REVISTA DE ODONTOLOGIA DA UNESP

ORIGINAL ARTICLE

Rev Odontol UNESP. 2016 Jan-Feb; 45(1): 41-46
Doi: http://dx.doi.org/10.1590/1807-2577.10815

 - ISSN 1807-2577

Influence of one- or two-stage methods for polymerizing complete dentures on adaptation and teeth movements

Influência dos métodos de um ou dois estágios para polimerização de próteses totais na adaptação e movimentação de dentes

Moises NOGUEIRA[a], Conrado Reinoldes CAETANO[a], Americo CORRER[a], Rafael CONSANI[a], Mateus Bertolini Fernandes dos SANTOS[b], Atais BACCHI[c*]

[a]Faculdade de Odontologia, UNICAMP – Universidade Estadual de Campinas, Piracicaba, SP, Brasil
[b]Faculdade de Odontologia, UFPel – Universidade Federal de Pelotas, Pelotas, RS, Brasil
[c]IMED – Faculdade Meridional, Passo Fundo, RS, Brasil

Resumo

Introdução: A qualidade das próteses totais pode ser influenciada pelo método de confecção. **Objetivo:** Avaliar a influência de diferentes métodos de confecção de próteses totais na adaptação e movimentação de dentes. **Material e método**: A confecção das próteses foi dividida em dois grupos (n=10) para arcadas superior e inferior de acordo com o método: 1) convencional de uma etapa - realizada uma base de prova em cera onde foram montados os dentes e levada para a termopolimerização; 2) Método de duas etapas - a base foi encerada e termopolimerizada. Com a base da prótese polimerizada, os dentes foram montados e em seguida realizou a polimerização da outra porção. Para movimentação de dentes foram avaliadas as distâncias entre incisivos (I-I), pré-molares (PM-PM), molares (M-M), incisivo esquerdo a molar esquerdo (IE-ME) e incisivo direito a molar direito (ID-MD) antes e após polimerização final. As próteses foram seccionadas em três posições para análise de adaptação: (A) face distal de caninos, (B) face mesial de primeiros molares, e (C) face distal de segundos molares. **Resultado:** As bases das próteses demonstraram melhor adaptação quando polimerizadas no processo de uma etapa, tanto superiores ($p<0,05$) quanto inferiores ($p<0,05$), com a região A apresentando melhor adaptação que a região C. Na arcada superior uma redução na distância entre I-I foi observada na técnica de uma etapa, enquanto que na técnica de duas etapas houve redução na distância ID-MD. Na arcada inferior, na técnica de uma etapa houve redução na distância ID-MD e houve redução significativa na distância IE-M pelo método de duas etapas. **Conclusão:** O método de uma etapa apresentou melhores resultados para a adaptação da prótese. Ambos os métodos de confecção apresentaram alteração na movimentação de dentes.

Descritores: Prótese total; adaptação; polimerização.

Abstract

Introduction: The quality of complete dentures might be influenced by the method of confection. **Objective:** To evaluate the influence of two different methods of processing muco-supported complete dentures on their adaptation and teeth movements. **Material and method:** Denture confection was assigned in two groups (n=10) for upper and lower arches according to polymerization method: 1) conventional one-stage - a wax trial base was made, teeth were arranged and polymerized; 2) two-stage method - the base was waxed and first polymerized. With the denture base polymerized, the teeth were arranged and then, performed the final polymerization. Teeth movements were evaluated in the distances between incisive (I-I), pre-molars (P-P), molars (M-M), left incisor to left molar (LI-LM) and right incisor to right molar (RI-RM). For the adaptation analysis, dentures were cut in three different positions: (A) distal face of canines, (B) mesial face of the first molars, and (C) distal face of second molars. **Result:** Denture bases have shown a significant better adaptation when polymerized in the one-stage procedure for both the upper ($p=0.000$) and the lower ($p=0.000$) arches, with region A presenting significant better adaptation than region C. In the upper arch, significant reduction in the distance between I-I was observed in the one-stage technique, while the two-stage technique promoted significant reduction in the RI-RM distance. In the lower arch, one-stage technique promoted significant reduction in the distance for RI-RM and two-stage promoted significant reduction in the LI-LM distance. **Conclusion:** Conventional one-stage method presented the better results for denture adaptation. Both fabrication methods presented some alteration in teeth movements.

Descriptors: Complete denture; adaptation; polymerization.

INTRODUCTION

The muco-supported complete denture (MSCD) still is an important treatment alternative to rehabilitate edentulous patients[1-3]. Excellent retention and stability obtained from well adapted dentures must be requisites to provide satisfaction to the patients[4,5]. With the advent of implants, other treatment alternatives have emerged, solving the deficiencies of the MSCD[6-8]. However, implant-supported or implant-retained rehabilitations have considerably higher cost, added to surgical procedures required which are avoided by some patients. So, there is still great demand for conventional complete dentures[9].

Acrylic resins have been used for manufacturing complete denture bases since 1937 due to its numerous favorable mechanical conditions. Although, there is a certain lack of dimensional accuracy due to the unavoidable denture base shrinkage during acrylic resin polymerization, which has been pointed out as one of the disadvantages of complete denture construction[10,11]. These changes can exert effective influence on the dimensional accuracy of the denture bases, interfering with the positioning of the teeth and loss of the occlusal harmony desired, which may change the planned vertical dimension[12-15]. Also dimensional changes can cause loss of retention and stability of the dentures under clinical conditions[16], caused by undesirable warpage and distortion[11] upon resin base water loss or uptake, stress release and base flexural fatigue[17-19].

There are two ways of making laboratory process of mucossuported complete dentures in regard to inclusion and polymerization: 1) one-stage - polymerizing denture base and teeth arrangement at the same time (one polymerization process - conventional), and 2) two-stage - first polymerizing the denture base with thermopolymerized resin, and after the teeth arrangement perform the final polymerization of the denture (two polymerization processes). That second method has been claimed to eliminate some sources of clinical inaccuracies, for example, the construction of a trial base as the final denture base to promote better adaptation for more precise wax rim adjustment. Still, the clinician is able to check the retention and stability of the final base at this initial time of the manufacturer process[20-22]. Still, as lower amount of acrylic resin is polymerized for the base, it might promoted lower shrinkage and better base adaptation. In the same way, after teeth arrangement lower amount of acrylic is polymerized which might also promote lower teeth movements.

The aim of this study was to evaluate the influence of two different methods of processing muco-supported complete dentures on their adaptation and teeth movements. The null hypothesis tested is that there is no difference in regard to adaptation and tooth movement during polymerization caused by the two methods.

MATERIAL AND METHOD

Complete Dentures Wax-up

Silicone molds (Elite Double, Zhermack, Rovigo, Italy) of edentulous arches were used to fabricate twenty maxillary and twenty mandibular plasters with type III dental stone (Herodent, Vigodent SA, Petropolis, RJ, Brazil). A wax base plate was made in each upper and lower stone cast with a thickness of 2 mm. The complete denture sets were mounted in a semi-adjustable articulator (A7 Fix; Bio-Art Equipamentos Odontologicos, Sao Carlos, SP, Brazil) with the aid of a mounting plate. Acrylic teeth (Trubyte Biotone, Dentsply, Petropolis, RJ, Brazil), model 3 P, 32 L, and 33 degrees were used. A vertical overlap of 1 mm and horizontal distance of 0.5 mm was defined in anterior teeth. Teeth were arranged in Angle Class I. Upper and lower dental arches were arranged with an index made with silicone (Zetalabor, Zhermack, Rovigo, Italy) to standardize teeth arrangement. In the first group, the complete dentures were mounted and polymerized using the conventional method, polymerizing the base plate with tooth arrangement waxed all together. In the second group, the complete dentures was made following these steps: first, the base plate were waxed up and heat cured. When the base plate was polymerized, the teeth were waxed up in the same ways that the first group, with aid of the mounting plate, and then, heat cured again, by the same method. Metallic pins were placed for measurement reference on the incisal border of the maxillary central incisors, buccal cusp of the first premolars, and mesiofacial cusp of the second molars. The distances defined for measurement were: incisor-to-incisor (I–I), premolar-to-premolar (P–P), and molar-to-molar (M–M), and the left incisor-to-left molar (LI–LM) and right incisor-to-right molar (RI–RM). They were measured before and after polymerization, with an optical linear microscope (Olympus Optical Co., Tokyo, Japan) with an accuracy of 0.0005 mm[23].

Flasking Procedure and Polymerization

Dentures were flasked in traditional metallic flasks (TF) with dental stone (Herodent). Flasks were immersed in boiling water for five minutes for wax softening and the complete wax removal ensured by the application of liquid detergent and hot water (Ype; Amparo Chemical Products, Amparo, SP, Brazil). Mechanical retention was made in the ridge lap surface of the artificial teeth with spherical bur to improve the tooth retention to denture base. A heat-curing acrylic resin (Classico Dental Products, Sao Paulo, SP, Brazil) was prepared according to the manufacturer's instructions and adapted into the flask. A hydraulic press (Delta, Vinhedo, SP, Brazil) under a load of 1,250 kgf for 5 minutes was used to ensure adequate resin flask. The acrylic resin of the denture bases was polymerized in water bath at 74ºC for 9 hours in a thermopolymerizing unit (Termotron Dental Products, Piracicaba, SP, Brazil). Flasks were cooled at room temperature after polymerization. Dentures were deflasked and the teeth distances measured by the same way as made prior denture procedure. In addition, the dentures were cut with a manual saw adopted to a device created to fix the model and standardize the denture section in three different regions: (A) distal face of canines, (B) mesial face of the first molars, and (C) posterior of second molars and the adaptation of the prosthesis were measured using the same optical linear microscope (Olympus Optical Co., Tokyo, Japan) with an accuracy of 0.0005 mm[24].

The prosthesis adaptation was measured in 5 points for upper arch and 6 points for lower arch in each transversal section. For upper dentures the points were: a) at the peripheral sealing of the right side; b) at the crest of rim at the right side; c) in the center of the palate; d) at the crest of the rim at the left side; e) at the peripheral sealing of the left side. For the lower dentures the points were: a) at the buccal peripheral sealing of the right side; b) at the crest

of the rim at the right side; c) at the lingual peripheral sealing of the right side; d) at the lingual peripheral sealing of the left side; e) at the crest of the rim at the left side; f) at the buccal peripheral sealing of the left side[24].

Mean values of the 5 or 6 points were taken to obtain the adaptation value of each region (A, B or C). Regions were compared among them and with the same region from the different polymerization process. Teeth movement was explored according to the percent of movement caused after polymerization in comparison to initial distance[23,24].

Statistical Analysis

Data were submitted to Student's t-test to analyze teeth movement. Two-way ANOVA was used to compare possible differences between denture base adaptations. Whenever ANOVA indicated a difference, Tukey's test was used to identify the multiple correlations. All the tests were performed at a level of significance of $\alpha = 0.05$.

RESULT

Denture bases have shown a significant better adaptation when polymerized in the one-stage procedure for both the upper (p=0.000) and the lower (p=0.000) arches (Tables 1 and 2). Still, either for upper (p=0.007) or lower (p=0.000) dentures, the region A presented a significant better adaptation than region C, irrespective of the polymerization method (Tables 1 and 2). Statistical interaction between polymerization technique and denture region was not observed in upper (p=0.898) or lower (p=0.688) arches.

In the upper arch (Table 3), significant reduction in the distance between I-I was observed in the one-stage method, while the two-stage method promoted significant reduction in the RI-RM distance. Other groups were statistical similar in the pre- and post-polymerization distances.

In the lower arch (Table 4), it was observed that the transversal distances measured (I-I, P-P, M-M) did not have statistical alteration

Table 1. Mean and standard deviation (SD) for upper denture adaptation (mm) in each measured point (A, B or C) for one- or two-stage polymerization method

	One-stage				Two-stage			
Region	**Mean**	**SD**			**Mean**	**SD**		
A	0.1036	0.0254	A	a	0.2039	0.0794	B	a
B	0.1313	0.0364	A	ab	0.2760	0.0552	B	ab
C	0.1945	0.0590	A	b	0.3511	0.0904	B	b

Different uppercase letters in the row and lowercase letters in the column denote statistical significant difference (p<0.05).

Table 2. Mean and standard deviation (SD) for lower denture adaptation (mm) in each measured point (A, B or C) for one- or two-stage polymerization method

	One-stage				Two-stage			
Region	**Mean**	**SD**			**Mean**	**SD**		
A	0.1134	0.0636	A	a	0.2114	0.0535	B	a
B	0.1426	0.0520	A	ab	0.2427	0.0440	B	ab
C	0.1603	0.0635	A	b	0.2857	0.0656	B	b

Different uppercase letters in the row and lowercase letters in the column denote statistical significant difference (p<0.05).

Table 3. Mean and standard deviation (SD) for the percentage alteration in teeth movement in the upper arch for one- and two-stage polymerization methods

	One-stage			Two-stage			Teste-t
	Mean	**SD**		**Mean**	**SD**		
I-I	98.2	4.3	B	100.6	2.7	A	P=0.025
P-P	99.6	0.3	A	99.3	2.1	A	P=0.622
M-M	99.3	0.3	A	99.7	2.4	A	P=0.879
RI-RM	101.7	1.7	A	98.3	5.6	B	P=0.007
LI-LM	97.4	1.9	A	99.4	2.7	A	P=0.067

Different letter mean statistical significant difference in the rows (p<0.05).

Table 4. Mean and standard deviation (SD) for the percentage alteration in teeth movement in the lower arch for one- and two-stage polymerization methods

	One-stage			Two-stage			Teste-t
	Mean	SD		Mean	SD		
I-I	99.51	1.48	A	98.7	2.7	A	P=0.404
P-P	99.79	0.76	A	99.6	3.3	A	P=0.762
M-M	99.56	0.57	A	99.9	2.2	A	P=0.129
RI-RM	97.66	4.81	B	102.4	5.4	A	P=0.03
LI-LM	101.87	4.17	A	98.3	5.3	B	P=0.04

Different letter mean statistical significant difference in the rows ($p<0.05$).

in both polymerization techniques. However, for anterior-posterior measurements, one-stage technique promoted significant reduction in the distance for RI-RM and two-stage promoted significant reduction in the LI-LM distance.

DISCUSSION

For denture base adaptation, there was significant differences between the studied groups, with the conventional one-stage processing method promoting smaller misfit for the 3 studied regions (A, B and C). The alternative two-stage method, with the base already in final thermopolymerized resin produced more misfits, being less precise, opposing the authors who claimed the method to be more accurate due to the lower amount of acrylic resin polymerized in the first stage[20,21]. The possible explanation for these results may be due to the need for double flask inclusion for assembling the artificial teeth, pressing the flask with 1,250 kgf required for resin to flow, which can also have an effect on the change in the size of the polymerized denture base. Still, this method resubmit the already polymerized acrylic base plate to high temperatures, which might promote its distortion[25].

Generally, the adaptation of the acrylic denture bases to the plaster models are pointed as unsatisfactory in the literature, mainly on the posterior regions as back palate, which is in accordance with the higher misadaptation in posterior regions in the study (regions C). Posterior is the larger region of the denture and, in this way, it is where the distortion caused by polymerization shrinkage is more pronounced. This denotes that besides the search for better techniques of fabrication, the development of materials with lower distortion must be a concern. The denture adaptation is also influenced by other factors such as shape of the palate[17], technician, post-pressing time trademarks acrylic resin[24], thickness of the denture base[26,27]. According to some authors, the thicker base cause minor dimensional changes compared to the thinner base[26]. Probably because the bases with thicker section are sufficiently rigid to prevent further release of tensions when removed from the mold. For this reasons, this study has been standardized all factors pointes as influent in literature. Like the thickness, the shape of the rims, after-pressing time, acrylic resin trademark and operator were standardized in order to avoid that these factors promote any effect on base plate distortion.

In regard to teeth movements during polymerization, for upper arch, there was a significant difference in values between incisors (I-I) caused by the one-stage method and between right incisors and molars (RI-RM) caused by the two-stage method. For the lower jaw, there were differences in the measurements between incisors and molars on both sides (RI-RM and LI-LM caused by the one- or two-stage, respectively). It was expected that the lower amount of acrylic resin polymerized in the two-stage method could promote lower material shrinkage e reduce teeth movements. However, based on our outcomes, it seems that the amount of resin is not a factor that significant affects the teeth movements during complete denture fabrication by the tested methods. The thermal and mechanical factors already discussed might have the principal influence on the movements.

Given these considerations, the null hypothesis of this study must be partially rejected, as the one-stage polymerization method promoted more accurate denture bases.

CONCLUSION

The conventional one-stage polymerization method presents the better results for denture adaptation. Both methods of fabrication presented some alteration in teeth movements with none promoting overall greater precision.

REFERENCES

1. Santos BF, Dos Santos MB, Santos JF, Marchini L. Patient's evaluations of complete denture therapy and their association with related variables: a pilot study. J Prosthodont. 2015 Jul;24(5):351-7. http://dx.doi.org/10.1111/jopr.12286. PMid:25864962.

2. Gaspar MG, Dos Santos MB, Dos Santos JF, Marchini L. Correlation of previous experience, patient expectation and the number of post-delivery adjustments of complete dentures with patient satisfaction in a Brazilian population. J Oral Rehabil. 2013 Aug;40(8):590-4. http://dx.doi.org/10.1111/joor.12070. PMid:23663179.

3. Da Siqueira GP, dos Santos MB, dos Santos JF, Marchini L. Patient's expectation and satisfaction with removable dental prosthesis therapy and correlation with patient's evaluation of the dentists. Acta Odontol Scand. 2013 Jan;71(1):210-4. http://dx.doi.org/10.3109/00016357.2012.654612. PMid:22299760.
4. Bellini D, dos Santos MB, De Paula Prisco da Cunha V, Marchini L. Patients' expectations and satisfaction of complete denture therapy and correlation with locus of control. J Oral Rehabil. 2009 Sep;36(9):682-6. http://dx.doi.org/10.1111/j.1365-2842.2009.01967.x. PMid:19508351.
5. Jo A, Kanazawa M, Sato Y, Iwaki M, Akiba N, Minakuchi S. A randomized controlled trial of the different impression methods for the complete denture fabrication: patient reported outcomes. J Dent. 2015 Aug;43(8):989-96. http://dx.doi.org/10.1016/j.jdent.2015.05.007. PMid:26051546.
6. Emami E, Heydecke G, Rompré PH, de Grandmont P, Feine JS. Impact of implant support for mandibular dentures on satisfaction, oral and general health-related quality of life: a meta-analysis of randomized-controlled trials. Clin Oral Implants Res. 2009 Jun;20(6):533-44. http://dx.doi.org/10.1111/j.1600-0501.2008.01693.x. PMid:19515032.
7. Da Cunha MC, Santos JF, Santos MB, Marchini L. Patients' expectation before and satisfaction after full-arch fixed implant-prosthesis rehabilitation. J Oral Implantol. 2015 Jun;41(3):235-9. http://dx.doi.org/10.1563/AAID-JOI-D-12-00134. PMid:23614813.
8. Boven GC, Raghoebar GM, Vissink A, Meijer HJ. Improving masticatory performance, bite force, nutritional state and patient's satisfaction with implant overdentures: a systematic review of the literature. J Oral Rehabil. 2015 Mar;42(3):220-33. http://dx.doi.org/10.1111/joor.12241. PMid:25307515.
9. Douglass CW, Shih A, Ostry L. Will there be a need for complete dentures in the United States in 2020? J Prosthet Dent. 2002 Jan;87(1):5-8. http://dx.doi.org/10.1067/mpr.2002.121203. PMid:11807476.
10. Artopoulos A, Juszczyk AS, Rodriguez JM, Clark RK, Radford DR. Three-dimensional processing deformation of three denture base materials. J Prosthet Dent. 2013 Dec;110(6):481-7. http://dx.doi.org/10.1016/j.prosdent.2013.07.005. PMid:24189112.
11. Gharechahi J, Asadzadeh N, Shahabian F, Gharechahi M. Dimensional changes of acrylic resin denture bases: conventional versus injection-molding technique. J Dent (Tehran). 2014 Jul;11(4):398-405. PMid:25584050.
12. Parvizi A, Lindquist T, Schneider R, Williamson D, Boyer D, Dawson DV. Comparison of the dimensional accuracy of injection-molded denture base materials to that of conventional pressure-pack acrylic resin. J Prosthodont. 2004 Jun;13(2):83-9. http://dx.doi.org/10.1111/j.1532-849X.2004.04014.x. PMid:15210003.
13. Negreiros WA, Consani RLX, Mesquita MF, Consani S, Valentino TA. Effect of the flask contention method on the displacement of maxillary denture teeth. Braz J Oral Sci. 2008 Jan-Mar;7(24):1493-6.
14. Dos Santos MB, Consani RL, Mesquita MF. Influence of different metal flask systems on tooth displacement in complete upper dentures. Gerodontology. 2012 Mar;29(1):30-5. http://dx.doi.org/10.1111/j.1741-2358.2010.00392.x. PMid:20561061.
15. Caetano CR, Consani RL, Bacchi A, Correr AB, Dos Santos MB. Influence of different flask systems on tooth displacement and framework misfit in mandibular fixed implant-supported complete dentures. J Prosthodont Res. 2013 Jul;57(3):213-8. http://dx.doi.org/10.1016/j.jpor.2013.04.001. PMid:23773375.
16. Jethlia H, Jethlia A, Naveen Raj P, Meshram A, Sharma N. Post insertion problems and their management in complete denture. J Evol Med Dent Sci. 2013 Jan;2(3):194-9. http://dx.doi.org/10.14260/jemds/243.
17. Sykora O, Sutow EJ. Posterior palatal seal adaptation: influence of processing technique, palate shape and immersion. J Oral Rehabil. 1993 Jan;20(1):19-31. http://dx.doi.org/10.1111/j.1365-2842.1993.tb01511.x. PMid:8429420.
18. Wong DM, Cheng LY, Chow TW, Clark RK. Effect of processing method on the dimensional accuracy and water sorption of acrylic resin dentures. J Prosthet Dent. 1999 Mar;81(3):300-4. http://dx.doi.org/10.1016/S0022-3913(99)70273-8. PMid:10050118.
19. Matsuo H, Suenaga H, Takahashi M, Suzuki O, Sasaki K, Takahashi N. Deterioration of polymethyl methacrylate dentures in the oral cavity. Dent Mater J. 2015;34(2):234-9. http://dx.doi.org/10.4012/dmj.2014-089. PMid:25740307.
20. Langer A. The validity of maxillomandibular records made with trial and processed acrylic resin bases. J Prosthet Dent. 1981 Mar;45(3):253-8. http://dx.doi.org/10.1016/0022-3913(81)90385-1. PMid:6938670.
21. Telles D, Hollweg H, Castellucci L. Conventional and implant-supported complete dentures. Sao Paulo: Ed. Santos; 2009. 492 p. In Portuguese.
22. Prisco V, Marchini L. Contemporary complete dentures in the oral rehabilitation. Sao Paulo: Ed. Santos; 2007. 277 p. In Portuguese.
23. Consani RL, Domitti SS, Mesquita MF, Consani S. Influence of flask closure and flask cooling methods on tooth movement in maxillary dentures. J Prosthodont. 2006 Jul-Aug;15(4):229-34. http://dx.doi.org/10.1111/j.1532-849X.2006.00111.x. PMid:16827735.
24. Consani RL, Domitti SS, Barbosa CMR, Consani S. Effect of commercial acrylic resins on dimensional accuracy of the maxillary denture base. Braz Dent J. 2002;13(1):57-60. PMid:11870965.
25. Anusavice KJ. Phillips' dental materials. 11th ed. Rio de Janeiro: Elsevier; 2013.
26. Chen JC, Lacefield WR, Castleberry DJ. Effect of denture thickness and curing cycle on the dimensional stability of acrylic resin denture bases. Dent Mater. 1988 Feb;4(1):20-4. http://dx.doi.org/10.1016/S0109-5641(88)80083-6. PMid:3077126.
27. Baydas S, Bayindir F, Akyil MS. Effect of processing variables (different compression packing processes and investment material types) and time on the dimensional accuracy of polymethyl methacrylate denture bases. Dent Mater J. 2003 Jun;22(2):206-13. http://dx.doi.org/10.4012/dmj.22.206. PMid:12873123.

CONFLICTS OF INTERESTS

The authors declare no conflicts of interest.

*CORRESPONDING AUTHOR

Atais Bacchi, Departamento de Prótese Dentária, Faculdade Meridional, Av. Senador Pinheiro, 304, 99070-220 Passo Fundo - RS, Brazil, e-mail: atais_bacchi@yahoo.com.br

Received: May 24, 2015
Accepted: August 27, 2015