ABSTRACT

Aims: To evaluate dimensional stability when various combinations of dental plaster and dental stone are used as an investment material.

Context: Dental plaster is routinely used as an investing material to acrylize dentures with some acceptable linear dimensional changes in the finished acrylic denture. This study aimed to evaluate which combination of dental plaster and dental stone, when used as an investment, will produce fewer linear dimensional changes in acrylic dentures.

Materials and methods: An aluminum block is prepared with sharp margins. The block is invested with various combinations of dental plaster and dental stone. The linear dimensional changes are measured using a digital caliper.

Statistical analysis: The results obtained were subjected to statistical analysis using analysis of variance test.

Results: Investing with 100% dental stone and a combination of 70% dental stone and 30% dental plaster showed fewer dimensional changes.

Conclusion: A combination containing higher percentage of dental stone may be used for investing to produce a finished denture with fewer linear dimensional changes.

Keywords: Dental plaster, Dental stone, Dimensional stability, Investment.

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INTRODUCTION

Gypsum (CaSO$_4$2H$_2$O; Calcium sulfate dihydrate) is a mineral mined in various parts of the world. Gypsum products are in use in dentistry since decades for making study models and casts on which the prosthesis and restorations are fabricated. The gypsum products are categorized based on the particle size, and their properties also vary based on these particle size. Dental plaster is used as an investment for waxed up dentures in making complete dentures. There are some acceptable dimensional changes in the acrylized denture, which could be a result of the dimensional changes caused during impression making, disinfection of impression, setting of cast, waxed up dentures, during investment, curing, and many more.

The present study was carried out considering the fact that these materials, when used as an investing medium, could cause dimensional changes during processing of complete dentures. Dental stone has higher compressive strength and undergoes less expansion than dental plaster. Hence, the aim of the study was to find out the dimensional changes occurring in a combination of dental plaster and dental stone when used as an investing medium, which would eventually alter less dimensional changes in the finished prosthesis.

MATERIALS AND METHODS

Type 2 dental plaster (Dentico, Neelkanth Minechem, Jodhpur, India), which is snow-white color, medium setting, fine-textured pure calcium sulfate, and type 3 dental stone (Labstone, Kalabhai Karson Pvt. Ltd, Mumbai, India), which is bright yellow in color, were the dental plaster and dental stone respectively, used as the two materials, along with tap water for mixing, powder weighing scale, water measuring cylinder, dental flask and clamp, digital caliper to take measurements. An aluminum block with the dimensions of 160 mm in total with AB = 20 mm, CD = 40 mm, EF = 20 mm, GH = 40 mm, IJ = 20 mm, and KL = 20 mm (Figs 1 and 2) was made as a standard model. Water: Powder ratio used was 0.4% for dental plaster and 0.3% for dental stone, according to ADA specification no. 25. The following five combinations of investing mediums were used:

- Group 1 – 100% dental plaster
- Group 2 – 100% dental stone
- Group 3 – 50% dental stone with 50% dental plaster

Group 4 – 70% dental stone with 30% dental plaster
- Group 5 – 100% dental plaster

Each group was poured as a single pour with the casting materials set for 24 hours. The linear dimensional changes were measured from the digital caliper.
Group 4 – 70% dental stone with 30% dental plaster and Group 5 – 30% dental stone with 70% dental plaster.

Procedure – For group 1, the lower portion of the dental flask was filled with 100% plaster mixed with the required amount of plaster and water. Then the aluminum block is placed into the mixture. The dental plaster is contoured to facilitate deflasking procedure. After the initial set, a separating medium is applied. The upper portion of the flask is positioned and it is filled with a second mix of 100% plaster. The lid of the flask is seated and the plaster is allowed to set. After setting, the lower portion of the flask is separated from the upper portion. The aluminum block remains in the lower portion of the flask (Fig. 3). The mold cavity in the upper portion of the flask is measured for the distances AB, CD, EF, GH, IJ, and KL using the digital caliper. A similar procedure was used for all the groups of mix with the respective combination of mix (Figs 4 to 7).

RESULTS
The total of measurements AB, CD, EF, GH, IJ, and KL was calculated for each sample of various combinations.
Evaluation of Linear Dimensional changes of Investment Material


Fig. 7: Seventy percent dental stone and Thirty percent dental plaster

was 160.298 mm, 70% dental stone with 30% dental plaster was 160.024 mm, and 30% dental stone with 70% dental plaster was 160.324 mm respectively (Table 6). Dimensional changes for the distances measured using 100% dental stone and 70% dental stone with 30% dental plaster showed less difference with the control block compared with other combinations.

DISCUSSION

To determine the dimensional accuracy of gypsum products, Sweeney and Taylor developed a method that made use of the surface of three embedded metal spheres to determine a reference plane at one end of the specimen and the surface of a single embedded sphere to determine

### Table 1: Hundred percent dental plaster

<table>
<thead>
<tr>
<th>Measurements (mm)</th>
<th>Ideal block</th>
<th>Flask-1</th>
<th>Flask-2</th>
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### Table 2: Hundred percent dental stone

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### Table 3: Fifty percent dental stone + fifty percent dental plaster

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### Table 4: Seventy percent dental stone + thirty percent dental plaster

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a point on the other end. The change in dimension of the specimen is determined by observing the difference in measurement developed between the reference plane and the point. The authors wished to draw no conclusions about them on the basis of data alone until the investigation of the storage properties of gypsum products is completed.8

Sajjad conducted a study on the effect of different investment media on movement of artificial teeth during the fabrication of complete dentures and concluded that the dental stone core method is superior because it produces significantly less artificial teeth movement than the conventional method and artificial teeth movement in the horizontal plane is minimized by the use of the investment combination of dental stone core and plaster mold. Further studies are required to evaluate artificial teeth movement in three dimensions of space serially, step by step from the wax, up to completion of processing, cooling, deflasking, and after deflasking.9 Many studies have been carried out on different types of gypsum products but very limited on various combinations. So, the present study was done using various combinations of dental stone and dental plaster as an investment material. Here we are evaluating the linear dimensional changes caused by these various combinations of dental stone

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### Table 5: Thirty percent dental stone + seventy percent dental plaster

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<th>Measurements (mm)</th>
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<tr>
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### Table 6: Mean and Standard deviation of each combination

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<th>Mean X</th>
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<th>(X - X)^2</th>
<th>SD = \sqrt{\frac{\sum(X - X)^2}{N}}</th>
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and dental plaster when used as an investing medium. In this study, we are investing the aluminum block itself instead of a wax block replica to prevent any undesirable dimensional changes caused by wax.

The aluminum block is used as a control. Measurements are done using digital caliper. The measurements AB, CD, EF, GH, IJ, and KL obtained from 100% dental stone and a combination of 70% dental stone and 30% dental plaster showed less difference in dimension compared with that of the control block and that of 100% dental plaster, combination of 50% dental stone and 70% dental plaster, and combination of 30% dental stone and 70% dental plaster.

A similar study was done by Adegbulugbe et al to evaluate the dimensional stability of casts using various combinations of dental stone and plaster with a conclusion that 75% dental stone and 25% dental plaster may be used for procedures not requiring very accurate replica such as mounting of teeth for dental training and for study models.\(^{10}\)

In his study, Adegbulugbe et al evaluated the dimensional stability of the casts made from a mixture of gypsum products where accuracy of cast was not jeopardized, whereas in the present study the focus was on the linear dimensional changes that could occur in the finished prosthesis when various mixtures of gypsum products were used as an investing medium as they undergo certain amount of contraction and expansion during the process.

**CONCLUSION**

The dimensional changes of investing medium that occur during the processing of a prosthesis affect the final dimension of the finished prosthesis, which could lead to inaccurate or loose prosthesis. Within the limits of the present study and based on the results obtained, it can be concluded that 100% dental stone and a combination of 70% dental stone and 30% dental plaster may be used as an investment material to produce fewer dimensional changes in the finished prosthesis compared with the other combinations.

**REFERENCES**