Antimicrobial activity of chemomechanical gingival retraction products

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Gingival retraction involves the displacement of soft tissues around a tooth to allow access during clinical preparation, when making impressions, and during cementation procedures for fixed prosthodontics. Particularly when making an impression, the clinician requires sufficient space in the lateral direction to place an adequate thickness of impression material to ensure resistance to tearing or collapse on removal.[1] Vertical gingival retraction may be indicated for situations in which retraction of the soft tissues facilitates visualization, access, or isolation of the operative field.

Methods of gingival retraction include mechanical, surgical, and chemomechanical techniques, of which the latter practices are used most widely.[1,2] The 3 most common applications are agents in a solution with a soaked retraction cord, agents impregnated into a retraction cord, and an injectable matrix (cordless) for gingival retraction. From a mechanical aspect, the soft tissues are displaced physically by means of either a cord or a matrix placed into the gingival sulcus. Astringent hemostatic agents that induce temporary shrinkage of soft tissues while controlling hemorrhage and fluid seepage are common additional medicaments.[3] Active agents include aluminum chloride, aluminum potassium sulphate, aluminum sulphate, ferric sulphate, and racemic epinephrine.[4]

ABSTRACT

Background. Application of astringent hemostatic agents is the most widely used technique for gingival retraction, and a variety of products are offered commercially. However, these products may have additional unintended yet clinically beneficial properties. The authors assessed the antimicrobial activities of marketed retraction products against plaque-associated bacteria in both planktonic and biofilm assays, in vitro.

Methods. The authors assessed hemostatic solutions, gels, pellets, retraction cords, pastes, and their listed active agents against a collection of microorganisms by means of conventional agar diffusion and minimum bacteriostatic and bactericidal concentration determinations. The authors then tested the most active products against monospecies biofilms grown on hydroxyapatite disks.

Results. All of the tested retraction products exhibited some antimicrobial activity. The results of the most active products were comparable with those of a marketed mouthwash. The listed retraction-active agents displayed relatively little activity when tested in pure form. At 10% dilution, some products evidenced inhibitory activity against most tested bacteria within 3 minutes of exposure, whereas others displayed variable effects after 10 minutes. The most active agents reduced, but did not completely prevent, the metabolic activity of a monospecies biofilm.

Conclusions. Commercial gingival retraction products exhibit antimicrobial effects to various degrees in vitro. Some products display rapid bactericidal activity. The antimicrobial activity is not owing to the retraction-active agents. Biofilm bacteria are less sensitive to the antimicrobial effects of the agents.

Practical Implications. The rapidity of killing by some hemostatic agents suggests an antimicrobial effect that may be efficacious during clinical placement. The results of this in vitro study suggest that clinicians should be aware of the potential antimicrobial effects of some hemostatic agents, but more research is needed to confirm these observations in clinical use.

Key Words. Dental impression; displacement; hemostatic; chemomechanical; aluminum.

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TABLE 1

Antimicrobial activities of undiluted hemostatic solutions and individual active agents compared with an antiseptic mouthwash (by agar well-diffusion assay).

SPECIES/STRAIN	HEMOSTATIC AGENT* (ZONE SIZE, MILLIMETERS)†									
	1	2	3	4	5	6	7	8	9	10
Escherichia coli, DH5α	8.6	7.6	8.5	4.6	9.1	1.3	0.4	0.2	0	6.1
Staphyloccocus aureus, Oxford	8.2	6.3	7.7	4.7	9.0	0.6	0	0	0	6.6
Pseudomonas aeruginosa, OT15	8.3	7.6	7.2	4.9	8.0	1.8	0.8	0	0	4.8
Enterococcus faecalis, JH22	8.1	7.2	8.1	6.0	9.6	0.4	0	0	0	5.4
Streptococcus gordonii, DL1	9.6	8.3	9.0	6.7	11.5	0.5	0	0	0	6.1
Streptococcus mitis, I18	9.7	8.4	9.5	7.0	11.8	0.5	0	0.3	0	6.6
Streptococcus mutans, UA159	8.9	8.2	9.3	6.5	11.5	1.2	0.5	0	0	9.2
Fusobacterium nucleatum, ATCC35586	13.8	10.9	13.0	7.1	13.0	4.0	3.0	0	3.0	11.2
Candida albicans, ATCC10261	5.7	4.9	6.0	4.2	7.7	1.6	0.9	0	1.8	7.2

* The agents are as follows: 1, Racestyptine (Septodont); 2, Retrax (Pascal International); 3, Hemodent (Premier Dental); 4, Astringedent (Ultradent); 5, Astringedent X (Ultradent); 6, aluminum chloride (25%); 7, aluminum sulfate (25%); 8, aluminum potassium phosphate (10%); 9, ferric sulfate (20%); 10, Savacol (0.2%) (Colgate-Palmolive).
† Distance from the edge of the well to the edge of the zone. Figures are the mean of 4 measurements with less than 10% variation.

Researchers of retraction products principally have been concerned with the degree of gingival displacement and the effects on gingival health,[5,6] whereas researchers rarely have considered the antimicrobial properties of these medicaments. Aluminum salts are inhibitory to cariogenic microorganisms probably because of a synergistic effect with fluoride.[7] Antimicrobial properties of retraction products may have clinical relevance, because laceration of the gingival tissue, acute gingival inflammation, or both often occur during placement of retraction cords.[6] Thus, an antimicrobial action may be advantageous for clinicians to reduce the adverse effects of microbial access to the wounded gingival sulcus. Reducing bacterial populations in the sulcus as an adjunct therapy for patients with periodontal problems would be an additional benefit.

Our objectives for this study were to determine whether commercially available gingival retraction products possess antimicrobial capabilities and, if so, to assess relative susceptibility among microorgansisms.

METHODS

Microorganisms and culture conditions. We revived test organisms (listed with their strain designations in Table 1) from frozen cultures maintained in the culture collection of the University of Otago (Dunedin, New Zealand). We incubated assays involving *Escherichia coli, Pseudomonas aeruginosa*, *Staphylococcus aureus,* and *Candida albicans* aerobically, whereas we incubated assays involving *Enterococcus faecalis*, *Streptococcus gordonii*, *Str. mitis*, *Str. mutans,* and *Fusobacterium nucleatum* anaerobically (85% nitrogen; 10% hydrogen; 5% carbon dioxide, in a Whitley MG500 Workstation, Don Whitley Scientific). We cultured aerobically incubated bacteria on tryptic soy broth (TSB) agar (Fort Richard Laboratories) and anaerobically incubated bacteria on Columbia sheep blood agar (Fort Richard). We kept all incubations at 37°C.

Gingival retraction products. We dissolved and diluted the commercial products (Table 2) and their listed active agents (analytical reagent grade; Table 2) in deionized water. We determined the pH level of retraction products and solutions by means of using an HI-1230B pH Electrode for Field Use (Hanna Instruments) and a microprocessor pH meter (pH 211, Hanna Instruments). We compared the antimicrobial activities of retraction products with Colgate Savacol Mouthwash (Colgate-Palmolive), which contains 2 milligrams per milliliter chlorhexidine gluconate.

Agar diffusion assays. We prepared TSB agar plates with 4 agar-sealed wells (6-millimeter diameter) per plate. We pipetted aliquots (30 microliters) of soluble retraction products into wells and allowed them to absorb into the agar (approximately 30 minutes). We swabbed overnight cultures over the agar and incubated the plates appropriately to make lawns of organisms. We measured the resulting zones of inhibition (at 4 points) from the edge of the well to the border of the microbial growth.

Alternatively, we placed lengths of retraction cords (2 centimeters) and preweighed hemostatic pellets (moistened with saline) directly on the surface of TSB agar that we had preseeded with microorganisms from overnight brain-heart infusion (BHI) cultures. We incubated agar plates and the resulting inhibition zones were measured at 6 positions from the edge of the cord or pellet to the border of the inhibition zone.

We diluted retraction pastes in distilled water and applied them to filter paper disks (6 mm diameter) by

ABBREVIATION KEY. **BHI:** Brain-heart infusion. **HA:** Hydroxyapatite. **MIC:** Minimum inhibitory concentration. **ND:** No activity detected at highest test concentration (12.5%). **TSB:** Tryptic soy broth.