

Características Relacionadas às Propriedades dos Elastômeros Odontológicos: Revisão

Particulars Related to Dental Elastomer Properties: Review

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Recebido: 7 de fevereiro de 2013; Aceito: 19 de julho de 2013.

Resumo

O objetivo neste estudo foi realizar uma revisão da literatura sobre as características relacionadas às propriedades dos materiais elastômeros odontológicos. Os materiais de moldagem são utilizados em Odontologia para reprodução de detalhes anatômicos dos arcos dentários, em diferentes especialidades odontológicas, tais como: Planejamento e execução do tratamento ortodôntico, tratamentos reabilitadores na área da prótese com objetivo da confecção de modelos de estudo e de trabalho. Esta etapa da confecção de modelos convencionais e troquelizados é uma etapa importante para diversos procedimentos, podendo ser realizada com gesso a partir do molde. Para a obtenção de um modelo preciso com reprodução de detalhes e sem distorção, os materiais de moldagem devem ter alguns requisitos: fluidez suficiente para adaptação aos tecidos bucais; viscosidade suficiente para escoamento nas áreas a serem moldadas; polimerização (elastômeros) na cavidade bucal com tempo de presa adequado; após a polimerização, ausência de distorção ou rasgamento após remoção da boca; estabilidade dimensional até que o gesso seja vazado no molde; estabilidade dimensional do molde após remoção do modelo; e biocompatibilidade com os tecidos bucais. Contudo, de acordo com esta revisão de literatura, o fator de limitação não é o tipo de elastômero, mas a qualidade do gesso utilizado.

Palavras-chave: Materiais para Moldagem Odontológica. Técnica de Moldagem Odontológica. Prótese Dentária. Sulfato de Cálcio.

Abstract

The aim of this study was to review in literature the characteristics of dental materials elastomers. The molding materials are used in dentistry for playing anatomical details of the dental arches in different dental specialties, such as planning and execution of orthodontic treatment, and rehabilitation treatments aimed at making study models. This stage of manufacture of models is an important step for many procedures, and can be performed in a cast from the mold. In order to obtain a precise model with detail reproduction and without distortion, some requisites are needed, such as sufficient fluidity to adapt to the oral tissues; viscosity to flow in the areas to be molded; polymerization at a suitable setting time while in the oral cavity. In addition, the materials must not distort or tear upon removal from the mouth; remain dimensionally stable until the plaster is poured into the mold; the model must maintain dimensional stability after removal from the mold, and allow second models to be constructed from the same impression, besides being biocompatible with the oral tissues. However, according to this literature review, the limiting factor is not the type of elastomer, but the quality of the plaster used.

Keywords: Dental Impression Materials. Dental Impression Technique. Dental Prosthesis. Calcium Sulfate.

1 Introduction

Impression materials are used in rehabilitative treatments with fixed and removable dentures and for fabricating study models in various other areas^{1,2}. The initial reports on the polysulphide-based elastomer materials (the first elastomer materials) in dental literature were made by Fettes and Jorczak³. Impression materials were simple to manipulation and work with, so professionals themselves could manufacture an individual acrylic resin cast⁴.

In order to obtain a precise model, impression materials must comply with certain requisites, such as being sufficiently fluid to adapt to the oral tissues and having sufficient viscosity to stay in the mold. While in the oral cavity, impression materials should become transformed into solid rubber in a short space of time, and after the setting reaction, they must

not distort or tear when removed from the mold. In addition, molds made of these materials must remain dimensionally stable until the cast is poured, and maintain its dimensional stability after removal from the model, in order to allow second models to be constructed from the same molding, besides being biocompatible with the oral tissues⁵.

Dimensional alterations in elastomers may occur due to several factors, such as the type of material used, viscosity and thickness between the molded structures and mold, method of molding material fixation in the mold, time elapsed for pouring the cast⁶, hydrophilicity of the materials⁷. Other factors include formation of byproducts, polymerization shrinkage, thermal contraction due to temperature changes between patient's mouth and environment, incomplete elastic recovery, and even imbibition, in some cases. In view of

this, the aim of the present study was to perform a literature review about the particulars related to the properties of dental elastomer materials.

2 Development

For the composition of the present review, we conducted a literature review in Medline, SciELO, periodical portal Coordination of Improvement of Personnel of Higher Education - CAPES in the year of 2011, using as descriptors: dental elastomers, dimensionally stable, elastic recovery and hydrophilic.

2.1 Review and discussion

According to Lefler and Reddy Junior⁸, a faithful model is necessary in order to perform adequate prosthetic work; therefore, a distortion-free mold is required. The materials that comprise the group of elastomers are the polyether, silicones of addition - and condensation - type reactions, found in 4 different viscosities: mass or density (type 0), weight (type I), medium or regular (type II) and light (type III), according to ISO 4823⁹. Johnson and Craig¹⁰ demonstrated that, in general, the silicones polymerized by addition reaction lead to more precise and faithful molded structures when compared with others made of elastomers. Furthermore, addition silicone material is produced by a reaction of the vinyl group with the hydride groups¹, without by-product formation, therefore without distortion of the impression material. Thus, these materials remain dimensionally stable after removal of the model, making it possible to manufacture other models from the same mold.

An ideal impression material would be dimensionally accurate over the course of time, and therefore, could be poured at the operator's convenience¹¹. Regarding the impression materials, addition silicone presents ideal dimensional stability¹¹, and among the other impression materials, the polyether presented the best dimensional precision in comparison with the condensation silicone and polysulphide materials¹². In other study¹³, this polyether material presented an intermediate behavior between the condensation and addition silicones. Therefore, in spite of the studies having used different methodologies, it appears by analogy that addition silicone has better dimensional accuracy, followed by polyether.

There are aspects for evaluating the reproduction of details of impression materials. According to the American Dental Association #19, elastomer materials used for precision models must be capable of reproducing details of 20 μm or less¹⁴. Differences in the reproduction of details would not be a clinical consideration because the limiting factor lies in the capacity of dental plasters to copy the finest details. The specification corresponding to dental plasters indicates that it should copy 50 μm . The majority of dental plasters copy better than this, but some plasters fall short of this. Thus,

Fernandes and Vassilakos¹⁵ found statistically different values between the same impression materials (addition silicone) for the reproduction of details.

There are significant differences in the capacity of elastomers to confer various viscosities for reproducing the finest details. In general, the lower viscosity of impression materials produces the finest details better. Materials with dense consistency are unable to reproduce the finest details (20 μm), reproducing on average, details of 75 μm ¹⁶. One of the deficiencies on using a dense consistency impression material is that critical areas of the dental preparation, such as the cervical margin are molded. According to Peutzfeldt and Asmussen¹⁷, impression materials with contact angle greater than 70 degrees show a positive correlation between the water repelling capacity and the contact angle, i.e., the water repelling capacity improved by the increase in viscosity. Therefore, plaster models with little precision are being poured for fabricating prostheses.

Among other requisites, the impression material must present good elastic recovery. Dimensional alterations in a mold must be avoided. These alterations or distortions may occur if elasticity develops in the material before the end of the polymerization reaction. This is due to elastic deformations are caused during seating of the mold, which are released after the mold is removed, resulting in distortions. Impression materials must be able to flow promptly into areas inside dental preparations, set in this position, and recover their original shape after removal from the mouth. No impression material has 100% elastic recovery and for all molding materials, the deeper dental preparations will have the greatest permanent distortion¹¹. According to Anusavice⁵, the decreasing order of elastic recovery is as follows: addition-reaction silicones, condensation silicones, polyethers and polysulphides. Addition-reaction silicones have better elastic recovery at a level of 99%¹⁸. This property, together with the excellent dimensional stability of the addition silicones, makes the material the most precise for the second pouring for until 7 days.

In the clinic, the dental surgeon faces the possibility of destroyed dental elements. According to the level of the destruction of such teeth, professionals have the option to recommend direct or indirect restorations¹⁹. One of the most important steps in the indirect metallic or non-metallic restoration is obtaining an accurate impression of the tooth to be restored and its adjacent tissues, in attempt to reproduce the correct relationship among all of the structures in the buccal cavity¹⁹. Thus, addition-reaction silicones have been cited as an efficient molding material to reestablish contact points between restorations in the manufacture of ceramic onlay²⁰.

In the literature, the term hydrophobicity has been used to describe two phenomena²¹. The first aspect refers to the free surface energy of the solid, polymerized material, and the high contact angle that is normally formed when impression

materials are wet with dental plaster²². The second aspect regards the surface free energy of the non-polymerized material, liquid of the impression material phase, and the capacity or lack of capacity of the liquid for wetting oral tissues during impression taking²¹.

A significant limitation when using addition silicones was hydrophobia²², which can be explained by its chemical structure that contains siloxanes linked around the aliphatic hydrocarbons (hydrophobic). In contrast, the polyether and polysulfide impression materials are more hydrophilic than the addition silicones because of the chemical structures containing functional groups that attract and interact with the water molecules through hydrogen bridge bonds. The hydrophilic structures of polyether are represented by the carbonyl (C=O) and ether (C-O-C) groups, while the polysulfide material contains the hydrophilic disulfide (-S-S-) and mercaptan groups (-S-H)⁵.

Due to this hydrophobic nature, a non-ionic surfactant paste may be added to make the impression material surface hydrophilic. This surfactant migrates to the impression material surface with its hydrophilic segment oriented in the direction of the surface, flowing better over the humid tissue and providing better reproduction of the details by the plaster poured⁵. According to Pratten and Craig²³, the wetting values of addition silicone showed no statistical difference in comparison with the polyether impression material. Therefore, the addition silicone is useful for impression taking in sites with similar humidity to that indicated for polyether. However, a study showed that the samples of polysulfide (permlastic) stored in sanitizing solution showed greater contraction as compared to the control group (not stored in sanitizing solution) after 60 minutes²⁴.

Therefore, the properties discussed are not variables that exclude the choice of some of these materials, considering that there is no clinically significant difference among them. It is recommended that dentists use the material to which they are best adapted, respecting the limit of each material among other external factors that may influence distortion of the impression material, such as precision of the plaster used for fabricating the models.

3 Conclusion

Based on the literature review, we concluded that:

In general, the lower viscosity of impression materials reproduces the finest details better.

Addition silicone impression materials have better elastic recovery at a level of 99%.

Addition silicone with surfactants and polyether materials present better results than the hydrophilic types.

The limiting factor is not the type of elastomer but the quality of the plaster used.

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