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# Study on dimensional accuracy of alginate impression: By employ distinct admixing and disinfection methods

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## ABSTRACT

Commercial mechanical mixers for mixing alginate impression materials are available in Indian dental market and they are more convenient and more consistent for the practitioner; however, there is very little information on the mechanical property of alginate mixed with device as compared with hand-mixing. Moreover, there is limited knowledge on dimensional changes after disinfection of auto-mixed alginates. This study was performed to study the dimensional accuracy of alginate impressions mixed by different methods with or without soaking in disinfection solution.
Commercially available alginate impression material (Kromopan, Lascod, Italy) was mixed by mechanical mixer (DB-988+, Coxo Medical Instrument Co. Ltd.) or hand-mixed according to manufacturer's recommended water powder ratio. Metal impression tray of appropriate size was loaded with mixed impression material and impression was made on plastic typodont model. Then after washing under running water, they were soaked in 0.5 % sodium hypochlorite solution for 10 minutes and then rinsed under running for 1 minute (disinfection, n=10) or cast immediately (control, n=10). Impressions were cast with dental stone (Fuji Rock, GC Co. Ltd., Tokyo, Japan). Tooth length and saddle length were measured with digital slide caliper. Unpaired t- test was employed to analyze data.
Significant differences were found between auto-mixed and hand-mixed samples and between control and disinfection samples. Automatic mixing with disinfection gave casts that were the closest representation of actual model.
Automatic mixing and subsequent disinfection by soaking in 0.5% sodium hypochlorite solution is preferred for more accurate alginate impressions.

## INTRODUCTION

Anatomical models are used for many diagnostic and treatment purposes in the dental practice. A dimensionally accurate impression, i.e. a negative mould of the jaw, is important for fabricating a precise anatomical model. The most commonly used impression material is alginate, irreversible hydrocolloid material. Alginates were originally developed in the 1930s.[1]The main advantages of alginates are the ease of use, cost-effectiveness, their hydrophilic characteristics, and the good patient acceptability.[2] Although alginate is easy to manipulate, the correct handling (water/powder ratio, spatulation) affects dimensional accuracy of the material. Therefore, it is imperative to follow the manufacturer's prescriptions on mixing.[2,3]
Nowadays, high-speed rotary mixing instruments for alginate impression materials are available to be used in a dental practice. These instruments easily produce a fine paste low in air bubbles compared with paste mixed by hand. Therefore, it is estimated that paste obtained by this method possesses superior rheological properties by reducing the number and volume of porosities in the mixed alginate.[4]
In addition, dental impressions become contaminated with the microorganisms from saliva and blood of the patients that can cross-infect gypsum casts poured against them.[5]). This potential of cross-contamination between clinical area and laboratory must be reduced.[6] Sterilization of impressions by dry or moist heat is unsuitable for alginates and therefore cold disinfection must be used for this purpose.[7] As the necessity for disinfecting impressions has become apparent, it has also become clear that the process itself should have no adverse impact on the dimensional accuracy and surface texture features of the impression material and resultant gypsum cast.[8] The ideal disinfection procedure must leave the physical and chemical properties of the impression material and gypsum unchanged to achieve optimal accuracy of the final casts and

the appliances made on the casts. The aim of this study was to quantify the effect of hand-mixing and automatic mixing technique with or without the use of a disinfectant on dimensional accuracy of alginate impression.

## MATERIALS AND METHODS

A partially edentulous typodont model was used to take the impression with alginate impression material. Commercially available alginate impression material (Kromopan, Lascod, Italy) was mixed by mechanical mixer (DB-988+, Coxo Medical Instrument Co. Ltd.) or hand-mixed according to manufacturer's recommended water powder ratio. Metal impression tray of appropriate size was loaded with mixed impression material and impression was made on plastic model. Then after washing under running water, they were soaked in 0.5 % sodium hypochlorite solution for 10 minutes and then rinsed under running for 1 minute (disinfection, n=10) or cast immediately (control, n=10). Impressions were cast with dental stone (Fuji Rock, GC Co. Ltd., Tokyo, Japan).
Six measurements were done for each cast sample by measuring teeth lengths (anterior, premolar, molar) and lengths of edentulous spans (anterior, premolar and molar regions) by using a digital slide caliper. Measured data was registered in spreadsheet program (Microsoft Excel, Version 2007) and examined by using 'Unpaired Samples T test' in SPSS (Statistical Package for Social Science) statistical software. The values of change between measurements from sample casts and measurements directly taken from the typodont model were calculated and expressed as a linear change in millimeter (mm).

## RESULT

Tooth length of all sample casts became shorter than that of typodont model (maximum 0.29 mm). Significant differences were found at anterior and molar tooth length of auto-mixed samples with subsequent disinfection.
Nevertheless, edentulous span of all samples was longer than that of actual model (maximum 0.27 mm). Although significant differences were seen at anterior of both auto-mixed and hand-mixed samples without subsequent disinfection, there were no significant differences in the samples with subsequent disinfection (Table 1 &2).

## DISCUSSION

The statistical analysis showed that significant differences were found in cast dimension and tooth lengths between two mixing methods with or without disinfection. Alginate impressions prepared with automatic mixing method have better dimensional accuracy than those mixed by hand. Koski showed that alginate mixed with the device produced fewer surface defects and had better detail reproduction with cast gypsum than hand-mixing. Inoue et al. investigated the setting characteristics and rheological properties of alginate mixed by three methods: a hand-mixing technique, a semi-automatic mixing instrument, and an auto-mixed instrument. They found almost no porosities using the auto-mixed instrument and concluded that in clinical use, homogenous mix produced by auto-mixed is preferred over hand mixing.[4] Frey et al used the Alginator II (Cadco, Oxnard, CA), a semi-automatic mixer and observed similar findings.[2]

However, it is noted that the working time of automatically mixed paste was significantly decreased. It may be because when the material is mixed at high speed, the temperature of the paste increases slightly due to friction between the material and mixing container. Similarly Inoue *et al* showed that pastes mixed automatically had a markedly shorter working and setting time compared with hand-mixing.[4] Disinfection of impressions has been taken for a topic of importance for a number of years. American Dental Association (1994) recommended a ten-minute immersion in a 1:10 dilution (0.525%) of sodium hypochlorite solution for disinfection of hydrocolloid impressions. So, 0.5% sodium hypochlorite solution was chosen as a disinfectant in our study. It has strong and immediate antimicrobial effect, cost effectiveness and is easily available in the market. Alginate impressions do not tolerate the heat treatment; therefore chemical disinfection has been the method of choice.[8] Immersion seems to be more secure than spraying.[9] As irreversible hydrocolloid has a tendency to be superficially dissolved in sodium hypochlorite, hydrocolloids should be disinfected for a limited time.[10]

In the present study, there was contradictory result regarding the effect of disinfection. Although disinfection gave casts with teeth that were the closest representation of actual model than without disinfection (especially with auto-mixing), for edentulous span length disinfection showed negative effect i.e. the span became longer than those without disinfection. Nevertheless, auto-mixing without disinfection resulted in the casts with the least change in edentulous span length. It is assumed that alginate materials prepared with manual method produce more porosity and more absorption of water (imbibition) can affect the precision of the impression and may result in inaccurate casts. Although the differences between the mixing methods with or without disinfection are found to be significant, the preference for device mixing is not only to standardize the alginate mixing procedure but also to facilitate the mixing, to reduce the amount of air bubbles, to obtain a homogenous mixture (Dreesen K et al., 2012).

## CONCLUSION

Within the limitation of the present study, it can be concluded that auto-mixing is preferable for more accurate alginate impression and subsequent disinfection with 0.5% sodium hypochlorite solution for 10 minutes has little effect on dimensional accuracy.

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**Table 1: Measurements of typodont model and sample casts (hand-mixing method)**

| Measurements | Typodont model | | | Sample casts without subsequent disinfection | | | Sample casts with subsequent disinfection | | |
|---|---|---|---|---|---|---|---|---|---|
| | Anterior | Premolar | Molar | Anterior Mean (SD) | Premolar Mean (SD) | Molar Mean (SD) | Anterior Mean (SD) | Premolar Mean (SD) | Molar Mean (SD) |
| Tooth length | 11.13 | 8.8 | 6.62 | 10.97 (0.07874) | 8.51 (0.091378) | 6.376 (0.013416) | 11.042 (0.034205) | 8.512 (0.050695) | 6.496 (0.082037) |
| Edentulous span length | 9.08 | 14.28 | 16.63 | 9.108 (0.027749) | 14.372 (0.099348) | 16.762 (0.076616) | 9.184 (0.074027) | 14.55 (0.082765) | 16.828 (0.112561) |

**Table 2: Measurements of typodont model and sample casts (automatic mixing method)**

| Measurements | Typodont model | | | Sample casts without subsequent disinfection | | | Sample casts with subsequent disinfection | | |
|---|---|---|---|---|---|---|---|---|---|
| | Anterior | Premolar | Molar | Anterior Mean (SD) | Premolar Mean (SD) | Molar Mean (SD) | Anterior Mean (SD) | Premolar Mean (SD) | Molar Mean (SD) |
| Tooth length | 11.13 | 8.8 | 6.62 | 11.078 (0.040866) | 8.566 (0.065038) | 6.518 (0.072595) | 11.086 (0.06269) | 8.636 (0.069857) | 6.596 (0.02881) |
| Edentulous span length | 9.08 | 14.28 | 16.63 | 9.078 (0.034928) | 14.332 (0.042661) | 16.726 (0.078613) | 9.152 (0.056303) | 14.476 (0.086776) | 16.8 (0.091924) |