G.Ü. Dişhek. Fak. Der.
Cilt XIII, Sayı 1, Sayfa 19-22, 1996

COMPARISON OF BOND AND TRANSVERSE STRENGTH OF FIVE SOFT DENTURE LİNERS TO POLYMETHYL METHACRYLATE

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ÖZET

Beş Yumuşak Kaide Materyalinin Bağlanma ve Kırılma Dayanıklığının Karşılaştırılması

Beş farklı yumuşak kaide materyalinin bağlama kuvveti tensile testle araştırılmıştır. İncelenen yumuşak kaide materyalleri şunlardır: Molloplast-B, Coe Süper - Soft, Viscogel, Fixo-gel, Soft-Oryl. Örnekler polimetil metakrilat protez kaide materyali üzerine, üretici firmaların önerdiği şekilde polimerize edilmiştir. Yumuşak kaideler, 10x10x20 mm boyutlarındaki polimetil metakrilat bloklar üzerine hazırlanmıştır. Örneklere sert kaideden ayrılana kadar gerilme tipi kuvvet uygulanmıştır. Ayrılma sonucu, kohesiv ve adesiv olarak kaydedilmiştir. Ortalama bağlanma değerleri 2,1 -11,9 kg/cm^2 arasında değişmektedir. 2 mm kalınlığındaki polimetil metakrilat plakalar üzerine polimerize edilen yumuşak kaide materyallerinin dayanıklılıkları, üç nokta kırılma testi ile karşılaştırıldı ve aralarındaki fark istatistiksel olarak önemsiz bulundu (p = 0,322).

Anahtar Kelimeler : Akrilik resinler, doku iyileştiricileri, yumuşak kaide materyalleri.

SUMMARY

The bond strength of five commercial soft denture liners were evaluated using tensile strength test. The soft denture liners investigated were Molloplast-B, Coe Super - Soft, Viscogel, Fixgo-gel, Soft-Oryl. The samples were processed according to the manufactures instructions anto cüret denture base resin polymethyl methacrylate (PMMA). The soft dentures were processed between two PMMA blocks, cf 10 x 10 x 20 mm dimensions. The samples were placed in tension until failure. The failure type, cohesive or adhesive, was also recorded. The mean bond strength values ranged from 2.1 to 11.9 kg/cm^2. The transverse bond strengths of liners, cured on PMMA of 2 mm thickness were compared using three - point bending tests. The effect of the resilient liners on the transverse properties of the base material was found to be insignificant (p = 0.322).

Key Words : Acrylic resins, denture liners, tissue conditioning.

INTRODUCTION

Soft denture liners have found increasing favor for several applications in prosthodontics. Although soft lining materials are widely used in prosthetic dentistry, their properties are far from ideal (1,2). A common problem of soft lined dentures is the failure of adhesion between the soft liner and the denture base (3,4). Several tests have been used to evaluate the bond and transverse strength of soft denture liners under different experimental conditions (5-12).

This study compares the tensile bond strength and transverse strength of five commercially available soft denture liners polymerized on a polymethyl methacrylate (PMMA) denture base resin.

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MATERIALS AND METHODS

Five different types of soft liners were selected for this study (Table I). For tensile bcnd strength tests PMMA (De Trey's QC 20 Dentsply Ltd.) samples, with cross - sectional area 10 x 10 mm, 20 mm length were processed and machined to Standard dimensions. Two PMMA blocks were flasked with a 3 mm plexiglass spacer betvveen them. After removing the spacer heat cured soft lining materials were packed and cured in the flask, self cured types were also polymerized at room temparature in the flask according to the manufacturers recommendations, then polymerized samples were trimmed. Eight samples were made for each type of soft liner. The samples vvere placed under tension, in a Hounsfield Tensometer (81) Morland Road Croydon - England) with an extensicn rate of 2 inch/min until failure occured. A specially designed brass fixture was used to attach the samples to the tensometer. A hole was drilled at each end of the processed samples to ensure parallelism of the samples (Fig 1).

Table I. List of materials and manufacturers.

Material	Manufacturer	Type
Coe Super - Soft	Coe Laboratories Inc., Chicago Illinois	Heat - curing acrylic
Molloplast-B	Molloplast, Regneri GmbH and Co. KG, Karlsruhe, Germany	Heat - curing silicone
Fixo - gel	International Dental and Industrial Polymer Supplies, London	Self - curing acrylic
Viscogel	Detrey Division, Dentsply Ltd., Weybridge, England	Self - curing acrylic
Soft - Oryl	The Williams Getz Dental Products Chicago, Illinois	Self - curing acrylic

For transverse strength tests the soft liners vvere processed according to the manufacturers instructions onto pre - cured, rectangular plates of PMMA 20x10x4 mm. The thickness of 4 mm consisted of 2 mm PMMA and 2 mm soft lining material. Six samples vvere prepared for transverse strength tests for each soft liner. After preparation of the samples for tensile and transverse tests, samples vvere stored in distilled water for a week, in order to complete the polymerization of the self-curing materials. The three - point bending tests were performed using tensometer testing machine. The transverse strength values were calculated by using the formula :

$$\text{Tranverse Strength} = \frac{3\ LP}{2\ WT^2}$$

L = distance betvveen supports
P = maxima! load
W = width of sample
T = thickness of the sample

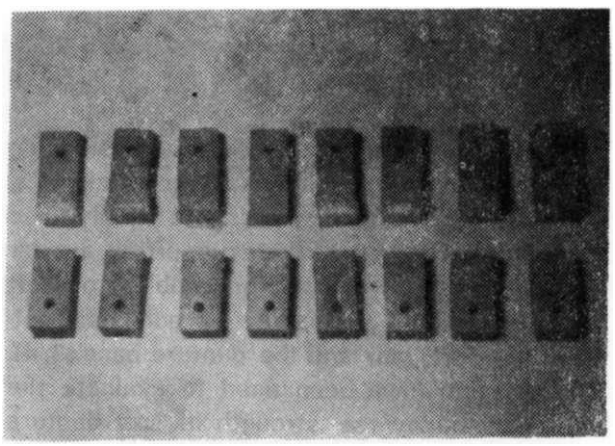

Fig 1. PMMA blocks after tensile bond strength test.

Mean values and their standard deviations were calculated for each data and materials were compared by Kruskal - Wallis One-Way ANOVA analysis. The significance of the results between two materials were tested, with Mann Whitney U test.

RESULTS

Table II shows the mean values, Standard deviations regarding the tensile bond strengths of the soft denture liners cured to PMMA. The mean bond strength to hard acrylic resin ranged from 1,9 to 11,9 kg/cm^2. The lowest bond strength was observed with bonded Soft-Oryl at 1,9 kg/cm^2. The highest bond strength was observed with bonded Molloplast-B at 11,9 kg/cm^2. Table III shows the type of bond failure

Table II. The tensile bond strength of lining materials to hard acrylic resin.

Materials	Mean values of bond strength (kg/cm^2)	Standard Deviation (SD)	Standard Error (SE)
Molloplast-B	11.9	2.70	0.95
Coe Super - Soft	11.2	1.81	0.64
Viscogel	3.9	0.54	0.19
Fixo - gel	3.5	1.47	0.52
Soft - Oryl	1.9	1.32	0.47

Table III. Type of failure at tensile loading.

Materials	Number of Samples		
	Adhesive	Cohesive	Adhesive Cohesive
Molloplast-B	—	8	—
Coe Super - Soft	2	6	—
Viscogel	6	—	2
Fixo - gel	6	—	2
Soft - Oryl	8	—	—

betvveen hard acrylic resin and soft liners. Transverse strength of soft lining materials cured on PMMA is given in Table IV.

Table IV. Transverse strength of soft lining materials cured on PMMA.

Materials	Transverse strength Mean values (kg/cm^2)	Standard Deviation (SD)	Standard Error (SE)
Coe Super - Soft	51.86	7.49	3.06
Molloplast-B	50.63	6.67	2.72
Viscogel	48.13	11.97	4.89
Fixo - gel	51.39	7.43	3.03
Soft - Oryl	56.41	7.45	3.04

DISCUSSION

Bonding failure of the soft denture lining materials is a common fact. If the bond strength to denture base resins is weak unhygienic areas may become (13).

The results of this study indicated that the force of failure for three types of chairside soft liners vvere significantly lower than that of the heatcured two. The heat-cured soft liners Molloplast-B and Coe Super-Soft bond well, to the PMMA denture base (12). This indicated that the tensile strength of the soft liner material is weaker than the PMMA.

Heat-cured silicone Molloplast-B, showed the highest bond strength (11,9 kg/cm^2), Coe Super-Soft followed it vvith close values (11,2 kg/cm^2). Due to the fact that silicone based liners have minimum or negligible chemical adhesion to PMMA resin, an adhesive is supplied for the purpose of bonding to the denture base resin (14). Coe Super-Soft is a methyl/ethyl methacrylate soft denture liner and has a chemical composition similar to that of the PMMA denture base resins. Molloplast-B failed cohesively, which indicates a good bond to the

denture base resin, and the tensile strength of the soft liner was weakerthan the bond strength of PMMA. Coe Süper-Soft exhibited six cohesive, two adhesive failures.

Viscogel, Fixo-gel. Soft-Oryl are modified acrylic products and are processed at room temperature, their bond strengths were found to be 3.9, 3.5, 1.9 kg/cm^2 respectively. Viscogel and Fixo-gel exhibited more adhesive failure (75 %) and less adhesive - cohesive failure (25 %). Adhesive - cohesive failure indicate that the tensile strength of the soft liner and the bond strength are nearly the same. Only Soft-Oryl failed adhesively which implies that the tensile strength of the soft liner material was greater than the bond strength to the PMMA resin.

There were two group of materials with distinct values that were statistically different. The first group, Molloplast-B, Coe Super-Soft were heat cured type, had the highest bond strengths and the statistical difference between them was insignificant (Mann - Whitney U test, p — 0.442). The second group, Viscogel, Fixo - gel, Soft-Oryl also exhibited insignificant results (Kruskal - Wallis One Way ANOVA p = 0.02).

The values obtained in our study are lower than that of the other investigators. For Molloplast-B different values such as 13.6 kg/cm^2 by Bates et al (4, 5) 23.9 kg/cm^2 by Khan et al (12), 17.6 kg/cm^2 by Kawano et al have been attained. Similar data can be obtained for others. This difference may be due to the PMMA base used, the roughness of the surface, the shape of the samples and the speed of the tensional force.

The resilient liners have no effect on the transverse properties of the base material. This results are in confirmity with Craig and Gibbons (9) findings. The effect of the liners, on the transverse strength of the acrylic base was found to be insignificant (p = 0.322). For Viscogel, elongation within itself has been excessive, so during transverse strength tests after the hard resin has broken it continued to elongate which resulted with a high value of Standard deviation (Table IV).

These results could be a guide to clinicians as to which materials should be utilized.

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