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COMPARATIVE EVALUATION OF DIFFERENT MECHANICAL MODIFICATIONS AND SURFACE TREATMENT OF ACRYLIC TEETH ON SHEAR BOND STRENGTH BETWEEN TREVALON HEAT CURE RESIN AND CROSS-LIKED ACRYLIC TEETH: AN IN-VTRO STUDY.

Dental Science

Dr. Madhu Ranjan Professor, Department of Prosthodontics, Hazaribagh College of Dental Sciences and Hospital, Demotand, Hazaribagh, Jharkhand.

Dr. Suneel Patil* Associate Professor, Department Of Prosthodontics, Karnataka Institute Of Medical Sciences, Hubli, Karnataka.*Corresponding Author

Dr. Barun Kant Senior Lecturer, Department of Prosthodontics, Hazaribagh College of Dental Sciences and Hospital, Demotand, Hazaribagh, Jharkhand.

Dr. Rafi Fahim Reader, Department of Prosthodontics, Teerthankar Mahaveer Dental College And Research Center, Moradabad UP

Dr . Anchal singh Consultant dentist, Department of dentistry, Sri Sai Hospital, Delhi Road, Moradabad, UP

ABSTRACT

Aims and objective: Acrylic teeth often get debonded from the denture bases. The present study was conducted with the aim of comparative evaluation of different mechanical modifications and surface treatment of denture teeth on shear bond strength between TREVALON heat cure resin and cross-liked acrylic teeth.

Materials and Methods: A statistically significant no. of the test specimens i.e. maxillary right central incisors [11] were collected and further divided into 4 groups. Group 1: control, whereas group 2, group 3 and group 4 were experimental groups. These experimental test groups included surface roughening of ridge lap with sandpaper grit no -100, T-shaped groove, and T-shaped groove painted with dicloromethane, respectively. The preparation of masterpiece was done by aligning the long axis of the central incisor teeth at 45° to the base of a wax block, with ridge lap surface contacting the base. These test specimens were prepared by using TREVALON heat cure resin. A shear load was applied at palatal surface of central incisor [11] using Universal Testing Machine (UTM) until failure occurred.

Results: Group 1 or Control Group specimens prepared by TREVALON heat cure resin showed the lowest shear bond strength value whereas Group 4 specimens prepared with T shaped groove along with application of dicloromethane packed with TREVALON showed the highest shear bond strength value.

Conclusion Within the limitations of this study, it can be concluded that the specimens prepared with T shaped groove by application of dicloromethane packed with Trevalon heat cure resin showed highest bond strength value, therefore this modification can be recommended as a reliable method to secure denture teeth in denture bases.

KEYWORDS

Denture teeth, Bond strength; round, vertical and L Shaped grooves, Ridge-lap and Dicloromethane.

INTRODUCTION

Heat cure denture base resins have been used in prosthetic dentistry for over six decades mainly due to their good mechanical properties, affordability and ease of manipulation.[1] Failure of adhesive bond between artificial teeth and resin material is the most frequently occurring failures in prosthetic dentistry.[1,2] Adequate bonding of artificial teeth to denture base resin is pivotal as it enhances strength since the acrylic teeth become an integral component of the denture bases. The bond strength at the denture base resin-acrylic teeth interface is multifaceted. This encompasses mechanical and chemical methods for better bond strength between teeth and denture base resin material. A plethora of dental researchers have over the decades have tested and tried to improve the bond strength by mechanical alteration of the ridge lap area. Yadav NS et al. [3] reported that the fracture occurs mainly within body of the tooth rather than at resin-tooth interface. Cardash et al. (1986)[4] reported that the there is no additional benefit of vertical retention grooves prepared in the ridge lap area of cross-linked teeth. However, Cardash et al. (1990)[4] opposed his previous statement and proved that vertical retention grooves made on acrylic teeth increased bond strength between cross-linked teeth and resin denture base material. The teeth were divided into three groups: Group 1—without any mechanical modification, Group 2—surface roughening of the ridge lap area of the tooth with sandpaper grit no -100. Group 3—a T- shaped groove was prepared a straight fissure bur, bisecting the ridge lap surface of the cross-linked teeth and Group 4—a T-shaped groove painted with dichloromethane. A shear force was applied at an angle of 130° to the lingual surface of the cross-linked teeth until failure occurred. The vertical retention grooves prepared in the ridge lap area of the teeth proved to be beneficial and modified retention to the resin material but there was no benefit of placement of the horizontal grooves. Hence, an attempt has been made to evaluate and compare the shear bond strength of cross-linked teeth bonded to TREVALON denture base resin material by providing different mechanical modifications of denture teeth and surface treatment of denture base by dichloromethane.

AIM AND OBJECTIVES

- To evaluate shear bond strength between heat cure denture base resin material and cross-linked teeth without any mechanical modification.
- Comparatively evaluate shear bond strength of denture base resin to cross linked teeth modified by surface roughening of ridge lap with sandpaper grit no -100, with different types of retention grooves i.e. round groove, vertical groove, and T-shaped groove grooves and application of dicloromethane.

MATERIALS AND METHODS:

A total number of 80 cross-linked maxillary right central incisors [11] (Acryloc), of same mould in respect to size and shape were selected to be bonded to TREVALON heat cure denture base resin. The sample size was calculated using the results of the previous studies by Takahashi, Chai, Takahashi, and Habu.[5] The sample size was calculated to be 20 per group keeping a confidence interval of 95% and a power of atleast 80%. The study was performed at Hazaribagh College ofDental Sciences and Hospital, Demotand, Hazaribagh, Jharkhand. The test specimens' central incisors [11] were divided into four groups.

The test specimens (central incisors [11]) were divided into 4 groups.
Group 1: (control group): Denture teeth without any modifications. These denture teeth were used just the way they were supplied by the manufacturer.

Group 2: Denture teeth were prepared by surface roughening of ridge lap with sandpaper grit no -100.

Group 3: Teeth were modified by preparing T shaped groove 2 mm deep and 2 mm wide with a straight fissure bur bisecting ridge lap surface of the cross linked teeth .

Group 4: Teeth were prepared by painting the ridge lap area with dichloromethane solvent using the microbrush applicator and left for 45 seconds prior being packed with TREVALON heat cure resin.

The preparation of the masterpiece was done by aligning the long axis of the central incisor teeth at 45° to the base of a wax block (5 mm × 10 mm × 30 mm), with ridge lap contacting the base.[5] Silicone mould was prepared with the help of the master specimen. This mould was used for standardizing the angulation of acrylic tooth with the base of all test specimens. The base of the test specimen was created by placement of acrylic teeth (with and without modification) into the silicone mould, into which molten wax was flown. A total of 80 identical wax models were obtained in this study. These test specimens (wax models) were prepared by the Trevalon heat cure resin. These specimens were divided into 4 groups with 20 teeth in each group. Each group was tested for shear bond strength with Trevalon heat cure denture base resin. Thus each group consists of 20 test samples and total of 80 samples from 4 study groups.

Curing of specimens

The prepared wax models were invested in the flask (KAVO) using dental stone, (Gyprock India, 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. One hour after the stone set, flasks were kept for dewaxing by immersing in boiling water for 5 min. A thin film of (sodium alginate solution) separating media was applied on all surfaces of the mold except the saddle portion of teeth with the help of a brush and dried. The ridge lap area of the denture teeth of Group 4 were painted with dichloromethane solvent using the microbrush applicator and left for 45 seconds prior being packed with TREVALON heat cure resin.

A combination of polymer and monomer, used in the ratio of 3:1 by volume was proportioned prior to mixing. Mixing was done in a porcelain jar, which was kneaded by hand upon achieving the dough consistency to increase its homogenecity and integrity and then packed into mold. After the flasks were then clamped, closure was done under force of 20 kN and kept for 30 min.[6] The flasks were then kept at room temperature for 1 h.

Then the flasks were submerged in water in an acrylizer at room temperature and processing was done as per the manufacturer's guidelines. After curing of all the specimens, the flasks were brought down to room temperature and deflasked. All samples were placed in water for 72 h to ensure complete polymerization. All 80 test specimens were prepared by means of these procedures.

Statistical Analysis:

The mean force (in newtons) was compared among the different groups using the one-way ANOVA test with posthoc tukey test for the inter-group comparisons, $p<0.05$ was considered as statistically significant.

RESULTS :

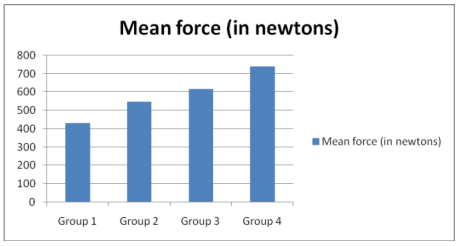
Table I and Graph 1 shows bond strength values (Newton) of different groups prepared with TREVALON heat cure denture base resin. There was a significant difference in mean force (in newtons) between the different groups. The mean force (in newtons) was significantly more among Group 4 which was significantly 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 TREVALON heat cure denture base resin:

Groups (n)	Mean	SD	Group 2	Group 3	Group 4
1 (20)	430.80	32.42	P<0.001, S	P<0.01, S	P<0.05, S
2 (20)	548.20	28.64		P<0.001, S	P<0.001, S
3 (20)	618.40	34.24			P<0.001, S
4 (20)	740.80	42.60			
F value			34.24		
P value			P<0.001, S		

p<0.05 was considered as statistically significant SD= Standard Deviation

Graph1. Comparative bond strength values (Newton) of different groups prepared with TREVALON heat cure denture base resin.



Group 4 showed highest bond strength value (740.80 N) followed by group 3 (618.40N), Group 2 (548.20N) and least in group 1 (430.80N).

DISCUSSION:

Debonding of tooth-denture base bond remains a major concern in prosthodontic practice. Acrylic teeth are the first choice of artificial teeth for creating dentures as they have the property of good colour stability and considerable esthetic results. Adequate bonding of acrylic teeth to denture base resin is important because it enhances bond strength, since the teeth become an integral part of the prosthesis. Several attempts have been made to improve the bonding of acrylic teeth to denture bases by treating the ridge lap of the tooth mechanically or treating them mechanically with solvents like dichloromethane.

Cunningham JL et al. [7] reported that 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. Catterlin RK, Plummer KD, Gulley ME [9] 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 made to comparatively evaluate different mechanical modifications and surface treatment of denture teeth on shear bond strength between denture base resin and teeth. The control group specimens prepared by TREVALON heat cure resin showed significantly lower bond strength value compared to that of Group II (sand paper grit no 100) specimens prepared with same material (Table 1 and Graph 1).These results are in agreement with the previous study done by Civjan,[10] Casewell and Norling,[11] This increase is due to production of numerous fine capillaries which permits mechanical interlocking.

The control group specimens prepared by the TREVALON heat cure denture base resin showed significantly lower bond strength compared to that of Group 3 specimens prepared with same material (Table 1 and Graph 1). The probable reason may be that the T shaped groove prepared in the denture tooth creates a path of resistance to fracture in a direction different from the tooth-denture base resin interface.

The control group specimens (Group 1) prepared by TREVALON heat cure resin showed significantly lower bond strength compared to that of Group 4 specimens prepared with same material (Table 1 and Graph 1). This finding is in agreement with the study done by Jain G et al. [12] The microroughness created by dichloromethane treatment on denture teeth surfaces increased mechanical retention thereby improving the bond strength between tooth and the denture base.

Group 3 specimens prepared by TREVALON heat cure denture base resin showed significantly higher bond strength compared to that of Group 2 specimens prepared with same material (Table 1 and Graph1). The probable reason for these results might be that the T Shaped lock area being wider area has greater flow of acrylic resin denture base material into that area. Therefore allows better bonding between the denture teeth and denture base, compared to mechanical bond induced by sand paper surface roughening.

Group 4 specimens prepared by TREVALON heat cure resin showed significantly higher bond strength value compared to Group 3 specimens prepared with the same material. (Table 1 and Graph1). The denture teeth surfaces treated with dichloromethane forms pits and pores suggesting micromechanical retetention as a mode of improved bonding compared to retention provided by T shaped grooves.

CONCLUSION:

1. The bond strength of acrylic teeth to heat cure denture base resin TREVALON was significantly increased by chemical and mechanical retentive modifications.

2. The specimens prepared by application of dicloromethane packed with Trevalon heat cure resin to T-shaped retentive grooves showed highest bond strength value, therefore this modification can be recommended as a reliable method to secure denture teeth in denture bases.

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