

# Effect of a Denture Adhesive on the Satisfaction and Kinesiographic Parameters of Complete Denture Wearers: A Cross-Over Randomized Clinical Trial

Department of Dental Materials and Prosthodontics, Araraquara Dental School, UNESP- Univ Estadual Paulista, Araraquara, SP, Brazil.

Correspondence: Prof. Marco Antonio Compagnoni, Rua Humaitá 1680 14801-903 Araraquara, SP Brasil. Tel: +55-16-3301-6411. e-mail: [compagno@foar.unesp.br](mailto:compagno@foar.unesp.br)

Danny Omar Mendoza Marin, Andressa Rosa Perin Leite, André Gustavo Paleari, Larissa Santana Rodriguez, Norberto Martins de Oliveira Junior, Ana Carolina Pero, Marco Antonio Compagnoni

The aim of the present study was to assess the effect of a denture adhesive (DA) on patient satisfaction and kinesiographic parameters of complete denture wearers by a cross-over study. Fifty edentulous patients received a set of new complete dentures. After an adaptation period, the participants were enrolled in the trial and randomized to receive a sequence of treatment protocols: Protocol 1- DA use during the first 15 days, followed by no DA for the next 15 days; Protocol 2- no DA during the first 15 days, followed by use of DA for the next 15 days. Outcomes were assessed after 15 days of each sequence of treatment. A questionnaire was used to assess the patients' satisfaction. A kinesiograph was used to record mandible movements and patterns of maxillary complete denture movement during chewing. The Wilcoxon test ( $\alpha=0.05$ ) and a paired sample t-test ( $\alpha=0.05$ ) were used to compare satisfaction levels and kinesiographic data, respectively. Use of DA improved the overall level of patient satisfaction ( $p<0.001$ ). The kinesiographic recordings revealed a significant increase (1.7 mm) in vertical mandible movements ( $p<0.001$ ) during chewing and a lower (0.3 mm) vertical intrusion of the maxillary complete dentures ( $p=0.002$ ) during chewing after using the DA. Use of DA in complete denture wearers improved the patients' satisfaction and altered mandible movements, with increases in vertical movements during chewing and less intrusion of maxillary complete dentures.

**Key Words:** complete dentures, adhesives, patient satisfaction, cross-over study, randomized controlled trial.

## Introduction

Although the rate of edentulism has been falling over the past 30 years, there are still many countries with a large number of edentulous patients who are in need of treatment by complete dentures (1). In recent years, there have been significant advances in treatment with complete dentures. Implant-supported prostheses or retained by osseointegrated implants are treatment options for many edentulous patients, improving their satisfaction, function, comfort and quality of life with the dentures (2). However, for most edentulous patients, the main treatment option involves conventional complete dentures, which are esthetically acceptable (3) and have a lower cost than other treatments.

It is known that not all complete denture wearers are able to adapt to their dentures, even if they are well-fitting and well-made. Many complaints are reported by patients who use these prostheses, especially with mandibular dentures, including problems of retention and instability, chewing difficulties, and low confidence, quality of life and satisfaction (4,5).

Successful treatment with complete dentures depends on the integration of the dentures with the functions of the

masticatory system and the psychological acceptance of the patient. The use of a DA improves the retention of dentures by increasing the adhesive and cohesive properties, as well as the viscosity of the medium between the dentures and supporting tissues, eliminating voids in the space between them (6). Previous reports about health-related quality of life in complete denture wearers have stated that using a DA increases the comfort, confidence and satisfaction of patients with their dentures (7). According to Ozcan et al. (8), 73% of complete denture wearers who did not use DA managed well their dentures, although 87% of them did not know about DA. In addition, as reported by Grasso et al. (6) many dentists are reluctant to prescribe these products for fear that it indicates their failure to provide an adequate prosthesis.

Patient satisfaction is currently the decisive factor regarding the overall success of prosthodontic treatment in complete denture wearers (9). The gradual changes in mandible movement patterns in denture wearers have not been studied extensively and a cross-over randomized clinical trial could persuade practitioners to choose a DA as a useful adjunct for patient rehabilitation, based on scientific evidence, and disclose how the masticatory

system reacts when a DA is applied. According to Rendell et al. (10), if a reduction in denture movement produces an improvement in chewing function, it should be revealed by changes in the kinematic properties of mandibular opening and closing during the cycle.

Within a restricted movement range, kinesiograph may provide accurate graphic records of mandible movements, such as opening-closure movements, chewing cycles and interocclusal rest space. This apparatus is also capable of detecting the pattern of maxillary complete denture movement during chewing (11,12).

The aim of the present study was to assess the effect of a denture adhesive (DA) on the denture satisfaction and kinesiographic parameters of edentulous individuals, wearing well-fitting complete dentures, by means of a cross-over randomized clinical trial. The null hypothesis was that the use of DA does not influence the satisfaction levels or kinesiographic parameters of complete denture wearers.

## Material and Methods

The present study was approved by the Institutional Ethics Committee (Protocol Number 04/10) and registered in the '[ensaiosclinicos.gov.br](http://ensaiosclinicos.gov.br)' database (Identifier: RBR-5qrt8h).

### Participants

Fifty completely edentulous patients (mean age:  $64.8 \pm 14.2$  years old), who had volunteered to receive new complete dentures at Araraquara Dental School, were assessed for possible inclusion in the present study. The selection of individuals was based on the following inclusion criteria: (a) adult patients (45 years or more) who needed new complete dentures; (b) mentally receptive individuals and (c) normal volume and resilience of residual edentulous ridges. Residual ridge volume was considered normal when the contour of a cross-sectional portion of the edentulous ridges displayed a grossly triangular shape, with the base ranging between labial/buccal vestibules and the sides corresponding to the bilateral linear projection of both ridge slopes (11,12). The exclusion criteria were the following: (a) dysfunctions in the masticatory system; (b) debilitating systemic diseases and (c) cardiac pacemaker, to avoid possible interference with the kinesiograph.

A sample size calculation was conducted after a preliminary assessment of the results from the first 21 participants. It was found that at least 27 participants were required to detect a significant difference between the groups ( $\alpha=0.05$ ;  $\beta=0.20$ ). Considering possible losses and withdrawals, a group of 50 participants was estimated.

### Fabrication of New Complete Dentures

Participants received a set of new complete dentures

fabricated according to the standard protocol of the Araraquara School of Dentistry, UNESP. The fabrication of complete new dentures was performed by two researchers and one dental technician. A methacrylate-based resin (Lucitone 550; Dentsply Ind. e Com. Ltda, Petrópolis, RJ, Brazil) and 33 acrylic resin teeth (Trubyte Biotone; Dentsply) were used. Denture base resin was mixed and packed according to the manufacturer's instructions and polymerized in an automatic polymerization water tank (Solab Equipamentos para Laboratórios Ltd, Piracicaba, SP, Brazil). The temperature and time used were 73 °C for 90 min, followed by 30 min at 100 °C, as per the manufacturer's instructions. All complete dentures were fabricated according to bilateral balanced occlusion.

After insertion of the new complete dentures, the patients were invited to participate in this clinical trial and written consent was obtained prior to enrollment. A period of 30 days was allowed to elapse before starting the experimental procedures, as this was deemed necessary for functional adaptation and adjustment of the denture base and occlusion (12).

### Experimental Design

After the adaptation period, six patients declined to participate. Forty-four patients were enrolled and randomized to receive two sequences of the proposed treatment in alternating periods of 15 days: Protocol 1- DA use during the first 15 days, followed by no use of DA over the next 15 days; Protocol 2- no use of DA during the first 15 days, followed by use of DA over the next 15 days. In the present study, the evaluated DA was Ultra Corega Cream (GlaxoSmithKline Brazil Ltda., Rio de Janeiro, RJ, Brazil).

In Protocol 1, twenty-two participants received the DA and were shown how to use it according to the manufacturer's instructions. The DA was applied to the maxillary and mandibular dentures using the "strip" method. Three 1-cm strips were applied to the frontal, right and left middle region of the posterior segments of the dentures. Then, the patients demonstrated to the investigator the placement of the DA in their dentures. In Protocol 2, twenty-two participants continued using their dentures until the first outcome assessment. After a period of 15 days, the first assessment was performed and the protocols were changed for each group. A second assessment was performed after another 15-day period.

The protocol for each patient was randomly defined using computer generated numbers (BioEstat 5.0; Universidade Federal do Pará, Belem, PA, Brazil). The numbers were stratified by gender and age and reviewed by another researcher. This research assigned each participant to the sequences of two protocols immediately after enrollment, without involvement in other parts of the experiment.

Application of the DA before the assessments was performed by a different researcher from the previous ones, following the manufacturer's instructions. Before the assessments, strips were measured with a Boley gauge and the excess was cut off. The dentures were inserted in the mouth and a 3-min break was allowed to enable the patient to reposition the denture comfortably and habitually. For the group assigned to Protocol 2 during the first 15-day period, the same researcher performed no procedure. The researcher responsible for the application of the DA was informed about the type of procedure (with or without DA) only after the patient sat in the dental chair. All procedures were performed out of the patient's sight.

### Denture Satisfaction

Patient satisfaction was assessed using a denture satisfaction questionnaire, based on the criteria used by Celebic and Knezovic-Zlataric (9), Souza et al. (13) and Paleari et al. (12). The answers for each question and respective scores were as follows: (A) unsatisfactory ("0"); (B) regular ("1"); (C) good ("2"). The overall result for denture satisfaction was calculated by summing the scores of each question, with a range from 0 to 16, which was the primary outcome variable of the present study. The questionnaire was applied by another researcher, who was unaware of all other procedures performed in this research.

### Kinesiographic Assessment

The kinesiographic assessment was performed by another researcher, who was unaware of the treatment used during the assessment. A kinesiograph (K7-I Diagnostic System; Myotronics Research Inc., Seattle, WA, USA) was used to track mandible movements and the pattern of maxillary complete denture movement during chewing. This instrument is connected to a computerized system that records and displays spatial coordinates in three

dimensions: vertical; anteroposterior and lateral axes, at 0.1 mm accuracy (14).

Three tracing modes (scans) were selected for recordings: Scan 1 – opening-closure movements from centric occlusion to maximal opening; Scan 3 – three-dimensional mandible movement from rest position to maximal occlusion and the pattern of maxillary complete denture movement during chewing; Scan 8 – three-dimensional mandible movement during habitual chewing.

The participant sat upright in a dental chair with the Frankfort plane parallel to the horizontal plane. The sensor array was positioned according to the manufacturer's instructions and the magnet was attached to the labial midline surface of the mandibular (scan 1, 3 and 8) or maxillary complete dentures (scan 3 – pattern of maxillary complete denture movement during chewing) (12). In order to study mandible movement and the pattern of maxillary complete denture movement during chewing, a piece of bread (5 x 10 x 15 mm) was placed in the patient's mouth on the top of the tongue with the mandible at rest.

Figure 1 represents a common graphic pattern for mandible movement (scan 8) and maxillary complete denture movement (scan 3) during chewing, according to the vertical, anteroposterior and lateral axes. Three chewing cycles were registered on all axes after a period of 20 s of mastication and individual mean displacement values were obtained for each axis during chewing.

All procedures were carried out according to the manufacturer's instructions. Three reproducible measurements were recorded for each scan mode and each patient, providing a mean value.

### Statistical Analysis

Statistical analysis was performed by another researcher, who was also unaware of all procedures performed in this research. The general score and the results of each question

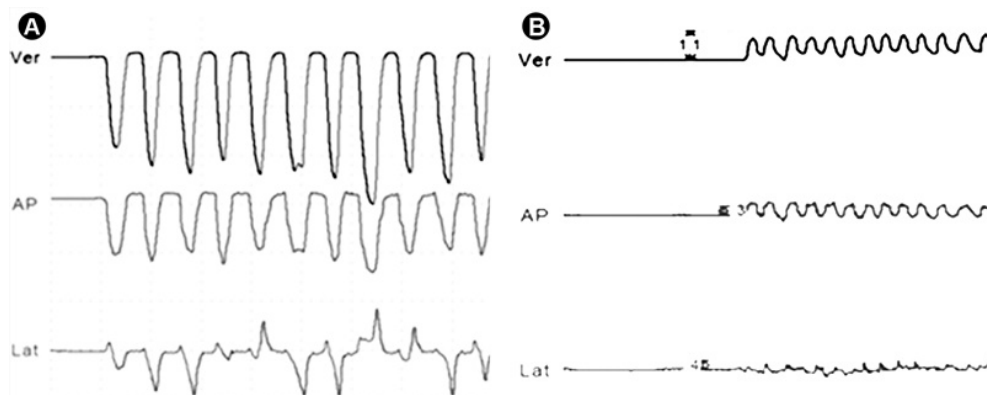


Figure 1. Common graphic patterns. A. Mandible movement during habitual chewing – scan 8. B. Maxillary complete denture movement during chewing – scan 3 on the vertical (Ver), anteroposterior (AP) horizontal and lateral (Lat) axes.

about denture satisfaction were assessed separately, described by counting frequencies and compared by the non-parametric paired sample Wilcoxon test, since a symmetrical distribution of data was not observed. For kinesiographic recordings, a comparison between the groups was performed using the paired sample *t*-test. All data were analyzed with PASW Statistics (version 19; SPSS Inc., Chicago, IL, USA), with the significance level set at  $\alpha=0.05$ .

## Results

Figure 2 displays a diagram of the participants throughout the course of the research. Forty-four patients

were recruited for the present study. During the follow-up, fourteen patients were lost from the study. Figure 3 shows that the use of DA resulted in an increase in the overall satisfaction of participants with their dentures (Wilcoxon test,  $p<0.001$ ). The results of the denture satisfaction questionnaire according to each question are shown in Table 1. The main positive influences of the DA were the following: comfort ( $p=0.001$ ); retention ( $p<0.001$ ) of mandibular complete dentures; general satisfaction ( $p=0.008$ ) and ability to chew ( $p<0.001$ ).

The results of the kinesiographic recordings are listed in Table 2. The positive values represent orientation movement for anterior, upper or right, while the negative

D.O.M. Marin et al.

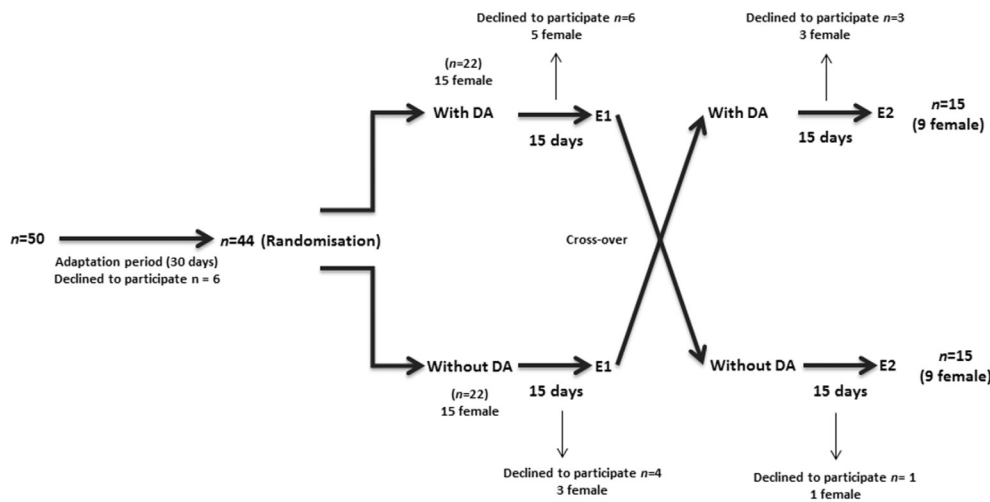


Figure 2. Flow diagram of participants: DA = denture adhesive; E1 = evaluation 1; E2 = evaluation 2.

Table 1. Frequency of answers for each question of patient satisfaction with complete dentures related to the use of denture adhesives

Original criteria	n (%)									p (Wilcoxon test)
	With DA			Without DA						
	U	R	G	U	R	G	U	R	G	
Comfort of wearing mandibular dentures	1 (3.3)	6 (20.0)	23 (76.7)	3 (10.0)	20 (66.7)	7 (23.3)				0.001*
Retention of mandibular dentures	1 (3.3)	4 (13.3)	25 (83.3)	2 (6.7)	22 (73.3)	6 (20.0)				0.000*
General Satisfaction	-	1 (3.3)	29 (96.7)	1 (3.3)	9 (30.0)	20 (66.7)				0.008*
Chewing	-	5 (16.7)	25 (83.3)	3 (10.0)	22 (73.3)	5 (16.7)				0.000*
Speech	-	1 (3.3)	29 (96.7)	-	6 (20.0)	25 (80.0)				0.059
Esthetics	-	2 (6.7)	28 (93.3)	-	1 (3.3)	29 (96.7)				0.564
Comfort of wearing maxillary dentures	-	2 (6.7)	28 (93.3)	-	2 (6.7)	28 (93.3)				1.000
Retention of maxillary dentures	-	-	30 (100)	1 (3.3)	-	29 (96.7)				0.317

\*Significant differences ( $p<0.05$ ). DA = denture adhesive; U = unsatisfactory; R = regular; G = good

numbers represent the opposite directions. There were no statistically significant differences for the opening and closure mandible movement limits or for the mandible

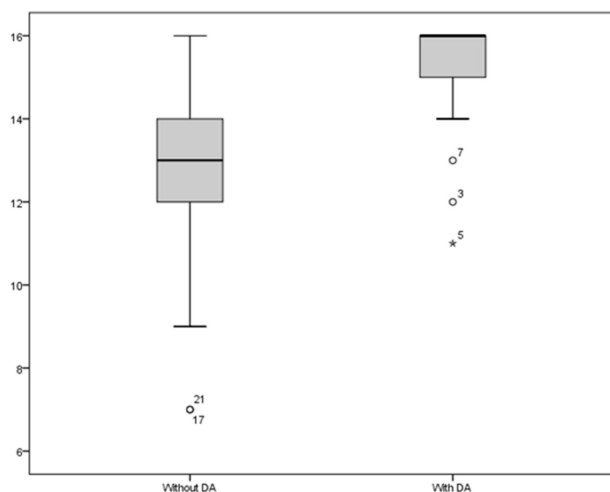


Figure 3. Box plot graph comparing overall satisfaction data with and without denture adhesive. DA = denture adhesive; Median without DA = 13; with DA = 16 (Wilcoxon test;  $p < 0.001$ ).

movement from rest position to maximal occlusion with or without DA. However, DA use produced an increase (1.7 mm) in mandible vertical movement during chewing and a lower intrusion (0.3 mm) of the maxillary complete dentures during chewing (paired  $t$ -test;  $p < 0.05$ ). Figure 4 displays the design of the pattern of mandible movement during chewing with and without the DA.

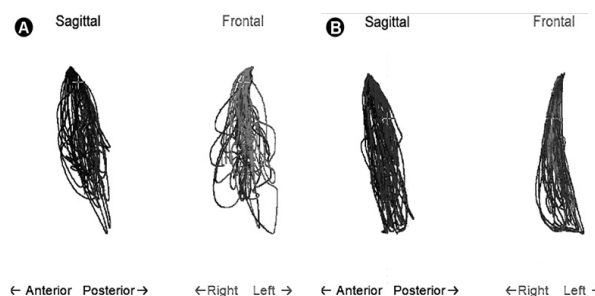


Figure 4 - Design of the pattern of mandible movement during chewing generated by the software in the sagittal and frontal planes. DA: denture adhesive. A: without DA. B: with DA.

Table 2. Mean values (and standard deviations) for mandible movement patterns and maxillary denture movement during chewing with and without denture adhesives

Criteria		Without DA	With DA	Differences	t-test	
					t	p
Scan 1- open-close cycle from centric occlusion to maximal opening	VO	35.5±6.4	36.8±5.7	1,3±3.8	-1.795	0.083
	HO	24.7±7.3	27.0±7.9	2.3±7.1	-1.768	0.088
	RO	3.2±3.3	2.9±3.4	-0.3±4.6	0.364	0.718
	LO	6.0±6.01	8.4±8.5	2.4±8.2	-1.616	0.117
Scan 3- Movement of the mandible from rest position to maximal occlusion	VER	3.4±2.4	3.3±2.3	-0.1±0.91	0.501	0.620
	AP	2.5±1.2	2.5±1.7	0.0±1.0	-0.048	0.962
	LAT	0.6±0.5	0.5±0.5	0.0±0.5	0.263	0.795
Scan 8- Movement of the mandible during chewing	VER	12.8±3.0	14.5±3.3	1.7±1.6	-6.100	0.000*
	AP	3.9±2.6	3.7±2.9	-0.1±2.3	0.266	0.792
	LAT	-0.3±21	-0.1±1.6	0.3±1.9	-0.712	0.482
Scan 3- Maxillary denture movement during chewing - Maximum	VER	0.9±0.5	0.7±0.3	-0.3±0.4	3.452	0.002*
	AP	0.5±0.6	0.3±0.3	-0.2±0.6	1.914	0.066
	LAT	0.0±0.4	0.0±0.2	0.1±0.4	-0.973	0.339
Scan 3- Maxillary denture movement during chewing - Residual	VER	0.1±0.1	0.2±0.1	0.0±0.2	-1.010	0.321
	AP	-0.1±0.2	0.0±0.1	0.1±0.2	-1.631	0.114
	LAT	0.0±0.2	0.1±0.2	0.1±0.2	-1.828	0.078

\*Statistically significant differences ( $p < 0.05$ ). DA = denture adhesive; VO = vertical opening; HO = horizontal opening; RO = right opening; LO = left opening; VER= Vertical; AP= Anteroposterior; LAT= Lateral. Positive values mean orientation movement with upper, anterior or right, while negative numbers represent the opposite directions.

## Discussion

In the present study, a questionnaire was used to identify the patient's satisfaction and a kinesiographic assessment was performed by a cross-over randomized clinical trial, to determine the effectiveness of DA in patients with new well-fitting complete dentures, after a 1-month period of adaptation. The aim of the present study was to ascertain if the DA provided a better satisfaction level for patients with new well-fitting dentures, independent of the product. Information about the influence of DA on mandibular dentures and mandibular movements is scarce. Most studies in the literature assessed only retention and static stability in maxillary dentures.

The results of the present study showed that the overall satisfaction was significantly higher when a DA was applied. These results could be associated with advantages related to the use of a DA by patients with conventional complete dentures, which include improvements in their masticatory function, greater retention and stability of the maxillary and mandibular dentures, increased incisal bite force and a sense of physical and psychological comfort (6).

According to Turker et al. (15), when overall satisfaction is assessed, the general results do not confirm if the dissatisfaction is caused by mandibular or maxillary dentures. According to Siadat et al. (4), mandibular complete dentures are usually associated with pain, lack of retention, poor stability and poor function. They may also compromise the patients' confidence and comfort (16). In addition, factors such as esthetics, speech, stability and comfort are frequently associated with overall satisfaction with dentures (17). The ability to chew has been considered a determining factor for the satisfactory acceptance of dentures (18). Considering the satisfaction results for each question in the present study, it was possible to detect specific issues that affected overall satisfaction. It was possible to suppose that complete mandibular dentures influenced directly the overall satisfaction of denture wearers (Table 1), since only 20 (23.3%) of the patients classified the comfort and retention of their mandibular complete dentures as "good", when DA was not used. On the other hand, a significant improvement was observed in these parameters after use of DA ( $p < 0.05$ ), with 76.7% (comfort) and 83.3% (retention) of the patients classifying the comfort and retention of their mandibular complete dentures as "good". This result confirmed the important role of a DA for edentulous patients, mainly for improving the retention and comfort of their mandibular complete dentures and, consequently, increasing their overall satisfaction.

It is important to observe that chewing ability was also influenced by the use of a DA ( $p < 0.05$ ), since 83.3 % of the patients using a DA answered "good" for this aspect

against 16.7% of the patients that were not using a DA. These findings are in accordance with other subjective studies (7,19), which indicate that chewing ability was significantly improved when a DA was applied to maxillary and mandibular dentures, providing the retention and stability expected by patients during functional activities, as well as a greater ability to chew, less denture movement and increased confidence and comfort.

No statistically significant differences were found for retention and comfort ( $p > 0.05$ ) of maxillary dentures. According to Kulak et al. (19), a possible explanation for these findings may be that the maxillary dentures occupy a larger space, and ridges are often less resorbed when compared with the highly resorbed alveolar ridges in the mandible. Moreover, the adaptation period was long enough for patients to become accustomed to the maxillary complete dentures when a DA was absent and did not feel any difference when a DA was applied. Similar results were also found for speech and esthetics with or without DA. According to Ellis et al. (20), speech is a complex skill that requires a prolonged period of adaptation, and a lack of significant improvement may be due to the short review period. It is also known that patients above 65 years are more concerned with functional aspects than esthetics, since they are retired and socially compromised, whereas patients aged between 45-65 are more conscious about esthetics and speech, because they are a potentially active group who require social and professional acceptance (21).

In the present study, the mean age of the patients was  $66.3 \pm 11.5$  years. The results show that after using a DA, a significant improvement was found in the masticatory ability of patients, suggesting that the use of adhesives can improve functional features, especially in patients over 65 who are more concerned with improving their masticatory ability.

Changes in mandible movement patterns in denture wearers have not been studied extensively. Until now, there are no randomized trials to assess the effect of a DA on mandible movement in complete denture wearers. In the present study, DA usage did not influence the movement of the mandible from the rest position to maximal occlusion. This result suggests that a DA does not change the freeway space necessary for complete denture wearers to exert their functional activities and, therefore, it could be hypothesized that it does not alter the vertical dimension of occlusion. Possible changes in the occlusal vertical dimension could result in bone resorption of the residual ridge with the time the complete dentures have been used.

The results of the present study showed that DA might increase (1.7 mm) the amplitude of mandible movements during the chewing cycles on the vertical plane. Adhesives probably improved the retention and stability of both

dentures, increasing the comfort and confidence of the patients, allowing them to chew more vigorously. Another important difference regarding this issue could be seen in the design of the mandible movement pattern generated by the software. According to Rendell et al. (10), irregular movements of both the mandible and mandibular dentures would suggest the possibility of increased tissue trauma and consequent ridge resorption of the mandibular base. In the present study, irregular patterns were observed when the participants were wearing conventional complete dentures without adhesives and a regular and organized pattern could be observed while using a DA (Fig. 4), suggesting a decrease in the likelihood of tissue trauma.

According to the results of the present study, a significantly lower vertical intrusion (0.3mm) of maxillary complete dentures was observed during chewing when a DA was used. This result was expected because the ridges serve as physical boundaries, limiting movement in the anteroposterior and lateral plane (14). The values found in the present study for the movement of maxillary complete dentures are normal, since a kinesiographic study (22) reported that the range of well-fitted maxillary complete denture movement varied from 0 to 1.4 mm on the chewing side and 0.1 to 1.6 mm on the other side. Grasso et al. (14), using a kinesiographic equipment, found an improvement in the retention and stability of maxillary dentures during chewing after the use of a DA. The authors suggested that although the application of DA produced significant improvements in several aspects, denture movement was never completely eliminated because of the natural elasticity of the adhesive and mucosa (14).

The test food (bread) used in this clinical trial can be classified as "soft" and is characterized by the occurrence of occlusal contact during chewing. (11) It also represents sticky food types, which are problematic for denture wearers. (10) Bread can provide interaction between antagonist occlusal surfaces, thereby resulting in a lesser amount of anteroposterior movement compared with "hard" food, which is first crushed by the teeth without contact, until a soft consistency is achieved (11).

A cross-over design was used to eliminate inter-subject response variations to the same treatment, as well as to reduce the influence of confounding covariates. Each participant serves as his/her own control, which increased the statistical efficacy (12). In addition, blinding the participants and researchers may have decreased the chance of bias which can occur if a treatment intervention (with or without DA) is provided preferably to one group and detrimentally to another. All procedures were performed to safeguard the internal validity of this research.

One limitation of the present study was the losses during the follow-up. Six of the "lost patients" failed to return after

the adaptation period with the new complete dentures. According to Ellis et al. (20), it is possible to interpret this in two ways. Either these patients were entirely satisfied with their replacement dentures, or alternatively, they were totally dissatisfied and did not wish to waste more time. After randomization, 5 patients were unable to return due to bad health (n=3) and domestic accidents (n=2). Six failed to return and three refused to complete the study because they lived in other cities.

The denture use time could also influence a subjective assessment of new dentures. Turker et al. (15) reported that patients that have already used their dentures for more than 3 years exhibit more satisfaction in some variables, such as chewing capacity, comfort, tasting, phonetics and general satisfaction. According to Jockman et al. (23), patients who have been edentulous for a short period were more dissatisfied with their new dentures. This could be a limitation, depending on how long the dentures had been worn or their quality. However, it may be minimized since the study protocol contemplated repeated measurements with the same patient and involving the same dentures (24). Furthermore, a period of adaptation is important before starting any treatment. Patients were included based on the selection criteria and were aged 45 years or more. After the installation of new dentures, they used them for a month for adaptation, which was sufficient to not interfere in the study variables of a "cross-over" study protocol with repeated measurements.

It is also necessary to consider the possibility of errors in the kinesiographic assessment. As related by Souza et al. (11), a mandible kinesiograph is accurate for a vertical range of motion below 40 mm, provided that the magnet is correctly positioned. The kinesiographic method has been employed in previous studies to assess the viscoelastic properties of mucosa (25) and was considered useful for documenting the denture displacement under different conditions of occlusal loading.

The results of the present study may be valid for edentulous individuals of both genders and all ages who were treated with complete dentures and who exhibited normal volume and resilience values for the residual edentulous ridges. Extrapolation for wearers with dysfunctional disorders of the masticatory system and systemic diseases should be assessed. Furthermore, depending on the type of DA, mucosal resiliency and the impact on the quality of life, long-term influence of DA usage should be assessed in future studies.

Based on the results of the present study, the null hypotheses were rejected for denture satisfaction and for certain kinesiographic parameters of edentulous patients. In conclusion, the use of a DA was enough to improve patient satisfaction with their complete dentures and to

change mandible movements, with increases in vertical mandible movements during chewing and lower intrusion of maxillary complete dentures, as long as the volume and resilience of the residual edentulous ridges of the participants were normal.

## Resumo

O objetivo deste estudo foi avaliar o efeito da utilização de um adesivo para prótese na satisfação e nos parâmetros cinesiográficos em usuários de próteses totais por meio de um estudo "cross-over". Cinquenta pacientes desdentados receberam novas próteses totais bimaxilares. Após um período de adaptação, os participantes incluídos no estudo receberam uma sequência de tratamento: Protocolo 1- utilização do adesivo para prótese durante os primeiros 15 dias, seguida por não utilização do adesivo os próximos 15 dias; Protocolo 2- não utilização do adesivo durante os primeiros 15 dias; seguida por utilização do adesivo nos próximos 15 dias. Os resultados foram avaliados após 15 dias de cada sequência de tratamento. Um questionário para avaliar a satisfação dos pacientes e um cinesiógrafo para registrar os movimentos mandibulares e o padrão de movimento da prótese total maxilar durante mastigação foram utilizados. O teste de "Wilcoxon" ( $\alpha=0,05$ ) e o "t-test" de Student para amostras pareadas ( $\alpha=0,05$ ) foram utilizados para comparar o grau de satisfação dos pacientes e os dados cinesiográficos, respectivamente. O adesivo para prótese melhorou significativamente a satisfação geral dos participantes ( $p<0,001$ ). Os registros cinesiográficos mostraram um aumento significativo (1,7 mm) no movimento mandibular vertical ( $p<0,001$ ) e uma menor intrusão (0,3 mm) da prótese total superior ( $p=0,002$ ) durante a mastigação após o uso de adesivo. O uso de adesivo para prótese melhorou a satisfação dos usuários de próteses totais e gerou um aumento no movimento mandibular vertical e uma menor intrusão da prótese total maxilar durante a mastigação.

## Acknowledgements

The authors gratefully acknowledge the financial support of FAPESP (Grant Numbers Proc. 2011/03204-0 and 2010/00736-9). We also thank Mr. João Monti Junior (dental technician) for his assistance in the fabrication of complete dentures and Prof. Raphael Freitas de Souza for his assistance in carrying out this research. The authors declare no potential conflicts of interest with respect to the authorship and/or publication of this article.

## References

1. Carlsson GE, Omar R. The future of complete dentures in oral rehabilitation. A critical review. *J Oral Rehabil* 2010;37:143-156.
2. Awad MA, Lund JP, Shapiro SH, Locker D, Klemetti E, Chehade A, et al. Oral health status and treatment satisfaction with mandibular implant overdentures and conventional dentures: a randomized clinical trial in a senior population. *Int J Prosthodont* 2003;16:390-396.
3. Doundoulakis JH, Eckert SE, Lindquist CC, Jeffcoat MK. The implant-supported overdenture as an alternative to the complete mandibular denture. *J Am Dent Assoc* 2003;134:1455-1458.
4. Siadat H, Alikhasi M, Mirfazaalian A, Geramipannah F, Zaery F. Patient satisfaction with implant-retained mandibular overdentures: a retrospective study. *Clin Implant Dent Relat Res* 2008;10:93-98.
5. Emami E, Heydecke G, Rompre 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-

6. Grasso JE. Denture adhesives: changing attitudes. *J Am Dent Assoc* 1996;127:90-96.
7. Kelsey CC, Lang BR, Wang RF. Examining patients' responses about the effectiveness of five denture adhesive pastes. *J Am Dent Assoc* 1997;128:1532-1538.
8. Ozcan M, Kulak Y, Arikan A, Silahtar E. The attitude of complete denture wearers towards denture adhesives in Istanbul. *J Oral Rehabil* 2004;31:131-134.
9. Celebic A, Knezovic-Zlataric D. A comparison of patient's satisfaction between complete and partial removable denture wearers. *J Dent* 2003;31:445-451.
10. Rendell JK, Gay T, Grasso JE, Baker RA, Winston JL. The effect of denture adhesive on mandibular movement during chewing. *J Am Dent Assoc* 2000;131:981-986.
11. de Souza RF, Marra J, Pero AC, Regis RR, Compagnoni MA, Palcari AG. Maxillary complete denture movement during chewing in mandibular removable partial denture wearers. *Gerodontology* 2009;26:19-25.
12. Palcari AG, Marra J, Rodriguez LS, De Souza RF, Pero AC, De AMF, Jr., et al. A cross-over randomised clinical trial of eccentric occlusion in complete dentures. *J Oral Rehabil* 2012;39:615-622.
13. de Souza RF, Terada AS, Vecchia MP, Regis RR, Zanini AP, Compagnoni MA. Validation of the Brazilian versions of two inventories for measuring oral health-related quality of life of edentulous subjects. *Gerodontology* 2012;29:e88-e95.
14. Grasso JE, Rendell J, Gay T. Effect of denture adhesive on the retention and stability of maxillary dentures. *J Prosthet Dent* 1994;72:399-405.
15. Turker SB, Sener ID, Ozkan YK. Satisfaction of the complete denture wearers related to various factors. *Arch Gerontol Geriatr* 2009;49:e126-e129.
16. van Waas MA. The influence of clinical variables on patients' satisfaction with complete dentures. *J Prosthet Dent* 1990;63:307-310.
17. De Lucena SC, Gomes SG, Da Silva WJ, Del Bel Cury AA. Patients' satisfaction and functional assessment of existing complete dentures: correlation with objective masticatory function. *J Oral Rehabil* 2011;38:440-446.
18. de Souza e Silva ME, de Magalhaes CS, Ferreira e Ferreira E. Complete removable prostheses: from expectation to (dis)satisfaction. *Gerodontology* 2009;26:143-149.
19. Kulak Y, Ozcan M, Arikan A. Subjective assessment by patients of the efficiency of two denture adhesive pastes. *J Prosthodont* 2005;14:248-252.
20. Ellis JS, Pelekis ND, Thomason JM. Conventional rehabilitation of edentulous patients: the impact on oral health-related quality of life and patient satisfaction. *J Prosthodont* 2007;16:37-42.
21. Singh BP, Pradhan KN, Tripathi A, Tua R, Tripathi S. Effect of sociodemographic variables on complete denture satisfaction. *J Adv Prosthodont* 2012;4:43-51.
22. Chong LC. Movement of maxillary complete dentures--a kinesiographic study. *J Dent* 1983;11:257-263.
23. Jonkman RE, van Waas MA, van 't Hof MA, Kalk W. An analysis of satisfaction with complete immediate (over)dentures. *J Dent* 1997;25:107-111.
24. Manes JF, Selva EJ, De-Barutell A, Bouazza K. Comparison of the retention strengths of three complete denture adhesives: an *in vivo* study. *Med Oral Patol Oral Cir Bucal* 2011;16:e132-e136.
25. Compagnoni MA, de Souza RF, Leles CR. Kinesiographic study of complete denture movement related to mucosa displacement in edentulous patients. *Pesqui Odontol Bras* 2003;17:356-361.

Received February 25, 2014

Accepted June 3, 2014