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Original Research Article

Effect of Different Dispensing Tips on Material Wastage of Polyvinyl Siloxane Impressionmaterial: An In-vitro Study

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Abstract:

Context: Newer dispensing tips that claim to minimize wastage of materials are now available in the market.

Aims: To evaluate the material wastage of polyvinyl siloxane impression materials (light-body) mixed with 2 different dispensing tips- MIXPAC Yellow T-Mixer Dispensing tips and a Conventional Dispensing tips.

Settings and Design: Study was conducted in the Department of Prosthodontics, Crown and Bridge and Implantology, Panineeya Mahavidyalaya Institute of Dental Sciences, Hyderabad, Telangana from 16th may 2022 to 23rd may 2022. MIXPAC INDIA supplied the MIXPAC Yellow T-Mixer tips and conventional helical dispensing tips. For weighing the Dispensing tips electronic precision balance (Electronic scale, Wensar Weighing Scales Limited.) is used.

Methods and Material: A sample of 40 dispensing tips- 20 MIXPAC Yellow T-Mixer tips (Sulzer Mixpac Yellow T- Mixer tips) and 20 conventional helical Dispensing tips were used for the study. The tips were weighed before and after the light body material was dispensed through these tips using a light body dispensing gun. Statistical analysis used: Paired T-test was used to compare the weights before and after mixing in each of the Dispensing tips, whereas, unpaired t-test was used to compare the difference in weight between the two groups. A p value of <.05 was considered significant for all analyses. IBM SPSS version 25 was used for the statistical analysis of the data.

Results: The difference in weights before and after mixing the polyvinyl siloxane impression material was significantly greater in the conventional helical dispensing tips group, indicating morematerial wastage when compared to yellow T mixer dispensing tips.

Conclusions: The MIXPAC yellow T- Mixer dispensing tips had low material wastage when compared to conventional helical dispensing tips.

Keywords: MIXPAC yellow T- Mixer Dispensing tips, Conventional helical Dispensing tips, polyvinyl siloxane impression material.

Introduction

Elastomeric impression materials are the most commonly used impression materialsbecause of their advantages like excellent detail reproduction, elastic recovery from deformation, dimensional stability, and a very low polymerization shrinkage of < 0.05%. [1]

Different mixing techniques may affect the superiority of set impression materials. Therefore, dimensional accuracy is the most significant factor when constructing a passive and accurate prosthesis. The mixing of impression material is critical and technique sensitive. A precise proportion of dental mixing material is necessary for a flawless impression. [2]

Polyvinyl siloxane impression materials, also known as addition reaction silicones, became extremely popular during the past decade. Although they are among the most expensive impression materials, they are now used in a wide variety of conditions in fixed prosthodontics, operative dentistry, removable prosthodontics, and implant dentistry. The popularity of these materials is understandable, given the combination of excellent physical properties, handling characteristics, and unlimited dimensional stability.[3,4] An elastomeric impression material in dentistry revised by the International Organization for Standardization (ISO) 4823.[5]

Polyvinyl siloxane impression materials are classified on the basis of viscosity of material: putty (type 0), heavy body (type 1), regular body (type 2), and light body (type 3).[6] In addition to low polymerization shrinkage, polyvinyl siloxane impression materials also have long-lasting dimension stability. Hence, they are widely used for impression making in dentistry.[7]

If high-quality impressions are to be obtained, the components must be mixed in the correct ratio and quickly, ensuring a homogeneous mix free of air bubbles.[8]

Various mixing techniques are available such as:[8]

Manual Mixing Technique

The manual mixing technique is the initial method for impression mixing using spatula. A measured quantity of base and catalyst is added, and a uniform motion mixes the impression content. The main disadvantage of the hand mixing or manual mixing technique is the inadequate mixing ratio caused by the unequal amount of base and catalyst.

Auto mix systems

These are the most recent self-mixing systems that dispensed a uniform amount of mixing material. The dispensing system refills cartilage in different quantities. Cartridges are constructed with two independent outlets to prevent premature contamination, which is a significant product benefit for cartridges.

Choice of mixing technique depends upon the operator's skills; procedure demands and equipment available. Dispensing tips are time-saving and prevent the excessive loss of mixing material. These are available in different sizes and operators can select according to the patient physiological conditions and procedure requirements.[8]

These impressions materials, especially the low viscosity type- are dispensed through an automix gun which was prepared by loading the cartridge and installing the dispensing tip. The system must be ready to dispense material when needed.[4] This method is convenient, provides a consistent mix, and is cost-effective.[9] The system encloses a two barrelled syringe, in which eachside extrudes an equal volume of material through a disposable dispensing tips.[10] The number ofbubbles incorporated in the mix is reduced with this system. From a patient comfort standpoint, these materials are ideal because they are clean, odourless, and tasteless. They polymerize quickly and, especially when used with a custom tray, the amount of bulk of material can be kept to a minimum.[9]

MIXPAC T-Mixer automix tips (Sulzer Mixpac Yellow T-Mixer tips) are new generation tips designed to diminish material waste while providing a consistent, high-quality mixingresult.[11] The innovative design allows for a more compact shape by integrating a higher number of mixing layers internally. It having advanced technology leads to more efficient material processing. These tips are available in various types of colours and sizes.[12]

This study aims to evaluate material wastage when both: Yellow T Dispensing tips and conventional helical dispensing tips are used to dispense polyvinyl siloxane material. The null hypothesis states that there will be no statistically significant difference in the material wastage of polyvinyl siloxane impression material between the conventional helical dispensing tips and the Yellow T-mixer tips.

Subjects and Methods:

A total of 40 samples were divided into two groups with 20 each, MIXPAC Yellow T- Mixer dispensing tips group, and the Conventional helical dispensing tips group **(Fig 1 and 2)**. As per the manufacturers, the conventional helical MB 5.4-14-D and T-Mixer MBT 4.2-12-D were used. Each Dispensing tips was weighed (in gms) individually on an electronic precision balance (Electronic scale, Wensar Weighing Scales Limited.) before and after dispensing the material in the tips, so as to evaluate the material wastage within the tips **(Fig 3- 6)**.

The material wastage was assessed by calculating the difference in the weight of mixers before and after mixing the impression material. Paired T-test was used to compare the weights before and after mixing in each of the dispensing tips, whereas, unpaired t-test was used to compare the difference in weight between the two groups. A p value of $<.05$ was considered significant for all analyses. IBM SPSS version 25 was used for the statistical analysis of the data.

Results

Shorter impression Dispensing tips such as the T-Mixer have been developed to reduce the material waste from mixing. The results of the present study showed that the T-Mixer Dispensing tips led to less material waste compared with the conventional helical Dispensing tips.

The Yellow T mixer dispensing tips showed a significantly lesser material wastagecompared to the

conventional helical dispensing tips (**Table 1**). However, a significant weight gain ($p< 0.05$) was detected both in the Yellow T-mixer and Conventional helical dispensing tipson comparing the weight before and after mixing the impression material (**Table 2)**.

Table 1: Between-group comparison of the difference in weights (material wastage) of theimpression material mixed using two techniques using an unpaired t-test.

Group	Mean difference	Std deviation	Percentagedifference	T statistic (p-value)
Yellow T mixer	.95	.016	5%	-69.20 (.000)**
Conventional	1.34	.019		
Helical				

**Highly significant at p<.01

Table 2: Intra-group comparison of before and after values within the two groups usingpaired t-test.

Mixer type	Time of measurement	Mean	Std deviation	Percentage difference	T statistic (p-value)
Yellow Tmixer	Before	1.93	.007	49.2%	-258.351 (.000)
	After	2.88	.018		
Conventional helical	Before	2.47	.010	54.2%	-312.134 (.000)
	After	3.82	.016		

**Highly significant at p<.01

Fig 1: Yellow T- mixer mixing tip.

Fig 2: Conventional Helical mixing tip.

Fig 3-6: Before and after weights of Yellow T- mixer and Conventional helical mixing tips.

Discussion

The results of the present study showed that the T-Mixer mixing tip led to less material waste compared with the conventional helical mixing tip (Tables 2 and 3). Therefore, the null hypothesis was rejected.

Auto mixing system was introduced in the 1980s for dispensing polyvinyl siloxaneimpression materials. S.C. Keck et.al in 1985 described the auto-mixing system as containing at win barrelled syringe, with each side simultaneously extruding an equal volume of material through disposable dispensing tips that is composed of three parts: a pre-mixer, a mixer, and a housing- that encloses both the pre-mixers and divides the two incoming streams into four wide ribbons. The eight-turn counter rotating helix within the mixer churns the material when it passesthrough. The resultant mixed product is thereby, ready to use. This concept was a significant breakthrough in the impression material delivery system and was intended to counteract the problem of contamination during contact with the spatula and mixing pad when polyvinylsiloxane impression material is mixed with a spatula.[7] Inadequate mixing in addition, could yielda distorted impression due to non-uniform curing.[11, 12]

Different dispensing tips are in use for dispensing light body polyvinyl siloxane impression materials. In the present study, two types of dispensing tips i.e., MIXPAC Yellow T- mixer and conventional helical dispensing tips were compared for material wastage after polymerization. This study demonstrated a lesser material wastage of 49% for MIXPAC Yellow T-mixer compared to that of conventional helical dispensing tips, thus leading to a rejection of the null hypothesis. Ana Teresa *et al*, in a study comparing material wastage from MIXPAC T mixer tip and Conventional helical dispensing tips, proved that the material wastage is less in T mixer dispensing tips. This was attributed to the shorter length of the MIXPAC T-mixer dispensing tips compared to the Conventional helical dispensing tips.[9] The internal design of the yellow T-mixer tip probably improves homogeneity while using a reduced amount of material as a result of cutting the tip shorter.[11]

Nagarmatta Swathi et al evaluated the reproduction of surface detail in polyvinyl siloxaneusing various mixing tips. The findings of this investigation demonstrated that T-mixer mixing tips greatly outperformed conventional mixing tips when used with polyvinyl siloxaneimpression material in comparison to other tips.[13]

According to the manufacturer, the T-mixer works by combining both shear and strain forces while mixing the light body material as opposed to conventional helical dispensing tips, which use only shear forces for mixing the light body impression material. As a result, a more homogenous mix is produced with the same number of elements by the MIXPAC Yellow T- mixer tip. It also improves the flow of material with the application of less force.[11] Using shorter dispensing tips reduces the wastage of polyvinyl siloxane light body impression material, which is not easily biodegradable.[12]

Limitation

Dispensing tips only used for polyvinyl siloxane light body impression materials in ourpresent study.

Conclusion

Based on the findings of this in-vitro study, the following conclusions were drawn:

MIXPAC Yellow T- mixer Dispensing tips showed lesser material wastage compared to the conventional helical dispensing tips (significant p-value, $p<0.05$)

Redesigning the dispensing tips, by reducing the length of the dispensing tips helped in reducing the material wastage of light body polyvinyl siloxane impression material while dispensing. More homogeneous mixing results enhances application safety

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