the properties of the resilient liner are altered and the bond strength values vary depending on the type of solution in which it is immersed and immersion. Resilient liners having increased porosity leads to accumulation of plaque and oral microbial flora that includes bacteria, viruses and fungi like candida albicans. Denture hygiene is compromised both due to limitation of denture material and lack of manual dexterity of denture wearer indicating chemical plaque control as the method of choice for geriatric patients, done by soaking in denture cleansers to prevent denture stomatitis.[16] However, denture cleanser can cause significant deterioration because they also cause loss of soluble components and plasticizers/absorption of water/saliva by soft liner materials. This process leads to change in tensile bond strength and can influence the properties of these materials. Thus, selection of denture cleanse should be considered in order to avoid/minimize changes in properties of resilient materials.[15]

According to the variance analysis, the type of material, storage time and storage solution had statistically significant effects on the bond strength of soft lining materials and denture base material. Several studies have been carried out about the bond strength of denture base and soft lining material. But there few published articles in regard to the effect of denture cleanser on the bond strength of denture base and resilient soft-liner materials.

Therefore, this study is carried out to evaluate the tensile bond strength of heat cure denture base material lined with Viscogel and GC soft liner after immersion in Clinsodent cleanser, Efferdent cleanser, Polident cleanser and water with soap solution as a control group and to know the better combination of the liners and denture cleanser to be used.

METHOD

This is an *in vitro* study carried out in department of prosthodontics at VYWS dental college and hospital, Amravati from period August 2017-March 2018 after approval from the institutional ethical committee.

The study was carried out in 5 phases: Grouping of acrylic samples, fabrication of stainless-steel mould-1 and mould-2. fabrication of 80 acrylic resin samples using standard procedure, applying soft liner between two acrylic sample using metal mold, submitting these samples group wise for immersion in the solution of denture cleansers and procedure to be used for giving treatment to acrylic samples.

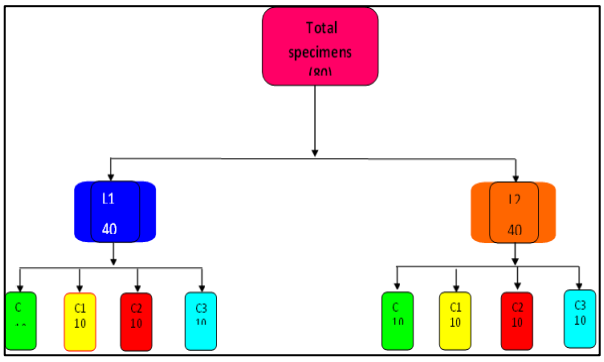

Figure 1: Grouping of acrylic samples.
D-Acrylic denture base material (DPI), L1-soft liner Visco gel, L2-GC Soft liner, C-Control group (cleanser-water and soap solution), C1-Clinsodent denture cleanser, C2- Efferdent denture cleanser, C3-Polident denture cleanser).

Fabrication of the stainless-steel mould 1 (Figure 2)

A stainless-steel mould was specially designed by Dr. Ram Thombare, prepared and used in this study for making acrylic specimens to be used in this study. Mould comprises of three metal plates A, A^1 and B^1 metal plates, A^1 and B^1 having a thickness of 2 mm and can be placed and locked in position on the stainless-steel plate (platform) A. These two stainless steel metal plates A^1 and B^1 interface with each other to provide each slot of dimensions 70 mm length, 10 mm width and 2 mm depth. Such seven slots were provided in this mould which were used for the making of the wax patterns for fabrication of acrylic samples. These metal plates were positioned on plate A to fit in orderly manner, to provide one-piece mould. The top blocks A^1 and B^1 were provided with two holes (H) each to accommodate the metal extensions E on platform A. This arrangement was to have proper orientation to position plates A^1 and B^1 over platform A.

The slots on the mould were then filled with molten modelling wax. Excess wax was carefully removed and a glass slab was used to check the complete and proper filling of the slots and to ensure even smooth surface of the wax patterns.

Making of the stainless-steel mould-2 (Figure 2)

A stainless-steel mould along with spacer was specially designed by Dr. Ram Thombare, prepared and used in this study to position the soft-liner between two acrylic sample. Mould comprises of three metal plates A, B and C metal plates. A and C are having a thickness of 5 mm and of B metal spacer is 2.5 mm. The length of this metal mould is 140 mm.

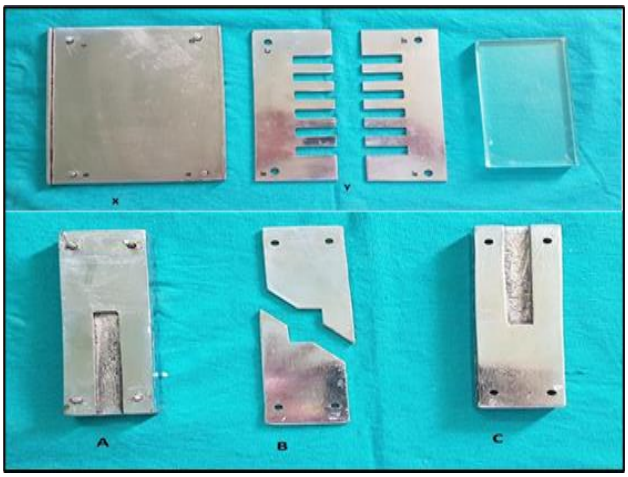

Figure 2 (A-C): Stainless steel mould-1 used for obtaining wax samples (X-Base of mouldY-metal template) and stainless-steel mould-2 used for applying soft liner. Bottom metal mould with space to accommodate acrylic space. Metal spacer with 3D space for placing soft liner (10×10×2.5). Top metal mould with space to accommodate another acrylic sample.

A-Bottom metal mould with space to accommodate acrylic sample (L=70 mm, W=10 mm and depth=2 mm), B-Metal spacer with 3D space for placing soft liners (10×10×2.5 mm) and C. Top metal mould with space to accommodate another acrylic sample (L=70 mm, W=10 mm and depth=2 mm).

Fabrication of 80 acrylic resin samples using standard procedure following manufacturer instructions with following steps

Specially designed metal mould used for prep of wax patterns for fabrication of acrylic resin samples of 70×10×2 mm. These wax patterns were then invested using plaster mix in varsity dental flask (flasking).

The wax elimination procedure was carried out to obtain mould for packing in acrylic dough for fabrication of acrylic resin samples, following standard manipulative procedures. Acrylic dough of each heat cure acrylic resin was prepared by strictly following manufacturer's instructions regarding ratio and manipulation. Slow curing cycle at 70^0C temperature for 9 hours curing was used for all samples using acrylizer having time and temperature control. The acrylic samples were carefully retrieved from the flask, inspected for completeness and porosity. Only approved samples were finished and polished using standard procedure with standard abrasive and polishing agents. By strictly observing the operating protocol all 80 samples of heat cure acrylic resin materials were fabricated. Only those acrylic resin samples were used for study having no porosity or artifacts.

These acrylic samples were then divided into two groups of 40 samples each for applying two variety of soft liner for each group (L1 and L2). The area (10×10 mm) of acrylic samples at the site of application of soft liners were made rough by using sand paper with the help of sand paper mandrel attaching to the straight hand piece which runs at the speed of 15000 rpm for 30 sec.

Applying soft liner between 2 acrylic sample using metal mould 2

Acrylic sample (1) is placed in the bottom part of metal mould (A) and acrylic sample (1') is placed in socket of top metal mould (C), metal spacer (B) is then positioned over bottom metal mould using holes rods system.

As per the manufacturer instructions, power and liquid form of soft liner is then mixed and applied between acrylic samples in 3D space within metal spacer(B).

Top metal mould is then positioned over metal spacer. The assembly of (A+B+C) is then placed under clamp pressure to allow bench cure of soft liners. After bench curing, the acrylic samples with soft liner were retrieved.

Same procedure is then repeated for application of soft liner L1 and L2 for all 80 acrylic resin samples.

Figure 3: Soft liners (acrylic based) (Viscogel-PEMA BPBG (86.2%) PMMA DBP (13.8%) EtOH (4.9%)Gc soft liner-PEMA BPBG (100%) DBP (4.3%) EtOH (14.8%) and denture cleanser used in the study (Efferdent denture cleanser-Potassium monopersulphate, sodium perborate monohydrate, lathonol, citric acid, sodium bicarbonate, EDTA, sodium sulfate, sodium carbonate, magnesium stearate, mint flavoring coloring. Polident denture cleanser-sodium perborate, potassium monopersulphate, proteolytic enzyme, detergent, effervescent base. Clinsodent denture cleanser-potassium persulphate, sodium perborate).

Table 1: Preparation of cleanser solution and exposing the acrylic samples groupwise to these cleansers.

Group	Solution
C	Plain water with soap solution
C1	Clinsodent tablet form
C2	Efferdent tablet form
C3	Polident Tablet form

Period of exposure of samples in cleanser solution

Considering 8 hours period of rest for the prosthesis (during night), keeping the specimen in solution of denture cleanser per day for 8 hrs. Keeping each specimen 3 times a day=Equals to 3 days treatment. Thus, keeping the specimen for 30 days×3 exposure=amount to 90 days (3 months) exposure.

Exposing acrylic samples in packed drinking water (Figure 4)

The bottle of plain water with soap solution is considered as a control group which is poured into 2 beakers of 500 ml each at room temperature.

Acrylic samples (10 nos) with soft-liner L1 i.e., Viscogel is paced in one of the beakers and acrylic samples (10 nos) with soft-liner L2 i.e., GC soft-liners paced in another beaker as per the period of exposure explained above i.e., total time of 720 Hrs. Water in the beaker was changed for every 8 hours of exposure.

Exposing acrylic samples denture cleanser (Clinsodent C1) (Figure 4)

The bottle of plain water is poured into 2 beakers of 500ml each at room temperature. Two tablets of Clinsodent (C1) denture cleanser are then mixed in both beakers containing water for group L1 and L2. Acrylic samples (10 nos) with soft-liner L1 i.e., Viscogel is paced in one of the beakers and acrylic samples (10 nos) with soft-liner L2 i.e., GC soft-liner is paced in another beaker as per the period of exposure 30 days equivalent of 90 days of exposure with 8 hours per day, i.e., total time of 720 hrs. Water in the beaker waschanged for every 8 hours of exposure.

Exposing acrylic samples denture cleanser (Efferdent C2): (Figure 4)

The bottle of plain water is poured into 2 beakers of 500ml each at room temperature. Two tablet of Efferdent (C2) denture cleanser is then mixed in both beakers containing water for group L1 and L2.

Acrylic samples (10 nos) with soft-liner L1 i.e., Viscogel is placed in one of the beaker and acrylic samples (10 nos) with soft-liner L2 i.e., GC soft-liners placed in another beaker as per the period of exposure 30 days equivalent of 90 days of exposure with 8 hours per day, i.e., total time of 720 Hrs. Water in the beaker was changed for every 8 hours of exposure.

Figure 4: Acrylic sample with soft liner (L1) exposed to denture cleanser C, C1, C2 and C3 and with soft liner (L2) exposed to denture cleanser C, C1, C2 and C3 respectively.

Exposing acrylic samples denture cleanser (Polident C3): (Figure 4)

The bottle of plain water is poured into 2 beakers 500 ml each at room temperature. Two tablets of Polident (C3) denture cleanser is then mixed in both beakers containing water for group L1 and L2.

Acrylic samples (10 nos) with soft-liner L1 i.e., Viscogel is paced in one of the beaker and acrylic samples (10 nos) with soft-liner L2 i.e., GC soft-liners paced in another beaker as per the period of exposure 30 days equivalent of 90 days of exposure with 8 hours per day, i.e., total time of 720 hrs. Water in the beaker was changed for every 8 hours of exposure.

Procedure to be used for giving treatment to samples following steps willbe as follow

Considering 8 hours period of rest for the prosthesis (during night), keeping the specimen in solution of denture cleanser per day for 8 hours.

Keeping each specimen 3 times a day equals to 3 days treatment. Thus, keeping the specimen for 30 days×3 exposure=amount to 90 days (3 months) exposure

All specimens were kept in beaker during period of study containing drinking water with soap solutions for 8 hours. Solution was changed 8 hourly for every exposure.

These samples were removed after 8 hours washed carefully under running tapwater. Same sample was then immersed again for next period of 8 hours in beaker containing fresh solutions of denture cleanse

The process was repeated for 90 exposures of each specimens in selected denture cleansers for L1 and L2 application (Figure 4).

After 90 exposures, the specimens were evaluated for the effect of the denture cleansers (C1, C2, C3) and C as a control group on tensile bond strength between acrylic denture base material and soft liners used in the study.

Value so received were tabulated and submitted for statistical analysis to decide the level of significance.

Failure strength was recorded in Newton. Modes of failure were visually determined for every specimen after testing and categorized into one of the following types: Adhesive failure: refers to total separation at the interface between the resilient liner material and acrylic resin, cohesive failure: refers to tears within the resilient liner material, and mixed failure: refers to both.[17]

Evaluation of tensile bond strength after immersion for 90 days period used as base line for this study using universal testing machine (Instron) (Figure 5). Values so received were tabulated for all groups with application of soft liners L1 and L2 immersed in solution of C1, C2, C3 and control group respectively.

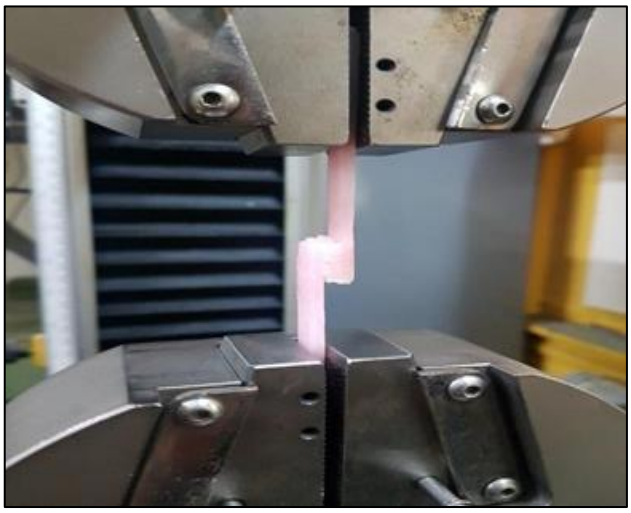

Figure 5: Sample are being tested for tensile bond strength.

Statistical analysis

Present study was conducted to evaluate the effect on tensile bond strength between commonly used acrylic denture base material lined with two variety of soft liners, after using three varieties of denture cleanser. Two variety of soft liners used in the study are Viscogel (Group A) and GC (Group B) soft liner. Analysis of the data was done by using descriptive and inferential statistics both.

The software used in the analysis were SPSS 22.0 and Graph Pad Prism 7.0 version and $p<0.05$ is considered as level of significance.

RESULTS

A total of 80 acrylic samples, 40 samples for each group were fabricated. Sub- grouping was done for each group and 10 samples were used for each sub group.

The acrylic samples fabricated in denture base material and lined with soft liners were subjected for evaluation of the tensile bond strength changes after exposure to 3 varieties of denture cleanser and water with soup solution. The readings were tabulated for all samples per group and subgroups. Mean values were calculated.

Comparative evaluation of the effect of these cleansers on acrylic resin samples with soft liners was done after exposure for evaluating tensile bond strength.

Statistically significant changes were observed in the tensile bond strength of material of group A after exposure to cleanser C, C1, C2, and C3 as compared to material of group B after exposure to cleanser C, C1, C2,

and C3 ($p<0.05$). The mean tensile strength values signify highest changes after exposure to cleanser C followed by cleanser C1, C2 and C3 in group A as below.

Mean tensile bond strength for L1C was 1.94±0.42, for L1C1 it was 1.6+0.34, for L1C2 it was 1.56±0.21 and for L1C3 it was 1.26±0.10 (Figure 6 and 7). By using one way ANOVA statistically significant variation was found in mean tensile bond strength among four types of denture cleansers (F=8.82, p=0.0001).

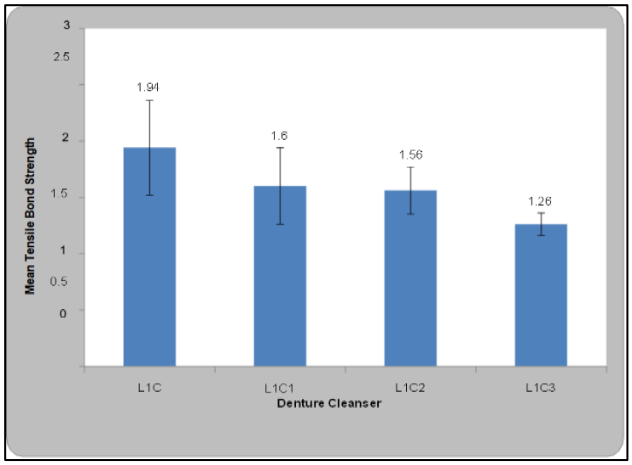

Figure 6: Comparison of tensile bond strength between denture based material and soft liner L1 after using three varieties of denture cleanser (Control group C).

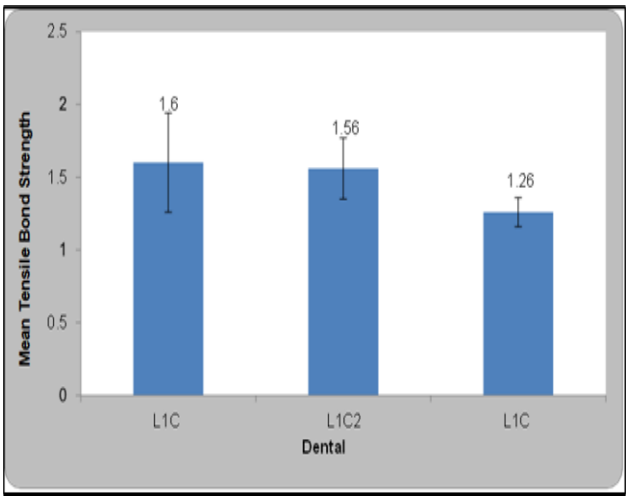

Figure 7: Comparison of tensile bond strength between denture based material and soft liner L1 after using three varieties of denture cleanser.

The mean tensile strength values signify insignificant changes after exposure to cleanser C followed by cleanser C1, C2 and C3 in group B as below.

Mean tensile bond strength for L2C was 1.60±0.28, for L2C1 it was 1.54±0.32, for L2C2 it was 1.46±0.23 and for L2C3 it was 1.41±0.19 (Figure 8 and 9).

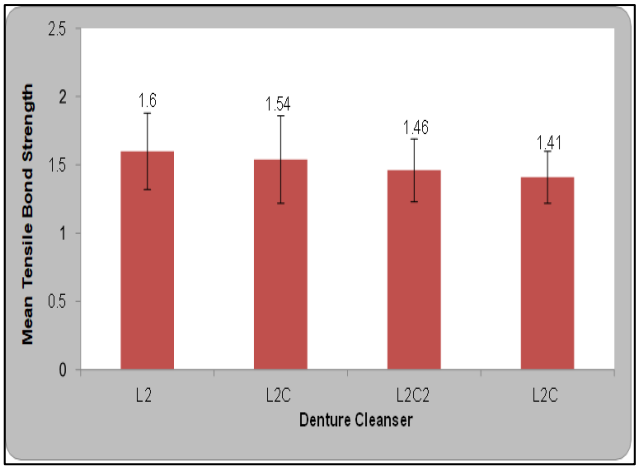

Figure 8: Comparison of tensile bond strength between denture based material and soft liner L2 after using three varieties of denture cleanser (Control group).

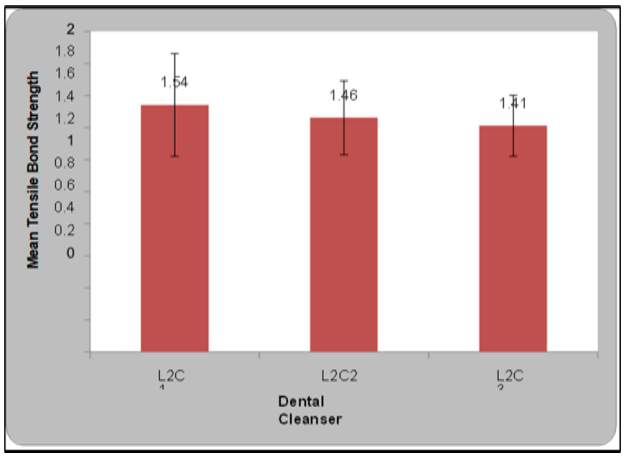

Figure 9: Comparison of tensile bond strength between denture based material and soft liner L2 after using three varieties of denture cleanser.

By using one way ANOVA statistically no significant variation was found in mean tensile bond strength among four types of denture cleansers (F=1.04, p=0.386).

The results of student's unpaired t test for the both groups are as below:

Mean tensile bond strength for denture-based material C for L1 was 1.94±0.42 and for group L2 it was 1.60±0.28. By using Students' unpaired t test statistically no significant difference was found between group L1 and group L2 for denture-based material C (t=2.08, p=0.052).

Mean tensile bond strength for denture-based material C1 for L1 was 1.60±0.34 and for group L2 it was 1.54±0.32. By using Students' unpaired t test statistically no significant difference was found between group L1 and group L2 for denture-based material C1 (t=0.39, p=0.69).

Mean tensile bond strength for denture-based material C2 for L1 was 1.56±0.21 and for group L2 it was 1.46±0.23. By using Students' unpaired t test statistically no significant difference was found between group L1 and group L2 for denture-based material C2 (t=0.99, p=0.33).

Mean tensile bond strength for denture-based material C3 for L1 was1.26±0.10 and for group L2 it was 1.41±0.19. By using Students' unpaired t test statistically significant difference was found between group L1 and group L2 for denture-based material C3 (t=2.24, p=0.038) (Figure 10).

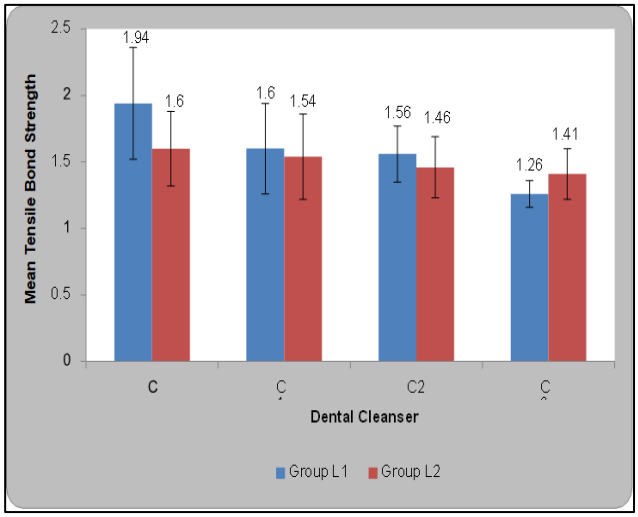

Figure 10: Evaluating tensile bond strength between denture-based material and two varieties of soft liner after using three varieties of denture cleanser.

DISCUSSION

Resilient denture lining materials are widely used in prosthetic dentistry, edentulism leading to loss of oral function for many centuries has been regarded as variable but inevitable consequence of ageing.[18] Over the past decades this has been minimized by the considerable advances in preventive dentistry and oral health care. Prosthodontic techniques have been developed to replace the lost teeth and oral tissues. One of the major concerns in geriatric dentistry is the functional performance of complete denture as a replacement for natural teeth.[19]

The introduction of the methyl methacrylate in dentistry in 1937 by Wright was clinically evaluated and observed that it fulfills virtually most of the requirements of an ideal denture base material viz, biocompatibility, acceptable aesthetics, good bond strength with artificial acrylic teeth, radio opacity, ease of repair, low cost, simple processing technique, optical properties and adequate strength.[4,20] Poly methyl- methacrylate is therefore the most popular material used for fabricating denture bases. Most of the removable dentures are fabricated from this material.[21] Recently, butadiene-styrene rubber was introduced to improve flexural, tensile and impact strength, reduced water sorption, and for effective and efficient manufacturing. Yet the mainstay for the management of complete or partially edentulous state till date remain to be an acrylic denture.[22]

The treatment of these individuals with artificial dentures not only rehabilitate them functionally, but also esthetically and psychologically. The literature has revealed numerous reports on patients expressing dissatisfaction with long term use of complete denture due to resorption of underlying alveolar bone. The use of ill- fitting denture for prolong period may result in hazardous and irreversible damage to residual bone (i.e., severe resorption), ultimately again leading to slow continuous but progressive irreversible resorption.[23] Therefore, the use of resilient liner may be advantageous for patients who are capable of delivering a relatively heavy occlusal forces to unfavorable denture bearing tissues thus restoring health of the inflamed mucosa and retention of the prosthesis.[8]

Denture lining materials have been used in dentistry for more than a century and the earliest soft liners were made from natural rubber. Soft denture liners are applied to the intaglio surface of dentures to achieve a more even force distribution to reduce localized pressures and to have a cushioning effect between the denture and underlying denture bearing tissues.[6] Currently, newer generation of materials and method is tried to overcome inherent properties of the soft liner by incorporating silver nanoparticles, antifungal agents and sealer coating.[24]

Resilient liners can be divided into two main types: plasticized acrylic resins and silicone elastomers. The soft liner used in this study were 1. Viscogel soft liner and 2. GC soft liner, both soft liners contain polymethyl methacrylate, poly methacrylate, butyl phthalybutyl glycolate, dibutyl phthalate, ethyl alcohol. However, their percentage in both soft-liner is different.[22]

Limitation of the resilient liner are loss of resiliency, color alteration and porosity due to leaching out of plasticizer and other component when immersion in solution such as denture cleanser. The loss of plasticizers can alter the bonding surfaces or the viscoelastic properties of the resilient liner due to which denture base material can be colonized and deeply infected by microorganism.

Gradual changes in oral tissues require complete or partial dentures to be relined to improve their adaptation to the supporting tissue. Although maintenance of appropriate denture hygiene is important, many denture wearers fail to maintain a satisfactory level of hygiene.[10]

Therefore, a wide range of chemical denture cleansers are available to facilitate denture hygiene. These solutions not only control plaque on dentures but may also cause significant deterioration of resilient liners as well.[15] Thus, proper selection of denture cleanser should be considered

to avoid or minimize changes in the properties of resilient material.[5] We used three commonly used denture cleanser which are easily available in India viz: 1. Clinsodent denture cleanser 2. Efferdent cleanser, 3. Polident denture cleanser and water with soap solution is taken as control group. Efferdent denture cleanser contains Potassium monopersulfate, sodium perborate monohydrate, lathonol, citric acid, sodium bicarbonate, EDTA, sodium sulphate, sodium carbonate, magnesium stearate, mint flavouring coloring.

Polident denture cleanser contains sodium perborate, potassium monopersulphate, proteolytic enzyme, detergent, effervescent base. Clinsodent denture cleanser contain potassium per sulphate, sodium perborate.[9] This study evaluated the bond strength between two different type of resilient liner and acrylic resin after using three different type of denture cleanser.

Total 160 acrylic samples were obtained by following standard technique of manipulation, processing, finishing and polishing using commonly used acrylic resin materials.

These samples (80 each) were grouped as group L1, group L2 as we have placed soft-liner between two acrylic sample to form a sample such as 40 samples for each group L1 and L2. These 40 samples of each group were divided into 4 sub group of 10 samples each for group L1 and L2.

A specially designed custom-made stainless-steel mould 2 is used for applying soft liner between two acrylic samples. Softness is a desirable property of resilient liners; their optimum thickness has been reported to be approximately 2.5 mm to 3 mm to provide good shock absorption.

Acrylic samples were placed in bottom part of metal mould A, with 4 rods provided on each corner as an extension, which have provided proper orientation of metal spacer B and top metal mould C. Metal spacing having thickness 2.5 mm was then placed over the bottom metal mould A. Metal spacer which was already cut diagonally to accommodate soft-liner placed between to acrylic samples. The mix of soft liner was then placed in the 3D space within metal spacer B. Top metal mould C with acrylic sample was then positioned over metal spacer B.

This assembly of A+ B + C were then hold under clamp pressure and soft liner was allowed to bench cure. Acrylic samples with soft-liner in the middle was then retrieved from the assembly of A+ B + C.

For evaluating the effect of denture cleanser on tensile bond strength between acrylic denture base material and soft liner, these acrylic resin samples group wise i.e., L1 and L2, was immersed in the solution of denture cleanser as C-Control group: Packaged drinking water with soup solution, C1-Clinsodent denture cleanser, C2: Efferdent denture cleanser and C3: Polident denture cleanser.

Considering the 8 hours period of rest for prosthesis (preferably during night), these acrylic specimens were placed in denture cleanser per day for 8 hrs. Accordingly, these specimens were placed 3 times a day, 8 hours each is equals to 3 days of treatment. This was done for continuous 30 days with 3 times a day, 8 hours each were equal to 90 days exposure i.e., 3 months. Thus, total exposure time given were 720 hrs.

After exposure to these solution as above, all sample were taken for evaluation in regards to tensile bond strength using universal testing machine (Instron) using a cross head speed of 2 cm/min. All readings were tabulated as per group and sub group were evaluated for statistical significance.

A comparative analysis was carried out to determine the effect of 3 varieties of denture cleansers (i.e., Clinsodent, Efferdent and Polident and water with soup solution as control group) on tensile bond strength between commonly used acrylic denture-based material (DPI) and two varieties of soft liners (i.e., Viscogel and GC soft-liner)

After the results evaluation it was observed that Viscogel temporary soft liner showed better bond strength as compared to GC temporary soft liner with acrylic denture-based material.

In group L1, Viscogel soft liner with acrylic based after immersing into packed water with soup solution had highest tensile bond strength followed by Clinsodent denture cleanser, Efferent denture cleanser and Polident denture cleanser ($p=0.0001$).

In group L2, GC soft liner with acrylic based after immersing into water with soup solution had highest tensile bond strength followed by Clinsodent denture cleanser, Efferent denture cleanser and Polident denture cleanser. However, the changes in tensile bond strength showed the insignificant changes, $p=0.386$

All specimens of the groups dominated in adhesive failures, 90% of group A specimens, 70% of group B specimens presented adhesive failures test represent mix and cohesive failure. Moreover, it can be seen that elongation of the resilient liner was the highest degree in groups A, followed by group B. This study is in agreement with the study carried out by Akin et al the study revealed that all the specimens revealed adhesive failure and further stated that specimens with the highest bond strength demonstrate adhesive failure.[17]

Acrylic liner group showed higher surface hardness when treated with cleanser Polident, cleanser Efferdent and cleanser water. These differences were statistically significant at all time intervals. Acrylic liner group

showed higher surface roughness when treated with cleanser Polident, cleanser Efferdent and cleanser water. These differences were statistically significant at all time intervals. High sorption and solubility of soft denture liners were associated with distortion, hardening and debonding of liners from denture bases. Therefore, sorption and solubility properties were important indicators to a liner's longevity. The results in respect of the tensile bond strength between acrylic resin and two variety of soft liner, (Viscogel, GC soft-liner) was in agreement with the studies of Chauhan et al stated that this bond were characterized by the interrelationships between the properties, chemical characteristics and compatibility of the liners and denture base materials.[22]

Noticeable increase tensile bond strength of acrylic resin and Viscogel soft liner were observed after exposure to the water followed by the Clinsodent denture cleanser, which was in agreement with the studies of Dayanand who stated that the soft-liner specimens immersed in water have shown increase in tensile bond strength than those immersed in Clinsodent.[25]

Insignificant effect of cleansing agents on the tensile bond strength of GC soft liners to denture base which were in agreement with the findings of Geramipanah who stated that the effect of denture cleansing agents on the bond strength of soft liners to denture base and revealed that immersion of different soft lining materials in 2.5% NaOCL and Corega solutions had no significant effect on the tensile bond strength of denture base to soft liners.[3]

Therefore, the present study was in agreement with the study conducted by Narwal which suggested that daily usage of denture cleansers can influence the physical properties of acrylic denture bases and soft liners.[24] It was observed that immersion in denture cleansers leads to an increase in hardness values of two resilient liners. The increase in hardness could be attributed to the loss of plasticizers and liquid percolation or absorption by the liners on long term storage in denture cleanser solutions. This increase in hardness can leads to the loss of elasticity and cushioning effect of liners and thus deteriorates its properties showed that immersion in denture cleansers increases the hardness and decrease the tensile bond strength of auto polymerizing acrylic-based lining materials bonded to denture base resin.

Within scope and limitations of this study, tensile bond strength of Viscogel soft liner with acrylic based was decreased with more Polident denture cleanser followed by Efferdent, Clinsodent and least affected by water which was statistically significant. Tensile bond strength of GC soft liner with acrylic denture base was decreased with more Polident followed by Efferdent and then Clinsodent leastby water, which statistically insignificant.

From the study carried out, it was revealed that**,** considering the cleansers except water, Clinsodent and Efferdent cleanser showed the better combination with Viscogel and GC soft-liner with denture-based material than that of Polident cleanser with Viscogel and GC soft-liner with denture-based material.

The mode of bond strength evaluation in the present study was under tensile stress only. Hence, further studies should be carried out to determine the bond strength after immersion in various denture cleansers under different types of stresses. Because it is not possible to completely simulate clinical conditions and reproduce the oral environment in the laboratory, so clinical investigations are also required to be carried out before reaching the final conclusion.

Limitations

Tensile bond strength of Viscogel with denture base was more than the bond strength of GC soft liner with denture base material after exposure to denture cleansers. Tensile bond strength of Viscogel with denture base significantly decreased with Polident cleanser followed by Efferdent cleanser, Clinsodent cleanser and least affected with water. GC soft liner with acrylic based after immersing into packed drinking water with soup solution had highest tensile bond strength followed by Clinsodent denture cleanser, Efferent denture cleanser and Polident denture cleanser. However, the changes in tensile bond strength showed the statistically insignificant change. It was observed that more adhesive failure exhibited by group A Viscogel soft liner in contrast to cohesive and mix failure for group B GC soft liner. Further, specimens with the highest bond strength demonstrated adhesive failure. Based upon the result of the study, it can be summarized that, the clinician should choose denture cleanser by considering not only the microbiologic properties of cleansers, but also material aspects such as the compatibility of denture cleanser with soft liners.

CONCLUSION

The acrylic base soft liner is available with different compositions. Among them most commonly used materials were evaluated in this study. The commonly used denture cleanser was used as a solution of immersion for these acrylic samples with soft liner to evaluate effect of cleanser on tensile bond strength between soft liner and denture base material. After critical analysis it was observed that the tensile bond strength of group A was more affected with different type of cleanser used in the study as compared with tensile bond strength of group B cleansers. Standardized manipulation and procedure were obtained by fabricating two types of stainless-steel mould of desired dimension. The specimens were tested for bond strength using universal testing machine (Instron). Acrylic samples of two groups were exposed to test solutions for specified time (30 days/ 720 hours), the tensile bond strength was evaluated and results obtained were tabulated and compared in respect with these varieties of materials and four test solutions.

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