Original Article

A CLINICAL COMPARISON OF POLYVINYL SILOXANE IMPRESSIONS FOR FIXED PARTIAL DENTURES USING THREE DIFFERENT TECHNIQUES

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ABSTRACT:
Background: Impression making of indirect restorations remains technically intricate due to the presence of voids, bubbles and other defects. Objective: The objective was to compare the defects present in impressions between three different techniques using hand mixing elastomers. Materials and methods: This is a cross sectional study. Three master impressions were made from each 32 crown preparations with three different techniques totaling to 102 master impressions. PVS impression material, putty (Aquasil) and light-body (Reprosil) viscosity combinations were used for every patient with the three techniques i) single stage double mix technique ii) two stage technique with using a spacer and iii) two stage technique without using a spacer. The impressions were rated by two evaluators using Heine binocular magnifying loupe (2.3×) and the results tabulated. The results were presented as percentages. Kappa test was done to compare the agreement of various impression techniques with each other. Results: Among the three techniques used, the single stage double mix technique showed the least presence of any type of defects in the impressions with (21%) followed by two stage technique without using a spacer (35%) and then the two stage technique using a spacer (44%). Kappa test was used to compare the agreement of the different methods. Between Technique 1 and 2 (kappa = 0.532, $p<0.001$), technique 1 and 3 (kappa= -0.097, p= 0.5) and techniques 2 and 3 (kappa=0.025, p= 0.881). Majority of the defects were voids (59%) and bubbles (30%) followed by pulls (11%). The number of defects located at the margins were 75% and 25% were located at others areas. Conclusion: The single stage double mix technique and two stage technique without using a spacer had a more favorable outcome in comparison to the two stage technique using a spacer using hand mixing technique.
Key words: polyvinyl siloxane impression material, voids, bubbles, tears, pulls

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INTRODUCTION

Dental impression making remains a challenging procedure due to the potential for voids and tears, which may adversely affect the precise fabrication of indirect restorations.[1] Poly vinyl siloxane impression materials (PVS) were successfully introduced in the 1970s.[1] Since that time and especially in past decade, these materials have gained in their acceptance and account for a larger share of the impression material market and used as impression materials in fabricating fixed partial dentures, removable appliances, and implant prostheses.[2,3] Vinyl polysiloxane silicones (also called addition silicones, polyvinyls, vinyls, and polyvinyl siloxane) are considered "state-of-the-art" for fixed partial denture impressions. They constitute the most widespread use of impression materials for fixed prosthetics.[4] The materials are presented in the form of two pastes (a base and an accelerator) which can be hand spatulated or autodispensed from a dual cartridge, and mixed in equal quantities for use.[3]

Although polyvinyl siloxane silicones (PVS) has some of the best properties among elastomers they

are also among the most expensive types of elastomers.[5] In a poor country like Nepal decreasing the cost of materials is important. Dentists, also practice impression making, without automixing systems and use hand mixing products to decrease the cost of impression. For the best clinical outcome it is essential to know the technique that produces least defects with hand mixing technique

Many techniques have been described in literature.[6, 7] but the number of clinical studies evaluating the clinical success of impression making is limited, compared to the number of in vitro studies.[8,9]

There are even less number of clinical studies on the different manual techniques to show which will produce the best result. This study is done to evaluate which method will bring the best result among the three techniques mostly used with polyvinyl siloxanes.

MATERIALS AND METHODS

Thirty four subjects (n) who required fixed partial denture (FPD) as a part of their dental treatment attending Prosthodontic department of KIST medical college and teaching hospital were assigned in the study, after obtaining their informed consent as approved by the Institutional Research Board of KIST medical college and teaching hospital. Assuming 92%* of number of acceptable impressions, at 95% confidence level and allowable error margin of 10%, a sample size of 34 was calculated. (*percentage of A and B (number of acceptable impressions) as quoted in Raigrodski AJ, Dogan S, Mancl LA, Heindl H. A clinical comparison of two vinyl polysiloxane impression materials using the one-step technique. The Journal of prosthetic dentistry. 2009;102(3):179-86)

The ages of the subjects were between 25 and 45 years. Subjects with a history of adverse reaction to materials to be used in the study, subjects with tooth preparation finish lines located completely supragingivally, and subjects who refused to provide informed consent were excluded from the study.

Three master impressions were made of each patient using three different techniques with polyvinyl siloxane (PVS) putty-wash impression technique. PVS impression material (Table I), putty (very high consistency) and light-body (LB) viscosity combinations were used for every patient with three different impression techniques;

i) Technique 1- single stage double mix technique
ii) Technique 2- two stage technique with using a spacer
iii) Technique 3- two stage technique without using a spacer.

Hence 102 master impressions were made.

Impression materials used in the study are listed in Table I

Table I: Impression materials used in the study

Brand	Material Type	Lot Number	Manufacturer
Aquasil	ISO 4823 Type 0 Very high consistency-Putty	13070000578	Dentsply Caulk, Milford, Del
Reprosil	ISO 4823 Type 3 Light-body Consistency	026401	Dentsply Caulk, Milford, Del

After tooth preparation was completed, a knitted gingival retraction cord (#00 Ultrapak; Ultradent Products, Inc, South Jordan, Utah 84095), was used. An appropriate metallic perforated stock tray was selected for both the maxillary and mandibular arch in every case. The abutment tooth was thoroughly rinsed with water and dried to clean and eliminate any moisture.

For group 1, impressions were subjected to the 1-step technique. Putty and wash impression materials were used simultaneously. The wash material was manually mixed and dispensed with a 3ml syringe around the prepared tooth with simultaneous removal of the retraction cord. The putty was mixed manually, loaded on the impression tray and placed over the whole arch. The impression was allowed to set in the mouth for 12 minutes.

For group 2, the 2-step technique was used with a polyethylene spacer. A polyethylene sheet was placed over the teeth. The preliminary putty impression was made and allowed to set for 10 minutes. Wash material was then added in the putty impression and the tray reseated after removal of the gingival retraction cord and allowed to set for 12 minutes.

For group 3, the 2-step technique was used without a spacer. A preliminary putty impression was made and allowed to set for 10 minutes. Wash material was then added over the putty impression and the tray

reseated after removal of the gingival retraction cord. It was allowed to set for 12 minutes.

Every impression was visually examined by two prosthodontist using a Heine binocular magnifying loupe (2.3×) and the results tabulated.

The overall score of each impression material (A to D rating) was described by frequency and percentage for each material (Table II). According to a rating scale for the readability of the abutment teeth, impressions were rated as acceptable (A or B) and unacceptable (C or D). The defects were observed in the impression, and were documented as bubbles, voids, tears, or pulls defects, and their location was documented as well.

Tears, voids, and bubbles were observed, which were also described by the frequency and percentage of each impression with any tear, void, or bubble for each material.

Kappa test was used to compare the agreement of the individual techniques

Table II: Rating criteria for visual assessment of defects of impression by clinical evaluator

A = No defects. Impression is useable.
B= Small defects such as tears, voids, bubbles which do not affect finish line to prevent use of impressions. Impression is useable.
C= Good reproduction of preparation finish line. Other defects require impression to be remade.
D= Defects at preparation finish line, impression needs to be remade.
T 1= Tears at the margin,
T2= Tears present in areas beside the margins
V1= voids present at the margin,
V2= voids present in areas beside the margin
B1= bubbles present at the margin,
B2= bubbles present in areas beside the margin
P1= pulls present on the lingual/ palatal aspect of the impression
P2= pulls present in the labial / buccal aspect of the impression
P3= pulls present in the proximal aspect of the impression

RESULT

Among the three techniques the least number of defects were shown by the single stage double mix technique with useable impressions (A&B) of 94.12% and the two stage technique with using a spacer being the least favorable with usable impression of 82.35%. The two stage technique without using a spacer also had a result of 85.29%.

Kappa test was used to compare the individual results. Between technique 1 and 2, there was fair significant agreement between the two methods (kappa = 0.532, p<0.001). But when comparing between techniques 1 and 3 (kappa= -0.097, p= 0.5) and techniques 2 and 3 (kappa=0.025, p= 0.881), there was insignificant weak agreement signifying that technique 2 impressions were not comparable with technique 1 and 3.

Among the defects there was presence of 26 void (59%), 13 bubbles (30%) and 5 pulls (11%) and absence of any tears (figure 1).

The number of defects located at the margins were 75% and 25% were located at others areas beside the margins. All the pulls were present at the lingual/ palatal aspect of margins while 81% and 54% if voids and bubbles were present at the margins respectively (figure2).

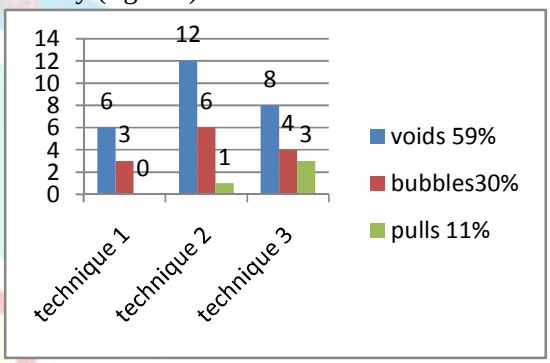

Figure 1: Number of defects with respect to the different techniques

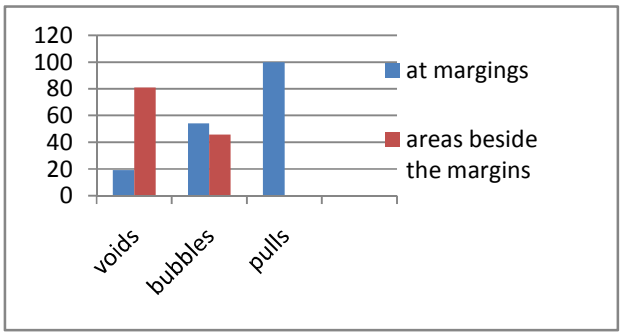

Figure 2: Distribution of voids, bubbles and pulls

DISCUSSION

Among the impression materials available in the market, selection of material is left to the discretion of the dentist, who makes choices based on personal preference, experience, impression philosophy and

the material used.[10] Manual mixing varieties of elastomers are popular, in poor and under developed countries like Nepal. The use of manual techniques over automixing techniques decreases the price as PVS materials are more expensive than competing elastomers and alginates. [4,5] While using the manual mixing elastomers voids and bubbles were the most prevalent among the defects (59% and 30% respectively). Idris B et al stated that there is tendency for more bubbles to be produced and included in the set impression with the putty/ wash one step impression technique, and with the use of two step technique this source of error can be minimized.[11] Our study contradicted with this result as the least defects were noted in the single stage putty wash technique. This may be due to the fact that bubbles in the impression can occur when spatulated and entrap air into the mix[2], less amount of wash material is used in the single step resulting in less chance of voids but in techniques using spacers, the operator had to manipulate a large amount to light body which might have incorporated air and may have caused the increased number of voids.

These defects are caused by the operators mixing technique, which could be prevented by using automixing techniques. Automixing cartridges tend to create fewer bubbles than hand spatulation.[2]

Tear resistance indicates the ability of a material to withstand tearing in thin interproximal areas and in the depth of the gingival sulcus.[12] There was absence of tears in the impression which might be due to the good tear resistant nature of material.[13,14] Most addition silicone materials provide higher tear strengths than polyether and hybrid materials.[15]

The adequacy of the impression is also affected by the clinician's experience level and skills and the material's handling proper- ties here clinically experienced prosthodontist had taken the impression which would elevate this question of adequacy.

Whenever possible, the margin of the preparation should be located supragingivally[16]; however, certain conditions may require the placement of subgingival margins.[17] A higher impression failure rate was also shown when the finish lines were placed 2 mm subgingivally and below.[18] in the current clinical study, none of the finish lines were placed more than 1 mm or below the free gingival margins so as not to violate the biologic width.

Further clinical studies using different materials, impression techniques, single and multiple abutment teeth, and evaluators should be considered, with a larger sample size, for the complete clinical assessment of manual mixing varieties of VPS impressions.

The outcome of this study can suggest the use of single stage double mix technique to make an impression free from visual defects. This will save time as well as the need to do a re-impression.

CONCLUSION

Within the limitation of this study the following conclusions were drawn:

i) The single stage double mix technique and two stage technique without using a spacer had a more favorable outcome in comparison to the two stage technique using a spacer for hand mixing techniques
ii) The voids and bubbles were the majority of defect that were present
iii) Marginal areas were more prone to defects

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