

## Comparison of various methods of gingival retraction on gingival and Periodontal health and marginal fit

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### Abstract

**Aim:** The aim of the study was to investigate different gingival retraction methods to check for the most accurate method and their effect on gingival and periodontal health.

**Material and Method:** Sixty patients requiring crown on mandibular first molar were divided into four categories: Group I included retraction with plain cord, Group II included retraction with cord soaked in local anaesthetic solution, Group III used Expasyl for retraction and in Group IV Magic foam cord was used. For marginal fit, marginal discrepancy between the measurement coping and the cast was assessed at 8 reference marks using Digital Vernier calipers.

**Result:** This study showed that all retraction techniques caused an acute injury after 1 day of retraction, which took 1 week to heal in the cord (plain and impregnated) and the Magic Foam groups. The Expasyl group had the highest GI compared with others, and showed slower healing. Its use might cause sensitivity in a small number of cases. The use of cordless techniques did not require haemostatic agent to control bleeding during retraction.

All the four techniques showed adequate gingival retraction for the prosthesis. Clinically insignificant differences were seen in the four groups regarding the retraction achieved.

**Conclusion:** Within the limitations of the study, it was concluded that all the four methods were effective for gingival retraction. Judicious clinical judgment & skill of the operator are the deciding factors for the selection of any one of the various methods of soft-tissue management.

**Keywords:** Gingival retraction, plain cord, cord soaked with LA, Expasyl, Magic foam cord, Gingival health.

### Introduction

For the success of any restoration, it should have a healthy, harmonious relation with the periodontium. Key to achieving such a relationship is an accurately made impression for indirect restorations.<sup>(1)</sup> Although, from periodontal point of view, it is preferable to place the margins of restorations supragingivally, for esthetic or other reasons, the dentist may be forced to place them subgingivally.<sup>(2)</sup>

In cases of subgingival margins, the exposure of the gingival sulcus without damaging the periodontal tissue and the control of haemorrhage are prerequisites to the treatment of cervical lesions and improving the quality of impressions prior to fabricating indirect restorations. Poor marginal fit, which is the major cause of failure of cast restorations usually, results from incomplete marginal detail in the impression.<sup>(3,4)</sup>

Gingival displacement is defined as the deflection of marginal gingiva away from the tooth. The aim of gingival retraction is to atraumatically allow access for the impression material beyond the abutment margins and to create space so that the impression material is sufficiently thick so as to be tear-resistant.<sup>(5)</sup> The critical sulcular width seems to be approximately 0.2 mm at the level of the finish line for there to be sufficient thickness of material at the margins of impressions so that they can withstand tearing or distortion on removal of the impression.<sup>(6)</sup>

Control of moisture in the sulcus, particularly when a hydrophobic impression material is used, is also

necessary because moisture can cause an incomplete impression of the critical finish line.<sup>(7)</sup>

The techniques of gingival tissue displacement can be broadly classified as nonsurgical and surgical methods. The non-surgical methods include mechanical (retraction cords) & chemomechanical (Pre-impregnated retraction cords, Expasyl, Magic Foam Cords etc.) while the surgical methods include Lasers, Electrosurgery & rotary curettage.

The use of retraction cords as a mechanical or chemo-mechanical technique is well established in practice due to their relative predictability, effectiveness, and safety. However, the use of retraction cord can be laborious, time-consuming, can cause gingival bleeding, uncomfortable for patients in the absence of anaesthesia, and when inappropriately manipulated, can lead to direct injury and gingival recession.<sup>(8)</sup>

Pre-impregnating and/or soaking a cord with a haemostatic can control the sulcular haemorrhage and improve its tissue retraction qualities. The chemicals used along with retraction cords (gingival displacement medicaments) can be broadly classified<sup>(9)</sup> into vasoconstrictors (Epinephrine, Sympathomimetic amine) and astringents (Aluminum sulfate compounds (aluminum potassium sulfate [Alum] and aluminum sulphate, Aluminum chloride, Ferric sulphate).

Recently, cordless techniques have been introduced with several claimed advantages, such as time-savings and enhanced patient comfort while being minimally invasive. Expasyl (Kerr Corp., Orange, CA, USA) is a

paste-like gingival retraction material that depends on the haemostatic properties of aluminium chloride and the hygroscopic expansion of kaolin upon contact with the crevicular fluid, to provide mild displacement of the gingiva in about 2 min.<sup>(10)</sup>

Magic Foam Cords (Colte `ne Whaledent AG, Altstatten, Switzerland) is an expanding poly vinyl siloxane material designed for easy and fast retraction of the sulcus without the potentially traumatic and time-consuming packing of retraction cord.

Most studies on cordless techniques are demonstrations of their clinical use; their effects on the gingival and periodontal tissues are not well documented.<sup>(11)</sup> This study was conducted to compare the influence of Retraction cord, Cord impregnated with Local Anaesthetic, Expasyl and Magic Foam Cord on the gingival and periodontal tissues and to investigate the marginal fit in fixed restorations.

## Material and Method

60 subjects requiring porcelain fused to metal crown in the mandibular first molar were selected. The inclusion criteria were patient with no relevant medical history and non-smoker. The selected teeth were screened for periodontal health and teeth included in the study were those with a gingiva not expressing a highly scalloped margin and at least 2mm of keratinized tissues, non-fibrotic gingival tissues, no recession, probing depths of <3mm, no evidence of significant loss of attachment, no bleeding on probing, and Loe and Silness gingival index zero.<sup>(12)</sup>

The selected patients were divided into three four groups (15 each)

1. Group I: retraction cords were used.
2. Group II: retraction cords impregnated with Local Anaesthetic agent (Lignocaine+Adrenaline .02mg) were used.
3. Group III: Expasyl was used for retraction.
4. Group IV: Magic foam cords were used.

Probing depth (PD), clinical attachment level (CAL), gingival index (GI) and bleeding on probing were recorded for the selected teeth before gingival retraction was initiated. Cold air test for sensitivity was also performed on the selected teeth through a one second application of cold air from a dental unit syringe. The same measurements were again recorded on the first and seventh days post-retraction.

Periodontal probing to the bottom of the sulcus was conducted on all aspects of every selected tooth with Williams probe. The probe was held with a light grasp parallel to the long axis of the tooth. Each measurement was rounded to the lowest whole millimetre.

Clinical attachment loss measurement was then recorded as the distance from the CEJ to the base of the probable crevice.

The GI was recorded for every selected tooth based on the modification of the method of Loe & Silness (1963).

Bleeding was observed within 15s after probing, or if there was any tendency to spontaneous bleed.

After the tooth preparation, tissue displacement was preceded with isolation and drying of the area. For group I patients, appropriate cord size and length was chosen and wetted with water. It was packed gently in the buccal gingival sulcus with an instrument in a counter clockwise direction, without anaesthesia and kept in the gingival sulcus 10min. The cord was then removed manually.

For group II patients, appropriate cord size and length was chosen and wetted with LA agent for 20mins. Excess medicament is blotted from the soaked cord with a sterile cotton sponge. It was packed gently in the buccal gingival sulcus for 10min. The cord was then removed manually.

For group III patients Expasyl was extruded into the buccal sulcus using the gun at even pressure, the tip was perpendicular to the axis of the tooth, and then it was pressed against the tooth and angled until it contacted the sulcus lining of the gingival margin.<sup>(10)</sup> Expasyl was left in place for 2min. The tooth was then copiously irrigated with water until no traces of materials were left.

For group IV patients a suitable Comprecap size was selected and adjusted proximally to allow its placement and Magic Foam was syringed into the buccal sulcus around the premolar and the Comprecap was placed for 5min. The tooth was then copiously irrigated with water until no traces of materials were left.

To check for the marginal fit, Impression was made using the two step putty technique. The impression was poured in type IV die stone. On the casts, measurement copings were fabricated and seated. In each coping the marginal discrepancy was assessed at 8 reference marks using Digital Vernier calipers, with an accuracy of .001mm.

## Statistical analysis

Statistical analysis for the present study was done by applying following formulas:

1. Mean Value
2. Standard Deviation (S.D)
3. Student 't' test
4. 4 'p' value - with 5% level of significance

## Results

60 subjects (22 females and 38 males) free of clinical signs of gingivitis participated in this study. The participants were between 25 and 35 years of age.

CAL measurements were not different among the four groups. The Gingival Index and Probing Depth values at the baseline measurements were similar among the four groups.

The PD values were not significantly different among the groups at all-time intervals. The use of cord resulted in a slight decrease in the mean of the PD values after 1 day (2.39mm) and a further decrease after 7 days (2.21mm) compared with the baseline (2.5mm). The use of pre-impregnated retraction cords also revealed the

same results with only slightly less changes (2.48, 2.37, 2.24 at baseline, 1, and 7 days, respectively). The mean of the PD for the Magic Foam group almost had the same values (2.46, 2.49mm, 2.42 at baseline, 1, and 7 days, respectively). The values of the PD for the Expasyl group showed a slight increase (2.45, 2.58mm, 2.53 at baseline, 1, and 7 days, respectively).

All four techniques resulted in a significant increase in the GI values after 1 day. The highest increase was induced by Expasyl and least was seen in cords impregnated with LA. After 7 days, the GI for the all techniques decreased to a non-significant level compared with their baseline measurements except the Expasyl group.

Sensitivity was only induced by Expasyl in six subjects on day 1. Bleeding during retraction and after removal was encountered only with the use of cord (Group 1). In Group II Bleeding was seen only during placement. No bleeding was seen for Group III & IV patients.

Overall marginal discrepancies ranged between 0 and 200 microm. There was a small but clinically insignificant difference between the four groups. The best marginal fit was achieved in Group IV patients followed by Group II, then Group III. Highest marginal discrepancies were seen in Group I subjects.

## Discussion

A narrow young age range group was studied and teeth included were mandibular first molars, which eliminated age/gender influence and ensured little variation in gingival thicknesses. This allowed using the same size cord in all subjects (size one) to minimize differences among the groups.

This study investigated the effects of different retraction techniques on gingival and periodontal health and the effectiveness of gingival displacement by studying the marginal discrepancies between the coping and the margins of the finished preparation on the cast.

Clinical diagnostic indicators including PD, CAL, GI, bleeding on probing and sensitivity were used to evaluate periodontal health in this study. These indices have been developed to identify the degree of severity of gingival and periodontal disease by analysing the degree of gingival inflammation in gingivitis and the degree of connective tissue destruction in periodontitis. They are easy to perform, cost-effective, and relatively non-invasive. Clinical probing is the most commonly used parameter.

The most commonly used method for gingival retraction is the use of retraction cords. Plain retraction cords were gently forced into the gingival sulcus, using a cord packing instrument, to displace the gingiva laterally from the tooth. The study used single cord technique. The cord is left there for at least 10 mins<sup>(13)</sup> as they have been reported to cause necrosis of the crevicular epithelium when placed longer than 10min. (Lo & Silness 1963).

The retraction cord achieves the desired retraction, but placing a retraction cord is not an easy method<sup>(14)</sup> It needs physical manipulation of the tissue, leading to gingival bleeding. Placement of retraction cords can cause injury to the sulcular epithelium and underlying connective tissues<sup>(15,16)</sup> leading to gingival recession.<sup>(17)</sup> According to Feng et al, gingival retraction causes an acute injury that heals clinically in 8 days to 2 weeks as is indicated by the Periodontal Indices.<sup>(8,15)</sup> Also, on removal, plain cords are associated with bleeding in more than 50% of situations, although wetting the cords before removal may help control the bleeding.<sup>(18)</sup>

In the present study, use of retraction cord caused PD reduction which might imply gingival recession. It may have occurred as result of low-grade trauma due to impaction of foreign bodies (retraction cord) on the gingival tissue. This study did not demonstrate destruction of the junctional epithelium and gingival recession at a significant level, due probably to the crudeness inherent in the PD measurement.

The plain cords work on the pressure principle. Unfortunately, the use of pressure alone often will not control sulcular haemorrhage. Placement of cord can also be uncomfortable for patients in the absence of anaesthesia. Thus, Pre-impregnating and/or soaking a cord with Local Anaesthetic solution can help in easy placement of the cord and can control the sulcular haemorrhage and improve its tissue retraction qualities.

A study carried out by Csempez et al<sup>(19)</sup> indicates that 20 minutes of soaking time is necessary for saturation of the cords before use. Hence, in the study, the cords were soaked for 20mins followed by 10mins of placement in the tissues.

Adrenaline present in LA provides effective vasoconstriction and hemostasis during retraction.<sup>(20)</sup> However, it should be used with caution because it may cause tachycardia particularly if it is placed on lacerated tissue.<sup>(18)</sup>

The results of the study indicates that pre-impregnated cords with LA showed no significant difference in achieving gingival retraction but leads to less tissue injury, less pain during placement and absence of bleeding during removal, though some bleeding is seen during placement of cords. The PD & GI were improved as compared to the plain cord technique.

The two main drawbacks of using chemicals with retraction cords are the occurrence of rebound hyperemia that often occurs after cord removal, which affects effective impression making,<sup>(21,22)</sup> and inflammatory reactions induced by these chemicals, which can affect the subepithelial connective tissue<sup>(23)</sup> Studies on the chemico-mechanical and purely mechanical cord retraction techniques have shown various degrees of necrosis and/or stripping of the gingival sulcus.<sup>(24)</sup>

Expasyl uses 15 percent aluminum chloride in a kaolin matrix. It opens the sulcus, providing significant retraction.<sup>(25,26)</sup> Homeostasis was controlled by the aluminium chloride present in the Expasyl. Furthermore,

its effectiveness in reducing the flow of sulcular exudate is similar to that of epinephrine-soaked cords.<sup>(27)</sup> It also is safe, with the results of one study showing no reports of adverse effects.<sup>(28)</sup> Gingival recession associated with an injection of aluminum chloride into the gingival sulcus is almost undetectable.<sup>(29)</sup> The injectable matrix is hydrophilic and can be flushed away relatively easily from the gingival crevice.<sup>(30)</sup> When compared with having a cord packed into the sulcus, an injection resulted in less pain for patients and was easier and quicker to administer & hence greater patient compliance. It is also least time consuming.

All techniques caused gingival injury after the first day as shown by the significant increase of GI. This may be explained by the reaction of the inflammatory cells to the mechanical or chemical trauma.<sup>(31)</sup> In the present study, greatest increase in GI and slower healing was significantly evident in the Expasyl group.

Expasyl contains 15% aluminium chloride, which has been reported to result in local tissue damage and transient ischemia in concentrations higher than 10%.<sup>(32,33)</sup> All groups showed tissue recovery after 7 days.

Expasyl induced sensitivity in six subjects. This might be attributed to its acidity, which may have affected the patency of the dentinal tubules.<sup>(34)</sup> In addition, it was noticed that Expasyl caused a degree of dryness, which although was a desirable characteristics for making successful impressions, it may have resulted in sensitivity.

Magic Foam showed the best healing followed by cord. Although these pastes cause greater temporary gingival inflammation; which also showed slower recovery, they do not induce bleeding during or after retraction.<sup>(17)</sup> According to Phatale et al,<sup>(35)</sup> the retraction procedure with the newly advanced material in the form of retraction pastes like Expasyl or Magic Foam Cord appears very safe and easy to use. Homeostasis was controlled by the little pressure applied on the gingiva in the Magic Foam group. Histologically, they are found to be better than the cord, with respect to the periodontium. The patient tolerance was observed to be very good. No anesthesia was required and the material exhibited total biocompatibility.<sup>(46)</sup> Kazemi et al also supported the evidence that gingival inflammation is less with the retraction paste. Yang et al.<sup>(29)</sup> reported no significant difference in achieving gingival deflection, but reported that the use of cord appeared to be more painful and produced more gingival recession than the cordless technique(s). This is in accordance with the results of our study.

In our study, though the cord provided greater sulcular width than the paste system but it was clinically acceptable in both the cases as supported by.<sup>(36)</sup> But, the amount of retraction offered by these pastes is limited with extremely subgingival margins.<sup>(27)</sup> According to Beier et al,<sup>(37)</sup> the pastes are less traumatic alternative method of gingival retraction in cases of epigingival and

subgingival (< 2 mm) preparation margins. However, when there were deep subgingival margins and a beveled preparation, the material was less effective than the single cord retraction technique.

Cranham et al also advocate displacement paste over cord.<sup>(38)</sup> These pastes are also advocated around cement-retained implant prostheses.<sup>(27)</sup> They are also preferred when taking a digital impression for CAD/CAM prostheses since the artefacts caused by retraction cord fibres can be avoided.<sup>(39)</sup>

The high cost of retraction pastes, commercially available with or without hemostatic agents, has also prevented them from becoming a mainstream commodity.

Each type of retraction appears to possess desirable characteristics. It is imperative to match positive characteristics to a particular challenge presented by each unique patient, clinical condition, and specific abutment.

## Conclusion

Several techniques have been advocated for relatively predictable and safe gingival retraction in fixed prosthodontics. Unfortunately, no scientific evidence has established the superiority of one technique over the other. This study showed that all retraction techniques caused an acute injury after 1 day of retraction, which took 1 week to heal in the cord (plain and impregnated) and the Magic Foam groups. The Expasyl group had the highest GI compared with others, and showed slower healing. Its use might cause sensitivity in a small number of cases. The use of cordless techniques did not require haemostatic agent to control bleeding during retraction.

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Judicious clinical judgment & skill of the operator are the deciding factors for the selection of any one of the various methods of soft-tissue management.

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