

Effect of time elapsed after setting on tear strength of different elastomeric impression materials

Thesis

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Cairo University**

*In partial fulfillment of the requirements of
Master degree in Fixed Prosthodontics*

By

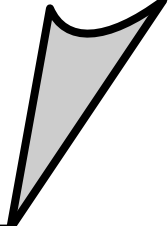
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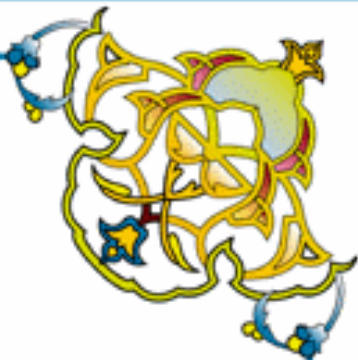
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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

قَالُوا سُبْحَانَكَ لَا عِلْمَ لَنَا
إِلَّا مَا عَلَّمْتَنَا إِنَّكَ أَنْتَ
الْعَلِيمُ الْحَكِيمُ





Dedication

*To my great **Father** and **Mother**,*

*Who were the reason for where I am today and
without their support, Enthusiasm and
encouragement, this work would have not been
possible.*

*To my lovely wife Mrs. **Nehal Nagy**, who was always
supporting me, and to my honey son **Ghaleb** for his love.*

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Introduction

The technical complexity inherent in fixed prosthodontics treatment is compounded by the necessity of utilizing an indirect approach, where fabrication occurs extraorally at the dental laboratory and the completed restorations are subsequently retrofitted in the oral cavity. One fundamental aspect in the fabrication of indirect restorations is the procurement of an accurate impression from which a refractory model can be created to precisely replicate the intraoral environment.⁽¹⁾

Although numerous materials and techniques have been advocated, the restorative dentist must have knowledge about the physical properties of these materials and their application in a variety of indirect procedures in prosthodontics, particularly in cases that involve multiple abutments.⁽²⁾

Dental impression materials have a number of stringent requirements placed upon them, most of which are critical to the successful use of the material. One of these requirements is tear strength. The material must be capable not only of flowing and forming thin films in the gingival crevice, but also of being withdrawn from undercuts without tearing after the material has set. Tearing in the impression causes defects, which affect the accuracy of the final restoration.⁽³⁾ Additionally, some impression material remnants remaining in the sulcus may produce inflammation reactions.^(4,5) Therefore, it is necessary for impression materials to have maximum tear strength at the time of removal.⁽⁶⁾



The clinical tear performance of a given material involves a complex relationship between polymer and filler types, flow to a particular film thickness, release properties (adhesion) from tooth and soft tissue, presence of internal and surface defects, and the rate of impression withdrawal.⁽²⁾

Because of the complexities of integrating and measuring these properties, this study is a laboratory test evaluating the maximum tensile yield stress of a thin film of impression material after different times elapsed after setting.



Review of Literature

The impression is the foundation and blueprint to restorative success for indirect restorations. ^(7,8) An ideal impression material should be biocompatible with oral tissue, non-toxic and non-irritating of acceptable odor and taste, easy to mix and requires minimal equipment for use. It should possess suitable working and setting times, adequate detail reproduction and good tear strength. It should have no dimensional change during polymerization or storage. Last, it should be compatible with die and model materials, long shelf life and affordable cost. ⁽⁹⁾

Still now we have not any impression material fulfills all of these requirements. So an ideal impression should be completely set upon removal and distortion free. Then it should has an uniform homogenous mix of materials, uniform bond between the impression material, adhesive, and tray and reproduce fine surface details free of debris such as saliva and blood, no evidence of voids, bubbles, drags or tears. And it should provide adequate wash thickness to withstand distortion and tearing when intraoral removed. ^(9, 10, 11)

Restorative success is governed by the quality of the impression. The impression process requires an integration of various elements of restorative dentistry. The restorative dentist must have knowledge of the physical properties of these materials and their application in a variety of indirect procedures in prosthodontics and restorative dentistry. However, as studies indicate, the accuracy of the impression may be controlled more by the technique than the material. ⁽¹²⁻¹⁶⁾



Therefore material knowledge must be integrated with the proper technique for each clinical situation. Consequently, the ultimate success of the final impression depends on the skill of the operator, and the experience acquired with that given technique. ^(3, 12-17)

The art of impression taking requires recording of the exact dimensions of the preparation, the position of the soft tissue, the architecture of the preparation margins, and the relationship of the prepared teeth to the surrounding dentition. Restorative and periodontal complications can occur from improperly positioned sub gingival margins, traumatic manipulation of the soft tissue, thin tissue biotype, and bulky fibrous papilla. ^(8, 18)

Achieving an accurate final impression is the result of properly integrating multiple interrelated steps during the preparation and impression-taking process. Numerous factors were cited as tissue management, hemostasis, moisture control, proper material selection, tray selection, volume of material, timing. ^(9,10, 11) A clinical procedure using the one-step/double-mix impression with a double-cord gingival displacement is reported to provide the clinician with a step-by-step approach to successful final impressions. ⁽¹⁷⁾

The historical development of modern impression materials spans a recent period of time from about 1925 to the present. Before this timing, materials such as waxes, plaster and compound were used with varying degrees of success. ⁽¹⁹⁾



Impression materials are commonly classified by considering their elastic properties once set. Therefore, they can be broadly divided into non elastic and elastic materials. ⁽²⁰⁾

Non-Elastic Impression Materials

For most of the first half of the 20th century, dental impression material choices were simple varying from dental compound which is a thermodynamic material and plaster. The procedure didn't matter much as both materials were often used together. Individual copper tubes used compound to take the impression of the prepared tooth and then a "pick up impression" was taken with plaster to link the copper tube to the adjacent teeth or preparations. Considering "the lack of give" in either of these materials, the consequences of undercut were lethal. ⁽²¹⁾

Compound was also used as a preliminary impression material for full denture cases, then modified for use as a tray. A wash impression of plaster was used as the final impression material. In these early days, the plaster was not fast setting, thus it was a messy and time-consuming process. ⁽²¹⁾

Non-elastic impression materials are generally not used for obtaining impressions of crown preparations because of their lack of elastic recovery from undercuts. The elastic impression materials are mainly used in fixed prosthodontics as final impressions. ⁽¹⁰⁾

The elastic impression materials can be broadly divided into two groups: the hydrocolloids and the synthetic elastomers. ⁽¹⁰⁾



Hydrocolloid impression materials

The two types of hydrocolloids used in dental impressions are Agar-agar and Alginate. **Agar-agar** is a reversible hydrocolloid because it can pass repeatedly between highly viscous gel and low viscosity sol simply through heating and cooling. Agar-agar was first introduced into dentistry for recording crown impressions by **Sears in 1937**⁽¹⁰⁾. It was the first elastic impression material available to produce casts of good accuracy and surface detail. Temperature change is controlled with a conditioning unit and water-cooled trays. ⁽¹⁰⁾

A typical reversible hydrocolloid impression material consists of 80-85% water and 12-15% Agar. Small quantities of potassium sulfate, borax and alkyl benzoate may be present. ⁽¹⁰⁾

The reversible hydrocolloids lack dimensional stability as water is readily released or absorbed through syneresis and imbibition. Accuracy is improved with the increase of the bulk of the material as feasible as possible. It is not commonly used in dental practice today because of the need for the technique sensitive, expensive conditioning baths. ⁽¹⁰⁾

Alginate unlike Agar-agar does not require any special equipment as once converted to the gel form cannot be converted back into sol, and it is therefore said to be irreversible hydrocolloid material. ⁽¹⁰⁾

Alginate consists of sodium or potassium salts of alginic acid which react with calcium sulfate and form insoluble calcium alginate. Other ingredients include diatomaceous earth which is a filler providing the desired consistency, sodium phosphate and similar compounds to control the setting rate and to extend the working time of the material.