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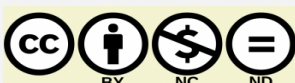


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Impact of erythritol air polishing in supportive periodontal care: literature review

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Abstract:

Background: Erythritol powder air polishing (EPAP) has emerged as a potential adjunctive treatment in supportive periodontal care (SPC). This literature review aims to evaluate the efficacy of EPAP in promoting periodontal health, focusing on clinical outcomes, microbial impact and patient-reported outcomes.

Methods: A comprehensive search was conducted in Google Scholar, PubMed, and Scopus to identify systematic reviews with meta-analyses and human, peer-reviewed clinical studies published between 2014 and 2024. Inclusion criteria encompassed studies evaluating EPAP in SPC, while exclusion criteria ruled out non-periodontal therapy studies and non-peer-reviewed articles.

Results: The search yielded 37 studies that met the inclusion criteria. Key findings include significant reductions in periodontal pocket depths, bleeding on probing, and plaque index scores with EPAP. Patient-reported outcomes indicated higher satisfaction, significant microbial impact and reduced post-treatment sensitivity with EPAP compared to traditional scaling and root planing (SRP).

Conclusion: The review suggests that EPAP is an effective adjunctive treatment in SPC, offering significant clinical improvements, reduced tissue damage, and greater patient comfort. EPAP shows promise for integration into routine periodontal maintenance protocols. However, further long-term randomized controlled trials are necessary to confirm its benefits and establish its role in periodontal therapy.

Keywords: erythritol; periodontal diseases; periodontal debridement; dental polishing; periodontal pocket

Introduction:

periodontal disease affects a significant portion of the global population. It is prevalent across all age groups and demographics, with varying degrees of severity ranging from mild gingivitis to severe periodontitis (Kalhan et al., 2022). It is an inflammatory condition that affect the periodontium caused by many harmful pathobionts that lead to

gingival bleeding, periodontal pocket and the detachment and erosion of the bone supporting the teeth (Mohammed et al., 2024). The condition is influenced by factors such as poor oral hygiene, tobacco use, genetic predisposition, systemic diseases like diabetes, and certain medications (Abdul Ameer & Ali, 2015).

The persistence of plaque biofilm on dental surfaces and its extension into periodontal pockets create a dysbiosis environment. This environment triggers inflammatory mediators and free radicals within gingival tissue, which predispose to the breakdown of periodontal tissues (Qasim et al., 2020).

The goal of active periodontal therapy is to restore immune system homeostasis achieved by reducing the microbial load to levels compatible with oral health and stability (Fragkioudakis et al., 2021). SPC refers to the ongoing maintenance phase of periodontal treatment after active periodontal treatments (APT) aims to maintain the health of the periodontal tissues and prevent the recurrence of diseases is crucial for long-term periodontal stability and preventing the progression of periodontal disease, ensuring that the improvements achieved during APT are sustained over time (Herrera et al., 2022).

The conventional non-surgical periodontal therapy comprises of frequent tooth instrumentation to remove soft and hard deposits from tooth surfaces. Unfortunately, this method has a drawback of damaging teeth surfaces and soft tissue due to physical scraping of instruments (Santos et al., 2023). Therefore, it is rationale to find less aggressive and more ergonomic approaches to achieve effective biofilm removal (Onisor et al., 2022).

Recently, there has been a rise in utilizing erythritol powder air polishing (EPAP) in periodontal therapy. This material is valued due to its advantages such as safety, antibacterial properties, and gentle impact on tooth and surrounding tissues (Kamil, 2023). For that reason, the objective of this study was to assess the effectiveness of erythritol air polishing suppurative periodontal therapy by examining clinical outcomes, microbial impact and patient reported outcomes.

Methods:

A comprehensive search was conducted in Google Scholar, PubMed, and Scopus to identify systematic reviews with meta-analyses and human, peer-reviewed clinical studies published between 2014 and 2024. Inclusion criteria encompassed studies evaluating EPAP in SPC, while exclusion criteria ruled out non-periodontal therapy studies and non-peer-reviewed articles.

Results:

The search yielded 37 studies that met the inclusion criteria. Key findings include significant reductions in periodontal pocket depths, bleeding on probing, and plaque index scores with EPAP. Patient-reported outcomes indicated higher satisfaction and reduced post-treatment sensitivity with EPAP compared to traditional scaling and root planing (SRP).

Periodontal diseases:

Periodontal diseases are immune-mediated and multifactorial diseases of involving the periodontium, It may affect one or more of the tissues related to the periodontium, including the gingiva ,periodontal ligament, cementum and alveolar bone process (Gasner & Schure, 2024).

Gingivitis is the earliest and most mild type of periodontal disease. If gingivitis is not treated, it can develop to involve supporting tooth structures, which is the advanced stage of disease (Mohammed Hussein & Ali, 2024). Periodontitis is characterized by severe inflammation, as

well as the loss of bone and connective tissue that support the gingival tissues and tooth roots(Gheisary et al., 2022).

Gingivitis:

Gingivitis is one of the most common oral disease conditions in humans and has been a global health burden for centuries(Huang et al., 2021). Gingivitis is caused by an abnormal immune and inflammatory response that is triggered by a persistent plaque biofilm, characterized as a reversible condition that is marked by redness, swelling, slight discomfort and bleeding during mastication, brushing and flossing(Vitkov et al., 2023).

There are different types of gingivitis, but the most common one is chronic gingivitis caused by plaque biofilm (7). Gingivitis can be defined and graded mostly by using BOP score, this score measures the proportion of sites that bleed when a periodontal probe (Chapple et al., 2018). From a clinical perspective, the gingival tissues exhibit swelling, redness, soreness, a shiny appearance, and bleeding when gently probed. Gingivitis rarely causes unprovoked bleeding and is typically devoid of discomfort; as a result, many people are unaware of the condition and do not seek medical attention (8).

The association between gingivitis and periodontitis is supported by many studies, which have shown that the beginning and progress of attachment loss is related with higher levels of gingival inflammation at the baseline(Kumar, 2019; Ravidà et al., 2020; Tonetti et al., 2018).

Periodontitis:

Periodontitis is one of abundant chronic inflammatory disease that can cause irreversible damage to the periodontal apparatus and subsequently tooth loss. It is can be avoidable and can be treated using various methods(Tonetti et al., 2018). This condition is the result of an exaggerated immune system response when the bacteria in the area below the gums, which are mostly Gram-negative, become imbalanced(Mahmood, 2024). The host-dysbiotic microbiome interaction triggers an excessive production of reactive oxygen species, which surpasses the body's antioxidant mechanism and results in further tissue damage(Abdulkareem et al., 2023). The main characteristics of this condition are the reduction of support for the tissues around the teeth that manifested clinically through presence of periodontal pocket, gingival bleeding and CAL, radiographically assessed the amount of alveolar bone loss (Papapanou et al., 2018).

Supportive periodontal care:

Supportive periodontal care denotes to the method used to provide appropriate maintenance and care to the patient. The term "care" encompasses more than just "therapy" when it comes to providing assistance for patients who are prone to periodontal disease, in order to maintain aesthetically and functionally acceptable dentitions impacted by periodontal issues for their entire lives(Kapoor, 2018). SPC should consist of updating the patient's medical and dental histories, reviewing radiographs, examining the soft tissues inside and outside the mouth, conducting a dental examination, evaluating the periodontal condition, removing bacterial plaque and calculus from both above and below the gumline, performing scaling and root planing as necessary, polishing the teeth, and assessing the patient's effectiveness in controlling plaque and modifying any necessary behaviors(Kolbe et al., 2014).

Supportive periodontal treatment often begins after the end of APT and is continued at different intervals throughout the lifespan of the teeth or their implant replacements(Sanz et al., 2020). If the

disease has a time of exacerbation, the patient may return to active care. The statement emphasizes the crucial requirement for therapeutic interventions to assist the patient in managing periodontal diseases and preventing further reinfection. It plays a vital function in preserving the overall dental health of the patient. The patient, as well as the periodontist, should adhere to the instructions diligently (Manresa et al., 2018).

Non-surgical periodontal therapy:

The non-surgical periodontal therapy is a term generally refers to the mechanical instrumentation supra- and subgingivally, which is the gold-standard and first line of treatment. NSPT is effectively controlling pathogenic bacteria in the subgingival domain which is not accessible to the patients (Izidoro et al., 2023). when periodontal pocket depth increasing, the diversity of microbiomes is also increased and complicated and bacteria such as *Porphyromonas gingivalis*. and *Aggregatibacter actinomycetemcomitans* which are considered as pathobionts are more evident (Ayoob & Abdulbaqi, 2024; Kumar et al., 2005). These bacteria, even with the presence at a relatively low abundance, may aid in initiation and the progression of disease. The crucial Eradication of these pathogens below their pathological thresholds is essential to prevent bacterial recolonization and recurrence of the disease (Mombelli, 2018).

The primary objective of standard periodontitis treatment is to reestablish immune system homeostasis. This is accomplished through three main approaches: (1) precise professional biofilm control, (2) educating the patient on maintaining proper daily oral hygiene, and (3) providing SPC to manage the biofilm and prevent the reoccurrence of the disease (Herrera et al., 2022). The latest guidelines for periodontal therapy focusing on controlling dental plaque biofilm and any risk factors and recommended approaches that involves the repetitive use of subgingival instrumentation in order to reduce PPD and alleviate gingival inflammation (Kebschull & Chapple, 2020).

At present, there are multiple techniques for removing biofilm in periodontal therapy, such as manual devices, sonic and ultrasonic scalers. Among them, manual devices and ultrasonic scalers are the most frequently employed equipment for effectively managing professional biofilm removal (Park et al., 2018). Nevertheless, the efficacy of removing sub-gingival biofilm has certain limitations and can be enhanced through the utilization of supplementary treatments such as air polish devices, laser, photodynamic therapy, or other innovative devices and therapies (Annunziata et al., 2023; De Angelis et al., 2022; Munteanu et al., 2022; Ng et al., 2018).

Utilizing curettes manually instrument roots is a highly effective treatment for patients who have shallow-to-moderate periodontitis. Multiple investigations have shown evidence that SRP can effectively decrease probing depths, promote clinical attachment gain, and impede the course of disease (Ciantar, 2014; Deas et al., 2016; Puglisi et al., 2022).

Yet, even the most proficient practitioners occasionally fail to attain the intended outcome of a physiologically suitable, pristine, and level root surface, mostly due to the intricate anatomy and the expertise of the practitioners. Furthermore, the use of manual instruments might lead to a reduction in the amount of tooth roots structure due to excessive use of these instruments (Zhang et al., 2020).

Ultrasonic debridement is the process of eliminating deposits on the surface of tooth using a vibrating mechanical device. This process is different from the process of manual instrumentation, which entails the elimination of root deposits and cementum until a flat and solid surface is achieved.

Multiple studies have demonstrated that ultrasonic devices have yielded comparable outcomes to manual instrumentation in term PPD(Perussolo et al., 2023).

Periodontal treatment using ultrasonic cleaning devices have been proven to effectively reduce post-procedural pain and enhance the overall therapeutic outcome due to the cavitation effect(He et al., 2022; Oza et al., 2022). By utilizing newly designed micro-ultrasonic tips, it is possible to more efficiently access difficult-to-reach locations, including deep flaws, root grooves, and furcations. These points may gradually penetrate more thoroughly into the pocket (Sabatini et al., 2024). Furthermore, the outcomes obtained with ultrasonic procedures are equivalent to those obtained with manual equipment. Moreover, the utilization of ultrasound devices seems to alleviate pain and enhance patient comfort. A prior investigation employed the visual analog scale (VAS) to evaluate the patient's perception following treatment by ultrasonic devices, with the level of pain and discomfort associated with the treatment being assessed towards the lower end of the scale. Patients are more inclined to embrace the treatment if the water temperatures in the devices used may be customized(Daly et al., 2020; Liss et al., 2021) .

The utilization of a combination of tools called SRP. This conventional procedure appears to be the most efficacious approach in order to prevent excessive therapy. The findings suggest that ultrasonic devices and manual equipment yield similar outcomes in terms of decreases in Pocket depth, clinical attachment loss, plaque index, bleeding on probing and gingival recessions(Cobb & Sottosanti, 2021).

Despite being time-consuming and technically demanding, SRP procedures are frequently linked to patient discomfort and pain both before and after treatment. This discomfort might include hypersensitivity produced by the loss of hard tissue on the tooth surface. However, NSPT with SPR is still widely regarded as the most reliable and fundamental approach for treating periodontitis (Sanz et al., 2020).

Recently, many of convincing evidence support the use of EPAP in periodontal disease management as less aggressive and less technique-demanding approaches for achieving effective biofilm removal. Contrary to the conventional SRP procedure, air-polishing equipment exclusively eliminates biofilm, resulting in reduced clinical time and decreased patient pain. EPAP can serve as a supplementary treatment during APT and as a substitute for standard SRP for SPC (Abdulbaqi et al., 2022; Gheorghe et al., 2023; Mensi et al., 2021).

Erythritol powder air-polishing:

Air polishing is a relatively new advancement for the dental community that has the potential to improve the overall oral health of patients with periodontitis(Petersilka et al., 2002). Only a limited number of air-abrasive materials and techniques have been studied for the purpose of removing subgingival plaque. An effective method for removing subgingival biofilm is the use of an air-polishing device that utilizes minimal abrasive glycine and erythritol powder. Erythritol is an alcoholic sugar that has been employed as an artificial sugar substitute in food manufacturing(Martins et al., 2023). Erythritol can be safely used on a daily basis, as it does not undergo metabolism after being ingested and is eliminated in the urine without undergoing any changes. Furthermore, erythritol does not promote tooth decay, making it a safe option for usage in the mouth. It is also well-tolerated because of its pleasant sweet flavor(Abdulbaqi et al., 2022).

Discussion:

In recent times, there has been a significant focus on the utilization of EPAP because of its non-invasive impact on both the soft and hard tissues. Furthermore, the erythritol particles, which have a size of around 14 μm , are considered to be safest for subgingival cleaning when used in conjunction with a new subgingival nozzle device (Abdulbaqi et al., 2022). EPAP was first introduced as a treatment approach well tolerated by patients during SPC (Hägi et al., 2013). Later studies have indicated the effectiveness of EPAP in both APT and SPC (Abdulbaqi et al., 2022; Jentsch et al., 2020).

This method has been demonstrated to result in higher decreases of colony-forming bacterial components in periodontal pockets ranging from (3-5 mm), compared to using SRP. (Cosgarea et al., 2021; Flemmig et al., 2012; Hägi et al., 2014). Their abrasiveness capability was determined to be 80% lower than when using bicarbonate powder air polishing that was previously employed. This resulted in less damage to hard tissue compared to the application of hand or ultrasonic instruments (Simon et al., 2015; Tsang et al., 2018).

A systematic review discovered that EPAP and manual / ultrasonic instrumentation are equally effective in limiting biofilm growth and lowering periodontal inflammation. These findings indicate that EPAP can be viewed as a viable substitute for biofilm removal, and there is no notable difference in the clinical results between subgingival EPAP and ultrasonic instrumentation (Abdulbaqi et al., 2022; Gheorghe et al., 2023; Nascimento et al., 2021).

Erythritol exhibits antibacterial activity against periodontal diseases. EPAP has been found to produce microbiological results comparable to those achieved with SRP when used to treat periodontal pockets (Hägi et al., 2013; Hashino et al., 2013; Jentsch et al., 2020; Mensi et al., 2023).

Moreover, the assessment of perceptions of pain and discomfort feeling during therapy by VAS demonstrated a preference for EPAP compared to conventional treatment. While there has been a growing in clinical research supporting the application of EPAP in periodontal therapy in recent years, it is important to note that air polishing devices are only effective in removing soft deposit biofilm. In contrast, SRP are capable of removing both soft and hard deposits (Ulvik et al., 2021). Air-polishing with erythritol can be employed either alone or in conjunction with SRP to eradicate residual pockets during the initial or supporting phase of periodontal therapy (Vouros et al., 2022).

Conclusion:

The literature review demonstrates that erythritol air polishing is a promising adjunctive therapy in supportive periodontal treatment, offering benefits such as improved clinical outcomes, reduced tissue damage, and enhanced patient comfort. These findings suggest that EPAP could be integrated into routine periodontal maintenance protocols, potentially leading to better long-term periodontal health outcomes.

Further research, particularly long-term randomized controlled trials is needed to solidify the role of EPAP in supportive periodontal therapy. This detailed literature search highlights the potential of EPAP to revolutionize periodontal maintenance and provides a foundation for future investigations.

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