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Clinical Outcomes and Exploratory Subgingival Microbiome Changes Following Erythritol Air Polishing Versus Scaling and Root Planing: A Pilot Randomized Clinical Trial

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Abstract

Background

To assess the feasibility of comparing clinical outcomes, treatment efficiency, and subgingival bacterial community changes associated with subgingival air polishing using erythritol powder versus scaling and root planing (SRP) in supportive periodontal therapy.

Methods

In this pilot randomized clinical trial, 20 patients diagnosed with periodontitis (Stage II–III, Grade B–C) in supportive periodontal therapy were allocated (1:1) to subgingival air polishing with erythritol powder or SRP. Probing depth (PD), clinical attachment level (CAL), and bleeding on probing (BOP) were assessed at baseline and 6 months. Subgingival plaque samples were analyzed using 16S rRNA gene sequencing at the bacterial family level to describe changes in relative abundance of selected taxa. Patient-reported discomfort (VAS) and treatment duration were recorded at baseline. Given the pilot nature of this study and the small sample size, all microbiological findings should be considered exploratory and hypothesis-generating only.

Results

Both interventions produced significant improvements in clinical parameters over 6 months, with no statistically significant differences between groups. Subgingival air polishing with erythritol was associated with significantly shorter treatment time and a non-significant trend toward lower patient-reported discomfort. Exploratory family-level 16S rRNA analysis revealed descriptive differences in the relative abundance of bacterial families between groups following treatment; however, these findings should be interpreted with caution given the small sample size, the compositional nature of the data, and the limited taxonomic resolution of family-level analysis.

Conclusions

In this pilot trial, subgingival air polishing with erythritol powder demonstrated clinical outcomes comparable to SRP while offering potential advantages in treatment efficiency. Exploratory microbiological data suggest descriptive differences in bacterial family-level abundance patterns between groups, warranting confirmation in larger, adequately powered studies with higher taxonomic resolution.

Trial registration:

ClinicalTrials.gov, NCT07344805, registered on November 19, 2025. Retrospectively registered.

BACKGROUND

Periodontitis is a multifactorial chronic inflammatory disease driven by a dysbiotic dental biofilm that elicits a host immunoinflammatory response and leads to progressive destruction of the tooth-supporting tissues. Its onset and progression are influenced by risk and susceptibility factors, including smoking, diabetes, oral hygiene, and genetic, behavioral, and sociodemographic determinants[1,2].

Periodontal treatment consists of an initial basic phase in which the bacterial biofilm is mechanically removed; in certain cases, a corrective phase that may require surgical therapy; and finally, the inclusion of the patient in a supportive periodontal therapy program, also known as periodontal maintenance[3]. Within this maintenance phase, sustained control of the subgingival biofilm is a key determinant of long-term periodontal stability.

Mechanical biofilm removal has traditionally been performed using hand instruments and ultrasonic devices. The reference treatment is scaling and root planing (SRP)[4]. However, its execution requires time, manual skill, and clinical experience and may be associated with certain adverse effects, such as dental hard-tissue loss (root cementum removal), soft tissue damage, or dentin hypersensitivity secondary to smear layer removal[1,5].

In recent years, alternative or adjunctive therapies to SRP have been developed. These approaches may reduce variability in intra- and postoperative outcomes, including pain, treatment discomfort, and tissue damage. Importantly, they also aim to improve procedural efficiency and patient-centered outcomes without compromising clinical effectiveness. According to recent evidence, these alternative therapeutic options may provide superior results in terms of patient comfort and time efficiency[6].

Among these, air-polishing devices use compressed air, water, and abrasive powders for root surface decontamination, demonstrating effective removal of bacterial deposits[7,8]. Sodium bicarbonate is one of the most commonly used powders and effectively removes bacterial biofilms; however, it may cause enamel erosion and corrosion of restorative materials such as silver amalgam, gold, or composite[9,10]. Less abrasive air-polishing powders have since been introduced, among which glycine stands out. Petersilka *et al.*[11] reported that glycine is approximately 80% less abrasive than sodium bicarbonate. Its use has been associated with reduced alteration of dental hard tissues compared with SRP and with decreased bacterial colony formation in periodontal pockets of 3–5 mm.

More recently, erythritol powder has been developed. It is a soluble, non-toxic material suitable for biofilm removal due to its small particle size and stable chemical properties as compared with glycine[12]. Available evidence suggests that erythritol may interfere with the structure and metabolic activity of the periodontal biofilm, demonstrating efficacy against pathogens such as *Porphyromonas gingivalis*[13] and clinical outcomes comparable to SRP in supportive periodontal therapy[14]. However, most studies to date

have focused predominantly on clinical endpoints, with limited characterization of the ecological shifts within the subgingival microbiome following different debridement strategies.

This represents a relevant knowledge gap, as periodontal stability is increasingly understood not only as improvement in clinical parameters but also as the re-establishment of a balanced and resilient microbial ecosystem. Moreover, different mechanical approaches to biofilm disruption may exert distinct ecological pressures on the subgingival microbiota, potentially resulting in divergent patterns of microbial reorganization despite similar clinical outcomes.

Therefore, the primary aim of this pilot study was to assess the feasibility of the protocol and to compare clinical outcomes — including probing depth (PD), bleeding on probing (BOP), clinical attachment level (CAL), patient-reported discomfort, and treatment duration — between subgingival air polishing with erythritol powder and SRP in supportive periodontal therapy. As a secondary and exploratory objective, this study aimed to describe changes in the relative abundance of subgingival bacterial families following each intervention, using family-level 16S rRNA gene sequencing analysis, in order to generate hypotheses for future adequately powered studies.

We hypothesized that the two mechanical debridement strategies would not induce differential shifts in subgingival bacterial community composition despite producing similar clinical improvements.

METHODS

Recruitment

Patients were recruited from the Master's Program in Oral Surgery, Buccofacial Implantology and Periodontics at the University Dental Clinic of CEU Cardenal Herrera University (Valencia, Spain) according to predefined inclusion and exclusion criteria. All participants provided written informed consent.

Patients were allocated (1:1) to either the intervention or control group by simple randomization generated using SPSS software (v29.0.2.0). Allocation concealment was ensured using sequentially numbered opaque envelopes managed by an independent investigator. Due to the nature of the interventions, operator blinding was not feasible; however, the clinical examiner was not involved in treatment allocation. The overall study timeline, including recruitment, intervention, and follow-up procedures, is illustrated in Figure 1.

Sample size

A pilot study involving 20 patients was conducted to assess the feasibility of the protocol, identify potential logistical limitations, and estimate the variability of the primary outcomes for future sample size calculation in order to ensure adequate statistical power. Given the exploratory nature of the study, no formal a priori sample size calculation for hypothesis testing was performed.

Ethics approval and consent to participate

The study was approved by the Biomedical Research Ethics Committee of CEU Cardenal Herrera University (CEEI23/405) and was registered at ClinicalTrials.gov (NCT07344805) on November 19, 2025. Retrospectively registered. All participants provided written informed consent. All procedures were performed in accordance with the ethical standards of the institutional research committee and with the 1964 Declaration of Helsinki and its later amendments.

Inclusion and exclusion criteria

Patients aged between 18 and 90 years diagnosed with periodontitis (Stage II–III, Grade B–C) who had received initial periodontal therapy within the previous 3–6 months were included. Exclusion criteria comprised pregnancy or lactation, use of systemic antibiotics within the previous 6 months, smoking >10 cigarettes/day, and uncontrolled diabetes.

Variables

The analyzed variables were classified as sociodemographic, behavioral, clinical periodontal, and microbiological. Sociodemographic variables included age and sex, and smoking status was recorded as non-smoker or smoker of ≤10 cigarettes/day. Clinical periodontal and microbiological variables were also recorded, as well as patient-reported discomfort and pain and treatment time.

The primary clinical outcome was the change in probing depth (PD) at 6 months. Secondary outcomes included changes in clinical attachment level (CAL), bleeding on probing (BOP), patient-reported discomfort, treatment duration, and microbiome composition. Clinical periodontal parameters were assessed at six sites per tooth (mesiobuccal, midbuccal, distobuccal, mesiolingual/palatal, midlingual/palatal, and distolingual/palatal) using a North Carolina periodontal probe. PD was measured as the distance from the gingival margin to the base of the periodontal pocket. CAL was calculated as the sum of probing depth and gingival recession. BOP was recorded 15 seconds after probing and expressed as the percentage of bleeding sites.

The microbiological component was designed as an exploratory analysis aimed at describing and comparing the relative abundance of bacterial families following the two supportive periodontal therapy protocols. Subgingival plaque samples were analyzed by 16S rRNA gene sequencing at the bacterial family level. This taxonomic resolution was selected to maximize reproducibility in 16S rRNA-based analyses; however, it does not allow species-level attribution, and changes in the relative abundance of a given family cannot be interpreted as changes in any specific species within that family. Results should therefore be regarded as descriptive and hypothesis-generating. The analysis focused on bacterial families that include species previously associated with periodontal dysbiosis and with the microbial complexes described by Socransky *et al.*[15] while acknowledging that each family encompasses multiple species with potentially distinct ecological roles.

Patient-reported discomfort during treatment was evaluated using a visual analogue scale (VAS) consisting of a 10 cm horizontal line, where the left end represented no pain and the right end represented the maximum intensity. Patients marked the point that best reflected their perception, and discomfort was classified as mild (≤4 cm), moderate (5–7 cm), or severe (>7 cm), as previously described by Vicente-Herrero *et al.*[16].

Treatment duration was recorded using a stopwatch, measuring the total time required to complete each procedure. Discomfort and treatment time were assessed exclusively at the baseline visit (time 0), coinciding with the application of the maintenance therapy.

Sample collection and methodology

In the intervention group, treatment was performed using an erythritol powder air-polishing device (Airflow®, EMS, Switzerland). Initially, supragingival decontamination was carried out using an erythritol powder suspension. Subsequently, the Airflow® system was used for the treatment of deep periodontal pockets (4–9 mm). Finally, the Piezon®PS system with a dedicated tip was employed for minimally invasive removal of hard deposits in supra- and subgingival areas, with the aim of promoting reductions in bleeding on probing (BOP), periodontal probing depth (PD), and reattachment of the junctional epithelium.

In the control group, ultrasonic instrumentation (Cavitron®) was used first, followed by selective SRP with previously sharpened Gracey curettes (Hu-Friedy®, Chicago, IL, USA), and completed with supragingival prophylaxis using sodium bicarbonate.

At time 0, baseline microbiological samples were collected, followed by the assigned maintenance treatment according to the study group. Patient-reported discomfort was recorded using a visual analogue scale (VAS), and total treatment time was also documented.

At the 6-month follow-up (time 1), supportive periodontal therapy was repeated according to the assigned protocol, and new microbiological samples were collected.

Subgingival plaque samples were obtained from the periodontal site with the greatest probing depth in each patient in order to standardize comparisons. After relative isolation of the field, sterile paper points were inserted into the periodontal pocket for 20 seconds. Subsequently, the samples were transferred to an anaerobic transport medium and stored at −80 °C until microbiological processing.

Statistical analysis

Data were analyzed using SPSS software. Descriptive statistics were reported as mean ± standard deviation for continuous variables and frequencies or percentages for categorical variables. Normality was assessed using the Shapiro–Wilk test. Within-group changes between baseline and 6 months were analyzed using paired tests, whereas between-group comparisons were performed using independent

tests as appropriate. A repeated-measures general linear model was used to evaluate the effects of time, treatment group, and their interaction. Statistical significance was set at $p < 0.05$. No missing outcome data occurred; all randomized participants completed follow-up and were included in the final analysis.

RESULTS

Twenty patients were included and randomly allocated into two groups (erythritol air-polishing (EAP), n=10; SRP, n=10). No statistically significant differences were observed between groups at baseline (Supplementary Table 1).

Clinical outcomes

Both treatments produced significant clinical improvement at the 6-month follow-up. In the EAP group, maximum probing depth decreased from 5.5 ± 1.4 mm to 3.5 ± 1.4 mm ($p < 0.001$), whereas in the SRP group it decreased from 5.1 ± 1.9 mm to 3.6 ± 1.0 mm ($p < 0.001$).

Similarly, maximum clinical attachment level improved after treatment in both groups, decreasing from 6.1 ± 1.6 mm to 4.1 ± 1.5 mm ($p < 0.001$) in the EAP group and from 5.5 ± 2.0 mm to 3.9 ± 0.9 mm ($p < 0.001$) in the SRP group. Bleeding on probing was also reduced from 23.9 ± 11.1% to 11.4 ± 8.4% ($p < 0.001$) in the EAP group and from 20.8 ± 8.2% to 9.9 ± 5.4% ($p < 0.001$) in the SRP group.

Analysis using a repeated-measures general linear model showed a significant effect of time for all evaluated clinical variables ($p < 0.001$), with no statistically significant interaction between treatment group and time, indicating comparable clinical efficacy between both protocols. Between-group differences in clinical parameter changes were small and not statistically significant, supporting the absence of a clinically meaningful difference between interventions within the limits of this pilot study.

No adverse events or unintended effects were observed in either group during the study period.

Exploratory microbiological findings

The following microbiological results are descriptive and exploratory. Given the small sample size (n = 10 per group) and the family-level taxonomic resolution of the 16S rRNA gene sequencing analysis, these findings cannot support confirmatory conclusions and should be regarded as hypothesis-generating only. In particular, changes in the relative abundance of bacterial families cannot be attributed to changes in any specific species within those families, as each family encompasses multiple species with distinct ecological roles. The correspondence between the main periodontopathogenic species and their respective bacterial families is presented in Supplementary Table 2. This correspondence is provided for reference only and does not imply that observed family-level changes reflect changes in specific species.

Global abundance

The five most abundant bacterial families in the SRP group at time 0 were Streptococcaceae (10.65%), Fusobacteriaceae (8.65%), Pasteurellaceae (8.29%), Lachnospiraceae (5.42%), and Prevotellaceae (5.09%). Together, these families accounted for more than 38% of the total relative abundance.

In the EAP group at time 0, the five most abundant families were Streptococcaceae (12.63%), Fusobacteriaceae (12.15%), Prevotellaceae (6.55%), Neisseriaceae (6.05%), and Veillonellaceae (4.46%). Together, these families represented 41.8% of the total relative abundance.

The baseline microbial profiles of both groups showed broadly comparable community structures, with no dominant outlier taxa observed between groups.

Overall differential abundance

Both treatments were associated with a reduction in the relative abundance of several bacterial families classically linked to periodontal disease. Specifically, decreases were observed in Prevotellaceae, Porphyromonadaceae, and Spirochaetaceae, families previously associated with taxa linked to periodontal dysbiosis, as well as in Micrococcaceae. In parallel, a relative increase was observed in Tannerellaceae, Enterococcaceae, Bacillaceae, and Lachnospiraceae, suggesting a common ecological shift following periodontal intervention. It is important to note that these changes were observed at the level of relative abundance and do not imply absolute increases or decreases in bacterial load.

However, changes in the relative abundance of other families showed distinct patterns between groups. As shown in Figure 2, the pattern of observed changes differed between the SRP and EAP groups, with more pronounced reductions in specific families depending on the applied protocol.

Differential abundance analysis suggested that EAP was associated with a more pronounced reduction in several bacterial families linked to periodontal dysbiosis compared with SRP, particularly Prevotellaceae, Flavobacteriaceae, and Leptotrichiaceae, families previously associated with taxa belonging to the orange complex. These findings suggest distinct descriptive abundance patterns associated with EAP in taxa related to active inflammatory stages. Conversely, maintenance therapy performed with SRP was associated with a more marked reduction in certain bacterial families, notably Spirochaetaceae, Porphyromonadaceae, and Neisseriaceae, which include taxa previously associated with advanced periodontal dysbiosis.

Thus, while both treatments reduced taxa associated with periodontal dysbiosis, the pattern of reduction differed between protocols, with EAP showing different descriptive abundance patterns, whereas SRP showed distinct reduction patterns in other bacterial families. In particular, Lachnospiraceae, Bacillaceae, Tannerellaceae, and Actinomycetaceae showed a significantly increased relative abundance in the EAP group compared with the SRP group. These families have been previously associated with microbial communities linked to post-treatment ecological stabilization, although no direct functional inference can be made from the present data.

These findings may reflect differences in the mechanisms by which each intervention disrupts the subgingival biofilm. Air-polishing, through its minimally invasive and more homogeneous surface debridement, may preferentially affect loosely organized or early colonizing taxa, thereby influencing microbial succession pathways. In contrast, SRP, with its more intensive mechanical instrumentation, may exert a different effect on deeply embedded or structurally mature biofilm components. From an ecological perspective, these differences could influence the trajectory of microbial recolonization and the resilience of the post-treatment community, although this hypothesis requires confirmation in longitudinal studies incorporating functional and species-level analyses.

Figure 3 shows the changes in the relative abundance of the main periodontopathogenic families when comparing both treatments. In the SRP group, a significant decrease in Spirochaetaceae was observed (Figure 3a). In the EAP group, a more marked reduction in Pasteurellaceae and Prevotellaceae was detected (Figures 3c and 3d), whereas Porphyromonadaceae (Figure 3b) showed a comparable decrease in both groups. In contrast, Tannerellaceae increased in both treatments, with a more pronounced rise in the EAP group (Figure 3e).

Erythritol air polishing was associated with a more pronounced reduction in several families linked to periodontal dysbiosis and with a greater increase in families potentially related to a more stable post-treatment microbiome, whereas the SRP group showed different reduction patterns in specific taxa. Overall, these results indicate that both treatments were associated with reductions in key periodontopathogenic families, although the magnitude and pattern of these changes varied between protocols.

Pain scores according to treatment are shown in Figure 4. Higher values were observed in the SRP group; however, the differences were not statistically significant ($p = 0.075$). A non-significant trend toward lower discomfort was observed in the EAP group.

Treatment time according to the protocol is shown in Figure 5. The EAP protocol (17.5 ± 1.9 min) was significantly faster than SRP (25.8 ± 7.1 min), with a mean difference of 8.3 min ($p = 0.002$).

DISCUSSION

In this randomized clinical trial, an erythritol powder air-polishing protocol in supportive periodontal therapy was compared with ultrasonic instrumentation and SRP. At 6 months, both treatments showed comparable clinical efficacy, with significant reductions in PD, CAL, and BOP. However, air polishing was associated with lower patient-reported discomfort (VAS) and greater treatment efficiency, reflected by shorter operative time.

These findings are consistent with the available evidence. Park *et al*.[1] and Wennström *et al*.[3] demonstrated that low-abrasive air-polishing powders such as erythritol provide clinical outcomes comparable to SRP in both active and maintenance phases. Similarly, recent meta-analyses and systematic reviews have confirmed that supra- and subgingival biofilm removal is comparable between

both therapeutic approaches, with no clinically relevant differences and with reduced impact on the root surface when low-abrasive air polishing is used[17-20].

The microbiological component of this study should be interpreted with particular caution. As an exploratory family-level 16S rRNA analysis conducted in a small pilot sample, these findings are hypothesis-generating only and do not support confirmatory biological conclusions. Rather, they provide preliminary insight into potential ecological differences between treatment modalities that warrant validation in larger studies.

In addition to the comparable clinical improvement observed with both protocols, a metagenomic analysis was performed to assess whether these clinical similarities were accompanied by differential microbiological effects. Both treatments were associated with a reduction in bacterial families classically related to periodontal dysbiosis and to the microbial complexes described by Socransky *et al*.[15], particularly Prevotellaceae, Porphyromonadaceae, and Spirochaetaceae. These findings are consistent with previous clinical trials reporting favorable microbiological changes during supportive periodontal therapy using erythritol[1, 8,12, 21].

However, differential abundance analysis revealed distinct microbial responses depending on the treatment applied. In the EAP group, more pronounced reductions were observed in certain families associated with the orange complex, such as Prevotellaceae, Flavobacteriaceae, and Leptotrichiaceae, whereas SRP showed different reduction patterns on other families associated with the red complex, including Spirochaetaceae and Porphyromonadaceae.

Rather than indicating superiority of one approach over the other, these findings suggest that the two treatment modalities may exert distinct ecological pressures on the subgingival microbiota, targeting different components of the dysbiotic community. In this context, air polishing may preferentially affect taxa associated with earlier or transitional stages of dysbiosis, whereas SRP may exert a different impact on taxa more closely linked to advanced disease states. Importantly, these differential microbial patterns occurred despite comparable clinical improvements, supporting the concept that similar clinical outcomes may be achieved through distinct ecological pathways of biofilm disruption and reorganization [3,12,21].

An aspect requiring cautious interpretation is the relative increase observed in some bacterial families after treatment, including Tannerellaceae, Lachnospiraceae, Bacillaceae, and Actinomycetaceae, particularly in the EAP group. This finding should be interpreted in light of the fact that 16S rRNA gene sequencing provides measures of relative abundance; therefore, a marked reduction in dominant taxa may result in proportional increases in other groups without necessarily indicating a true increase in absolute pathogenic load, as previously described in periodontal microbiome studies[15]. Thus, given the compositional nature of 16S rRNA gene sequencing data, such increases should be interpreted as proportional changes rather than absolute expansion of these taxa. Notably, the increase in Tannerellaceae should be interpreted with caution, as this family includes both health-associated and

pathogenic members, and family-level resolution does not allow species-specific attribution. Furthermore, erythritol has been shown to modify the microstructure and metabolic behavior of the biofilm, promoting ecological reorganization following periodontal treatment[13].

Regarding patient experience, a trend toward lower discomfort was observed with air polishing, consistent with the findings of Petersilka *et al*.[11], who associated low-abrasive powders with reduced discomfort during periodontal therapy. In addition, treatment time was significantly shorter in the EAP group, in agreement with the findings of Martins et al.[22] As noted by Liu *et al*.[23], this time optimization may translate into greater clinical efficiency without compromising therapeutic outcomes. The observation that comparable clinical improvements were accompanied by distinct microbiome responses raises important questions regarding the biological interpretation of periodontal stability. Traditionally, clinical endpoints such as probing depth reduction and bleeding on probing have been considered sufficient indicators of therapeutic success. However, the present findings suggest that these clinical improvements may mask underlying differences in microbial community structure, which may have clinically relevant implications for the long-term stability of periodontal health and the risk of disease recurrence. From this perspective, periodontal maintenance may not represent a single ecological endpoint but rather multiple potential trajectories of microbial reorganization, influenced by the nature of the mechanical intervention. This concept aligns with emerging ecological models of dysbiosis, in which the stability and functional capacity of the microbial community, rather than its taxonomic composition alone, determine disease susceptibility.

This study is limited by the small sample size and the microbiological analysis performed at the family level, which restricts taxonomic resolution. As a pilot trial, the findings should be considered exploratory and hypothesis-generating. The use of relative abundance data further limits interpretation of absolute microbial changes. Therefore, larger studies with longer follow-up and species-level resolution are needed to confirm these findings.

CONCLUSION

Within the limitations of this pilot randomized clinical trial, EAP demonstrated clinical outcomes comparable to scaling and root planing in supportive periodontal therapy, with shorter treatment time and a trend toward improved patient comfort. The exploratory microbiological findings suggest potentially distinct patterns of subgingival bacterial family abundance between treatments; however, these observations are hypothesis-generating only and require confirmation in larger, adequately powered studies with higher taxonomic resolution.

Abbreviations

PD: Probing depth

CAL: Clinical attachment level

BOP: Bleeding on probing

SRP: Scaling and root planing

EAP: Erythritol air-polishing

VAS: Visual analogue scale

Declarations

Funding

This research received no external funding.

Conflict of Interest

The authors declare no conflict of interest.

Data Availability Statement

The datasets generated and/or analysed during the current study have been deposited in the CEU Institutional Repository and are publicly available at https://hdl.handle.net/10637/25274.

Authors' contributions

CMM and AB contributed to study conception and design. CMM, AB, and RGM performed data collection. VV contributed to microbiological analysis. CCS, ICB and RMP contributed to data interpretation and critical revision of the manuscript. All authors read and approved the final manuscript.

Ethics approval and consent to participate

The study was approved by the Biomedical Research Ethics Committee of CEU Cardenal Herrera University (CEEI23/405) and registered at ClinicalTrials.gov (NCT07344805) on November 19, 2025. Retrospectively registered. All participants provided written informed consent. All procedures were performed in accordance with the ethical standards of the institutional research committee and with the 1964 Declaration of Helsinki and its later amendments.

Consent for publication

Not applicable

Acknowledgements

Not applicable

References

1. Park EJ, Kwon EY, Kim HJ, Lee JY, Choi J, Joo JY. Clinical and microbiological effects of the supplementary use of an erythritol powder air-polishing device in non-surgical periodontal therapy: A randomized clinical trial. **J Periodontal Implant Sci.** 2018;48(5):295-304.
2. Ulvik IM, Saethre T, Bunaes DF, Lie SA, Enersen M, Leknes KN. A 12-month randomized controlled trial evaluating erythritol air-polishing versus curette/ultrasonic debridement of mandibular furcations in supportive periodontal therapy. **BMC Oral Health.** 2021;21(1):38.
3. Wennström JL, Dahlén G, Ramberg P. Subgingival debridement of periodontal pockets by air polishing in comparison with ultrasonic instrumentation during maintenance therapy. **J Clin Periodontol.** 2011;38(9):820-27.
4. Schmidlin PR, Beuchat M, Busslinger A, Lehmann B, Lutz F. Tooth substance loss resulting from mechanical, sonic and ultrasonic root instrumentation assessed by liquid scintillation. **J Clin Periodontol.** 2001;28(11):1058-66.
5. Greenstein G. Periodontal response to mechanical non-surgical therapy: A review. **J Periodontol.** 1992;63:118-30.
6. Nong Z, Ya Z, Zheng J, Yong X, Tao R. The efficacy of subgingival air polishing and subgingival debridement in periodontal support therapy: A meta-analysis. **Evid Based Dent.** 2023;24(3):142-3.
7. Zhang J, Liu J, Li J, Chen B, Li H, Yan F. The clinical efficacy of subgingival debridement by ultrasonic instrumentation compared with subgingival air polishing during periodontal maintenance: A systematic review. **J Evid Based Dent Pract.** 2019;19(4):101314.
8. Hägi TT, Hofmänner P, Salvi GE, Ramseier CA, Sculean A. Clinical outcomes following subgingival application of a novel erythritol powder by means of air polishing in supportive periodontal therapy: A randomized controlled clinical study. **Quintessence Int.** 2013;44(10):753-61.
9. Albonni H, Alseirafi W, Tekleh H, Abo Orabi F, Alhaj M, Almasri D, et al. Clinical outcomes of using erythritol powder by means of air polishing with ultrasonic debridement in the treatment of initial periodontal pockets in the hands of dental students: A split-mouth randomized controlled study (Part I). **Int J Dent Hyg.** 2021;19(3):262-72.
10. Albonni H, Alseirafi W, Tekleh H, Sawaf H. Clinical outcomes of performance of dental students using erythritol powder by means of air polishing with ultrasonic debridement with students' assessment (Part II). **Int J Dent Hyg.** 2022;20(2):391-400.
11. Petersilka GJ, Bell M, Häberlein I, Mehl A, Hickel R, Flemmig TF. In vitro evaluation of novel low-abrasive air polishing powders. **J Clin Periodontol.** 2003;30:9-13.
12. Müller N, Moëne R, Cancela JA, Mombelli A. Subgingival air-polishing with erythritol during periodontal maintenance: A randomized clinical trial of twelve months. **J Clin Periodontol.** 2014;41(9):883-89.
13. Hashino E, Kuboniwa M, Alghamdi SA, Yamaguchi M, Yamamoto R, Cho H, et al. Erythritol alters microstructure and metabolomic profiles of biofilm composed of Streptococcus gordonii and

Porphyromonas gingivalis. **Mol Oral Microbiol.** 2013;28:435-51.

14. Nascimento GG, Leite FRM, Pennisi PRC, López R, Paranhos LR. Use of air polishing for supra- and subgingival biofilm removal for treatment of residual periodontal pockets and supportive periodontal care: A systematic review. **Clin Oral Investig.** 2021;25(3):779-95.
15. Socransky SS, Haffajee AD, Cugini MA, Smith C, Kent RL Jr. Microbial complexes in subgingival plaque. **J Clin Periodontol.** 1998;25(2):134-44.
16. Vicente Herrero MT, Delgado Bueno S, Bandrés Moyá F, Ramírez Íñiguez de la Torre MV, Capdevila García L. Valoración del dolor: Revisión comparativa de escalas y cuestionarios. **Rev Soc Esp Dolor.** 2018;25(4):228-36.
17. Abdulbaqi HR, Shaikh MS, Abdulkareem AA, Zafar MS, Gul SS, Sha AM. Efficacy of erythritol powder air-polishing in active and supportive periodontal therapy: A systematic review and meta-analysis. **Int J Dent Hyg.** 2022;20(1):62-74.
18. Onisor F, Mester A, Mancini L, Voina-Tonea A. Effectiveness and clinical performance of erythritol air-polishing in non-surgical periodontal therapy: A systematic review of randomized clinical trials. **Medicina (Kaunas).** 2022;58(7):866.
19. Tan SL, Grewal GK, Mohamed Nazari NS, Mohd-Dom TN, Baharuddin NA. Efficacy of air polishing in comparison with hand instruments and/or power-driven instruments in supportive periodontal therapy and implant maintenance: A systematic review and meta-analysis. **BMC Oral Health.** 2022;22(1):85.
20. Gheorghe DN, Bennardo F, Silaghi M, Popescu DM, Maftei GA, Bătăiosu M, et al. Subgingival use of air-polishing powders: Status of knowledge. **J Clin Med.** 2023;12(21):6936.
21. Hägi TT, Hofmänner P, Eick S, Donnet M, Salvi GE, Sculean A, et al. The effects of erythritol air-polishing powder on microbiologic and clinical outcomes during supportive periodontal therapy: Six-month results of a randomized controlled clinical trial. **Quintessence Int.** 2015;46(1):31-41.
22. Martins O, Costa A, Silva D. The efficacy of air polishing devices in supportive periodontal therapy: Clinical, microbiological and patient-centred outcomes. **Int J Dent Hyg.** 2023;21(1):41-58.
23. Liu CC, Dixit N, Hatz CR, Janson TM, Bastendorf KD, Belibasakis GN, et al. Air powder waterjet technology using erythritol or glycine powders in periodontal or peri-implant prophylaxis and therapy: A consensus report of an expert meeting. **Clin Exp Dent Res.** 2024;10(1):e855.

Figures

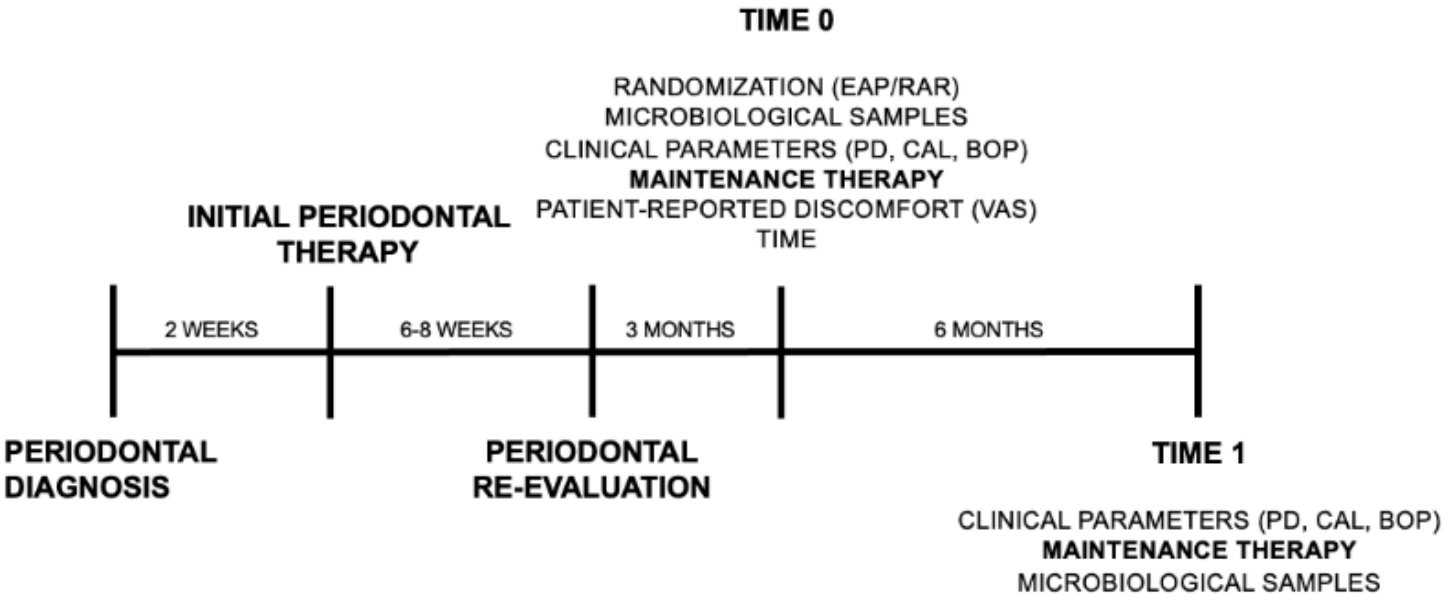


Figure 1

Timeline and sequence of the study design.

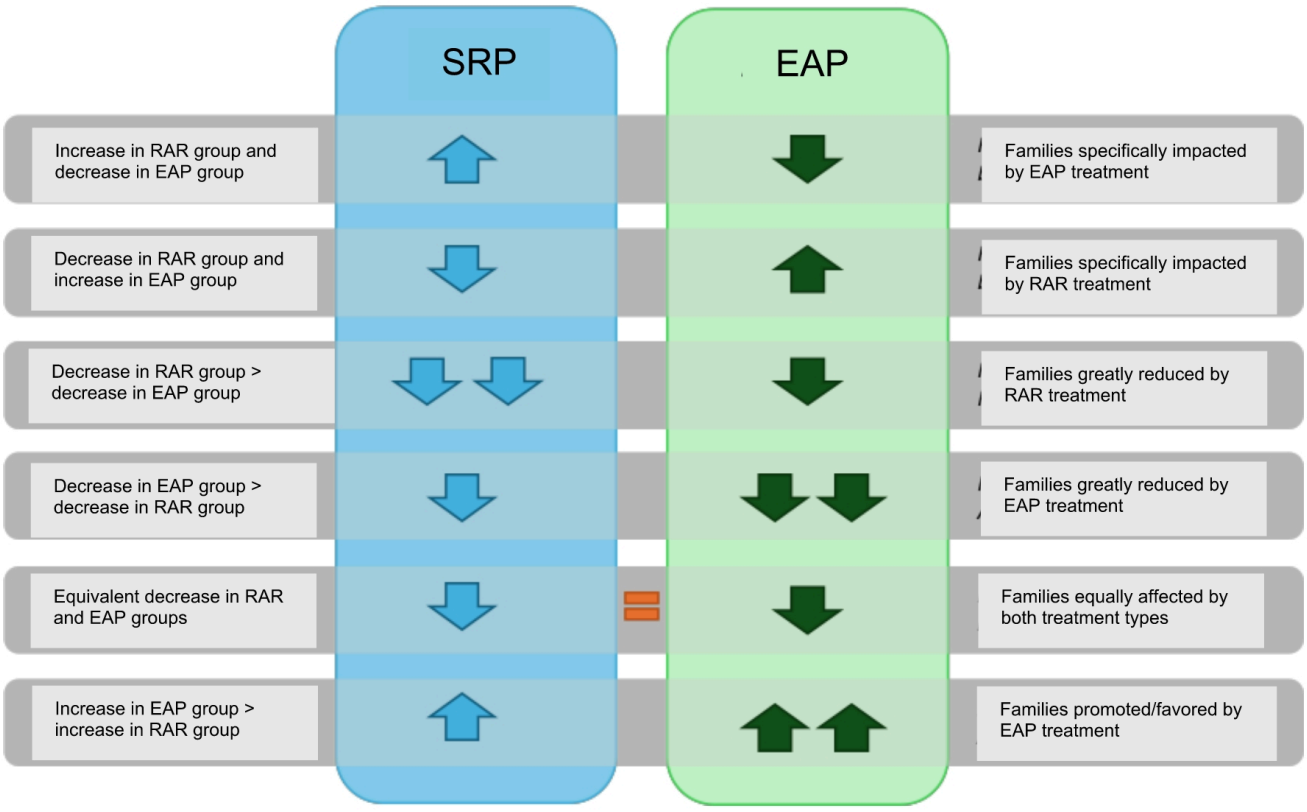


Figure 2

Changes in the relative abundance of bacterial families according to treatment type.

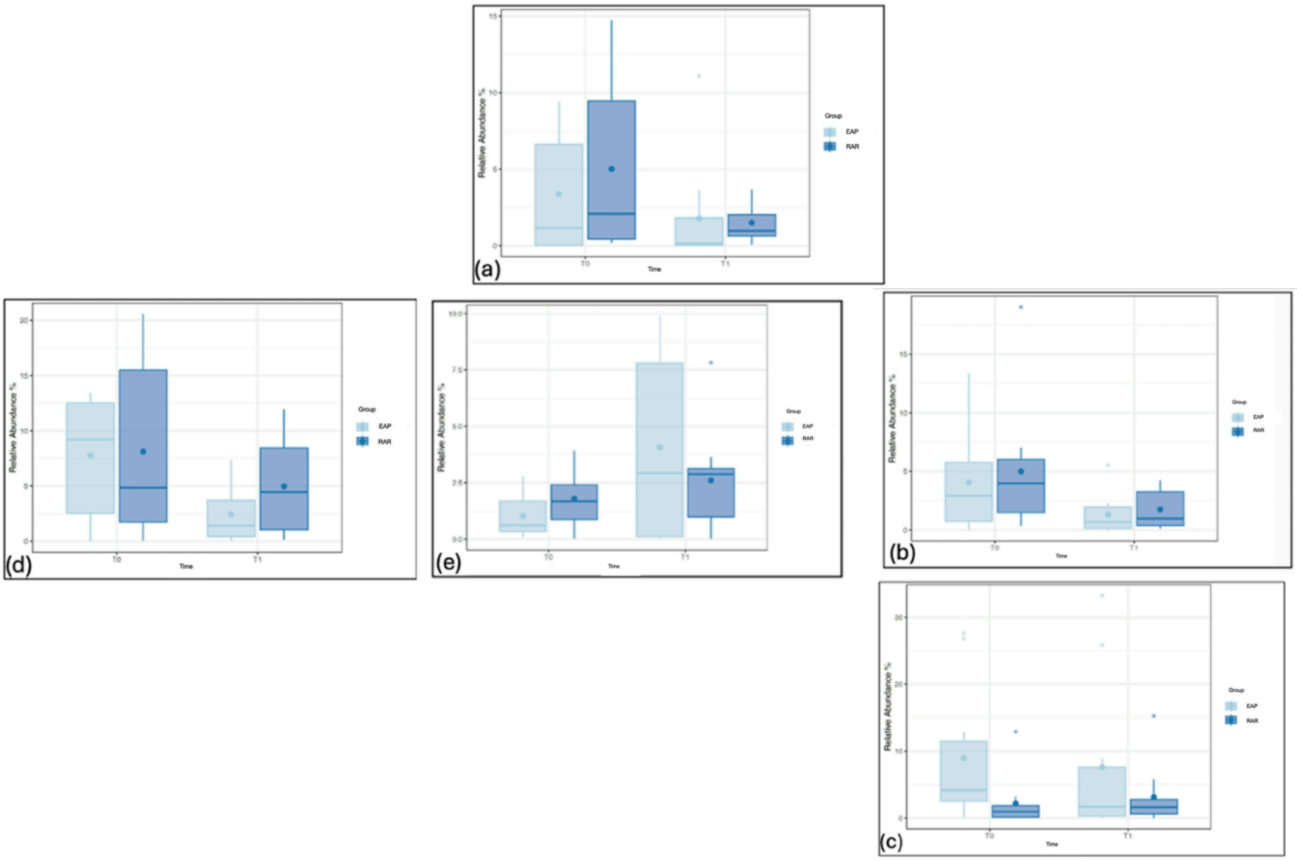


Figure 3

Distribution of the relative abundance of the main periodontopathogenic families comparing both treatments: Spirochaetaceae (a), Porphyromonadaceae (b), Pasteurellaceae (c), Prevotellaceae (d), and Tannerellaceae (e).

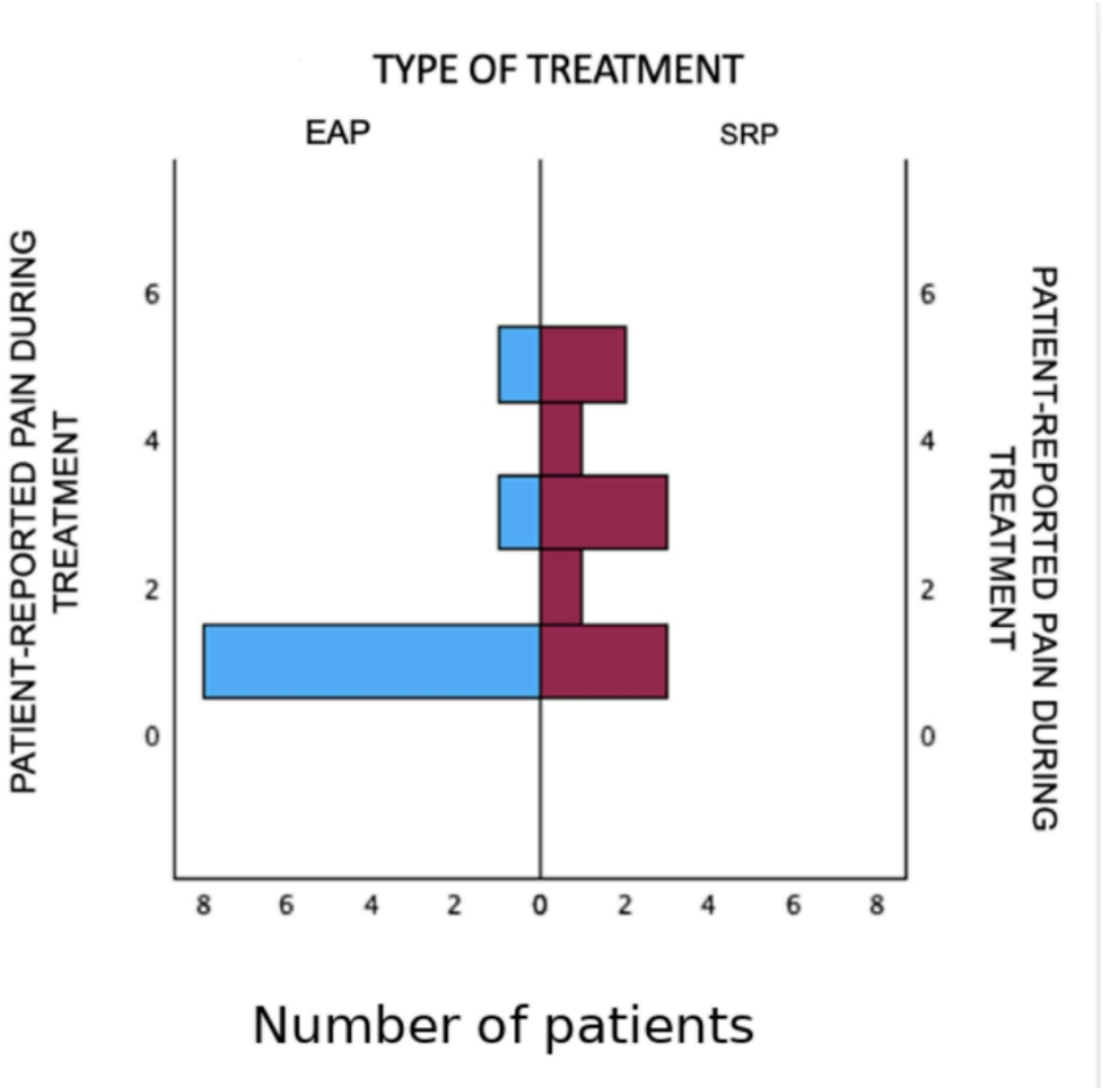


Figure 4

Distribution of patient-reported pain scores according to treatment group.

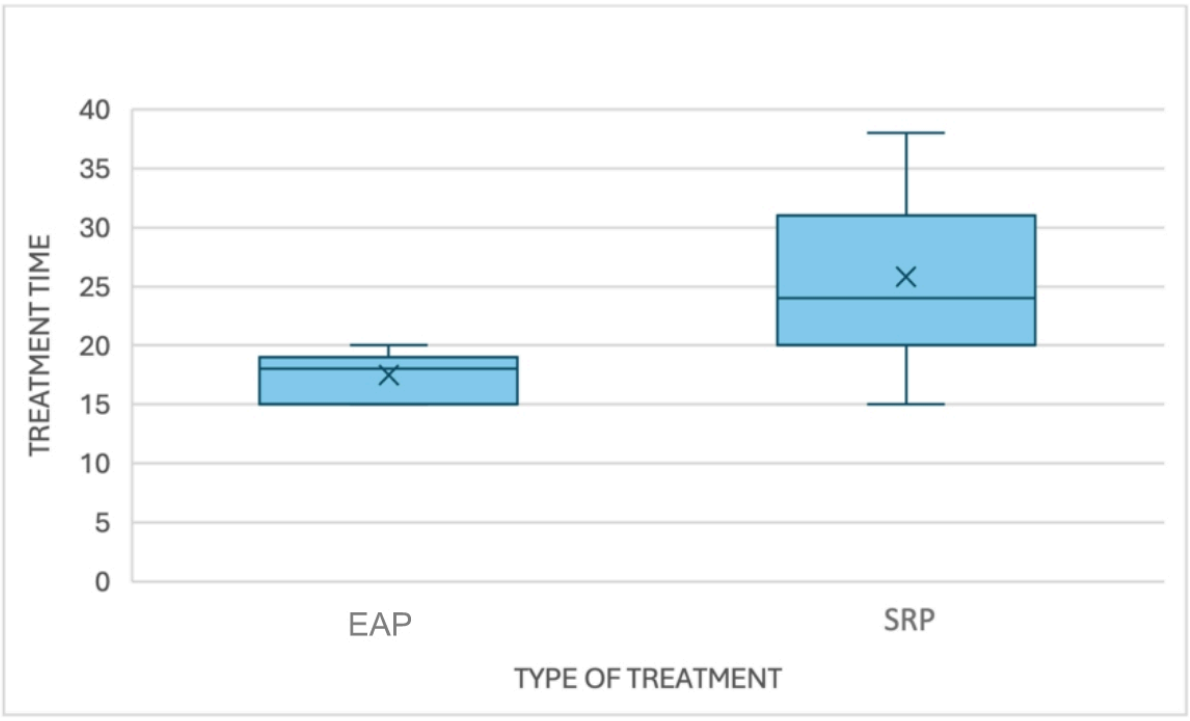


Figure 5

*Treatment time according to the protocol (*EAP *vs. SRP).*

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- SUPPLEMENTARYAPPENDIX.docx