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Evaluation of the maladaptation of the test base in acrylic resin regarding the technique of preparation, place of measurement and storage time

Avaliação da desadaptação da base de prova em resina acrílica em relação à técnica de confecção, local de mensuração e tempo de armazenagem

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Resumo

Introdução: O material mais empregado para confecção da base de prova é a resina acrílica por oferecer maior rapidez e praticidade, embora tenda a maior distorção. **Objetivo:** Avaliar técnica de confecção, região e tempo de armazenagem que apresente menor desadaptação da base de prova confeccionada com resina acrílica ativada quimicamente. **Material e método:** Confeccionaram-se modelos em gesso tipo III simulando maxila edêntula que foram divididos em 3 grupos (n = 10): GC - (grupo controle) resina acrílica termopolimerizável; G1 – técnica da adaptação manual; e G2 – técnica do gotejamento. Para as mensurações utilizou-se silicone por condensação de consistência leve que foi interposto entre base e modelo. Com uma prensa hidráulica aplicou-se pressão de 50 kg levando a base de encontro ao modelo. O molde obtido foi mensurado nas regiões de palato, caninos e molares com paquímetro digital nos seguintes tempos: imediatamente após a polimerização da base, em 24, 48, 72, 96 horas e uma semana. Os resultados foram submetidos à análise estatística. **Resultado:** O G1 apresentou média de desadaptação de 0,43mm±0,10, enquanto o G2 obteve 0,39 mm ± 0,11. Os menores valores de desadaptação ocorreram no GC; A região do palato apresentou maior desadaptação (0,52 mm ± 0,07) e a região de caninos, as menores (CD = 0,27 mm ± 0,07 e CE = 0,27 ± 0,09); Não houve diferença estatisticamente significante para os tempos de armazenagem. **Conclusão:** O G2 apresentou menores valores que o G1, sem diferença estatisticamente significante; A região de palato apresentou maior desadaptação, seguida de molares e caninos; As bases continuaram desadaptando ao modelo após a polimerização imediata, sem diferença estatisticamente significante.

Descritores: Resinas acrílicas; prótese total; retenção de dentadura; materiais dentários.

Abstract

Introduction: The most used material for the preparation of the baseplates is the acrylic resin, but it can present distortions. **Objective:** To evaluate preparation technique, region and storage time that presents less maladaptation of the base when made with self-cured acrylic resin. **Material and method:** Models were created in gypsum type III simulating edentulous maxilla, as divided into 3 groups (n = 10): GC (control group) thermopolymerizable acrylic resin; G1 - manual adaptation technique and G2 - drip technique. For the measurements, silicone by condensation of light consistency that was interposed between base and model was used. With a hydraulic press, 50 kg pressure was applied leading the base of the model. The obtained mold was measured in the palate, canine and molar regions with a digital caliper at the following times: immediately after the base polymerization, at 24, 48, 72, 96 hours and one week. The results were submitted to statistical analysis. **Result:** G1 presented maladaptation of 0.43 mm ± 0.10, while G2 obtained 0.39 mm ± 0.11. The lowest maladaptation occurred in the CG. The palate region presented greater maladaptation (0.52 ± 0.07) and the canine region, the lowest (CD = 0.27 mm ± 0.07 and CE = 0.27 ± 0.09); There was no statistically significant difference for storage times. **Conclusion:** G2 presented lower values than G1, with no statistically significant difference. The palate region presented greater maladaptation, followed by molars and canines. The bases continued to maladaptation the model after the immediate polymerization, with no statistically significant difference.

Descriptors: Acrylic resins; denture, complete; denture retention; dental materials.

INTRODUCTION

It is estimated that approximately 63.1% of the population aged 65-74 years old use a superior total prosthesis in Brazil, and 37.5% of the same age range use the total inferior prosthesis[1]. Such a condition often results in low self-esteem of these individuals, besides to the development of TMD[2].

The total prosthesis should provide health and satisfaction concomitantly to the patient, so retention becomes essential[3]. This is due to the precision of the molding techniques, among other things, both from the initial molding where the individual tray is obtained and from where the proof base is made.

The most commonly used base material is acrylic resin. Although it is highlighted for the practicality and rigidity, it has the disadvantage of presenting distortions mainly due to the contraction of polymerization, the release of tensions caused by the manipulation and amount of residual monomer[4]. The residual monomer is used especially in the first 24 hours[5], and especially in chemically activated acrylic resins (RAAQ). This contraction is not uniform and ends up causing maladaptation of the base to the higher plaster model in the posterior region of the palate due to its flatter geometry and with fewer restrictive areas, providing greater stress release[6].

Many studies have investigated the adaptation of the base to laboratory techniques with thermally activated acrylic resin (RAAT)[7-9], as well as others that demonstrate the superiority of RAAT over RAAQ mainly in the dimensional stability, which would lead to a better adaptation of the bases[10,11].

However, there are also the techniques with RAAQ that are taught in most dental schools in Brazil. In this line of work, techniques such as manual adaptation, liquid dripping, and deposition of the powder on the model and pressing of the resin between two glass plates are found. They are the ones that students learn and apply to make the bases in their academic routine[12].

A study with RAAQ that evaluated the level of roughness with the techniques of dripping and manual adaptation of the resin to the model found greater roughness in the technique of manual adaptation, assigning such result to the fact that there is a larger number of polymer grains not impregnated by the monomer, besides its contraction[13]. Another study did not observe a significant difference in the storage form (in water or not), obtained less maladaptation in the time of one week and greater distortions were observed in the palate region[12].

Regarding the storage time, there are works observing the dimensional stability of the piece between 24 hours and a week[14], contraction of the resin evident in the first 7 days and expansion in the subsequent periods[15] and still, authors who recommend the immersion of devices made with RAAQ in water for the first 24 hours[5,16,17].

Thus, considering the preparation of evidence bases by the different techniques and the importance of its good clinical adaptation, this work aimed to identify the technique, region and time of storage with lower values of maladaptation. The null hypothesis will be confirmed if the techniques of manual adaptation and dripping, measurement sites and storage times do not present a statistically significant difference in the control group. The alternative hypothesis would occur if one of the techniques, places and times of storage have greater maladaptation than the control group.

MATERIAL AND METHOD

In a metallic model simulating edentulous maxillary ridge, five points on the lower part of the model corresponding to the posterior palate, molar and canine regions (right and left) were demarcated with the aid of a drill to define the standard measurement location.

From it, a silicone mold was made in the laboratory[12] (Figure 1) that allowed the production of 10 models in type III gypsum plaster (Asfer®, São Caetano do Sul, SP, Brazil). These models were divided into 2 groups and identified according to the technique used: G1- manual adaptation of the resin to the model and G2- dripping.

Figure 1. Silicone mold + metal model.

Also, thermopolymerizable resin bases were also made, denominated as CG (control group).

The G1 and G2 bases were made with colorless RAAQ - (JET® Classic Incolor, Campo Limpo Paulista, SP, Brazil) that according to works in the literature, it produces a smaller dimensional change when compared to pigmented resins[14].

The models were isolated with resin isolator (Cel Lac® - SS White, São Cristóvão, RJ, Brazil) and using 3 parts of powder and 1 part of the liquid. Then, the resin was manipulated in a glass jar, and when reaching the plastic phase, it was deposited on the model in the palate region. With the fingers moistened in the monomer[3], the adaptation on the ridge and other areas was made, trying to maintain a uniform thickness. Excesses were removed with a monomer-moistened Lecron spatula before polymerization. No adjustment or buffing was performed on the base.

For the dripping technique, the same amount of material as described above was provided. After confection and isolation of the models, the powder was deposited and the liquid was dripped, giving the necessary slopes to the model for the resin to settle.

The base of the control group was made with the Thermally Activated Acrylic Resin - (Classic Incolor - Campo Limpo Paulista, SP, Brazil) according to the proportions indicated by the manufacturer. After removal of the wax base, resin pressing was performed by applying a standard 50 kg load on the metal muffle. The polymerization was done by the conventional method in a pot with water heated until reaching boiling temperature, in which it remained for two hours. Before the furnace, the cooling of the muffle was on the bench at room temperature.

One and a half measures of the condensation-activated material (Xantopren®; Heraeus Kulzer, Hanau, Hessen, Germany) were handled to obtain the silicon film, and then, it was deposited in the base. Using a hydraulic press (VH, Vipi Delta, Araraquara, SP, Brazil) a standard load of 50 kg was applied to adapt the base to the model and maintain uniform pressure until the silicone polymerization (Figure 2).

The base-model interface was molded with a digital caliper (Digitimatic - Mitutoyo, Kawasaki, Japan) with a precision of 0.01mm for the misalignments at the predetermined points printed on the silicon film. The accuracy of the three basal preparation techniques (G1, G2 and GC), the different storage times (immediate, 24, 48, 72, 96 hours and one week) were evaluated, as well as the region that could present the lowest values of maladaptation: right canine (RC), left canine (LC), right molar (RM), left molar (LM) and palate (P).

The maladaptation was measured following the protocol established for the test and occurred in the immediate times, 24, 48, 72 and 96 hours and one week. The bases and models were made and stored at room temperature.

The results were submitted to ANOVA statistical analysis followed by the Tukey test, at a significance level of 5%

RESULT

Table 1 shows the mean and standard deviation of general maladaptation in millimeters of the manufacturing techniques used and the regions measured. Figures 3 and 4 were obtained after

Figure 2. Hydraulic Press Pressing the Base to Model.

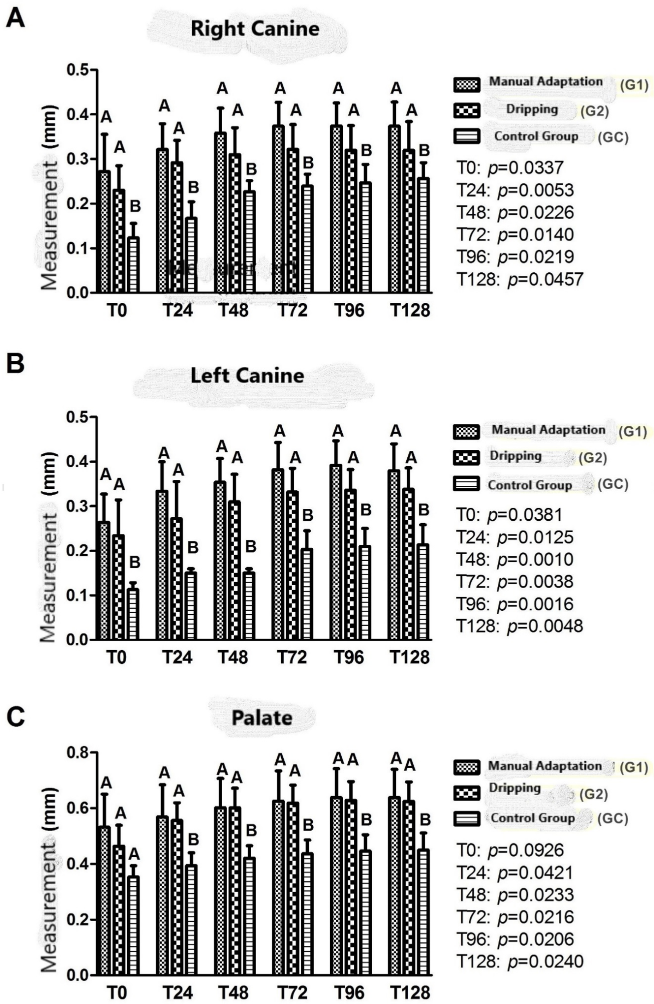

Figure 3. Mean values of the maladaptation values (mm) for the techniques of making the base as a function of storage time for the regions of right canine (A), left canine (B) and palate (C).

Table 1. Mean of general maladaptation (mm) of different manufacturing techniques and regions analyzed

General maladaptation average in millimeters (mm)							
Technics			Regiões				
Manual Adaptation (G1)	Dripping (G2)	Control Group (CG)	RC	LC	RM	LM	P
$0.43^{A} \pm 0.10$	$0.39^{A} \pm 0.11$	$0.27^{A} \pm 0.11$	$0.27^{A} \pm 0.07$	$0.27^{A} \pm 0.09$	$0.37^{B} \pm 0.08$	$0.39^{B} \pm 0.09$	$0.52^{C} \pm 0.07$

Technics: p=0.0798; Regions: p=0.0001; Different letters (A, B and C) represent statistically significant differences between the groups for each Technique or Region (ANOVA, Tukey Test, $p < 0.05$).

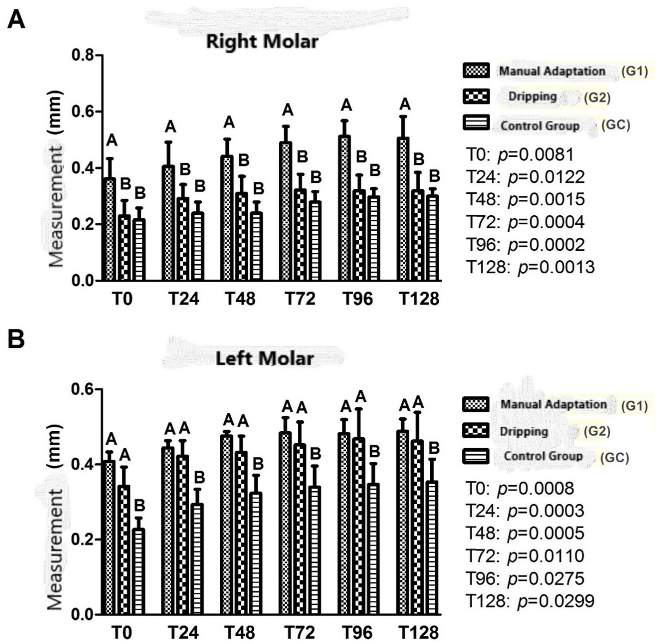

Figure 4. Mean of the maladaptation (mm) for the three techniques of base preparation as a function of storage time for the regions of right molar (A) and left molar (B).

the statistical analysis and the regions measured were right canine (RC), left canine (LE), palate (P), right molar (RM), left molar (LM). They show the value of measurement of the maladaptation in millimeters as a function of the storage time of the bases for each technique used.

DISCUSSION

With the results obtained, it can be verified that the alternative hypothesis of the study was confirmed: there was a statistically significant difference in relation to the measurement site. There was no statistically significant difference in the groups made with chemically activated acrylic resin and the control group. Also, although the values of maladaptation increased in the different storage times measured, there was no statistically significant difference in this factor.

The best results were verified in the control group, in which the bases were made with acrylic resin activated by the conventional technique with inclusion in a metallic muffle. It was observed a general maladaptation of 0.27 mm ± 0.1, a result similar to those obtained by Consani et al.[7] and Garbelini et al.[18]. These results are due to the properties of the RAAT that presents the lower release of residual monomer and better dimensional stability when compared to RAAQ[10], contributing to a better adaptation of the base. However, the technique requires a greater number of laboratory steps beside the need for more devices and specific instruments.

The technique used was also analyzed in relation to the base maladaptation. The G1 (a manual adaptation of the resin to the model) showed greater misfit when compared to G2 (dripping), with no statistically significant difference. Based on the assumptions that the bases had approximately the same thickness, they were made in a standard model for both techniques and using the same type of gypsum and acrylic resin. This difference can originate from the fact that for the bases of G2, there was no stress induction as in the G1 bases when the resin was manually adapted to the model. Later, these tensions are released, is one of the main factors that promote the dimensional alteration of the resin, as previously analyzed by Phillips[4], Woelfel et al.[6], and others[7,19].

Also, in the technique used to make the bases of G1, the operator uses the moistening of the fingers in the monomer to adapt the resin to the model. Although it is a widely diffused technique, proposed by Tamaki[3], it entails a portion of monomer unreacted, being released later and resulting in distortion of the base as well. Although the G2 bases showed a greater tendency to release residual monomer due to the higher liquid-to-powder ratio, the G1 bases showed greater long-term maladaptation, caused by the association of tensions at the base and a greater amount of liquid during the adaptation of the resin.

The differences obtained in relation to the cooking technique did not prove to be clinically relevant, since the values of maladaptation did not exceed the limit of 1 mm, especially in the palate region. According to Skinner[19], the maladaptation below 1 mm would be within the acceptable clinical limit for success in the manufacture of the total prosthesis.

Regarding the region measured, the palate presented the highest values of maladaptation, followed by the molars and finally the canines. Probably, this result is due to the greater contraction of polymerization and release of tensions of the resin in the posterior region of the palate due to the flatter geometry and with less restrictive areas, resulting in greater distortion of the base, as also observed by Kimpara et al.[12], Consani et al.[7], Skinner[19] and Almeida et al.[8] There was no statistically significant difference between the RM and LM groups and between the RC and LC groups, probably because they were regions with similar geometry, although on opposite sides in the lateral.

When analyzing the storage times, the base maladaptation increased after the immediate time, with no statistically significant difference. The mismatch values tended to stabilize between 72 hours and 96 hours, agreeing with work by Gonçalves et al.[14] who found dimensional stability between 24 hours and one week after the polymerization. However, this work presented lower results than the studies of Dixon et al.[20] and García-Lopez et al.[15] who verified the effect of the storage of their parts in water, with a better adaptation, due to the recovery of the polymerization contraction due to the sorption of water by the acrylic resin[21], in addition to lower residual monomer release[22,23].

A greater difference in maladaptation occurred between the first and the second measurement (immediately and after 24 hours) when compared to the consecutive measurements. This result was due to a higher release of unreacted monomer in these first 24 hours, especially in the bases of group 2, because although maintained standard thickness for both groups, it becomes inevitable to use more liquid than powder for this technique. This would significantly increase the unreacted monomer content, being released in greater quantity in the first 24 hours and causing greater maladaptation in this period, according to Consani et al.[7], Rocha et al.[5] and Menezes et al.[16]. This study prioritized the methods most commonly used in dental schools in Brazil and did not use the storage of bases in water during this period, which would reduce the release of this residual monomer (because it is a medium with low oxygen solubility)[5], resulting in better dimensional stability.

Comparing the results of G1 and G2 with the CG, where the bases were made with thermopolymerizable resin by the conventional technique in heated water, the best results of this group can be verified in the adaptation and uniformity of the base, considering that the RAAT presents more effective polymerization due to the activation of benzoyl peroxide is carried out by heat, forming free radicals and initiating the polymer chain[4,10].

Although the thermal activation resins have produced better results, the maladaptation values of the self-curing resins found in this work are within limits that are clinically acceptable. According to Polyzois et al.[24], the oral mucosa would not tolerate maladaptation in the order of 1 mm or more. It is important that the total prosthesis presents good stability, providing aesthetics, function, and comfort to the edentulous patient while performing their mouth functions[25]. It should be emphasized here the need for more studies regarding the techniques of making bases of evidence with RAAQ and its storage time since in this work, it was not possible also to carry out the measurements in the times of 120 and 144 hours corresponding to the two days preceding the time of one week.

CONCLUSION

The control group presented better adaptation, with no statistically significant difference;

The dripping technique presented better adaptation when compared to the technique of manual adaptation, with no statistically significant difference;

Although the bases continued to be maladapted to the model after the immediate polymerization, the results of the storage times did not show statistically significant differences between them;

The palate region presented higher maladaptation rates, followed by molars and canines.

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CONFLICTS OF INTERESTS

The authors declare no conflicts of interest.

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