Scripta Scientifica Medicinae Dentalis, 10(1):33-39
DOI: 10.14748/ssmd.v10i1.9750
ISSN 2367-7236 (Print)
ISSN 2367-7244 (Online)

REVIEWS

LOW-ABRASIVE AIR-POLISHING POWDERS—CHARACTERISTICS AND APPLICATION IN CLINICAL PRACTICE. A REVIEW

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ABSTRACT

INTRODUCTION: Gingivitis and periodontitis are inflammatory plaque-induced periodontal diseases, which are associated with the presence of a supra- and subgingival biofilm. Successful removal of supra- and subgingival plaque and calculus from hard and soft surfaces in the oral cavity is essential in the therapy of these diseases. Airflow powders remove biofilms in a minimally invasive manner, supra- and subgingivally, from all types of surfaces in oral cavity.

AIM: The aim of this article is to conduct a literature survey on the characteristic features and use of different low-abrasive powders in dental practice.

MATERIALS AND METHODS: The survey is based on a summary of already published articles and researches.

CONCLUSION: The use of low-abrasive air-polishing powders requires less time and is associated with better comfort for patients, and they are a good alternative for subgingival removal of bacterial biofilms.

Keywords: *air-polishing powders, bacterial biofilm, erythritol, trehalose, glycine*

INTRODUCTION

Gingivitis and periodontitis are inflammatory plaque-induced periodontal diseases and are among the most frequently observed diseases of the oral cavity (1), affecting up to 50% of the population (2), and with a higher prevalence in adults. Plaque-induced periodontal diseases are associated with the presence of a supra- and subgingival biofilms in which microorganisms are highly organized in an extracellular matrix (3,4). The main objective aim of periodontal treatment is to reduce or eliminate the opportunistic bacterial infection (5).

Successful removal of supra- and subgingival plaque and calculus from hard and soft surfaces in the oral cavity is essential for the treatment of these diseases (6). Therefore, non-surgical periodontal therapy (scaling and debridement), manually and/or with ultrasonic devices, has been the most essential part of the treatment of plaque-induced periodontal diseases for many years (7,8,9). In supportive therapy, preventive removal of dental plaque and calculus deposits is performed every 3–12 months, depending on the individual periodontal risk assessment (10,11), and sound and ultrasound devices, oscillating devices, abrasive-powder polishing devices, polishing pastes in combination with polishing rubbers and brushes, and lasers can be used for this purpose (12).

AIM

The aim of this article is to conduct a literature survey on the characteristic features and use of different low-abrasive powders in dental practice.

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Received: March 25, 2024
Accepted: June 9, 2024

MATERIALS AND METHODS

The article is based on the summary of previous researches of the topic during the years, in the databases of PubMed and Google Scholar. It summarizes the current knowledge about the characteristics, advantages and disadvantages, and practical use of different low-abrasive powders.

LITERATURE REVIEW

Airflow powders remove biofilm in a minimally invasive manner, supra- and subgingivally, from all types of surfaces: enamel, exposed dentin, root cementum, soft tissues, crowns and veneers, braces and implant surfaces, producing aerosols of water, compressed air, and particles of air-polishing powder. They are used for:

- removal of dental plaque of hard and soft surfaces supra- and subgingivally (7,8);
- removal of exogenous discolorations in supragingival regions due to smoking, coffee, tea, red wine (13);
- prevention of gingivitis, periodontitis, and carious lesions;
- non-surgical therapy (14,15) and maintenance (16) of peri-implantitis and perimucositis;
- supportive periodontal therapy (SPT) (17);
- cleaning fissures before sealing;
- plaque removal in cases of orthodontic appliances (braces);
- tongue cleaning to prevent halitosis.

Airflow powders are contraindicated in patients with chronic airway diseases (e.g., bronchitis or asthma), infectious diseases, and on damaged or hypomineralized enamel (12).

Many studies have reported the advantages of air-polishing devices over hand and rotary instrumentation (18). For example, such advantages are saving time (19) and greater efficiency in removing exogenous discolorations (13), reducing patient discomfort and better patient acceptance, and less trauma to the surrounding soft and hard tissues (20). Possible adverse side effects of their use include emphysema in soft tissues (21), abrasion of root cementum and exposed dentin (22,23), injuries to gingival tissues (24), and gum recession with exposed root surfaces (25).

There are different low-abrasive powders with different compositions based on different agents, particle sizes, and abrasiveness:

1. Erythritol

Erythritol is chemically neutral and it is completely soluble in water polyol, which is a result by the reduction of erythrose (26). The erythritol molecule is low-abrasive, with a particle size of only 14 µm, and can be used both supra- and subgingivally (27). One study reported that erythritol has bactericidal effect (28) and can disrupt the microstructure and suppress the metabolism of a bacterial biofilm composed primarily of *Streptococcus gordonii* and *Porphyromonas gingivalis* (29).

The advantage of this type of powder is selective minimal abrasive dispersion. It has the ability to remove dental plaque effectively, leaving soft and hard tissues uninjured. The powder is an ideal choice for supra- and subgingival polishing in non-surgical periodontal therapy in combination with mechanical debridement (30) and in supportive periodontal therapy (SPT) (31,32), as well as for use in children, orthodontic, and hypersensitive patients, owing to the patient's comfort (33). It is suitable for subgingival decontamination in furcation areas, especially in maintenance therapy (34), as well as in non-surgical therapy for perimucositis and peri-implantitis (35).

Other low-abrasive powders such as glycine and trehalose are also used in dental practice. They are suitable for use in overexposed root surfaces, as well as subgingivally in deep periodontal pockets (36,37,38).

2. Glycine

An air-polishing powder based on glycine was first developed in 2003. Glycine is a nonessential amino acid. Glycine pearls are colorless, odorless, sweet, and highly soluble in water. The average size of glycine pearls is less than 40 µm. That is why they are approximately four times smaller than those of sodium bicarbonate particles (39,40). Some studies have indicated that the abrasiveness of glycine pearls is 80% lower than that of sodium bicarbonate particles (41).

Glycine powder can also be used for supragingival polishing, but its main application is for effective removal of dental plaque from root surfaces (cementum and dentin) without significantly damaging them (39,40,41). Some researches demonstrate that the use of glycine low-abrasive powder for removal of subgingival biofilm in periodontal pockets up to 5 mm deep is more effective in comparison to the manual treatment with periodontal curettes (42,43,44). Compared to ultrasonic devices, no differences were found in its effectiveness (19). Optimal results have been recorded with the application of low-abrasive air powders in combination with mechanical debridement (32).

In addition, the use of low-abrasive air powders is less traumatic to the gingival tissues compared to air powders whose content is based on calcium carbonate and sodium bicarbonate (13,45,46).

3. Trehalose

The recently introduced in practice trehalose is a highly water-soluble disaccharide, which is suitable for diabetics. The average particle size ranges from 30 to 65 μm and can be used both supra- and subgingivally (37). The abrasive effect of trehalose on hard dental tissues is comparable to that of glycine. Kruse et al. indicated that subgingival polishing with trehalose leads to clinical results similar to those of subgingival ultrasonic scaling (periodontal debridement (PD), bleeding on probing (BoP)) (17).

In comparison to low-abrasive powders, the high-abrasive sodium bicarbonate ($NaHCO3$) is the most widely used agent in dental practice (47). It has a particle size of up to 250 μm, and there is a risk of injury to the soft and hard tissues in the oral cavity. It has no direct antibacterial effect, but a good cleaning effect by removing deposits from dental plaque and exogenous stains. This powder is used only for supragingival polishing. Due to it leading to an increase in the pH in oral cavity, we may say that it can hinder the growth of acidophilic bacteria (48).

DISCUSSION

The efficacy of periodontal therapy is associated with the microbial load in the periodontal pockets. Effective debridement of root surfaces is difficult because of their anatomical features (49). The use of different low-abrasive air-polishing powders has a similar effect in removing and reducing the subgingival microbial load. The effect of using of these powders in subgingival polishing of root surfaces in the case of periodontal pockets with probing depth above 10 mm, in furcation zones, or in hard-to-reach grooves of root surfaces, has been proven in several studies (50,51,52).

Different researches in many studies discuss the advantages and disadvantages of the use of low-abrasive powders. Although mechanical subgingival debridement of the pathologically exposed root surface remains the most essential part of nonsurgical periodontal therapy (53,54), its frequent application is often associated with traumatic damage to periodontal tissues, resulting in gingival recession and tooth hypersensitivity (19). Another advantage is that air-powder devices are more effective in removing dental plaque in areas with narrow grooves and furcation involvement (34).

However, a disadvantage is that the air-polishing powders used for subgingival application are not effective against larger deposits of dental plaque or calculus. That is why their application in nonsurgical periodontal therapy is limited (17,38).

The use of sodium bicarbonate and calcium carbonate is indicated for polishing intact enamel surfaces, but is not suitable for root surfaces or exposed dentin where loss of hard tooth tissues is established. This is confirmed by many studies that show that the use of high-abrasive air powders on root surfaces leads to cementum substance loss, with defects up to 856 μm deep (48,55,56). As a result, low-abrasive powders such as glycine and trehalose have been created to compensate for the disadvantages of high-abrasive polishing powders and to improve the safety of polishing dentin and cementum (57,58).

Although the use of low-abrasive powders has increased in recent years, data from clinical trials are limited. In addition, the powders have an antibacterial effect on residual bacteria, inhibiting their activity. Drago et al. reported a 30% reduction in bacterial cells in a dental biofilm after polishing with glycine powder (27). In another research, Petersilka et al. also reported results demonstrating that polishing with glycine powder significantly reduced the number of subgingival bacteria compared to a manual treatment (17,59,60). Similar results were reported in a study by Flemmig et al. in which subgingival glycine powder polishing led to a reduction in microbial diversity compared to a manual treatment (44). Studies on polishing the titanium surfaces of implants showed similar results in terms of bacterial colonization in the first 24h after treatment. The results were significantly better for glycine powder than for sodium bicarbonate. (48,61)

In another study, which compared 4 groups—Group 1 group using glycine powder, Group 2—trehalose, Group 3—treated only with water, and Group 4 (control group)—untreated, the lowest number of residual bacteria was found when using glycine powder (87% reduction compared to the untreated control group). When trehalose was used, the average bacterial reduction was 75.47% (62).

The use of low-abrasive powders in the treatment of deep periodontal pockets may also be effective in the treatment of halitosis, but more data are necessary. Further research is needed to demonstrate the benefits of using the powders both alone and in combination with nonsurgical periodontal therapy in terms of reducing the bacterial load in the dentin tubules and root cementum, as well as to demonstrate a possible effect in the deeper layers of the root dentin.

Many studies showed that patients have less discomfort and less pain when using glycine- or erythritol-based powders compared to manual root surface treatment with manual instruments or with ultrasonic scalers (51,57,63,64). In addition, their use saves time (19) and no side effects have been reported (20). This is especially important in the supportive phase, when we rely on patient cooperation. So the use of airflow may increase patient compliance (65).

CONCLUSION

In conclusion, the use of low-abrasive air-polishing powders requires less time and is associated with better comfort for patients. They are a good alternative for subgingival removal of bacterial biofilms.

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