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Effect of Antiseptic Mouthwash as Water Substitute on Setting Time and Detail Reproduction of Alginate Impression Material

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Abstract

Introduction: Alginate is the most frequently used impression material in dentistry because of its elasticity and ease of use. However, while making a patient's impression, patient and dental clinicians may be contaminated by the patient's saliva, transmitting viruses or bacteria. The COVID-19 virus can be transmitted or spread through droplets and is currently a pandemic. Alternative to reducing cross-contamination on the impression is manipulating alginate with an antiseptic mouthwash as a water substitute which is known as a self-disinfecting irreversible hydrocolloid. **Purpose:** To evaluate the effect of using antiseptic mouthwash as a water substitute on setting time and detail reproduction of alginate impression material. **Methods:** Thirty alginate specimens were made and divided into 5 groups, each using a different antiseptic mouthwash and treated with the same procedures. The specimens were tested for the setting time and the detail reproduction test according to ISO 21563/2013. Detail reproduction was evaluated from the ability of gypsum to replicate 50 µm lines on alginate impressions and calculated in detailed reproduction scores (Owen's Score). Data analysis using IBM SPSS Statistic with Kruskal Wallis test. **Results:** The setting time of alginate impression material mixed with antiseptic mouthwash was slower than alginate impression material mixed with distilled water. There was no significant difference in detail reproduction in each group. **Conclusion:** Antiseptic mouthwash can be used instead of distilled water to manipulate alginate impression material without changing reproduction detail and setting time that is still within the specified time limit.

Keywords: Alginate; Antiseptic Mouthwash; Disinfectant Solution; Detail Reproduction; Setting Time

Introduction

Alginate has been the most widely anatomical impression material used in dentistry for many years, with elastic properties, irreversibility, ease to use, and economical cost.[1] However, in manipulating dental impressions, the impression can be contaminated with the patient's saliva and possibly transmit bacteria or viruses to the dental technician. Corona virus (COVID-19), a currently pandemic virus, is a respiratory tract infection that can be transmitted through saliva droplets and nasal secretions.[2-4] Alginate impressions made from these patient are often found to be contaminated with microorganisms from the patient's saliva and blood.[5,6]

American Dental Association (ADA) developed guidelines to limit cross-contamination during dental clinical procedures such as disinfection of the impression.[2,7] Disinfection of the impression is vital in limiting cross-contamination on alginate mold. Prevention of cross-contamination is one of the main goals in making a dentalimpression.[6] The impression generally disinfected by immersion or spraying techniques, but itonly affects its surface. Moreover, surveys showed that only about 37.5% to 90% of alginateimpressions are routinely disinfected. Many impressions were sent to the laboratory without a disinfection process because disinfection is an imperceptible action, and spraying or immersion can lead to inaccurate surface details and dimensional accuracy.[8]

Due to difficulties and weaknesses of the disinfection techniques, a new technique was developed, in mixing alginate with a disinfectant or antiseptic solution, referred to as a self-disinfecting irreversible hydrocolloid.[7,8] Flanagan et al. and Cserna et al. showed that this technique reduces bacteria on alginate impression material and shows better dimensional stability than spraying or immersion techniques.[8]

There is a predetermined setting time for the standard alginate set, about 2 minutes 30 seconds to 5 minutes, and it is very crucial to know the rate of setting time for alginate mixed with an antiseptic mouthwash. The impression material must have adequate setting time so that the impression is accurate. In addition, the setting time of the alginate impression can also affect the reproduction details of the impression. Detail reproduction is needed to analyze the accuracy and replicability of alginate impressions. If the setting time exceeds the predetermined limit, it will affect the quality of detail reproduction of alginate impression material. The longer the setting time, the quality of detail reproduction will decrease, which can be influenced by syneresis and imbibition properties and other properties. This study aims to determine the effect of using antiseptic mouthwash as a water substitute on the setting time and detail reproduction of alginate impression material.

Methods

The specimens were divided into 5 groups according to the antiseptic mouthwash solution, each group consisted of 6 specimens. There are 30 specimens for setting time evaluation and 30 for reproduction test details. The test block based on ISO 21563/2013 for setting time was made from PVC plastic cylinder (pipe) with 28mm in diameter and 16mm in height. For detail reproduction, there are 2 test blocks, for alginate test blocks were made of

anodized aluminum, brass, and corrosion-resistant steel with 30mm in diameter and 3mm in height, and gypsum test blocks were made of cast or wrought corrosion-resistant austenitic steel with 30mm in diameter and 17mm in height.[9]

The alginate was mixed with each antiseptic mouthwash solution. A part (equivalent to 8.4gram) of alginate powders with the standard setting type (Aroma Fine, GC Corp, Japan) and antiseptic mouthwash solution (equivalent to 20ml) were put in a mixing bowl, then mixed and pushed with a spatula against the wall of the bowl to get a homogenous mixture. The antiseptic mouthwash used in this study were Minosep antiseptic mouthwash (PT. Minorock Mandiri, Indonesia), Betadine gargle antiseptic mouthwash (Mahakam Beta Farma, Indonesia), Mustika Ratu antiseptic mouthwash (PT. Mustika Ratu, Indonesia), and Enkasari antiseptic mouthwash (PT. Kimia Farma, Indonesia).

The setting time was calculated from the beginning of the manipulation and counted using a stopwatch, then the alginate dough was placed on the mold and the excess dough was removed using a spatula until it had the same surface as the mold's height. The tip of a stick with 10cm in length and 6mm in diameter was placed on the top of the alginate dough, then withdrew and the stick were cleaned with tissue. This step was repeated with 10 seconds interval until no sticky dough was found on the stick tip, the dough hardened and the setting time was recorded.

Detail reproduction based on ISO 21563/2013 was observed on the 50µm line for type III dental stone with a length of 25mm carried out by observing along the A-line (50µm) between line d1 and line d2 (Figure 1) which was reproduced on the gypsum impression using a digital camera with 6x magnification and then the assessment of the detailed reproduction results are categorized according to the predetermined score.[9] Data results of setting time and detail reproduction tests were analyzed using IBM SPSS Statistic 26th version with the Kruskal Wallis test. Based on ISO 21563/2013, the detailed reproduction are seen on the 50µm line whether reproduce 25 mm long or not. The detailed reproduction results will be categorized into 4 scores[10]:

1. Score 1 = Continuously reproduced lines with sharp edges overall
2. Score 2 = Line reproduced >50% with clarity and sharpness of the lines and there are small holes on the smooth surface

3. Score 3 = Line reproduces <50%, decrease on detailed reproduction, the line is not sharp and porosity
4. Score 4 = Lines are not reproduced at all with a rough surface and porosity

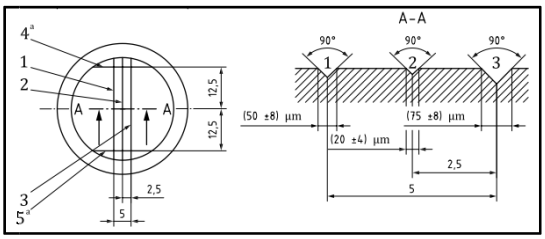

Figure 1. Test Block Detail Reproduction
(1) Linea (50 μm). (2) Line b (20 μm). (3) Line c (75 μm). (4) Line d_1. (5) Line d_2
(Source: Dentistry - Hydrocolloid Impression Materials (ISO 21563: 2013). 2013: 28p)

Results

The effect of alginate mixed with an antiseptic mouthwash as a water substitute on setting time are presented in Table 1. It can be seen that the five groups showed different setting times and the mean obtained showed significant differences in the alginate impression mixed with distilled water, Minosep antiseptic mouthwash, Betadine gargle antiseptic mouthwash, Mustika Ratu antiseptic mouthwash, and Enkasari antiseptic mouthwash (Table 1).

Table 1. Setting Time of Alginate Mixed with Antiseptic Mouthwash as a Water Substitute

Antiseptic Mouthwash	Distilled water	Minosep	Betadine Gargle	MustikaRatu	Enkasari
Setting Time (minutes)	2.33	4.26	4.20	3.20	3.50
	2.40	4.27	4.16	3.20	3.48
	2.31	4.28	4.18	3.21	3.45
	2.33	4.30	4.20	3.22	3.47
	2.34	4.31	4.20	3.22	3.45
	2.34	4.30	4.20	3.21	3.49
Mean (± SD)	2.34 (±0.03)	4.28(±0.02)	4.19(±0.02)	3.21(±0.01)	3.47(±0.02)

*p-value <0.05

Based on the statistical analysis, distilled water as the control group had the fastest average setting time and Minosep antiseptic mouthwash had the longest average setting time.

The result of the Kruskal Wallis test showed that there were significant differences (p-value <0.05) in setting time. Thus, there is a statistically significant difference in setting time between alginate mixed with antiseptic mouthwash and alginate mixed with distilled water as the control group.

Table 2 shows the detailed reproduction scores of alginate impression material mixed with an antiseptic mouthwash as a water substitute. The detailed reproduction ability of alginate impression material was seen in Type III gypsum impression by classifying specimens based on the scores. The Wallis test obtained a p-value $\geq$0.05, which means there is no significant difference in detail reproduction between alginate impression material mixed with antiseptic mouthwash and alginate mixed with distilled water as a control group.

Table 2. Comparison of Detail Reproduction Scores between Alginate Impression Material Mixed with Antiseptic Mouthwash as a Water Substitute

Antiseptic	**Detail Reproduction Score**			
Mouthwash	1	2	3	4
Distilled water	2	2	2	-
Minosep	-	4	2	-
Betadine Gargle	2	3	1	-
Mustika Ratu	2	2	2	-
Enkasari	-	3	3	-

Figure 2 presents the clinical result of manipulating alginate impression material with an antiseptic mouthwash as a water substitute. The photos has shown that the detail of reproduction on Mustika Ratu antiseptic mouthwash group had similar qualities as the distilled water group (control). The compatibility with gypsum shows that Mustika Ratu antiseptic mouthwash had the best quality result among other mouthwashes (Figure 3). According to the test block in the laboratory, in 50 µm line is at the top.

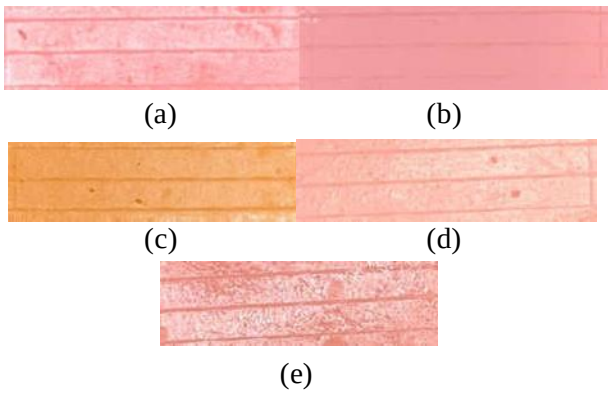

Figure 2. Clinical photos of detail reproduction with 6x magnification.
(a) Distilled water, (b) Minosep, (c) *Betadine Gargle*, (d) Mustika Ratu, (e) Enkasari

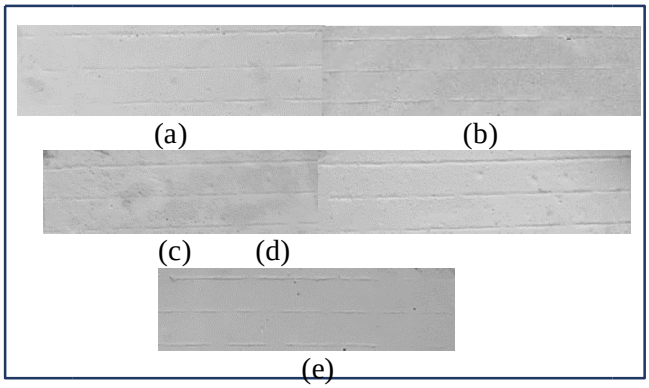

Figure 3. Compatibility with Gypsum.
(a) Distilled water, (b) Minosep, (c) *Betadine Gargle*, (d) Mustika Ratu, (e) Enkasari.

Discussion

The setting time of alginate impression material mixed with antiseptic mouthwash was slower than the distilled water group (control). The slower setting time was caused by the delay in the supply of calcium ions needed during the gelation process which caused the setting time to be longer. The longer gelation times have shown reduced gel strength which can be attributed to the low cross-linking density of sodium phosphate. Amalan et al. stated that alginate impression material mixed with chlorhexidine 0.2% showed higher flowability, associated with a longer gelation time. In addition, a study concluded that the setting time by Heraplast NF alginate impression material mixed with chlorhexidine 0.2% showed a longer setting time than distilled water.[8,11]

Betadine gargle antiseptic mouthwash had a slower setting time because povidone-iodine 1% as the main ingredient absorbed part of the mixing water ration which had an

important role in dissolving calcium sulphate dihydrate reactor. In addition, this reactor is responsible for the release of calcium ions which displace sodium or potassium ions from alginate compounds converting its soluble form into insoluble calcium alginate. Therefore, the water absorption can reduce the ionization rate of the calcium sulphate dihydrate reaction,hence slowing the setting time.[7,12]

Mustika Ratu and Enkasari antiseptic mouthwash contain phenol which is a compound quite soluble in water. Phenol has properties that tend to be acidic, it can release H^+ ions from its hydroxyl group. The release of these ions makes phenoxide anion $C_6H_5O^-$ which can be dissolved in water. Navaro et al. showed that the pH of the solution affected phenol adsorption. The adsorption was greatly decreased at low pH values indicating that an efficient adsorption interaction only occurred between the adsorbent and the negatively charged phenol. The adsorption mechanism is driven by the phenol and not the ionization of the adsorbent.[13]Amalan et al. showed that changes in pH can affect the dissociation and cross-linking of reactive materials, and thus can affect gelation time, strength, and permanent deformation.[11] In this study, the pH of the antiseptic mouthwash solution was lower than distilled water. It concluded that a lower pH could cause a longer setting time. The concentration in the solution also affects the setting time. The higher concentration the faster setting time.

The surface detail reproduction of alginate impression material is seen from replication on the gypsum impression. The highest quality detail reproduction requires replicating as close as possible to the patient's anatomical structure. Therefore this property is significant for alginate impression material. It is recommended that gypsum casting be carried out as soon as possible to avoid syneresis and imbibition in alginate impression material which causes dimensional changes.[14] Ramer et al. stated that there was no statistical difference in the accuracy of irreversible hydrocolloids mixed with water and those mixed with disinfectant solution. Guiraldo et al. also showed that there was no statistically significant difference in dimensional accuracy on the combination of disinfectant procedures with alginate impression materials.[15]

Xanthorrhizol as the main ingredient of Enkasari antiseptic mouthwash contains a phenol chain, an organic compound and is sufficiently soluble in water so that the reaction occurs does not significantly affect the detail reproduction on alginate impression. Betel leaf

extract in Mustika Ratu antiseptic mouthwash has a nanoparticle size, so this small and homogeneous particle size can be dissolved in water and does not affect the detail reproduction result. Chlorhexidine gluconate 0.2% as the main ingredient of Minosep antiseptic mouthwash has the high water-soluble ability so it does not affect the work of potassium sulfate and potassium zinc which are responsible for providing the high quality (the best score) of the alginate impression. Although Betadine gargle antiseptic mouthwash has povidone-iodine 1% as the main ingredient which absorbs part of the water ratio when mixed, it does not affect the detail reproduction of alginate impression material.[1,7,16,17]

Conclusion

Alginate mixed with antiseptic mouthwash resulted in a longer setting time than mixed with distilled water. However, there was no significant difference in detail reproduction. Alginate impression material mixed with Minosep antiseptic mouthwash obtained the longest average setting time and Mustika Ratu antiseptic mouthwash had the fastest average setting time among all mouthwashes.

Furthermore, it is recommended that further research can be conducted on other properties of alginate impression material when mixed with an antiseptic mouthwash as a water substitute, such as tear strength and other further research on antibacterial effect and effectiveness on alginate impression when mixed with an antiseptic mouthwash.

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