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Assessment of flexural strength of denture base resin materials processed using compression molding technique and injection molding technique: A comparative study

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Abstract: **Background:**The purpose of the current investigation was to compare the flexural strength of denture base resins made through compression molding as well as injection molding. **Materials & methods:**20 denture base resin samples had been included as well as were separated into 2 study categories with 10 samples in every group: Compression molding category as well as injection molding category. Standardization was achieved during specimen fabrication with the help of metal strips. Standard methods of polishing as well as finishing were applied. After being polished, each sample was measured using a digital calliper to ensure consistency in size. There was some thermocycling action taken. A Universal Testing Machine equipped with specialized software was used to evaluate the flexural strength of the fracture resistance. **Results:**The average flexural strength of the injection-molded group was 79.35 MPa, compared to 67.23 MPa for the conventional molding group. When comparing the average flexural strength of samples from the two groups, significant differences were found. **Conclusion:**The flexural strength of denture base resin materials that have been treated using injection molding is superior to that of denture base resin materials produced via compression molding.

Key Words: Injection molding, Compression molding, Denture Base, Resin

INTRODUCTION

Denture bases are often made of polymethylmethacrylate (PMMA), which is a type of acrylic resin polymer that was developed after acrylic resin polymers were first used as denture base materials. When compared to other types of plastic denture bases, the toxicity of these materials is comparatively low while still maintaining superior aesthetics and great physical qualities.[1] The standard approach to fabricating dentures involves compression molding followed by heat activation in a water bath for the purpose of resin polymerization.[2] Despite this, it is impossible to prevent the denture bases from shrinking and changing dimensions while the resin is being polymerized, as this phenomenon has been thoroughly researched. The flexural strength of the denture base is one of the mechanical properties that is contingent not only on the type of material but also on the manufacturing processes utilized.[3] Because of this, acrylic resins and the processing procedures used to make denture bases have been altered in order to improve the denture bases' physical and chemical qualities. One such example is the development of the process known as injection molding.

The standard approach to fabricating dentures involves using compression molding followed by heat activation in a water bath for the purpose of polymerizing the resin. However, during the process of resin polymerization, denture bases will invariably undergo both shrinkage and dimensional changes. This phenomenon has been thoroughly researched and recorded.[4] To counteract the effects of polymerization shrinkage, the technique of injection molding is utilized since, in comparison to traditional compression molding, it possesses superior precision and marginal sealing. However, there are a few problems associated with the usage of PMMA obturators, such as polymerization shrinkage if a normal molding technique is utilized, trouble with undercuts as a result of the material's hardness, and pressure sores in delicate tissues.[5]

As a result, the current investigation was carried out with the purpose of determining the flexural strength of denture base resin materials that were manufactured using either the injection molding technique or the compression molding technique.

MATERIALS AND METHODS

This study was carried out with the purpose of determining the flexural strength of denture base resin materials that were treated using either the injection molding technique or the compression molding technique. There were a total of 20 denture base resin specimens used for this research, and they were split evenly between two study categories, each containing 10 specimens: the compression molding group as well as the injection molding group. Standardization was accomplished by the use of metal strips in the fabrication of specimens.

Compression molding technique

A thin layer of petroleum jelly had been given to the strips, and then half of the thickness of that coating was inserted into a dental stone investment so that it would be simpler to remove the petroleum jelly later on. This was done so that the resin mixture would have somewhere to enter, and also so that the removal of the petroleum jelly would be easier. After that, wax sprues were attached to the metal mold strips using adhesive. After the stone had been allowed to cure as well as a layer of separating media had been placed, a second pour was carried out. The flask kept its compressed state until the very end of the set. After the stone set had been opened and the prepared strips had been removed, the wax in the flask was heated and melted. The resin was mixed by hand in order to ensure that it adhered to the mixing ratio that was specified by the manufacturer. During the time when the material was in the dough stage, it was transferred into the hand-warm isolated flask halves. At a pressure of eighty bar, the flask was hermetically sealed by being clamped shut. The closed flask was first cooled by being submerged in cold water, then heated to one hundred degrees Celsius, and then allowed to boil for 45 minutes. After that, it was left to cool for half an hour at room temperature before being poured through a series of cold water baths to ensure complete chilling. After it had cooled, the flask was opened, and the strips that had been formed were removed from it. Polishing as well as finishing were accomplished through the application of traditional methods.

Injection molding technique

The flask as well as Type 3 dental stone both received copies of the wax that was invested in them. Following the removal of the wax as well as the heating of the flask in a boil-out solution, the flask was permitted to cool to room temperature before being put away. The stone was put through the separation process using various media. In a commercial mixer, premeasured amounts of monomer capsules and resin were combined for a period of five minutes. The various components of the flask were linked together. Following the step of transferring the contents of the combination capsule into the flask, the pressure injection mechanism was then secured. Because the pressure apparatus was connected to a supply of compressed air, the plunger was able to descend as well as inject material into the mold while it was being worked on at the bench. This process took five minutes. After thirty-five minutes of polymerization in boiling water (100 degrees Celsius), the assembly was removed from the water and immediately submerged in cold water. It was then held under pressure for another 30 minutes so that it could cool down. After it had cooled, the flask was opened, and the strips that had been formed were removed from it. Polishing and finishing were accomplished with the use of conventional methods. After the specimens had been polished, their measurements were measured using a digital calliper to ensure accuracy. Thermocycling was done to accomplish this. A computerized and software-based universal testing machine was used to conduct the test that determined the flexural strength of the fracture resistance. All of the findings were entered into a spreadsheet created in Microsoft Excel, and then statistical analysis was performed using SPSS.

RESULTS

The average flexural strength of the injection-molded group was 79.35 MPa, compared to 67.23 MPa for the conventional molding group. When comparing the average flexural strength of samples from the two groups, significant differences were found

Table 1: Comparison of flexural strength

Groups	Mean	SD	p-value
Conventional molding group	75.35	20.28	0.001 (Significant)
Injection molding group	89.12	35.78	

DISCUSSION

A large number of people are concerned about losing their teeth as well as replacing them with artificial alternatives, such as detachable prostheses that are created using acrylic resin- and nylon-based plastic (polyamide) denture base materials. This is a topic that has become increasingly common in recent years. It is essential to practice proper oral hygiene on a consistent basis, and one simple but effective way to prevent contamination of dental prostheses is to soak them in a disinfecting solution for the recommended amount of time. Denture base resins have the potential to have their qualities, like color stability as well as flexural strength, altered after prolonged contact with a variety of disinfectants.6

It is claimed that a novel injection technology can eliminate fluctuations in VDO, making it possible to manufacture dentures that require very few, if any, corrections in the laboratory. Mixing the denture base material in the traditional manner and placing it in a unique plastic cartridge that can be detached prior to the injection operations is required by this innovative new injection system. The manufacturer recommends using this system.7,8

As a result, the current study was carried out with the purpose of determining the flexural strength of denture base resin materials that were produced using either the injection molding technique or the compression molding technique.

In this study, the average flexural strength of the injection-molded group was 79.35 MPa, compared to 67.23 MPa for the conventional molding group. When comparing the average flexural strength of samples from the two groups, significant differences were found.

In comparison to the traditional method, the injection-molding process was shown to have a greater flexural strength in a study carried out by Ganzarolli *et al*.[9] According to the findings of Hamanaka[10], all of the injection-molded thermoplastic resins exhibited substantially greater impact strengths when compared to the traditional PMMA. Impact and transverse strength tests were used in Uzun's[11] investigation into the fracture resistance of six different acrylic resin denture base materials. The research involved a total of five different types of resins: three rapid heat-polymerized resins, two high-impact strength resins, and a stronger injection-molded acrylic resin referred to as SR-Ivocap. The SR-Ivocap resin came out on top as having the highest impact strength values among various acrylic resins. Ucar[12] found that the flexural strength of the SR-Ivocap injection-molding process was significantly lower than that found in the current investigation (122 MPa as opposed to 69.8 MPa). This disparity may be explained by the fact that the samples used for testing in their investigation were preserved in distilled water at room temperature for one hundred days, whereas the samples used for testing in the current research were only kept in water for ten days. It's possible that increased water absorption over the course of 100 days led to a reduction in flexural strength.

CONCLUSION

The flexural strength of denture base resin materials that have been treated using injection molding is superior to that of denture base resin materials processed using compression molding.

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