

Changes in Clinical, Periodontal, And Radiographic Parameters Following Comprehensive Treatment of Chronic Localized Periodontitis

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Abstract: Background: Minimally invasive subgingival biofilm control with air polishing may provide clinical outcomes comparable to conventional root debridement while improving patient comfort and limiting iatrogenic tissue damage. Objective: To evaluate changes in clinical periodontal and radiographic parameters in patients with chronic localized periodontitis following comprehensive treatment that included subgingival air-abrasive root-surface debridement and subsequent prosthodontic rehabilitation. Methods: The study included 160 patients aged 18–59 years with mild chronic localized periodontitis and 20 periodontally healthy controls. Patients were stratified according to tooth vitality and crown design. Periodontal probing depth (PPD), clinical attachment level (CAL), bleeding on probing (BOP), OHI-S, SBI, and radiographic parameters were assessed longitudinally. Results: At 6 months, PPD, CAL, BOP, SBI, and OHI-S improved across all clinical subgroups. The greatest PPD reductions were observed with the periodontally oriented crown: 1.87 mm for vital teeth and 1.72 mm for non-vital teeth. Complete clinical response was more frequent around vital than non-vital teeth (73.8% vs 55.0%). No progression of bone resorption was observed in 95.0% and 88.8% of patients in the vital- and non-vital-tooth groups, respectively. Conclusions: Comprehensive periodontal treatment followed by prosthodontic rehabilitation produced sustained clinical improvement at 6 months. Periodontally oriented crowns were associated with favorable periodontal stabilization in both tooth-vitality groups.

Keywords: Chronic localized periodontitis; air polishing; periodontal therapy; prosthodontic rehabilitation; zirconia crown; periodontal probing depth.

Introduction: Even after clinically successful initial root debridement, the biofilm re-establishes, and long-term periodontal stability is largely determined by the supportive periodontal therapy program, including individualized recall intervals, professional plaque removal, and reinforcement of patient motivation

[2,9]. Systematic reviews indicate that evidence supporting a fixed maintenance interval is limited; a risk-based approach accounting for baseline disease severity, residual pockets, bleeding on probing, and behavioral factors appears more appropriate [1,3,10]. Meta-analyses also emphasize adherence to

supportive periodontal therapy as a determinant of long-term outcomes, including tooth loss; therefore, procedural comfort and pain reduction are clinically relevant considerations when selecting a treatment modality [6,11].

From this perspective, air polishing offers an additional methodological advantage. Several systematic reviews evaluating patient-reported experience have shown a tendency toward less discomfort compared with conventional instrumentation, consistent with randomized clinical trials reporting lower visual analog scale (VAS) pain scores in air-polishing groups [3,5]. In chronic localized periodontitis, where treatment is often performed segmentally and repeatedly, good treatment tolerance and patient adherence become practical prerequisites for maintaining a low inflammatory burden and preventing recurrent pocket deepening [7,8].

Clinical monitoring after root surface debridement generally focuses on early assessment of inflammation and pain sensitivity during the first weeks, followed by intermediate-term evaluation of stabilization in periodontal probing depth (PPD), clinical attachment level (CAL), and bleeding on probing (BOP) at 3–6 months. This schedule is reflected in randomized studies of air polishing used during supportive periodontal therapy [4,5]. In particular, the 3- and 6-month time points allow clinical parameters to extend beyond the acute healing phase and begin to reflect the stability of the newly established balance between biofilm and the host immunoinflammatory response. In some protocols, retreatment of persistent pockets is considered part of the strategy for controlling residual disease sites [1,7].

Taken together, the available evidence supports minimally invasive subgingival biofilm control as a clinically viable alternative to conventional aggressive root planing, particularly during supportive periodontal therapy and in the management of residual pockets. Low-abrasive powders such as glycine, erythritol, and trehalose generally provide clinical outcomes for PPD, CAL, and BOP comparable to those achieved with manual and ultrasonic debridement, while potentially improving patient tolerance and reducing damage to hard and soft tissues. However, between-group differences are often small, and heterogeneity in treatment protocols and pocket characteristics limits

the strength of the evidence, underscoring the primary importance of high-quality initial debridement and subsequent plaque control.

Within this framework, combining modified air-abrasive root surface treatment for controlled biofilm removal and minimization of iatrogenic trauma with subsequent application of a protective root-surface coating as a potential barrier and desensitizing agent has a plausible clinical and biological rationale for improving outcomes in localized periodontal lesions [12]. This approach may simultaneously reduce bacterial burden and accelerate resolution of inflammation, decrease dentin hypersensitivity and thereby support early oral hygiene adherence, and potentially reduce plaque retention by modifying the treated root surface microtopography [3,10]. Therefore, air-abrasive treatment followed by root-surface coating may represent a rational component of a contemporary minimally invasive protocol for chronic localized periodontitis; further longitudinal clinical evaluation is warranted to determine the durability of the effect [11,12].

Objective: To evaluate longitudinal changes in clinical periodontal and radiographic parameters in patients with chronic localized periodontitis before and after comprehensive treatment incorporating air-abrasive debridement of subgingival tooth/root surfaces.

METHODS

The study included 160 patients aged 18–59 years with mild chronic localized periodontitis who required comprehensive periodontal treatment followed by prosthodontic rehabilitation with full-coverage crowns. An additional 20 periodontally healthy individuals served as the control group. Clinical Group I comprised 80 patients with periodontal involvement around vital teeth, whereas Clinical Group II comprised 80 patients with involvement around non-vital teeth. Each clinical group was divided into four subgroups: A, metal-ceramic crown; B, uncoated zirconia crown; C, coated zirconia crown; and D, periodontally oriented crown.

Periodontal examination was performed according to a standardized protocol and included periodontal probing depth (PPD), clinical attachment level (CAL), bleeding on probing (BOP), the Simplified Oral Hygiene Index (OHI-S; Greene–Vermillion), and the Sulcus Bleeding Index (SBI; Saxer–Mühlemann). Gross

supragingival deposits were removed before measurements only when they interfered with accurate probing; the same approach was applied consistently at all follow-up visits.

The comprehensive treatment and prosthodontic rehabilitation protocol included the following:

1. Preparatory phase. Before prosthodontic treatment, professional oral hygiene was performed with removal of supragingival and subgingival deposits.
2. Periodontal/therapeutic phase. Local factors contributing to persistent inflammation were eliminated. Antiseptic treatment of the oral cavity and inflamed sites was performed using an aqueous chlorhexidine digluconate solution. In the vital-tooth group, a topical anti-inflammatory agent (Periogel) was applied to the affected tissues.
3. Endodontic phase. In patients with non-vital teeth, nonsurgical endodontic retreatment was performed when indicated. When a furcation defect was identified, it was repaired with a mineral trioxide aggregate (MTA)-based material because of its biocompatibility, sealing ability, and stability in a moist environment.
4. Periodontal treatment. The principal periodontal intervention consisted of air-abrasive debridement of root surfaces within periodontal pockets to remove biofilm and root-surface contaminants using a COXO air-abrasion device and 27- μ m aluminum oxide particles.
5. Prosthodontic phase. An impression was first obtained to fabricate a silicone index. The tooth was then prepared, and a provisional crown was fabricated and temporarily cemented during production of the definitive restoration. Once completed, the definitive crown was luted with glass ionomer cement.

For patients receiving a periodontally oriented crown, the prosthodontic phase included the following modifications:

- After obtaining the impression for fabrication of the provisional resin restoration, the soft tissues were displaced using polytetrafluoroethylene (PTFE) tape to gain access to the full depth of the pathologic periodontal pocket without surgical incision;
- The abutment tooth was prepared using a finish-line-

free approach extending to the full depth of the periodontal pocket. A provisional resin restoration was fabricated from the previously obtained impression, with additional relining of the subgingival portion using a flowable composite resin, and was temporarily cemented;

- Two weeks later, after maturation of the soft-tissue contour around the provisional crown and remodeling of the supracrestal tissue attachment, an impression was obtained for fabrication of the definitive periodontally oriented crown. The definitive restoration closely reproduced the contours of the provisional restoration and the anatomy of the tooth, with a deeply subgingival emergence profile. It was fabricated from zirconia; the cervical region was highly polished and left without veneering ceramic. This design was intended to promote close adaptation of the gingival tissues to the cervical crown surface and thereby limit bacterial penetration.

6. Supportive phase. During follow-up, patients were instructed to maintain individualized oral hygiene and attended scheduled evaluations at 2 weeks, 3 months, and 6 months after treatment.

RESULTS

Before treatment, the eight A–D subgroups were comparable with respect to the principal clinical and structural parameters. No statistically significant differences were observed in PPD, CAL, OHI-S, radiographic loss of alveolar bone support, or most laboratory parameters ($P > .05$). This baseline comparability supports subsequent comparisons among restorative designs because the type of planned crown could not yet have influenced periodontal status.

The difference between vital and non-vital teeth was not reflected in greater pocket depth. Mean PPD was 5.12 mm in Group I (vital teeth) and 5.20 mm in Group II (non-vital teeth), whereas CAL was 4.13 and 4.23 mm, respectively. A more consistent difference was observed in inflammatory activity: BOP and SBI were higher in the non-vital group. These findings distinguish structural disease severity from current inflammatory activity.

At 14 days after completion of active treatment, the predominant change was a reduction in inflammatory parameters, whereas structural measures changed

more modestly. Most of the reduction in pocket depth was evident by 3 months, and the response became more stable by 6 months (Table 1). Patients with non-vital teeth showed a slower early response; nevertheless, reductions in PPD and CAL were maintained across all subgroups.

Table 1

Changes in periodontal probing depth and clinical attachment level at 6 months

Group	PPD baseline, mm	PPD at 6 month, mm	CAL baseline, mm	CAL at 6 month, mm
I-A	5.14±0.19	3.53±0.16	4.13±0.19	3.35±0.15
I-B	5.06±0.17	3.36±0.14	4.21±0.21	3.38±0.17
I-C	5.17±0.20	3.39±0.16	4.23±0.22	3.36±0.18
I-D	5.13±0.17	3.26±0.13	3.93±0.23	3.03±0.18
II-A	5.32±0.19	3.84±0.15	4.28±0.21	3.56±0.17
II-B	5.05±0.19	3.49±0.15	4.30±0.21	3.54±0.17
II-C	5.25±0.17	3.61±0.14	4.06±0.22	3.26±0.17
II-D	5.16±0.17	3.44±0.13	4.28±0.20	3.44±0.16

PPD decreased significantly in all subgroups. The greatest reductions were observed in I-D (vital teeth with a periodontally oriented crown) and II-D (non-vital teeth with a periodontally oriented crown), at 1.87 mm and 1.72 mm, respectively. The reduction was less pronounced in the metal-ceramic crown subgroups. Gains in clinical attachment were smaller in magnitude. Importantly, the decrease in PPD could not be attributed solely to resolution of gingival edema

because CAL improved concurrently.

Bleeding decreased more rapidly than the structural periodontal parameters (Table 2). The lowest 6-month BOP values were observed in subgroups I-C and I-D, at 9.6% and 9.4%, respectively. Within the non-vital Group II, subgroups II-C and II-D showed the most favorable inflammatory profile, although their values remained higher than those observed around vital teeth.

Table 2

Changes in bleeding on probing and the Sulcus Bleeding Index

Group	BOP baseline, %	BOP at 6 months, %	SBI baseline	SBI at 6 months
I-A	55.7±3.0	15.2±2.4	1.67±0.05	0.70±0.04
I-B	53.6±2.7	10.9±2.2	1.71±0.06	0.69±0.05
I-C	54.4±2.5	9.60±2.03	1.71±0.07	0.63±0.06
I-D	56.5±2.7	9.40±2.17	1.69±0.09	0.57±0.07
II-A	62.9±3.0	25.7±2.4	1.79±0.08	0.90±0.06
II-B	59.3±2.8	20.1±2.3	1.80±0.07	0.86±0.06
II-C	57.6±3.0	16.3±2.4	1.87±0.07	0.88±0.06
II-D	58.5±2.9	15.2±2.3	1.84±0.07	0.81±0.05

OHI-S decreased in all subgroups. Patients with vital teeth achieved lower final values (1.13 vs 1.33 in Group II). The lowest OHI-S values were recorded in I-C and I-D (1.04 in both subgroups). Among patients with non-vital teeth, OHI-S remained higher, particularly in II-A and II-B. This difference may account for part, but not all, of the residual bleeding, because BOP in II-C and II-D differed from II-A to a greater extent than would be

expected on the basis of plaque levels alone.

The proportion of patients achieving a complete clinical response increased from restorative option A through option D (Table 3). Among patients with vital teeth, a complete response was achieved in 65.0% of I-A, 70.0% of I-B, 75.0% of I-C, and 85.0% of I-D. Corresponding values for non-vital teeth were lower: 40.0%, 50.0%, 60.0%, and 70.0%, respectively. Overall, the complete-

response rate was 73.8% for vital teeth versus 55.0% for non-vital teeth.

Table 3
Changes in the Simplified Oral Hygiene Index (OHI-S)

Group	OHI-S baseline	OHI-S At 6 month	Reduction, %	p
I-A	2.34±0.12	1.22±0.10	47.9	<0.001
I-B	2.40±0.11	1.22±0.09	49.2	<0.001
I-C	2.29±0.11	1.04±0.09	54.6	<0.001
I-D	2.34±0.13	1.04±0.11	55.6	<0.001
II-A	2.42±0.15	1.38±0.12	43.0	<0.001
II-B	2.48±0.13	1.40±0.10	43.5	<0.001
II-C	2.41±0.13	1.27±0.11	47.3	<0.001
II-D	2.47±0.12	1.27±0.09	48.6	<0.001

A complete treatment response was defined as PPD ≤ 3.5 mm, BOP $< 15\%$, no deterioration in CAL, and OHI-S ≤ 1.2 . An inadequate response was uncommon but occurred predominantly in subgroups II-A and II-B. Restorative option D, the periodontally oriented crown, was associated with the highest proportion of complete clinical stabilization in both clinical groups.

Radiographic changes over 6 months were small in absolute magnitude but clinically relevant for assessing

the safety of the prosthodontic phase. No progression of bone resorption was observed in 95.0% of patients in the vital-tooth group and 88.8% of those in the non-vital-tooth group. Among non-vital teeth, periapical stability was most frequently maintained in II-D, in which 19 of 20 patients showed no adverse radiographic change; the corresponding figure in II-A was 17 of 20. This difference coincided with greater residual bleeding and a higher number of partial responses in II-A (Figure 1).



Figure 1. Radiographic images before and after comprehensive treatment

Residual signs of inflammation were not randomly distributed. They were concentrated in the non-vital subgroups II-A and II-B, which simultaneously showed higher BOP and SBI values and a greater proportion of sites with PPD ≥ 4 mm. In the vital-tooth group, the number of patients with residual BOP $\geq 15\%$ was lowest in I-C and I-D. The coated zirconia crown showed a more favorable reduction in inflammatory parameters,

whereas the periodontally oriented crown combined an anti-inflammatory effect with a lower need for repeat occlusal adjustment.

DISCUSSION

Comprehensive treatment of chronic localized periodontitis followed by prosthodontic rehabilitation with full-coverage crowns resulted in substantial improvement in periodontal clinical status across all

study subgroups. At 6 months, PPD had decreased by approximately one-third; BOP decreased nearly fivefold in patients with vital teeth and more than threefold in patients with non-vital teeth; and SBI decreased 2.6-fold and 2.1-fold, respectively. A complete clinical response was more frequent around vital teeth, with a rate 18.8 percentage points higher than that around non-vital teeth. No evidence of progressive bone resorption was observed at the 6-month follow-up.

CONCLUSION

The findings of the present study support the clinical effectiveness of a comprehensive periodontal and prosthodontic treatment approach incorporating subgingival air-abrasive debridement. The results further suggest that the use of periodontally oriented crowns may contribute to more favorable stabilization of periodontal tissues during prosthodontic rehabilitation. Further well-designed controlled studies with longer follow-up periods are warranted to confirm the long-term clinical and radiographic effectiveness of the proposed treatment approach.

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