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Astringents in dentistry: a review

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ABSTRACT

Astringents are any group of substances that cause the contraction or shrinkage of tissues & that dry up secretions. Although Astringents were being used from age-old in one form or the other but their role & efficacy in dentistry & in mucosal health is now well explained & now it has emerged from salt water to various newer drugs. This article provides professionals with a broad overview of various categories of drugs as astringents and their implications for dental patients and treatment.

INTRODUCTION

Rapid progress in dental pharmacotherapeutics requires that clinicians constantly update their knowledge of new drugs, drug interactions and useful therapeutic trends. Astringents play a useful role in prosthodontics in the management of bleeding during gingival retraction. They also help in increasing the gingival resistance against infections.

Astringents are the substances that precipitate proteins, but do not penetrate cells, thus affecting the superficial layer of mucosa only. They toughen the surface by making it mechanically stronger and decrease exudation. The word "astringent" derives from the Latin word *adstringere*, meaning "to bind fast". They have relatively low cell permeability, and they act generally as irritants in moderate concentrations and caustics in high concentrations[1].

The common sources of astringent foods are legumes such as beans and lentils. Raw fruits and vegetables like lemon, pomegranate, cranberry, gooseberry, pears, cauliflower, asparagus, turnip are also good sources. These items when eaten create a puckering sensation in the mouth making it feel dry and this property is called Astringency. This is also found in green tea and wine and is attributed to the presence of tannins in them.

Astringent are also used to improve blood circulation and tighten the skin besides improving the pH level of the skin. Astringents due to its remarkable shrinking and water absorption qualities are majorly used in skin care as toners to remove excess oil and makeup from the skin. One of the popular tannin, Oak Bark, is used to prepare commercial astringents for cosmetic and medical use.

Astringents cause contraction of tissues. They accomplish this by constricting small blood vessels, extracting water from tissue or precipitating protein. Astringents are widely used in medicines especially in dental care to cleanse, tighten the gums and detoxify them and remove plaque from teeth. Dentist can also apply astringents to gingival tissues before taking impressions, placing Class V or root surface restorations.

Astringents for Gingival Retraction :

The entire impression process for fixed prosthodontics requires careful management of the soft tissue. The inability of impression material to adequately displace soft tissue, fluids, or debris to record finish line, mandates adequate isolation. Chemicomechanical method has been described in the literature to achieve exposure of the finish line and create an acceptable environment for the impression materials [2,3].

Several displacement cords preimpregnated with epinephrine are available commercially. (Fig. 1 to 5) Epinephrine used in concentrations of 0.1% and 8% to saturate the retraction cord creates local vasoconstriction of the gingival tissues [4,5,6]. Controversy has developed over the use of epinephrine, because it has been shown that 1inch of cord saturated with 8% solution contains 2 to 15 times the safe dose of epinephrine recommended for outpatients [7,8]. There is evidence of increased heart rate and elevated blood pressure when epinephrine is applied to lacerated gingiva. Contraindications include a positive history of cardiovascular disease, hyperthyroidism, patients receiving monoamine oxidase inhibitors for treatment of depression [9].

Figure 1. Finished tooth preparation

Figure 2. Placement of primary compression cord

Figure 3. Insertion of second retraction cord

Figure 4. Removal of second retraction cord Before taking impression

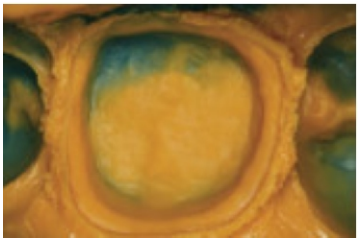

Figure 5. Finished tooth preparation

Equally effective astringent gingival deflection agents exert no systemic effects [2].

Astringents may be administered by retraction cords already impregnated with the agent or by applying them to cotton pellets. Some of the examples are alum, aluminum chloride, zinc chloride (8-20%) and tannic acid. Styptics are the concentrated form of astringents. They cause superficial and local coagulation. Some of the examples are ferric chloride and ferric sulfate. Aluminum chloride and Ferrous sulfate are preferred astringents amongst prosthodontists because they cause minimum tissue damage.

Aluminum sulfate compounds (aluminum potassium sulfate [Alum] and aluminum sulfate) : Alum (potassium aluminum sulfate) in a 100% concentration has been shown to be only slightly less effective in shrinking the gingival tissues than epinephrine, and it shows good tissue recovery. Only slight tissue injury was noted in a 10-minute application, and that completely healed in 10 days [5,10]. 0.1 mm permanent loss of crestal gingiva usually occurs. Fischer indicated that although alum is kind to the tissue, the tissue retraction and hemostatic ability is limited. Alum has been recommended for use in place of epinephrine because it is safer and has fewer systemic effects [8,11][8]. The cord should be wet when placed to avoid tearing the tissue on removal. Cord saturated with 100% alum can be safely left in the sulcus for as long as 20 minutes without adverse effect [5].

Aluminum sulfate, which differs from alum, has been suggested as a gingival retraction material. The available data indicated that the material is effective and biologically acceptable. A practical concern is that, like most sulfates, aluminum sulfate compounds can inhibit/retard the setting reaction of additional reaction impression materials [8].

Aluminum chloride: Aluminum chloride is one of the most commonly used astringents [7,12]. The actions of aluminum chloride result from its ability to precipitate protein, constrict blood vessels, and extract fluid from tissues. It is used in the concentration of 5% to 25%. A permanent crestal gingiva loss of 0.1 mm can be expected. There are no known contraindications and has minimal systemic effects [8]. Studies have shown that solutions stronger than 10% can cause local tissue destruction. A 10-minute application is usually sufficient. Aluminum chloride is the least irritating of the medicaments used for impregnating retraction cords, but it is shown to disturb the setting of Polyvinyl siloxane impression materials. The inhibitory effect can be greatly reduced by thoroughly rinsing the preparation with water after the treated cord is removed.

Ferric subsulfate : also known as Monsel's solution, has been advocated for use in gingival displacement [7,13,14] . It is slightly more effective than epinephrine in gingival displacement. Tissue recovery is good, but the solution is messy to use [13]. The recommended time of use is 3 minutes. The literature infers that ferric or ferrous salts should not be used because they are corrosive and injurious to the soft tissues and enamel and because they stain the teeth. These properties are attributed to the high acidity (72%) of the solution [7].

Ferric sulfate: Ferric sulfate (13.3%) used for tissue displacement has recently been reported. It does not traumatize the tissue as noticeably, and healing is more rapid than with aluminum chloride. Solutions of ferric sulfate above 15% are very acidic and can cause significant tissue irritation and postoperative root sensitivity. Ferric sulfate is compatible with aluminum chloride but not with epinephrine. When used with epinephrine, a massive blue precipitate develops. Ferric sulfate coagulates blood so quickly that it must be placed directly against the cut tissue. If it is not, the ferric sulfate becomes tied up with the extravasated blood and floats away, leaving a bleeding surface. The recommended use time is 1 to 3 minutes, but can be used for 10 to 20 minutes. The resulting tissue displacement is maintained for at least 30 minutes, so that repacking is seldom necessary for multiple impressions [1]. The tissue is temporarily discolored to a

black or bluish color but will appear pink again after 1 or 2 days. In vitro tests failed to show the corrosive or staining effects on the enamel that had previously been reported with ferric compounds. However, ferric sulfate can modify the accuracy of surface detail reproduction during impressions because it disturbs the setting reaction of polyvinyl siloxanes. Therefore, all traces of medicament should be carefully removed from the tissues before the impressions are recorded [7]. Due to its iron content, ferric sulfate stains gingival tissues a yellow-brown to black color for several days after being used as a retraction agent.

Zinc chloride (bitartrate): has been used in 8% and 40% solutions. Gingival displacement effectiveness of the 8% solution is about equal to that of epinephrine, while the 40% solution is a little more effective. The 8% solution caused severe necrosis of the tissue that did not heal for 60 days. The 40% solution is so caustic that it has been classified as a chemical cautery agent. Because both of these concentrations are escharotic and cause permanent injury to the soft tissue and sometimes to the bone, their use is not recommended [7,15].

Tannic acid (20% and 100%): is less effective than epinephrine but shows very good tissue recovery. The recommended use is for 10 minutes [16]. The hemostatic effectiveness of tannic acid is minimal.

Negatol solution: is a 45% condensation product of metacresol sulfonic acid and formaldehyde. It provides better retraction than epinephrine. Tissue recovery is poor. It is highly acidic and decalcifies teeth in both 10% and 100% so1utions. It is classified as a chemical cautery agent and is not recommended for gingival displacement [4].

Various combinations of chemicals have also been described as tissue displacement agents. Zinc chloride with 8% epinephrine gave better retraction than epinephrine alone but only fair tissue recovery. If applied for an excessive time, the tissue may be cauterized [13]. Alum and aluminum chloride is reported as an acceptable combination that attempts to gain the advantages of both chemicals. Rather than mixing the two chemicals together, it is recommended that the cord be saturated with one solution before insertion and the other applied after the cord has been placed in the sulcus. The epinephrine with alum combination showed a slightly better gingival retraction effectiveness than epinephrine alone and fair tissue recovery.

The acidity of the commonly used gingival displacement medicaments are high, with pH ranging from 1 to 3 [17,18]. This could result in the removal of the smear layer and can negatively affect the bonding mechanism of the self-etch dentin bonding systems [18] . The removal of smear layer could also cause the opening up of the dentinal tubules cervically and cause dentinal hypersensitivity.

Advantages and disadvantages of the various agents used for gingival retraction

Astringents for completely edentulous patients :

Butcher and Mitchell observed that continued covering of the palatal surface results in progressive regression of the palatal

The astringents used in gingival displacement are as follows:

Drug	Advantages	Disadvantages
Alum 100% (potassium aluminum sulfate)	Good displacement Minimal tissue loss Good response Good hemostasis	Less displacement and hemostasis than epinephrine
Aluminum chloride 5% and 25%	Minimal tissue loss Good hemostasis	Local tissue destruction in concentrations > 10%
Ferric subsulfate (Monsel's solution)	Good displacement	Messy to use High acidity Corrosive to tooth structure and soft tissue
Ferric sulfate 13.3%	Good tissue response Compatible with aluminum Chloride Extended working time Good displacement	Not compatible with epinephrine Transient tissue discoloration Unpleasant taste
Zinc chloride 8% and 40%	Good displacement	Tissue necrosis Permanent tissue injury
Tannic acid 20% and 100%	Good tissue response	Less displacement than with epinephrine Minimal hemostasis
Negatol 10% and 100%	Good displacement	Poor tissue response Corrosive to teeth High acidity

glands. Rinsing the mouth with an astringent reflexly stimulates palatal glandular activity. This activity and dilation of the ducts cause turgidity within the adjacent tissues [19]. Frequent removal of any restoration and rinsing will keep the mucous membrane in a better physiologic state.

Astringents are also used as an aid in obtaining accurate maxillary arch impressions. Astringent mouthwash helps in removal of excess mucus secretions from the oral cavity and thus minimizing effectively the defects due to mucus secretions [20].

Gum astringent

Gum paints are the combination of antiseptics and tanning agents which precipitate proteins but do not penetrate cells thereby affecting only the superficial layer making it mechanically stronger and decreases exudation. They have germicidal, fungicidal, anesthetic and healing properties. When applied, they provide a soothing, cooling and an astringent effect. All these preparations contain Choline salicylate, Tannic acid, Cetrimide, Thymol, Camphor, Cinnamon oil, Iodine and Alum (hydrated potassium aluminium sulfate). They are applied on flabby edentulous ridges for gum massage to improve the edentulous foundation.

Zingisol containing 2% Zinc Sulfate is used to control bleeding gums. The patient is advised to apply 3-4 drops on finger and massage 3-4 times a day. Sensoform gum paint (Warren) contains tannic acid, glycerine and potassium iodide and is applied on affected area several times with the cotton applicator for the treatment of stomatitis, inflammation and bleeding gums. It also decreases sensitivity and increases gingival resistance against infections.

Stolin gum paint 15ml contains cetrimide 0.1 % w/v, tannic acid 2 % w/v, zinc chloride 1 % w/v. Sensorok gum astringent with zinc sulfate is used for gum massage 2-3 times daily.

S. G. PAINT contains Tannic acid- 27% , Potassium Iodide - 0.05% , Iodine - 0.03% , Thymol-0.033% , Menthol- 0.05%, Glycerine -72%. Tannic acid in S. G. PAINT has been used as an astringent for the mucus membranes of the mouth and throat. Ingredient rationale of S. G. PAINT gum paint, provides cooling, soothing, astringent effect. Similarly, ingredients like iodine, potassium iodide have germicidal, fungicidal, anaesthetic and healing properties. Menthol provides the cooling effect and also it possesses local anesthetic action. Glycerine helps the healing of the ulcer as well as it has anti- inflammatory property. Gum paint is indicated for treatment of Stomatitis, Glossitis and Aphthous Ulcers.

Arofil gum paint contains Iodine 1.0%, Potassium Iodide 2.0%, Thymol 0.25%, Menthol 0. 25%, Camphor 0.2%, Tannic Acid 1.55%.

Astradent contains Tannic Acid 5% w/v, Choline Salicylate 8% w/v, Cetrimide 0.01% w/v, Lignocaine 2%, Glycerine base.

Ayurvedic medicines with astringent properties:

- Myrrh (*Commiphora molmol*) has antimicrobial and astringent properties that help to tighten the gums. It is considered one of the best herbs for healing bleeding gums and mouth ulcers,

List of Astringents used in Dentistry

Brand name	Constituent	USE
Gel Cord/ Gel cord clear (Pascal)	25% Aluminum sulfate Gel	Gingival retraction
Stat Gel FS (Pascal)	15.5% Ferric sulfate	Gingival retraction
Hemostatic gel	20% Ferric sulfate	Gingival retraction
Traxodent/ Hemodent (Premier dental products)	15% Aluminum chloride	Gingival retraction
ViscoStat clear (Ultradent)	Aluminum chloride gel	Gingival retraction
Racestyptine (Septodent)	25 % aluminum chloride, oxyquinol hydroalcoholic excipients	Gingival retraction
QuickStat FS (Vista)	15.5% Ferric sulfate gel	Gingival retraction
Zingisol	2% Zinc Sulfate	Gum astringent (to apply 3-4 times a day on bleeding gums)
Sensoform gum paint (Warren)	Tannic acid, glycerine and potassium iodide	Stomatitis, gingivitis (to apply several times)
Stolin gum paint (dr. reddy's)	Cetrimide 0.1 %, tannic acid 2 %, zinc chloride 1 %.	Gingivitis
Astradent	Tannic Acid 5%, Choline Salicylate 8%, Cetrimide 0.01%, Lignocaine 2%, Glycerine base.	Gum astringent
S. G. Paint	Tannic acid- 27% , Potassium Iodide - .05% , Iodine - .03% , Thymol, Menthol, Glycerine.	Stomatitis, glossitis, Apthous ulcer (applied after every 3-4 hrs)

and helps fight the bacteria that cause tooth decay and gum disease.

- Aloe vera (*Aloe barbodensis miller*) has antiseptic and astringent properties. It is extremely helpful in the treatment of gingivitis and periodontitis, it reduces the bleeding of the gums; it is powerfully antiseptic in gum pockets and its antifungal properties help greatly in the problem of denture stomatitis.

- Oregon grape root (*Mahonia spp.*), possessing a high concentration of antimicrobial compounds and astringent properties, is excellent for helping to prevent and heal gum problems.

- Sage (*Salvia officinalis*) has strong astringent properties, making it a favorite herb for tightening the gums and soothing a sore mouth.

- White oak bark (*Quercus alba*), a strong astringent, is helpful for healing swollen, tender and bleeding gums and mucous membranes, and has a clotting and antiseptic effect.

- Salt water has astringent properties and speeds wound healing through reducing inflammation and contracting the tissues. In a British Dental Journal Study published in 2003, it was determined that the heat of the solution produces a therapeutic increase in blood flow to the affected area that promotes wound healing and that the isotonic (balanced inside and outside the cell) environment created prevents destruction of the cells migrating into the area that are trying to repair the wound [21,22].

- Citric acid present in fruits has astringent properties and is used for dermatology treatment. It is used for demineralization of root surfaces to enhance gingival reattachment after flap surgery and detoxifying and cleaning implants during reentry of tissue to repair defect. It increases astringency of phenolic compounds like tannins, tannic acid but astringency of alum is decreased.

For both intraoral and dermatological applications, present astringent materials for application to body tissues are comprised of active ingredients which immediately react with the body tissues upon contact therewith. If a practitioner applies an excessively large quantity of such material to the tissues, then those tissues are immediately subjected to an excessively large quantity of reactive agent. A problem that may result from such an occurrence is that delicate tissues may be irritated by the excess astringent substances. Thus, it is an object of the invention to provide an astringent composition which provides an active astringent on demand for contact with body tissues and therefore does not subject the delicate tissues to excessive quantities of reactive agents which cause tissue irritation.

CONCLUSION

It is well said by Leonardo Da Vinci that "A physician who practices without knowledge of science is like a sailor who sails a ship without a compass. He is never sure of where he is going." This article provides an insight to the background knowledge of various astringents, their role & their interactions in dentistry & they can really help a dentist/ prosthodontist in obtaining good gingival & mucosal health without compromising on the quality of their work.

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