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Original Article

Oral health-related quality of life and pain after periodontal regenerative therapy

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Abstract

Purpose: The use of patient-centered assessments, including oral health-related quality of life (OHRQoL), alongside conventional clinical assessments, such as attachment level, has been recommended in periodontal treatment. This study surveyed OHRQoL to evaluate postoperative patient burden and pain after periodontal regenerative therapy.
Methods: The participants were 104 patients who underwent periodontal regenerative therapy using enamel matrix derivative (EMD), fibroblast growth factor-2 (FGF-2), or open flap debridement. OHRQoL was assessed with the General Oral Health Assessment Index (GOHAI). Pain was evaluated using a visual analog scale (VAS).
Results: As compared with preoperative values, GOHAI total score was significantly lower on days 3 and 7 in all groups and VAS score was significantly higher on day 3 in all groups. VAS scores on day 14 were significantly higher in the FGF-2 group than in the EMD group.
Conclusion: Periodontal regenerative therapy caused a temporary decline in OHRQoL, and postoperative pain was more prolonged in the FGF-2 group than in the EMD group. These results suggest that patient burden needs to be considered when selecting the procedure for periodontal regenerative therapy.

Keywords: enamel matrix derivative, fibroblast growth factor-2, oral health-related quality of life, periodontal regenerative therapy

Introduction

Periodontal disease is a condition in which periodontal tissues are progressively destroyed by chronic inflammation caused by periodontal pathogens. The age-standardized prevalence of severe periodontitis was approximately 10% in 2017 [1], underscoring that its prevention and treatment are a major challenge in dentistry. Clinical practice and research in dental treatment since the 2000s have increasingly emphasized quality of life (QOL) and activities of daily living (ADL). With respect to periodontal disease, it has become evident that periodontitis reduces oral health-related QOL (OHRQoL) and that the resulting loss of functional teeth impairs masticatory efficiency, thereby further diminishing QOL and ADL [2-5]. Periodontal treatment can improve outcomes by preventing tooth loss, increasing the number of functional teeth, and inhibiting the onset and exacerbation of systemic inflammatory diseases.

It has recently been suggested that patient-centered evaluations, including OHRQoL, should be used in periodontal treatment, in addition to conventional evaluations with radiographs for alveolar bone resorption and clinical parameters such as periodontal pocket depth and attachment level [6,7]. In 2015, the International Dental Federation (FDI) proposed using OHRQoL in patient-centered outcome evaluations for dental treatment [8], and periodontological studies investigated the impact of periodontal treatment on OHRQoL [9,10]. Ozcelik et al. used the General Oral Health Assessment Index (GOHAI), an indicator of OHRQoL, to evaluate OHRQoL after periodontal surgery and found that GOHAI scores were lower than those for nonsurgical treatment [9].

Periodontal surgical treatment of subgingival pockets with vertical bone defects caused by periodontal disease involves periodontal regenerative therapy using bioactive enamel matrix derivatives (EMD) or fibroblast growth factor-2 (FGF-2). The EMD-based surgical procedure was first reported by Heijl et al. [11] in 1997 and Hammarström et al. [12] in 1998. In Japan, EMD was approved in 1998, and its effectiveness was later confirmed in numerous studies. An FGF-2 product for periodontal tissue regeneration was approved in Japan as an insured pharmaceutical product in 2016 [13-15]. Both are widely used clinically, and although the two procedures have been compared in studies focusing on clinical parameters such as attachment level, no previous study has compared patient burden, such as OHRQoL and postoperative pain. To facilitate surgical procedure selection and reduce the postoperative burden of periodontal treatment, the present questionnaire survey evaluated patient burden after periodontal regenerative therapy by assessing changes in OHRQoL and pain after surgery.

Materials and Methods

Participants

The study participants were patients with chronic periodontitis who underwent periodontal regenerative therapy using EMD, FGF-2, or open flap debridement (OFD) as tissue attachment therapy for residual periodontal pockets after initial periodontal treatment at the Periodontology Department of Meikai University Hospital during the period from September 2016 and December 2020. Those who did not consent to participate or did not complete all four questionnaires (described below) were excluded.

In total, 104 patients (37 men and 67 women; mean age 61.1 years) were selected as the study participants: 46 underwent EMD (17 men, 29 women; mean age 59.4 years), 35 underwent FGF-2 (15 men, 20 women; mean age 59.2 years), and the 23 who underwent OFD (5 men, 18 women; mean age 62.9 years) served as the control group. OFD was selected as the control group because the surgical procedure is consistent with periodontal regenerative therapy using EMD or FGF-2 agents, but without the use of bioactive substances at the bone defect site. Selection of EMD, FGF-2, or OFD was based on clinical indications, defect morphology, patient preference, and insurance coverage considerations and was not randomized. In oral and written explanations, all participants were informed of the study's context and purpose, safety considerations, and procedures to protect their personal information, and informed consent was obtained. All study procedures were performed in accordance with the ethical standards of the Institutional Research Committee and the Helsinki Declaration of 1964 and its subsequent amendments or comparable ethical standards. This study was approved by the Ethics Committee of Meikai University School of Dentistry (A1603).

Surgical procedures

All procedures were performed by periodontists certified by the Japanese

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Society of Periodontology. All participants underwent basic periodontal treatment, and oral hygiene instruction was provided to achieve an O'Leary plaque control record of ≤20% before surgery.

All procedures were performed after local infiltration anesthesia was induced by lidocaine hydrochloride and epinephrine injection solutions. An intrasulcular incision was made, and a full-thickness mucoperiosteal flap was reflected, after which debridement of the granulation tissue, scaling, and root planing were performed. Alveolar bone morphology was not corrected.

In the EMD group, root conditioning with 24% EDTA was performed, and Emdogain Gel (Straumann Japan, Tokyo, Japan) was applied to the bone defect site. In the FGF-2 group, Regroth (Kaken Pharmaceutical, Osaka, Japan) was applied to the bone defect site, without root conditioning. The gingival flap was then sutured and the wound was closed in all groups. No periodontal dressings were used in any surgical procedure. The patients were instructed to take amoxicillin hydrate (250 mg) as an antibiotic three times daily for 3 days postoperatively. Additionally, they were asked to refrain from brushing the surgical site for 1 week postoperatively and to rinse with 0.004% benzethonium chloride solution three times daily. For pain relief, 60 mg of loxoprofen sodium hydrate or 400 mg of acetaminophen was prescribed in six doses, and the decision to take the medication was left to the participants.

Questionnaire survey

A questionnaire survey was conducted at baseline (immediately before surgery) and on postoperative days 3, 7, and 14. For questions related to OHRQoL, participants were instructed to answer based on events that occurred in the past week at baseline and events that occurred after the previous response on postoperative days 3, 7, and 14. Participants were instructed to base their answer to questions related to pain on their current condition at the time of response. To minimize bias, participants were asked to complete the questionnaire without viewing their previous responses. If participants were unable to complete the questionnaire at the clinic, they were instructed to complete it at home, place it in a designated envelope, and bring it at their next visit.

OHRQoL was assessed with the GOHAI, a comprehensive scale for measuring OHRQoL developed by Atchison et al. [16] in 1990. The Japanese version of the GOHAI was developed by Naito et al. [17], and national standard values for Japan, which were used in this study, were published in 2006. The GOHAI consists of 12 questions divided into three subscales: physical function, psychosocial function, and pain and discomfort. The response format uses a five-point Likert scale: 1 = Always, 2 = Often, 3 = Sometimes, 4 = Rarely, and 5 = Never. A higher total score indicates a higher OHRQoL. In this study, both total and subscale scores were considered.

Postoperative pain was evaluated with a visual analog scale (VAS) [18], which has high sensitivity and reproducibility for subjective pain assessment and has been widely used in clinical studies in multiple disciplines. In this study, the VAS evaluation used a scale with a 100-mm horizontal line, with the left end labeled "0: no pain" and the right end labeled "10: the greatest pain imaginable." The distance from the left end to the point marked by the subject was measured using calipers and scored in millimeters (minimum: 0 mm, maximum: 100 mm). Pain intensity was evaluated based on the location of the current pain indication on the line. VAS results for each group were compared and analyzed in relation to sex, site (maxilla vs. mandible), and age (<65 years vs. ≥65 years).

Statistical analysis

Statistical analysis was performed using statistical software (SPSS 23.0; IBM Japan, Tokyo, Japan). Comparisons between preoperative GOHAI scores and the national standard value were performed using a one-sample *t*-test. Comparisons among the EMD, FGF-2, and OFD groups at each time point were performed with the Kruskal-Wallis test, followed by Bonferroni-adjusted *post hoc* multiple comparisons when appropriate. For intragroup comparisons of repeated measurements over time (baseline and postoperative days 3, 7, and 14), the Friedman test was used, followed by Bonferroni correction for multiple comparisons. The results are presented in tables as the mean ± standard error. Tests were performed at a two-sided 5% significance level, and a *P* value of <0.05 was considered to indicate statistical significance.

Table 1 Baseline GOHAI scores and the national standard value

Group	GOHAI score
EMD	52.6 ± 6.3
FGF-2	53.0 ± 6.0
OFD	51.2 ± 8.5
National standard value	53.1 ± 7.0

Data are presented as mean ± SD. No significant differences were observed in comparisons with the national standard value. SD, standard deviation

Table 2 Change in GOHAI total scores after periodontal surgery

Group	Baseline	Day 3	Day 7	Day 14
EMD	52.6 ± 1.0	44.3 ± 1.5†	47.8 ± 1.4†	50.2 ± 1.8
FGF-2	53.0 ± 1.1	45.6 ± 1.4†	49.0 ± 1.4†	51.9 ± 1.3
OFD	51.2 ± 1.3	46.7 ± 0.6†	49.4 ± 0.6†	50.9 ± 0.3

Data are presented as mean ± SE. †$P < 0.05$ vs baseline. SE, standard error

Table 3A Change in GOHAI physical function scores

Group	Baseline	Day 3	Day 7	Day 14
EMD	21.6 ± 0.5	16.9 ± 0.7†	18.4 ± 0.7	19.6 ± 0.8
FGF-2	21.9 ± 0.5	17.4 ± 0.7†	19.0 ± 0.6	20.8 ± 0.6
OFD	21.2 ± 0.8	18.2 ± 0.9†	19.4 ± 0.7	20.6 ± 0.4

Data are presented as mean ± SE. †$P < 0.05$ vs baseline. SE, standard error

Table 3B Change in GOHAI psychosocial function scores

Group	Baseline	Day 3	Day 7	Day 14
EMD	22.5 ± 0.4	19.8 ± 0.6†	21.0 ± 0.6	22.0 ± 0.7
FGF-2	22.5 ± 0.7	20.3 ± 0.7	21.4 ± 0.7	22.2 ± 0.7
OFD	21.3 ± 1.6	20.5 ± 0.8	21.4 ± 0.7	21.7 ± 0.3

Data are presented as mean ± SE. †$P < 0.05$ vs baseline. SE, standard error

Table 3C Change in GOHAI pain and discomfort scores

Group	Baseline	Day 3	Day 7	Day 14
EMD	7.7 ± 0.3	7.5 ± 0.3	8.3 ± 0.3	8.5 ± 0.3
FGF-2	8.6 ± 1.1	7.9 ± 0.3	8.6 ± 0.3	8.9 ± 0.3
OFD	8.6 ± 1.5	8.0 ± 0.7	8.6 ± 0.7	8.7 ± 0.3

Data are presented as mean ± SE. SE, standard error

Results

Oral health-related QOL

The mean preoperative GOHAI total scores of 52.6 in the EMD group, 53.0 in the FGF-2 group, and 51.2 in the OFD group did not significantly differ from the national standard value (Table 1). Temporal change in GOHAI score in each group and differences among groups were then examined. In all groups, GOHAI scores were significantly lower on postoperative days 3 and 7 (Table 2) and physical function scores were significantly lower on postoperative day 3 (Table 3A). The score for psychosocial function was significantly lower on postoperative day 3 in the EMD group but did not significantly change in the FGF-2 and OFD groups (Table 3B). There was no significant change, and no intergroup differences, in pain and discomfort during the observation period (Table 3C).

Postoperative pain

VAS scores were significantly higher on postoperative day 3 that at baseline in all groups. In the EMD and OFD groups, there was a significant decrease from postoperative day 3 to postoperative days 7 and 14. In the intergroup comparison, the VAS score on postoperative day 14 was significantly higher for the FGF-2 group than for the EMD group (Table 4).

With respect to surgical site, all groups showed a significant increase in VAS score on postoperative day 3, as compared with baseline, for both the maxilla and mandible. For the mandible, the VAS score significantly decreased from postoperative day 3 to day 14 in the EMD group. In the intergroup comparison, the VAS score for the maxilla was significantly higher in the FGF-2 group than in the EMD group on postoperative day 14 (Table 5). Scores for the maxilla and mandible did not significantly differ in any group.

Table 4 Postoperative pain intensity assessed by VAS

Group	Baseline	Day 3	Day 7	Day 14
EMD	2.4 ± 0.8	13.1 ± 2.7†	4.9 ± 1.2‡	1.8 ± 0.6‡
FGF-2	2.2 ± 1.2	12.4 ± 3.2†	8.3 ± 3.0	7.8 ± 3.0*
OFD	1.2 ± 0.7	11.3 ± 4.5†	6.4 ± 2.9‡	4.0 ± 2.0‡

Data are presented as mean ± SE. †$P < 0.05$ vs baseline. ‡$P < 0.05$ vs postoperative day 3. *$P < 0.05$ vs EMD group at the same time point. SE, standard error

Table 5 Postoperative pain intensity assessed by VAS, by surgical site

Surgical site/Group	Baseline	Day 3	Day 7	Day 14
Maxilla				
EMD (n = 26)	2.6 ± 1.2	12.4 ± 4.7†	5.7 ± 3.9	1.6 ± 0.7
FGF-2 (n = 19)	3.5 ± 2.3	13.8 ± 4.4†	8.6 ± 3.9	9.3 ± 4.5*
OFD (n = 14)	2.0 ± 1.1	16.5 ± 7.0†	8.6 ± 4.5	5.0 ± 3.2
Mandible				
EMD (n = 20)	2.4 ± 1.4	11.6 ± 2.7†	3.4 ± 1.4	0.8 ± 0.5‡
FGF-2 (n = 16)	0.6 ± 0.4	10.7 ± 5.0†	7.4 ± 4.9	5.3 ± 4.3
OFD (n = 9)	0.0 ± 0.0	12.4 ± 4.1†	4.8 ± 2.3	2.9 ± 1.6

Data are presented as mean ± SE. †$P < 0.05$ vs baseline. ‡$P < 0.05$ vs postoperative day 3. *$P < 0.05$ vs EMD group at the same time point. SE, standard error

Table 6 Postoperative pain intensity assessed by VAS, by sex

Sex/Group	Baseline	Day 3	Day 7	Day 14
Male				
EMD (n = 17)	2.5 ± 1.1	8.3 ± 2.8†	4.8 ± 1.8	1.8 ± 0.7
FGF-2 (n = 15)	3.7 ± 2.6	12.9 ± 4.3†	9.5 ± 4.5	9.4 ± 5.2
OFD (n = 5)	1.6 ± 1.6	11.0 ± 6.6†	5.0 ± 3.1	2.0 ± 2.0
Female				
EMD (n = 29)	2.1 ± 1.0	12.6 ± 3.4†	4.0 ± 1.4	1.6 ± 0.9‡
FGF-2 (n = 20)	1.5 ± 0.8	11.0 ± 3.2†	5.2 ± 1.8	2.9 ± 1.1‡
OFD (n = 18)	1.1 ± 0.8	16.0 ± 5.5†	7.8 ± 3.6	4.8 ± 2.6‡

Data are presented as mean ± SE. †$P < 0.05$ vs baseline. ‡$P < 0.05$ vs postoperative day 3. SE, standard error

Table 7 Postoperative pain intensity assessed by VAS, by age

Age/Group	Baseline	Day 3	Day 7	Day 14
≥65 years				
EMD (n = 21)	4.0 ± 0.9	7.9 ± 1.8†	4.3 ± 2.0	0.8 ± 0.6‡
FGF-2 (n = 13)	4.4 ± 2.6	17.5 ± 4.3†*	10.8 ± 4.3	11.0 ± 5.1*
OFD (n = 10)	0.0 ± 0.0	13.7 ± 8.1†	7.9 ± 6.3	5.1 ± 4.4
<65 years				
EMD (n = 25)	2.7 ± 1.1	13.9 ± 4.0†	4.3 ± 1.2	2.3 ± 0.9‡
FGF-2 (n = 22)	1.0 ± 0.6	10.7 ± 4.0†	7.3 ± 3.4	4.5 ± 2.9‡
OFD (n = 13)	2.2 ± 1.1	15.8 ± 5.2†	6.6 ± 2.0	3.5 ± 1.4

Data are presented as mean ± SE. †$P < 0.05$ vs baseline. ‡$P < 0.05$ vs postoperative day 3. *$P < 0.05$ vs EMD group at the same time point. SE, standard error

With respect to sex, VAS scores were significantly higher on postoperative day 3 than at baseline in both men and women in all groups. In women, VAS scores significantly decreased from postoperative day 3 to day 14 in all groups (Table 6). No significant difference between men and women was observed in any group.

With respect to age, VAS scores were significantly higher on postoperative day 3 than at baseline in patients aged ≥65 years and <65 years. In those aged ≥65 years, VAS score significantly decreased from 3 to 14 days postoperatively in the EMD group. In those aged <65 years, VAS score significantly decreased from 3 to 14 days postoperatively in the EMD and FGF-2 groups. In intergroup comparisons, among patients aged ≥65 years, VAS scores on postoperative days 3 and 14 were significantly higher in the FGF-2 group than in the EMD group (Table 7). There was no significant difference between age groups in any group.

Discussion

The GOHAI is considered an indicator of OHRQoL and is sensitive to relatively minor oral symptoms. Previous studies reported that the GOHAI also accurately reflects psychological effects [19], and studies have used it to evaluate OHRQoL after periodontal surgery. Because a Japanese version has been developed and national standard values based on the census distribution have been published, the GOHAI was considered appropriate for evaluating changes in the oral cavity after periodontal regenerative therapy in this study.

The present preoperative GOHAI score did not differ from the national standard, consistent with previous reports that periodontitis reduces OHRQoL and initial periodontal treatment improves it [20-23]. Because GOHAI was not measured before the initial periodontal treatment in this study, change in GOHAI attributable to basic periodontal treatment could not be examined. However, it is likely that, as in previous reports, basic periodontal treatment conducted before periodontal surgery was effective and improved OHRQoL. Thus, no differences in GOHAI scores were observed between the groups and national standard values preoperatively.

Analysis of GOHAI total scores showed that periodontal regenerative therapy temporarily worsened OHRQoL postoperatively and that the decrease occurred between postoperative days 3 and 7. Yuan et al. [24] reported that although OHRQoL decreased immediately after periodontal surgery, it recovered to preoperative levels by the time of suture removal. In the present periodontal regenerative therapy protocol, suture removal was performed approximately 2 weeks postoperatively, which is consistent with the present finding that OHRQoL decreased until day 7 and recovered to preoperative levels by day 14. On GOHAI subscales, physical function scores on day 3 were lower in all groups. The decline in OHRQoL after periodontal regenerative therapy suggests that physical functions such as speech and eating influence this decline. Additionally, the psychosocial function score on postoperative day 3 was lower only in the EMD group, perhaps because of psychosocial characteristics such as patient expectations regarding treatment, as periodontal regenerative therapy using EMD is not covered by insurance in Japan.

VAS data indicate that postoperative pain peaked on the postoperative day 3 in the EMD and FGF-2 groups, as was the case in the OFD group. Recovery to preoperative levels appeared to be slower in the FGF-2 group, and postoperative pain on day 14 was significantly greater in the FGF-2 group than in the EMD group. EMD tended to suppress postoperative pain in patients with OFD, whereas FGF-2 tended to exacerbate it. In this study, postoperative analgesic intake was at the discretion of the participants and was not quantitatively standardized. Therefore, analgesic use may have influenced postoperative VAS scores. However, the proportion of patients who received analgesics at least once was 57.5% in the EMD group, 65.0% in the OFD group, and 54.8% in the FGF-2 group. When conducting pain-related research, including studies of postoperative patient burden, factors such as the number of analgesic doses and dosage guidelines must be considered when designing the study. Thus, the present data are insufficient to draw conclusions on the effects of analgesics. EMD is generally associated with less postoperative pain and inflammatory findings, such as gingival swelling after periodontal surgery [25], and amelogenin may play a role in this. Amelogenin, the main protein in EMD, is central to its activity. It stimulates macrophages to produce anti-inflammatory cytokines and growth factors, including interleukin-10, vascular endothelial growth factor, and insulin-like growth factor-1 [26]. Furthermore, amelogenin suppresses expression of major histocompatibility complex class II in macrophages, thereby inhibiting differentiation and activation of CD4-positive T cells that bind to it and reducing the production of interleukin-2. Thus, EMD is thought to suppress activation of immune responses centered on cell-mediated immunity by T cells, thereby promoting wound healing [27]. In contrast, FGF-2 acts on vascular endothelial cells to promote angiogenesis, leading to alveolar bone regeneration. FGF-2-stimulated periodontal ligament cells increase production of vascular endothelial growth factor, which acts simultaneously and synergistically to enhance angiogenesis [28]. In light of this healing process, FGF-2 is thought to be associated with postoperative inflammatory findings such as gingival redness and swelling. Although localized tissue overgrowth or induration associated with FGF-2 administration has been reported, postoperative soft tissue reactions were not systematically evaluated in the present study. Therefore, their relationship with postoperative pain could not be directly assessed. However, such local inflammatory responses may partially contribute to prolonged postoperative discomfort in some patients. The difference in postoperative pain in the EMD and FGF-2 groups is likely related to differences in their respective healing mechanisms.

Analysis of VAS results by sex, site (maxilla vs. mandible), and age (<65 years vs. ≥65 years) showed that VAS values were significantly higher in the FGF-2 group than in the EMD group on postoperative day 14

in the maxilla, and on postoperative days 3 and 14 in those aged ≥65 years. Several biological mechanisms may explain prolonged postoperative pain in elderly patients treated with FGF-2, particularly at maxillary sites. Anatomically, maxillary gingival tissues are generally thicker than mandibular gingiva, which may influence wound healing dynamics and inflammatory resolution [29]. In addition, aging is associated with reduced regenerative capacity and delayed tissue repair in periodontal tissues. Huang et al. [30] noted that aging leads to a general decline in stem cell function, which manifests as a loss of alveolar bone volume and atrophy of the periodontal ligament. Therefore, regeneration of periodontal tissue takes longer in older adults than in younger ones. Experimental studies have shown that FGF-2 enhances angiogenesis, vascular endothelial proliferation, and gingival connective tissue thickness during periodontal wound healing [31,32]. Although these biological effects may facilitate periodontal regeneration, enhanced vascular and soft tissue responses may also contribute to prolonged postoperative tissue reactions and discomfort in some patients. These differences in gingival properties and age-related changes strongly suggest that postoperative inflammation occurred in the maxilla and in FGF-2 group patients aged ≥65 years, resulting in differences in postoperative pain outcomes between the EMD and FGF-2 groups.

Several confounding factors may have influenced postoperative OHRQoL and pain outcomes in the present study. Previous studies of patient-reported outcomes after periodontal surgery reported that increased surgical extension and procedural complexity are associated with greater postoperative discomfort and analgesic consumption [33]. In addition, defect morphology, including defect depth and configuration, may influence surgical invasiveness, wound stability, and healing responses. Technique-related factors such as tissue handling, wound closure, and operative time may also affect postoperative wound healing and patient discomfort. Furthermore, patient-related factors, including sex, socioeconomic background, psychological stress, pain perception, and postoperative analgesic intake, may have influenced subjective outcome measures. Because these variables were not fully standardized or quantitatively evaluated in the present study, the findings should be interpreted cautiously. In this study, the limited number of participants prevented a detailed examination of factors influencing OHRQoL and postoperative pain after periodontal regenerative therapy. Future studies should include a larger sample and further investigate factors affecting patient burden. Additionally, while EMD and FGF-2 have nearly identical indications, EMD is not covered by insurance in Japan, and the difference in surgical costs may have affected the patients' choice of procedure. Therefore, when evaluating changes in postoperative OHRQoL, the economic and social backgrounds of the participants should be considered in future studies. All of the present procedures were performed by board-certified periodontists. However, because multiple surgeons were involved, differences between surgeons in surgical skill or procedure time may have affected the results, which is another limitation of this study.

Dental treatment has traditionally focused on improving clinical parameters. However, when selecting and explaining surgical procedures to patients, it is now essential to also consider changes in OHRQoL—including functional and psychosocial aspects—as well as differences in patient burden, such as postoperative pain. Furthermore, dentists must recognize that while dental treatment can improve OHRQoL overall, certain surgical procedures may temporarily reduce it.

The present findings show that periodontal regenerative therapy caused a temporary postoperative decline in OHRQoL. Postoperative pain peaked on the third day after EMD and FGF-2 and, in the FGF-2 group, recovery took longer after maxillary procedures and in patients aged ≥65 years. In conclusion, differences in OHRQoL and postoperative pain should be considered when selecting surgical procedures and in preoperative explanations for patients.

Abbreviations

ADL: activities of daily living; EMD: enamel matrix derivative; FGF-2: fibroblast growth factor-2; GOHAI: General Oral Health Assessment Index; OFD: open flap debridement; OHRQoL: oral health-related QOL; QOL: quality of life; VAS: visual analog scale

Ethics Statements

The study protocol was approved by the Ethics Committee of Meikai University School of Dentistry (A1603) and conducted in accordance with the Helsinki Declaration.

Conflicts of Interest

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

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The authors report no financial or personal interest related to any products, services, and/or companies presented in this study.

Author Contribution Statement

YT: methodology, investigation, data curation, formal analysis and validation, writing – original draft preparation, writing – review and editing; JT: data curation, writing – original draft preparation, writing – review and editing; HN: investigation, writing – review and editing; KN: investigation, writing – review and editing; YY: investigation, writing – review and editing; MU: investigation, writing – review and editing; MI: investigation, writing – review and editing; RS: methodology, writing – review and editing; KS: writing – review and editing, project administration; JH: conceptualization, methodology, investigation, data curation, writing – review and editing, project administration, supervision

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Data Availability Statement

Data generated during the current study are available from the corresponding author on reasonable request.

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