

Effect of Different Retentive Modes on Tooth Denture Base Bond: An In Vitro Study

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ABSTRACT

Background: Debonding remains a major problem in prosthodontic practice. The objective of this study was to evaluate effect of different retentive modes on tooth denture base bond. The test specimens, maxillary left central incisors (21) were divided into 4 groups with Group I as control. The teeth were arranged with the angulation of 130 degree on wax blocks. These test specimens were prepared by Lucitone 199 heat cure resin. A shear load was applied at Cingulum of central incisor (21) using Universal Testing Machine until debonding occurred. Bond strength was evaluated and statistically analyzed. The control group specimens without any modification prepared by Lucitone 199 heat cure resin showed lowest bond strength value whereas the specimens modified by preparing Y shaped groove on cingulum of maxillary left central incisors (21) and also modified by applying MMA monomer 5 minutes prior being packed with Lucitone 199 heat cure denture base resin showed highest bond strength value, therefore this modification can be recommended as a one of the method to secure denture teeth in denture bases.

Keywords: Denture teeth, Bond strength, Monomer application, Y shaped groove.

INTRODUCTION

Acrylic resin polymer teeth have the ability to bond to denture base polymers. The heat curing is the best procedure to obtain good bond between polymer teeth and denture base polymer.¹ Bonding of heat curing resin to acrylic resin teeth increases tooth retention and strengthens denture bases because the plastic teeth become an integral part of the denture bases. In most instances the bond seems satisfactory although failures can be found in practice. The most common type of failure in a denture is adhesive bond failure between the acrylic resin polymer tooth and the denture bases.^{2,3} Most attempts to improve the bond strength of denture teeth to an acrylic resin denture base have involved chemical or mechanical modification of the ridge lap

portion of the denture tooth. Conflicting results with the use of monomer, the removal of denture tooth glaze and placement of a diatoric have been reported.⁴ Hence an attempt has been made to evaluate effect of different retentive modes on tooth denture base bond

AIMS AND OBJECTIVE

1. To evaluate bonding of denture teeth to acrylic bases.
2. Comparatively evaluate effect of different retentive modes on tooth denture base bond.

Material and Methods followed:

Received: Dec. 27, 2016; Accepted: Mar. 3, 2017

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A. Standardization of specimen :A total number of 80 cross linked maxillary left central incisors [21] (acryrock), of same mould with regard to size and shape were selected to be bonded to Lucitone 199 heat cure denture base resin

The test specimens (central incisors [21]) were divided into 4 groups.

Group I (control): Denture teeth without any modifications. These teeth were used as supplied by the manufacturer.

Group II: Y shaped groove 1.5 mm deep and 2 mm wide was prepared on cingulum of maxillary left central incisors [21] and packed with LUCITONE 199 HEAT CURE RESIN

Group III: Teeth were modified by applying MMA monomer 5 minutes prior being packed with Lucitone 199 heat cure denture base resin

Group IV: Y shaped groove 1.5 mm deep and 2 mm wide was prepared on cingulum of maxillary left central incisors [21] and also modified by applying MMA monomer 5 minutes prior being packed with Lucitone 199 heat cure denture base resin

Triangular Die [stainless steel] 3x3x3 cm was used for making rubber mould. Wax models were prepared by flowing molten wax (Golden Dental Products, Hyderabad) into rubber mould

B. Standardization of Force Application

The notch (2mm diameter) was made on Cingulum of each tooth 3mm apical to the center of incisal tip to prevent slipping of testing apparatus.⁵

C. Teeth Arrangement on Wax Block

The central incisors were arranged with the angulation of 130 degree on each side of triangular wax block. This angle was chosen to stimulate the average angle of contact found between maxillary and mandibular teeth when dentures are in function. The studies by **Barpal D, Curtis DA, Finzen F, Perry J, Gansky SA et al⁴ and Cardash HS, Applebaum B, Baharav H, Liberman R et al⁵** used similar angular forces for evaluating bond strength of denture teeth to acrylic bases. Finally 80 identical wax models were obtained. These wax

models were prepared by Lucitone 199 heat cure denture base resin. These specimens were divided into 4 groups with 20 teeth in each group. Each group was tested for bond strength with lucitone 199 heat cure denture base resin. Thus each group consists of 20 test specimens and total of 80 specimens from 4 study groups.

D. Preparation of the moulds

The prepared wax models were invested in the flask (KAVO) using dental stone, (Asian Chemicals, Rajkot) following the manufacturer's instructions for water – powder ratio, mixing time and setting time. A mechanical vibrator (Confident) was used to prevent air trapping during investing

E. Dewaxing

Dewaxing was done by immersing flasks in boiling water for 5 minutes. After dewaxing, two halves of the flasks were separated and the molten wax was flushed out with clean hot water.

F. Application of separating medium

A separating medium (sodium alginate solution) was applied to all surfaces of the mould except the saddle portion of teeth, with the help of a brush and dried. The ridge lap of the denture teeth of Group III and Group IV were coated with monomer solution 5 minutes prior to being packed with lucitone 199 heat cure resin.

G. Packing and Trial Closure

Polymer and monomer of ratio 3:1 by volume was mixed and packed in the mould at dough consistency. Flasks were then closed with the cellophane sheet in between them. Trial closure was carried out using a hydraulic press (Kavo) using 20 KN of pressure. Excess material was trimmed using a BP blade. Finally the flasks were clamped and final closure was done under a pressure of 20 KN and kept for 30 mins.⁶ The applied pressure that the dough flows into every part of the mould

H. Bench Curing

After final closure, the flasks were kept at room temperature for one hour.

Purpose of bench curing:

1. Permits an equalization of pressure throughout the mould.
2. It allows time for a more uniform dispersion of monomer throughout the mass of dough

I. Curing of specimens

Then the flasks were immersed in water in an Acrylizer at room temperature and processing was done according to manufacturer's recommendation.

J. Bench cooling

After all the specimens were cured, the flasks were bench cooled to room temperature and deflasked. All specimens were stored in water for 48 hours to ensure complete polymerization. A total of 80 test specimens were prepared using this procedure.

K. Testing Of Specimen

Each specimen was placed in a metallic fixture and kept in a Universal Instron Testing Machine to avoid any change of position. A shear load was applied with stainless steel pin of diameter 1mm at a cross head speed of 5 mm/min, until failure occurred (Fig. 1)

Statistical Analysis:

Group comparisons were done by **One-way ANOVA test And Post-hoc tukey test**, $p < 0.05$ was considered as statistically significant

RESULTS

From the study following results were obtained

Table I and Graph 1 shows bond strength values (Newton) of different groups prepared with lucitone 199 heat cure denture base resin. The mean force (in newtons) was compared among the different groups using the one-way ANOVA test with post-hoc tukey test for the inter-group comparisons. There was a significant difference in mean force (in newtons) between the different groups. The mean force (in newtons) was significantly more among Group 4 which was significantly more than group 3 which was significantly more than group 2 which was significantly more than group 1.

Table 1: Comparative bond strength values (Newton) of different groups prepared with lucitone 199 heat cure denture base resin.

Groups	Number	Mean	SD	F-value	p-value
Group 1	20	418.20			< 0.001* ^a
Group 2	20	514.60			
Group 3	20	605.60			
Group 4	20	672.20			
Group 1 vs Group 2 ^b					0.001*
Group 1 vs Group 3 ^b					< 0.001*
Group 1 vs Group 4 ^b					< 0.001*
Group 2 vs Group 3 ^b					0.002*
Group 2 vs Group 4 ^b					< 0.001*
Group 3 vs Group 4 ^b					0.039*

^a **One-way ANOVA test** ^b **Post-hoc tukey test**

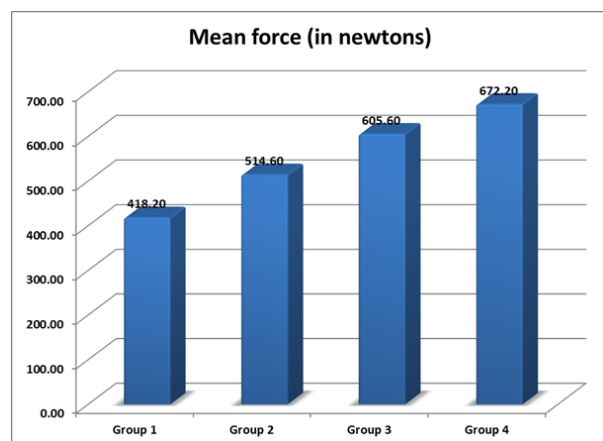
* **Significant difference**

DISCUSSION

Adequate bonding of acrylic resin teeth to denture base resin is necessary because it increases stiffness and strength, since the teeth become an integral part of the prosthesis. Several attempts have been made to improve the bonding of acrylic resin teeth to denture bases by treating the ridge lap of the tooth mechanically or with solvents. **Cunningham JL, Benington IC**⁷ reported monomer cementing of the tooth surface significantly improved the bond strength. **Geerts GAVM, Jooste CH**⁸ stated that surface treatment by roughening did not enhance bond strength, whereas priming with monomer significantly improved the bond strength of microwaved PMMA. **Civjan S, Huget EF, Desimon LB**⁹ reported that adequate retention of acrylic teeth to fluid resin in denture base can be obtained by grinding of the ridge laps. **Catterlin RK, Plummer KD, Gulley ME**¹⁰ reported that contamination of ridge lap area of denture tooth with tinfoil substitute significantly reduces the bond strength of acrylic resin denture teeth bonded to their denture base. The results of these studies were mixed and conflicting, hence an attempt has been



Fig 1: Universal strength testing machine.



Graph 1: Comparative bond strength values (Newton) of different groups prepared with Lucitone 199 heat cure denture base resin.

made to evaluate bonding of denture teeth to acrylic bases and to carry out a Comparative evaluation of effect of different retentive modes on tooth denture base bond.

The control group specimens prepared by LUCITONE 199 HEAT CURE RESIN showed significantly lower bond strength value compared to that of Group II specimens prepared with same material (TABLE 1 AND GRAPH 1).The probable

reason is that Y shaped grooves provides mechanical interlocking between tooth denture base bond

The control group specimens prepared by the LUCITONE 199 heat cure denture base resin showed significantly lower bond strength compared to that of Group III specimens prepared with same material (TABLE 1 AND GRAPH 1). This result is supported by **Anusavice**.¹¹ A cross linking agent glycol dimethacrylate is added to the monomer. It possesses two double bonds per molecule .As a result ,an individual molecule of Glycol dimethacrylate may serve as a bridge or cross member that unites two polymer chains. A polymer formed in this manner yields a net like structure that provides increased resistance to deformation.

The control group specimens (Group I) prepared by LUCITONE 199 HEAT CURE RESIN showed significantly lower bond strength compared to that of Group IV specimens prepared with same material (TABLE 1 AND GRAPH 1). The probable reason is that Y shaped groove 1.5 mm deep and 2 mm wide prepared on cingulum of maxillary left central incisors [21] and monomer application provides consistent mechanical joint between tooth and the denture base. Group III specimens prepared by LUCITONE 199 heat cure denture base resin showed significantly higher bond strength compared to that of Group II specimens prepared with same material (TABLE 1 AND GRAPH 1). This finding is in agreement with the study done by **Cunningham**.⁷ This increase might be due to solvent action of monomer. This plasticizes the polymer of the ridge area and therefore allows better bonding between the denture teeth and denture base, compared to mechanical bond induced by Y shaped groove 1.5 mm deep and 2 mm wide prepared on cingulum of maxillary left central incisors [21] .

Group IV specimens prepared by LUCITONE 199 HEAT CURE RESIN showed significantly higher bond strength value compared to Group III specimens prepared with the same material. This increase is due to combined effect of Y shaped groove 1.5 mm deep and 2 mm wide prepared on cingulum of maxillary left central incisors [21]and monomer application which, increases the surface area available on the denture teeth to interact with polymerizing denture base

resin and mechanically strengthens the bond more than the bond produced by the solvent action of monomer.

CONCLUSION

1. The bond strength of denture teeth to heat cure denture base resin was significantly increased by retentive means.

2. The specimens modified by preparing Y shaped groove on cingulum of maxillary left central incisors (21) and also modified by applying MMA monomer 5 minutes prior being packed with Lucitone 199 heat cure denture base resin showed highest bond strength value, therefore this modification can be recommended as a one of the method to secure denture teeth in denture bases.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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