Effect of 3 Different Medicaments on Dimensional Stability and Surface Detail Reproduction Of Polyvinyl Siloxane Impression Material

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Abstracts: Aim:Surface detail reproduction and dimensional stability of Poly vinyl siloxane impression material is most important property for final success of fixed partial denture. Purpose: This study was carried out to determine the effect of retraction cord medicaments (epinephrine, aluminum chloride and ferric sulfate) on the dimensional accuracy and surface detail reproduction of polyvinyl siloxane impressions. Method and materials: Polyvinyl siloxane impressions were made of standardized metal dies (American Dental Association [ADA] specification No. 19) and was treated with 1 of the 3 retraction cord medicaments. Dimensional accuracy was evaluated by comparing the average length of a line in the impressions to the standard die. Surface detail reproduction was evaluated by viewing the impressions under low-angle illumination at 10X magnification. Reproduction was considered satisfactory if 2 of 3 horizontal lines were reproduced continuously. The dies were also evaluated under the microscope before the impression was made. Results: The medicaments did not significantly affect the dimensional stability. Aluminum chloride and ferric sulfate had an adverse effect on surface detail reproduction. Epinephrine had no effect. Discussion: The changes in dimensional accuracy were within ADA guidelines, the surface detail reproduction was modified such that the impression would be considered clinically unacceptable. For optimal results, care must be taken to remove all traces of these retraction cord medicaments prior to recording of a polyvinyl siloxane impression. [Tanna N et al NJIRM 2012; 3(4) : 124-130]

Key Words: Dimentional Stability, Surgace Detail, Polyvinyl siloxane Impression Material

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Introduction The success of fixed Prosthodontics restoration is largely dependent upon the long term health and stability of the surrounding periodontal structures [1]. Marginal integrity is one of the basic principles of tooth preparation. Margins are one of the most important and weakest links in the success of restorations, and also referred as 'gingival finish line[2]. The restoration can survive in the biological environment of the oral cavity only if the margins are closely adapted to the cavosurface finish line of the preparation. If the proper margin placement is not done, then there is a chance of the development of recurrent caries and periodontal diseases[3]. The placement and accurate record of finish line has a direct bearing on the ease of fabrication of the restoration and on the ultimate success of the restoration.

There are three types of gingival finish lines according to location of the marginal placement: Supra-gingival, Equi-gingival, Sub-gingival.

Supra-gingival and equi-gingival margin exert less impact on the health of abutment teeth as compared to sub-gingival margin, because of difficulty in recording during impression procedure, to finish the restoration and to maintain the health of abutment teeth. But in many situations such as caries, existing restoration, esthetic demands, the need for additional retention, the placement of sub-gingival margin on the abutment teeth is necessary[4]. So the gingival tissue must be expanded vertically and horizontally to allow sufficient impression material to be injected in to the expanded gingival tissue to record the sub-gingival margin accurately.

Various techniques and methods have been used to manage the gingival tissues. They include: (1) Mechanical methods (2) Mechanico-chemical methods (3) Rotary gingival curettage (Gingitage) (4) Electrosurgery. The mechanico-chemical method is most frequently used method and causes the least amount of tissue injury. For this method; the retraction cord is either immersed in or pre-impregnated with haemostatic solutions. The retraction cord mechanically displaces the gingival tissue and absorbs moisture contamination in the gingival sulcus, while the

chemical agent controls hemorrhage and shrinkage of the gingival tissue [5,6] The mechanical effects of the cord itself will be considered equal for all materials, so that difference discussed will be solely a result of the medicaments used [7].

The medicaments should satisfy the following criteria:
1. It must be effective as a haemostatic agent.
2. Use of the material should not cause significant irreversible tissue damage.
3. Use of the material should not produce potentially harmful systemic effect [7].
Many different medicaments have been used or suggested for gingival retraction procedures. These include epinephrine, aluminum chloride ($AlCl_3$), aluminum sulfate, zinc chloride, alum (aluminum potassium sulfate), ferric sulfate, ferric sub sulfate, and Negatan [8,9]. When the effectiveness and lack of the local injury are considered, the materials appear to be acceptable as gingival retraction agents: alum, aluminum sulfate, ferric sulfate, aluminum chloride (buffered), and racemic epinephrine 8%.

Polyvinyl siloxane impression material has become more popular in recent years because of its accuracy, ease of manipulation, excellent elastic recovery, and dimensional stability[11].

However, the polyvinyl siloxane impression materials suffer from one limitation: they are hydrophobic. The hydrophobic nature of these materials demands that the clinician pay particular attention to those techniques and/ or reagents that control moisture in problematic areas such as the gingival sulcus[11].

The purpose of this study was to determine the effects of 3 medicaments (epinephrine, aluminum chloride and ferric sulfate) on the dimensional accuracy and surface detail reproduction of PVS material. Need of the study is weather either of these properties is adversely affected by the retraction cord medicaments, as the accuracy of the die and, ultimately, the restoration will be compromised.

Materials And Methods: The materials were used for this study are epinephrine (Orostat, Gingi-pak, Camarillo, USA, Item # 1014, contain 8 % solution of dl-epinephrine HCL), aluminum chloride (Gingi-Aid, Gingi-pak, Camarillo, USA, Item # 12115 ,topical astringent solution of aluminum chloride ($AlCl_3 . 6H_20$) 25 %), Ferric sulfate (Statis, Gingi-pak, Camarillo, USA, Item # 13115, viscous supermint flavored, amber colored glycerol or aqueous solution containing 210 mg / ml ferric sulfate (21 %), physiological saline(0.9 % (W/V) Sodium chloride), Polyvinyl siloxane impression material (Flexitime-monophase, Hydrophilic, medium body type-2 polyvinyl siloxane, Heraeus-Kulzer, Germany).

Five standardized stainless steel dies (Figure.1, 2) were prepared according to the ADA specification No. 19 for making impression of polyvinyl siloxane impression material [10]. According to ADA Specification No. 19 it consists of a cylindrical stainless block of 38 mm diameter, with a 30 mm diameter step on its superior surface.

Figure 1. Schematic representation of Master Die

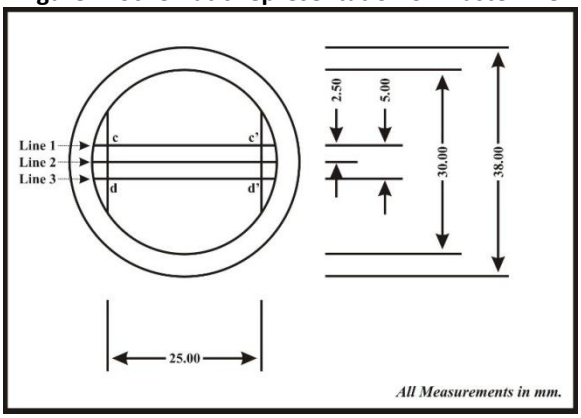
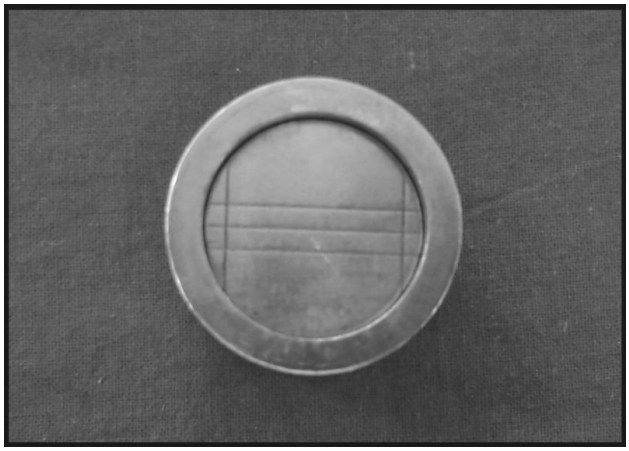
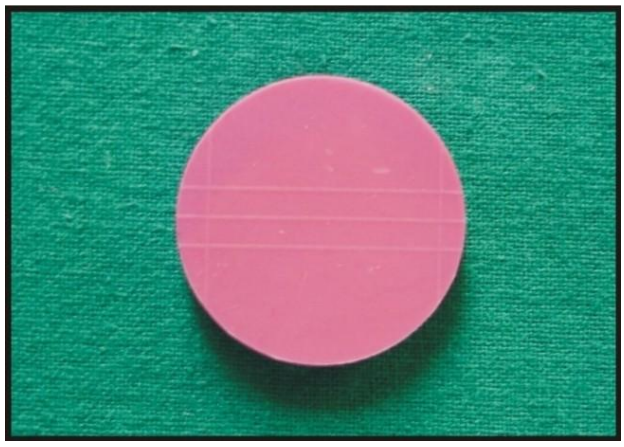


Figure 2. Master Die



Dies were scored with 3 horizontal lines and 2 vertical lines on the top of impression surface. The horizontal lines were numbered as 1, 2 and 3 and the vertical lines were numbered as cd and c'd' for ease in making measurements. The distance between two horizontal lines was 2.5 mm and between two vertical lines was 20 mm. The die was subjected to Nd-YAG Laser treatment and 3 horizontal and 2 vertical lines were prepared, with the width of 0.016 mm, on top of 30 mm diameter surface. Die had highly polished surface. The die also contained a ring that surrounds the periphery of it, which serves as a tray or as a container for the impression material. The dies were individually numbered and marked with an arrow to facilitate the orientation with the ring. The die was dried and freed of any dust. The square gauze piece was soaked in the medicament and all the excess fluid was removed by blotting. It was then placed on the top surface of the master die for 30 seconds. The gauze piece was removed and die was blown with dry compressed air for 1 minute. Care was taken to ensure that, the medicament was dried on the surface of die before the impression was made.

Figure 3. Impression of Control group



Material was manipulated with the help of automix cartridges and dispensed through the dispensing gun providing homogenous mix of the material to be studied. Latex gloves were avoided as it may inhibit the polymerization of the polyvinyl siloxane material. The cartridge was blended initially and the material was allowed to flow on the critical lined areas of the die and then was pushed and spreaded over the entire die surface with the tip of the cartridge. This procedure yields least possible amount of voids incorporated into the mixed material. The metal rings at the periphery helps to contain the material in place.

After the proper amount of material was dispensed onto the die, a thin polyethylene sheet and a flat metal plate was placed atop the die. 500 grams weight was placed on top of the flat metal piece. Then, the whole assembly was then transformed into water bath (32°C± 2°C) simulating that in oral conditions. The impression material allowed setting according to manufacturer's instructions. As recommended by ADA Specification No. 19, the materials allowed setting for an additional period of 3 minutes before the impression is removed from the die. Once the material was set, the impression was removed from the die with the help of raiser and the impression was numbered on the back.

A total of 96 impressions were made, with 24 impressions for each groups according to tested solutions, i.e., physiological saline as control, epinephrine, aluminum chloride, and ferric sulfate.

After removal of impression, the die was sonicated for two minutes in alcohol and air dried to ensure die was totally free of any surface contaminants before taking new impression.

Dimensional accuracy was evaluated 24 hours after making each impression by measuring the length of horizontal lines cc' or dd' on each impression with the help of the measuring microscope at X 10 magnification. Each measurement was taken for three times and averaged to minimize measurement errors. The percentage of change was then calculated by subtracting the known standard die line length on the surface of die from this averaged impression value and then divided by the standard line value.

Surface detail reproduction for each impression was evaluated 1 hour after the impression was removed from the die by viewing each of the horizontal line (Numbered 1, 2,and 3) under measuring microscope at X 10 magnification using low angle illumination. The reproduction of line was considered unacceptable if any part of line indistinct, e.g., appeared melted or flattened or the borders of the line were fuzzy or blurred. In addition, the medicament pooled on the impression material and obscured the line reproduction or incorporated in to the material which destroyed the line integrity. This line was considered unacceptable. The reproduction was considered an acceptable, if 2 out of 3 horizontal lines were reproduced continually and well defined for the full 25 mm length between 2 vertical lines. Anything less than this was considered unacceptable.

The standard and treated dies were also evaluated under microscope at 10X magnification, to determine whether the retraction cord medicaments had any effect on the surface of the dies before the impression was made. The dies were closely evaluated for pooling of medicament along the lines, the formation of surface coating, and any effect of the medicaments on the surface detail of the dies.

All data were analyzed by SPSS Statistical software (IBM SPSS Statistics 19.0 - August 2010). Fisher's exact test was used to determine the effect of medicaments exposure on surface detail reproduction. Fisher's exact test considers all the possible cell combinations that would still result in the marginal frequencies as highlighted. The test is exact because it uses the exact hypergeometric distribution rather than the approximate chi-square distribution to compute the p-value.The dimensional accuracy data were evaluated statistically by using a 1-factor analysis of variance with Tukey's mean comparison post analysis.

Observation and Discussion: The accuracy and dimensional stability of the dental impression material is an important factor for the accuracy of the final restoration. Because of superior dimensional stability and accuracy of polyvinyl siloxane, it is most widely used. But after gingival retraction procedure, a problematic interaction occurs between the polyvinyl siloxane impression materials and commonly used gingival retraction agents.

So, this study was done to determine the effect of retraction cord medicaments (epinephrine, aluminum chloride, and ferric sulfate) on the dimensional stability and surface detail reproduction of polyvinyl siloxane impression material.

Table-1 shows that the dimensional stability did not appear to be affected by any of the retraction cord medicaments used in this study.

Medicaments	n	Mean	S.D	S.E	t-value	p-value
Epinephrine	24	20.056	0.043	0.009	23	P< 0.01
Aluminum chloride	24	20.091	0.028	0.006	23	P< 0.01
Ferric sulfate	24	20.027	0.025	0.005	23	P< 0.01
Physiological saline	24	20.081	0.025	0.005	23	P< 0.01

Dimensional changes occurred in all impressions, including the control, were within the ADA Specification for the polyvinyl siloxane impression material(less than 0.5%).

Table-2 showed that, the surface detail reproduction was adversely affected by aluminum chloride and ferric sulfate.

Result	Control	Epinephrine	Aluminum Chloride	Ferric sulfate
Acceptable	24	24	0	0
Unacceptable	0	0	24	24
Total	24	24	24	24

But epinephrine exerted no effect on surface detail reproduction of polyvinyl siloxane impression material (Figure 4).

The aluminum chloride produced an extremely rough, melted appearance with whole sections of lines were completely obliterated on the impression surface (Figure 5).

Figure 4. Impression of Epinephrine treated die

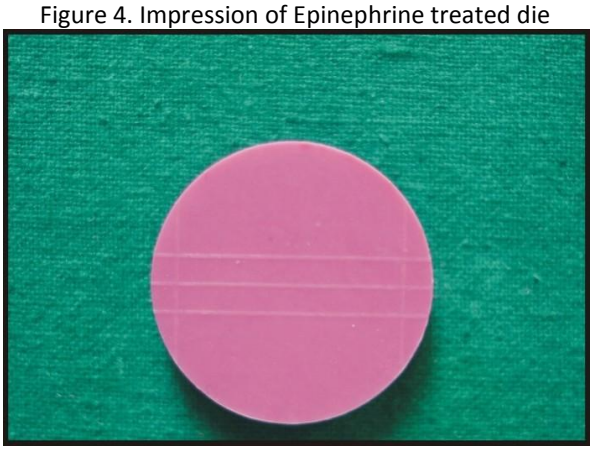


Figure 5. Impression of Aluminum Chloride treated die

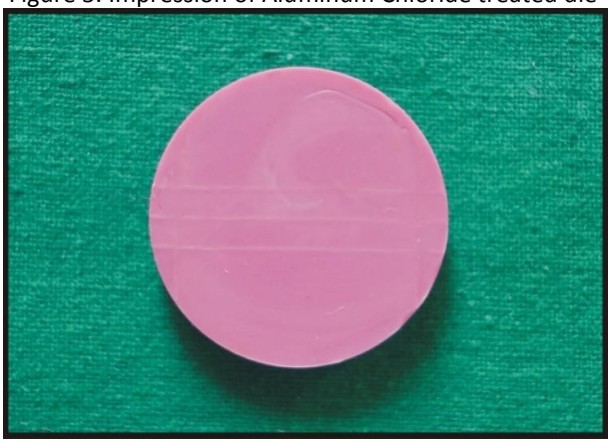
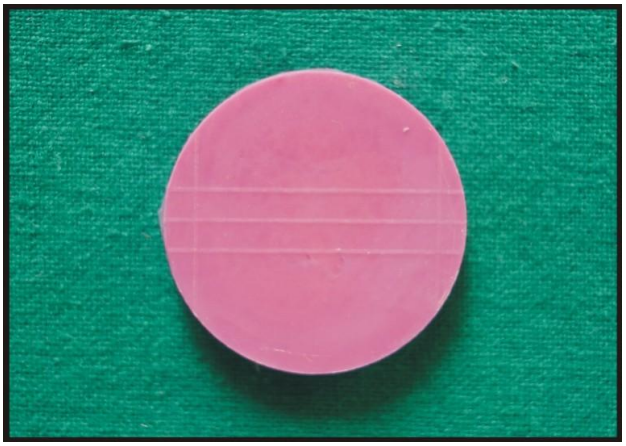


Figure 6. Impression of Ferric Sulfate treated die



A close observation by naked eye of aluminum chloride treated dies showed that, the horizontal lines were visually indistinct in many areas. While under the microscope, the medicament left a thin film on the surface of the dies, but the horizontal and vertical lines were visually distinct. It is unclear whether the aluminum chloride had an additional effect on the polyvinyl siloxane impression material or the polyvinyl siloxane impression material recorded accurately a contaminated die. Either way, it is critical that the clinician must remove all the trace amount of aluminum chloride medicament from the preparation prior to making a polyvinyl siloxane impression.

In comparison with aluminum chloride, the adverse effect of ferric sulfate was associated primarily with pooling of residual medicament around the edge of lines. Often this pooled medicament was incorporated in to the edges of lines and destroying its integrity. The treated dies with ferric sulfate medicament, when viewed under microscope, did not appear to have a surface coating but very small traces of the

medicament were noted along the vertical and horizontal lines. The medicament caused uneven changes in color of die surface.

The impressions of these treated dies were considered unacceptable. The horizontal lines were distinct in most areas of the impression, except in very small areas where remnants of medicament were incorporated in to lines or edges of the lines. With the ferric sulfate, the impression appeared as a reproduction of contaminated die (Figure 6).

The ferric sulfate medicament had a less sever adverse effect on the impression and the die then did aluminum chloride.
The results of this study suggest that, the clinician must be diligent in his or her effort to remove retraction cord medicament prior to recording a polyvinyl siloxane impression.

Additional studies are also required to determine the effect of other medicaments as well as the interaction of the medicaments used in this study on the wide variety of commercially available polyvinyl siloxane impression materials.

Conclusion:

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