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Comparative evaluation of gingival displacement using retraction cord impregnated with Astringedent®, Magic foam and Expasyl: an *in vivo* study

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ABSTRACT

Background: Gingival retraction helps in achieving good quality impressions. These are needed for a precision fit and long-term success with fixed prosthodontic restorations.

Aim: This study aimed to evaluate the clinical efficiency of gingival displacement obtained using Expasyl, Magic foam cord and Medicated retraction cord.

Materials and methods: One hundred twenty patients with the requirement of full veneer crowns were selected. They were divided into three groups, forty subjects in each group (twenty subjects by each operator) namely Expasyl, Magic foam cord and Medicated retraction cord. The impressions obtained before and after placing the retraction system were poured with type IV die stone. The casts obtained before and after placing the retraction system were coded in a blind fashion to avoid the influence of the operator. The casts were viewed under tool maker microscope "10X" magnification for the amount of both depth and width of gingival displacement.

Results: Mesial, distal, mid-buccal, mid-lingual were taken as reference points and for Medicated retraction cord, Expasyl and Magic foam cord the mean values are 0.50mm, 0.49mm and 0.29mm respectively in horizontal displacement and 0.56mm, 0.47mm and 0.31mm respectively in vertical displacement. One way ANOVA was used to calculate the p-value and multiple range test by the Tukey-HSD analysis to identify significant groups at 5% level. The level of significance for all tests was set as $p < 0.05$.

Conclusion: Within the limitations of this study, Magic foam cord showed the ease of placement followed by Expasyl retraction system and Medicated retraction cord.

Clinical significance: Gingival retraction helps in achieving good quality impressions. These are needed for a precision fit and long-term success with fixed prosthodontic restorations. Selecting techniques and materials that produce transient retraction and dry field without irreversible damages to the tissues is of utmost importance.

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1. Introduction

Tissue management is one of the critical factors in achieving a successful fixed prosthodontic restoration. The success of the restoration is not only evaluated in terms of fit, function and esthetics but also a restoration must have a suitable emergence profile with well-adapted and smooth gingival margins. Gingival and periodontal factors also play a significant role in a restoration's longevity and aesthetics. The health of gingiva and periodontium must be considered while planning restorative procedures that are in close proximity with soft tissues. In such restorations, isolation for subgingival placement becomes an important step [1,2].

The increasing use of cast restorations makes effective gingival retraction essential. 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 [3].

For a precision fit and long-term success with fixed prosthodontic restorations, the quality of impressions made is a key element. Gingival displacement is one of the procedures, which helps in achieving this. The goal of any method of gingival retraction should be to achieve effective gingival fluid free sulcus that is predictable and repeatable, without tissue damage. Therefore, the dentist must select techniques and materials that produce transient retraction and dry field without irreversible damages to the tissues [1].

A number of gingival retraction systems presently available in the market which include retraction cords, pastes and foam. Newer cordless retraction systems like Expasyl and Magic foam cord are easy to handle and comfortable to the patient [4]. These systems displace gingiva and are supportive to the periodontal tissue [5]. Choice of appropriate gingival retraction system is still a dilemma in the mind of the operator [4].

Gingival displacement approaches include mechanical, chemical and surgical methods. Mechanical methods are fast, simple and inexpensive. They achieve hemostasis and control crevicular seepage but are tough and exhausting to use. They are painful procedures and need anaesthesia to be administered. They may cause an injury to the epithelial attachment. Chemical agents exhibit hemostatic effects under physiological condition through protein precipitation. They inhibit plasma proteins inter-capillary immigration, decrease cell permeability, control the moisture in the peripheral tissues through protein precipitation on the superficial layer, and increase the mechanical strength of the mucosa. The disadvantage of this method is that denatured proteins can be involved in topical tissue destruction. The present study has been compelled to evaluate the clinical efficiency of gingival displacement obtained using Expasyl, Magic foam cord and Medicated retraction cord [5].

2. Materials and methods

Prior to the start of the study, ethical clearance was taken from the Institutional Ethics Committee, Sri Sai College of Dental Surgery, Vikarabad. One twenty patients with the requirement of full veneer crown on tooth were selected.

First and second molar teeth were included with thick gingival biotype. A periodontal probe was used to evaluate gingival biotype. Patients having healthy gingiva and periodontal status were selected. Criteria for assessing healthy gingival and periodontal status was kept as probing depth of 1-3mm; no bleeding on probing/mobility/furcation involvement; 0mm clinical attachment loss/bone loss and no visible inflammation. Only molars were used for establishing standardization and also considering that the effect of gingival retraction is better evaluated in larger sized teeth. This requirement was set as the inclusion criteria for the study.

Exclusion criteria were set as patients having attachment loss or signs of periodontal disease, cardiovascular disorders, hypertension, tilted or tipped tooth. Hypertensive patients were excluded from the study as one of the retraction systems used (Astringedent®- 15% ferric sulphate) is an agent that causes tissues to vasoconstriction and reduces capillary flow which may compromise the health of a hypertensive patient. The retraction systems used for this study were:

Group A: Expasyl (ACTEON France) (figure 1), a unique paste system that is injected into sulcus using the applicator. It takes between 15-20 seconds to apply the paste. This has a highly viscous organic binder,

KAOLIN-especially clay (responsible for rigidity) which is mixed with small amount of aluminum chloride (15%) to act as a haemostatic agent and also to keep the working field dry.

Mechanical action- Compressive action of paste into the sulcus.

Chemical action- Aluminum chloride, which is astringent, leads to protein coagulation on the surface of the tissue.

Group B: Medicated retraction cord (figure 2.a and 2.b), by soaking plain knitted retraction cord (Ultrapak; Ultradent South Jordan, Utah) of size #0 or #1 in 15% ferric sulphate (Astringedent®; Ultradent South Jordan Utah). Astringedent® (15% ferric sulphate) is an agent that causes tissues to vasoconstriction by precipitating proteins associated with limiting cell membrane permeability; by reduction of mucous and various secretions and reduction of capillary blood flow.

Group C: Magic foam cord (Coltene Switzerland) (figure 3), is a low consistency addition silicone elastomer (Poly vinyl siloxane). It is directly applied to sulcus without pressure or packing. Provides effortless removal, thus is comfortable for the patient. This contains no haemostatic chemicals that may contaminate the impression. The magic foam cord has inbuilt cotton rolls which show resistance to pressure. While applying, patients were asked to stop biting once they reach the resistance from cotton rolls.

The instrument used was a Toolmaker microscope (METLAB India) (figure 4). These are special type of microscopes that are used to create precision tools and measure small distances between two points of a specimen. It works on principles of optics. In contrast to a conventional light microscope, a toolmaker microscope is typically used as a measuring device. Fundamentally, it can be used to measure up to 1/100th of a millimetre. Die focused under Toolmaker microscope measuring the depth and width of gingival displacement after placing retraction system (figure 5).

The impressions obtained before and after placing the retraction system were poured with type IV die stone (Ultrarock, India). The casts obtained before and after placing the retraction system were coded to constant identity being influenced by the operator. Hence, this study was conducted in blind fashion.

Figures 1 - 3: Materials used in the study. Where 1. Expasyl; 2. Medicated retraction cords, a. Ultrapak, b. Astringedent®; and 3. Magic Foam Cord - Low consistency Polyvinyl siloxane material.

Mesial, distal, mid-buccal and lingual were taken as reference points because of the difference in closure patterns in mid-buccal, lingual and interproximal areas and due to anatomic and microstructural differences [5]. The casts are viewed under Toolmaker microscope for the amount of both vertical and horizontal gingival displacement. The difference was evaluated as the amount of retraction obtained by the retraction systems. The differences were measured and subjected to statistical analysis.

3. Results

The present clinical study was carried out to evaluate the efficacy of Expasyl retraction system, medicated retraction cord and magic foam cord. The mean gingival retraction width at the mesio-buccal area for Group A

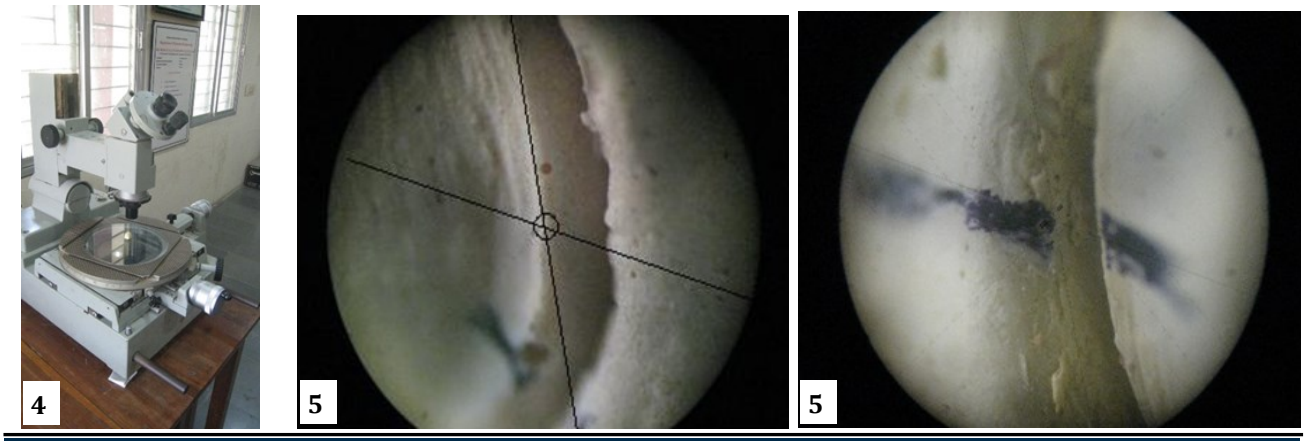

Figure 4. Tool maker microscope.
Figure 5. Microscopic images of the depth and width of gingival displacement after placing retraction system.

was 0.36mm, Group B was 0.46mm, and Group C was 0.33mm. The mean gingival retraction width at the disto-buccal area for Group A was 0.38mm, Group B was 0.42mm and Group C was 0.37mm. The mean gingival retraction width at the mid-buccal area in Group A was 0.41mm; 0.54mm in Group B, and 0.22mm in Group C with a 5% level of significance and p-value of <0.001. The mean gingival retraction width at the mid-lingual area in Group A was 0.47mm; 0.58mm in Group B, and 0.23mm in Group C. One-way ANOVA test and tukey-HSD procedure was applied to identify significant groups at 5% level. The mean gingival retraction depth at the mesio-buccal area for Group A was 0.37mm; 0.50mm in Group B, and Group C was 0.33mm. The mean gingival retraction depth at the disto-buccal area for Group A was 0.40mm; Group B was 0.40mm, and Group C was 0.35mm. Group A and B showed similar results. The mean gingival retraction depth at the mid-buccal area in Group A was 0.59mm; 0.68mm in Group B, and 0.27mm in Group C with a 5% level of significance and p-value of <0.001. The mean gingival retraction depth at the mid-lingual area in Group A was 0.5mm; 0.67mm in Group A, and 0.29mm in Group C.

The mean gingival retraction width in each retraction technique Group A 0.41mm, Group B 0.50mm and Group C 0.29mm (Figure 6). The mean gingival retraction depth in each retraction technique Group A 0.47mm, Group B 0.56mm and Group C 0.31mm. The results indicate that Medicated retraction cords (Group B) have effective retraction but are skill dependent and may cause gingival inflammation. Expasyl has produced retraction and was the least time consuming while magic foam cord has the ease of manipulation and has been maximum tissue supportive.

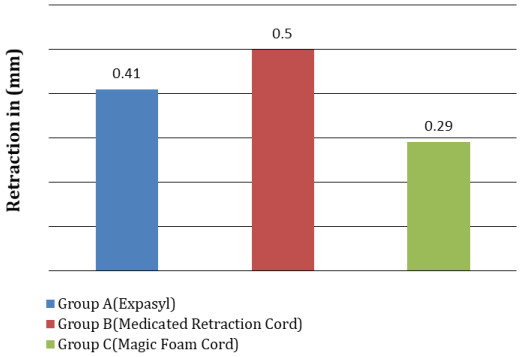

Figure 6. Mean gingival retraction width in each retraction technique

4. Discussion

The goal of any retraction system is to reversibly displace the gingival tissues in a lateral direction so that a bulk of low-viscosity impression material can be introduced into the widened sulcus and capture the marginal details [8].

The critical sulcular width in this regard seems to be approximately 0.2mm. 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 [9].

The results of the present study showed that Expasyl and Medicated Retraction Cord had greater values in the mid-buccal and the mid-lingual when compared to the mesio-buccal and the disto-buccal areas in both vertical and horizontal displacement of the gingiva.

This could be due to anatomic and microstructural differences in collagen fiber relation. As the gingiva at the proximal area is not only thicker than the buccal and lingual area but is also richer in collagen fibers with the intersection of the dentogingival, semicircular fibers and the transgingival fibers that originate from the adjacent tooth [10]. The forces applied in both the systems are uniform all through the gingival crevice.

Whereas in Magic Foam Cord mesio-buccal and disto-buccal areas showed greater values than mid-buccal and mid-lingual areas. This could be best explained as the magnitude and direction of force is not equal throughout gingival as contour and size of comp recap will exert more pressure interproximally than the mid-buccal and the mid-lingual which explains the difference in mean values between the locations.

In Magic foam cord and Expasyl, the disto-buccal area showed higher value compared to mesio-buccal. The mean values for Expasyl are 0.38mm, 0.36mm and 0.37mm and 0.33mm for magic foam cord. The reason could be when occlusal forces are applied, distal surfaces of teeth come in contact taking arc of closure into consideration.

All three groups showed a sulcular width greater than 0.2mm. However, Group C showed results matching with critical sulcular width in relation to mid-buccal and mid-lingual, which may need improvement in the design for better results.

Standard deviation which is high in vertical displacement (0.14) for Medicated retraction cord, shows it is extremely technique sensitive and multiple factors which makes it less predictable than other two retraction systems which have low standard deviation (Expasyl showing 0.06 and Magic foam showing 0.05).

Thimmappa *et al.* (2018) compared the efficiency of three non-invasive gingival displacement systems; Merocel strip, Ultrapak cord and Magic foam cord. The study showed that the Merocel strip provided the maximum amount of vertical and lateral tissue displacement, followed by Ultrapak cord and least with magic foam cord [11]. Singh *et al.* (2019) compared the efficiency of foam cord and retraction cord, and stated that the retraction cord provided 0.8% more gingival displacement when compared to the magic foam cord [12].

Gingival retraction methods provide ample vision and ideal working environment along with maintaining hemostasis to a certain extent. Thorough knowledge of gingival retraction agents and techniques available is necessary to procure superior bonding and minimal contamination from numerous factors of the oral cavity. Also, to be able to apply the appropriate one for specific purposes. Moreover, a particular clinical situation may indicate a specific technique. Selecting techniques and materials that produce transient retraction and dry field without irreversible damages to the tissues is of utmost importance.

5. Conclusion

Expasyl showed superior result when compared to Magic foam and less when compared to Medicated retraction cord taking both the parameters into consideration because of the presence of kaolin-clay which endures atraumatic mechanical retraction and aluminium chloride, causing chemical retraction. This synergistic effect leads to a maximum amount of gingival displacement.

Within the limitations of the study, Magic foam cord showed the ease of placement followed by Expasyl retraction system and Medicated retraction cord. However, the amount of vertical and horizontal displacement observed with Medicated retraction cord was significantly higher when compared to Expasyl and Magic foam cord.

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