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Establishing a Protocol for Gingival Retraction- A Review

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ABSTRACT

To ensure the success of fixed dental prostheses, it is critical to obtain accurate impressions of the prepared finish line, whether it is a tooth-supported or implant-supported prosthesis. Gingival retraction techniques can be used to reduce any discrepancy between the restoration and the abutment if the prepared finish line is near the gingival sulcus. Accurate marginal positioning is crucial for optimal therapeutic, preventive, and aesthetic outcomes. Gingival retraction techniques can be classified into mechanical, chemical, or surgical methods. This article provides an overview of various conventional and modern methods of gingival retraction used in impression making of tooth-supported and implant-supported prostheses, and summarizes the conclusions extracted from studies on gingival tissue management.

Keywords: *Impression making, gingival retraction, cordless retraction, and implant*

INTRODUCTION

Gingival retraction is a vital procedure in restorative dentistry and prosthodontics, where accurate impressions are necessary for achieving optimal clinical outcomes(1). The procedure involves displacement of the gingival tissue to expose the tooth margin, which is necessary to create an adequate space for impression material. It is a crucial step in the fabrication of fixed dental prostheses, and accuracy is paramount to achieve a proper fit and avoid complications such as marginal discrepancies, which can lead to failure of the restoration(2). Gingival retraction can be achieved using various techniques, including mechanical, chemical, and surgical methods. With the advent of new technologies, modern techniques such as laser-assisted gingival retraction have also been introduced, which offer advantages such as decreased patient discomfort and reduced bleeding(3)(4)(5). Mechanical gingival retraction techniques involve physically pushing the gingival tissues away from

the prepared tooth surface. This is typically done using cord-based materials, which can be impregnated with astringent chemicals that help to control bleeding and inflammation(6). These cords are placed in the gingival sulcus surrounding the prepared tooth and then gently pulled to displace the tissue. The cord is left in place for several minutes to allow the tissue to be displaced and to give time for the astringent chemicals to take effect. After removal of the cord, the gingival tissue will remain retracted for a short period of time, allowing for easy access to the prepared tooth surface for impression taking(7,8).

Chemical gingival retraction techniques involve the use of chemicals to achieve gingival retraction. These chemicals cause the gingival tissue to shrink, creating space for impression material(9). Chemicals used for this purpose include aluminum chloride, ferric sulfate, and potassium aluminum sulfate. These chemicals are usually applied to the gingival tissue using a syringe or a cotton pellet(10).

Surgical gingival retraction involves the use of a scalpel or laser to create an incision in the gingival tissue. This technique is less commonly used due to the risk of bleeding and post-operative pain. However, it can be useful in cases where other techniques have failed(1).

Less invasive techniques have been developed to reduce the discomfort associated with traditional cord-based methods. For example, Expasyl, a paste-like material containing aluminum chloride, has been shown to produce moderate gingival displacement(11). Another cordless technique, Magic Foam cord, is based on a poly(vinyl siloxane) material and is designed for quick and easy retraction of the gingiva(12). Merocel, a synthetic material in strip form, works by absorbing gingival fluids and mechanically displacing the gingiva. In addition, diode lasers have been used for periodontal and implant surgeries, with the advantages of easy application, patient comfort, and good hemorrhage control.

The success of gingival retraction largely depends on the clinician's ability to select the most appropriate technique for each individual case, taking into consideration factors such as the location of the tooth, the condition of the gingival tissue, and the type of impression material being used(13)(14). In recent years, cordless gingival retraction techniques have gained popularity due to their ease of use and decreased patient discomfort compared to traditional cord packing techniques. The use of chemical agents such as aluminum chloride and ferric sulfate have also been widely studied, with promising results in achieving adequate gingival displacement.

However, it is important to note that gingival retraction is not without its risks, and complications such as tissue trauma, bleeding, and gingival recession can occur if the procedure is not carried out correctly. For this reason, proper training and expertise in the technique are crucial to ensure successful outcomes and avoid adverse events(15).

Overall, gingival retraction is a critical step in the preparation of fixed dental prostheses. Clinicians must carefully evaluate the risks and benefits of each technique and ensure that the amount of retraction is adequate for accurate impression taking. Proper management of the gingival tissue after retraction is also essential for optimal outcomes. With careful technique selection and management, gingival retraction can lead to successful fixed dental prosthesis outcomes(16). The aim of this review is to establish a protocol on which gingival retraction technique performs best in various clinical scenarios based on current evidence.Our team has extensive knowledge and research experience that has translated into high quality publications(17–22), that made us do multiple research.

Search Strategy

All experimental clincial studes on gingival retraction methods and their comparison prior to fixed dental prosthesis impression making were explored on online databases PubMed, Cochrane Library, Scopus, and Google Scholar from the year 2000 till 2022. The present review primarily focused on reporting descriptive statistics of the extent of gingival retraction attained by various retraction methods and the periodontal parameters described in the included studies.

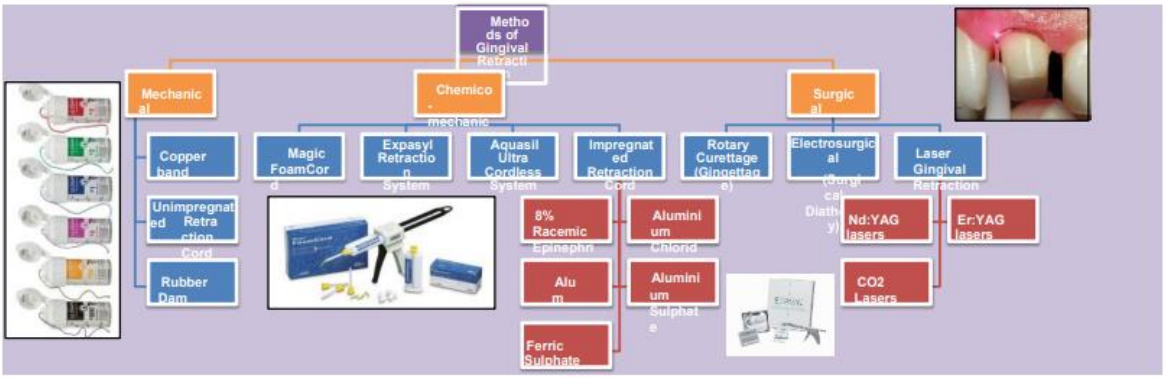

FIGURE 1: Classification of methods of gingival retraction

DISCUSSION

Gingival retraction can be accomplished using various techniques, such as chemical, mechanical, laser, electrosurgery, ultrasound, surgical, and photodynamic therapy. Chemical retraction involves the use of chemicals like aluminum chloride or ferric sulfate to reduce the gingival tissue. Mechanical retraction utilizes devices like cords or wedges to displace the gingival tissue and reveal the tooth margin. Laser retraction involves removing a small amount of gingival tissue using a dental laser, creating space for impression or restorative material. Electrosurgery utilizes an electric current to modify or remove the gingival tissue. Ultrasound retraction uses ultrasound waves to displace the gingival tissue, while surgical retraction involves surgically removing a portion of the gingival tissue to expose the tooth margin. Photodynamic therapy involves using a photosensitive dye and a special light source to shrink the gingival tissue. The selection of the appropriate retraction method depends on various factors such as the location of the tooth, the type of restorative material, and the patient's oral health condition.

Mechanical Retraction Methods

Mechanical gingival retraction involves the use of physical devices to displace the gingival tissue and create space for impression materials or restorative materials. This technique is widely used in restorative and prosthodontic procedures to improve the accuracy of impressions and achieve better aesthetic outcomes. The mechanical gingival retraction method is effective in achieving a gingival displacement of up to 0.5-0.7 mm, which is sufficient for most restorative procedures.(23)

Retraction cords are the most commonly used method, and they are made of various materials such as cotton, polyester, and braided or twisted fibers. The cords are placed around the tooth, underneath the gingival margin, and left in place for several minutes to allow for gingival retraction.

Jokstad A(24) found out that the consistency of the gingival retraction cord, whether twined or knitted, seems to be more important than the medicament used. A study done 2003 (25) demonstrated that knitted cords provided more retraction as compared to braided cords kept for the same amount of time in gingival sulcus (0.61mm vs 0.44mm). Regarding the displacement time, 4-8 minutes seem to be the ideal amount to provide proper retraction without compromising the integrity of the periodontal tissues (25) (26)(27)

Retraction cords can be mainly used in 2 techniques: single or double cord. In the dual cord technique, two knitted cords with different diameters are used. The thinner apical cord is left in place during the impression making process to create a valley around the tooth preparation, delaying the recoil of gingival cuff. This technique has been shown to be effective in achieving adequate gingival displacement, particularly in subgingival margin cases. Additionally, it has been reported to result in less

bleeding, less tissue trauma, and better retention of the impression material compared to single cord techniques. (28) (29)

The size of retraction cord used also affects the impression quality. Better impression qualities were observed in groups with easy insertion, proper dilatation, less recurrent bleeding, and no remnants or fraying.(30) Also it should be noted that there is no standardized size among various brands of retraction cords used and therefore the use completely depends on the clinicians capability to access the gingival biotype and skills in cord packing.(31)

Typically, serrated round-end cord packing instruments are used with braided cord to prevent slippage and further trauma to the epithelial attachment. The small indentations in the instrument's head help to anchor the cord. In contrast, non-serrated flat-end instruments are applied in twisted cords with sliding motion, as they have a smooth surface that allows for easy placement and adaptation of the cord without causing any damage to the surrounding tissues.(32)

Chemical Retraction Methods

Chemical retraction is a technique to temporarily shrink the gingival tissue in order to expose the margin of a prepared tooth for the purpose of making an impression or placing a restoration. This technique involves the use of chemical agents, such as aluminum chloride or ferric sulfate, that cause localized inflammation in the gingival tissue, leading to temporary shrinkage and displacement(10). The use of chemical retraction is considered less invasive compared to other methods like mechanical or surgical retraction, and is commonly used in combination with other techniques(33)(34). The choice of chemical agent and technique depends on several factors, including the location of the tooth, the type of restorative material being used, and the patient's oral health.

The use of aluminum chloride and ferric sulfate as astringents in dentistry for chemical gingival retraction is well documented in the literature. These agents are commonly used because they are effective at causing tissue contraction, while minimizing tissue irritation and providing ease of use. In addition, numerous studies have demonstrated their ability to provide satisfactory results when used appropriately.(35)(36). However, it should be noted that chemical agents alone may have limited effectiveness in cases where the gingival pockets are deeper than 2 mm. In such cases, a combination of chemical and mechanical retraction methods may be needed to achieve optimal results(37)(38).

Epinephrine and Sympathomimetic agents

Epinephrine is another commonly used retraction agent that provides good hemostasis by causing localized vasoconstriction and tissue ischemia through the activation of sympathetic peripheral vascular α1 receptors(39). Epinephrine absorption can be affected by the health of the gingiva. In a study it was reported that the epinephrine absorbed from the retraction cord ranges from 65% to 95%(40). Another study demonstrated that an intact gingival/ sulcular epithelium can act as a barrier against the binding of epinephrine to plasma proteins(41). Though it leads to temporary displacement of gingiva, the side effects, such as overdose and contraindication for patients with cardiovascular disease, limit its use(42). On the other hand, vasoconstrictive materials such as oxymetazoline and tetrahydrozoline, which are commonly used as decongestant drops for eyes and nose, have demonstrated adequate effect without any systemic and/or local complications, making them preferred over epinephrine as a retraction agent. Studies have shown that tetrahydrozoline is better when compared to epinephrine in causing gingival retraction(43).

Aluminium Chloride

Aluminum chloride as an astringent reacts with tissue proteins causing their precipitation followed by vascular constriction. Its vasoconstrictor action is not as potent as that of epinephrine. It is one of the least irritating of the medical impregnated cords. It is usually used in a concentration of 5% and has minimal systemic side-effects(44). However, its main drawback is its inhibition of impression materials like polyether(PE) and polyvinyl siloxane(PVS).

When the cord impregnated with epinephrine is removed, 50% of the sulcus width is closed, while the gingival sulcus of the teeth retracted by the cord impregnated with aluminum chloride will maintain 80% of its initial retraction till twelve minutes(45). Prior to making an impression, all the remnants of aluminum chloride must be rinsed thoroughly to avoid interference with setting reaction of polyvinyl siloxane(PVS) (46)(47).

Ferric Sulphate

Ferric sulfate works by denaturing the proteins in the tissue, resulting in localized hemostasis and temporary gingival retraction(48). However, ferric sulfate can have some side effects. One common side effect is staining of the teeth and surrounding tissue. This can be particularly noticeable if the ferric sulfate solution comes into contact with composite restorations or other dental materials(49). Additionally, ferric sulfate can cause tissue irritation or chemical burns if it is not used carefully. To use ferric sulfate for gingival retraction, a small amount of the solution is applied to the gingival tissue using a small brush or cotton pellet. After a few minutes, the tissue will begin to retract, exposing the tooth surface. The ferric sulfate is then rinsed away with water or saline solution(33). Usually, hemostasis is achieved within a few minutes(1-3) and keeps the sulcus open wide for at least half an hour(50).

Chemicomechanical Retraction Methods

This is the most commonly used method of retraction. Non-medicated simple cords are not an effective option for controlling bleeding, as cord pressure alone is usually insufficient to achieve hemostasis(51). In fact, bleeding occurs in more than 50% of cases after the cord is removed. Moisturizing the cord is a simple technique that can help reduce bleeding. Retraction cords can be soaked in a chemical solution before its used(52).

It also includes use of cordless systems like Expasyl paste (Kerr Corp), Magic Foam cord (Coltene/Whaledent Inc.), Racegel (Septodont), Gingi Trac (Centrix Inc.), retraction capsule (3M ESPE astringent retraction paste capsule; 3M Corporation), retraction paste (Traxodent® Hemodent® Paste Retraction System; Premier Dental Co.), polyvinyl acetate strips (Merocel; Merocel Co.), Aquasil Ultra Cordless Tissue Managing Impression System (Dentsply Caulk) (53)

Magic Foam Cord

This retraction system is a type of gingival retraction material that was introduced as an alternative to traditional cord systems. It is composed of an inert matrix polyvinyl siloxane system that expands when it comes into contact with moisture in the sulcus releasing hydrogen dioxide(1). This expansion creates pressure against the gingival tissue, causing it to retract and exposing the margin. One of the key advantages of the Magic Foam Cord system is that it is fast (2 minutes setting time) and easy to use, and it does not cause any chemical reactions, inflammation, or tissue trauma. It is also a painless system, which makes it a popular choice for patients who are anxious about dental procedures(52).

Some companies also provide a compre cap that is used to encircle the tooth with GingiTrac impression material to be pushed downward causing displacement of gingiva.

Expasyl

A cordless retraction system that displaces the gingiva and also produces hemostsis composed of aluminum chloride (6.5-15%) and kaolin (66.75%). The high viscosity paste is directly injected into the gingival sulcus with curved fine tips. The pressure applied by the expanding paste helps to control bleeding and encourages the gum tissue to retract from the tooth, making it easier to take an accurate impression(54).The strength of the epithelial attachment has been reported to be approximately 1 N/mm. During paste infusion, a constant pressure of 0.1 N/mm is applied, which is non-destructive. If the paste remains in the gingival sulcus for 1 minute, it can achieve enough pressure to open the sulcus by 0.5 mm within 2 minutes(55).

The 3M ESPE retraction capsule is a paste-like material containing 15% aluminum chloride and

is designed with a specific dispenser. On the other hand, Traxodent retraction paste is a syringe-based product with 15% aluminum chloride and is supplied with comprecaps(56).

Multiple systematic reviews have been published comparing mechanical vs chemico-mechanical retraction methods(57)(58)(59). A study by Gupta et al(60) revealed that gingival retraction values were as follows- StayPut (retraction cord) > Magic Foam Cord> Expasyl. Though the values obtained were clinically adequate for all the methods. A similar trend of better retraction by the use of cords was seen in other clinical studies(61,62).

Some studies showed that cordless system was slightly better than retraction cord(63,64)

Surgical Retraction Methods

Rotary Curettage

A trough can be created in the gingival sulcus of the prepared tooth using a diamond bur after local anesthesia administration. This technique preserves the zenith of the free marginal gingiva while deepening the sulcus. However, it should only be used if keratinized gingiva is adequately present because encroachment of biological width can lead to recession due to the inflammatory response generated in response to the injury(65). Kamansky et al(66) conducted a study to evaluate the gingival response to rotary curettage. One abutment was treated with rotary curettage while the other was treated with hemodent cord, and they observed that the use of rotary curettage resulted in a greater increase in sulcus depth.

Electrosurgery

It's a form of surgical reduction of sulcular epithelium facilitated by using a electrode to deliver high frequency electric current and is also known as Surgical Diathermy(67)(68). Its use is usually indicated in cases of inflamed and overgrown gingiva(69). A fully rectified, filtered current is the most preferred as has an excellent cutting ability. Electro-surgery is contraindicated in patients who have undergone cardiac pacemaker surgery as it can interfere with its functioning(70)(71). It also involves high risk if used in conjugation with Nitrous oxide and other inflammable aerosols.The results of a study comparing electro-surgery and rotary curettage showed no significant difference in tissue response within 4-12 weeks. However, the volume of the impression material in the sulcus was found to be greater in the electro-surgery group compared to the rotary curettage group(72).

Laser

Laser gingival retraction is a non-invasive and bloodless technique used to achieve gingival displacement. The laser used in this technique is typically a diode laser, which produces a focused beam of light that is absorbed by water and hemoglobin in the gingival tissues, causing them to evaporate and create a channel for impression material(73). It provides great hemostasis and can be used without administering any localized anesthesia. It has shown to have minimal postoperative discomfort and associated pain(74). The process begins with isolating the tooth to be treated and applying a protective material to the surrounding tissues. The laser is then used to create a trough in the sulcus around the tooth, usually at a power setting of around 1-2 W for a few seconds per spot. The trough is deepened until it reaches the desired depth, typically 0.5 to 0.7 mm, and the laser beam is moved along the sulcus to create a continuous channel.

Few studies have been done comparing retraction chemicomechanical methods and laser retraction and revealed that the use of laser lead to minimal inflammation and subsequent recession with adequate retraction (0.40- 0.65mm)(75,76)(77)

CONCLUSION

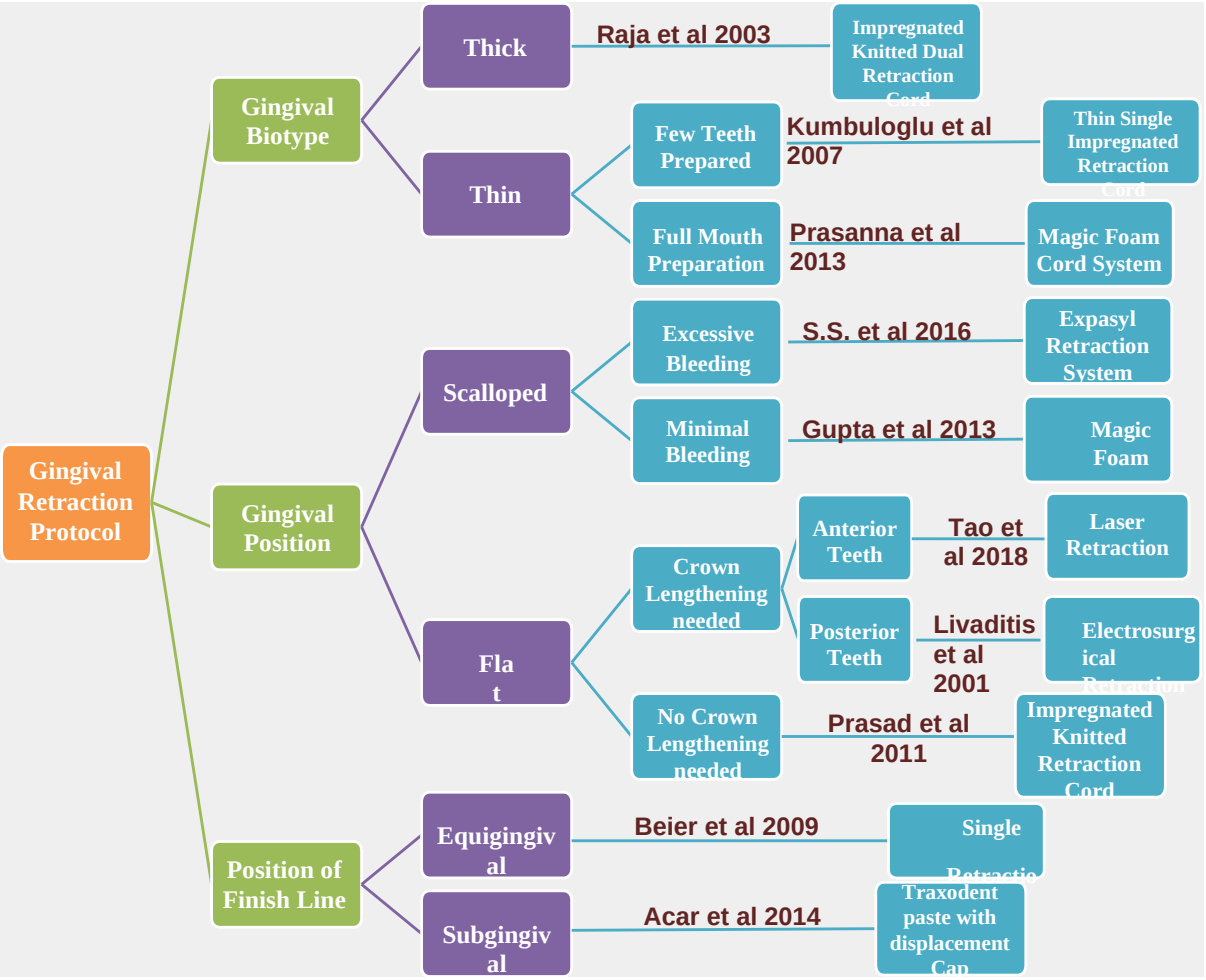

FIGURE 2: Protocol suggested for gingival retraction based on various clinical scenarios

In conclusion, gingival retraction is an essential step in obtaining accurate and well-fitting impressions in restorative dentistry. The choice of retraction method depends on various factors, including the extent of retraction required, the presence of gingival inflammation, the patient's medical history, and the clinician's expertise. Chemical retraction methods, such as ferric sulfate and aluminum chloride, are safe and effective, while electrosurgical and laser methods provide precise control and minimal tissue trauma. Regardless of the method used, proper technique and adequate hemostasis must be ensured to prevent post-operative complications. Close communication and collaboration between the dentist and dental technician are also necessary to achieve optimal results. By following a systematic and evidence-based approach to gingival retraction, clinicians can improve the quality and longevity of restorative dental treatment.

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