

Original Research

Comparative evaluation of two different hemostatic agents used for gingival retraction – A clinical study

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ABSTRACT:

Introduction: There are numerous retraction agents used in chemico mechanical method of gingival retraction. Aluminium chloride which is more commonly used for gingival retraction produces efficient retraction but they have been also reported to cause collateral soft tissue damage due to its low pH whereas oxymetazoline, xylometazoline which were reported as safer vasoconstrictors and retraction agents in literature have very little scientific evidence regarding its efficacy. **Aims and objectives:** The purpose of the study was to know how much amount of retraction was achievable with safer retraction agents: Oxymetazoline and Xylometazoline with that of Aluminium chloride, which is more commonly used and is more efficient in retraction, so that a retraction agent which is effective in retraction as well as safer to use can be known. **Material and methods:** Thirty patients with healthy gingiva and periodontium requiring full veneer crown restorations were selected and randomly divided into three groups namely Group A: Oxymetazoline hydrochloride, Group B: Xylometazoline hydrochloride and Group C: Aluminium chloride solution. **Results:** To compare the intragroup differences in vertical and horizontal displacement using three different materials Paired t tests were employed. In all three groups the gingival retraction was observed both horizontally and vertically. One way ANOVA tests were used to compare the displacement in vertical and horizontal displacement between the groups. One way ANOVA test revealed that the difference in the amount of retraction achieved among the three groups with a p value (0.58) for vertical displacement and a p-value (0.66) for horizontal displacement was statistically insignificant. **Conclusions:** Within the limitations of the study, gingival retraction achieved with Xylometazoline and Oxymetazoline was comparable with Aluminium chloride and was found to be as efficient as Aluminium chloride and can be used as a safer gingival retraction agent in the daily clinical practice.

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INTRODUCTION

Gingival retraction techniques are broadly classified as mechanical, chemico mechanical, cordless and surgical techniques¹. Chemico-mechanical method used in the present study employed the retraction cord with use of a chemical or a medicament and delivers non-invasive tissue management. The application of conservative retraction cords as a mechanical or chemo-mechanical system is well recognized in practice because of its comparative predictability, efficacy and security². The chemically available gingival displacement agents were broadly divided into astringents and vasoconstrictors. Astringents act by precipitating protein, constricting the blood vessels and extracting the fluid from the

tissues. The most commonly used astringents are 10–20% aluminium chloride (AlCl₃) and 15.5%–20% ferrous sulphate (Fe₂SO₄)³. Aluminium chloride and ferrous sulphate left remnants of coagulum and also stained the tissue. Vasoconstrictors are sympathomimetic amine groups which include mainly racemic Epinephrine, Oxymetazoline, Xylometazoline and Tetrahydrozoline^{3,4}. Epinephrine may cause systemic complications in cardiovascular patients whereas oxymetazoline and tetrahydrozoline did not cause any soft tissue damage and were proven to be safer vasoconstrictors as reported by Bowels et al (1991)⁵ and KopačI et al (2002)⁶. Chemical agents exhibit haemostatic effects under physiological condition through protein precipitation. The

disadvantage of this method is that, the denatured proteins can be involved in topical tissue destruction⁷. Oxymetazoline and Xylometazoline containing sympathomimetic amine group of the vasoconstrictors are better alternatives to Epinephrine. The agents used in the present study were 0.05% Oxymetazoline hydrochloride and 0.05% Xylometazoline hydrochloride. They mainly act by constricting the blood vessels and are safer causing less systemic side effects⁸. Although the reported data about these substances as retraction agents is promising, yet they are referred as experimental in science literature. Tissue management is the critical factor in achieving a successful fixed prosthodontic restoration. Tooth preparation followed by gingival retraction is done to accurately record the prepared tooth margin during impression making so that the restoration has a suitable emergence profile with well adapted and smooth gingival margins. It is necessary to effectively displace the free gingival margin with open, dry and clean gingival sulcus⁹. For an effective gingival retraction, tissue covering gingival margins must be retracted horizontally to provide for a

sufficient bulk of impression material. Tissue coronal to the gingival margin of a preparation must be displaced vertically to expose margins. Haemorrhage must be arrested. Hard and soft tissues must be clean and dry¹⁰. There are numerous studies done on different gingival retraction systems but there are very few studies done on Oxymetazoline and Xylometazoline as a retraction agent.

MATERIALS AND METHODS

Thirty patients requiring full veneer crown restorations were selected and randomly divided into three groups ten in each where n=10. Patient selection was done based on the inclusion and exclusion criteria. Patients were informed of the treatment procedures and the study it was intended for, after which an informed consent was obtained. The study was done in three groups, two tests groups and one control group. Test Groups: Group A: 0.05% oxymetazoline hydrochloride (Table 1), Group B: 0.05% Xylometazoline hydrochloride (Table 2) and Control Group: Group C: 10% Aluminium chloride solution (Table 3).

Table 1: Shows the raw data of pre-retraction and post-retraction vertical and horizontal displacement of Group A (0.05% Oxymetazoline hydrochloride).

Sample no	Pre-retraction Vertical displacement (in mm)	Post-retraction vertical displacement (in mm)	Difference (in mm)	Pre-retraction Horizontal displacement (in mm)	Post-retraction horizontal displacement (in mm)	Difference (in mm)
1	1.73	2.21	0.48	0.84	0.91	0.07
2	0.67	0.96	0.29	0.52	1.11	0.37
3	1.41	1.62	0.21	1.06	1.62	0.5
4	1.79	2.03	0.24	1.79	2.03	0.24
5	1.67	1.91	0.24	1.12	1.39	0.27
6	0.74	0.89	0.15	0.43	0.69	0.26
7	1.71	2.02	0.31	1.17	1.46	0.29
8	0.71	0.9	0.19	0.69	0.94	0.25
9	2.24	2.59	0.35	0.91	1.62	0.71
10	1.79	1.93	0.14	0.96	1.24	0.28

Table 2: Shows the raw data of pre-retraction and post-retraction vertical and horizontal displacement of Group B (0.05% Xylometazoline hydrochloride)

Sample	Pre-retraction Vertical displacement (in mm)	Post-retraction Vertical displacement in mm	Difference (in mm)	Pre-retraction Horizontal displacement (in mm)	Post-retraction Horizontal displacement (in mm)	Difference (in mm)
1	2.0	2.48	0.48	1.04	1.47	0.43
2	0.29	0.68	0.39	0.83	0.94	0.11
3	0.67	1.49	0.82	1.23	1.74	0.51
4	1.67	1.91	0.24	1.12	1.39	0.27
5	2.57	2.84	0.14	0.48	0.58	0.1
6	0.52	1.15	0.63	1.2	1.92	0.72
7	2.16	2.51	0.35	0.96	1.24	0.28
8	3.92	4.27	0.35	0.91	1.62	0.71
9	1.3	1.86	0.56	0.71	1.44	0.73
10	1.63	2.1	0.47	1.92	2.4	0.48

Table 3: Shows the raw data of pre-retraction and post-retraction vertical and horizontal displacement of Group C (Control group- Aluminium chloride)

Sample	Pre-retraction vertical displacement (in mm)	Post-retraction vertical displacement (in mm)	Difference (in mm)	Pre-retraction Horizontal displacement (in mm)	Post-retraction Horizontal displacement (in mm)	Difference (in mm)
1	1.78	2.93	1.15	0.83	0.97	0.14
2	2.06	2.50	0.44	0.60	1.26	0.66
3	1.34	2.21	0.87	1.22	1.36	0.14
4	2.21	2.36	0.15	1.50	1.68	0.18
5	2.23	2.33	0.10	1.04	1.47	0.43
6	1.60	2.06	0.46	0.68	1.17	0.49
7	1.45	2.92	1.47	0.68	1.11	0.43
8	1.77	2.48	0.71	0.92	1.14	0.22
9	2.41	2.52	0.11	0.65	0.88	0.23
10	1.60	2.06	0.46	0.68	1.17	0.49

RESULTS

The vertical and horizontal displacement values obtained were tabulated and subjected to statistical analysis using SPSS software v 2.5. One-way ANOVA test was performed to compare the mean difference amongst the three groups: Group A (Oxymetazoline hydrochloride), Group B (Xylometazoline hydrochloride) and Group C (control group Aluminium chloride). Pre-retraction and post-retraction values of Group A (Oxymetazoline hydrochloride) were mentioned in the above table. The highest value of pre-retraction vertical displacement value was 2.24mm and the lowest pre-retraction vertical displacement value was 0.67mm. The highest value of pre-retraction horizontal displacement was 1.79 mm and the lowest pre-retraction horizontal displacement value was 0.43mm. The highest value of postretraction vertical displacement was 2.59mm and lowest vertical post-retraction vertical displacement value was 0.89mm. The highest value of post-retraction horizontal displacement was 2.03mm and lowest post-retraction horizontal displacement value was 0.69mm. The highest value of retraction achieved in vertical displacement was 0.48mm and lowest value was 0.14 mm. The highest value of retraction achieved in horizontal displacement was 0.71mm and lowest value was 0.07mm.

DISCUSSION

MJ Thompson¹¹ (1949) first introduced gingival displacement in dentistry. Benson¹² et al. (1986) introduced the chemico-mechanical method of gingival displacement. Gingival displacement procedures have evolved from cotton strings, use of cords impregnated with chemical agents to cord less system. Among all the systems used for gingival displacement cords impregnated with chemicals are most commonly used as reported by Csempez¹³ et al (2003). The goal of any retraction systems is to reversibly displace the gingival tissues in a vertical and lateral direction so that a bulk of low-viscosity impression material could be introduced into the

widened sulcus and capture the marginal detail, because the impression material would neither displace tissues nor stop the seepage of blood or fluid as reported by Nemetz¹⁴ (1974). In order to record sub-gingivally placed margins, the adjacent soft tissues need to be retracted for the impression to penetrate and capture, not only the features of preparation and finish line, but also some unprepared tooth structure apically which gives the restoration an emergence profile. Chemico-mechanical method of retraction employs retraction cord with medicaments. They can be vasoconstrictors that cause contraction of the blood vessels, astringents that contract the gingival tissue or chemicals that cease bleeding by haemostats and coagulation. Some products are available in gel or liquid formulation, which can be directly syringed into the gingival sulcus for arrest of bleeding and crevicular fluid. This can be followed by placement of the cord. The chemicals used for this purpose can be classified according to their mode of action as astringents and vasoconstrictors. In the present study chemico mechanical method of retraction with astringent aluminium chloride and vasoconstrictors oxymetazoline and xylometazoline were used. In the present study knitted retraction cords were used which are popular and have interlocking loops which helps to shape and bend the cord passively during placement in the gingival sulcus. This configuration also prevents the cord's displacement once the adjacent segment is being pushed into the sulcus. This type of cord has a tendency to compress while being placed and, therefore, a slightly thicker size should be selected to compensate for this. Also, a non-serrated and smoother instrument should be used for their packing as they have a tendency to unravel if used with serrated instruments. Braided cords have a tight weave, and don't fray, they also have good absorbency if used with medicaments. Braided cords have a greater tendency to push out of the sulcus from one point when pressure is applied along another segment because of this reason braided cords were not included in this study. Various types of

hemostatic agents are available for tissue displacement prior to dental impression procedures. Tetrahydrozoline and oxymetazoline had a more acceptable pH and they were kinder to tooth structure and soft tissue than the conventional solutions as reported by Woody¹⁵ et al (1993). Although the reported data about substances as retraction agents is promising yet they are referred as experimental in science literature. Thus, the present study was done in order to compare and evaluate the effect of two different hemostatic agents used for gingival retraction with gold standard Aluminium chloride. Oxymetazoline and xylometazoline tetrahydrozoline are strong retraction agents without any systemic side effect. Oxymetazoline and xylometazoline tetrahydrozoline are better than epinephrine in gingival retraction as reported by Tardy¹⁶ (1991). In the present study, total of 30 patients requiring full veneer crown restorations were selected and randomly divided into 3 groups of 10 each containing Oxymetazoline group, xylometazoline group and Aluminium chloride group (n=10). The size of the sample size in confirmatory with Rayyan¹⁷ et al (2019) (n=10). Since the gingival crest is a soft-tissue landmark, an indigenously thought standard third point of reference was made on the buccal surface of the prepared tooth with a round bur at the level of gingival crest margin which remained as a constant point in the models before and after displacement for the measurements. Retraction in this study was calculated using the base of this reference point, the deepest point in the gingival sulcus, and the highest point on the height of contour of marginal gingiva. This procedure is in confirmatory with the study done by Gajbhiye¹⁸ (2019) who also placed reference point at the crest of the gingival margin. Cords employed in this study were chosen owing to its non-shredding property, constant shape and absorbent capacity as they were well suited to expose the gingival sulcus and improve access visibility. The reason why braided cord was not used in this study is that air trapping capacity of braided cord is higher as a result of which the gingival fluid absorbency capacity will be reduced. In a study done by K R Nagraj¹⁹ et al. (2010) they reported that thin retraction cord should be used for thin gingival biotype for this reason #000 was selected and #00 retraction cord should be used for thick gingival biotype which is in accordance with the present study. With open, dry and clean gingival sulcus, accurate impressions can be made without systemic complications and with minimal tissue trauma. In order to record subgingivally placed margins, the adjacent soft tissue needs to be retracted and displaced adequately for the impression material to penetrate and capture fine details that are necessary for a successful outcome of the restoration. An ideal gingival retraction agent is suggested to have the following characteristics. It should be effective in causing significant horizontal and vertical gingival recession and controls bleeding and gingival

fluid flow. The agents applied do not cause any permanent damage in adjacent tissues. Any manipulation and chemical tissue treatment if it results in damage to some extent must be reversible and recover within 2 weeks clinically and histologically. Absorption of the retraction agents into the surrounding tissues must not cause any systemic effects. The amount of reabsorbed material depends on the type of retraction agents, tissue ulceration and the amount of prepared tooth abutments as reported by Kumbuloglu²⁰ (2007). The agents used in the present study fulfilled the above criteria as an effective gingival retraction agent. In a study done by Lahoti²¹ (2016) pH of Aluminium chloride, kaolin and oxymetazoline hydrochloride were determined by pH meter and found that, 21.3% aluminum chloride had least pH of 1.82 followed by expasyl paste containing kaolin and aluminum chloride, of 3.86 and 0.05% oxymetazoline hydrochloride was found to be 6.44. It is a logical relationship that with acidic pH of retraction agents, the smear layer is bound to be altered. With more acidity, there is more alteration of smear layer and dentin. Therefore, to avoid this alteration, alternative would be to use a retraction agent that has a neutral/alkaline pH. However, chemicals used for retraction are not stable in alkaline pH and therefore, some alteration of the smear layer and dentin is to be expected. Hence, from the pH meter reading, one can propose that 0.05% oxymetazoline hydrochloride (pH-6.44) would alter the tooth structure minimally, and 21.3% aluminium chloride (pH-1.82) would have maximum effects. Donovan²² (1985) suggested the some ideal properties of retraction cords which include: Biocompatible, non-toxic material, ability to absorb blood, crevicular fluids and medicaments, easy to apply and remove, contrasting colour with the surrounding tissue and which do not cause damage to the supporting tissues. In a study done by Shamsuzzaman²³ (2014) retraction cords was soaked in retraction agents for 20 minutes and placed in gingival sulcus for 5 minutes. The mean value and standard deviation of this study is 0.58 ± 0.14 whereas minimum and maximum values were 0.25-0.75 which were less than the values obtained in the present study. Laufer²⁴ et al. (1996) investigated the length of the time medicated displacement cords should remain in the gingival crevice prior to impression making. They concluded to achieve a crevicular width of 0.2 mm, cord should remain in the gingival crevice for an optimum time of 4 min prior to impression making when using materials evaluated in their study. However, contemporary textbooks recommended that the cord should remain in the gingival crevice for an optimum time of 10 min. Hence, the displacement cord was allowed to remain in the sulcus for 10 min. In a study conducted by Shaw²⁵ et al (1986) to see the effect of retraction cords soaked in AICl3 on gingiva reported that AlCl3 when used in a solution 0.033% with retraction cord

produced no detectable additional inflammation of the gingiva whereas as concentrated solution of $AlCl_3$ produced severe inflammation with ulceration within 24 to 36 hours. In these circumstances concentrated solutions of $AlCl_3$ are contraindicated in retracting the gingiva. This is the reason why low concentration of $AlCl_3$ solution was used in the present study. In the present study addition silicone was used for impression making as they reproduce better detail, have dimensional stability and a great elastic recovery, moderately short working time with moderately high resistance to tears. The long-term success of fixed prosthodontic restorations is greatly dependent upon the health and stability of the surrounding periodontal structures which was achieved by accurate impression making after proper gingival tissue displacement. The sulcular width should be at least 0.2 mm so that the impression material does not tear or distort when removed from the sulcus. A width of less than 0.2mm results in impressions that have a higher incidence of voids in a marginal area, an increase in tearing of material and reduction in marginal accuracy. Hence, it is imperative that a small amount of impression material flows beyond the prepared margin, and this permits accurate trimming of required die. In the present study highest vertical retraction was achieved with Aluminium chloride whereas lowest with oxymetazoline. Xylometazoline showed the highest horizontal retraction highest and lowest was seen with Aluminium chloride. Four forces such as retraction, relapse, collapse and displacement have a role in displacing the periodontal tissue as reported by Hedge²⁶ et al (2018).

CONCLUSION

Gingival retraction is a procedure to deflect the marginal gingiva away from the tooth to record an accurate impression to produce acceptable restorations in terms of fit, function and esthetics. The different approaches for gingival retraction are mechanical, chemico-mechanical, surgical and cordless system of which chemico-mechanical method is more preferred due to efficacy and reliability. Preimpregnated cords or cords soaked in medicament are used. Astringents like aluminium chloride, ferric chloride and ferrous sulphate have low pH resulting in effective retraction but cause tissue reactions, hypersensitivity in higher concentrations whereas vasoconstrictors like oxymetazoline, xylometazoline and epinephrine are alkaline in nature and cause effective retraction without any potential damage to soft tissues. Thirty patients requiring full veneer crown restorations were selected and randomly divided into 3 groups of ten each to clinically evaluate the efficiency of gingival retraction with oxymetazoline hydrochloride (Group A), xylometazoline hydrochloride (Group B) and aluminium chloride solution (Group C). Following tooth preparation, a reference point was placed on the

buccal surface of the prepared tooth. Gingival retraction was done using the above stated gingival retraction agents. Elastomeric addition silicone impression materials were used for making pre-retraction and post- retraction impressions. Samples coded to constant identity were magnified using stereomicroscope and measured with AmScope software. The retraction obtained was calculated by the difference of post retraction and pre-retraction values. Pre-retraction and post retraction values were tabulated and subjected to statistical analysis. Results of the present study showed there was efficient retraction vertically and horizontally in all the three groups with no significant difference in the retraction achieved.

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