

Surgical periodontal treatment positively affects oral health-related quality of life in patients with periodontal diseases: A prospective clinical observational study

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Abstract

Background: Periodontal diseases are common among adults and can significantly affect both oral health and overall quality of life. This study aimed to evaluate changes in oral health status and quality of life before and after surgical periodontal treatment using standardized clinical assessments.

Methods: A total of 25 patients over 20 years of age who underwent periodontal surgery were enrolled. General characteristics, perceived oral health were investigated, and quality of life were assessed using the Oral Health Impact Profile-14 (OHIP-14). Alveolar bone loss (ABL) was measured using dental panoramic radiographs obtained before and after surgery.

Results: Objective oral health status, as indicated by reduced ABL, improved significantly following treatment ($p < 0.01$). Subjective quality of life also improved across multiple OHIP-14 domains, particularly physical pain, physical and psychological disability, and social handicap ($p < 0.05$), with the most notable improvement in social disability ($p < 0.01$). Overall satisfaction with oral health and quality of life increased significantly ($p < 0.01$). However, the correlation between objective improvements and subjective gains was not statistically significant.

Conclusions: Surgical periodontal treatment effectively enhances both clinical oral health status and patient-reported quality of life in individuals with periodontitis, supporting its value as a comprehensive approach to patient-centered care.

Introduction

Periodontal diseases are among the most prevalent oral health problems worldwide. The progressive destruction of the periodontium can lead to various clinical signs and symptoms that negatively affect patients' quality of life. Previous studies have demonstrated that poor periodontal health is associated with a lower quality of life (1). In Korea, oral health-related conditions remain a significant public health concern. According to the 2015 Korean Oral Health Survey, 15.5% of adults aged 30–39, 30.1% of those aged 40–49, 47.0% of those aged 50–59, and 47.1% of those aged 60–69 were affected by periodontal disease. Common among adults over 30, periodontal diseases progressively destroy the periodontium, resulting in alveolar bone loss and tooth loss, with prevalence increasing with age. These chronic conditions are difficult to cure and are often accompanied by symptoms such as tooth mobility, oral pain, halitosis, and aesthetic concerns (2). Without continuous care, these symptoms may worsen, leading to social difficulties and reduced quality of life. They may also cause masticatory dysfunction, nutritional deficiencies, and digestive disturbances, further compromising physical health. As physical health declines, patients may lose self-confidence, which can interfere with their daily lives (3). Consequently, numerous studies emphasize that periodontal diseases negatively affect both physical and psychological well-being (1, 4).

Traditionally, dental professionals have assessed periodontal conditions using objective clinical indicators such as bleeding on probing, probing depth, tooth mobility, ABL on radiographs, and disease

prevalence (5). However, these measures do not sufficiently capture the complex and subjective aspects of oral health, nor do they reflect patient-reported outcomes such as pain or discomfort. Consequently, clinical indicators alone may be inadequate for fully evaluating the impact of treatment on patients' quality of life (6).

According to the World Health Organization (WHO), quality of life is defined as an individual's perception of their position in life within the context of the culture and value systems in which they live, and in relation to their goals, expectations, standards, and concerns. It is influenced by physical health, psychological state, personal beliefs, social relationships, and environmental conditions (7). When physical health is considered a key component, enhancing quality of life in the context of disease management becomes as important as treatment itself. Increasingly, health professionals are also addressing psychological aspects in clinical practice. The 2003 World Workshop on Periodontics emphasized the importance of subjective oral health assessment as a primary outcome for evaluating periodontal treatment (8). In dentistry, awareness of oral health–related quality of life is now recognized as a critical treatment outcome (9), reflecting the conceptual framework proposed by Locker in 1988 (10).

Among the instruments developed to measure oral health–related quality of life, the Oral Health Impact Profile (OHIP), created by Slade, is one of the most widely used tools (11). The abbreviated version, OHIP-14, reduces the original 49-item scale to 14 questions—two from each of seven domains—making it more efficient and user-friendly for patients (12). OHIP-14 has been employed in numerous studies. For example, Mendez et al. used it to evaluate the effects of non-surgical periodontal treatment (13), while Saito et al. applied it to examine surgical outcomes (14). In modern medicine, evaluating the impact of disease on daily functioning and quality of life is considered essential, with patient-centered outcomes often deemed more meaningful than traditional clinical metrics.

Previous studies utilizing OHIP-14 have primarily focused on the effects of periodontal conditions or non-surgical treatments on quality of life. Additional research has examined the association between malocclusion and quality of life in specific age groups. Although many studies have investigated the relationship between patient perceptions and outcomes following non-surgical treatment, no research to date has explored the correlation between objective periodontal status after surgical intervention and subjective quality of life (5, 15).

In the present study, we evaluated and compared changes in objective oral health status (i.e., ABL) and subjective quality of life (i.e., OHIP-14) before and after surgical periodontal treatment. We also investigated the relationship between these changes to assess the overall impact of surgical periodontal therapy in patients with periodontitis.

Materials and Methods

Study population and sample size calculation

This prospective clinical observational study was conducted at the Department of Periodontology, Ewha Womans University Medical Center, between December 2017 and December 2018. The study included adults over 20 years of age who underwent surgical periodontal treatment, specifically periodontal flap surgery. Periodontal flap surgery is indicated for severe periodontal destruction, such as in cases of Stage III or IV periodontitis with Grade B or C progression, where subgingival curettage or gingivectomy alone is expected to be insufficient, or when treatment involving the alveolar bone is required. This surgical procedure involves making incisions in the gingiva under local anesthesia, elevating the soft tissue from the tooth surface and alveolar bone, removing necrotic and inflamed tissue, and performing bone grafting or reshaping as needed. All subjects in this study received the surgical treatment described above.

With informed consent, a self-administered questionnaire was distributed to patients who had undergone surgical periodontal treatment. Patients were excluded if they were unable to communicate effectively due to physical or mental conditions, were pregnant, had uncontrolled systemic diseases, or discontinued treatment due to noncompliance or irregular follow-up visits that hindered data collection. The study protocol was approved by the Institutional Review Board of the School of Medicine, Ewha Womans University (Approval No. 2017-10-042-002), and was conducted in accordance with the Declaration of Helsinki (2000 revision). All participants provided written informed consent before enrollment. The study followed the Strengthening the Reporting of Observational Studies in Epidemiology guidelines.

The initial sample size for primary outcome was calculated using the G*Power program (version 3.1.9; Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A.; Germany). Assuming a two-tailed significance level of 5%, a statistical power of 80%, and an effect size of 0.5, the minimum required sample size was estimated at 34. Considering a potential dropout rate of 20%, the final sample size was set at 40 participants.

Study methods

Participants who agreed to the purpose of the study and voluntarily consented to participate were asked to complete a self-administered questionnaire. This questionnaire collected information on participants' general characteristics and their perceived oral health status. These data were gathered once before the surgical periodontal treatment. To assess objective oral health status, ABL was measured using panoramic radiographs taken both before and after the surgical procedure. Subjective quality of life was evaluated using the OHIP-14 questionnaire, which participants completed twice: once prior to surgery and again one month after surgical periodontal treatment.

Survey on general characteristics

To assess participants' general characteristics, a self-administered questionnaire was completed once before the surgical periodontal treatment (see Supplemental Appendix 1). The questionnaire included

seven items covering gender, age, education level, income level, smoking status, alcohol consumption, and physical activity status.

Survey on perceived oral health-related characteristics

To evaluate participants' perceived oral health-related characteristics, a second questionnaire was completed once before the surgical periodontal treatment (see Supplemental Appendix 2). This questionnaire included **10** items based on participants' oral health experiences and symptoms over the past year. The items assessed frequency of toothbrushing per day, use of oral hygiene aids, history of dental scaling, presence of halitosis, gum discomfort (e.g., swelling, soreness, and bleeding), tooth mobility, history of tooth extraction, and experience of toothache. Tooth extractions performed for prosthodontic, occlusal, or orthodontic adjustment purposes were excluded.

Measurement of Objective Oral Health Status (alveolar bone loss)

The average interval between pre- and post-treatment measurements of ABL was 6.6 ± 2.9 months (see Supplemental Fig. 1). Digital panoramic radiographs were obtained before and after surgical periodontal treatment and were digitally processed. Image analysis was performed using Scion Image Beta 4.02 software (Scion Co., Frederick, MD, USA). For each region of interest, a vertical line was drawn from the lowest point of the interproximal contact area of the adjacent crowns to the midpoint of the alveolar bone crest. Changes in ABL were determined by measuring the length of this vertical line (Fig. 1).

Measurement of Subjective Quality of Life (Oral Health Impact Profile-14)

Subjective quality of life was assessed using the OHIP-14 questionnaire, administered before and after surgical periodontal treatment. The survey was conducted twice: once prior to surgery and once following the procedure. OHIP-14 consists of 14 items divided into seven domains: functional limitation, physical pain, psychological discomfort, physical disability, psychological disability, social disability, and social handicap. Each domain includes two questions. Responses are rated on a 5-point Likert scale, where 0 indicates "Never," 1 "Rarely," 2 "Sometimes," 3 "Often," and 4 "Very often." Total scores range from 0 to 56. Because all items are negatively worded, higher scores indicate greater discomfort or negative impact associated with oral health problems. In this study, the Korean version of the OHIP-14 was used. Its validity and reliability have been previously verified (16) (see Supplemental Appendix 3).

Statistical analysis

All statistical analyses were performed using SAS version 9.4 (SAS Institute Inc., Cary, NC, USA). Descriptive statistics, including frequency analysis, were used to summarize participants' general characteristics and perceived oral health-related characteristics. Paired Student's t-tests were used to compare objective oral health status and subjective quality of life before and after surgical periodontal

treatment. Pearson's correlation analysis was conducted to examine the relationship between changes in objective oral health status and changes in subjective quality of life. Statistical significance was set at $p < 0.05$ and $p < 0.01$.

Results

Characteristics of the study subject

As shown in Supplemental Fig. 2, a total of 25 patients were ultimately included in the study. Initially, a self-administered questionnaire was distributed to 44 patients who had undergone surgical periodontal treatment. After excluding 10 patients with incomplete responses, data from 34 patients were retained. Of these, 25 patients were selected based on the availability of both objective oral health measurements (i.e., ABL changes) and subjective quality of life assessments (i.e., OHIP-14 scores) at matched time points.

General characteristics of the study subjects

Table 1 presents the general characteristics of the 25 study participants. Of these, 12 were male (48%) and 13 were female (52%). Regarding age distribution, the largest group comprised participants aged 60 years and older ($n = 9$, 36%), followed by those in their 50s ($n = 7$, 28%), 40s ($n = 6$, 24%), and 30s ($n = 3$, 12%). In terms of education level, high school graduation was the most commonly reported, with 11 participants (44%). The most frequent monthly income level was over 3 million KRW, reported by 10 participants (40%). Regarding smoking status, the majority of participants were non-smokers ($n = 18$, 72%), while 7 participants (28%) reported current smoking. In contrast, a higher proportion of participants reported alcohol consumption ($n = 13$, 52%) compared to those who did not ($n = 12$, 48%). Regular exercise was reported by 15 participants (60%), whereas 10 participants (40%) reported not exercising regularly.

Table 1
Demographic characteristics of the study
population (N = 25).

Variable	N (%)
Gender	
Male	12 (48)
Female	13 (52)
Age (years)	
20–29	0 (0)
30–39	3 (12)
40–49	6 (24)
50–59	7 (28)
≥ 60	9 (36)
Education	
Elementary school	3 (12)
Middle school	0 (0)
High school	11 (44)
University	9 (36)
Graduate school	2 (8)
Monthly income (KRW ×10,000)	
<100	6 (24)
100–200	4 (16)
200–300	5 (20)
>300	10 (40)
Smoking	
Yes	7 (28)
No	18 (72)
Alcohol consumption	
Yes	13 (52)
No	12 (48)

Variable	N (%)
Gender	
Regular exercise	
Yes	15 (60)
No	10 (40)

Oral health-related characteristics perceived by the study subjects

The results of the survey on participants' perceived oral health-related characteristics are as follows. Regarding toothbrushing frequency, 22 participants (88%) reported brushing their teeth more than twice per day. Fourteen participants (56%) reported using oral hygiene aids, while 11 (44%) indicated that they did not. Thirteen participants (52%) stated that they had not undergone dental scaling within the past year and reported experiencing halitosis. Additionally, 13 participants (52%) reported swollen gums, 16 (64%) experienced gum pain, and 15 (60%) experienced gum bleeding. Tooth mobility was reported by 14 participants (56%), and 15 (60%) indicated that they had undergone tooth extraction within the past year. Finally, 17 participants (68%) reported having experienced toothache. Overall, the majority of participants reported experiencing subjective oral symptoms consistent with periodontal disease (Table 2).

Table 2
Oral health-related characteristics of the
study population (N = 25).

Variable	N (%)
Tooth brushing frequency (times/day)	
1	3 (12)
2	12 (48)
3	10 (40)
Use of oral hygiene aids	
Yes	14 (56)
No	11 (44)
Scaling within past year	
Yes	12 (48)
No	13 (52)
Bad breath (halitosis)	
Yes	13 (52)
No	12 (48)
Swollen gums	
Yes	13 (52)
No	12 (48)
Sore gums	
Yes	16 (64)
No	9 (36)
Bleeding gums	
Yes	15 (60)
No	10 (40)
Drifting teeth	
Yes	14 (56)
No	11 (44)

Variable	N (%)
Tooth brushing frequency (times/day)	
Loose teeth	
Yes	15 (60)
No	10 (40)
Toothache	
Yes	17 (68)
No	8 (32)

Note: Frequency and percentages are reported for categorical variables based on participant self-report.

Comparing objective oral health status (alveolar bone loss) before and after surgical periodontal treatment

The average measurement of ABL decreased from 6.46 ± 1.14 mm before treatment to 5.83 ± 1.24 mm after surgical periodontal therapy, indicating a clinical improvement in objective oral health status. This reduction in ABL was statistically significant ($p < 0.01$) (Table 3).

Table 3
Mean alveolar bone loss (ABL) before and after surgical periodontal treatment (N = 25).

Measurement	Pre-treatment Mean $\pm$ SD	Post-treatment Mean $\pm$ SD	p-value
ABL (mm)	6.46 ± 1.14	5.83 ± 1.24	$< 0.001^{**}$

Note: Values are presented as mean $\pm$ standard deviation (SD).

Average interval between pre- and post-treatment radiographic measurements was 6.6 ± 2.9 months.

Statistical significance threshold: $p < 0.01$.

$p < 0.01$ is indicated by **.

Comparing subjective quality of life (Oral Health Impact Profile-14) before and after surgical periodontal treatment

Following surgical treatment, OHIP-14 scores decreased across multiple domains. The mean scores for functional limitation and psychological discomfort decreased from 1.12 ± 1.36 to 0.52 ± 1.08 and from 2.08 ± 1.50 to 1.28 ± 2.34 , respectively; however, these changes were not statistically significant. In contrast, the mean scores for physical pain, physical disability, psychological disability, and social handicap decreased from 2.24 ± 1.54 to 1.60 ± 1.73 ; 1.72 ± 1.80 to 0.84 ± 1.46 ; 1.28 ± 1.34 to 0.64 ± 1.11 ;

and 1.04 ± 1.31 to 0.40 ± 1.00 , respectively. These reductions were statistically significant ($p < 0.05$). Notably, the social disability domain score decreased markedly, from 1.80 ± 1.58 to 0.64 ± 1.35 , with a statistically significant difference ($p < 0.01$). The total OHIP-14 score improved from 11.28 ± 7.40 before treatment to 5.92 ± 7.23 after treatment, indicating a significant overall improvement in subjective quality of life ($p < 0.01$) (Table 4 and Fig. 2).

Table 4
Mean Oral Health Impact Profile-14 (OHIP-14) scores before and after surgical periodontal treatment (N = 25).

OHIP-14 Domain	Pre-treatment Mean $\pm$ SD	Post-treatment Mean $\pm$ SD	p-value
Functional limitation	1.12 ± 1.36	0.52 ± 1.08	0.134
Physical pain	2.24 ± 1.53	1.60 ± 1.73	0.043 *
Psychological discomfort	2.08 ± 1.50	1.28 ± 2.34	0.057
Physical disability	1.72 ± 1.80	0.84 ± 1.46	0.036 *
Psychological disability	1.28 ± 1.34	0.64 ± 1.11	0.043 *
Social disability	1.80 ± 1.58	0.64 ± 1.35	< 0.001 **
Social handicap	1.04 ± 1.31	0.40 ± 1.00	0.018 *
Total OHIP-14 score	11.28 ± 7.40	5.92 ± 7.23	0.001 **

Note: Values are presented as mean $\pm$ standard deviation (SD).

Paired t-tests were used to assess statistical significance.

* $p < 0.05$ and ** $p < 0.01$ indicate statistically significant differences.

Correlation between objective oral health status (ABL) and subjective quality of life (OHIP-14)

The correlation between changes in objective oral health status (ABL) and changes in subjective quality of life (OHIP-14) yielded a positive coefficient of 0.129. However, this correlation was not statistically significant (Table 5 and Supplemental Fig. 3).

Table 5
Correlation between alveolar bone loss (ABL) and OHIP-14 scores before and after surgical periodontal treatment (N = 25).

Variable	Statistic	ABL	OHIP-14
ABL	Pearson's correlation	1	0.129
	<i>p</i> -value		0.538
OHIP-14	Pearson's correlation	0.129	1
	<i>p</i> -value	0.538	

Note: Pearson's correlation coefficient (*r*) was used to assess the relationship between ABL and OHIP-14.

$p < 0.05$ was considered statistically significant.

No statistically significant correlation was observed.

Discussion

Evaluating the impact of disease on daily functioning is a key component of modern medicine, and patient-centered assessment is often more meaningful for evaluating physical and psychological well-being than traditional clinical examination alone. Quality of life assessment is now recognized as a reliable and appropriate indicator in clinical and public health research (17). Assessing health conditions from the patient's perspective has become an essential area of investigation in both medicine and public health (18). Consequently, research approaches focusing on patient-centered oral health outcomes have increased (19).

Several studies have found that patients experience improvements in quality of life following periodontal treatment, regardless of the specific type of treatment administered (20–22). Although periodontal diseases can be prevented through regular dental checkups and scaling, their prevalence tends to increase with age. Previous research has shown that delayed treatment can result in the progression of negative symptoms, leading to a decline in quality of life (23). In addition, patients with chronic periodontitis have been reported to exhibit significantly lower functional, physical, and psychological quality of life compared to individuals without the disease (24).

In this study, the most prevalent age group among participants was 60 years and older, with all participants being over the age of 30. This is consistent with a 2020 report by the Korea Disease Control and Prevention Agency, which found that the incidence of periodontitis had significantly increased among adults aged 30 and above in South Korea, supporting the appropriateness of the selected study population. In addition, this trend aligns with findings from the 2015 Korean Oral Health Survey, which reported that as age increases, the proportion of individuals with a healthy periodontium decreases, and the likelihood of periodontal disease increases.

Before surgical periodontal treatment, more than half of the participants reported experiencing subjective symptoms such as halitosis, swollen gums, sore gums, bleeding gums, drifting teeth, tooth mobility, and toothache. Although these participants maintained above-average oral hygiene habits—including frequent tooth brushing, the use of oral hygiene aids, and prior dental scaling—they still reported a high prevalence of oral discomfort. These patients represent a group whose symptoms exceeded the scope of routine oral hygiene care or non-surgical periodontal therapy. Therefore, the high prevalence of perceived periodontal symptoms in this group was expected, as they were selected based on the clinical need for surgical periodontal intervention.

The changes in objective oral health status, as measured by ABL, demonstrated significant clinical improvement following surgical periodontal treatment, with a mean reduction of approximately 0.63 mm. Surgical periodontal therapy has been confirmed as an effective and definitive method for managing periodontitis, particularly with the goal of promoting alveolar bone regeneration. Results from the OHIP-14 survey revealed that improvements in subjective quality of life were most pronounced in the following domains: social disability, social handicap, physical disability, psychological disability, and physical pain. A notable observation was that patients with periodontitis appeared to be more affected by limitations in their daily and social environments than by personal physical or psychological discomfort. These findings highlight the close relationship between periodontal disease and patients' quality of life, and they suggest that surgical periodontal treatment contributes meaningfully to improving this aspect of patient care. In our study, surgical periodontal therapy had a marked effect on enhancing the daily and social quality of life among patients with periodontitis.

Hoexter noted that complications such as oral bleeding, pain, and swelling may occur immediately following surgical periodontal treatment (25). We hypothesized that postoperative discomfort resulting from these complications contributed to the limited improvement observed in the OHIP-14 domains of functional limitation and psychological discomfort. Previous studies have reported that complications associated with surgical periodontal treatment are generally more severe than those associated with non-surgical procedures. Patients undergoing surgical treatment were found to have lower perceived quality of life, reflected in higher OHIP-14 scores—particularly in the domains of functional limitation, physical pain, and psychological discomfort (26). These findings may help explain the limited improvement observed in the aforementioned domains following surgery in our study. Nevertheless, the overall average OHIP-14 score—representing subjective quality of life—showed a significant reduction after treatment. This result is consistent with the findings of Mendez et al. and Saito et al., who reported that periodontal treatment led to lower OHIP-14 scores and consequently improved quality of life in patients with periodontitis.

The correlation between changes in objective oral health status and subjective quality of life showed a positive direction, with a proportional trend and a positive correlation coefficient; however, the association was not statistically significant. Surgical periodontal treatment was shown to improve both objective clinical assessments by dentists and subjective evaluations reported by patients. The presence of a positive, albeit non-significant, correlation between these two indicators is a meaningful and

expected finding. Future studies with larger sample sizes and more detailed analyses may help clarify this relationship and establish a more definitive correlation.

In this study, we applied broad inclusion criteria when selecting participants. Surgical periodontal treatment was defined to include all invasive procedures performed for periodontitis, including incision, suturing, and tooth extractions. However, the relatively small sample size ($n = 25$) limits the generalizability of our findings. This limitation highlights the need for further research using a systematic approach and a larger, more representative sample. Additionally, future studies should classify patients in greater detail according to the stage and grade of periodontitis and evaluate outcomes in relation to the timing of treatment initiation, recovery periods, and post-treatment healing capacity. This will allow for more precise analysis of changes in alveolar bone loss and quality of life, both independently and in combination, across different time points. Addressing these limitations will enhance the robustness and clinical relevance of future research outcomes.

Despite the limitations outlined above, the findings of this study align with previous research demonstrating that periodontal treatment has a positive impact on the quality of life of patients with periodontitis. It is also important to note that few studies have specifically examined quality of life outcomes following surgical periodontal treatment in this patient population. Future research should employ a variety of assessment tools to more comprehensively evaluate the objective and quantifiable clinical outcomes of surgical periodontal therapy and explore how these outcomes relate to improvements in patients' subjective experiences and perceived quality of life. The expectation of a positive and reinforcing interaction among advancements in periodontal treatment, reduction of disease burden, and alleviation of patient discomfort may encourage and guide future investigations into treatment strategies for periodontal disease.

Conclusion

We found that surgical periodontal treatment not only improved objective oral health status, as indicated by reductions in ABL, but also favorably enhanced patients' subjective quality of life, as measured by the OHIP-14. Contrary to our expectations, a proportional correlation between these two outcomes was not observed among patients with periodontitis. These results suggest that the subjective pain and discomfort experienced in daily life by patients with periodontitis may not be fully alleviated by successful surgical outcomes alone. Emotional and psychological challenges may persist even after clinical indicators have improved. Therefore, periodontists should continue to develop and implement strategies aimed at improving the overall well-being of patients, including adjunctive interventions that complement surgical treatment. We hope that the findings of this study will motivate further efforts in this direction. Ultimately, we believe that surgical periodontal treatment holds substantial potential to enhance the quality of life of patients with periodontitis when integrated into a comprehensive, patient-centered care approach.

Abbreviations

OHIP-14

Oral Health Impact Profile-14

ABL

Alveolar bone loss

WHO

World Health Organization

SAS

Statistical Analysis System

KRW

Korean Republic Won.

Declarations

Ethics approval and consent to participate

The study protocol was approved by the Institutional Review Board (IRB) of the School of Medicine, Ewha Womans University (Approval No. 2017-10-042-002). All procedures were performed in accordance with the Declaration of Helsinki (2000 revision).

Consent for publication

Not applicable

Availability of data and materials

The datasets generated and/or analyzed during the current study are not publicly available due to containing information that could compromise the privacy of research participants but are available from the corresponding author on reasonable request.

Competing Interests

The authors declare no conflicts of interest related to this article.

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Author's Contributions

YJK contributed to the result analysis and manuscript writing/editing. HS contributed to the data collection, result analysis, and drifting. SJK contributed to the development of the research infrastructure, and supervision of data analysis. JBL was responsible for the conception, study design, development of the research infrastructure, and direct supervision of data collection/analysis. Also, he

directly contributed to the result analysis and manuscript writing/editing. All the authors have read and approved the final version of the manuscript.

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Figures

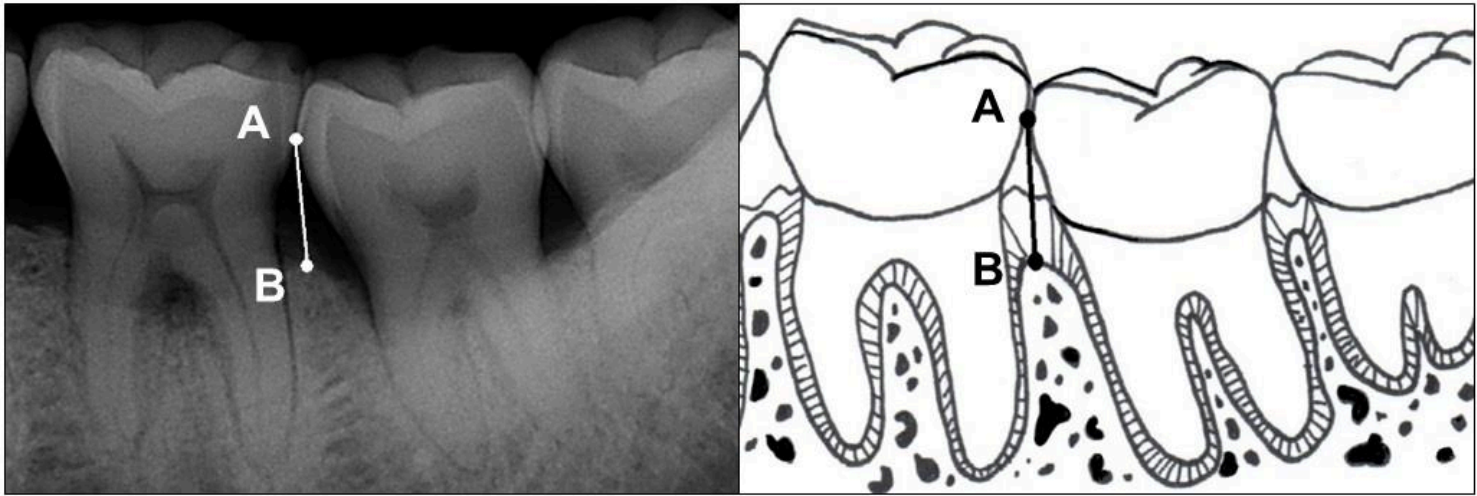


Figure 1

Measurement method for alveolar bone loss (ABL). A: The lowest point of the crown's interproximal contact area between adjacent teeth; B: The midpoint of the alveolar bone crest.

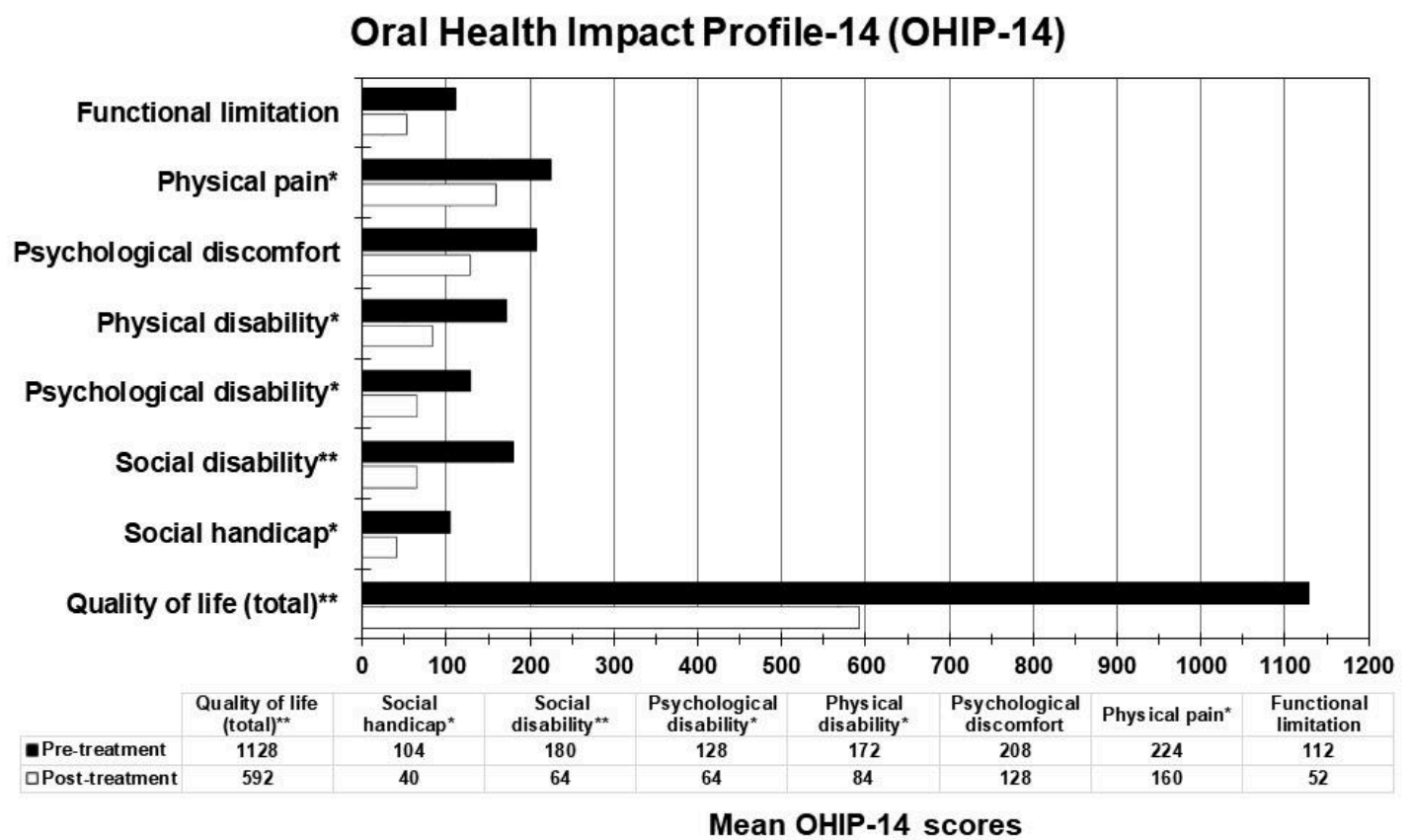


Figure 2

Mean scores of the Oral Health Impact Profile-14 (OHIP-14) before and after surgical periodontal treatment. Statistical significance indicated as: * $p < 0.05$; ** $p < 0.01$.

Supplementary Files

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

- [PeriodontalTxQOLsupplementalfiguresJCPpf.JBLee.docx](#)
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