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Analysis of Changes in Plaque Index and Gingival Index Before and After Non-Surgical Periodontal Therapy

Ziqiong Wu*

Science in Dentistry, Lincoln University College, Kuala Lumpur 50000, Malaysia.

*Corresponding author: Ziqiong Wu, 2675527405@qq.com.

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Abstract: Periodontal disease (PD), a prevalent chronic inflammatory malady of the oral periodontal tissues in need of proper treatment, is essentially attributed to plaque biofilm accumulation. The aim of the present trial was to determine whether NSPT is effective in reducing plaque and gingival indices among CP individuals. Patients who were diagnosed with periodontal disease agreed to complete non-surgical treatment that involved scaling, root surface smoothing, and support for optimal oral hygiene. Clinical features were examined periodically at baseline and six months post-intervention. After the intervention, both the plaque index and gingival index decreased significantly, and the maximum reduction occurred in the first observation following analysis of data. These benefits persisted during the 6-month follow-up. These findings highlight the importance of maintenance and plaque control to obtain and maintain optimal duration-related periodontal health and in addition demonstrating the superiority of non-surgical periodontal therapy as a first-line management approach for patients with PD.

Keywords: non-surgical periodontal therapy; plaque index; gingival index; chronic periodontitis; periodontal maintenance



1. Introduction

1.1. Background and Literature Review

When the high prevalences described in various populations are considered, epidemiological data indicate that this is one of the most prevalent chronic conditions and public health problems worldwide, with a prevalence between 20% and 50% in adults (Nazir et al., 2020). A complicated immune reaction, with proinflammatory cytokines such as interleukin-1, interleukin-6, and tumor necrosis factor, is initiated by plaque bacteria biofilms that begin an inflammatory response (Neurath & Kesting, 2024). The principal etiological factor in the conversion of gingivitis to destructive periodontitis is dental plaque; it also induces expression from several bacterial virulence factors that provoke host inflammation (Yekani et al., 2025).

Non-surgical periodontal therapy—mechanical debridement and patient education—has been demonstrated to be effective when the proper treatment protocols are followed (Tomasi et al., 2022). According to a thorough review of the literature, this therapeutic approach is the most commonly used for initial periodontal therapy in the majority of clinical cases, effectively reducing inflammatory phenomena without the need for surgery (Ghuman, 2019). Plaque indices and gingival indices are used to monitor periodontal diseases and treatment outcomes because they represent indispensable tools for the assessment of bacterial plaque accumulation and inflammation, respectively. Standard diagnostic criteria are also required for proper assessment of treatment development (Heitz-Mayfield, 2024).

1.2. Research Objectives and Significance

Although non-surgical periodontal treatment is a frequent procedure in the daily clinical routine, so far, no systematic review on patient-linked outcomes exists (Khan, Khalid, Bettiol, & Crocombe, 2021). The effectiveness of subgingival instrumentation has been broadly documented and continuous improvement in periodontal parameters has been observed (Suvan et al., 2020). This study evaluates the decrease of Plaque Index and Gingival Index scores after non-surgical periodontal treatment, their correlation, and dynamic trends in prosthetic patients over time on multiple follow-up



dates. This investigation provides practical guides in patient education programs and prevention programs, supports the role of plaque control in periodontal disease management, and provides a database for clinical judgment.

2. Materials and Methods

2.1. Study Subjects and Design

Patients were gathered during standard clinical consultations at the Department of Periodontology. The selection of candidates was predicated on comprehensive oral examinations that demonstrated moderate to severe chronic periodontitis, which is typified by multiple sites with probing depths greater than 4 millimeters, clinical attachment loss, and radiographic bone loss. These were selected to limit confounders that would affect the treatment effect of known risk associations in periodontal disease populations; that is, eligibility was based on epidemiological studies identifying risk factors for periodontal disease (Alawaji et al., 2022). In addition, subjects presenting uncontrolled diabetes mellitus or cardiovascular diseases in need of anticoagulation treatment, recent history of antibiotic use (in the last 3 months), pregnancy or lactation, and periodontal therapy within the last three months were excluded from the study. All the participants were provided detailed written and spoken descriptions of the study procedures, which had been approved by the institutional ethics committee; full informed consent was obtained.

The future self-controlled design enhanced statistical power to detect a treatment effect that varied over time, as each individual served as their own reference. Periodic recalibration exercises and training of examiners contributed to the consistency in measurement across the study. The statistical significance of observed differences was calculated at the conventional sig. 0.05 level.

2.2. Treatment Protocol and Evaluation Indicators

Patient-specific instruction on oral hygiene was given according to baseline deficits, as patient behavior modification is crucial for a long-standing therapy success (NSPT). For systematic subgingival scaling, site-specific Gracey curettes were used to remove subgingival deposits and prepare root surfaces to produce smooth roots that



would promote reattachment of gingiva. The a priori number of follow-up visits would be four (at best), six at most in combined cases. This not only allowed for recovery in between quadrant treatments but also facilitated slow injection of the local anesthetics during the procedure toward patient comfort (Yan, Zhan, Wang, & Hou, 2020).

Clinical measurements were made using the Silness-Löe Plaque Index, which goes from zero for surfaces free of plaque to three for extensive accumulation that is visible to the unaided eye. A periodontal probe is placed along the gingival margin of each tooth to detect soft deposits. Gingival inflammation was assessed using the Löe-Silness Gingival Index, which goes from zero, which represents healthy pink tissue, to three, which represents spontaneous bleeding and obvious inflammation. Each tooth's mesial, distal, buccal, and lingual regions were gently probed to obtain it. Baseline assessments established pre-treatment reference values before any therapeutic intervention. After the active treatment phase ended, systematic reassessments were scheduled at one-month intervals. Three-month evaluations recorded intermediate stability, and six-month exams detailed long-term maintenance results.

3. Results

3.1. General Characteristics and Changes in Primary Indicators

72 of the 77 subjects who were originally enrolled finished the six-month observation period, resulting in a 93.5% completion rate. Five participants withdrew due to follow-up difficulties. There were 38 men (52.8%) and 34 women (47.2%) in the baseline demographics, and age stratification showed that 24 participants (33.3%) were in the young adult group (25–40 years old), 31 people (43.1%) were in the middle-aged group (41–55 years old), and 17 patients (23.6%) were in the elderly cohort (over 55 years old). According to **Table 1**, the periodontal disease severity assessment identified 54 cases (75.0%) as having severe periodontitis with probing depths greater than 6 millimeters and significant radiographic bone destruction, and 18 cases (25.0%) as having moderate periodontitis with moderate bone loss and probing depths of 4-5 millimeters. Early Plaque Index and Gingival Index values averaged 2.18 ± 0.42 and 2.03 ± 0.38 , respectively.

Table 1

Baseline Characteristics of Study Subjects

Characteristic	Category	n (%) / Mean ± SD
Total Participants		72 (100%)
Gender	Male	38 (52.8%)
	Female	34 (47.2%)
Age (years)	Overall	46.3 ± 11.2
	Young (25-40)	24 (33.3%)
	Middle-aged (41-55)	31 (43.1%)
	Elderly (>55)	17 (23.6%)
Disease Severity	Moderate	18 (25.0%)
	Severe	54 (75.0%)
Baseline PI		2.18 ± 0.42
Baseline GI		2.03 ± 0.38
Mean PD (mm)		5.2 ± 1.1
Completion Rate		93.5%

Plaque Index values showed a significant decrease after non-surgical periodontal therapy was implemented. At one month after treatment, they had dropped from a baseline mean of 2.18 ± 0.42 to 1.15 ± 0.31 , a 47.2% reduction. During the subsequent periods of evaluation, the PI gradually increased to stabilize at 0.76 ± 0.22 (decrease of 65.1%) after six months and dropped back to 0.82 ± 0.24 at three months (decrease of 62.4%). With no significant differences between 3 and 6 months ($t = 1.4$, $P = 0.182$), repeated measures ANOVA in statistical analysis showed highly significant effects between visit points after stabilization period, indicating the establishment of a stable plaque control pattern ($F = 287.4$, $P < 0.001$). Significant change over consecutive intervals to 3 months were found by post-hoc paired comparisons (baseline vs. 1 month: $t = 18.3$, $P < 0.001$; and 1 month vs. 3 months: $t = 7.9$, $P < 0.001$). The Gingival Index scores also improved, falling from 2.03 ± 0.38 at baseline to 1.08 ± 0.29 (46.8% reduction) at one month, 0.73 ± 0.21 (64%) at three months, and 0.68 ± 0.19 at six months (66%). During the active treatment period, there was a significant decrease in inflammation (baseline vs. 1 month: $t = 17.6$, $P < 0.001$; 1 month vs. 3 months: $t = 8.4$, $P < 0.001$), and maintenance stability was achieved later after treatment with maintenance medication (3 months vs. 6 months: $t = 1.2$, $P = 0.235$). Significant longitudinal changes were shown by repeated measures ANOVA ($F = 312.6$, $P < 0.001$). The detailed parameters are presented in **Table 2**, and the corresponding change trend over time is illustrated in **Figure 1**.

Table 2

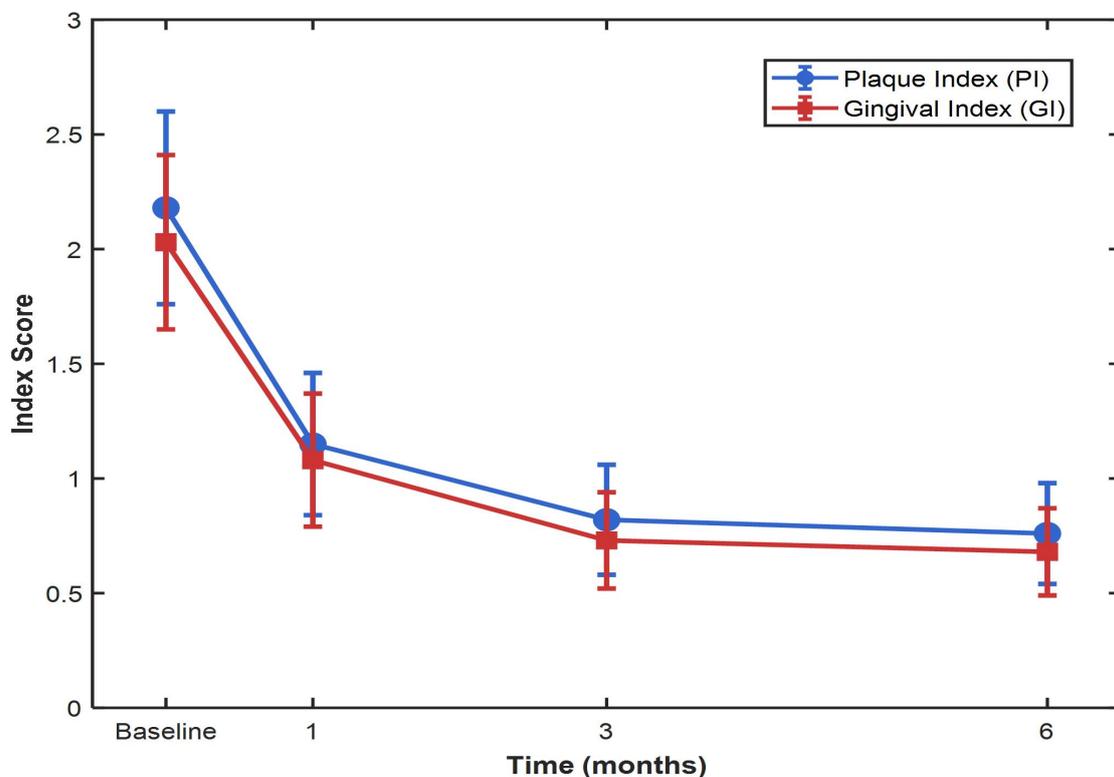
Comparison of Plaque Index and Gingival Index at Different Time Points

Time Point	Plaque Index (PI)	Gingival Index (GI)	PI Reduction (%)	GI Reduction (%)
Baseline	2.18 ± 0.42	2.03 ± 0.38	-	-
1 Month	1.15 ± 0.31***	1.08 ± 0.29***	47.2%	46.8%
3 Months	0.82 ± 0.24***	0.73 ± 0.21***	62.4%	64.0%
6 Months	0.76 ± 0.22***	0.68 ± 0.19***	65.1%	66.5%
F value	287.4	312.6	-	-
P value	<0.001	<0.001	-	-

Note. ***P < 0.001 compared with baseline (paired t-test)

Figure 1

PI and GI change trend over time



3.2. Correlation Analysis and Subgroup Comparison

This raised plaque score was correlated with a higher degree of persisting gingival inflammation severity ($r = 0.847$, $P < 0.001$ by Pearson correlation coefficients) over baseline and endpoint determinations. The results of the correlation showed it is notable that the Plaque Index and the Gingival Index were positively correlated significantly for all periods. As shown in Fig. 2, the scatter plot distribution



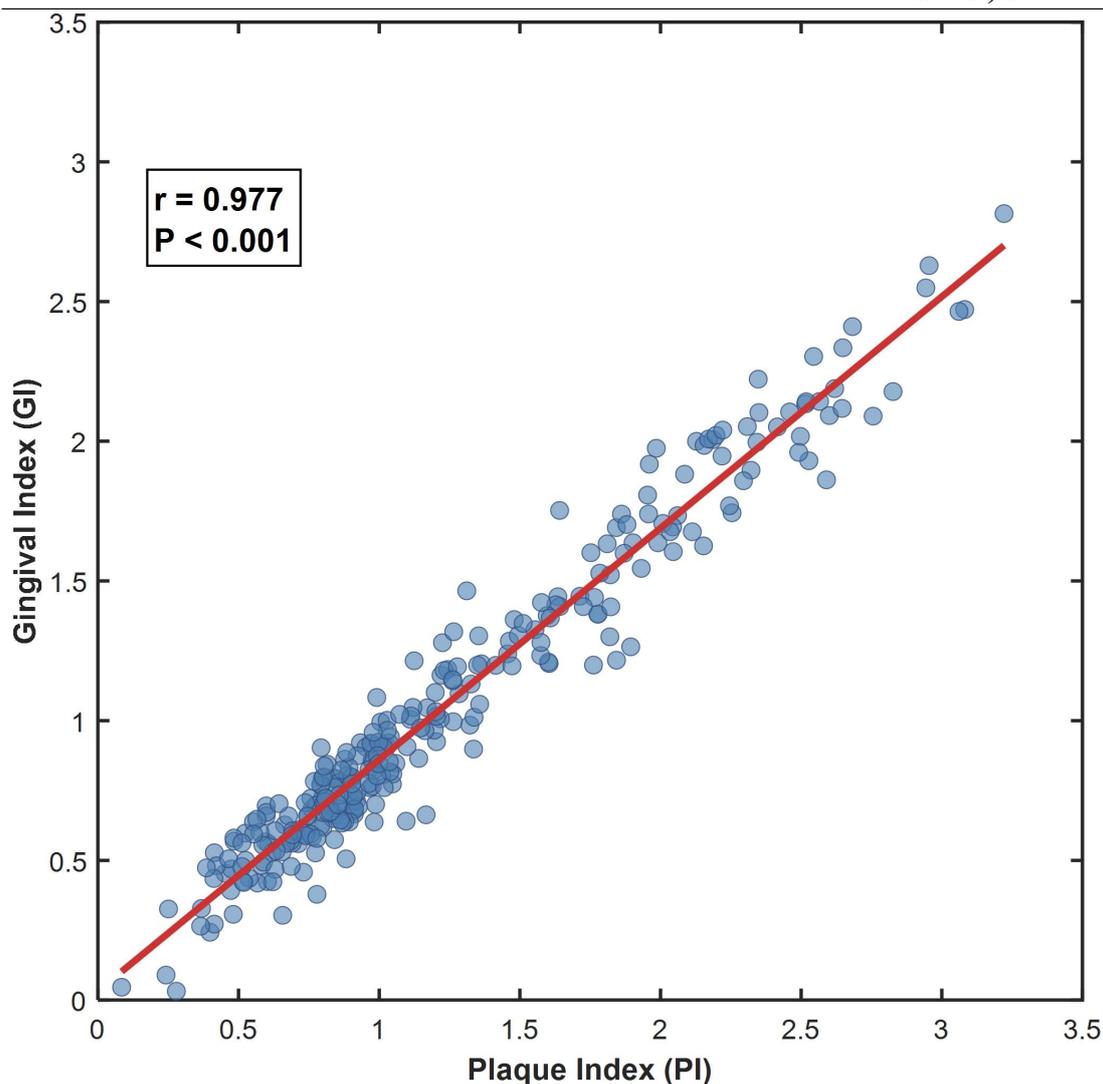
of the values indicated that they were closely clustered near the regression line, suggesting predictable relationships between bacterial burdens and tissue inflammatory responses. At one, three, and six months ($r = 0.826$, $P < 0.001$; $r = 0.812$, $P < 0.001$; and $r = 0.798$, $P < 0.001$) of the follow-up period, this correlation was significant and persisted from one time point to another throughout the observation period between CAF and AFC as well. These findings indicate that the degree of efficacy of plaque control immediately influenced the improvement in inflammatory activity during any stage.

When evaluating prognoses and creating treatment plans, a range of response patterns were found through subgroup analyses that were stratified by clinical and demographic characteristics. Male and female participants' treatment responses did not differ significantly, according to gender-stratified comparisons. At six months, males experienced PI reductions from 2.21 ± 0.45 to 0.78 ± 0.24 , while females experienced decreases from 2.15 ± 0.38 to 0.74 ± 0.19 ($P = 0.421$ for gender \times time interaction). GI improvements also showed similar trajectories between genders when consistent treatment protocols were used ($P = 0.386$), suggesting that biological sex had no appreciable impact on therapeutic outcomes. While all age groups showed statistically significant improvements from baseline values ($P < 0.001$ for each group), age-stratified comparisons showed slightly attenuated responses in older participants compared to younger cohorts. Young adults achieved a mean six-month PI of 0.68 ± 0.18 , middle-aged individuals reached 0.76 ± 0.21 , and elderly patients stabilized at 0.88 ± 0.26 ($P = 0.034$ for age group differences). Patients with moderate periodontitis experienced slightly greater percentage reductions in both indices than patients with severe periodontitis, according to the results of the disease severity subgroup analysis; mean PI decreases for moderate cases were 71.3% versus 63.2% for severe cases ($P = 0.048$), and mean GI reductions were 73.1% versus 64.3% for severe cases ($P = 0.041$). However, by six months, absolute endpoint values converged to similar ranges (moderate: PI = 0.71 ± 0.19 , GI = 0.62 ± 0.16 ; severe: PI = 0.78 ± 0.23 , GI = 0.70 ± 0.20 ; $P > 0.05$ for both comparisons). This suggests that the initial disease burden affected the magnitude of improvement without preventing eventual achievement of acceptable periodontal health parameters. The experimental setup is illustrated in

Figure 2.

Figure 2

Scatter plot of correlation between PI and GI



4. Discussion, Conclusion and Perspectives

4.1. Main Findings and Mechanism Analysis

The current study shows that non-surgical periodontal therapy significantly improves gingival and plaque indices, and that these two clinical measures have a strong positive correlation over the course of treatment. The effectiveness of the treatment was most noticeable in the first month after the intervention and then leveled off over the course of the three to six-month observation period, creating a treatment response pattern that is consistent with the biological processes of periodontal tissue healing.

The processes by which non-surgical periodontal therapy lowers the plaque index work in several parallel ways, primarily through the mechanical removal of



calcified accretions, the removal of local retention factors that promote plaque accumulation, and the removal of supragingival and subgingival bacterial deposits. Because less bacterial irritation attenuates the inflammatory cascade within gingival tissues, edema can resolve, vascular permeability can be reduced, and normal tissue architecture can be restored. As a result, the gingival index increases. The temporal dynamics of the study show a biphasic response pattern, with a plateau phase that necessitates ongoing plaque control measures to sustain therapeutic gains after an acute phase of rapid improvement brought on by the immediate reduction of inflammatory stimuli.

The reproducibility for these treatment interventions in different patient groups is ratified and echoed when compared with the literature. This finding is in agreement with other studies which reported similar clinical outcomes following non-surgical periodontal therapy. But the outcomes that were reported differently from trial to trial may be due to methodological heterogeneity, such as baseline disease severity, treatment strategy, and physician expertise. This present study provides new knowledge with respect to gingival health and plaque control, showing the minute-by-minute alternation between these conditions while also providing quantifiable targets for the anticipated expansion of treatment at differing times. This information further supports clinical decisions and patient treatment expectations and education in maintenance needs.

4.2. Clinical Significance, Limitations and Conclusion

The clinical ramifications of the findings emphasize how important non-surgical periodontal therapy is in the management of periodontal disease. Since gingival inflammation and plaque buildup are strongly correlated, patient education is a crucial part of periodontal control. Furthermore, although the improvements in plaque control are small, they are clinically significant and can encourage patients to brush their teeth more thoroughly. On the basis of this observation, the efficacy of primary therapy and compliance with professional maintenance programmes in the long term should be emphasized in prevention strategies because ongoing preventive care seems to be necessary for maintaining therapy results.

When interpreting these results, some methodological limitations need to be taken into account. It was an inevitable drawback that the generalizability of results is limited due to differences in patient demographics, operator skills, and



institution-based protocols compared with real-world periodontal care settings. Although ethical considerations would normally not permit treatment to be withheld from patients with pre-existing periodontal disease, the absence of a control group of patients who varied on this hypothesis prevents us from disambiguating intervention effects. Although the six-month follow-up is suitable for an assessment of short-term results, it does not provide data as far as long-term stability and recurrence occurrences are concerned in order to support developing optimal maintenance strategies. Moreover, even with well-established standardization and calibration, the subjective nature of plaque index and gingival index evaluations can contribute to measurement variability.

Prolonged longitudinal follow-up should be considered the most important aspect in any future study to determine the durability of the treatment and identify risk factors for the recurrence of disease. External validation (preferably with multicenter collaboration) would help in this regard, and permit assessment of subgroups of patients where prognosis may be different. Molecular markers and microbiological evaluation may be used together to elucidate the underlying biological gradient of the response to treatment and, ultimately, personalized treatment regimens for different risk strata and disease endotypes. The results of the study clearly demonstrate that non-surgical periodontal therapy significantly reduces the gingival and plaque indices and that plaque control is a major long-term factor in influencing gingival health. Because these methodologies provide practical, reliable measures of the treatment tools that are being used clinically and in research today, these clinical indicators persist as the most widely used metrics for treatment monitoring. Optimal periodontal health in the long term, however, is highly dependent on the patient performing self-care at home and returning for treatment maintenance.

Conflict of interest: The author declares no conflict of interest.

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