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Clinical Effect of Quadrant-wise Non-surgical Periodontal Treatment on Patients with Stage III Grade B and C Periodontitis

Kadran bazlı Cerrahi Olmayan Periodontal Tedavinin Evre III Derece B ve Derece C Periodontitis Hastalarındaki Klinik Etkisi

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ABSTRACT

Objective: The aim of this study was to evaluate clinical effects of quadrant-wise non-surgical periodontal treatment in patients with stage-III grade-B and grade-C periodontitis.

Methods: Forty-five non-smoker individuals who were systemically healthy, including 15 periodontally healthy, 15 stage-III grade-B periodontitis participant, and 15 stage-III grade-C periodontitis participant, were involved in this study. At baseline, plaque index, gingival index, probing depth, clinical attachment level, and bleeding on probing were evaluated for all participants, and in periodontitis groups, probing depth measurements were categorized as intermediate (4-6 mm) and deep (>6 mm), and the percentages of all categorized probing depths were calculated. Quadrant-wise non-surgical periodontal treatment was performed in both periodontitis groups, and clinical measurements were performed again 1 and 3 months after quadrant-wise non-surgical periodontal treatment.

Results: At baseline, periodontitis was higher in stage-III grade-C group than stage-III grade-B group ($P < .05$), whereas plaque index, gingival index, bleeding on probing, and clinical attachment level were similar between 2 groups ($P > .05$). All clinical parameters improved from baseline to 1 and 3 months in all periodontitis groups ($P > .05$). The reduction of percentage of the regions with probing depth of 4-6 mm from baseline to 3 months was higher in stage-III grade-B group than stage-III grade-C group ($P < .05$). As compared to the stage-III grade-B group at 1 and 3 months, the percentage of sites with probing depth ≥ 5 mm and BOP+(%) was higher in the stage-III grade-C group ($P < .05$).

Conclusion: According to residual probing depth and deep periodontal pockets, the clinical response of quadrant-wise non-surgical periodontal treatment was superior in stage-III grade-B periodontitis group than stage-III grade-C periodontitis group, and there was a need for periodontal surgical treatment after quadrant-wise non-surgical periodontal treatment in the stage-III grade-C periodontitis group

Keywords: Dental scaling, periodontitis, root planing

ÖZ

Amaç: Bu çalışmanın amacı, evre III derece B (EIII-DB-P) ve derece C periodontitisi (EIII-DC-P) olan hastalarda kadran bazlı cerrahi olmayan periodontal tedavinin (KCPT) klinik etkinliğini değerlendirmektir.

Yöntem: Bu çalışmaya periodontal sağlıklı 15 katılımcı, EIII-DB-P 15 ve EIII-DC-P 15 hasta olmak üzere sistemik olarak sağlıklı sigara içmeyen 45 birey dahil edildi. Başlangıçta, tüm katılımcılardan plak indeksi (Pİ), gingşival indeks (Gİ), sondalama derinliği (SD), klinik ataşman seviyesi (KAS), sondalamada kanama (SK) ölçüldü ve periodontitis gruplarında, SD ölçümleri orta 4-6 mm ve derin >6 mm şekilde kategorize edilerek kategorize edilmiş tüm PD'lerin yüzdeleri hesaplandı. Her iki periodontitis grubuna KCPT uygulandı ve KCPT'den 1 ve 3 ay sonra klinik ölçümler tekrar yapıldı.

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Bulgular: Başlangıçta SD, EIII-DC-P grubunda EIII-DB-P grubuna göre daha yüksek (*P* < ,05) iken Pİ, Gİ, SK ve KAS iki grup arasında benzer bulundu (*P* > ,05). Tüm klinik parametreler, her iki periodontitis grubunda başlangıca göre 1. ve 3. aylarda azaldı (*P* > ,05). SD = 4-6 mm olan bölgelerin yüzdesinin başlangıca göre 3 aya göre azalması EIII-DB-P grubunda EIII-DC-P grubuna göre daha yüksekti (*P* < ,05). 1. ve 3. ayda EIII-DB-P grubu ile karşılaştırıldığında, SD ≥ 5 mm ve SK+(%) olan bölgelerin yüzdesi EIII-DC-P grubunda daha yüksek bulundu (*P* < ,05).

Sonuç: Rezidüel ve derin periodontal ceplere bakıldığında, KCPT ile EIII-DB-P'de EIII-DC-P grubuna göre daha iyi klinik iyileşme meydana geldiği ve EIII-DC-P grubunda KCPT sonrası periodontal cerrahi tedaviye ihtiyaç duyulduğu görüldü.

Anahtar Kelimeler: Diş yüzey temizliği, kök yüzey düzleştirmesi, periodontitis

INTRODUCTION

Periodontitis is a chronic multifactorial destructive inflammatory condition that affects the tooth-supporting tissues. It is characterized by the development of periodontal pockets, loss of attachment, and resorption of the alveolar bone and may also cause tooth loss.[1] Therefore, it negatively affects masticatory function, aesthetics, and quality of life. Due to its high prevalence, periodontitis is a major health problem in the world. In 2018, periodontal diseases were reclassified.[2] Periodontitis is divided into 4 stages according to the severity, complexity, prevalence, and distribution of the condition and grades A, B, and C according to the rate of progression.[3] Early diagnoses of periodontitis is crucial for efficient treatment, controlling the disease's severity and progression, and improving person's quality of life by preserving their healthy teeth.

The main objectives of periodontal therapy are to prevent tooth loss and to manage spread and development of periodontitis. Non-surgical periodontal therapy (NPT) is accepted as gold standard and the initial stage in the treatment approach for patients with periodontitis.[4-6] Mechanical debridement was used to eliminate the periodontal pathogens and their byproducts. Scaling and root planing (SRP) are the fundamental NPT procedures that help to reduce gingival inflammation. Scaling and root planing is considered as the cornerstone of cause-related treatment. Nevertheless, SRP is technically challenging, and total calculus removal is daunting to perform.[4] According to previous studies, after SRP pocket depth (PD) decrease, resolution of inflammation, and clinical attachment (CA) gain were obtained in patients with periodontitis.[7,8] Moreover, NPT is particularly less effective in mobile teeth and/or in deep periodontal pocket and at posterior teeth with furcation involvements. Thus, residual PDs following NPT can be detected.[9] It has been reported that there is a decrease in PD ≥4 mm after NPT, and the severity of periodontitis decreased significantly 1 month after NPT.[10] Clinical studies and clinical practice frequently use surrogate outcomes like CA level (CAL), PD, or bleeding on probing (BOP) to predict disease progression and risk of tooth loss.[11] In the re-evaluation of NPT, site-specific factors such as BOP positive site, PD ≥5 mm, and CA loss are among the prognostic factors used in the evaluation of periodontal diseases.[9,11-14]

As far as we know, there were limited studies which investigated the clinical effects of NPT in participants with stage-III grade-B (SIII-GB-P) and C (SIII-GC-P) periodontitis.[15] The null hypothesis of the present study was that severe forms of SIII-GB-P and SIII-GC-P would respond clinically similarly to quadrant-wise NPT (QNPT). The purpose of this study was to investigate the effects of QNPT on clinical parameters in patients with SIII-GB-P and SIII-GC-P at 1 and 3 months.

MATERIAL AND METHODS

Study Design and Sample Size Calculation

This study was designed as a prospective controlled clinical trial. The study protocol was approved by the Marmara University Faculty of Dentistry, Clinical Study Ethics Committee (25.11.2021 and protocol number; 2021/27). According to the 2013 revision of the 1975 Declaration of Helsinki, all participants gave their written consent after being informed about the objectives and methods of the study before any recordings were made.

The PD was the study's primary outcome. The sample size was determined with a software application (G* Power Version 3.1.9.2, 2014, University of Kiel, Germany) using a previous study.[16] The minimum sample size for each group was calculated as 13 with a power of 80% at α error of 0.05 according to the PD difference of 0.59 mm between baseline to three months in the severe periodontitis group, assuming that the standard deviation is 0.68.

Study Population and Clinical Assessment

In the Periodontology Department, Dental Faculty, Marmara University, İstanbul, Türkiye, 45 systemically healthy and non-smoking volunteers between the ages of 30 and 55 (17 women and 28 men; mean age 39.89 ± 6.99 years) were registered for the current study between December 2021 and May 2022.

Dental and medical anamneses and panoramic radiographs were taken from all individuals, and the presence of systemic disorders, smoking, pregnancy or lactation, any periodontal therapy, and use of antibiotics or anti-inflammatory medicines during the previous 6 months were the exclusion criteria.

All patients who had 20 or more teeth were examined with periodontal clinical measurements including plaque index (PI),[17] BOP, gingival index (GI),[18] PD, and CAL, and radiographic assessment, except for third molars. PD was categorized as intermediate (4-6 mm) and deep (>6 mm), and percentages of all categorized PDs were calculated inperiodontitis groups.[19] The ratios of sites with PD ≥ 5 mm and BOP positive were evaluated before and after NPT in periodontitis groups.[12]

The periodontal diseases of the participants were determined according to the standards in the consensus report published in 2017. According to this, participants were separated into 3 groups.[3] Patients in the healthy group (n = 15) had BOP <10%, PD ≤3 mm, no attachment loss, and no radiological evidence of alveolar bone loss.[11] Inclusion criteria were patients with SIII periodontitis who had interdental CAL ≥5 mm, PD ≥6 mm, radiographic bone loss that extended at least to the middle third of the root but no periodontitis symptoms. They lost no more than 4 teeth because of periodontitis. In addition, because there was no clear

evidence of progression, the grade was determined based on the age and radiographic bone loss. The worst-affected tooth in the dentition was chosen, and radiographic bone loss was estimated as a percentage of root length and divided by the patient's age in calibrated and not imposed periapical radiographs. The patients (n = 15) were classified as having grade B if the percentage of bone loss/age was .25-1.0. The participants were assigned to the grade C group (n = 15) if percentage of bone loss/age was >1.0.[3]

A calibrated blinded examiner (SK) measured the clinical parameters from 6 sites of each tooth using a periodontal probe (University of North Carolina 15 periodontal probe, Hu-Friedy, Chicago, Ill, USA) at baseline and 1 and 3 months after QNPT. Intra-examiner calibration was performed on 7 patients with SIII periodontitis who were excluded from the study. PD and CAL were recorded 2 times 24 hours apart. For PD and CAL, the intra-examiner kappa scores were .93 and .91, respectively.

Non-Surgical Periodontal Therapy

After completion of initial clinical evaluations, patients with periodontitis received motivation and oral hygiene instructions (OHI) including modified Bass brushing technique and interproximal cleaning with dental floss or interdental brushes. A periodontist (HSY) carried out QNPT using manual (Gracey curettes, Hu-Friedy, Chicago, Ill, USA; 5-6, 11-12, 12-13) and ultrasonic (Woodpecker UDS-A, Cavitron, Guilin Woodpecker Medical Ins. Co., China) instruments. Four sessions of quadrant-wise subgingival SRP were performed under local anesthesia over the course of 4 weeks. Antibiotics and antibacterial drugs were not used during therapy. Throughout the study period, OHI and motivation were reiterated at every visit. Clinical evaluations were repeated in patients with periodontitis at 1 and 3 months after QNPT.

Statistical Analysis

Statistical Package for Social Sciences (SPSS) 23.0 software (IBM Corp.; Armonk, NY, USA) was applied to analyze the data. The distribution of the parameters was evaluated using Shapiro–Wilk's normality test. Nonparametric tests were applied because of the variables' non-normal distribution. While qualitative data were presented as percentages, quantitative data were given as median, minimum, and maximum ranges. The Kruskal–Wallis test was applied to assess multiple intergroup comparisons; if significance was found, the Bonferroni-adjusted Mann–Whitney *U* test was performed to analyze pairwise comparisons. Multiple intragroup comparisons were applied with Friedman's test, and pairwise comparison with the Bonferroni-adjusted Wilcoxon signed-rank test was performed. $P < .05$ was considered statistically significant.

RESULTS

The demographic data for individuals are presented in Table 1. Gender distribution, age, and the number of teeth were similar among groups ($P > .05$). Clinical parameters are shown in Table 2. The baseline PI, BOP (%), GI, PD, and CAL of the SIII-GB-P and SIII-GC-P groups were higher than that in the healthy group ($P < .0001$). The periodontal measurements in both periodontitis groups were similar at baseline and 1 and 3 months after QNPT ($P > .05$), except for PD ($P < .05$). At the baseline and 1 and 3 months after QNPT, PD was higher in the SIII-GC-P group than in the SIII-GB-P group ($P < .05$). In periodontitis groups, all clinical measurements dramatically reduced from baseline to 1 and 3 months following QNPT ($P < .0001$). Nevertheless, comparing the SIII-GB-P and SIII-GC-P groups, from baseline to 3 months, there was no noticeable difference in the reductions of PI, GI, BOP (%), PD, and CAL ($P > .05$).

DISCUSSION

Chronic inflammatory conditions known as periodontal diseases affect the alveolar bone, gingiva, and other periodontal tissues around the teeth[1] and may arise as a consequence of the host's reaction to the pathogenic microorganisms and their products in the biofilm.[20] The clinical signs and symptoms of periodontal diseases include changes in the gingiva's color, consistency, and volume; gingival bleeding; formation of periodontal pockets; tooth mobility; loss of attachment and alveolar bone; and tooth loss.

In the new periodontal disease classification, periodontitis is divided into 4 stages as I, II, III, and IV according to its severity, including CAL, alveolar bone, or tooth loss.[3] In order to demonstrate the effectiveness of the QNPT, this study was performed in SIII patients with severe periodontitis and with at least 20 teeth. Although stage IV (SIV) periodontitis involves masticatory dysfunction in contrast to SIII periodontitis, multi-disciplinary treatments such as periodontology, orthodontics, and prosthetic therapy are required.[2] However, in SIV periodontitis, there are some factors that increase the complexity of periodontitis, such as tooth mobility, more tooth loss due to periodontal disease, and bite collapse, which affect the response to NPT,[3] and for these reasons, the present study was not performed in patients with SIV periodontitis. In addition, in the new classification of periodontal disease, periodontitis is subdivided into 3 grades as A, B, and C according to the progression rate of the disease.[3] The present study was conducted in patients with SIII-GB-P and SIII-GC-P with the same severity and different periodontal disease progression rate as moderate and rapid, respectively.

Non-surgical periodontal therapy is the first step in the treatment of periodontal diseases and performed to control the infection and contains OHI, mechanically removing supra and subgingival dental plaque and calculus with curettes and ultrasonic instruments, and application of antimicrobial agents if necessary.[4] There are different treatment methods in the application of NPT such as conventional QNPT,[21] full-mouth disinfection method using local antimicrobial drugs in 24 hours,[22] and full-mouth NPT without using antimicrobial drugs in 24 hours.[23] The conventional QNPT approach allows repeating OHI in each session and detailed

Table 1. Demographic Characteristics of Study Groups

	Groups			
	Healthy (n = 15)	SIII-GB Periodontitis (n = 15)	SIII-GC Periodontitis (n = 15)	P*
Age (years)				
Median (minimum–maximum)	43.0 (32.0-48.0)	44.0 (30.0-52.0)	39.5 (30.0-55.0)	.680
Gender n (%)				
Female	7 (46.7)	5 (37.5)	5 (33.7)	.746
Male	8 (53.3)	10 (62.5)	10 (66.7)	
Number of teeth				
Median (minimum–maximum)	28.0 (22.0-28.0)	27.0 (22-28)	26.0 (22-28)	.088

SIII-GB, Stage III Grade B; SIII-GC, Stage III Grade C.*Kruskal–Wallis or chi-square test; $P < .05$.

Table 2. Comparisons of Clinical Parameters Among the Study Groups at Baseline and 1 and 3 Months

		Groups						
		Healthy (a)	SIII-GB Periodontitis (b)	SIII-GC Periodontitis (c)				
		(n=15)	(n=15)	(n=15)				
	Time Points	Median (minimum–maximum)	Median (minimum–maximum)	Median (minimum–maximum)	(a-b-c)P^{*}	(a-b)$P^{\dagger}$	(a-c)$P^{\dagger}$	(b-c)$P^{\dagger}$
PI	Baseline	0.10 (0.00-0.27)	2.26 (2.02-2.93)	2.10 (1.54-3.00)	.000	.000	.000	.160
	1 month		0.15 (0.00-0.50)[‡]	0.02 (0.00-0.83)[‡]				.373
	3 months		0.05 (0.00-0.41)[‡]	0.17 (0.00-0.68)[‡]				.031
	$P^{\sharp}$	–	< .0001	< .0001				
	Δ0-3	–	2.22 (1.94-2.85)	2.01 (1.37-2.93)				.072
GI	Baseline	0.04 (0.00-0.27)	1.72 (1.34-2.40)	1.87 (1.27-2.08)	.000	.000	.000	.417
	1 month		0.11 (0.03-0.54)[‡]	0.18 (0.03-0.48)[‡]				.373
	3 months		0.07 (0.00-0.33)[‡]	0.08 (0.00-0.40)[‡]				.475
	$P^{\sharp}$	–	<.0001	<.0001				
	Δ0-3	–	1.65 (1.21-2.39)	1.78 (1.27-2.04)				.607
BOP (%)	Baseline	7.71 (1.92-9.26)	71.46 (47.02-100.00)	89.10 (100.00-26.67)	.000	.000	.000	.267
	1 month		12.16 (3.47-31.41)[‡]	21.43 (2.67-48.72)[‡]				.101
	3 months		10.00 (2.27-26.19)[‡]	14.49 (1.00-40.12)[‡]				.123
	$P^{\sharp}$	–	<.0001	<.0001				
	Δ0-3	–	61.52 (38.69-87.68)	67.95 (21.34-90.38)				0.635
PD (mm)	Baseline	1.92 (1.51-2.32)	3.71 (3.37-4.94)	4.74 (2.81-6.88)	.000	.000	.000	.010
	1 month		2.80 (1.98-3.35)[‡]	3.34 (1.94-4.42)[‡]				.025
	3 months		2.49 (1.47-3.06)[‡,§]	2.87 (1.24-3.76)[‡,§]				.042
	$P^{\sharp}$		<.0001	<.0001				
	Δ0-3		1.46 (0.66-2.44)	1.40 (0.44-3.05)				.692
CAL (mm)	Baseline	1.92 (1.52-2.32)	4.15 (3.60-5.85)	4.59 (1.69-6.66)	.000	.000	.000	.075
	1 month		3.19 (2.20-5.25)[‡]	3.57 (2.04-5.86)[‡]				.020
	3 months		2.96 (1.89-4.92)[‡]	3.40 (0.02-5.42)[‡,§]				.144
	$P^{\sharp}$		<.0001	<.0001				
	Δ0-3		1.26 (0.29-2.50)	1.13 (1.26-4.14)				.937

BOP, bleeding on probing; CAL, clinical attachment level; GI, gingival index; PI, plaque index; PD, probing depth; SIII-GB, Stage III Grade B; SIII-GC, Stage III Grade C.
*Kruskal–Wallis test, [†]Bonferroni-corrected Mann–Whitney *U* test or Mann–Whitney *U* test, [‡]significant difference compared to baseline (Wilcoxon signed-rank test), [♯]Friedman test, [§]significant difference compared to 1 month (Wilcoxon signed-rank test), $P < .05$.

SRP of a small number of teeth in 1/4 quadrant.[21] It has been also shown that the session duration of the full-mouth NPT method is longer than conventional QNPT. Additionally, conventional QNPT applied to 1/4 quadrant of mouth in each session was compared with full-mouth NPT procedure, for PD, BOP, and CAL measurements, neither of these 2 treatment methods was superior to the other.[24,25,26] The European Federation of Periodontology assessed the treatment techniques of stages I, II, and III periodontitis and prepared a guideline for clinical practice.[9] Subgingival instrumentation with curettes or sonic/ultrasonic instruments is suggested in this periodontal treatment guideline. Subgingival laser applications, local or systemic non-steroidal anti-inflammatory drugs are not recommended, and they stated that there is no enough data to support the use of subgingival antiseptics and antibiotics.[27] One of the study findings suggests that application of diode laser as an adjunct to mechanical periodontal treatment does not demonstrate any additional clinical effect on the residual pockets.[14]

It has been reported that various follow-up intervals, ranging from 2 weeks to 6 months, have been used to assess the clinical outcome of NPT.[28] The response of the soft tissues to the NPT reveals the efficacy of therapy. Waerhaug[29] reported that healing of the junctional epithelium occurs within 2 weeks after NPT, but the granulation tissue is still immature and has not been replaced by collagen fibers. It has been suggested that it would

Table 3. Comparisons of the Percentages of 4-6 mm, >6 mm Pocket Depths and ≥5 mm Pocket Depth with Bleeding on Probing Positive Sites within and Between Periodontitis Groups at Baseline and 1 and 3 Months

		Groups		
		SIII-GB Periodontitis	SIII-GC Periodontitis	
		n=15	n=15	
	Time Points	Median (minimum–maximum)	Median (minimum–maximum)	P^{*}
PD=4-6 mm (%)	Baseline	42.00 (23.00-66.00)	36.00 (12.00-42.00)	.041
	1 month	16.50 (5.00-80.00)[‡]	30.00 (5.00-51.00)[‡]	.338
	3 months	10.00 (0.00-26.00)[‡,§]	17.00 (0.00-25.00)[‡,§]	.072
	$P^{\dagger}$	.000	.001	
	Δ0-3	32.50 (8.00-66.00)	15.00 (5.00-34.00)	.008
PD >6 mm (%)	Baseline	4.62(1.86-15.00)	13.28 (7.86-20.00)	.024
	1 month	0.48 (0.00-1.49)[‡]	1.86 (0.56-7.51)	.000
	3 months	0.00 (0.00-1.94)[‡]	1.64 (0.68-5.00)[‡]	.002
	$P^{\dagger}$	.000	.000	
	Δ0-3	4.12 (1.86-15.00)	9.16 (5.30-19.23)	.063
PD ≥5 mm and BOP+ (%)	Baseline	22.45 (16.67-62.96)	45.51 (4.67-69.87)	.123
	1 month	2.38 (0.00-9.26)[‡]	8.93 (0.00-19.23)[‡]	.042
	3 months	1.27 (0.00-9.26)[‡]	4.93 (0.00-13.58)[‡]	.041
	$P^{\dagger}$	.000	.000	
	Δ0-3	20.83 (14.01-57.74)	39.51 (3.34-58.97)	.252

BOP, bleeding on probing; CAL, clinical attachment level; GI, gingival index; PD, probing depth; PI, plaque index; SIII-GB, Stage III Grade B; SIII-GC, Stage III Grade C. *Kruskal–Wallis test, [†]Bonferroni-corrected Mann–Whitney *U* test or Mann–Whitney *U* test, [‡]significant difference compared to baseline (Wilcoxon signed-rank test), [♯]Friedman test, [§]significant difference compared to 1 month (Wilcoxon signed-rank test), $P < .05$.

be appropriate to evaluate the healing of soft tissues 4-6 weeks after NPT, as the collagen fibers in the connective tissue mature completely in 4-6 weeks.[30] Moreover, the clinical severity of periodontitis significantly decreased 1 month after NPT. Decrease in PD and CAL gain have occurred within 1–3 months, and tissue healing was completed within 3 months after NPT.[20] Hence, it has been suggested that baseline and 3 months measurements can be used to evaluate the efficacy of NPT.[12] Therefore, this study aimed to clinically assess the response of SIII-GB-P and SIII-GC-P patients with the same severity and different periodontal disease progression rate to QNPT at 1 and 3 months.

Clinical parameters used to determine periodontal disease severity, response to treatment, and disease activity are useful for assessment. In this study, PI, GI, BOP, CAL, and PD parameters were examined to diagnose periodontal disease and evaluate the effectiveness of NPT. Removal of dental plaque containing periodontopathogens from the tooth surface and providing oral hygiene for patients play an important role in evaluating the effectiveness of NPT.[26] Hence, PI was recorded to determine dental plaque accumulation and to evaluate oral hygiene in our study. In the present study, the PI of the healthy group at the baseline was found to be lower than the SIII periodontitis groups. Comparable to previous studies, in the present study, baseline PI was higher in the SIII periodontitis group than in the healthy group.[21,31] In the comparison of PI values within the group, decreases were found in the SIII-GB-P and SIII-GC-P groups at 1 and 3 months following QNPT. These PI improvement findings of this study are also consistent with the data of other previous studies.[32,33] As a result of removing the dental plaque and providing oral hygiene with NPT, a decrease in the PI occurs. In patients with SIII periodontitis, the decrease in PI during the follow-up periods after NPT and reaching the PI level of healthy individuals show that patients with periodontitis maintain adequate oral hygiene after NPT.

Gingival index is a clinical parameter used to evaluate the color and consistency of the gingiva and the presence of bleeding to determine the level of inflammation.[18] Moreover, BOP is recorded as a percentage and reveals objective information about inflammation in the gingival sulcus or periodontal pocket.[34] In this study, GI and percentage of BOP were higher in SIII periodontitis groups than the healthy group. In previous studies involving patients with SIII-GB-P and SIII-GC-P, the clinical effect was evaluated in conventional NPT, and similar to our study findings, it was observed that GI and BOP percentages of the groups with periodontitis were higher than that in healthy individuals.[32,35] The GI and percentage of BOP within the groups decreased in the SIII-GB-P and SIII-GC-P groups at 1 and 3 months in our study. Previous studies including patients with periodontitis reported a reduction in GI and percentage of BOP after NPT, parallel to our present study results.[31] The reduction in GI and percentage of BOP was associated with the healing of the soft tissue wall of the gingival sulcus due to the resolution of inflammation after NPT. Thus, GI and BOP might be utilized to distinguish between periodontal health and disease sites and patients.

At the examination session, the measurement of PD is used for detecting the existence of periodontal disease and to estimate the degree of soft tissue loss. On the other hand, the CAL is used for measuring periodontal destruction up to the clinical examination. Thus, effective assessment can be made when PD and CAL parameters are measured together in the evaluation of an individual's past and present periodontal status and clinical response to NPT.[24] When compared to the SIII-GB and SIII-GC groups at baseline, the healthy group's PD and CAL were found to be considerably lower. These findings are consistent with previous studies.[32,36] The PDs in the SIII-GC-P group were higher than that in the SIII-GB-P group at the baseline and 1 and 3 months. Although patients with SIII-GB-P and SIII-GC-P are at the same age, deep PD in the SIII-GC-P group before NPT may be explained by severe and excessive soft and hard tissue loss. Throughout 1 and 3 months following NPT, compared to baseline, both periodontitis groups in the current study demonstrated a decrease in CAL and PD. In the other previous studies, PD and CAL outcome also were similar to our findings.[35,37] As a result of NPT, the inflamed connective tissue transforms into organized and tight tissue rich in collagen, and a decrease in PD and attachment loss might be observed clinically with the formation of long junctional epithelium and the increase in the number of collagen fibrils in the connective tissue.[38]

As the PD comprises the average of the full mouth, it includes both healthy (PD <4 mm) and diseased areas (PD ≥4 mm). It is known that the response to NPT varies in different PD categories.[5] Suvan et al[14] in their meta-analysis defined sites with PD of 4-6 mm as medium pocket depth and sites with PD >6 mm as deep pockets. The residual pocket definition is used for areas with PD ≥5 mm + BOP after NPT, and it has been reported that CA loss continues with disease activity.[11,12] In the present study, at baseline, the percentage of sites with PD of 4-6 mm was higher in SIII-GB-P group than in SIII-GC-P group, whereas the percentage of sites with PD >6 mm was detected lower, and percentage of sites with PD ≥5 mm + BOP was found to be similar in both periodontitis groups. In addition, the percentage of sites with PD ≥5 mm + BOP and PD >6 mm in the SIII-GC-P group were found to be significantly higher compared to the SIII-GB-P group in each period after NPT. According to recent research, it may be challenging to completely remove subgingival biofilm and calculus from teeth with deep probing depths (>6 mm) or complex anatomical surfaces, such as root concavities, furcations, or infra bony pockets. As a result, additional treatment may be necessary to help patients with periodontitis reach the endpoints of NPT. After a healing time, the individual response to the NPT should be evaluated. The surgical stage of treatment should be used if the NPT objectives of no periodontal pockets >4 mm with bleeding on probing or deep pocket depth 6 mm have not been met.[27] According to our research, the SIII-GC-P group had a substantially larger percentage of sites with PD 5 mm + BOP and PD >6 mm than the SIII-GB-P group at 1 and 3 months after NPT. These results indicate that SIII-GC-P did not meet the NPT objectives and that additional surgical therapy may be performed on this patient. In our study, similar to other studies, improvements were observed in the percentage of regions with PD of 4-6 mm, PD >6 mm, and PD ≥5 mm + BOP in both periodontitis groups at the 1 and 3 months than baseline.[37,38] In the meta-analysis of Citterio et al,[39] it was reported that residual pockets may remain at a rate of 11.71% after NPT. The baseline PD, tooth root anatomy and surface structure, and clinician's experience have an impact on success of mechanical instrumentation.[25] Deep periodontal pockets are most challenging areas for removing all calculus and biofilm. According to Meseli et al,[13] favorable associations between initial PD and PD decrease, GR increase, and attachment gain were found while analyzing the effects of NPT on clinical parameters. Badersten et al [25] reported that residual pockets with an initial PD greater than 6 mm can still contain up to 44%

of calculus. Since NPT may be insufficient especially in furcation areas of molars, groves, deep pockets, and mobile teeth,[4,7] residual pockets are likely to remain following the NPT.[40] Consequently, the elimination of residual pockets is an important parameter that is used to evaluate the success of NPT.

One of the limitations of the current study may be the lack of all periodontitis grades or stages. It should be highlighted that while all the participants were non-smokers and systemically healthy, our results might not fully reflect the prevalence of periodontitis in the general population. The present study's short follow-up periods was another limitation. Therefore, a further study including patients with all stages and grades of periodontitis with longer follow-up would reveal the clinical effect of QNPT in periodontal diseases.

According to the findings of this study, it was revealed that all clinical parameters were dramatically improved following QNPT in the SIII periodontitis groups. The clinical response of QNPT was superior in SIII-GB-P than in SIII-GC-P group by residual pocket depths and deep periodontal pockets, and there was a need for periodontal surgical treatment after QNPT in the SIII-GC-P group.

Ethics Committee Approval: Ethics committee approval was received for this study from the clinical study ethics committee of Marmara University Faculty of Dentistry (Date: November 25, 2021, Protocol Number: 2021/27).

Informed Consent: Written informed consent was obtained from patients who participated in this study.

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