Effect of contemporary retraction agents and cleaning with hydrogen peroxide on the polymerization of elastomeric impression materials

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Abstract
The aim of the study is to investigate the polymerization inhibition of elastomeric impression materials vinylpoly siloxane (VPS) and polyether (PE) when used in combination with retraction materials with and without subsequent cleaning with hydrogen peroxide (H2O2). Methods: Seven stainless steel specimens were fabricated. Four hundred and twenty impressions were made with three different elastomeric materials (140 each) as follows: group 1: VPS-Panasil; group 2: VPS-Express; group 3: PE-Monophase. Each material group was further subdivided into seven subgroups, based on use of no retraction material (control), three different retraction materials [Retraction capsule (RC3M), Dryz, Expasyl], and two cleaning techniques (water and H2O2). All subgroups included 20 impressions, which were made by a single operator using an automix gun. Evaluations were made using a visual scale by three calibrated examiners blindly and independently. Subjective categorization of the impressions were made as inhibited and uninhibited. Data were analyzed using Fisher’s exact test and significance was set at \( p < 0.05 \). Results: Inhibited impressions were lower than uninhibited impressions among VPS materials (Panasil and Express); Panasil and Express showed comparable \( (p > 0.05) \) impression retardation. PE showed significantly higher inhibition compared to VPS materials \( (p < 0.05) \). Expasyl showed significantly higher polymerization inhibition than other retraction materials \( (p < 0.05) \). The use of H2O2 for cleaning showed significant reduction in polymerization inhibition than cleaning with water for Expasyl \( (p < 0.05) \). Conclusion: Overall contemporary retraction materials showed low potential for polymerization inhibition of elastomeric impression materials. Expasyl should be cleaned with H2O2 prior to impression making. However, Dryz and RC3M can show accurate impressions with water cleaning alone.

Keywords
Vinylpoly siloxanes, polyether, impression, gingival retraction, polymerization, hydrogen peroxide

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Introduction

Impressions using elastomeric materials are frequently performed to record the prepared surfaces of teeth prior to the fabrication of restorations. The accuracy of dental impressions is critical for the long-term clinical success of definitive indirect restorations. Vinylpoly siloxane (VPS) material is considered the material of choice along with polyethers (PEs) due to its excellent elastic recovery, working, and setting times, tear resistance, and marginal accuracy. However, VPS is hydrophobic and its ability to wet the prepared tooth surface for accurate impressions is compromised by the presence of moisture and saliva. A further limitation of these impression materials is their poor compatibility with other dental materials, including dental acrylic resins, composite resin, retraction and hemostatic agents, and latex.

Soft tissue retraction and hemostasis around prepared teeth is pivotal in capturing a durable and accurate impression. It includes the placement of impregnated cords in the gingival crevice to physically displace and provide chemical hemostasis, allowing the impression material to flow freely in the gingival sulcus. Retraction cords have traditionally been used for this purpose, but their use is time consuming, causes patient discomfort, causes damage to the epithelium, and allows unrestrained absorption of vasoconstrictive agents (ferric sulfate and aluminum chloride). By contrast, the clinical use of contemporary paste form retraction materials has shown potential for superior ease of use, patient comfort, controlled application of hemostatic chemicals, and minimal damage to the periodontium. These paste form materials, once placed in the crevice, expand by absorption of saliva and crevicular fluid and release aluminum chloride (or other chemicals) for hemostasis.

In a clinical condition, retraction agents must be washed and removed completely prior to impression making. However, absolute eradication of these chemicals and pastes is seldom achieved, and interaction between the elastomeric impression materials (VPS and PE) with retraction agents may occur. These interactions have been investigated, suggesting that retraction chemicals such as ferric sulfate, ferric sub-sulfate, and aluminum chloride interfere with the polymerization reaction of elastomeric materials due to the presence of sulfur. Similarly, a recent study on the paste form of retraction material (Expasyl) with its effect on polymerization showed significant inhibition of VPS and PE materials. It was concluded that Expasyl on the specimen caused a significant polymerization inhibition of the impression materials tested. Subsequent cleaning with 3% H$_2$O$_2$ significantly reduced this inhibitory effect on polymerization.

Some recent introductions among retraction pastes materials are Retraction Capsule (RC3M) (3M, ESPE, Seefeld, Germany) and Dryz (Parkell-Edgewood-USA), based on a variable quantity of aluminum chloride (15–30%) and fillers.

They are potentially easy to use and compatible with elastomeric impressions to provide a clean, dry gingival crevice. However, to our knowledge from the indexed literature, evidence related to their ability to leave residues or remnants and their interaction with impression materials in relation to polymerization inhibition is not available. Therefore, it is hypothesized that contemporary retraction materials will demonstrate better polymerization outcomes compared to Expasyl retraction paste. In addition, we also postulate that different cleaning methods (water and hydrogen peroxide) of retraction materials (RC3M and Dryz) will have an insignificant influence on the polymerization of contemporary elastomeric impression materials (VPS and PE). Therefore, the aim of this study is to investigate the polymerization inhibition of elastomeric impression materials (VPS and PE) when used in combination with retraction materials (RC3M, Dryz, and Expasyl) with and without cleaning with hydrogen peroxide.

Methods

Specimen design and study groups

Seven stainless steel circular specimens were fabricated. The specimen design had a 38 mm outer circle with a 30 mm (diameter) step down to the inner circle with three horizontal and two vertical precision grooves on the floor. All grooves were 1 mm wide and 2 mm deep, and the vertical (C–D and C–D) and horizontal (1, 2, and 3) grooves were 2.5 and 20 mm apart, respectively (Figure 1). Specimen details were adapted from the study by Abduljabbar et al. The study was designed and executed within the parameters of CRIS guidelines. Each specimen was highly polished and numbered. Four hundred and twenty impressions were made with three different elastomeric impression materials (140 each) as follows:

- group 1: VPS-Pan (Panasil – Initial Contact Light fast – Kettenback, GmbH & Co. KG, Eschenburg);
- group 2: VPS-Exp (Express Regular Set – Light Body – Hydrophilic, 3M, ESPE, Seefeld, Germany);
- group 3: PE (Monophase, 3M ESPE, Seefeld, Germany).

Specimens were disinfected with alcohol, steam cleaned, and air-dried to confirm removal of any contaminants. Each material group was divided into seven subgroups. A sample size calculation was performed using power calculation, incorporating the means and standard deviations from subgroups of previous studies. A sample size of 20 samples was considered acceptable using the calculations. Subgroups were allocated according to the exposure of impression materials to three retraction materials [Retraction capsule – 3M ESPE – (RC3M) – Seefeld, Germany; Dryz Syringe Hemostatic Retraction Paste (Dryz) – Parkell-Edgewood – USA, and Expasyl Gingival Retraction Paste – Acteon,
Marignac, France (Expasyl) and two washing techniques, the use of water and hydrogen peroxide \((\text{H}_2\text{O}_2)\) and water only. Twenty impressions in each impression material served as control without the application of any retraction material or washing technique.

The subgroups among VPS-Pan impression material are presented as follows.

Gp1-Pan-Control. Impression without application of retraction material and cleaning technique.

Gp1-Pan-RC3M-\text{H}_2\text{O}_2. Application of RC3M (2 minutes) with subsequent 60 seconds washing with water and air-drying.

Gp1-Pan-RC3M-\text{H}_2\text{O}. Application of RC3M (2 minutes) with subsequent cleaning with water (10 seconds) and application of 3% hydrogen peroxide with a brush for 10 seconds. The specimens will be then washed for 5 seconds and air-dried before making impressions.

Gp1-Pan-Dryz-\text{H}_2\text{O}_2. Application of Dryz (2 minutes) with subsequent 60 seconds washing with water and air-drying.

Gp1-Pan-Dryz-\text{H}_2\text{O}. Application of Dryz (2 minutes) with subsequent cleaning with water (10 seconds) and application of 3% hydrogen peroxide with a brush for 10 seconds. The specimens will be then washed for 5 seconds and air-dried before making impressions.

Gp1-Pan-Expasyl-\text{H}_2\text{O}. Application of Expasyl (2 minutes) with subsequent 60 seconds washing with water and air-drying.

Gp1-Pan-Expasyl-\text{H}_2\text{O}_2. Application of Expasyl (2 minutes) with subsequent cleaning with water (10 seconds) and application of 3% hydrogen peroxide with a brush for 10 seconds. The specimens will be then washed for 5 seconds and air-dried before making impressions.

Similar subgroups were included in Group II (VPS-Exp) and Group III (PE), respectively, resulting in a total of 420. For operator convenience, all subgroups of one material (randomly chosen) were tested first, followed by the other two materials (Figure 2).

**Impression making**

All impressions were made by one operator using auto mixing and a dispensing gun with material cartridges under standardized conditions at room temperature. The operator was calibrated and trained for the procedure and the kappa score for intra-operator reliability was assessed. The initially extruded impression material for each application was discarded following application in the grooves and even distribution over the entire specimen surface. An acrylic sheet cover (Triad, DeguDent, Dentsply, Hanau/Wolfgang, Germany) was placed on the material followed by the application of a flat surface metal 5 kg load. This was performed to avoid voids and obtain uniform application of the impression material. In order to avoid polymerization inhibition by latex, vinyl gloves were used. The setting time for each material was predetermined as per manufacturers’ instructions, and 1 minute in addition was allowed to compensate for the absence of intra-oral temperature and to ensure adequate time for the polymerization of each impression material. All impressions were kept at 21°C (body temperature) during the process of evaluation.

Three practitioners (comparable experience), using a visual scale, blindly and independently made evaluation of the
polymerization inhibition. Inter-examiner and intra-examiner reliability was determined and operator training and standardization was performed prior to experimentation.

**Evaluation of polymerization inhibition**

All impressions were removed after completing the designated setting time from specimens and were labeled accordingly. The partial or complete polymerization inhibition was evident as unset residue, which can be distorted to varying degrees by blunt instrument scraping. Three evaluators assessed polymerization inhibition on each impression using a visual scale adopted from previous studies. Intra- and inter-evaluator reliability was evaluated as a pilot test on predetermined impressions in the form of a kappa score ($\kappa = 0.84$). Impressions were blindly classified into four categories (Table 1). All scores were visually and subjectively awarded immediately after removal.

**Statistical analysis**

Data obtained was tabulated according to the study groups using the Statistical Program for Social Sciences (SPSS Inc, v19.0., Chicago, IL). The statistically significant influence of the retraction materials and cleaning techniques among the study groups was determined by using Fisher’s exact test at a significance level of $p < 0.05$.

**Results**

Among all impression materials, all (100%) control group impressions showed complete polymerization without inhibition (Table 2 and Figure 3). For the VPS-Panasil impression material in combination with Dryz and RC3M (retraction materials), uninhibited impressions were significantly higher ($p < 0.001$)
than inhibited specimens. However, impressions after cleaning Dryz with water showed significantly higher polymerization inhibition (30%) than cleaning with H$_2$O$_2$ ($p < 0.05$). Use of Expasyl showed comparable polymerization inhibition as compared to the other retraction materials ($p < 0.05$). Cleaning Expasyl with water showed higher polymerization inhibition as compared to cleaning with H$_2$O$_2$ ($p < 0.05$) (Table 2).

Among the VPS-Express group, uninhibited impressions were higher than inhibited impressions ($p < 0.001$). Uninhibited impression among RC3M and Dryz subgroups were comparable ($p = 0.81$). Impressions after cleaning

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**Table 2.** Scores of polymerization outcomes among different study groups using retraction agents and cleaning techniques.

| Impression material | Retraction agent | Washing technique | Uninhibited [n (%)] | - | ++ | +++ | Total |
|---------------------|------------------|-------------------|--------------------|---|----|-----|-------|
| VPS-Pan             | None             | None (control)    | 20 (100%)$^{ab}$   | 0 | 0  | 0   | 0     |
| Dryz                | Water            |                   | 14 (70%)$^{ac}$    | 6 (30%) | 0 | 0   | 6 (30%) |
| H$_2$O$_2$          |                  |                   | 20 (100%)$^{a}$    | 0 | 0  | 0   | 0     |
| RC3M                | Water            |                   | 20 (100%)$^{a}$    | 0 | 0  | 0   | 0     |
| H$_2$O$_2$          |                  |                   | 20 (100%)$^{a}$    | 0 | 0  | 0   | 0     |
| Expasyl             | Water            |                   | 14 (70%)$^{ac}$    | 5 (25%) | 1 (5%) | 0 | 6 (30%) |
| H$_2$O$_2$          |                  |                   | 18 (90%)$^{ab}$    | 2 (10%) | 0 | 0   | 2 (10%) |
| VPS-Express         | None             | None (Control)    | 20 (100%)$^{ab}$   | 0 | 0  | 0   | 0     |
| Dryz                | Water            |                   | 18 (90%)$^{a}$     | 2 (10%) | 0 | 0   | 0     |
| H$_2$O$_2$          |                  |                   | 20 (100%)$^{a}$    | 0 | 0  | 0   | 0     |
| RC3M                | Water            |                   | 17 (85%)$^{a}$     | 3 (15%) | 0 | 0   | 3 (15%) |
| H$_2$O$_2$          |                  |                   | 18 (90%)$^{ab}$    | 2 (10%) | 0 | 0   | 2 (10%) |
| Expasyl             | Water            |                   | 14 (70%)$^{ac}$    | 6 (30%) | 0 | 0   | 6 (30%) |
| H$_2$O$_2$          |                  |                   | 18 (90%)$^{ab}$    | 2 (10%) | 0 | 0   | 2 (10%) |
| PE-Mono             | None             | None (Control)    | 20 (100%)$^{a}$    | 0 | 0  | 0   | 0     |
| Dryz                | Water            |                   | 16 (80%)$^{a}$     | 4 (20%) | 0 | 0   | 4 (20%) |
| H$_2$O$_2$          |                  |                   | 20 (100%)$^{a}$    | 0 | 0  | 0   | 0     |
| RC3M                | Water            |                   | 15 (75%)$^{a}$     | 5 (25%) | 0 | 0   | 5 (25%) |
| H$_2$O$_2$          |                  |                   | 20 (100%)$^{a}$    | 0 | 0  | 0   | 0     |
| Expasyl             | Water            |                   | 4 (20%)$^{ac}$     | 10 (50%) | 6 (30%) | 0 | 16 (80%) |
| H$_2$O$_2$          |                  |                   | 8 (40%)$^{bc}$     | 12 (60%) | 0 | 0   | 12 (60%) |

VPS: vinyl poly siloxanes; PE: polyether; Pan: Panasil; Mono: Monophase; n: number of samples; H$_2$O$_2$: hydrogen peroxide.

$^{a}$Significantly different from inhibited at $p < 0.05$.

$^{b}$Significantly different from washing with water alone (with control, same impression, and retraction material) at $p < 0.05$.

$^{c}$Significantly different from washing with H$_2$O$_2$ at $p < 0.05$.

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**Figure 3.** Examples of uninhibited (a) and inhibited (b) impressions.
Expasyl with water showed higher polymerization inhibition compared to cleaning Expasyl with H$_2$O$_2$ ($p < 0.05$).

PE impressions exhibited the highest instances of polymerization inhibition as compared to the other impression materials. However, uninhibited impressions were significantly higher than inhibited impressions ($p < 0.001$). Uninhibited impressions were significantly higher ($p < 0.001$) among the Dryz (80–100%) and RC3M (75–100%) subgroups as compared to the Expasyl subgroup (20–40%). There was a 50% reduction in polymerization inhibition after cleaning Expasyl with H$_2$O$_2$ as compared to cleaning with water (Table 2).

Use of Expasyl showed higher instances of polymerization inhibition among all impression materials as compared to Dryz and RC3M. Use of Expasyl in combination with PE impression material showed a higher degree (60–80%) of polymerization inhibition in comparison with other combinations of impression and retraction materials. Cleaning Expasyl with 3% H$_2$O$_2$ showed significant reduction in polymerization inhibition in comparison to cleaning with water among all impression materials ($p < 0.05$). Polymerization inhibition among study groups ranged from a mild degree (20–60%) to moderate degree (15–30%) with no samples showing severe polymerization inhibition among all subgroups (Table 2).

**Discussion**

The present study was based on the hypothesis that contemporary retraction materials will demonstrate better polymerization outcomes compared to Expasyl retraction paste, and cleaning prior to impression with H$_2$O$_2$ will not have any significant effect on polymerization. As the investigation showed insignificant inhibition of polymerization due to Dryz and RC3M in comparison to Expasyl, the first hypothesis was accepted. Cleaning with H$_2$O$_2$ did not show a significant influence on the polymerization of impressions except for Expasyl paste, and therefore the second hypothesis was partly established.

Retraction materials are readily placed in gingival crevices for tissue management prior to impressions. The crevice presents complex anatomy (narrow and deep with rough areas) and packed retraction materials influence vasoconstriction and widen the crevice. In addition, hydrophilic retraction materials, such as Expasyl, absorb saliva and undergo hygroscopic expansion, resulting in mechanical opening of gingival crevices. These and associated physical and chemical processes result in dispersion of material within the crevice, therefore making the effective and complete removal of retraction material clinically challenging. In the present study, the metal specimen grooves were 1 mm wide and 2 mm deep to allow the assessment of impressions made and to simulate clinical conditions. In a clinical scenario, a minimum crevicular width of 0.2–0.3 mm is required to capture the preparation margins and the area beyond for durability of the impression recorded and the ability to remove and pour. A known criterion for polymerization inhibition evaluation was employed, as its validity has been verified in multiple previous studies. The three categories (Table 1) of un-polymerized impressions were presented to demonstrate the severity of polymerization inhibition; however, all three categories were considered inhibited impressions as they cannot be recommended as successful impressions clinically. To standardize impressions among the three evaluators, inter- and intra-examiner reliability was assessed using some pilot tests. The assessments were undertaken within 5 minutes of the impression being recorded to exclude the influence of overtime polymerization if present.

In the present study, the majority of inhibitions of impressions after cleaning were related to the use of Expasyl. Previous studies have shown the polymerization retardation effect of Expasyl. Expasyl is an injectable material commonly used for soft tissue management in the form of a retraction paste and hemostatic agent by placement in the crevice. Although it is able to expand the crevice mechanically, it also acts as an astringent by protein precipitation and vasoconstriction with aluminum chloride as its main component. The inhibitory effect of Expasyl was dominant in combination with PE impression material (Table 2). A possible explanation for the inhibitory effect of Expasyl on PE is related to the presence of aluminum chloride. It is known to delay and inhibit the polymerization process of PE impression materials. Studies have suggested that a possible reaction of aluminum chloride with ethers, resulting in oxygen and onium ions, is a potential cause of polymerization inhibition. In addition, due to this reaction, chloride may also undergo the rapid breakdown of ethers, inhibiting cross-linking and causing polymerization delay. Furthermore, it is pertinent to mention that the physical properties, including the viscosity and contact angle, of VPS materials (Panasil and Express) are lower than for PE (Monophase), therefore introducing a compromise in flow, adaptation, and wettability for PE (Monophase) in comparison to VPS and, hence, resulting in polymerization inhibitions and impression flaws, as shown in the present study.

In the present study, the efficacy of the cleaning methods for retraction materials (Dryz, RC3M, and Expasyl) using water and H$_2$O$_2$ was also investigated. Removal of Dryz and RC3M with H$_2$O$_2$ prior to VPS impressions was effective, showing no polymerization inhibition. However, use of water as a cleaning agent for Expasyl prior to impressions with PE and VPS materials showed significantly high polymerization inhibition in comparison to H$_2$O$_2$ [10–30% (VPS) and 20–80% (PE)]. Dryz and RC3M are aluminum chloride-based retraction pastes containing fillers and cellulose gum and no residue formation. However, Expasyl paste (aluminum chloride, stabilizers, and kaolin) when used clinically undergoes expansion on imbibing saliva and forms residues. It is the residue formation of Expasyl, in the
authors’ opinion, which is the primary cause of the higher polymerization retardation of impressions made after Expasyl use in comparison to the use of Dryz and RC3M. Expasyl has shown resistance to complete removal of residual remnants on all specimens exposed to it in a previous study. In addition, associated factors, which complicate the effective cleaning of residue producing retraction materials, include complex anatomy of crevices and teeth, the depth and width of crevices, imbrication of teeth with limited access, and operator error. Moreover, it is clear that diluted H2O2 has shown efficacy in removing aluminum chloride from Dryz and RC3M; however, it has not been effective in removing all remnants of Expasyl, especially in PE impressions. H2O2 is a known disinfectant and oxidizing agent (hydroxyl radicals) that can dissolve organic constituents, shows antimicrobial activity, and lowers surface tension. Its due to these properties that it is has shown a significant influence on the cleaning methods in the present study. The inability of H2O2 cleaning in producing uninhibited impressions among all subgroups may be attributed to the disparity in the conditions and surface of grooved metal specimens and the clinical gingival crevice.

The outcomes of the present study should be interpreted in light of the limitations. The study was conducted under experimental conditions, lacking oral temperature, crevicular fluid, and soft tissue texture. These are known to influence the physical properties, including the viscosity, wettability, and texture of impression materials. In addition, the extent of material polymerization was not assessed and the surface was examined. It is pertinent to mention that the outcomes presented should only be associated with the materials used (commercial brands) used and should not be generalized among other impression and retraction materials. It would be interesting to know if the inhibitory effect on impression materials could be minimized over a period of time or by impression pouring. Therefore, further studies assessing the extent of polymerization inhibition among contemporary impression materials and ways to minimize it through pouring or other techniques, in a clinical setting, are recommended.

However, based on the findings, the clinical use of combined VPS and PE with Dryz and RC3M is recommended. Operators should show caution and apply enhanced cleaning regimes (H2O2) in the application of Expasyl, especially in combination with PE impressions (Monophase).

Conclusion

Within the study limitations, contemporary retraction materials showed low potential for polymerization inhibition of elastomeric impression materials. Retraction materials Dryz and RC3M showed uninhibited impressions with water cleaning alone. Use of Expasyl revealed significantly high polymerization inhibition when used with PE as compared to VPS. H2O2 should be used for Expasyl cleaning prior to impression making.

Contributorship

FA, KAA, and AA: Data collection, study design, manuscript writing, final manuscript approval.
TA and KA: Data collection, study design, manuscript drafting, data analysis, and manuscript approval.
YA and ABT: Data collection, manuscript approval, and data interpretation.
FV and AAY: Data collection, writing, revising, and editing, and final manuscript approval.

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References

1. Nassar U and Chow AK. Surface detail reproduction and effect of disinfectant and long-term storage on the dimensional stability of a novel vinyl polyether silicone impression material. J Prosthodont 2015; 24: 494–498.
2. Guiraldo RD, Berger SB, Punhagui MF, et al. Influence of chloramine-T disinfection on elastomeric impression stability. Eur J Dent 2018; 12: 232.
3. Sogancı G, Cinar D, Caglar A, et al. 3D evaluation of the effect of disinfectants on dimensional accuracy and stability of two elastomeric impression materials. Dent Mater J 2018; 37: 675–684.
4. Baig MR, Buzayan MM and Yunus N. Accuracy of a new elastomeric impression material for complete-arch dental implant impressions. J Investigat Clin Dent 2018; 9: e12320.
5. Papadiochos I, Papadiochou S and Emmanouil I. The historical evolution of dental impression materials. J Hist Dent 2017; 65: 79–89.
6. Abduljabbar TS, Al Amri MD, Al Rifaiy MQ, et al. Effects of gingival retraction paste and subsequent cleaning with hydrogen peroxide on the polymerization of three elastomeric impression materials: an in vitro study. J Prosthodont 2017.
7. Machado CE and Guedes CG. Effects of sulfur-based hemostatic agents and gingival retraction cords handled with latex gloves on the polymerization of polyvinyl siloxane impression materials. J Appl Oral Sci 2011; 19: 628–633.
8. Al-Sowygh ZH. The effect of various interim fixed prosthetic materials on the polymerization of elastomeric impression materials. J Prosthet Dent 2014; 112: 176–181.
9. Neeraj Sharma PM, Srivastava R and Shahrma S. Recent concepts in gingival retraction. Natl J Dent Sci Res 2014; 2: 46–54.
10. Peregrina A, Land MF, Feil P, et al. Effect of two types of latex gloves and surfactants on polymerization inhibition of three polyvinylsiloxane impression materials. J Prosthet Dent 2003; 90: 289–292.
11. Al-Sayed HD, Al-Resayes SS, Jamjoom FZ, et al. The effect of various core build-up materials on the polymerization of elastomeric impression materials. King Saud Univ J Dent Sci 2013; 4: 71–75.
12. Salinas TJ. Treatment of edentulism: optimizing outcomes with tissue management and impression techniques. J Prosthodont Implant Esthet Reconstr Dent 2009; 18: 97–105.
13. Kumbuloglu O, User A, Toksavul S, et al. Clinical evaluation of different gingival retraction cords. Quint Int 2007; 38: e92–98.
14. Bennani V, Schwass D and Chandler N. Gingival retraction techniques for implants versus teeth: current status. J Am Dent Assoc 2008; 139: 1354–1363.
15. Runyan DA, Reddy TG Jr and Shimoda LM. Fluid absorbency of retraction cords after soaking in aluminum chloride solution. J Prosthet Dent 1988; 60: 676–678.
16. Acar O, Erkut S, Ozcelik TB, et al. A clinical comparison of cordless and conventional displacement systems regarding clinical performance and impression quality. J Prosthet Dent 2014; 111: 388–394.
17. O’Mahony A, Spencer P, Williams K, et al. Effect of 3 medicaments on the dimensional accuracy and surface detail reproduction of polyvinyl siloxane impressions. Quint Int 2000; 31: 201–206.
18. Sabio S, Franciscone PA and 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 2008; 16: 280–285.
19. Vaishnav KC, Patel PR, Shah DS, Maheta SP. Effect of 3 different medicaments on dimensional stability and surface detail reproduction of polyvinyl siloxane impression material. Natl J Integr Res Med 2012; 3: 124–130.
20. Jones RH, Cook GS and Moon MG. Effect of provisional luting agents on polyvinyl siloxane impression material. J Prosthodont Dent 1996; 75: 360–363.
21. Walid Y, Al-Ani Z and Gray R. Silicone impression materials and latex gloves: is interaction fact or fallacy? Dent Update 2012; 39: 39–42.
22. Browning GC, Bromme JC Jr and Murchison DF. Removal of latex glove contaminants prior to taking poly (vinylsiloxane) impressions. Quint Int 1994; 25: 787–790.
23. Shannon A. Expanded clinical uses of a novel tissue-retraction material. Compend Contin Educ Dent 2002; 23: 3–6; quiz 18.
24. Laufer BZ, Baharav H and Cardash HS. The linear accuracy of impressions and stone dies as affected by the thickness of the impression margin. Int J Prosthodont 1994; 7: 247–252.
25. Abdullah AA. Effect of gingival retraction material on the physical properties of polyvinyl siloxane impression material. Egypt Dent J 2011; 57: 899–905.
26. Prasad KD, Hegde C, Agrawal G, Shetty M. Gingival displacement in prosthodontics: a critical review of existing methods. J Interdiscip Dent 2011; 1: 80–86.
27. Pos S. An innovative tissue-retraction material. Compend Contin Educ Dent 2002; 23: 13–7; quiz 8–9.
28. Polat NT, Ozdemir AK and Turgut M. Effects of gingival retraction materials on gingival blood flow. Int J Prosthodont 2007; 20: 57–62.
29. McOmie JFW and Crow WD. 3,3-Dihydroxybiphenyl. In: HE and IB (eds). New York: Wiley, 1973, pp.412–414.
30. ME El Deeb, Waly GH, Habib NA. Evaluation of rheological properties of two elastomeric impression materials during working time. J Am Sci 2011; 25: 492–499.
31. Marshall MV, Cancro LP and Fischman SL. Hydrogen peroxide: a review of its use in dentistry. J Periodont 1995; 66: 786–796.
32. Wadhwani C, Pineyro A, Hess T, et al. Effect of implant abutment modification on the extrusion of excess cement at the crown-abutment margin for cement-retained implant restorations. Int J Oral Maxillofac Implant 2011; 26: 1241–1246.