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Original Article

Periodontal surgery improves oral health-related quality of life in chronic periodontitis patients in Asian population

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Abstract The effect of periodontal surgery on patients' quality of life was investigated. Sixty patients received regenerative surgery or resective osseous surgery. Oral health-related quality of life and health-related quality of life instruments were used to assess the participants' quality of life before surgery and 4 weeks after surgery. Periodontal surgery can improve patients' quality of life by alleviating the physical pain and psychological discomfort. The scores were lower (more favorable) in the regenerative surgery group, and the functional limitations of the regenerative surgery group improved substantially compared with those of the resective osseous surgery group ($P = 0.0421$). The patients' oral health-related quality of life scores improved significantly after periodontal surgery. Clinicians can take advantage of the positive functional oral health-related quality of life impacts of regenerative surgery.

Conflicts of interest: All authors declare no conflicts of interest.

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Background

Periodontal disease is a major oral health problem that reportedly affects numerous adults worldwide. Destruction of the periodontal supporting tissue causes various clinical signs and symptoms that can substantially affect quality of life (QoL). Several studies have shown that periodontal conditions exert a negative impact on the QoL of patients [1,2]. The periodontal condition of oral cavities affects the ability to eat, speak, and socialize, as well as interpersonal relationships and daily activities; thus, it may affect QoL [1].

Research on periodontal disease has typically focused on the clinicopathological mechanisms of the disease rather than its impact on patients. Traditional measurements fail to explain the impact of the disease on patients. Increasingly more studies have recognized patient perception of health-related QoL (HRQoL) as a critical indicator of dental care outcomes [3,4]. Assessing the perception of patients with periodontitis is particularly crucial because their concerns may differ from those assessed based on traditional clinical endpoints [5]. According to the 2003 World Workshop on Emerging Science in Periodontology, subjective oral health-related QoL (OHRQoL) should be based on realistic endpoints to evaluate periodontal therapy [6].

Close curettage and flap curettage are procedures for eliminating the etiogenic factors of periodontal disease. Previous studies have frequently indicated that surgical intervention is suitable for treating advanced periodontitis after non-surgical therapy [7]. Advanced periodontal disease may be treated using resective osseous surgery (RS) or regenerative surgery (RG). Shallow bony defects can be employed in RS to facilitate the formation of a normal probing depth (PD) and physiological morphology, in which supporting bone and soft tissue are in harmony, providing an easily maintained periodontal environment [8]. However, previous studies have indicated that deep intrabony defects can be employed in RG to recover lost periodontal tissue. Nevertheless, surgical treatment may lead to complications, such as oral bleeding, swelling, and sensitivity [9]. When assessing treatment outcomes, patients and periodontists might have different ideas and opinions on the impact on QoL after surgery. Although previous research has investigated the relationships between patient perceptions and non-surgical periodontal therapy outcomes [10], few studies have examined the impact of periodontal surgery on patient perception.

This study compared the effects of different types of periodontal surgery on patients' QoL by using OHRQoL and HRQoL to assess patients with chronic periodontitis 4 weeks after they had undergone RG or RS.

Materials and methods

Study population

This study investigated the impact of periodontal surgery on the OHRQoL of patients from the Division of Periodontics in Kaohsiung Medical University Hospital, and the Department of Dentistry at Kaohsiung Municipal Ta-Tung Hospital. No formal power analysis was performed. The sample size was designed primarily based on the data from a non-surgical periodontal therapy [11]. For inclusion in this study, patients were required to have $\geq$16 teeth and favorable general health. All participants had chronic periodontitis and were not tobacco users. Patients who had poorly controlled diabetes, were lactating women, required antibiotic prophylaxis before receiving periodontal treatment, or had markedly active caries, or other oral diseases were excluded.

Clinical examination

Each participant underwent comprehensive periodontal examination and oral screening. A comprehensive periodontal examination was conducted to measure PD, clinical attachment level, and bleeding upon probing [12]. At six sites on each tooth (the mesiobuccal, midbuccal, distobuccal, mesiolingual, midlingual, and distolingual aspects), a Williams probe was used to measure the aforementioned clinical parameters. Radiographic examination was assessed using periapical films by applying a long-cone parallel technique.

Procedures

Fig. 1 summarizes the flow of the present study. All patients received initial periodontal therapy, which consisted of oral hygiene instructions, and removal of any cause-related factors. After tissue healing (at least 4 weeks [13]), the patients were reevaluated using an OHRQoL and HRQoL survey (Questionnaire I). Patients completed a second OHRQoL and HRQoL survey (Questionnaire II) 4 weeks [13] after the periodontal surgery. Patients who had a PD deeper than 5 mm and an infrabony component larger than 4 mm were considered RG patients (guided tissue regeneration and flap operation with bone graft were included). Patients who had a PD deeper than 5 mm and suprabony defects were considered RS patients (pocket reduction, and osseous resective surgery were included). The surgical procedures and clinical examination were performed by 2 well-trained periodontists.

Questionnaire

We obtained patient information by using questionnaires comprising demographic analysis items and QoL instruments (Oral Health Impact Profile, OHIP; Oral Impacts on Daily Performances, OIDP; and World Health Organization QoL, WHOQOL-BREF).

Oral health-related quality of life (OHRQoL)

We used a 25-item short version of the OHIP and OIDP instruments to assess OHRQoL, which is a multidimensional construct that reflects comfort when eating, sleeping, and engaging in social interaction; self-esteem; and satisfaction with oral health.

Fourteen items were adopted from the validated Taiwanese short version of OHIP (OHIP-14T) [14], and the remaining 9 items were selected using the expert-based approach [15]. Responses to the OHIP-49 questions were

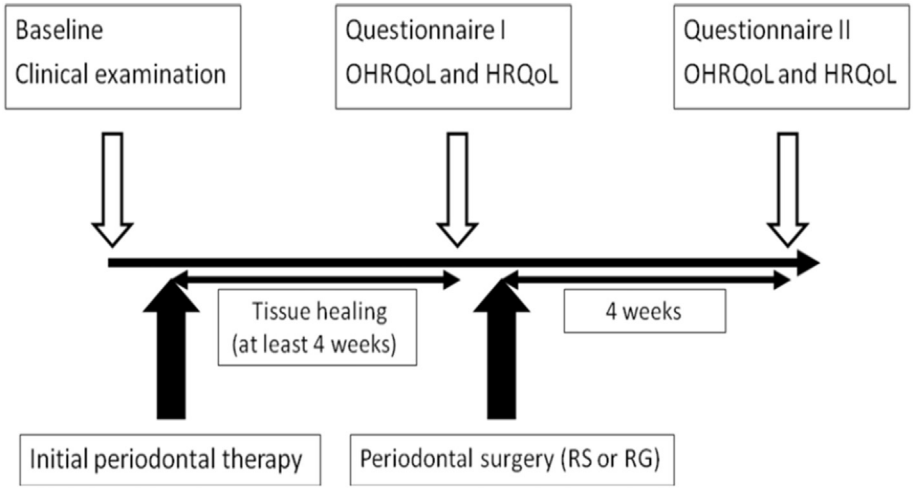

Fig. 1. Study design.

measured using a 5-point Likert scale to indicate whether the problem was been experienced *very often* (score = 4), *fairly often* (score = 3), *occasionally* (score = 2), *hardly ever* (score = 1) or *never* (score = 0). The total OHIP-25 score was obtained by summing the individual item scores of all 25 questions. The OHIP-25 was divided into seven dimensions and each conceptual dimension was measured by summing the corresponding item scores.

The OIDP instrument was used to assess oral impacts on QoL when patients performed the following 9 daily activities [16]. The score of each activity was calculated by multiplying the frequency (0—5) and severity scores (0—5). Subsequently, the scores for the 10 repetitions were summed. The total OIDP score was divided by the maximal score and multiplied by 100 to obtain a final percentage.

Health-related quality of life (HRQoL)

General HRQoL was measured using the Taiwanese version of the WHOQOL-BREF instrument [17]. The 28 items in this instrument comprised 2 general items, 24 items adopted from the WHOQOL-BREF to measure 4 dimensions, and 2 national items that were designed specifically for Taiwanese people. The WHOQOL-BREF items were rated on a 5-point scale to assess the frequency, intensity, capability, and evaluation of the performed actions. Each dimension score was calculated by multiplying the mean of all facet scores by a factor of 4 for each dimension; and a higher score indicated more favorable HRQoL (range: 4—20).

Statistical analysis

Cronbach's alpha was used to assess the internal consistency of the QoL instruments. The demographic characteristics of the patient groups were compared using chi-square and ANOVA tests. A multivariable analysis was conducted to compare differences in the outcome measures of the patient groups (OHIP, OIDP, WHOQOL-BREF, and their dimension scores) after adjusting for demographic characteristics.

The Cohen's standardized effect size (ES) [18], which was calculated by dividing the mean of the difference in presurgery and postsurgery scores by the standard deviation of the presurgery score, was used to evaluate the responsiveness of various measurements. ES can be considered based on several levels of clinical meaningfulness (small: $0.2 \leq ES < 0.5$; moderate: $0.5 \leq ES < 0.8$; large: $0.8 \leq ES$). The statistical analyses were performed using the SAS Version 9.2 (SAS Institute Inc., Cary, NC, USA).

Results

Regarding the internal consistency of the QoL instruments, the Cronbach's alpha of the OHIP (0.95) was higher than that of the OIDP (0.89) and WHOQOL-BREF (0.94).

This study examined 60 patients with chronic periodontitis; of these patients, 35 received RG (RG group) and 25 received RS (RS group). At baseline, the full-mouth mean PD of the RG group and RS group was 3.51 ± 0.69 mm and 3.56 ± 0.71 mm. After non-surgical periodontal therapy, the full-mouth mean PD of the RG group was 2.43 ± 0.61 mm and the full-mouth mean PD of the RG group was 2.34 ± 0.53 mm. The mean PD of RG group teeth was 5.55 ± 1.32 mm and the mean PD of RS group teeth was 5.46 ± 1.18 mm. All of the diseased teeth had bleeding upon probing after initial periodontal therapy.

Table 1 shows the demographic characteristics of participants at the baseline. The patient in the RG group were significantly older than those in the RS group ($P = 0.0010$), and the socioeconomic status of the patients in the RG group was significantly higher than that of those in the RS group ($P = 0.0075$).

The results of the OHRQoL assessment indicated that the indices of all periodontal surgery patients improved significantly, after surgery (Table 2). Small differences were observed between the presurgery and postsurgery measurements in the following 6 dimensions: (1) OHIP score of functional limitation (5.83 ± 2.54 vs. 4.68 ± 2.33, $P = 0.0001$, ES = 0.45); (2) physical disability (4.68 ± 3.23 vs. 3.23 ± 2.32, $P = 0.0007$, ES = 0.45); (3) psychological disability (3.32 ± 2.84 vs. 2.12 ± 1.98, $P = 0.0009$, ES = 0.42); (4) social disability (1.32 ± 1.40 vs. 0.87 ± 1.11, $P = 0.0062$, ES = 0.32); (5) handicap (1.68 ± 1.81 vs. 1.02 ± 1.38, $P = 0.0065$, ES = 0.36); and (6) OIDP score

Table 1 Demographic characteristics at pre-treatment (n = 60).

Variables	All surgery patients (n = 60)	Regenerative surgery (n = 35)	Resective surgery (n = 25)	*P*-value[c]
	n (%)	n (%)	n (%)	
Age (year), mean (SD)	42.88 (12.08)	47.09 (10.59)	37.00 (11.75)	**0.0010**[a]
Gender				
Male	26 (43.33)	18 (51.43)	8 (32.00)	0.1343[b]
Female	34 (56.67)	17 (48.57)	17 (68.00)	
Education				
≦12 years	14 (23.33)	7 (20.00)	7 (28.00)	0.4701[b]
>12 years	46 (76.67)	28 (80.00)	18 (72.00)	
Economical status				
Enough/just enough	36 (60.00)	26 (74.29)	10 (40.00)	**0.0075**[b]
Slightly insufficient/Insufficient	24 (40.00)	9 (25.71)	15 (60.00)	
Chronic diseases				
Without any disease	35 (58.33)	19 (54.29)	16 (64.00)	0.4518[b]
≧ one disease or above	25 (41.67)	16 (45.71)	9 (36.00)	

[a] ANOVA test: one-way analysis of variance test (*P-value < 0.05 is highlighted in bold).
[b] Chi-square test (*P-value < 0.05 is highlighted in bold).
[c] Comparison of the QoL measurements between regenerative and resective surgery patients.

Table 2 Mean scores of the QoL measurements on pre-treatment and post-treatment for all surgery patients (n = 60).

Periodontal parameters and QoL measurements	All surgery patients (n = 60)			
	Pre-treatment	Post-treatment	*P*-value of pair t test	ES[a]
	Mean (SD)	Mean (SD)		
OHIP score				
Total score (25)	30.17 (15.28)	20.93 (12.49)	<0.0001	**0.60**
Functional limitation (4)	5.83 (2.54)	4.68 (2.33)	0.0001	**0.45**
Physical pain (6)	7.70 (3.72)	3.57 (2.26)	<0.0001	**1.11**
Psychological discomfort (3)	5.63 (2.69)	3.87 (2.57)	<0.0001	**0.65**
Physical disability (4)	4.68 (3.23)	3.23 (2.32)	0.0007	**0.45**
Psychological disability (3)	3.32 (2.84)	2.12 (1.98)	0.0009	**0.42**
Social disability (2)	1.32 (1.40)	0.87 (1.11)	0.0062	**0.32**
Handicap (3)	1.68 (1.81)	1.02 (1.38)	0.0065	**0.36**
OIDP score	8.88 (11.64)	3.48 (5.15)	0.0011	**0.46**
WHOQOL-BREF (TW)				
Total score (28)	65.48 (9.17)	66.84 (8.72)	0.1385	0.15
Physical (7)	15.25 (2.22)	15.34 (2.17)	0.7084	0.04
Psychological (6)	14.33 (2.33)	14.57 (2.32)	0.2699	0.10
Social relationship (4)	14.55 (2.32)	14.86 (2.28)	0.1896	0.13
Environment (9)	14.72 (1.96)	14.87 (1.95)	0.0581	0.08

[a] $0.2 < ES \leq 0.5$: small difference, $0.5 < ES \leq 0.8$: moderate difference, $0.8 < ES$: large difference.

(8.88 ± 11.64 vs. 3.48 ± 5.15, $P = 0.0011$, ES = 0.46). Moderate differences were observed between the presurgery and postsurgery measurements in the following 2 dimensions: (1) total OHIP score of total score (30.17 ± 15.28 vs. 20.93 ± 12.49, $P < 0.0001$, ES = 0.60), and (2) psychological discomfort (5.63 ± 2.69 vs. 3.87 ± 2.57, $P < 0.0001$, ES = 0.65). Significant differences were observed between the presurgery and postsurgery measurements of physical pain (7.70 ± 3.72 vs. 3.57 ± 2.26, $P < 0.0001$, ES = 1.11). The HRQoL scores (WHOQOL-BREF) between the presurgery and postsurgery measurements did not have significant difference.

Table 3 shows the presurgery and postsurgery QoL measurement results, facilitating a comparison between the RG and RS groups after adjustment for age, gender, education, economic status, and chronic disease variables. In the OHIP scores of the RG group, small differences were observed between the presurgery and postsurgery measurements in the following 2 dimensions: (1) psychological disability (ES = 0.49, $P = 0.0073$); and (2) handicap (ES = 0.46, $P = 0.0123$). Moderate differences were observed among the following 4 dimensions: (1) total score (ES = 0.79, $P < 0.0001$); (2) functional limitation (ES = 0.61, $P = 0.0012$); (3) psychological discomfort (ES

Table 3 Mean scores of the QoL measurements on pre-treatment and post-treatment for regenerative and resective surgery patients.

Periodontal parameters and QoL measurements	Regenerative surgery (n = 35)				Resective surgery (n = 25)				*P*-value[a]
	Pre-treatment Mean (SD)	Post-treatment Mean (SD)	*P*-value of pair t test	ES[b]	Pre-treatment Mean (SD)	Post-treatment Mean (SD)	*P*-value of pair t test	ES[b]	
OHIP score									
Total score (25)	30.89 (14.02)	19.77 (11.23)	**<0.0001**	**0.79**	29.16 (17.13)	22.56 (14.15)	**0.0142**	**0.39**	0.0763
Functional limitation (4)	5.77 (2.43)	4.29 (2.16)	**0.0012**	**0.61**	5.92 (2.74)	5.24 (2.47)	**0.0290**	**0.25**	**0.0421**
Physical pain (6)	8.29 (3.43)	3.4 (2.29)	**<0.0001**	**1.43**	6.88 (4.01)	3.80 (2.24)	**0.0002**	**0.77**	0.0746
Psychological discomfort (3)	5.49 (2.24)	3.71 (2.31)	**<0.0001**	**0.79**	5.84 (3.25)	4.08 (2.94)	**0.0010**	**0.54**	0.7970
Physical disability (4)	5.14 (3.09)	3.14 (2.34)	**0.0003**	**0.65**	4.04 (3.37)	3.36 (2.34)	0.3132	0.20	0.0711
Psychological disability (3)	3.20 (2.52)	1.97 (1.84)	**0.0073**	**0.49**	3.48 (3.28)	2.32 (2.19)	0.0544	0.35	0.2615
Social disability (2)	1.20 (1.32)	0.8 (1.11)	0.0700	0.30	1.48 (1.50)	0.96 (1.14)	**0.0396**	**0.35**	0.4541
Handicap (3)	1.80 (1.92)	0.91 (12.70)	**0.0123**	**0.46**	1.52 (1.66)	1.16 (1.55)	0.2652	0.22	0.1690
OIDP score	9.28 (13.03)	3 (4.45)	**0.0089**	**0.48**	8.32 (9.59)	4.16 (6.03)	0.0588	0.43	0.5983
WHOQOL-BREF (TW)									
Total score (28)	66.66 (9.66)	68.51 (9.45)	0.1834	0.19	63.84 (8.36)	64.49 (7.11)	0.5320	0.08	0.4950
Physical (7)	15.41 (2.29)	15.58 (2.25)	0.6463	0.07	15.01 (2.14)	15.12 (2.04)	0.7856	0.05	0.5735
Psychological (6)	14.67 (2.33)	14.99 (2.43)	0.3175	0.14	13.87 (2.29)	13.97 (2.07)	0.6557	0.04	0.8078
Social relationship (4)	14.94 (2.51)	15.20 (2.48)	0.4777	0.10	14.16 (2.06)	14.52 (1.84)	0.2652	0.17	0.2664
Environment (9)	15.31 (2.20)	15.35 (2.19)	0.1835	0.02	14.12 (1.42)	14.38 (1.42)	0.1615	0.18	0.8032

[a] Comparison of difference scores of QoL measurements between regenerative and resective surgery patients (adjusting pre-treatment measurement, sex, age, education, economical status and chronic diseases).
[b] $0.2 < ES \leq 0.5$: small difference, $0.5 < ES \leq 0.8$: moderate difference, $0.8 < ES$: large difference.

= 0.79, $P < 0.0001$); and (4) physical disability (ES = 0.65, $P = 0.0003$). Significant differences were observed in the physical pain variable (ES = 1.43, $P < 0.0001$). The OIDP score of the RG group indicated that a small difference existed between the presurgery and postsurgery measurements (ES = 0.48, $P = 0.0089$), whereas the HRQoL scores (WHOQOL-BREF) show no difference. Among the patients in RS group, small differences were observed in the total OHIP score (ES = 0.39, $P = 0.0142$), functional limitation score (ES = 0.25, $P = 0.029$), and social disability score (ES = 0.35, $P = 0.0396$). In addition, moderate differences were observed in physical pain (ES = 0.77, $P = 0.0002$) and psychological discomfort (ES = 0.54, $P = 0.0010$). The OIDP and HRQoL scores (WHOQOL-BREF) were not significant in the RS group.

Regarding the changes in QoL before and after surgical treatment, the RG group exhibited lower QoL measurement scores than did the RS group. Higher ES values were obtained for the RG group than for the RS group in all items except for the social disability item. Furthermore, the RG group exhibited a more significant improvement in functional limitation than did the RS group ($P = 0.0421$).

Discussion

Pain-related and HRQoL outcomes have been investigated in various medical fields throughout the decade [19]. OHRQoL instruments are used to assess patient-based outcomes, and they have been recognized as an integral part of general health management [20]. Previous studies have reported that a correlation exists between the severity of periodontal disease and OHRQoL scores [1,21]. Needleman et al. [22] indicated that OHRQoL measures can be used to detect changes in QoL before and after periodontal therapy. A previous study indicated that initial periodontal therapy exerted a positive effect on QoL [23], and open-flap debridement can significantly improve patients' QoL [24]. Among the participants in this study, the physical pain (psychological discomfort) scores exhibited large (moderate) difference (ES = 1.11 and 0.65) between presurgery and postsurgery results (4 weeks) (Table 2). The total OHIP and OIDP scores differed significantly (ES = 0.60 and 0.46). Saito et al. [24] reported that a significant difference existed (ES = 0.2) between the pre-treatment and post-treatment QoL (approximately 12 ~ 14 weeks) results among periodontal surgery patients. Compared to the study by Saito et al., although our study used less time (4 weeks vs. approximately 12–14 weeks), our results indicated a more significant improvement in physical pain and psychological discomfort. However, the appropriate length of the postoperative period remains controversial.

To our knowledge, few studies have published information on the influence of periodontal surgery on patients' QoL [24]. We observed that RG and RS significantly improved the total OHIP score of patients with periodontal diseases (Table 3). This score reflects comfort when eating,

sleeping, and engaging in social interaction; self-esteem; and satisfaction with oral health. Among the patients in the RG group, significant differences were observed in the total OHIP and OIDP scores as well as the functional limitation, physical pain, psychological discomfort, physical disability, psychological disability, and handicap item scores. Furthermore, among the patients in the RS group, significant differences were observed in the total OHIP score and the functional limitation, physical pain, psychological discomfort, and social disability scores. Except for the social disability score, all of the OHRQoL scores resulted in higher ES values in the RG group than in the RS group, indicating that RG procedures greater improvement than RS does. The scores for the functional limitation item of the OHIP revealed that the patients in the RG group had a significantly greater improvement than the patients in the RS group did. The functional limitation items of the OHIP are "trouble pronouncing words," "stale breath," "taste worse," and "food catching." The results indicated that RG can improve patients' QoL more effectively than RS can, based on the aspects of pronouncing words, halitosis, sense of taste, and food trapping.

Periodontal surgical treatment options for periodontal pockets include RS and RG. RG is performed to regenerate tooth-supporting tissues; changes in the appearance of the periodontal apparatus are minor and periodontal tissues can be recovered without being destroyed, resulting in substantial improvements in functional limitation and physical disability observed in the RG group. By contrast, a considerable amount of periodontal tissue is removed during RS. Previous research showed that postoperative pain was more severe in RS patients than in RG patients [25]. RS involves sacrificing some periodontal structure, and it is considered more painful than RG. In this study, we observed a moderate improvement in physical pain among the RS patients. In addition, the OHIP total scores, psychological discomfort, and social disability of the RS patients also significantly improved compared with preoperative levels.

Small difference or no difference were observed in the OHRQoL parameters (psychological disability, social disability, handicap, and OIDP scores) of the RG group, as well as those (functional limitation, physical disability, psychological disability, social disability, handicap, and OIDP scores) of the RS group. Furthermore, the WHOQOL-BREF (TW) scores of both groups exhibited either a minor difference or no difference; this may be because the initial (non-surgical) periodontal therapy improved the overall QoL. During periodontal treatment, periodontal surgery is a subsidiary treatment option after undergoing initial non-surgical treatment. Minor difference resulting from the effects of periodontal surgery and the benefit of initial periodontal therapy are difficult to distinguish. In this study, no significant differences were observed among the WHOQOL-BREF scores, which were used to assess the general HRQoL. Patients who had severe medical conditions are typically excluded from periodontal surgery. Although periodontal diseases impact patients' QoL, because HRQoL comprised multiple concepts, patients' QoL regarding periodontal surgery could not be clearly determined based on WHOQOL-BREF scores.

A limitation of our study is that many RG and RS techniques exist. In this study, the various techniques could not be organized into unique groups for analysis. Another possible limitation is that the impact of patient perception in the 4-week postoperative period on long-term changes in QoL was not considered. In addition, previous study revealed that adverse relationships have been shown among socioeconomic status, smoking, and periodontal status on OHRQoL [26]. In our study, we removed the smoking factor. However the socioeconomic status of RG group was higher than that of RS group. This might be some intrinsic difference may affect our results.

Despite these limitations, this study provided initial data for evaluating the impact of various types of periodontal surgery on patients' QoL. In conclusion, the results of this study indicated that both RG and RS can improve patients' QoL, particularly regarding physical pain and psychological discomfort. Following periodontal treatment, the RG patients obtained more favorable QoL scores (i.e., lower scores) than the RS patients did. Compared with the patients who underwent RS, the functional limitation of patients who underwent RG improved significantly more.

Conclusion

The patients' OHRQoL scores improved significantly after they underwent periodontal surgery. Clinicians can take advantage of the positive functional OHRQoL impacts of regenerative surgery.

Ethics

The study protocol was approved by the Institutional Review Board of Kaohsiung Medical University Chung-Ho Memorial Hospital, Taiwan (KMUH-IRB-990489).

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