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Research Article

Accuracy of New Generation Extended Pour Alginate V/S Addition Silicone Impression Materials for Fabricating Single Crowns – Research Articles

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ABSTRACT

Aim: The aim of this study was to evaluate the fit of single copings fabricated from addition silicone and new generation alginate impression materials by comparing their marginal fit and internal adaptation using a 2D digital analysis method.

Materials and Methodology: A maxillary second molar (Nissin typodont) was prepared and impressions were made using four different impression materials: CAVEX crème alginate, extended pour Alginate (Hydrogum5) with immediate pouring (EPI), extended pour Alginate with delayed pouring for one hour (EPD), and addition silicone (President, Coltene). Wax patterns were fabricated on stone dies and copings were cast. The copings were analysed for marginal and internal fit using a 2D digital analysis. One-way ANOVA with post hoc analysis was used to compare the mean marginal gap and internal fit among the groups

Results: The study found that the mean marginal gap was 0.17 mm for the EPI group, 0.23 mm for the CAVEX crème alginate group (Group C), 0.20 mm for the EPD group, and 0.30 mm for the addition silicone group (Group PVS). Post hoc analysis revealed a significant difference in marginal fit between the EPI and PVS groups (p=0.03), indicating superior marginal fit in the EPI group. However, there was no statistically significant difference in internal fit among the groups.

Conclusion: These results suggest that extended pour alginate materials, particularly when poured immediately, offer better marginal fit compared to addition silicone for single-tooth impressions. The internal fit was comparable across all materials tested.

Clinical significance: Extended pour alginates can be used for fabricating a single coping due to their longer working time and flexibility in the impression process.

Keywords: Extended pour alginates, addition silicone, marginal fit, internal fit

INTRODUCTION

A fixed dental prosthesis with good marginal and internal adaptation may reduce the risk of secondary caries and periodontal diseases by minimizing marginal accumulation of food, bacteria and plaque. (1) Jacob et al

reported that saliva can dissolve cement in margins over 150 μm. [2] One of the significant factors for producing restorations with accurate internal and marginal fitness is the impression material and technique. Alginate is one of the most used impression materials in dentistry because of its easy accessibility, economic viability, ease of manipulation, accuracy, and patient comfort. [3] Its hydrophilic nature makes it easier to record an accurate impression even in presence of blood and saliva are present. However, it requires a specific usage protocol. All the manipulative factors like water/powder ratio, spatulation, and temperature, affect the strength and accuracy of the set material. So, it is critical to follow the manufacturer's directions to obtain an accurate impression. [4]. The main disadvantages of alginate are its low dimensional stability because of tendency of its inherent phenomenon of syneresis and imbibition and lower tear strength than elastomeric impression materials. Elastomeric impression materials are supposedly the material of choice for recording prepared teeth because of their good detail reproduction and dimensional stability, but their high cost, hydrophobic nature and requirement for custom tray& adhesive limits their usage also.
According to a survey conducted on the basis of type of material used for fixed partial denture impressions, 55.46 % practitioners excluding prosthodontist use alginate as final impression material and 44. 54 % use elastomeric impression material. [5] To alleviate the shortcomings of traditional alginates, extended pour alginate has been introduced. With delayed pouring intervals of up to 120 hours, extended pour alginate maintains dimensional stability and accuracy. [6] Due to differences in formulations, products of different manufacturing companies have variable characteristics and properties in terms of consistency, setting time, dimensional stability, elasticity and strength
Aim of this study was to compare the accuracy of addition silicone impression and new generation alginate impressions by relating marginal fit and internal adaptation of cast copings to accuracy of impression material using a newer 2D digital analysis method. Null hypothesis was that there is no difference in fit of single crown copings fabricated on dies obtained from addition silicon and newer generation alginate impressions.

MATERIALS AND METHODOLOGY

A maxillary second molar (Nissin typodont) was mounted in dental stone and prepared with 1 mm axial reduction with chamfer finish line, 1.5 mm occlusal reduction, and 8-degree taper (Figure 1). [7] A silicone index (President, Coltene) was prepared to monitor the amount of reduction. An auto polymerizing acrylic resin special tray (perforated) was fabricated on the master model was with uniform wax spacer of 3 mm thickness. Two stops on the cylindrical sides of the master model were made, to facilitate orientation of tray on metal die.

Study groups

The study was conducted in 3 groups with 12 sample each based on impression material used.
Group C: Impression made with CAVEX crème alginate
Group EPI: Impression made with extended pour Alginate (Hydrogum5), and poured immediately.
Group EPD: Impression made with extended pour Alginate (Hydrogum5) and poured after 1hr
Group PVS: Impression made with Addition silicone (President, Coltene)
12 impressions were made for each study group with respective material. Each impression was inspected under a magnifying lens before being poured. The dies were separated from the impressions after 45 minutes as per manufacturer's instructions and were inspected under a magnifying lens for any defect in the area of the preparation. Wax patterns fabricated on each stone die were invested immediately with phosphate bonded investment material to minimize the possibility of distortion of the wax patterns. The patterns were cast using Co-Cr alloy in induction casting machine. The copings were sandblasted, finished, polished and checked for passive fit on the stone die

Analysis of fit using 2D digital analysis

Scanning was performed in 3 steps (Medit Korea, lab scanner) first scan of the master model (Figure 2), second scan of the coping on the master model (Figure 3) and third scan of intaglio of the coping (figure 4). These 3 scans were superimposed using Exo cad software. The measurements were done in 2D mesiodistal and buccolingual cross sections (Figure 4 A &B). Mid occlusal gap and marginal gap at buccal, lingual, mesial and distal were measured for each sample. For marginal fit of each coping, 4 readings were taken from 4 different locations and the average value was taken. For internal fit of each coping, 1 reading was taken. One-Way ANOVA with post hoc analysis was performed to analyse the mean marginal gap and internal fit.

Result

Maximum mean marginal gap of 0.30 mm was seen in Group PVS followed by Group C (0.23 mm) and Group EPD (0.19 mm) with least marginal gap in Group EPI (0.17 mm). Post Hoc analysis gave insignificant difference among various groups except between Group EPI and Group PVS where the difference was significant (p=0.03) indicating superiority of extended poured alginate over addition silicone impression

material in terms of marginal fit (Table 1). Highest mean internal gap was reported in group EPD (0.62 mm) and least in Group C (6.48 mm). Post hoc analysis showed that difference among all the group was statistically insignificant establishing extended pour alginate as equivalent alternative to addition silicone impression material for recording prepared tooth.

Discussion

The null hypothesis of the study was partially rejected as the marginal gap of Group EPI was significantly less than that of group PVS although there was no statistically significant difference in the internal fit of materials evaluated in the study.

Accuracy of impression material can be assessed by studying surface detail reproduction and dimensional stability. [8] In 2002, Brosky et al, introduced a computer-aided 3D assessment method for accuracy of conventional impression based on the ISO concepts of trueness and precision where trueness is the deviation of a measurement from a reference, while precision is the deviation between multiple measurements of the same reference. [9] Evaluating the accuracy of an impression technique through the fit of the produced restoration is considered more clinically relevant as it is the summation of multiple production steps, including impression as a significant factor. [10]

A variety of methods and testing parameters have been used to evaluate the fit of prosthetic restorations, including the mainly direct measurement, cross-sectional measurement, and Impression replica technique [11]. Impression replica method is widely used to study the fit of (FDPs) [11,12]. This method involves measurements of thickness of silicone layer that corresponds to cement space under the microscope. There can be possible cause of human error during the procedure. The use of digital scanners allows for a more accurate and comprehensive evaluation of the fitting accuracy of FDPs .2D digital analysis involves scanning of the master model, intaglio of the restoration and restoration in place on the master model, and then superimposing the three scans. 2D sections can be made in the software for analysing the fit of restoration. This eliminates error caused during manual procedure.

Extended pour alginate depicted better accuracy than gold standard addition silicone group even after delayed pouring in terms of marginal fit. This suggests that inexpensive extended pour alginate can replace the addition silicone impression material for impression of single prepared tooth. Alginate is less expensive and much more accessible to communities in need of prosthetic rehabilitation, especially where developing communities are concerned.

Results of the present study are supported by, Peutzfeldt et al who had also concluded that alginate impression material possesses a degree of accuracy comparable to elastomeric impression material in terms of surface reproduction. [13] Faria et al investigated the accuracy of various impression materials and discovered that alginate is comparable to elastomeric impression materials in terms of accuracy and can be utilized to replace condensation n and addition silicone impression materials. [14] Singh et al evaluated the dimensional accuracy of alginate with that of improved alginate, and the dimensional accuracy of improved alginate with that of elastomer and concluded that improved alginates have comparable surface detail reproduction as compared to that of elastomers. [15]

However, Lin et al had reported poor marginal adaptation of metal copings made on cast obtained from alginate impression material as compared to polyether or polysulphide impression materials. [16] However, the castings were one piece on four abutment teeth and a travelling microscope had been used to measure the gap only on labial surface. Fatima et al had measured the distance between longitudinal and vertical lines incorporated in the stainless-steel test block in impression material only (alginate v/s addition silicone) using travelling microscope. Moreover, they had used only putty consistency of addition silicone and their results cannot be extrapolated to medium consistency and double consistency putty light body impression. [17] Chen et al evaluated the accuracy of alginate, addition silicone and polysulphide impression materials by comparing the discrepancies in diameter of occlusal surfaces between the master dies and stone casts at 0hr, 1hr and 24hr interval. Single impression was used to obtain stone casts at different intervals and digital photographs with scale were used to measure the discrepancies. Cavex(alginate) was found to be less accurate than addition silicone impression with significant difference except at 0hr interval. [18]

The extended-pour irreversible hydrocolloids are newer materials that show promising dimensional stability up to 120 h. Literature reports studies by Imbery et al, Mohammed E Sayed et al , Todd et al ,Eriksson et al, Walker et al , Jiang et al , Aalaei et al, Kusugal et al showing that the newer generation extended pour irreversible hydrocolloid performed better with respect to the surface detail reproduction and dimensional change as compared to traditional alginates.[19-26] In our study (0, 1 hr) intervals were taken for the extended pour alginate impressions and EDI group shows better results than addition silicone in terms of marginal fit and there was no significant difference in terms of internal fit. No study in literature assessed accuracy of extended pour alginate with addition silicone impression materials by relating it to fit of fixed dental prosthesis.

Further in vivo and in vitro studies must be conducted evaluating the accuracy of new generation alginates for multiple unit FDPs.

CONCLUSION

Both alginates tested in the study appeared to be suitable for making impression of single prepared tooth. Extended pour alginate if poured immediately proved to be better option than addition silicone
In extended pour alginates Delayed pour up to one hour showed better result in terms of marginal fit and comparable in terms of internal fit. Study results suggests that new generation alginates can be used as alternative to addition silicone impression materials.

CLINICAL SIGNIFICANCE: Extended pour alginates can be used as an alternative to addition silicone impression material for fabricating a single coping with increased flexibility in impression process.

LIST OF ABBREVIATIONS:

FDPs: Fixed dental prostheses
2D: Two dimensional
3D: Three dimensional

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Tables and table legends

Impression Material	**Marginal gap**		Group-Wise Comparison*	**Internal gap**		Group-Wise Comparison*
	Range (mm)	Mean + SD (mm)		Range (mm)	Mean + SD (mm)	
GROUP C	0.17-0.29	0.23±.05	NS	0.35-0.60	0.48±.09	NS
GROUP EPI	0.08-0.29	0.17±.08	NS	0.32-0.60	0.49±.10	NS
GROUP EPD	0.10-0.28	0.20±.07	EPD VS. PVS p value =0.03	0.37-0.92	0.62±.22	NS
GROUP PVS	0.22-0.42	0.30±.08	NS	0.32-0.65	0.50±.13	NS

Table 1: One-way ANOVA with Post hoc Testing: NS: Not significant SD: standard deviation

Figures and figure legend

Figure 1 : Prepared maxillary second molar mounted in dental stone

Figure 2 :Scan of master model.

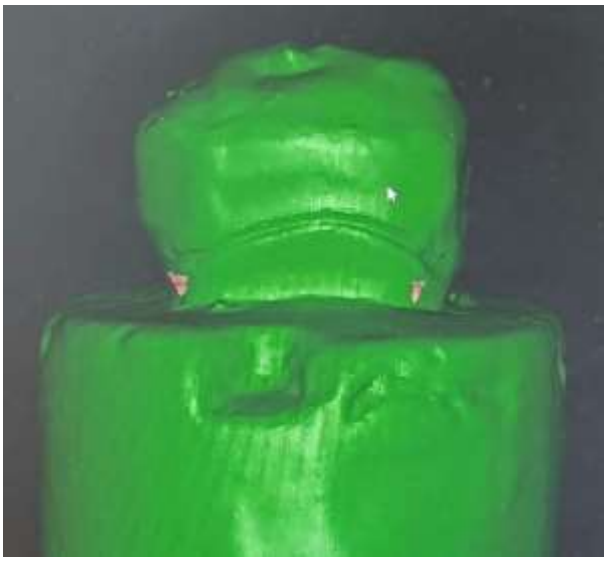


Figure 3: Scan of cast coping placed on master model

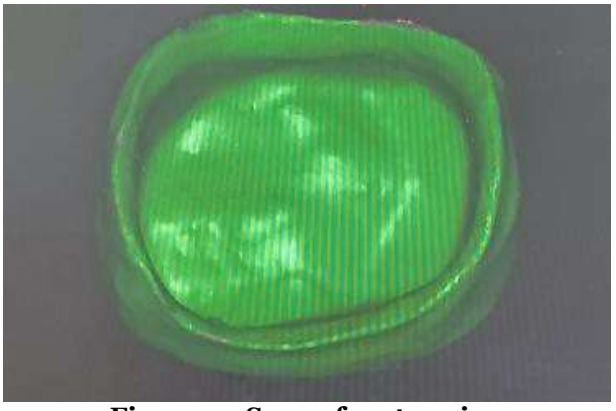
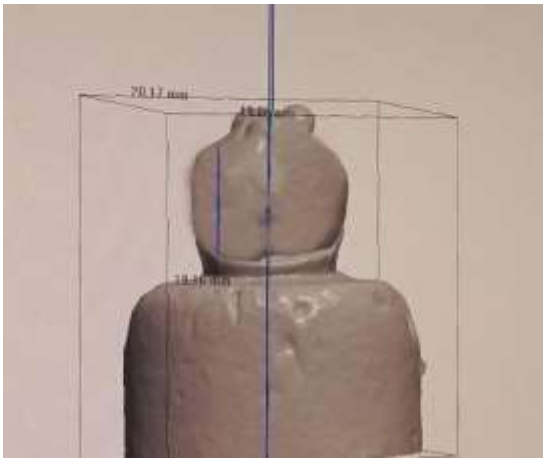
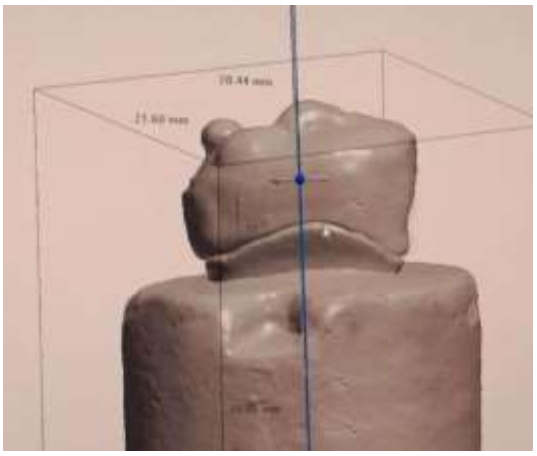


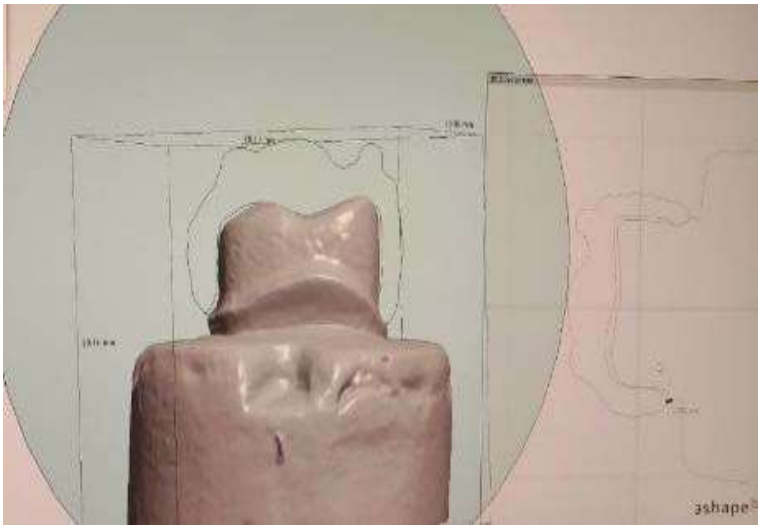
Figure 4 : Scan of cast coping



5A



5B



5C

Figure 5a: Mesio-distal section of coping superimposed on master model , 5 b: Bucco-lingual section, 5 c: Bucco-lingual section with 2-D measurement of internal fit and marginal gap.