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ORIGINAL RESEARCH

Assessment of Influence of Contact Time between Alginate and Type III Dental Stone on Properties of Cast Model: An *in vitro* Study

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ABSTRACT

Introduction: Alginate is a versatile, irreversible hydrocolloid impression material, which is cost-effective and forms an essential component in dental practice. For elevating the hardness of the cast models, hardeners are combined with stone. Hence, we planned the present study to evaluate the impact of altering the time of contact between alginate and stone after various interim periods.

Materials and methods: The present study included the assessment of impact of time of contact between alginate and stone by the construction of 90 casts using a cylinder model. Two bisecting lines were marked and were named as y and y′. These lines were used for testing the dimensional stability. Using chemically cured acrylic resin, the construction of ten special trays was done. All the impression casts were randomly divided into two study groups, with 45 casts in each group–group I: control group, casts were removed after 60 minutes; group II: study group, casts were removed after 9 hours. A digital caliper was used for measuring the dimensional stability of the cast. All the data were collected and analyzed.

Results: In the specimens of the control group (group I) and the study group (group II), the mean dimensions from y to y′ were found to be 17.54 and 17.95 respectively. The mean reading of hardness in the control group and study group was found to be 0.59 and 0.20 respectively. In groups I and II, the number of specimens showing clarity of two lines (X and X″) was 0 and 5 respectively.

Conclusion: There was no change in the dimensional stability of the dental stone model when the contact time was increased.

Clinical significance: Within certain limits, the contact time between alginate and stone can be altered without significantly altering the properties of the cast.

Keywords: Alginate, Plaster, Stone.

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INTRODUCTION

Alginate is a versatile, irreversible hydrocolloid impression material. Irreversible hydrocolloid impression pieces are usually inseparable during their oblique retrieval.[1] Alginate stands out among the most utilized dental materials; and alginate impression is straightforward, financially savvy, and essential piece of dental equipment.[2] However, not very many individuals can establish alginate connections without flaw the first time. For a long time, alginate impression material has been the staple of most dental practices.[3-5] They constitute a noteworthy greater part of our clinical practice even today. Also, it exhibits a plain and precise material and henceforth keeps away from repeat impressions.[6] For enhancement of the hardness of the cast, hardeners are added to the stone. Cyanoacrylate expands the surface hardness by 150% and the scraped area resistance by 48%. Albeit a few investigations demonstrated the unaffected surface hardness by impression sterilization, others cannot help contradict these outcomes.[7-9] The measurement steadiness of the cast is influenced by alginate syneresis and imbibition as well

as relies on the way of dentist's treatment of alginate.[10] Hence, we planned the present study to evaluate the impact of altering the time of contact between alginate and stone after various interim periods.

MATERIALS AND METHODS

The present study was conducted in the Department of Prosthodontics of the dental institution and included the assessment of the influence of contact time between alginate impression and Type III dental stone. Following the American Dental Association specification No. 18, a stainless steel model was framed for alginate impression materials.[11] Ethical approval was taken from the institutional ethical committee before commencing the study. The dimensions of the constructed stainless steel cylindrical model were as follows:

- Width: 25 mm
- Length: 15 mm
- Reference lines: 2.5 mm apart

These reference lines were used for the measurement of the surface details that were reproduced.

Two bisecting lines were marked and were named as y and y′. These lines were used for testing the dimensional stability. This was done by the measurement of the distance between these lines. By measurement of microscratches which were made by making indents along the 50-µm longitudinal lines, the hardness was assessed.[11]

Uniform tying of two wax sheets was done around the cylindrical models. Afterward, some acrylic portions could be found associated with an equal dimension of alginate impression and cylindrical models. Using chemical cure acrylic resin, the construction of ten special trays was done. Finishing and perforation of the final special trays was done once the material has completely set. High-precision technique and chromatic alginate were used for making the impression of the cylinder. For making the cast models, Type III dental stone was used. A total of 90 cast models were obtained after receiving impressions at different time intervals. These impressions were randomly divided into two study groups, with 45 casts in each group, as follows:

- *Group I*: Control group, casts were removed after 60 minutes
- *Group II*: Study group, casts were removed after 9 hours

Until the testing procedure was carried out, preservation of all the casts was done in a completely sealed plastic bag. A single examiner carried out the procedure of determination of all the properties. A digital caliper was used for measuring the dimensional stability of the cast. Examination of the surface details was done by reproducing X, X′, X″ according to the criteria given in Table 1. Using the combined magnification of ×40 and ×1000, evaluation was done. By measurement of the depth of indentation made by using a force of approximately 995 to 1000 N for 15 seconds, examination of the hardness was done. All the data were collected, summarized, and analyzed by Statistical Package for the Social Sciences software.

RESULTS

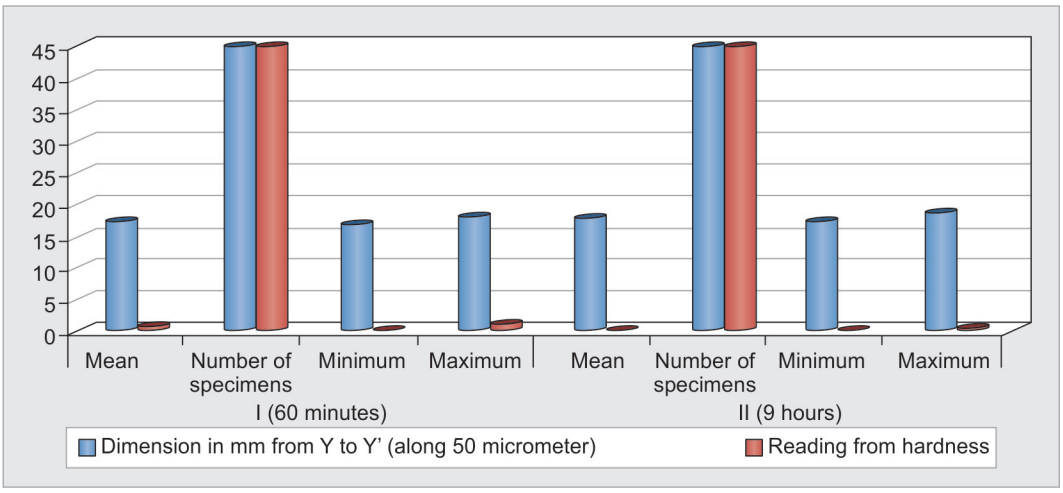
A description of the dimensions and hardness of the specimens of the two study groups is shown in Table 2 and Graph 1. In the specimens of the control group (group I) and the study group (group II), the mean dimensions from y to y′ were found to be 17.54 and 17.95 respectively. The maximum values of dimensions from y to y′ in the control group and the study group were found to be 18.12 and 18.69 respectively. As far as the hardness reading is concerned, the mean value observed in the control group and study group was found to be 0.59 and 0.20 respectively. The mean surface details of the specimens of both the groups are shown in Table 3. In groups I and II, the number of specimens showing clarity of two lines (X and X″) was 0 and 5 respectively. As far as the clarity of all the three lines was concerned, the number of specimens in groups I and II was found to be 48 and 37 respectively.

Table 1: Index of surface details

Score	*Surface of impression*
Zero	No visibility of either of three lines
One	Clarity of only line (75 µm)
Two	Clarity of line X and presentable line X′
Three	Clarity of lines X and X′
Four	Clarity of lines X, X′, and X″

Table 2: Description of dimensions and hardness of groups

Group	*Dimension in millimeter from y to y′ (along the 50-µm lines)*	*Reading from hardness*
I (60 minutes)		
Mean	17.24	0.59
Number of specimens	45	45
Minimum	16.88	0.22
Maximum	18.12	1.08
II (9 hours)		
Mean	17.95	0.20
Number of specimens	45	45
Minimum	17.01	0.05
Maximum	18.69	0.47



Graph 1: Descriptive values of dimensions and hardness of groups

Table 3: Mean surface details of the specimens of both the groups

	Surface details		
Groups	*Clarity of two lines (X and X')*	*Clarity of all the lines (X, X' and X'')*	*Total*
I	0	48	45
II	5	37	45
Total	5	85	90

DISCUSSION

Irreversible hydrocolloid has for quite some time been one of dentistry's most serviceable items. These are easy to use with minimal effort due to their improved clinical and physical properties. Therefore they are well-known and extensively used for impression making in dentulous/edentulous patient, for the fabrication orthodontic apparatus with study casts.[12-14] Hence, we planned the present study to evaluate the impact of altering the time of contact between alginate and stone after various interim periods.

In the present study, we observed no significant change in the dimensional stability of the cast models of the stone at different time intervals (Table 2 and Graph 1). Also a significant difference was obtained while comparing the surface details and hardness of the specimens of the two study groups (Tables 2 and 3). Our results were in correlation with the results obtained by Ibrahim et al[15] who reported similar findings in their study. Ibrahim et al[16] tried to demonstrate the impact of the time of contact between an alginate impression and Type III dental stone on the cast properties. They acquired 67 cast models from a stainless steel model by utilizing irreversible hydrocolloid impression material and Type III dental stone. A total of 37 cast models were isolated from the impression after 60 minutes (control group) and 30 cast models were isolated after 6 hours (study group). The specimens were assessed under a light magnifying lens for surface subtle elements and measured by computerized caliper for dimensional dependability. A space on the cast was made and the profundity of the space was then measured with an advanced caliper to gauge hardness. The dimensional strength of the cast models was not influenced when the contact time was expanded from 1 hour to 6 hours ($p = 0.507$). Surface subtle elements did not break down when the contact time was expanded, as the greater part of the examples could repeat all points of interest after the 1-hour and 6-hour interim periods. Be that as it may, hardness was more prominent after 1 hour of contact time ($p = 0.001$) than after 6 hours of contact time. Ibrahim et al[15] measured the impact of various interaction times among the alginate imprint and Type III dental stone on the cast properties. They acquired 67 cast imprints made from stainless steel barrel which utilized the alginate imprint materials and Type III dental stone. After 1 hour, isolation of 37 cast models was done and after 9 hours, another 30 cast imprint isolation was done. Light magnifying instrument was used for the assessment of models for their surface subtle elements. All these measurements were done by advanced caliper instrument and assessment of hardness was done by utilizing the point space on the cast. Computerized calipers were used for this purpose. From the results, they concluded that by expansion of the contact time between the above-said two dental materials, enhancement of hardness was achieved.

The impact of the contact time between alginate and gypsum was assessed by Marquezan et al,[17] who demonstrated the techniques which affected the properties of cast models. They used 30 cylindrical stainless steel models which were used for making Type III gypsum. In all the cast models, five reference lines were made. All the specimens were divided into two study groups. The first group was G1 which consisted of specimens with 60 minutes contact time. The second group in their study was G2 which consisted of specimens with contact time

of 12 hours. By means of visual examination and profilometer, assessment of surface details and dimensional stability was done. From the results, they concluded that between the two study groups, there existed a massive significant difference in the surface details and other physical properties. Schleier et al[18] assessed the impact of the capacity time in a 100% stickiness condition on the exactness of gypsum throws poured from a more current definition of reversible hydrocolloid impressions and presumed that this sort of reversible hydrocolloid can be put away in 100% moistness for <60 minutes.

CONCLUSION

By increasing the contact time, there was no change in the dimensional stability of the dental stone model. However, we recommend future studies with the purpose of exploring the change occurring in the mechanical properties when there was a contact between alginate and stone.

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