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The Role of Erythritol/Glycine Air Polishing Powder In Non-Surgical Periodontal

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Abstract:

Objective: This narrative review assesses the literature on the effectiveness of erythritol/glycine powder air polishing (EPAP/GPAP) in non-surgical periodontal treatment (NSPT) in terms of improving the clinical and microbiological parameters of periodontium status after air-polishing debridement. **Methods:** A detailed search of the literature was conducted in the following electronic databases: Google Scholar, PubMed, and Scopus. The inclusion criteria encompassed systematic reviews with meta-analyses that were published throughout the timeframe of 2014 to 2022, and human, peer-reviewed clinical studies examining the efficacy of usage of air-polishing devices in the treatment of periodontitis that were published between 2008 to 2022. **Results:** The search yielded 4 systematic reviews and 6 original research papers, encompassing a total of 8 clinical investigations. **Conclusion:** The selected literature lacked data that included a long-term evaluation of more than 12 months on the effect of air polishing powder in non-surgical periodontal treatment. Regardless of that, powder air polishing showed a comparable outcome compared with scaling root planning (SRP) with the superiority of powder air polishing in terms of antimicrobial effectiveness and exhibits better patient experience

Key words: periodontitis, non surgical periodontal treatment, erythritol, glycine, air polishing powder

Introduction:

One of the most common cause of periodontitis is the buildup of bacterial deposits on teeth, and treating the condition effectively has been shown to depend on completely removing these deposits. As known previously, dental plaque represents a typical causative element. Therefore, a dental plaque was considered to avoid peri-implant or periodontal disorders. Personal care routines at home are essential for maintaining oral hygiene, involve using a toothbrush with toothpaste (Sahni et al., 2016; Meto 2020). Even with careful cleaning, a certain amount of dental biofilm remains difficult to reach in certain areas. dental anatomical features, including the protrusion of cervical enamel, furcation,

concavities and deep groves might be suitable ecological niches for bacteria (Parl., 2018). Effective treatment of dental biofilm allows professionals to access difficulty-accessible areas when remains dental plaque are undetected. Scaling root planning (SRP) is widely regarded as the most effective method for non-surgical mechanical removal of plaque (NSPT), as it effectively disrupts the biofilm through mechanical means (Lasserre., 2018). While considered a conventional therapeutic choice, it has some drawbacks such as requiring technical expertise, a lengthy process, requiring technical expertise, and possibly causing discomfort to patients (Fleischer., 1989). Following scaling and root planning (SRP), reports have indicated that the lingual surface of the tooth and furcation areas may be prone to residual calculus (Rabbani., 1981). furthermore, furcation areas are shown to possess inadequate root planning (Fischer., 1991). In addition, it has been observed that repeated use of scaling and root planning (SRP) as supportive periodontal therapy (SPT) can lead to gingival recession and permanent root injury (Sultan et al., 2017). These unfavorable events will result in dentinal hypersensitivity (Greenstein., 1992). Moreover, it has been noted that the result of SRP is also depending upon the proficiency of the operator (Boyd., 2016). Due to these limitations, several techniques and equipments are developed to eradicate bacterial biofilm. These consist of air polishing agents, lasers, and vector scaling systems. Therefore, the aim of this literature review is to evaluate the effectiveness of the newest technology in bacterial eradication by using erythritol/glycine air polishing devices (EPAP/GPAP).

Methodology:

A comprehensive literature search was performed for this narrative review in the following electronic databases: Google Scholar, PubMed and Scopus. The inclusion criteria encompassed systematic reviews with meta-analyses that were published throughout the timeframe of 2014 to 2022, and human, peer-reviewed clinical studies examining the efficacy of usage air-polishing devices in treatment of periodontitis that were published between 2008 to 2022.

Guided Biofilm Therapy:

The presence of plaque and calculus can be identified by using a disclosing agent, and then it can be effectively removed using air abrasive powder to eliminate stains and plaque. Ultimately, the calculus and subgingival plaque are eliminated using a nozzle designed for a certain purpose, and if necessary, scaling is conducted with a specialized designed tip (Shrivastava et al., 2021). Figure 1 provides a detailed explanation of the sequential process of GBT. Figure 2 shows the applied disclosing agent on natural teeth.

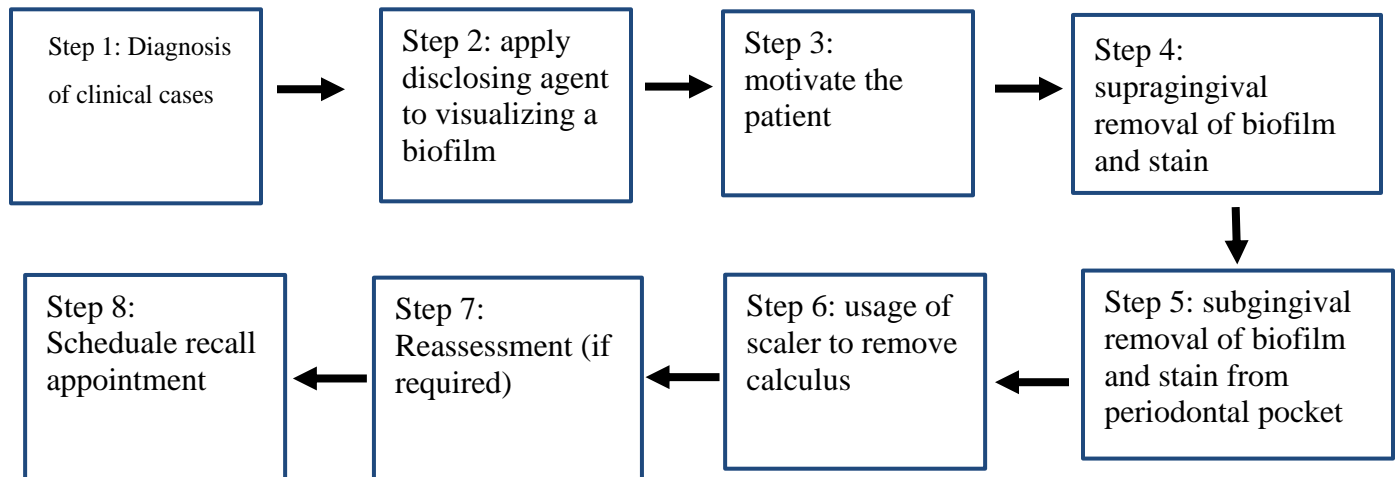


Figure 1. Steps of guided biofilm treatment (GBT)



Figure 2. shows the application of the disclosing agent before periodontal treatment (left picture), and the application of the disclosing agent 24 hours post nonsurgical periodontal treatment (right picture).

Role of Disclosing Agent:

A plaque detector, also known as a disclosing agent, is a nontoxic material that effectively attaches to and colors bacterial plaque deposits, making them easily visible and allowing for precise removal. As stated by Wilkins (1959), a disclosing dye is a special dye that is dissolved within a solution or in tablet form. Its purpose is to make dental biofilm on tooth surfaces visible and identifiable (Montevecchi., 2012). The plaque detector assists the patient in comprehending their oral hygiene status at home care and aids the clinician in detecting it. This is applicable in both the active phase and the period of professional hygiene maintenance. This will allow the clinician to track the development over time and ensure with Complete assurance that every accumulation of plaque has been removed. fully eliminated following periodontal therapy (Nepale., 2014). By administering the disclosing dye directly before tooth brushing, scaling root planning, or periodontal surgical treatment. It is feasible to accurately detect plaque and obtain a higher level of biofilm elimination in relation to professional oral hygiene, therefore enhancing clinical outcomes (Barrows et al., 2003). A large number of practitioners utilize disclosing agents in order to incentivize and quantify the performance of patients' dental hygiene home care. The methodology has been named "colorimetric technique" (Allam., 2017). Properly using the disclosing agent aids the patient in improving their dental hygiene (Datta et al., 2017). By employing a disclosing agent, patients can easily perceive the regions surrounding their teeth, including the bacterial biofilm. This, in turn, enables the clinician to encourage patients to take preventive measures against periodontal disease effectively.

Prior to applying the disclosing agents, it is important to address some technical considerations:

- Exercise caution when applying it on restorative materials since it has the potential to create stains.
- It must not be used prior to applying a sealer.
- It is not advisable to store solutions containing alcohol for Exceeding a duration of 2 to 3 months, Since alcohol is volatile, it will evaporate, resulting in a solution that is too concentrated.
- Prior to using the plaque detector, it is important to do clinical evaluation of soft tissue colour, gingival bleeding index and gingival status. This is necessary because Coloring the solution may conceal the true clinical condition of the tissues.
- Prior to using the detectors in any manner, it is imperative to do an assessment for any potential allergies in patients (Block., 1972).

Air Polishing Devices:

Firstly, air polishing devices were introduced in 1945. Presently, these air polishing systems are employed for the purpose of eliminating biofilm. The air-polishing device operates by propelling a collection of abrasive air particulates (powder) and pressurized water within a specialized nozzle (Petersilka., 2002). The air-powder polishing tools operate in two fundamental concepts. The "venturi" powder within chamber principle (Donnet., 2021) is based on the concept that the powder primarily leaves from the lower part of that chamber. This approach involves the creation of an air and powder mixture through the conjunction of a carburetor; The method involves the use of technique and swirling (Donnet., 2021). The quantity of air and powder released via the tube is contingent upon the placement of an inclined deflector located at the filler cap (Petersilka., 2002). According to the second concept, the air-powder slurry is created by injecting pressurized air into the powder chamber and causing it to swirl toward the outlet. The quantity of powder discharge is contingent upon the screw configuration. It's noted that a quantity of polishing powder released can be controlled using the initial principle, while the second one indicates that the regulation of Powder emission varies. In second category, a reduction in the mass of polishing powder might lead to a decrease in the amount of powder produced (Petersilka., 2002). Presently, there are two options for air-polishing equipment: a portable device that can be held in the hand and a separate device that operates independently. The dental unit is connected to these units using an air turbine adapter. The powder chamber in the portable device it's smaller, necessitating frequent refilling. In addition, the connection unit of the portable device is larger in size. Therefore, it is impractical to utilize in regions that are difficult to access (Petersilka., 2002). A split-mouth research lasting two months was conducted on 20 patients who were called back for a follow-up. The study demonstrated that there were no significant differences in clinical or microbiological outcomes between ultrasonic debridement and subgingival air polishing (Wennstrom et al. 2011). In a further investigation conducted by Flemmig et al. in 2012, the impact on bacterial biofilm in periodontal pockets of moderate-to-deep severity was studied over a span of 90 days. The research revealed positive changes in the makeup of the subgingival microbiota.

Air Abrasive/Polishing Powders:

Presently, sodium bicarbonate (NaHCO_3), glycine powder, erythritol powder, and bioactive glasses are among the air abrasive powders that can currently be marketed commercially (Sultan., 2017). These substances are air abrasive powders. The main difference is the size and shape of the particles, which ultimately affect the final result. The particle size ranges from 1 to 250 μm , with the glycine powder having a particle size between 45 and 60 μm , and the erythritol powder having a particle size of roughly 14 to 31 μm . The bioactive glass exhibits the smallest particle size, ranging from 1 to 10 micrometres. When comparing the particle morphology of air abrasives, NaHCO_3 exhibits chiselled and sharp edges. The morphology of glycine particles closely resembles that of NaHCO_3 , however it exhibits a less pronounced chiselling effect. Erythritol possesses granules with a very fine texture, while bioactive glass exhibits granules in a regular form (Sultan., 2017).

Glycine Powder:

Glycine is an amino acid that is composed of non-toxic, biocompatible organic salt crystals. These crystals have a low rate of solubility in water. Glycine powder has been found to be around 80% less abrasive than NaHCO_3 , resulting in less soft tissue injury, as reported by various investigations. Occasionally, cases of air emphysema have been documented as an adverse event that was resolved within a span of four days (Munro., 1998).

Erythritol Powder:

It is a synthetic sweetener and food additive. It is a polyol that is chemically neutral, non-toxic, and soluble in water. When compared to glycine, it has a reduced particle size and greater stability (Hashino., 2013). Reports have indicated that its utilization in patients with periodontitis reduces the quantities of *P. gingivalis* (Hashino., 2013) and is more acceptable and well-tolerated by patients (Caygur., 2017). Many researchers have documented that the usage of erythritol powder does not result in notable harm to either soft or hard tissue. In addition, the surface of dentin treated with erythritol powder seemed smoother when compared to dentin treated with NaHCO_3 and glycine powder. During a 12-month follow-up period, it was discovered that erythritol powder led to a notable decrease in probing pocket depth (PPD) and bleeding on probing (BOP) (Müller., 2014). A study conducted by Tocha in 2013 examined the impact of using erythritol powder, sodium bicarbonate, and glycine powder on dentine during air-polishing, in vitro. Erythritol resulted in the least amount of volume loss and defect depth, and it provided the smoothest surface.

Side Effect of Air Polishing Devices:

Although it is extremely uncommon, it is not worth mentioning that the utilization of air-polishing equipment in such subgingival regions poses an emphysema risk, that often subsides spontaneously within 24-72 hours in healthy patients. Following administration of mildly abrasive powders like erythritol and glycine, there have been few cases of emphysema documented (Petersilka et al., 2010). This implies that particles with a modest degree of abrasiveness are efficiently cleaning the subgingival zones, resulting in the absence of significant damage to the periodontal tissue. By utilizing specifically designed nozzles that are inserted into the pockets subgingivally, the air stream is vertically directed toward the surface of the root. This approach reduces the pressure at operating site and the risk that leads to developing emphysema as a result.

Furthermore, another study reported by Muller et al (2010), mentioned that The predominant response from the participants during post-treatment questioning was that they experienced a sensation of coldness during air-polishing. Five patients remarked that the powder exhibited an unpleasant flavor. Upon being contacted to verify the 3-month appointment, an individual stated that they had encountered a sense of discomfort and elevated body temperature during the evening following the initial therapy, which resolved spontaneously within a few hours.

Clinical effectiveness of using erythritol/glycine air polishing powder in the management of periodontitis:

According to A randomized controlled study with double blinds that lasted for six months reported by Sekino et al. (2020), The clinical therapeutic impact of recurrent subgingival plaque

removal using air-polishing in SPT were evaluated with a comparison between 3 groups. The first group received Glycine powder/air polishing every 30 days, the second group glycine powder/air polishing at baseline and on day 90, while the third group performed with water irrigation every 30 days. The researchers discovered that the application of GPAP every 30 days had a substantial positive effect on probing pocket depth and clinical attachment levels within the initial 90 and 180 days, respectively, as in comparison to the use of water irrigation alone. But when simulated the effect of the SPT at a time frame from the 30 days to the 90 days. they detected The only change that showed statistical significance when compared to the group that only received water irrigation was in the amount gained of CAL from the baseline, and There was an absence of observable Disparity in the degree of enhancement in PPD. They gave a probable explanation of this result; the initial contraction of tissue was successfully achieved with active management but left the majority of the residual inflammation at the bottom of the pockets.

This finding was partly consistent with the findings reported by Kargas, et al. (2015). The trial involved Supportive periodontal therapy participants who obtained one of two treatments spaced 3 months apart. The management includes either GPAP, scaling root planning with a hand scaler, ultrasonic scaler with subgingival debridement, or supragingival plaque treatment alone. They discovered that while the average PPD fell substantially one month following GPAP, the difference with the baseline disappeared by the time they tested after six months. The extent of enhancement in clinical parameters was notably inferior compared to the results obtained by the utilization of a manual or ultrasonic scaler.

Furthermore, another study what was reported by Muller et al. (2014) assessed the subgingival with air-polishing The powder of erythritol includes 0.3% chlorhexidine (test side) compared with ultrasonic management (control side) and evaluated at 3 months intervals (baseline, 3, 6 and 9 months). Despite there being no significant difference, it is worth noting that The mean number of PPD sites declined from 4.6 to 3.6 per participants on the test side, while it decreased from 4.8 to 3.9 on the control side. Ultrasonic instrumentation was assigned to 55 sites for all four treatment sessions, but only 39 sites received air polishing for four rounds.

Furthermore, in an additional study conducted by Ivnic-Resnik et al. (2022), 31 chronic periodontitis patients were included in a split-mouth, randomised clinical trial. After 6 months, the test group showed a significant increase in the initial deeply pockets (PPD > 5.5 mm) that were decreased to the shallow (PPD ≤ 3.4 mm), and a greater improvement in attachment level was noted. Nevertheless, Eon-Jeong Park et al (2018) noted that there was no notable difference between the test group (SRP+EPAP) and the control group (SRP) in their investigation. According to a systematic review and meta-analysis that was reported by Abdulbaqi et al. (2021) they reported A significant gain in CAL was noted when EPAP was used as an adjunct during active periodontal therapy (APT) as compared with the conventional mechanical technique alone. The EPAP demonstrated a notable increase in the total CAL gain (0.016 mm, p = 0.004) when compared to the usual gold standard technique. These findings indicate that subgingival administration of EPAP is effective and promotes the healing of the periodontal tissue at the root of the pocket (Hagi et al., 2015; Nascimento et al., 2021). Also, A study

conducted by Jenkins et al. (2000) found that there was no significant difference in improved clinical parameters when comparing Regular subgingival debridements utilizing either manual instruments or ultrasonic equipment every 3 months, with removal of plaque above the gumline only during supportive periodontal therapy (SPT).

microbiological effectiveness of using erythritol/glycine-powder air polishing in the management of periodontitis:

Petersilka et al. (2003) and Flemmig et al. (2012) A studies found that using a glycine powder with air polishing device in individuals with moderated periodontitis led to a notable decrease in the total bacterial count (TBC) compared to standard root planing (SRP) treatment during follow-up care, and this consistency with what was reported Park EJ et al.(2018), The study demonstrated a substantial decrease in TBC between the initial assessment and 30 days after therapy in the scaling root planning with EPAP group. Nevertheless, that total bacterial count (TBC) had a substantial increase between the first and third month following treatment in the group that received only scaling and root planing (SRP). This aligns with the results made by Flemmig et al. (2012), The researchers who saw a rise in the total bacterial count (TBC) three months after being treated with glycine powder in moderate and also deeply periodontal pockets. Hence, the implementation of maintenance therapy is crucial in order to prevent and manage periodontal disease. Furthermore, Based on the same study that was reported by Park EJ et al.(2018), the concentration of *P. gingivalis* in that group that had scaling root planing with EPAP was substantially reduced compared to the group that involved control participants at the first month after the treatment. that finding aligns with what was concluded in a study conducted by Hashino et al. (2013), which demonstrated this erythritol powder possesses antibacterial properties by Altering the microscopic composition and metabolic characteristics of the *P. gingivalis* biofilm in a laboratory setting. We have clinically verified that there is an antibacterial action against *P. gingivalis*, which belongs to the "red complex" of periodontopathic bacteria. This species plays a crucial role in the Chronic periodontitis progression by causing an imbalance in the periodontal microbiota (Ulvik et al., 2021; Hagi et al., 2015). Moreover, Evans et al. (1992) and Persson et al. (1994) It was observed that the reduction of *P. gingivalis* in living organisms prevented the loss of alveolar bone. In addition, in several cases, this damage to the tissue of periodontium was also minimized. Hence, reducing this presence of *P. gingivalis* is crucial in lowering the occurrence of periodontal disorder. However, In accordance with the aforementioned study conducted by Sekino S et al. (2020), There was no significant difference in the subgingival microbiota between the GPAP group and the group that just received water irrigation. while Wennström et al. (2011) discovered that this usage of glycine polishing powder in SPT participants with 5-8 mm pockets resulted in a temporary decrease in The rates of detecting the red complex and orange complex. However, these rates reverted to their initial levels after 14 days. However, the clinical measures exhibited improvement 2 months later. most potential explanation could be that in the study conducted by Sekino S et al.(2020) study, microbiological tests were conducted at 3-month periods, and it is possible that the initial reduction in bacterial count following the surgery was not noticed. Furthermore, another study reported by Listgarten et al. (1978) The study showed that the percentage of mobile spirochetes and rods dropped following subgingival

plaque removal, but returned to the original state following 2 months. Also, Magnusson et al. (1984) It was stated that if the control of plaque, after undergoing scaling and root planning (SRP), is not effective, the level of mobile bacilli in regards ratio with spirochaetes reverted back to its original value during a period of 2 months. Flemmig et al. even It was discovered that treating the remaining periodontal pockets in participants with SPT using GPAP resulted in an immediate decrease in the total number of bacteria, as well as the counts of *P. gingivalis* and *T. forsythia*. This drops was preserved until 10 days, but by day 90, the counts returned to original the initial levels. From a bacteriological perspective, it is appropriate to do subgingival perfect debridement at a time-frame less than every 2-3 months.

Conclusion:

Based on the existing studies, one may conclude that powder air polishing is highly efficient in eliminating biofilm from the area surrounding the implant or tooth. In Comparison to SRP, powder air polishing was reported to better patient compliance and less pain perception in non-surgical periodontal therapy or supportive periodontal therapy. In addition to comparable clinical and microbiological outcomes for both SRP and powder air polishing. its utilization as monotherapy necessitates longer-term research is needed since the clinical result is transient.

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