EGYPTIAN DENTAL JOURNAL

VOL. 57, 899:905, JANUARY, 2011

I.S.S.N 0070-9484

WWW.EDA-EGYPT.ORG

EFFECT OF GINGIVAL RETRACTION MATERIALS ON THE PHYSICAL PROPERTIES OF POLYVINYL SILOXANE (PVS) IMPRESSION MATERIAL

Abdulaziz M.A. Albaker

ABSTRACT

Purpose: This study was conducted to evaluate the effect of Expasyl and Hemox-A on the setting time and tear strength of polyvinyl siloxanes impression material.

Material and method: 60 specimens of PVS impression material were tested using Oscillating Rheometer to measure setting time; 20 specimens were contaminated with Expasyl, another 20 specimens were contaminated with Hemox –A and twenty specimens were included as the control group. 60 specimens of PVS impression material were tested using Instron machine to measure the tear strength; 20 specimens were contaminated with Expasyl, another 20 specimens were contaminated with Hemox-A. Twenty of these specimens were used as a control group

Result: A significant difference was observed in the setting time of PVS impression material when contaminated with Expasyl or Hemox-A.

Conclusion: Within the limitation of this study, it was noticed that the setting time and tear strength of PVS impression material was affected by the contamination with Expasyl and Hemox-A.

KEY WORDS: Polyvinyl siloxane, gingival retraction material, setting time, tear strength, polymerization.

INTRODUCTION

Polyvinyl siloxane (PVS) impression materials are also known as addition reaction silicones[1]. They have a wide range of application in fixed, removable prosthodontics and implant dentistry because of their excellent physical properties and handling characteristics[2]. PVS are the most popular impression material for fixed prosthetics [3]. They undergo setting without reaction by products which may affect the physical properties[4].

PVS impression materials have a short setting time[5]. This helps in reducing the clinical time and

*Assistant Professor, King Saud University, College of Dentistry, P.O.Box 60169,Riyadh 11545, Saudi Arabia.

minimizing the gag reflexes[6]. Deformation of PVS impression materials occur at much slower rate and tear at points of less permanent deformation[7]. It flows around the soft and hard tissues of mouth and has sufficient elastic recovery [4, 8].

The dimensional accuracy of this material depends on time[9]. It is said to be maximum, soon after the polymerization and reduces on storage for a period of time [10, 11]. One of the major limitations of PVS material is their hydrophobicity[2, 12]. One of the aspect of hydrophobic nature of this material relates to surface free energy of the unpolymerized, liquid phase of the impression material and lack of ability to wet the oral tissue during impression making[1, 13].

The rationale for tissue management is a critical aspect of impression making, so that all tooth preparation margins are captured in the impression to assure an excellent marginal fit of a laboratory fabricated restoration[14, 15]. Many different medicaments are used for gingival retraction, to minimize hemorrhage from the gingival sulcus during impression making[16]. This includes epinephrine, zinc chloride, alum (aluminum potassium sulfate, aluminum sulfate, aluminum chloride). The retraction materials containing aluminum compounds or derivatives causes less local injuries and they are more effective as retraction material [17]. The chemical substances in these products may interfere with the quality of impression [18].

Despite the excellent physical properties of this material, distortions do occur. This is mainly due to their susceptibility to contaminations before the setting [4]. The interference that happens during the setting reaction prevents the cross-linking of the material [19]. Sulfur compounds present in latex gloves and rubber dam is reported to be one source of contamination [10]. This contamination can affect the physical properties of polyvinyl siloxanes (PVS) that can lead to major distortions and finally resulting in failure of the prosthesis [4]. O'Mahony et al [20],found that ferric subsulfate, ferric sulfate, and aluminum chloride interfere with the quality of reproduction of the PVS impression and this could be due to the action of sulfur that delays or inhibits polymerization. The impression materials injected in the subgingival areas to capture the cervical level of tooth preparation are very thin and can be distorted easily [10]. Low dimensional stability and tear strength can cause permanent distortion of the PVS[21].

In general, impressions should be capable of withstanding tensile stresses during impression removal and cast separation from the set impression. Some impression materials are susceptible to tearing in gingival crevices and interproximal areas. Tearing of the impression causes defects, which affect the accuracy of the final restoration. Therefore, it is necessary for impression materials to have maximum tear strength at the time of removal[22].

Expasyl™ paste (Pierrie Rolland, France) and Hemox-A solution (Deepak Products Inc. USA) are hemostatic materials commonly used during dental procedures[23].Expasyl is an injectable retraction and hemostatic agent[24]. Apart from the hemostatic qualities, Expasyl is capable of opening the sulcus, physically displacing the tissue and leaves the field dry, making the area fit for impression taking or cementation [24, 25]. Hemox-A is aluminium chloride six hydrate 25% in a specially prepared aqueous vehicle with buffering agents[26]. They are effective in shrinking the gingival tissues [26].

The purpose of this study was to investigate the effect of two different physical form of aluminium chloride haemostatic agents' contamination on the setting time and the tear strength of the polyvinyl siloxanes impression materials.

MATERIALS AND METHOD

The setting time and the tear strength of PVS Impression material (rapid set) was in vitro tested after being contaminated with two different gingival retraction materials. The impression material used in this study was a hydrophilic, light-body, type 1 PVS impression material (Genie, Sultan HealthCare, Englewood, NJ) and gingival retraction materials used were, Expasyl™ paste (Pierrie Rolland, France) which contains, kaolin (white clay), water and aluminium chloride (15%)and excipient [25,27], and liquid form of Hemox-A(Deepak Products Inc. USA) which contains aluminium chloride 6-hydrate (25%).

The protocol of each test was as follows

Setting time test: Setting time of 60 specimens of PVS impression material was tested using the Oscillating Rheometer (Linseis Inc. Prinston, JCT-NJ) (Figure 1). The machine was adjusted to let the material set at 37°C (oral) temperature and the chart recorder to move with a speed of 1 cm/min. All the specimens were tested to obtain a consistent value of setting time (Minutes). The specimens were divided in three groups. Group I included 20 specimens of PVS and Expasyl which was obtained by mixing 10 cm of the PVS impression material from the duel-port cartridge with 10 cm of Expasyl using sterile dry spatula without wearing latex gloves on mixing paper pad for 10 seconds and were placed on the Oscillating Rheometer. The setting time was calculated from the chart. Group II (PVS and Hemox-A) also included 20 specimens and were formed after mixing 10 cm of the PVS impression material from the duel-port cartridge with 0.05 ml of Hemox- A solution using sterile dry spatula without wearing latex gloves on mixing paper pad for 10 seconds and place it in Oscillating Rheometer for testing. Group III included 20 specimens of PVS without any contamination. This group was considered as the control group and the setting time was recorded in a similar manner as that of the other two groups.

Tear Strength test: According to the standards of the American society of testing material (ASTM), Dumbbell shaped stainless steel mould with the dimension of A= 10.2 cm; B = 3.8 cm; C = 2 cm; and D = 0.9 cm was prepared to make the 60 specimens (Figure 2). The specimens were divided into three groups. Group I included 20 specimens of PVS mixed Expasyl. Group II included 20 specimens of PVS mixed with Hemox-A, and group III was the control group. The tear strength tests of 60 specimens of PVS impression material were measured using Instron universal testing machine (model 8500, Instron Corp., Canton, Mass) (Figure 3).

These specimens were placed between the upper and lower grip of the machine. Tests were performed at a crosshead speed of 10 inches/minute using a 100 pound load cell. Tests were performed immediately after the specimens were removed from the die. A single technician performed the test to ensure the consistency. The data was analyzed using SPSS software (IBM Inc,Armonk, New York,USA)

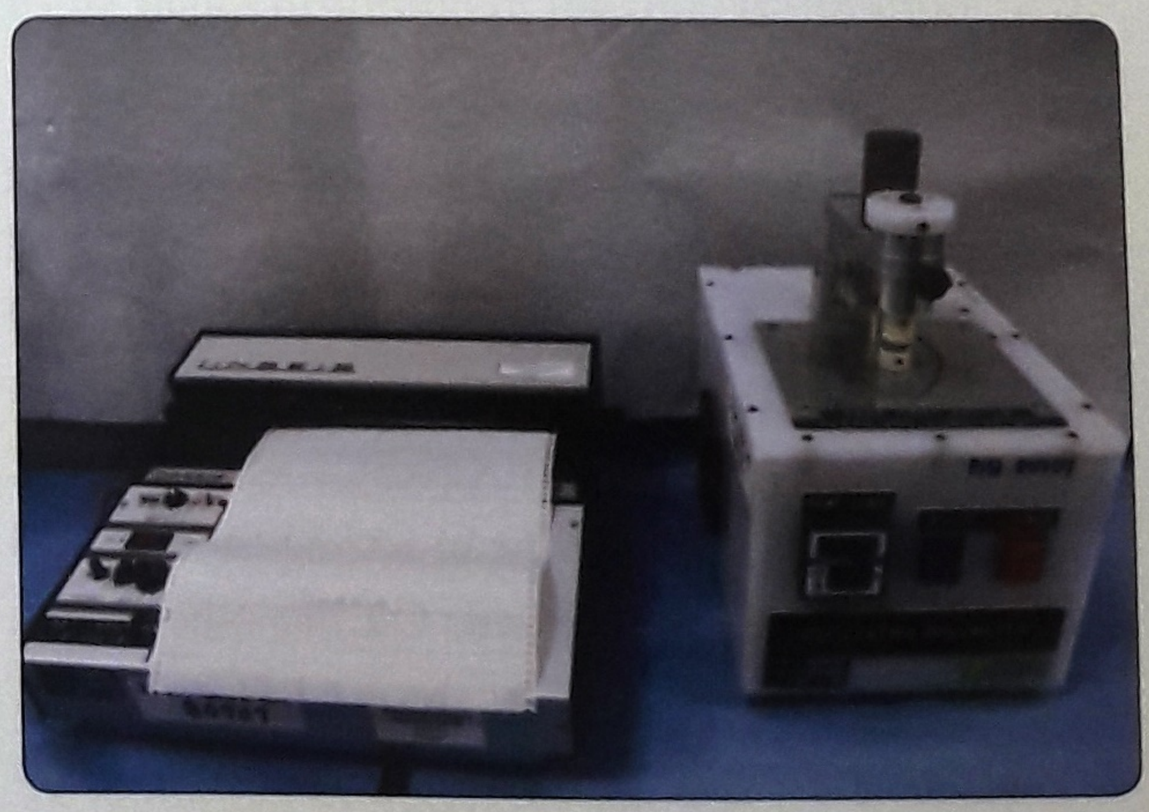

FIG. (1) Oscillating Rheometer.

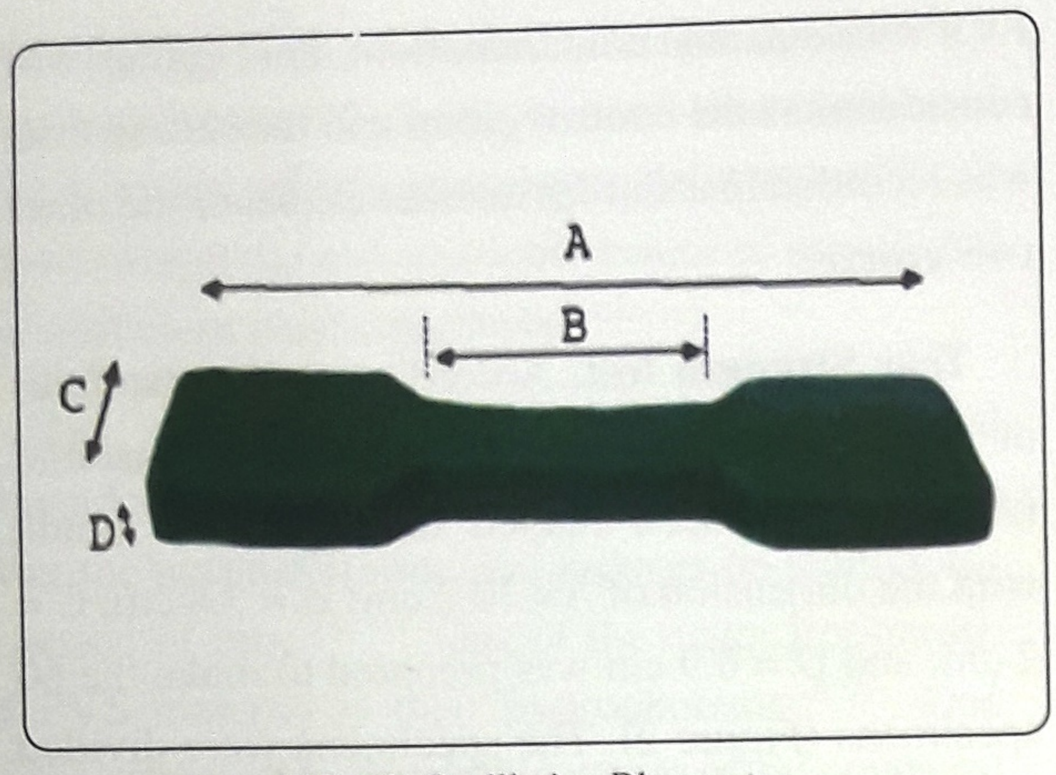

FIG. (2) Oscillating Rheometer.

FIG. (3) Instron Universal Testing Machine

TABLE (1) Setting Time of PV

Material	N	Mean	Std. Deviation
PVS	20	2.10	0.05
PVS_Expasyl	20	2.58	0.13
PVS_Hemox	20	3.18	0.19

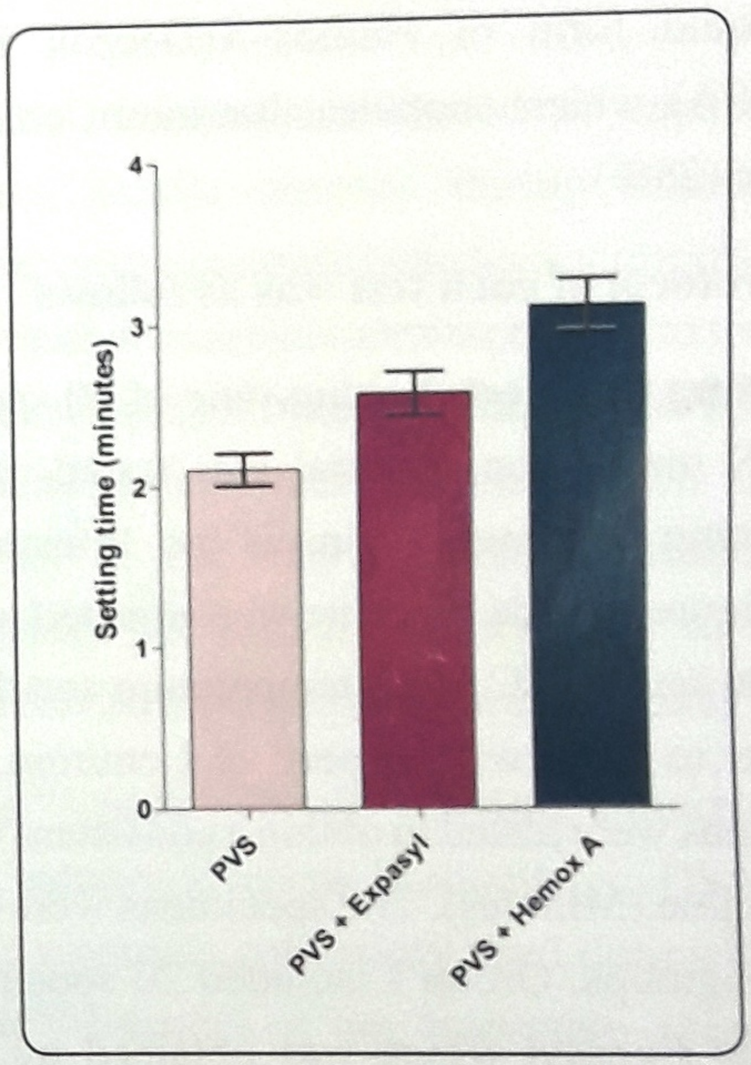

FIG. (4) The mean setting time of the three groups of materials studied (PVS, Expasyl+PVS and + PVS +Hemox)

RESULT

One-way ANOVA test showed that the setting time of the PVS impression material was influenced by the presence of both the materials Expasyl and Hemox-A. The mean setting time was 2.58±0.13 minutes for group I (PVS + EXPASYL). For group II (PVS + HEMOX – A) the mean setting time of 3.18 ± 0.19 minutes was observed. On the other hand, for group III (PVS), which is the control group the mean setting time was 2.10 ± 0.05 minutes (Table 1, Figure 4).

On comparing the control group with group I and group II, a significant increase in setting time was observed. The mean setting time of group II (PVS + Hemox-A) was significantly higher than that of group I (PVS + Expasyl). Group I (PVS + Expasyl) had significantly higher setting time when compared to the control group which was free of any contamination.

On analysis the values obtained for tear strength it was observed that the mean tear strength for Group I (PVS + Expasyl) was 102.01±6.18 MPa,

group II (PVS + Hemox-A) was 119.49±6.55 MPa and the control group; group III (PVS) had 121.39±6.65 MPa (Table 2, Figure 5). The analysis showed that both Expasyl and Hemox-A solution decreased the tear strength of the PVS impression material.. The mean tear strength was lowest for group I (102.01±6.18 MPa) when compared to group II (119.49±6.55 MPa) and the control group (121.39±6.65 MPa).

When each group was compared with the control group it was observed that both group I (PVS + Expasyl) and group II (PVS + Hemox-A) showed a significant reduction in the tear strength values.

Table 2: Tear Strength of PVS, Expasyl+PVS and + PVS +Hemox

Material	N	Mean	Std. Deviation
PVS	20	121.39	6.65
PVS_Expasyl	20	102.01	6.18
PVS_Hemox	20	119.49	6.55

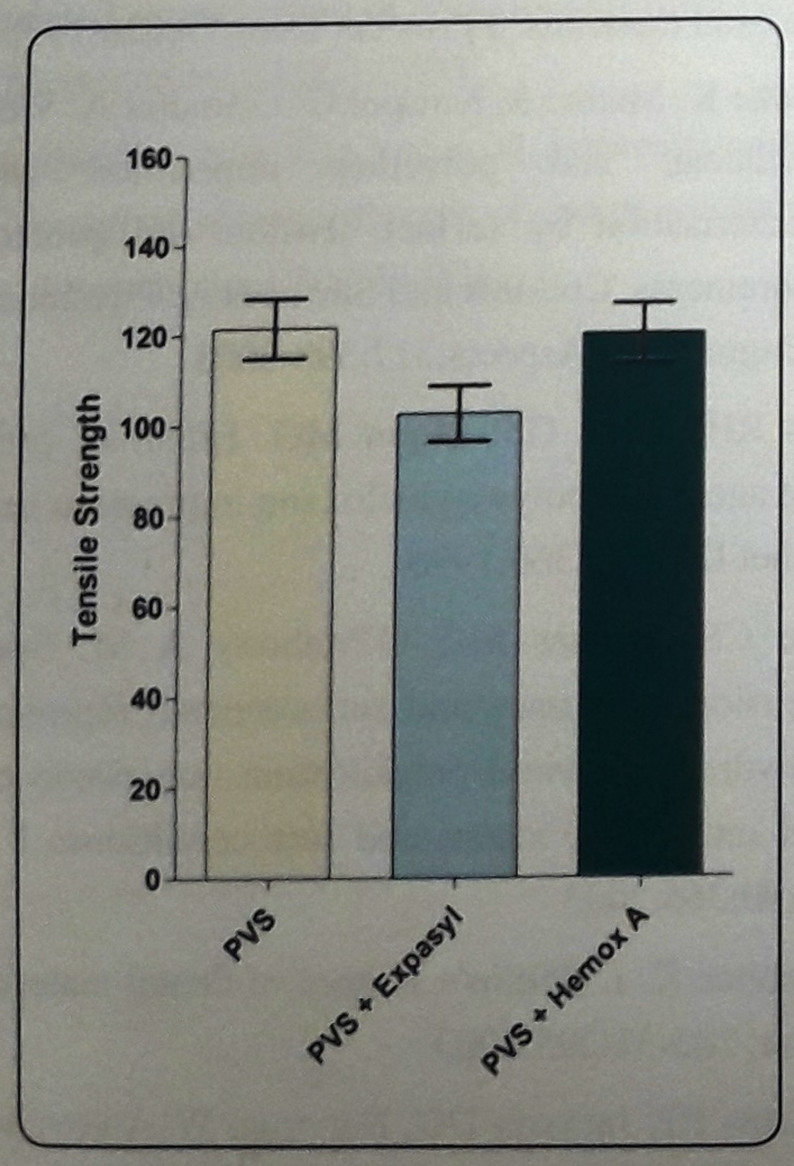

FIG. (5) The tensile strength of the three groups of materials studied (PVS, Expasyl+PVS and + PVS +Hemox)

DISCUSSION

There are many factors influencing the physical properties of elastomeric dental impression materials[6,28]. The medicaments used for gingival retraction can interfere with polymerization of PVS material[29]. Inhibited polymerization of PVS is manifested as rippled surface on set impression, this inhibition is limited and superficial[30].The contact of impression material with gingival retraction materials happens when adequate air and water is not used. The Expasyl with its paste-like nature are injected directly in the gingival sulcus and remain for 2-3 minutes in order to be open the gingival sulcus around the prepared tooth margins[25]. The retractions cord is soaked in Hemox-A and placed in the gingival sulcus. Many factors can contribute to the difficulty of removal of the retraction materials from the sulcus. The narrow space, the depth nature of the sulcus and the rough surface of the cervical region of the prepared tooth can make complete removal of the retraction material difficult task. Also, the Expasyl absorb the sulcus fluid and saliva in order to expand and apply its hygroscopic pressure to open the sulcus[31]. This can lead to dispersion of the Expasyl more inside the sulcus. PVS impression material is then injected in the gingival sulcus after removal of the retraction materials to capture the fine details of the prepared tooth margin. Any distortion of the impression material in this area can cause major distortion of the final restoration[9].

It was observed that the PVS impression material was influenced by the presence of both materials Expasyl and Hemox-A. There was an increase in setting time in an order of group II (3.18±0.19 minutes)>group I (2.58±0.13 minutes)>group III (2.10 ± 0.05 minutes). A significant reduction in the tear strength was observed, with maximum reduction for group I. The result of this study was in agreement with other studies[18, 20] that show delay or inhibition of polymerization of PVS can be a result of contamination with the aluminum chloride.

The sulfur can delay or inhibit the polymerization of PVS impression material that can affect the setting time and the tear strength. In contrast, a study by Kumbuloglu et al[29] has concluded that the physical properties of PVS material were not influenced by the gingival retraction material. This could be due to the different size, diameter, quality and quantity of retraction material used. As PVS materials are sensitive to temperature[4]changes, the room temperature was maintained at 21˚C and after preparation of the specimen immediately transferred to a water bath to remain in oral temperature before testing. Care was taken to avoid the generation of pitter areas in the form of air bubbles while preparing the specimens. However, one of the major limitations of PVS material is its hydrophobic properties due to the presence of hydrophobic aliphatic hydrocarbon groups surrounding the siloxane bond[4,32]. The aqueous nature of the retraction material can contribute to the dimensional instability of the PVS impression material[9].

Despite the resemblances of this laboratory study with the clinical conditions, there are differences that need to be taken in consideration. The gingival sulcus fluid is difficult to be applied in the laboratory study while it can play important role affecting the retraction material. The setting time was measured without contacting the tooth surface or affected by the moist environment of the oral cavity. Further investigations within a clinical setting are required to analyze the effect of different retraction material on the physical properties of the PVS impression material.

CONCLUSION

Within the limitations in this in vitro study, the following conclusions are drawn:

- The presence of Expasyl and Hemox-A with their different physical form has an effect on the setting time of the PVS Impression material.
- Both materials found to delay the setting of PVS impression.
- Expasyl showed a lesser effect on the setting time when compared to Hemox-A
- Expasyl and Hemox-A have a significant effect on the tear strength of PVS impression material.

REFERENCES

1. Chee WW, Donovan TE. Polyvinyl siloxane impression materials: a review of properties and techniques. J Prosthet Dent;68:728.1992
2. Mandikos MN. Polyvinyl siloxane impression materials: an update on clinical use. Aust Dent J;43:428.1998
3. Donovan TE, Chee WW. A review of contemporary impression materials and techniques. Dent Clin North Am;48:vi.2004
4. Rubel BS. Impression materials: a comparative review of impression materials most commonly used in restorative dentistry. Dent Clin North Am;51:629.2007
5. Nissan J, Laufer BZ, Brosh T, Assif D. Accuracy of three polyvinyl siloxane putty-wash impression techniques. J Prosthet Dent;83:161.2000
6. Corso M, Abanomy A, Di Canzio J, Zurakowski D, Morgano SM. The effect of temperature changes on the dimensional stability of polyvinyl siloxane and polyether impression materials. J Prosthet Dent;79:626.1998
7. Grundke K, Michel S, Knispel G, Grundler A. Wettability of silicone and polyether impression materials: Characterization by surface tension and contact angle measurements. Colloids and Surfaces A: Physicochemical and Engineering Aspects;317:598.2008
8. Jones RH, Cook GS, Moon MG. Effect of provisional luting agents on polyvinyl siloxane impression material. J Prosthet Dent;75:360.1996
9. Petrie CS, Walker MP, O'Mahony A M, Spencer P. Dimensional accuracy and surface detail reproduction of two hydrophilic vinyl polysiloxane impression materials tested under dry, moist, and wet conditions. J Prosthet Dent;90:365.2003
10. Anusavice K. J. Phillip's science of dental materials. 11th edition. 205-31:205.2003
11. Williams PT, Jackson DG, Bergman W. An evaluation of the time-dependent dimensional stability of eleven elastomeric impression materials. J Prosthet Dent;52:120.1984

12. Derrien G, Le Menn G. Evaluation of detail reproduction for three die materials by using scanning electron microscopy and two-dimensional profilometry. J Prosthet Dent;74:1.1995
13. Takahashi H, Finger WJ. Dentin surface reproduction with hydrophilic and hydrophobic impression materials. Dent Mater;7:197.1991
14. Radz GM. Soft-tissue management. The key to the perfect impression. Compend Contin Educ Dent;31:463.2010
15. Salinas TJ. Treatment of edentulism: optimizing outcomes with tissue management and impression techniques. J Prosthodont;18:97.2009
16. Albaker AM. Gingival retraction- techniques and methods: A review. Pakistan Oral & Dental Journal;30.2010
17. Polat NT, Ozdemir AK, Turgut M. Effects of gingival retraction materials on gingival blood flow. Int J Prosthodont;20:57.2007
18. Sabio S, Franciscone PA, Mondelli J. Effect of conventional and experimental gingival retraction solutions on the tensile strength and inhibition of polymerization of four types of impression materials. J Appl Oral Sci;16:280.2008
19. Craig R.G. OBWJ, Power J.M., Dental materials: properties and manipulation. (6th ed.), Mosby, St. Louis (1995) p.136-77
20. O'Mahony A, Spencer P, Williams K, Corcoran J. Effect of 3 medicaments on the dimensional accuracy and surface detail reproduction of polyvinyl siloxane impressions. Quintessence Int;31:201.2000
21. Hamalian TA, Nasr E, Chidiac JJ. Impression materials in fixed prosthodontics: influence of choice on clinical procedure. J Prosthodont;20:153.2011
22. Lawson NC, Burgess JO, Litaker M. Tear strength of five elastomeric impression materials at two setting times and two tearing rates. J Esthet Restor Dent;20:186.2008
23. Tosches NA, Salvi GE. [Gingival retraction methods. A literature review]. Schweiz Monatsschr Zahnmed; 119:121.2009
24. Poss S. An innovative tissue-retraction material. Compend Contin Educ Dent;23:13.2002
25. Shannon A. Expanded clinical uses of a novel tissue-retraction material. Compend Contin Educ Dent;23:3.2002
26. Donovan TE, Gandara BK, Nemetz H. Review and survey of medicaments used with gingival retraction cords. J Prosthet Dent;53:525.1985
27. Pescatore C. A predictable gingival retraction system. Compend Contin Educ Dent;23:7.2002
28. Rodriguez JM, Bartlett DW. The dimensional stability of impression materials and its effect on in vitro tooth wear studies. Dent Mater;27:253.2011
29. Kumbuloglu O, User A, Toksavul S, Boyacioglu H. Clinical evaluation of different gingival retraction cords. Quintessence Int;38:e92.2007
30. de Camargo LM, Chee WW, Donovan TE. Inhibition of polymerization of polyvinyl siloxanes by medicaments used on gingival retraction cords. J Prosthet Dent;70:114.1993
31. Bublewitz A, Reber JP. Pasty Insert Material for Widening of Gingival Sulcus and Use Thereof. In: Google Patents; 2009.
32. Walker MP, Petrie CS, Haj-Ali R, Spencer P, Dumas C, Williams K. Moisture effect on polyether and polyvinylsiloxane dimensional accuracy and detail reproduction. J Prosthodont;14:158.2005