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Alternative technique for preliminary impression in edentulous patients

Técnica alternativa para moldagem preliminar de pacientes desdentados totais

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ABSTRACT

Objective: The aim of this study was to analyze the reproducibility of the anatomic models of edentulous maxillary and mandibular arches. **Material and Methods:** Alginate molds of the edentulous arches of standard model were performed and the tray was placed to the special device. These models received three metal spheres on surface with two positioned on the crest of the alveolar ridge (spheres 1 and 2) and other one perpendicular to the intersection of the midpalatal suture (sphere 3) and impression was performed using alginate. The proportion powder/liquid was measured according manufacturer for both arches. To double molding technique with alginate was necessary to uniformly relieve using an acetate film. After that, were performed the first impression and the second layer of alginate with conventional water-powder-proportion and also the second layer of alginate with altered water-powder-proportion. The distances of each spheres wereobtained using a three-dimensional measuring-machine, and the data were analyzed byDunnet, ANOVA and Tukey tests with a significant level of 5%. **Results:** A comparison of the water-powder-proportion showed significant differences in the maxillary archer with sphere distance between 3-2 ($p<0.0001$) and 1-3($p<0.0001$). The mandibular archer showed significant differences when relief between distance 1-2 ($p<0.041$). The Dunnet test showed different in 1-2 mandibular groups ($p<0.0450$). **Conclusion:** The reline alginate techniques showed differences in results in comparison to the conventional technique, however, the proportion water/powder technique modified, decreasing the viscosity, showed satisfactory results, the relief variable showed no difference statistically

RESUMO

Objetivo: O propósito deste estudo foi analisar o grau de reproducibilidade de modelos anatômicos de arcos maxilares e mandibulares. **Material e Métodos:** Moldes de alginato de modelos padrão desdentados foram realizados a partir do uso de uma moldeira adaptada em um dispositivo metálico. Os modelos receberam três esferas em sua superfície onde duas eram posicionadas na crista do rebordo alveolar (esferas 1 e 2) e uma outra perpendicular à interseção da rafe mediana (esfera 3) e a moldagem foi realizada com o emprego do alginato. A proporção pó e liquido foi mensurada de acordo com o fabricante do alginato para ambos os arcos. Para a técnica de moldagem dupla com alginato foi necessário fazer um alívio com filme de acetato. Após isto foi realizada a primeira moldagem e depois uma segunda camada onde empregou-se a proporção pó líquido convencional e ainda, uma outra situação onde esta proporção foi alterada. A distância entre as esferas foi medida no modelo por uso de equipamento de mensuração tridimensional e os dados foram analisados por Dunnet, Anova e teste Tukey com nível de significância em 5%. **Resultados:** A comparação da proporção água e pó mostrou diferença estatística significante para os arcos maxilares entre as esferas 3-2 ($p<0.0001$). O arco mandibular mostrou diferenças significantes quando avaliada a distância 1-2 ($p<0.041$). O teste Dunnet mostrou diferenças para o grupo mandibular entre esferas 1-2 ($p<0.0450$). **Conclusão:** A técnica de rembasamento de alginato mostrou resultados diferentes à técnica convencional, contudo a técnica de modificação da proporção água pó diminuiu a viscosidade do alginato, mostrou resultados satisfatórios,

significantly and the techniques proposed could be employed in clinical practice.

KEYWORDS

Alginate;Complete denture;Edentulism

outrossim a variável alívio não mostrou diferenças estatísticas. A variação técnica proposta mostrou-se ser viável do ponto de vista clínico.

PALAVRAS-CHAVE

Alginato; Dentadura Completa; Edentulismo.

INTRODUCTION

Complete dentures should restore the masticatory function, phonetics, aesthetics and, in addition, be pleasant for the patient. For these requirements, retention and stability of the prosthesis should be appropriate and important to accomplish this step [1].

Adequate impression procedures are essential to obtain a peripheral sealing zonefor good retention and proper extensions for support and stability of a complete denture [2]. This stage of fabricating complete dentures aims to customize the denture bases that will promote the optimal denture-supporting area and ensure that the border form of the prostheses provides a peripheral seal and it is directly proportional to the reproduction of the tissues [3].

The use of elastic materials such as alginate is common for this type of procedure, since it produces the appropriate mold at this stage of the treatment. This material is derived from a natural substance extracted from brown algae as the calcium, magnesium and sodium salts, called alginic acid [4]. Compared to other molding materials available alginate is the most used by professionals. The main factors responsible for the success of this type of material are: ease of handling, patient comfort, low cost and the fact it does not require sophisticated equipment [5].

The alginate is a material of low-tear strength, which should be supported by an impression tray to give an even thickness of material, thus avoiding distortions of the material [6]. RUDD et al. [7] envisaged that the thickness of the alginate should be uniform to prevent different compressions according to the amount of material which could change the mold [8].It is a good material choice for anatomical moldings associated or not with other materials [4]. However, there are limitations due to viscosity. When a low viscosity material is used it is much easier to copy the oral tissues but on the other hand it is more difficult to keep it into the tray for achieving sulcar area. The viscosity is therefore one of the factors that influence surface detail reproduction and when controlled the mucosal detail is superior [9].

Research on the dimensional stability of alginate and also about molding techniques has been applied [4,9,10]. Variations in molding techniques aim at a more detailed reproduction of the molded areas. Some studies report a molding in two stages, in other words, the first mold is obtained and then applied to a new layer of an impression material [9].

The reline technique has been described by in clinical reports[11], where it recommended to reline the first layer of alginate with a new low viscous mixture in a ratio of one part powder to two parts water. According to the author of this technique relining the irreversible hydrocolloid can increase oral tissues, contributing to improve the final characteristics of the mold with a consequent increase in the accuracy of the anatomical model.

Even though the use of alginate is enshrined a focus on proportion, manipulation and applicability is important when studying

the variations. Only then the clinic can get the best equipment to reach the best final results. Although the literature currently emphasizes fewer researches on this specific material, it is acknowledged that new formulations of alginate contribute to the use of high practicality, quality and time.

Considering the lack of research regarding the reliability of the technique of double molding studies should be conducted to further evaluate whether this procedure with variables such as the validity of the technique. The use of alginates with different formulations, when used as relief of the first layer and altered consistency of the second layer, can influence the reproduction of the edges. Therefore, plaster models made from such molds, aimed at improving the quality of work in dentures and related areas.

The aim of this study was to analyze the reproducibility of the anatomic models of edentulous maxillary and mandibular arches when using the technique of double molding alginate (reline) with two experimental conditions: relief or non-relief from the first layer and variation in the water-powder-ratio of the second layer.

MATERIAL & METHODS

Experimental design and the groups are described in the Table I.

Conventional molding technique with alginate

Alginate molds of the edentulous maxillary and mandibular arches of standard model made of a polymer and silicone coating serve to reproduce the anatomic characteristics of mucosal. Plastic trays for the edentulous arches were selected to cover the whole area of the edentulous mucosa remaining of approximately 5mm.

The standard model and tray was coupled to the designed device that was made especially for this research (Figures 1a and 1b),

Table I - Description of the maxillary and mandibular archers groups

Groups	Impression	Relief	Water-powder-proportion
Maxillaryarcher(N=5)			
Control	Simple	No	No
DNN	Double	No	No
DNY	Double	No	Yes
DYN	Double	Yes	No
DYY	Double	Yes	Yes
Mandibular archer(N=5)			
Control	Simple	No	No
DNN'	Double	No	No
DNY'	Double	No	Yes
DYN'	Double	Yes	No
DYY'	Double	Yes	Yes

which allowed them to make the molding so as to have a copy of the condition of the edentulous ridge. This device has a docking area for the standard model. It has another part where the tray is fitted to adjust. The distances between the tray impression and the standard model in order to maintain the predetermined distance and the thickness of the molding material (Figure 2a).

These standard models received three metal spheres on surface with two positioned on the crest of the alveolar ridge in the approximate molar region and one in the middle region, in a line perpendicular to the intersection of the midpalatal suture, positioned respectively. These metal spheres (Ø 3mm) have been fixed in the corresponding region by drilling into the silicon and the material was attached with a cyanoacrylate glue. With the models fixed in the device, the molding was performed.

The molding was performed with alginate (Cavex ColorChange - Cavex Holland – Netherlands). First, stirring the powder container to ensure its homogenization. The proportion powder/liquid in volume was provided by the manufacturer's devices(1:1), two portions of powder (20g) and two portions of water (40ml) for both arches. The material

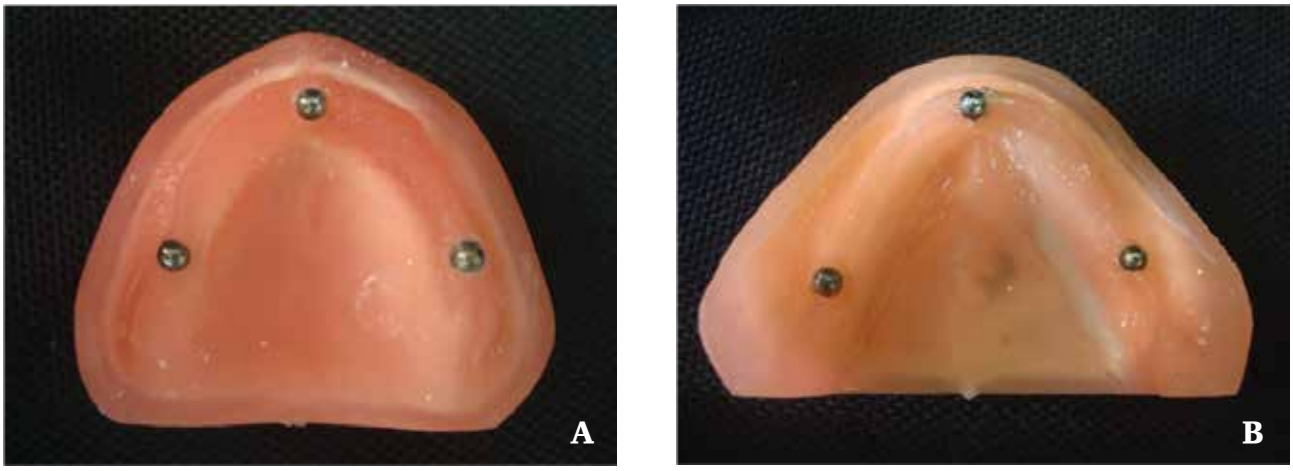

Figure 1 - a) Standard upper model with metal spheres attached with a cyanoacrylate glue. b) Standard lower model.

was manipulated during 45 s/1 min and the plastic tray impression was properly completed. The setting time prior to removal of the mold was standardized at 5 min. After the removal, it was verified that a good reproduction of the standard model, which included the entire denture bearing area without the occurrence of bubbles, thickness uniformity and free tearing, was well suited to the tray impression.

Double molding technique with alginate

Before proceeding with the molding, it was necessary to uniformly relieve the entire area of the edentulous plaster mold, including the sulcar area whereby the relief was made using an acetate sheet of 1mm thickness.

First Impression

After having performed the molding with the same previous protocol, the mold was removed from the plate acetate following the application of another layer of alginate.

Second layer of alginate with conventional water-powder-proportion

The alginate was proportioned 1:1 (powder/water; 10g/20ml). The manipulating was 45s to 1min following manufacturer's recommendation. The mold was filled with this new hydrocolloid layer in order to cover its entire area (Figure 2b).

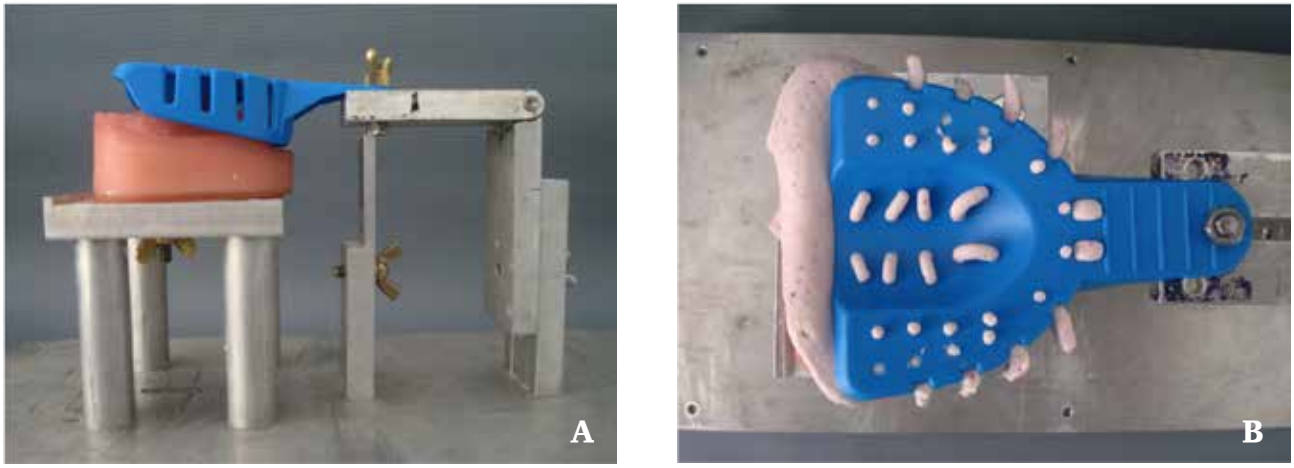

Figure 2 - a) Device used for impression standardization. b) Impression of standard upper model by alginate.

Second layer of alginate with conventional water-powder-proportion

The proportion of alginate was modified to 1:1.5 (powder/water; 10g/30ml) making materials mixedlower viscosity than these obtained according to the manufacturer's recommendation. Before the application of the second layer a layer of adhesives for the alginate TAC Bosworth (Bosworth Company, Illinois, USA) was applied to the stabilization of the new layer.

Primary Models

The disinfection simulation of the molds was performed with 2% glutaraldehyde for 10 min under spray and then rinsing in copious water. It is known that the disinfection process of molding is necessary in clinical procedures [12]. For the model, the gypsum IV(Zero stone – Dentona – Germany) was used in the proportion of 23ml and 100g (water/powder). Also it was mixed vigorously for 1 min in a rubber mixing bowl and rubber trowel plaster until obtaining a homogeneous mixture. At the end of the mix, the vibrator plaster was used to eliminate air bubbles. After 30 min the mold/model was conditioned in a plastic box with a cover containing cotton dipped in water to set a relatively high humidity inside the box. For the separation of the mold/model cure-time of one hour was expected. The models were kept at room temperature (22°C ± 2°C and 55% ± 10% of relative humidity) in a plastic container coated with 5 mm-thick foam dipped in water for 48 hours (Figure 3).

Analyses of samples

A three-dimensional measuring-machine, i.e. 3D Hexagon Global, capable of measuring 500nm CNC, is composed of a body which moved in three axes, X, Y and Z-axis. It was fixed at a spherical tip measuring 1 mm in diameter. For find the centre of sphere the measuring tip was touched 5 times at sphere surface and the coordinate of the centre was recorded and exported to a software (Program PC – DMIS CAD++ 3.7).The spheres' distance among themselves with the surface composed of the three points, results in a value of angular difference determined in the x- and y- axis.

Figure 3 - Example of final maxillary model.

The experimental conditions of this study were: variation of technique (simple or double); alginate proportion; relief or not. ANOVA and Tukey test was used to comparison between variables and Dunnet test was chosen to compare each experimental group against Its control. Both Dunnet test, ANOVA and Tukey were used for the statistical analysis with a significant level of 5%.

RESULTS

A comparison of the water-powder-proportion showed significant differences in the maxillary archer with sphere distance between 3-2 ($p<0.0001$) and 1-3($p<0.0001$). The mandibular archer showed significant differences when relief between distance 1-2 ($p<0.041$). However the other distance no significant differences were observed ($p>0.05$) (Table II). The pos-hoc Tukey test was performed for the water-powder-proportion in the maxillary archer and to relief in the mandibular archer (Table III and IV).

The dimensional alteration was analysed in percentage and the values are

in the Table II and III. Dunnett's test were performed to compare the control group with others groups at a significance level of 0.05% (Table V) and showed different in the 1-2 mandibular groups ($p<0.0450$). The DNY´ group (double impression, no relief and water-powder-proportion altered) showed significant statistically value.

The sphere distance 1-2 for maxillary archer did not show any difference between groups concerning water-powder-proportion

The spheres distances 1-3and 3-2 for mandibular archer did not show any difference between groups concerning water-powder-proportion.

Table II - ANOVA 2-way of the maxillary archer and mandibular archer

Maxillary archer - ANOVA 2-WAY			
	Sphere distance 1-3	Sphere distance 3-2	Sphere distance 1-2
Relief	p=0.8080	p=0.86662	p=0.7380
Water-powder-proportion	**p<0.0001**	**p<0.0001**	p=0.5425
Relief and water-powder-proportion	p00.6687	p00.668	p00.8067
Mandibular archer - ANOVA 2-WAY			
	Sphere distance 1-3	Sphere distance 3-2	Sphere distance 1-2
Relief	p=0.9146	p=0.4820	p<0.0410
Water-powder-proportion	**p=0.4386**	**p=0.7558**	p=0.1374
Relief and water-powder-proportion	p=0.1936	p=0.2261	p=0.3721

Table III - Pos hoc Tukey of the maxillary archer

Pos hoc Tukey – Maxillary archer		
Water-powder-proportion modified	**Sphere distance 1-3**	**Homogeneous Group**
YES	100.0073	A
NO	101.3587	B
	Sphere distance 3-2	
YES	100.0229	A
NO	101.3770	B

Different letter show statistical difference.

Table IV - Pos hoc Tukey of the maxillary archer

Pos hoc Tukey – Mandibular archer		
Water-powder-proportion modified	**Sphere distance 1-2**	**Homogeneous Group**
YES	98.2107	A
NO	100.4870	B

Different letter show statistical difference.

Table V - Dunnett's test to compare the control group with others groups

Pos hoc Dunnet test (p<0.05)				
SPHERE DISTANCE		1-3	3-2	1-2
MAXILLARY ARCHER	DNN	0.122384	0.100231	0.985208
	DNY	0.216897	0.211534	0.900665
	DYN	0.304605	0.233338	0.972845
	DYY	0.276086	0.296017	0.622429
MANDIBULAR ARCHER	DNN'	0.639192	0.933804	0.866597
	DNY'	0.948892	0.233800	**0.045081***
	DYN'	0.999639	0.702115	0.995726
	DYY'	0.938425	0.995644	0.997892

* statistical difference

DISCUSSION

To analyze the reproducibility of anatomical models of maxillary and mandibular edentulous arches, metallic spheres have been adapted into three different points on the alveolar ridge, two spheres in the molar region and one sphere in the midline region. These points are important clinically to obtain a copy to fabricate complete dentures. Thus, moldings with trays stock were performed in a coupled device.

At first impression, the proportion water/powder was as recommended by the manufacturer. The first impression of the models was used the conventional methods. An alginate adhesive recommended by the manufacturer was used to secure the trays before fixing the material. The use of bonding agent increased the bonding strength for all-water-powder ratio. Relief or not was used to perform a second layer and alter or not the ratio recommended by the manufacturer in the mixture of alginate and water.

The water/powder ratio established for the alginate in the second layer showed statistical difference. Low viscous alginate showed greater accuracy than the conventional proportion. Probably because the thin alginate being low viscous induce less stress on the first layer thus minimizing the deleterious effect. These results are not in accordance with Aoyama [13], that higher viscosity will have greater fidelity in the final product than the low viscosity.

The conventional methods demonstrated a satisfactory performance with dimensional changes of 1.3% on average. We can also suppose that these characteristics have been presented because of the type of alginate used in this study, in the case it has silicone composition which provides good dimensional stability characteristics, some authors considering acceptable 0,5% of dimensional shrinkage for alginate [14].

The water and powder proportion alteration forthree distances (1-3 and 3-2 for maxillary archer and 1-2 for mandibular archer) promoted better behaviour than control group because Its closer than 100%.

The position of spheres (1, 2 and 3) influenced the results differently. Perhaps the difference founded to 2 and 3 spheres, Table V, be justified due to amount of mold material among theirs or archer form.

Other variable was the presence or absence of preliminary relief of the second layer to minimize possible stress generated on the first layer. The results however showed that this factor was statistically significant just in a situation when in the mandibular impressions and the relief groups were more distant in percent comparing to standard group.

Al-Athel [1] emphasized the importance of promoting specific reliefs and use adhesives trays seeking good reproducibility in the molds. Due to the standards models are made of silicone a greater adhesion between the second layer with silicone and not the union alginate/alginate expected to obtain this second layer. Prior to the first impression, an adhesive was used onto the trays, as the composition of the powder is similar to the edentulous ridge of the study models (which is made by silicon).

Complete denture construction usually require two types of impressions, the first one is a preliminary molding and alginate is used. An adequate molding in this phase results in better quality of preliminary casts consequently

it helps to the construction of this prostheses. A preliminary molding is considered satisfactory when it shows good copy of edentulous areas, free of porous or distortions.

The viscosity of alginate may influence in that final impression characteristics, low viscosity improve the copy of tissue details. The association of techniques presented in this study promoted better qualitative results without dimensional alterations in impression and cast.

Other studies in terms of impression materials may be performed in order to check on the type of alginate used in the analyses to influence the variables employed here. Thus, future examinations are necessary.

CONCLUSION

In this in vitro study, the lining alginate techniques showed differences concerning distances between measured points in the arches when powder and water proportion was modified. However, that differences did not promoted meaningful dimensional shrinkage. The water/powder proportion modified to the second layer decreased the viscosity and showed satisfactory results once that promoted better detail in molding area and consequently improved cast quality. The relief did not show statistical differences, then it is possible to conclude that the techniques proposed is adequate to be use in preliminary impression for upper and lower edentulous archer.

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