

GINGIVAL RETRACTION - TECHNIQUES AND MATERIALS: A REVIEW

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SUMMARY

Accurate final impression of the prepared teeth is of extreme importance for successful fixed prosthetic restorations. One of the problems appearing in the process of the impression making is the marginal details. A number of materials and methods have been described in literature for the retraction of gingival tissue. This article outlines the knowledge available from previously published studies and discusses the currently popular materials and methods used in gingival retraction.

The selection of method and gingival retraction cords frequently depends on the clinical situation. The extent of hemorrhage influences the preference for a specific retraction cord. Scarcely any drug is completely free of side-effects, and package inserts accompanying these products list a number of possible side-effects that may occur if used repeatedly, over an extended period of time. The possibility of an allergic reaction exists for patients who may be sensitized to the product. Dentists should carefully consider the benefits and disadvantages of the various materials and methods of gingival retraction in light of the potential risk of adverse effects.

Key words: *Gingival retraction, tissue displacement, gingival hemostasis, retraction cords, retraction pastes, retraction gels*

INTRODUCTION

The retraction of the gingival tissue is a long established technique. It can be defined as the process of deflection of the marginal gingiva away from a tooth. Periodontal factors influence the quality of the marginal fit of a restoration. A good quality impression is influenced by location of finish lines, periodontal health and sulcus bleeding during impression making.¹⁻²

Though the necessity to place the finish line into the gingival sulcus obviously has a negative effect on the quality of the impression,^{4,8-10} aspects of gingival retraction have only been sparsely investigated.³⁻⁵ The aim of gingival retraction is to allow access for the impression material beyond the abutment margins and to create space for the impression material to be sufficiently thick. Tear resistance of the impression material can be affected by the material thickness.⁶ Gingival retraction should be mandatory prior to impression so as to expose the prepared tooth surfaces.⁷⁻⁸ Impression with less sulcular width have higher incidences of voids, tearing of impression materials,

and reduction in marginal accuracy.⁹⁻¹⁰ Occasionally, gingival retraction is required in order to permit the completion of tooth preparation or to allow cementation of laboratory-manufactured restorations.¹¹ A number of studies have been done on the various materials and methods used for gingival retraction.⁷

According to a 1985 survey, 95% of North American dentists routinely used gingival retraction cords.¹² There are approximately 125 gingival retraction cords in various shapes, sizes and medications available in the market. A gingival retraction agent should be (1) effective for its intended use, (2) safe-both locally and systemically, and (3) the effects should be spontaneously reversible, wearing off in a short time, leaving no permanent tissue displacement.

In the past retraction was implemented using various techniques like for example, the application of cuprum ferrule. Later on, retraction cords gained wide application. In a histological study on dogs, Harrison¹³ compared plain cord, cord impregnated with two concentrations of epinephrine and zinc chloride and cord

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impregnated with 100% alum. Cords that contained zinc chloride at 8% and 40% concentrations caused severe tissue destruction, while the other materials caused only reversible injury. Both 8% epinephrine and 100% alum were effective in the control of moderate bleeding.

Woychesin¹⁴ found unacceptable tissue damage with zinc chloride in dogs. Ramadan studied the length of time the sulcus remained open and the width of the sulcus with plain cord, 1/1000 epinephrine, 100% alum, and hemodent. He concluded that the treated strings were effective as compared to the plain string.¹⁵ But de Gennaro et al.¹⁶ studied the histological responses among humans to plain cord and cord impregnated with potassium sulfate, hemodent, and 8% racemic epinephrine and concluded that there was no practical difference between the cords. Aluminum sulfate causes hemostasis by a weak vasoconstrictor effect in addition to precipitation of tissue proteins with tissue contraction, inhibited transcapillary movements of plasma proteins, and subsequent arrest of capillary bleeding. The medicament is regarded as safe and devoid of systemic effects when used appropriately.

GINGIVAL RETRACTION TECHNIQUES

According to Benson et al¹⁷, gingival retraction measures fall into one of four major categories: (1) simple mechanical methods, (2) chemo-mechanical methods, (3) rotary gingival curettage, and (4) electro-surgical methods. Of these four categories, the chemo-mechanical method of gingival retraction is the most widely used.¹² The mechanical aspect of this method involves placement of a string into the gingival sulcus to displace the tissues physically. The chemical aspect of the method involves treatment of the string with one or more of a number of compounds that will induce temporary shrinkage of the tissues and should also control the hemorrhage and fluid seepage that often accompany sub gingival margin preparation

Mechanical Retraction – Cord

Clinicians place retraction cords by using cord-packing instruments. Some manufacturers make purpose-designed packing devices that have smooth, non-serrated circular heads that can be used to place and compress twisted cord with a sliding motion. Other manufacturers make devices with serrated circular heads for use with braided cords. The thin edges of

these serrated circular heads sink into the braided cord, and the fine serrations keep it from slipping off and cutting the gingival attachment. The advantage of using a cord is that it is inexpensive and can achieve varying degrees of retraction. But, cords can be painful and uncomfortable for the patient. Also the sulcus collapses soon after the removal of the cord. Hemostasis achieved is limited and the placement of the cord in the sulcus takes time. There are two techniques for mechanical retraction, namely, single-cord and double-cord technique.

Single-cord versus dual-cord technique: (Figs 1, 2 & 3)

Gingival sulcus can be enlarged by placing a cord into the sulcus and leaving it in place for a considerable period of time. Clinicians may place untreated plain cord safely in the sulcus for periods of five to 30 minutes, but the pressure of cords alone will not control sulcular hemorrhage.¹⁸ They provide more effective control of gingival hemorrhage when used in conjunction with medicaments than when used with no medicaments. The use of a single retraction cord often provides inadequate gingival retraction. The dual-cord technique in which the first cord remains in the sulcus reduces the tendency for the gingival cuff to recoil and partially displace the setting impression material.¹⁹ Results from a survey showed that 98 percent of prosthodontists use cords, with 48 percent using a dual-cord technique and 44 percent using a single-cord technique.⁷ The filaments or fibers of conventional cords also may cause residual contamination of sulcular wounds, creating foreign body reactions and exacerbating inflammation.²⁰ Healing of the sulcus can take 7 to 10 days.²¹ Use of minimal force is necessary when packing cords to protect Sharpey's fibers, and application of excessive force is inappropriate because it may cause crevicular bleeding, gingival inflammation and shrinkage of marginal tissues.²² On removal, plain cords are associated with bleeding in more than 50 percent of situations, although wetting the cords before removal may help control the bleeding.²³ In a study by Jokstad²⁴ comparing the knitted cords and twined cords, he found that the knitted cords performed better.

Chemicals in an injectable matrix: (Fig 4)

Injecting 15 percent aluminum chloride in a kaolin matrix opens the sulcus, providing significant me-

chanical retraction.²⁵⁻²⁶ It is injected into the sulcus and hence it is generally more comfortable for the patients, and it is also quick to administer. The results of one study showed no reports of adverse effects.²⁷ Furthermore, its effectiveness in reducing the flow of sulcular exudates is similar to that of epinephrine-soaked cords. The injectable matrix is hydrophilic and can be flushed away relatively easily from the gingival crevice. As with any foreign materials introduced into the oral cavity, there remains a small risk of residues' persisting in the gingival crevice. The advantage of this technique is the reduced risk of inflammation and the ease of placement. But, it interferes with the setting of the polyvinyl siloxane and polyether impressions and is also expensive as compared to the other techniques.

Chemicals in an inert matrix

A polyvinyl siloxane material for gingival retraction was introduced in 2005. It works by generating hydrogen, causing expansion of the material against the sulcus walls during setting. It does not cause any inflammation or irritation of the tissue. It is easy to place in the sulcus and has no adverse effects. The drawbacks are that it may not improve the speed or quality of retraction obtained.

Surgical retraction – Lasers

Lasers' properties largely depend on their wavelength and waveform characteristics. The commonly used diode lasers have a wavelength of 980 nanometers (nm). Neodymium:yttrium-aluminum-garnet (Nd:YAG) lasers have a wavelength of 1064 nm. They cause less bleeding and hence the gingival retraction is minimal. Tissue shrinkage is less through scarring, which helps to preserve gingival margin heights.²² Visualizing the action of laser beams are difficult, owing to the plume

of coolant water. Therefore, there is potential for attached gingiva to be obliterated when lasers are used for retraction purposes, since clinicians receive virtually no tactile feedback.

Electrosurgery

An electrosurgery unit may be used for tissue removal before impression making. However, electrosurgery is not recommended as the concentrated electrical current at the tip of electrodes can generate heat, which may cause osseous or mucosal necrosis and also there is a potential for gingival recession after treatment.²⁸⁻²⁹

Rotary curettage

Rotary curettage involves the use of a high-speed turbine to cut the gingival tissue quickly and create a trough around the margins. It helps to reduce the excessive tissue and can also help to contour the gingival outline. For healthy, disease-free tissue around natural teeth, rotary curettage has little effect on gingival margin heights. However, for periodontally weak tooth, it may cause deepening of the sulcus.³⁰⁻³¹ Owing to the amount of tissue destruction, this method of gingival retraction is best avoided.

Azzi and colleagues²¹ studied the effect of retraction cords, electrosurgery and rotary gingival curettage on gingival recession and loss of attachment in dogs. They found that cords had the smallest effect on the gingiva and rotary curettage had the largest effect.

GINGIVAL RETRACTION MATERIALS

Gingival retraction materials can be broadly classified into three groups based on the method of application: gingival hemostatic agents, gingival retraction cord/caps and gingival retraction paste/gels of the material. (Table1)

TABLE 1: GINGIVAL HEMOSTATIC AGENTS

Gingival Hemostatic Agents				
S No.	Product Name (Company)	Material Type	Dispensor Type	Composition
1	Hemostasy1™ Hemostatic Agent (Kerr Corporation)	Gel	Syringe	15% Aluminum Chloride
2	FS Hemostatic (Premier Products Company)	Solution	Dropper bottle, Bottle	15.5% ferric sulfate
3	Astringent (Ultradent)	Solution	Bottle	15.5% ferric sulfate
4	Hemodent (Premier Products Company)	Inquire	Bottle	Buffered Aluminum Chloride

TABLE 2: GINGIVAL RETRACTION CORD AND CAPS

Gingival Retraction Cord and Caps				
S No	Product Name (Company)	Sizes available	Dispensor Type	Medicated
1	Hemodent Retraction Cord (Premier Products Company)	Braid: Thin, Medium-Thin Twist: 3, 9		Not medicated
2	CrownPak (GingiPak)	4-ply	Kutter Kap	Epinephrine HCl (Racemic epinephrine)
3	GingiAidZ-Twist (GingiPak)	0, 1, 2, 3	Kutter Kap	Aluminum Sulfate
4	Gingiplain Soft (GingiPak)	1, 2, 3	Kutter Kap	Non-impregnated
5	Pascord (Pascal Company, Inc)	7, 8, 9, 10		Aluminum Sulfate
6	Racord (Pascal Company, Inc)	7, 8, 9, 10		Racemic Epinephrine HCl
7	Racord II (Pascal Company, Inc)	7, 8, 9, 10		Reduced Racemic Epinephrine HCl and Zinc Phenosulfonate
8	Sulpak (Sultan Healthcare)	Small, Medium, Large	Pull 'n Cut Dispenser	Astringent - Aluminum Potassium Sulfate NF; Vasoconstrictor - 4% Racemic Epinephrine HCl; and Combination - Aluminum Potassium Sulfate and 4% Racemic Epinephrine
9	Ultrax (Sultan Healthcare)	Small, Medium, Large	Pull 'n Cut Dispenser	Astringent - Aluminum Potassium Sulfate NF; Vasoconstrictor - 4% Racemic Epinephrine HCl; and Combination - Aluminum Potassium Sulfate and 4% Racemic Epinephrine
10	Unibraid (Van R)	0, 1, 2		Epinephrine/Alum 87 or Aluminum Potassium Sulfate

TABLE 3: GINGIVAL RETRACTION PASTES AND GELS

Gingival Retraction Pastes and Gels				
1	Expasyl™ Gingival Retraction Paste (Kerr Corporation)	Viscous Paste	Capsules, Applicator Tips Applicator Gun	Aluminum Chloride
2	Traxodent Hemodent Paste Retraction System (Premier Products Company)	Paste	Syringe	Medicated
3	Gingitrac (Centrix)	Gel	Auto-mix gun delivery	Non medicated
4	GingiTrac Singles (Centrix)	Gel	Syringe	Medicated and Astringent included
5	Magic Foamcord (Coltene Whaledent)	PVS material	Syringe	Not medicated

Adapted with some modification from the website (<http://www.dentalcompare.com/jump/107/Gingival-Retract-ion-Material-And-hemostatics.html>)

Gingival Hemostatic Agents

Astringents and vasoconstrictors are commonly used for presoaking retraction cords. Astringents exert their action topically on the injured mucosal surface, whereas the hemostatic effect of vasoactive molecules is accomplished through a direct vascular action. Aluminum chloride has been found to be least irritating, and it may be left in the sulcus for up to 15 minutes without causing any permanent damage.³² Aluminum chloride is solid in a stable acidic buffer resulting in an etched dentine.³³ Aluminum chloride and zinc chloride in high concentrations are caustic to gingival tissues and thus are not recommended. Ferric sulfate acts as a clotting agent, and often, when the string is removed, the clot is pulled out with it, and hemorrhage begins. Also, ferric sulfate does not cause actual shrinkage of the tissues. Alum acts mainly as an astringent and is considered to be safe and moderately effective as a tissue-displacing agent.

Gingival Retraction Cord / Caps

Epinephrine is very commonly used along with gingival retraction cords to effectively control bleed-

ing.^{13,34,33} The sulcus bleeding is said to be better controlled with this than astringent containing cord.³⁵ Epinephrine-impregnated retraction cord contains 8 percent racemic epinephrine. It has been shown that epinephrine produces a syndrome of undesirable side effects^{12,17,23,36} that may include tachycardia, increased respiratory rate, hypertension, nervousness, and feelings of weakness in the extremities, frank apprehension, and post-operative depression. Tissue injury may also occur on introducing cords impregnated with epinephrine.¹⁸ Therefore, recommendations have been made to either limit or avoid use of such epinephrine impregnated retraction cords.³⁷⁻³⁸ In a recent study, the authors could not find any clear advantage of using cords impregnated with epinephrine.²⁴ Pure cotton cords on the other side do not sufficiently reduce the crevicular fluid flow.³⁹

Gingival Retraction Paste / Gels: (Fig: 5)

Expasyl is a universally accepted and widely used gingival retraction paste. It is composed of three materials: Aluminum chloride ($\approx 15\%$), Kaolin and Excipient. The product is supplied in reusable capsules.

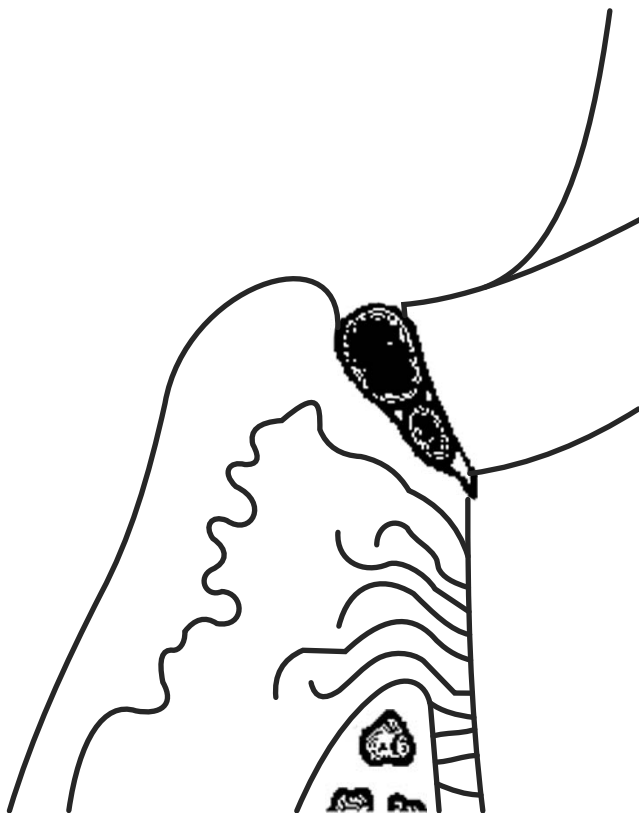


Fig 1: One Cord Retraction Technique

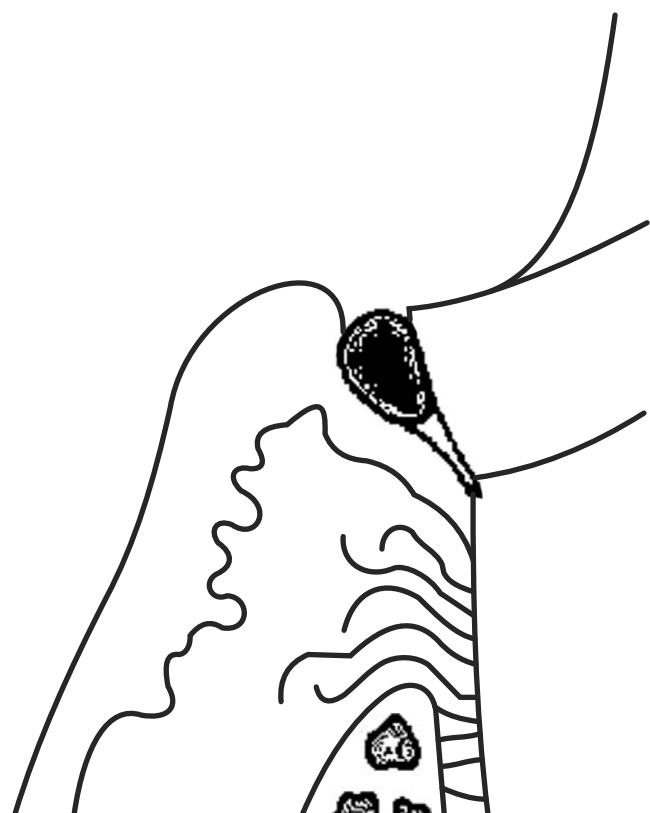


Fig 2: Two Cord Retraction Technique



Fig 3: Ultrapak Retraction Cords



Fig 4: Injectable Retraction Agents



Fig 5: Expasyl and Applicator Gun

Depending on the clinical situation and number of teeth, four to ten preparations can be performed with a single capsule.⁴⁰ The consistency of Expasyl is especially formulated not to damage the healthy periodontium; the phenomena of gingival recession or bone resorption are thus avoided. Gingival retraction is obtained by a single application of Expasyl in the sulcus. On contact with crevicular fluid, this material provides mild displacement of the gingiva within two minutes.⁴¹ Expasyl, easily visible owing to its colour, is simply eliminated by an air and water spray, and a dry and widely opened sulcus is then obtained. It is painless when used on a healthy periodontium. Absence of bleeding or oozing allows achieving a perfectly dry sulcus.²⁵

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