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Structured oral hygiene instruction in the treatment of periodontitis – an explorative study

Introduction: According to the actual EFP guidelines, first step of periodontal therapy should include oral hygiene instructions (OHI), comprising the use of interdental brushes (IDBs). Yet, non-conclusive evidence exists for their effect. The present multicentric clinical controlled explorative study compared the clinical outcomes of two NSPT (non-surgical periodontal therapy) concepts under university settings, one with (in Germany (NSPT-G)) and one without IDBs (in Egypt (NSPT-E)).

Methods: 23 stage III/IV periodontitis patients (NSPT-G/NSPT-E:11/12) were examined before (T0) and after NSPT (T1). Patients' demographic data, tooth loss, clinical attachment loss (CAL), probing depths (PD) and bleeding on probing (BOP) were assessed. ANOVA and Mann-Whitney-U tests were used for statistical analysis.

Results: Baseline differences were observed in terms of age, severity and tooth number per patients. NSPT duration was 1.6 times longer in NSPT-G vs. NSPT-E. Improvements of BOP, PD and CAL were observed in both groups, with greater mean percentage reduction of PD for NSPT-G vs. NSPT-E (–26.86 (9.29) %/–12.61 (9.38) %; p=0.004). Similar effects were observed for changes in CAL, with higher improvement in NSPT-G vs. NSPT-E (–34.84 (11.18) %/–10.98 (10.6) %; p<0.001).

Conclusion: Both NSPT concepts achieved significantly beneficial clinical effects for patients within their socio-economic circumstance. However, according to the limitations of the explorative study, a clear benefit for a treatment concept comprised of NSPT in combination with comprehensive OHI and IDC during periodontal treatment remains unconfirmed.

Keywords: bleeding on probing; instruction; motivation; non-surgical periodontal therapy; oral hygiene; periodontitis

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Introduction

Periodontitis is one of the most prevalent inflammatory diseases, affecting more than 65 % of the worldwide population [2]. Untreated, a progressive periodontal destruction [12] could lead to functional and aesthetic constraints, discomfort and ultimately tooth loss [7]. The primary goal of periodontal therapy, either non-surgical or surgical, remains the removal of the microbial biofilm and its mineralized forms, thereby reversing the associated bacterial dysbiosis to arrest the inflammatory destructive disease process. Systematic non-surgical periodontal therapy (NSPT) is still the gold standard of a successful periodontal treatment [16]. Health behavioral strategies directed at patient's motivation for self-performed supra-gingival plaque control or smoking cessation should accompany NSPT [17]. Failure to control these factors could be detrimental on the progression of periodontal inflammatory destructive processes [1, 10], following active periodontal therapy [21].

Recently published guidelines by the EFP for the treatment of periodontitis stages I–III [21] recommend for each step of therapy the same procedures for oral hygiene practices to control gingival inflammation, including mechanical self-performed plaque control, employing regular tooth brushing supplemented by interdental cleaning devices, including dental floss, interdental brushes (IDBs), oral irrigators and wood sticks [19]. Although professional oral hygiene instructions (OHI), including advise on self-performed home-use interdental cleaning (IDC) with IDBs, should be professionally taught to patients [23], the use of IDBs is not common in all countries worldwide, depending on their availability, cost or social aspects. Yet, there are specific treatment approaches that emphasize to varying degrees the importance of OHI or other procedures during NSPT, often without sufficient internal or external evidence of their clinical effectiveness.

Over the last nine years, the two periodontal departments at the Faculty of Dentistry, Cairo University, Egypt and at the Christian Albrechts University of Kiel, Germany aligned and standardized in a long-term project their periodontal curricula and treatment concepts. Yet, two differences remained between their NSPT concepts, namely the higher number of visits for supragingival professional mechanical plaque removal (PMPR) and the regular instruction of all patients for the use of interdental cleaning devices at Kiel University as compared to Cairo University. The aim of the explorative study was to compare stage-III/IV periodontitis patients receiving NSPT in university setting either (1) in Germany (NSPT-G) with IDBs or (2) in Egypt (NSPT-E) without IDBs, as a first step towards the design of a future large-scale multicenter randomized controlled trial on this topic.

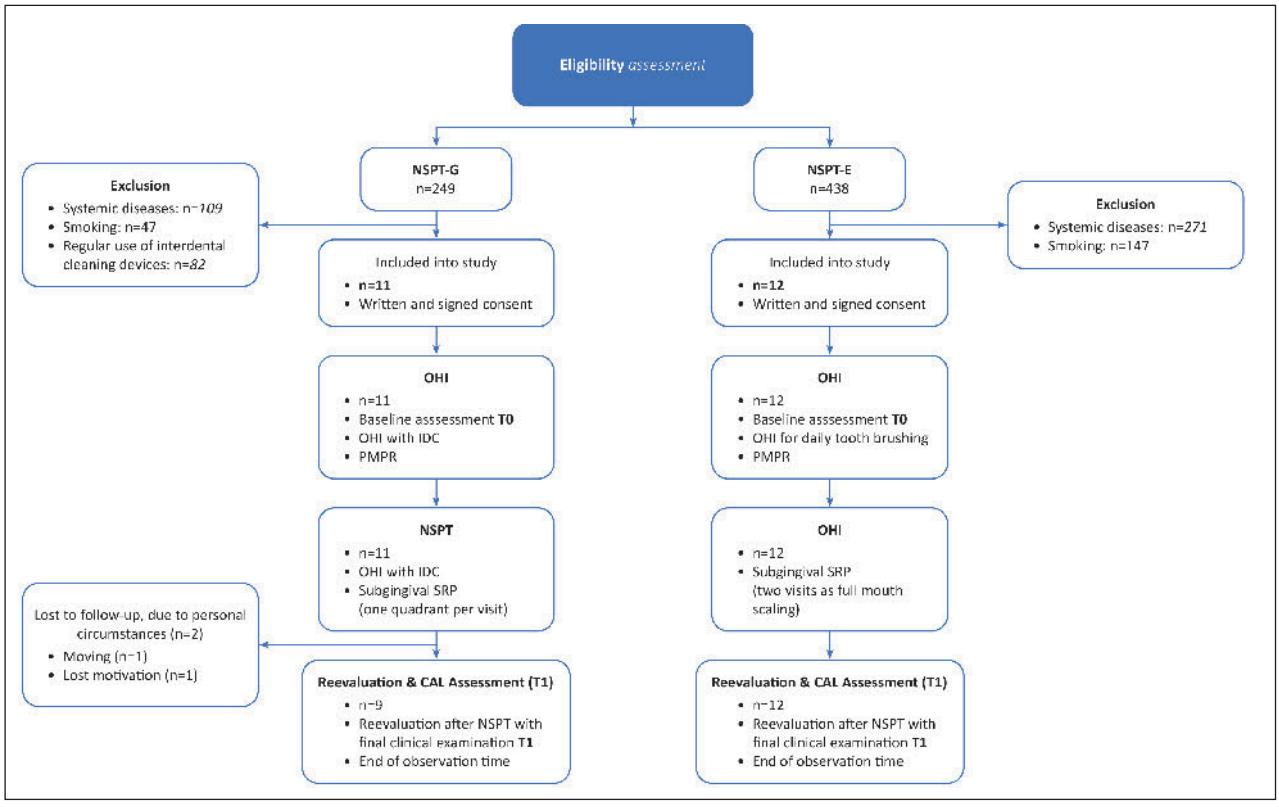

Figure 1 Flowchart of the recruitment and treatment protocol during observation time.

T0: Initial treatment visit, T1: reevaluation after treatment phase; bleeding on probing (BOP), clinical attachment loss (CAL), professional interdental cleaning instruction (IDC), non-surgical periodontal therapy (NSPT), non-surgical periodontal therapy in Kiel, Germany (NSPT-G), non-surgical periodontal therapy in Cairo, Egypt (NSPT-E), supragingival professional mechanical plaque removal (PMPR), professional oral hygiene instructions (OHI)

Methods

Study population

The present explorative study included 23 patients at two university clinics, who were diagnosed with periodontitis stages III or IV and scheduled for periodontal therapy between July 2018 and July 2019 at the Clinic of Conservative Dentistry and Periodontology, Christian Albrechts University Kiel, Germany or at the Oral Medicine and Periodontology Department, Faculty of Dentistry, Cairo University, Giza, Egypt.

Participants were eligible if they met the following inclusion criteria: (1) ≥18 and ≤70 years of age at the time of start of the periodontal therapy; (2) stages III or IV periodontitis and ≥16 scorable teeth without root caries (3) available for NSPT and reevaluation after 6±1 months; (4) no physical or mental impairment; (5) no medication influencing salivary flow and (6) no special dietary restrictions.

Possible participants were excluded if they (1) presented with oral diseases other than periodontal disease (forms of acute necrotizing ulcerating periodontitis or periodontitis of stage I); (2) suffered systemic diseases that could influence the outcome of therapy (e.g. uncontrolled diabetes mellitus, tumor of hard or soft oral tissue) or with specific conditions to treat (e.g. prophylaxis of endocarditis); (3) women who are aware of being pregnant or who are breast-feeding; (4) patients who were active smokers at T0 or quit smoking <5 years ago; (5) patients who were already using any interdental cleaning devices regularly at T0.

At both centers, stage-III/IV periodontitis patients were consecutively included without randomization, as the aim of the study was to compare the effect of each clinical concept of NSPT without influencing the internal procedures at each treatment center. At the center of Kiel, 232 patients were assessed first for eligibility of this study. Regarding the above-mentioned inclusion and exclusion criteria eleven patients were included into the study, from whom two dropped out until T1 (Figure 1). In the meantime, 438 patients were initially screened for their eligibility for the study at the Cairo center, and after applying both inclusion and exclusion criteria, twelve patients were included and completed the study (Figure 1). Before starting the clinical trial, all investigators were internally calibrated by one dentist (C.G.) during a two-week practical training in the department of periodontology at the University of Kiel as part of the international collaboration between the two universities. In each group all treatments and evaluations were conducted by only one calibrated investigator (NSPT-G: M.K., NSPT-E: M.M.), using a PCPUNC15 probe (Hu-Friedy, Chicago Ill, USA).

Oral hygiene instruction (OHI) and supragingival professional mechanical plaque removal (PMPR)

Following baseline examination with a full attachment level status, all subjects received a PMPR and a center-standard OHI for daily tooth brushing, including (NSPT-G) or excluding (NSPT-E) IDC. For NSPT-G, initial periodontal therapy with 1–2 visits of PMPR and OHI, focused on IDC with IDBs and took up to three weeks in total before subgingival debridement started (NSPT-E: one visit in the first week). During the instruction and motivation phase, special care was taken for the adequate use and correct choice of size of the IDBs (TePe D-A-CH GmbH, Hamburg, Germany), repeatedly. For NSPT-G, an additionally reevaluation of bleeding on probing (BOP) and PD was performed at week 4 (T0a).

Non-surgical periodontal therapy phase

All subjects received a standard NSPT under local anesthesia, which consisted of scaling and root planing (SRP) with hand instruments and with ultra-/sonic scaler. Further treatments, e.g. extraction, endodontic treatments, splinting of mobile teeth were carried out in individual cases. According to the internal guideline of both centers, NSPT followed at individualized intervals of one quadrant per visit for NSPT-G (maximum of around 4–5 weeks in total) versus two visits as full mouth debridement for NSPT-E (maximum of 1–2 weeks in total).

Reevaluation and CAL Assessment

A reevaluation (T1) was performed for all subjects 8±2 weeks after NSPT at both centers and marked the end of our observation time.

Independent variables

All patients were classified according the classification of 2018 [15] at T0. In addition to gender and age, the following variables were measured for statistical analysis; (1) number of missing teeth (T0, T1), (2) PDs, (3) BOP, and (4) CAL (T0, T1) at six sites per tooth with a PCPUNC15 probe (Hu-Friedy, Chicago Ill, USA). CAL was calculated as the sum of PD and the distance from the cementum-enamel-junction to the gingival margin. The surrogate parameters plaque, mobility, furcation involvement and bone loss were not consistently measured in NSPT-E at T0 and had therefore to be excluded from the statistical analysis. At T1, a range of further variables was recorded by the treating dentist; including (5) tooth loss during T0–T1, (6) number of visits (T0–T1) for periodontal treatment and (7) duration (in days) for NSPT.

Data management and statistical analysis

Data were managed using electronic case report forms. Statistical evaluation was performed with SPSS 22 (SPSS, Chicago, IL, USA). Descriptive analyses were conducted. ANOVA, Mann-Whitney U were used to compare the two treatment groups and a binary logistic regression analysis was performed with BOP as dependent variable. Regression coefficients, standard errors (SE), p-values and 95 % Confidence Intervals (CI) were used as effect estimates. The sample size was calculated considering a mean difference of 20 % in BOP reduction [24], power of 80 %, and α of 5 %.

Results

Sample and base line characteristics

In this hypothesis-generating explorative study, at baseline (T0), 23 patients (NSPT-G/NSPT-E: n=11/n=12, male/female: 10/13) with a mean (±SD) age of 46.6 (10.5) years

(NSPT-G/NSPT-E: 54.8 (9.9)/42.1 (7.8) years) with 648 teeth (NSPT-G/NSPT-E: 302/346 teeth) were enrolled. The mean number of teeth (±SD) at T0 per patient was significantly lower at 24.8 (2.9) teeth/patient for NSPT-G compared to NSPT-E (28.8 (2.4) teeth/patient; p<0.001). None of the 23 patients had implants. Further details on patients and periodontal parameters (e.g. PD, CAL and BOP) at T0 are shown in Table 1.

Comparing baseline data, the NSPT-G group demonstrated older age (p=0.003), with a non-statistically significant higher prevalence of stage IV periodontitis, whereas NSPT-E group showed a higher prevalence of stage III periodontitis (p=0.069). No differences between both examined groups were detected according to prevalence of grades B/C at T0 (p=0.640).

During the observation phase, two participants (male/female: 1/1) of the NSPT-G cohort stopped participating (please see recruitment flow chart figure 1a). Both patients were diagnosed at baseline with stage IV periodontitis, one with grade B and the other one with grade C.

The duration of NSPT-G treatment (T0–T1) was with 148.8 (46.1) days significantly longer (NSPT-E treatment: 90.2 (20.1) days; p=0.002). During observation time, a total of eight teeth were extracted in five NSPT-G patients (NSPT-E: n=0). In detail, three patients lost one tooth, one patient lost two teeth and one patient three teeth in NSPT-G. NSPT-E patients showed non-significantly higher prevalence of teeth surviving between T0 and T1 (Table 1, p=0.079).

Inter- and intragroup analyses during different treatment stages (T0, T1) were conducted to detect treatment effects regarding BOP, PD and CAL (Table 2). At T0 patients of the NSPT-G group showed a higher mean PD and CAL than patients of the NSPT-E group (p<0.001 and p=0.026), while NSPT-E patients showed a significantly higher prevalence of BOP (p<0.001). For NSPT-G, results concerning the intermediate PMPR and OHI evaluation (T0 and T0a) showed statistically significant decreases in the prevalence of BOP, mean PD and CAL (Table 2). In addition, statistically significant decreases for BOP and PD were observed between T0a and T1 (Table 2).

In general, treatment outcomes at T1 for both groups (NSPT-G and NSPT-E) showed a statistically significant improvement in all three parameters (PD, CAL and BOP). The observed effect for PD and CAL was higher in the NSPT-G group (Table 2). For PD, the NSPT-G group showed a significantly higher mean percentage reduction (–26.86 (9.29) %) compared to the NSPT-E group (–12.61 (9.38) %; p=0.004). The CAL mean percentage reduction demonstrated a similar significant difference (NSPT-G/NSPT-E: –34.84 (11.18) %/–10.98 (10.6) %; p<0.001). Interestingly, the observed effect for the mean percentage reduction of 12.6 % for BOP in the NSPT-G group between T0 and T0a (p<0.001) was comparable with results of the whole observation time (T0–T1) in the NSPT-E group of 19.6 % BOP reduction (p<0.001). For NSPT-G, between T0a and T1 a further reduction of 29.1 % of teeth with BOP were measurable (p<0.001) leading to a nearly doubled reduction of BOP in the NSPT-G group for the whole observation time (T0–T1: 41.7 %, p<0.001) compared to the NSPT-E group (p<0.001).

	NSPT-G	NSPT-E	
Baseline characteristics (T0)	Kiel (n=11)	Cairo (n=12)	*P*-value
Gender (n)			
Male	4	6	0.680
Female	7	6	
Age (Years)			
Mean (SD)	54.8 (9.9)	42.1 (8.3)	0.003*
Periodontitis stage (n)			
Stage III	6	11	0.069
Stage IV	5	1	
Periodontitis grade (n)			
Grade B	8	10	0.640
Grade C	3	2	
Periodontitis extent (n)			
Localized	1	0	0.478
Generalized	10	12	
Teeth status (n)			
Not available at T0	48	38	
Survived from T0 to T1	296	346	0.079
Removed during T0 to T1	8	0	
Mean number of teeth per patient at T0 (SD)	24.8 (2.9)	28.8 (2.4)	<0.001
Mean number of teeth per patient at T1 (SD)	24.2 (2.3)	28.8 (2.4)	
Time from T0 to T1 (Days)			
Mean (SD)	148.8 (46.1)	90.2 (20.1)	0.002*

Table 1 Demographic and clinical data of both groups at T0 and T1.

Mean, standard deviation (SD), frequencies (n) and results of Student's t-test, Chi-square test and Fisher's Exact test for comparisons of baseline characteristics in the two centers; *: Significant at P ≤ 0.05, **: Fisher's Exact test,
NSPT-G: non-surgical periodontal therapy including instruction/motivation of oral hygiene at home; NSPT-E: non-surgical periodontal therapy without instruction/motivation of oral hygiene at home; T0: baseline; T1: reevaluation visit after end of NSPT-G/NSPT-E

Visit	NSPT-G	NSPT-E	Mean Difference (95% CI for Difference)	P-value between NSPT-G and NSPT-E (Effect size (Partial Eta squared or OR)
Mean (SD) PD at T0	5.67 (0.88)	3.56 (0.61)	2.1 (1.42–2.78)	<0.001 (0.689)*
Mean (SD) PD at T0a	5.34 (1.07)	n.a.		
Mean (SD) PD at T1	4.09 (0.44)	3.1 (0.56)	0.99 (0.52–1.47)	<0.001 (0.500)*
P-value (Effect size, Partial Eta squared) for PD at T0 vs. T0a	0.010 (0.589)*	n.a.		
P-value (Effect size, Partial Eta squared) for PD at T0a vs. T1	<0.001 (2.415)*	n.a.		
P-value (Effect size, Partial Eta squared) for PD at T0 vs. T1	<0.001 (0.776)*	0.012 (0.289)*		
Mean (SD) CAL at T0	4.67 (1.34)	3.52 (0.84)	1.81 (0.93–2.68)	0.026 (0.236)*
Mean (SD) CAL at T1	4.19 (1.46)	3.13 (0.79)	1.61 (0.69–2.52)	0.044 (0.197)*
P-value (Effect size, Partial Eta squared) for CAL at T0 vs. T1	0.001 (0.455)*	0.001 (0.428)*		
N of teeth with BOP (%) at T0	234 (77.5)	334 (96.5)		<0.001 (2.063)**
N of teeth with BOP (%) at T0a	196 (64.9)	n.a.		
N of teeth with BOP (%) at T1	86 (35.8)	266 (76.9)		<0.001 (2.694)**
P-value (Effect size, v) for BOP at T0 vs. T0a	<0.001 (0.527)*	n.a.		
P-value (Effect size, v) for BOP at T0a vs. T1	<0.001 (0.915)*	n.a.		
P-value (Effect size, v) for BOP at T0 vs. T1	<0.001 (0.207)*	<0.001 (0.233)*		

Table 2 Descriptive statistics and results for comparison between both groups of treatment as well as visits (T0, T1) for PD (mm), CAL (mm) (subject level) and for BOP (tooth level).

NSPT-G: non-surgical periodontal therapy including instruction/motivation of oral hygiene at home; NSPT-E: non-surgical periodontal therapy without instruction/motivation of oral hygiene at home; PD: pocket probing depth; CAL: clinical attachment loss; T0: baseline; T0a: intermediate reevaluation visit after PMPR and OHI in the NSPT-G group (only PD and BOP, no data for CAL); T1: reevaluation visit after end of NSPT-G/NSPT-E. *: Partial Eta squared; **: Odds Ratio (OR)

Discussion

The aim of the present explorative study was to investigate the clinical benefits of two different concepts for NSPT, namely with as well as without the inclusion of IDBs in the oral hygiene regimes, at two university centers in Egypt and in Germany, as a first step towards the design of a future large-scale multicenter randomized controlled trial on this topic. Both treatment concepts improved all periodontal parameters, namely PD, CAL and BOP in patients diagnosed with stage III or IV periodontitis, in accordance with earlier studies about the efficacy of NSPT [22]. Yet, apart from initially different periodontal baseline characteristics of both groups (e.g., number of teeth per patient, mean PD, etc.), the NSPT-G employing the OHI/IDC focusing on IDBs, demonstrated a significantly higher mean PD percentage reduction (p=0.004) and a higher mean improvement of CAL (p<0.001) compared to the NSPT-E group.

Although dental plaque is believed to be a primary etiological factor in the development of periodontal diseases [9], scoring of BOP could deliver more crucial information for further attachment loss [6,8]. In this context, we decided to exclude smokers from this study, to minimize external interferences on this sensitive parameter [13, 14]. NSPT-G patients showed more stage-IV periodontitis cases, yet BOP at baseline (T0) and throughout the follow-up visit (T1) was significantly lower than in the NSPT-E group. A possible explanation could rely on the higher adherence of the NSPT-G patients to the OHI/IDC training given at baseline and during all visits as well as their behavioral compliance in a university setting [4], whereas the NSPT-E patients, who mostly visited university clinics to receive symptomatic therapy, were probably less compliant with the procedure. Aside from such special socioeconomic conduct, the present findings are in accordance with data of a multilevel analysis from Japan on the importance of OHI, demonstrating that factors related to the treating centers, such as length of oral health instruction and number of dental hygienists, could clearly affect a patient's tooth loss [18]. The study recommended sufficient time for dental hygienists to provide OHI, as patients attending dental clinics, who were provided with OHI for 20 min or more, had a significantly lower risk of tooth loss (OR 0.69, 95 % CI 0.50–0.96). In the present investi-

gation, NSPT-G performed similar OHI procedures, with a clearly positive impact on all periodontal parameters, except tooth loss. However, this increased tooth loss observed in the NSPT-G patients must be interpreted in light of the significant differences between the two treatment groups, regarding the initial severity of periodontal diseases (Table 1), as well as the fact that for the NSPT-E group previous tooth extractions before/at T0 were not documented. Yet, all in all it underlines the beneficial effects of OHI/IDC, in accordance with actual guidelines of the EFP [21], especially for IDC [19], as a first step of NSPT.

A greater reduction of PD was noted in the NSPT-G group. However, this could have been partially influenced by the generally higher baseline values of PD and CAL, with higher expectancy for a clinical improvement following NSPT [22]. To overcome this limitation, the percentage reduction in addition to the absolute clinical reduction in millimeters of PD and CAL was compared. In accordance with earlier studies [3] this could be attributed to a more intensified OHI/IDC. In this context it remains important to emphasize that, apart from a higher number of visits used for PMPR in the NSPT-G, an earlier investigation demonstrated that PMPR performed prior to SRP does not improve clinical results of the subsequent SRP [5]. Therefore, our study negates the effect of the higher number of visits of PMPR in the NSPT-G as a factor affecting the difference in the measured periodontal outcomes. The subsequent subgingival debridement was performed in the NSPT-E group in a full-mouth manner and in the NSPT-G over up to four visits, with no substantial clinical differences reported between the two treatment approaches [20].

A number of definitive procedures, including alignment and standardization of the periodontal treatment concepts of the two centers over the last nine years and consecutive recruitment of participants with rigid inclusion criteria and additional pre-study investigators' calibration, were performed to achieve a high degree of standardization and reduce possible sources of bias. Nevertheless, the results of this study cannot be generalized due to its limitations. First, a sample of well-compliant patients in the NSPT-G group in Germany [4] was compared with a sample of assumingly less compliant younger-aged patients with low socio-economic status and unequal gender distribution in the NSPT-E group in Egypt, attending the university clinic for symptomatic dental therapy with no interest in long-term periodontal maintenance visits. Second, NSPT-G showed initially more severe periodontitis stages with significant higher PD and clinical attachment loss than the patients in the NSPT-E group (Table 2). Third, although the current explorative investigation is a clinically controlled trial, no randomization or observer blinding was performed. Fourth, plaque scores were not considered in this study, due to inconsistent scoring, and BOP was employed as an indicator for an active periodontal destruction [6, 8]. Notwithstanding, we staged and graded the participants using the data available, similar to other authors groups like Nascimento, Dahlen [11].

Conclusion

Patients with stages III and IV periodontitis at baseline, who were systematically treated during NSPT, showed a significant clinical improvement in PD, CAL and BOP. However, because of the limitations of this exploratory study, including baseline differences among the subjects studied, a clear benefit of a treatment approach consisting of NSPT combined with comprehensive OHI and IDC during periodontal treatment remains unconfirmed. Where devices such as IDBs are not available, e.g., due to socioeconomic circumstances, performing appropriate NSPT on its own could be an evidence-based and effective method for treating periodontitis, as shown by the results of the current study. Further investigations with a higher number of comparable participants have to be conducted to validate the presented results, i.e. compare it with other national healthcare systems for generalization.

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Conflict of interest

All authors declare that they have no competing interests. The work was supported by the Clinic of Conservative Dentistry and Periodontology, University of Kiel, Germany and the Clinic of Oral Medicine and Periodontology, Cairo University, Giza, Egypt.

All procedures performed in studies with human participants were in accordance with the ethical standards of the institutional and/or national research committee (approved locally by the ethics committees of the Faculty of Medicine, Kiel University (AZ: 428/15) and Cairo University (AZ: 39/7/20)) and the 1964 Declaration of Helsinki and its subsequent amendments or comparable ethical standards. Written informed consent was obtained from all individual participants included in the study. A clinical trial registration was done retrospectively: ClinicalTrials.gov (NCT04339309).

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