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ORIGINAL ARTICLE

Influence of adaptation of removable partial denture on masticatory performance.

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Abstract: Objective: To compare the masticatory performance (MP) of patients with old removable partial denture (RPD), recently inserted RPD and already adapted RPD by means of the simple sieve test. Material and Methods: Twenty-nine adult (>18 years old) volunteer patients were recruited, with lower and upper RPD, excluding total edentulous subjects in the upper and lower jaw, with temporomandibular disorders, severe periodontal disease, mental disability or systemic disease compromising the masticatory or nervous system. Dentures were designed and fabricated by an expert operator. MP was evaluated in old RPD (MP1), recently inserted RPD (MP2) and adapted RPD (MP3). The simple sieve test used was Edlund-Lamm in percentage of MP, using Optosil® Comfort condensation silicone tablets, with standard sizes (5.0x20mm). In each phase, the patient chewed the tablet with 20 masticatory strokes. The crushed fragments were dried at 80°C for 60 minutes and weighed on an analytical scale. A multiple vibration sieve analysis was performed, using sieves with opening sizes of 2.8mm and 1.4mm. Shapiro-Wilk test and Anova test with Bonferroni correction were performed. Results: It was observed that MP1 presented a mean of 8.40% (SD±5.59), MP2 a mean of 8.56% (SD±5.56), and MP3 a mean of 18.26% (SD±8.12). There was a significant difference ($p<0.05$) between the MP1-MP3 groups, as well as between the MP2-MP3 ($p<0.05$). Conclusion: There is a significant increase in MP thirty days after the insertion of RPD, checkups, and adjustments performed by the dentist.

Keywords: *Dental prosthesis, Removable partial denture, Mastication.*
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INTRODUCTION.

The increase in life expectancy has had consequences in the human body, and a particularly strong impact on public and private health care.[1] Loss of teeth, and its subsequent decrease in masticatory ability and efficiency, is one of the most frequent conditions affecting quality of life in numerous ways,[2,3] even resulting in cognitive impairment in older adults.[4] Given the above, some authors[5,6] point out that the restoration of an adequate masticatory function is one of the main goals in dentistry as it improves dietary, systemic, mental and physical functions of the human body.

The use of removable prostheses is still a viable and widely used treatment. Prostheses play an important role in restoring health and oral function,[7] almost paralleling the masticatory ability of patients with complete dentition.[8] Masticatory function can be described in objective terms as a person's ability to chewing solid food. "Masticatory performance" (MP) is the concept used to measure this parameter, defined as the capacity to chewing a specific type of food. Silva *et al.*[10] showed that the MP's mean of patients rehabi-

litated with removable partial denture (RPD) increased by 25%. However, they did not perform a statistical analysis to determine if their results were statically significant. Besides, they did not consider the stage of RPD adaptation in subsequent checkups, a factor that could be relevant in the study of MP.[11] On the other hand, Asakawa *et al.*[12] reported measures performed with the "sieving test", in which patients with new and adapted prostheses showed an increase in masticatory efficiency after a few weeks. However, they recommend that other tests measuring MP should be performed to complement their findings.

The aim of this study was to compare the MP of patients with old RPD and adapted prostheses (AP) by means of a simple sieving test. A secondary objective was to describe the perception of patients with old and adapted RPD. The hypothesis was that patients with AP show a significant difference in MP compared to their old prosthesis and to the recently inserted RPD.

MATERIALS AND METHODS.

Design

The present study was carried out at the School of Dentistry at Universidad Andrés Bello, Santiago (2014-2015). This study was approved by the local ethics committee in compliance with its requirements (Code PROPRGFO_2014.62).

Population

Patients older than 18 years who required complete replacement of upper or lower RPD were included in the study. Total edentulous patients in the upper and/or lower jaw, as well as those with symptoms of temporomandibular disorders, severe periodontal disease, who did not use new prostheses every day during the tests, with mental disability, *i.e.*, not being able to understand instructions, with presence of systemic disease compromising their masticatory or nervous system, were excluded from the sample.

Thirty-five patients of a total of 356 examined subjects were selected according to the criteria defined above. Six opted out of the study. Fourteen acrylic RPDs and fifteen metal-acrylic RPDs were manufactured. Patients were classified according to Kennedy: 9 class I, 14 class II, 4 class III and 2 class IV. Reasons for RPD replacement are given in Table 1, with the main one being "improving function".

Groups

Groups were: old RPD (MP1), recently inserted RPD (MP2) and adapted RPD (MP3). The study included up to the last checkup in which the patient reported absence of discomfort and absence of problems with the prosthesis. Each patient answered a questionnaire after they had adapted to their new prosthesis in order to obtain information about their perception of the use of the prosthesis (Table 1).[10] The questionnaire was applied by an external operator.

Measurement of masticatory performance

The method for evaluating MP was published by Edlund and Lamm.[13] This corresponds to the use of an Optosil® Comfort condensation silicone tablet made in bronze molds with 5mm in thickness, 20mm in diameter and 2g in weight. Three tablets were made for each patient. Tablets were crushed by 20 chewing strokes. Particles were then expectorated in a plastic strainer and washed with water.

Crushed fragments of each phase were carefully washed, dried in an electric oven at 80°C for 60 minutes and weighed on an analytical scale with 0.1-gram precision. Particles were separated by size, using a multiple vibration sieve analysis. Sieves had opening sizes of 2.8mm and 1.4mm. Particles were deposited in the first sieve activating the vibrating sieve device. Consequently, thicker particles remained in the first sieve; medium-size particles in the second, and the smaller particles remained at the base of the device.

Particles collected in each sieve were weighed on an analytical scale recording their weight to calculate the Edlund & Lamm's MP index.[13]

Bias control

All prostheses were designed by an operator specialist in prosthetic dentistry and fabricated by the same laboratory. The MP test was performed by a different operator, and the statistical analysis by a blinded statistician.

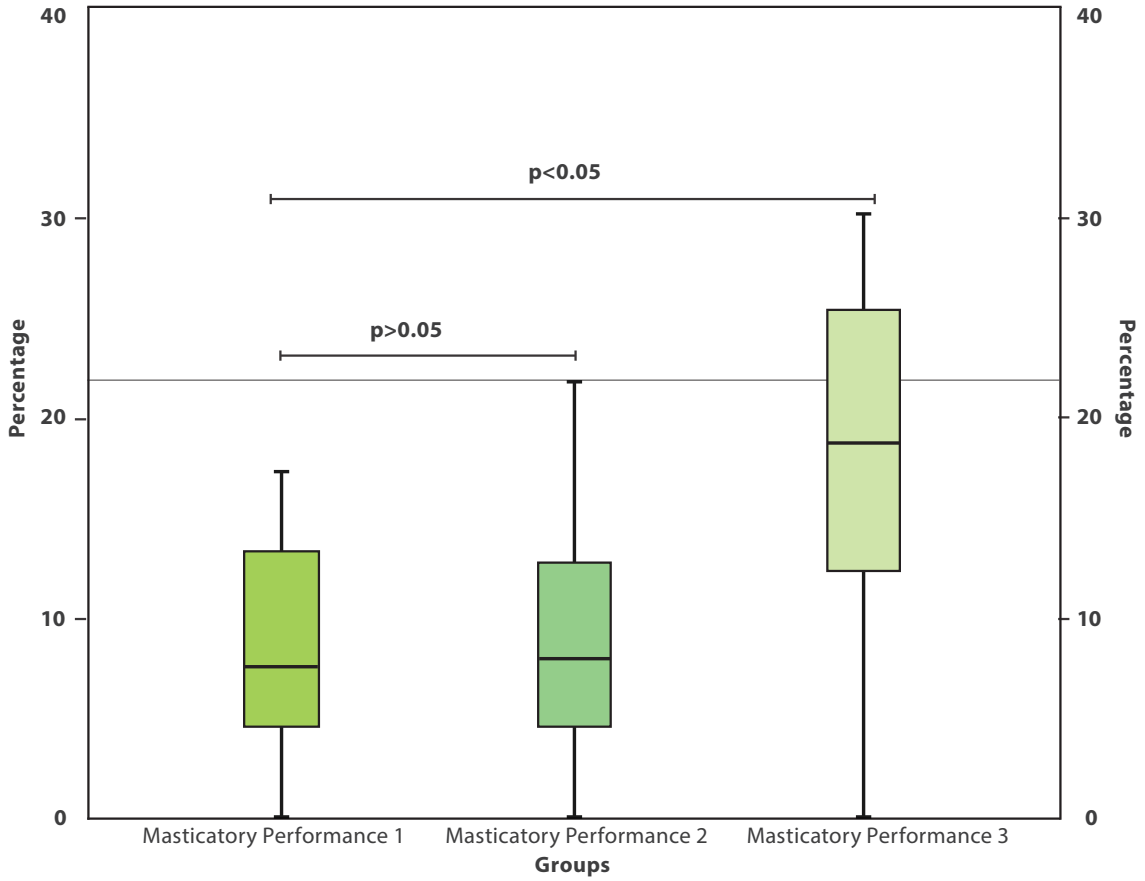
Statistical analysis

Shapiro-Wilk and Anova tests of repeated measures (Bonferroni correction) with a confidence level of 95% were used. The analysis was performed using SPPS 17.0 (IBM, USA).

Table 1. Questionnaire answered by patients with adapted RPD.

Question	%
1. ¿Why did you change your prosthesis?	
a. Esthetical reasons	17.2
b. Functional reasons	41.4
c. Esthetical reasons and functional ones to a lesser extent	13.8
d. Functional reasons and esthetical ones to a lesser extent	27.6
2. Comparing your current prosthesis with your old prosthesis, which one makes you feel that you are eating better?	
a. The new prosthesis	75.9
b. The old prosthesis	24.1
c. I feel no difference, both are okay	0.0
3. Can you eat with your new prosthesis the same foods you ate with the old one?	
a. Yes, my diet has not changed	48.3
b. No, with the old prosthesis I could eat a greater variety of foods	10.3
c. No, with new prosthesis I can eat a greater variety of foods	41.4
4. Has prosthetic treatment improved your quality of life?	
a. Yes	72.4
b. Partially	24.1
c. No	3.4

Figure 1. Comparison of MP percentage between groups.



RESULTS.

Of a total of 29 patients, the 58.6% (17) were women, mean age was 64.3 years (41-77 years). The average time of adaptation to the new RPD was 32.5 days. MP for the different groups was: MP1 8.40% (SD±5.59%), MP2 8.56% (SD±5.56%) MP3 18.26 (SD±8.12%) (Figure 1).

A significant difference was found between the groups ($p<0.001$). Comparison between them indicated that there were significant differences between the groups MP1-MP3 ($p<0.001$) and MP2-MP3 ($p<0.001$).

The 89.7% of the patients indicated that they could eat the same foods or even an increasing food variety with the recently adapted RPD. Regarding quality of life, the 72.4% indicated that it had improved; the 75.9% indicated that the improvement was due to the new prostheses. The rest of the results are shown in Table 1.

DISCUSSION.

Results confirm the hypothesis, there is a significant increase in MP3 compared to MP1-MP2 groups. This is consistent with similar studies by Asakawa *et al.*[12] and Bessadet *et al.*[14] in which masticatory ability and efficiency showed a significant increase in adapted prostheses after a given time. Retention problems and RPD stability can explain lower MP in the MP1 condition as they directly affect the physiology of mastication.[15]

In the MP2 group, patients can perceive the new RPD as a foreign element, negatively affecting their confidence while chewing food. This is explained in part because oral tissues and tactile receptors need time to gradually recognize the new prosthesis. This statement would be supported by studies reporting at least a 30-day adaptation period for patients with new RPD.[12,16]

In spite of the above observations, it is necessary to mention that the adaptation of the prosthetic appliance is a purely personal and subjective matter.[14] A patient may require longer adaptation time or may not be able to use his or her prosthesis after checkups, as was the case with a patient who showed a MP equal to zero in the 3 evaluations. This patient was the same one reporting in the survey not having experienced any improvement in quality of life. This particular situation could be explained because this patient was unable to chew the silicone tablet due to lack of confidence in RPD and perhaps because of a lesser skill for the chewing process. It should be remembered that masticatory ability is an individual and subjective process that depends on other aspects such as psychological factors and age.[17] While such processes are complementary, a person with significant tooth loss may report that he/she has no problem masticating.[18-21] There is a common misconception that people with zero MP are unable to eat. This is not the case, because there are several compensatory mechanisms such as swallowing of larger foods, increase in masticatory frequency or the use of a consistency diet.[14,15]

The sieving of a ground artificial food was chosen because most studies still use this methodology. However, currently there are multiple, more accurate methods whose use would be advisable in future studies. For example, there is the analysis of color mixing and loss of sugar from chewing gums, colorimetric methods and optical scanning of ground particles.[22-24] On the other hand, in sieving tests natural foods such as almonds, peanuts, carrots, or artificial foods based on silicone (such as Optosil) can be used, the latter being one of the most recommended.[25] The main advantage of natural foods is that people are familiar with them, however, the variability of choices is wide and depends on the geographical area.[24]

Given the above, the Optosil artificial food test was chosen because of the advantages of having standard hardness, a specific dissolution resistance in saliva, less probability of being swallowed and storage at room temperature.[26] However, it is necessary to mention that there may be a possible source of bias regarding Optosil because "human beings" have the capacity to "learn". This would imply the possibility that food samples in the first test may not have been chewed adequately because the type of food was unknown to the subjects and that they eventually "learned" to masticate it to the third attempt,

improving their scores in masticating. Future studies should consider this variable.

One of the limitations of the study was the low number of patients. Another limitation was not including a control group without postoperative checkups, due to the ethical recommendations of leaving RPD patients without clinical follow-up. It is important to mention that there are other more accurate methods of sieve calculation for MP, such as the X50 in multiple sieves, which uses a regression technique of average particle size after processing through different types of sieves.[27] It would be highly advisable to incorporate them in the design of future studies.

On the other hand, it is necessary to carry out similar studies that could confirm these findings and that provide more information especially regarding quality of life through validated instruments like the OHIP-14.[28]

CONCLUSION.

There is a significant increase in MP thirty days after the insertion of RPD, checkups, and adjustments performed by the dentist.

Influencia de la adaptación del aparato protésico parcial removible en el rendimiento masticatorio.

Resumen: Comparar el rendimiento masticatorio (RM) de pacientes con prótesis parcial removible (PPR) antigua, PPR recién instaladas y adaptadas mediante test de trituración simple. Material y Método: Se reclutaron 29 pacientes voluntarios mayores 18 años, recambio PPR superior o inferior, excluyendo a desdentados totales superior y/o inferior, con trastornos temporomandibulares, enfermedad periodontal severa, enfermedad mental o enfermedad sistémica que comprometa el sistema masticatorio o nervioso. Las prótesis fueron planificadas y realizadas por un operador experto. El RM fue evaluado en PPR antigua (RM1), PPR recién instalada (RM2) y PPR adaptada (RM3). El test de trituración utilizado fue de Edlund-Lamm en porcentaje de RM, utilizando pastillas de silicona condensación Optosil® Comfort, con dimensiones estandares (5,0x20mm). Cada fase el paciente trituró la pastilla con 20 golpes masticatorios. Los restos triturados fueron secados a 80°C por 60 minutos y pesados en una balanza analítica. Se realizó un análisis de tamizado vibratorio múltiple, utilizando tamices de 2.8mm y 1.4mm de apertura. Se aplicaron el test Shapiro-Wilk, test Anova con corrección de Bonferroni. Resultados: Se observó que RM1 presentó una media de 8,40% (DS±5,59), RM2 una media de 8,56% (DS±5,56) y RM3 una media de 18,26% (DS±8,12). Entre los grupos RM1-RM3 hubo diferencia significativa ($p<0,05$) al igual que RM2-RM3 ($p<0,05$). Conclusión: El RM aumenta significativamente tras 30 días de instalación de una PPR coincidiendo con los controles y ajustes por parte del odontólogo.

Palabras clave: *Prótesis dental; prótesis parcial removible; Masticación.*

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