

# Problems with working with acrylic resins-letter

## Abstract

The aim of this article is to introduce dentists and dental technicians to the possible stages of formation of troubles during the work and the fabrication of removable dentures. Based on 20 years of experience, author would like to share with readers this experiences, thoughts and conversations with various people about acrylic resins. If you have ever had problems such as porosity, discoloration or falling out teeth with a finished acrylic denture, this article will help you to follow through the different stages of work and find out what needs to be corrected and that there is no need to repair a new denture.

**Conclusion:** A necessary condition for the production of a suitable acrylic denture is to strictly follow the manufacturer's recommendations.

**Keywords:** acrylic resin, polymerization, dough, trouble with denture base

Volume 4 Issue 4 - 2020

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**Received:** August 12, 2020 | **Published:** September 23, 2020

## Introduction

Although acrylics have been used for over 80 years, they still pose problems during processing. The source of these errors and failures should be looked for at the beginning during and through the next stages of working with acrylic. Therefore, this article is divided into several sections in the order of their clinical application.<sup>1</sup>

### Mixing powder and liquid

Each acrylic material consists of two components: polymethyl methacrylate powder with a small content of dibesoyl peroxide (polymerization initiator) and pigments whose task is to imitate the color of the gums of the future denture. The liquid, or monomer, is a mixture of methyl methacrylate with a small amount of dimethacrylate (which reduces the solubility and sorption of the prosthesis made). To prevent the monomer from polymerizing during storage, a small amount of stabilizers (methyl hydroquinone) are added to it.<sup>1</sup> After mixing the powder with the liquid, the material goes through several stages of "maturing the dough".<sup>2</sup> The mixing ratio between powder and liquid is very important. If we use too much powder then all of the powder may not be wetted properly with the monomer, the dough will be dried and made problems during further processing. As a consequence, it may lead to an increase in the occlusal disturbance of the future prosthesis.<sup>2,3</sup>

If too much liquid is used, the preparation time for the dough is considerably longer. This material sticks to the hands or walls of the vessel all the time. If such material is polymerized, then some of the monomer will evaporate, forming closed gas bubbles inside the polymerized prosthesis, because the boiling point of MMA is 100.3 °C, which is as much as boiling water is used to harden acrylic.<sup>4</sup> Too much monomer also causes excessive prosthesis contraction during polymerization, since methyl methacrylate polymerizes to polymethylacrylate has a volumetric shrinkage of over 22%.<sup>5</sup> Therefore, for the production of dentures, we use a polymer and monomer in the amount of 3 parts of powder for 1 part of monomer, which reduces the contraction of the prosthesis. As was mentioned, when mixing the powder with the liquid, we should strictly follow the instructions for use provided by the manufacturer. Monomer and powder would be good to weigh on the scales. Measuring with

the provided measuring cups may result in major or minor errors.<sup>6</sup> However, if we do not have either scales or measuring cups, we can pour the monomer into the glass vessel and cover it with the powder until it is saturated<sup>6</sup> similar to mixing gypsum and water.

### Storage of acrylic dough

The method of storing the mixed acrylic material is also very important. It should be stirred in a glass or ceramic vessel, after mixing we cover the vessel with cover, which prevents excessive evaporation of monomer from the mixture. If the dough becomes excessively dry during storage, it may cause white lines and discoloration in the interior of the future denture. I don't recommend storing the dough in silicone dishes, as silicone has strong monomer absorption properties, which in turn leads to the drying of the entire material. The period of time when we store the acrylic cake is also very important. During storage, the monomer is absorbed by the polymer particles, which swell. At the beginning, after mixing the powder and liquid in the material, we can distinguish individual polymer particles, which gradually expand and dissolve in the monomer, creating a fiber structure. The material then sticks to the hands, tools and the vessel walls.<sup>8,9</sup> After a few minutes, the material resembles a soft plasticine. Then it can be used and placed in a mold. After about 30 minutes, it forms a hard gum, which is no longer suitable for further processing.<sup>9</sup> Too early use of the material, placing it in a polymerization cuvette and starting the polymerization process causes vaporization of non-absorbed MMA and the formation of bubbles in the polymerized material.<sup>8</sup>

### Gypsum model

The plaster that was used to make the plaster model, has to be class 3 hard dental gypsum, and it is very important. Model made with too soft plaster during the dough pressing process in the polymerization cuvette may crack and the acrylic material will be mixed with the gypsum. The second important thing is that the gypsum model must be soaked in water before polymerization.<sup>8</sup> If you do not do it, and the model is dry, during polymerization it may cause the release of air bubbles from the plaster into the acrylic and deformation of the prosthesis or the closing of gas bubbles inside the prosthesis.<sup>8</sup> To fill the space between the plaster model with acrylic teeth fixed with wax, inside the cuvette, it is necessary to use a model plaster class 2.<sup>10</sup>

## Wax elimination

After the plaster in polymerization cuvette is completely hardened, usually it takes from 20-30 minutes, it is the time for wax elimination with boiling water. There are also many mistakes that can be made during this process. To avoid problem, firstly put the cuvette into the boiling water for about 8-10 minutes, so that the wax contained inside is partially dissolved. We cannot heat the closed cuvette in hot water for too long because wax will completely melt and may begin to penetrate into the rough plaster. As a result, the applied gypsum-acrylic insulator will not be able to react with gypsum in the later period of operation and we will not obtain proper insulation between acrylic and gypsum. At the end after the polymerization process acrylic can connect with the plaster forming one whole mass, which is very difficult to separate.<sup>11,12</sup>

After removing the polymerization cuvette from the hot water, it is necessary to open it and use a steam gun or hot water to eliminate wax residues from the surface of the plaster and acrylic teeth. After proper opening the cuvette acrylic resin remain in the plaster. Wax elimination is one of the crucial moment, because the residual wax remain on gypsum surface may cause poor insulation between acrylic and plaster in the future.<sup>12</sup> For this reason I do this process twice, using a small amount of dishwashing liquid with the first half of hot water. Thoroughly rub the water over the plaster and acrylic teeth with a toothbrush. Once all the wax has been removed, I let the cuvette cool down for about 10 minutes and use a plaster- acrylic insulator (based on sodium alginate solution). I pour a small amount of separator onto the plaster surface inside the cuvette. I spread the liquid insulator with a soft brush over the broad plaster surface and exactly around the acrylic teeth, avoiding at the same time putting the insulator on the cervical surface of the teeth.

I apply the insulator twice or even three times, each time waiting a few minutes for the previous insulator layer to be absorbed by the plaster surface. A well-insulated plaster surface should be uniformly smooth and shining under the light.<sup>13</sup>

## Preparation of acrylic teeth surface

To obtain a proper connection between the denture base and the teeth, the surface of the teeth must be properly ground in the initial period of setting the acrylic teeth in the wax. Sometimes in molars, I make retention holes with cutters to ensure a better connection between the tooth and acrylic. After the wax is boiling, and the plaster surface is insulated with an insulator, it is a time to wash the acrylic teeth surfaces with the monomer. This step is carried out twice by applying a small amount of monomer to the cervical part of the acrylic tooth with the help of an ear cleaning stick and rubbing it well into the entire surface of the tooth.<sup>9,14</sup> The task of the monomer is to partially dissolve the surface of the acrylic tooth, penetrate it and create a proper chemical bond between the tooth and the acrylic denture plate.<sup>9</sup>

## Applying and pressing acrylic dough

I take the acrylic dough out of the vessel and using the polyethylene gloves I mix it thoroughly in my hands. It is in the moment when it does not stick to the vessel wall - the, soft rubber phase". Then it will also not stick to gloves not covered with talcum powder. Then I put the dough in one piece on the plaster and the teeth surfaces inside the polymerization cuvette. If the dough is applied in several pieces on the border between them, white discoloration may occur after curing process. If I recognize that I took too small portion of the dough, then

I choose another piece and mix them together again for 30-45 seconds with hands equipped with gloves. Very important when kneading the dough are dry hands or gloves. The acrylic dough cannot be mixed under the stream of water. If you do such mistake, after 1-2 days from the moment of polymerization of such acrylic, it will start to change color, which will be visible as a white lines inside the material, with each day will be whiter and more visible.<sup>15</sup> Immediately after dough placement it is time to close the cuvette.

After closing it, I put everything in the press and gradually increase the pressure in this instrument to about 1000-1200 kg/cm<sup>2</sup>. This process has to be repeated until the pressure does not change and the pressed acrylic stops flowing between two pieces of the cuvette. It is necessary to keep the cuvette in the press for at least 10 minutes, so that the material is well pressed.<sup>15</sup> Next, I place the cuvette in the polymerization frame and twist firmly.

## Polymerization

Long-term polymerization is very important for thick lower dentures (thicker than 15 mm). The polymerization cuvette must be placed in cold water and warmed up gradually. When the denture has a thickness about 15 mm, the time that has elapsed since the moment of putting the cuvette into the cold water to boil it should be at least 60 minutes. The water should be heated very slowly. In the case of even thicker dentures, sometimes this stage should be proceed even 90-120 minutes.<sup>2,7</sup> You can also use long-term polymerization, for example 7-9 hours at a temperature of 70°C, but start with water at room temperature, and then at the end finish the curing by boiling for 60-80 minutes.<sup>7,16</sup> Too fast heating of the cuvette with a thick prosthesis inside causes the monomer to evaporate and the air bubbles inside the polymerized prosthesis are closed.

The appropriate polymerization time is also very important. Too short, results at high content of residual monomer, which may cause allergic reactions. Cured acrylic resin for 45 minutes in boiling water has a fracture resistance from 70-80 MPa. Material polymerized for more than 90 minutes in boiling water breaks under pressure of about 90-100 MPa.<sup>15,16</sup> Cool down the cuvette very slowly after the polymerization is finished. This process performed too quickly may result in stressing inside the material and faster fracture of the denture.<sup>16</sup>

## Conclusion

I hope that the information's presented in this article will be helpful to the reader and facilitate further work. Despite the developing 3 D printing technology, traditional acrylic dentures will be present in every laboratory of dental technology for several years, and the information's contained in this article reduces the number of errors and additional work.<sup>17</sup>

## Acknowledgments

None.

## Conflicts of interest

Author declares that there are no conflicts of interest.

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