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Evaluation of an individually tailored oral health educational programme on periodontal health

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Abstract

Aim: To evaluate an individually tailored oral health educational programme (ITOHEP) on periodontal health compared with a standard oral health educational programme. A further aim was to evaluate whether both interventions had a clinically significant effect on non-surgical periodontal treatment at 12-month follow-up.

Material and Method: A randomized, evaluator-blinded, controlled trial with 113 subjects (60 females and 53 males) randomly allocated into two different active treatments was used. ITOHEP was based on cognitive behavioural principles and motivational interviewing. The control condition was standard oral hygiene education (ST). The effect on bleeding on probing (BoP), periodontal pocket depth, ''pocket closure'' i.e. percentage of periodontal pocket >4 mm before treatment that were <5 mm after treatment, oral hygiene [plaque indices (PlI)], and participants' global rating of oral health was evaluated. Preset criteria for PlI, BoP, and ''pocket closure'' were used to describe clinically significant non-surgical periodontal treatment success.

Results: The ITOHEP group had lower BoP scores 12-month post-treatment (95% confidence interval: 5–15, $p<0.001$) than the ST group. No difference between the two groups was observed for ''pocket closure'' and reduction of periodontal pocket depth. More individuals in the ITOHEP group reached a level of treatment success. Lower PlI scores at baseline and ITOHEP intervention gave higher odds of treatment success.

Conclusions: ITOHEP intervention in combination with scaling is preferable to the ST programme in non-surgical periodontal treatment.

Key words: clinical significance; cognitive behavioural strategies; oral hygiene behaviour; periodontitis; randomized-controlled trial

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The positive effect of mechanical non-surgical pocket therapy is demonstrated in several studies and systemic reviews, with the exception of sites with a probing pocket depth (PPD) of $\leqslant 3$ mm (Badersten et al. 1984, Tunkel et al. 2002, Van der Weijden & Timmerman 2002, Hallmon & Rees 2003). Mechanical non-surgical pocket therapy reduces inflammation, pocket depth, and increases clinical attachment level (Suvan 2005). Wennström et al. (2005) propose, ''pocket closure'' as a successful treatment endpoint after mechanical non-surgical pocket therapy. Pocket closure means the proportion of closed periodontal pocket (<5 mm) of the pockets that was >4 mm before treatment. Pocket closure as measurements of reduction in probing depths indicates sufficient removal of biofilm and/or calculus, which results in reduction of inflammation and can be used as an outcome variable to determine the efficacy of subgingival instrumentation.

To reduce the risk of future progression of periodontal disease, some risk factors are mentioned (Lang & Tonetti 2003). Individuals with a mean bleeding on probing (BoP) $>25\%$ are considered a high risk for periodontal breakdown in conjunction with residual PPD >4 mm. Bacterial plaque is an important local factor in the aetiology of periodontal disease (Kornman & Löe 1993) and for individuals with chronic periodontitis, a high standard of oral hygiene is a major factor for attaining and maintaining periodontal health (Nyman et al. 1975, Rosling 1983, Westfelt et al.

Conflict of interest and source of funding statement

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1998). Plaque control at site level has a positive treatment effect (Tomasi et al. 2007), and plaque can be used as a predicive indicator for future alveolar bone loss (Renvert & Persson 2004). Consequently, non-surgical periodontal treatment aims to create an enviroment that makes periodontal healing possible and prevents further progression. Pocket closure in combination with low BoP scores indicate sufficient debridment, and low plaque scores, as a sign of the effectiveness of the patient education programme, are factors that need to be considered in the evaluation of non-surgical peridontal treatment.

As individual self-care is important in attaining proper oral hygiene, methods that encourage adherence to recommendations given by the dental hygienist or dentist are needed. The move away from the traditional oral care provider's perspective towards a more patient-orientated perspective empowers the patient's active role in the treatment and produces a better outcome (Hamman Calley et al. 2000). An individually tailored oral health educational programme (ITOHEP) based on social cognitive strategies and motivational interviewing have a more positive impact on oral hygiene behaviour i.e. gingivitis, plaque control and self-reported frequency of daily inter-dental cleaning, compared with the standard oral hygiene educational programme (Jönsson et al. 2009a). In the social cognitive process, both short- and long-term goals are important as a guide for daily self-care and a source of motivation. Long-term goals set a course of personal change, whereas, short-term attainable goals help people to succeed by enlisting effort and guiding action in the ''here and now'' (Bandura 2004). Therefore, it is important to identify levels of appropriate periodontal treatment outcome to guide both the dental care provider and the patient in their evaluation of long- and short-term goals. In this perspective, the individual as such is in focus rather than specific surfaces i.e. site level.

Except for one study by Little et al. (1997), there is, to our knowledge, no study evaluating the effect of psychological interventions in oral health education and its effect on periodontal treatment outcome measures such as PPD and BoP. The aim of the present study was to evaluate an ITOHEP integrated in non-surgical periodontal treatment on periodontal health compared with a standard oral health educational programme (ST). Additional aims were (i) to evaluate whether both interventions had a clinically significant effect based on plaque score [plaque indices (PlI)], BoP score, and pocket closure at 12-month follow-up and (ii) study how baseline assessment of PlI- and BoP scores, PPD > 5 mm, and oral hygiene education programme influences the treatment success of non-surgical periodontal treatment.

Material and Method

The data analysed in this report are derived from a randomized-controlled trial by Jönsson et al. (2009a) evaluating the effectiveness of two different oral hygiene educational programmes. The study was conducted at a specialist clinic for periodontics in a Swedish county with approximately 320,000 inhabitants. Participants were recruited from subjects referred to the clinic and examined during the period of March 2006 to March 2007. A power calculation with mean gingivitis interproximally as the main outcome was performed based on data from a previous study by Jönsson et al. (2006). The study was approved by the Ethics Committee of Uppsala University, Sweden and all participants provided informed consent before the start of the study.

Patients [$n = 113$, mean age, 51.2 (SD 9.4; [25–65]), 53% females] with chronic periodontitis were recruited to the study after an examination including full-mouth probing and radiographic evaluation, and some pre-treatment actions e.g. tooth extraction. The participants were randomly allocated to an ITOHEP (experimental group, $n = 57$) or a standard oral health educational programme (control group, $n = 56$). The sample was stratified for smoking and allocated to the two dental hygienists who performed the treatment. Demographic characteristics of the participants are presented in Table 1. The experimental group received an ITOHEP based on cognitive behavioural perspective and Motivational Interviewing. The central theme of the ITOHEP was tailoring the treatment to each individual's cognitions and beliefs, capacity, and goals, with a subsequent guidance towards appropriate and effective oral hygiene habits. The programme comprised of seven separate components with different tactics for tailoring each individual regarding oral health and dental hygiene habits. The components were: (1) initiation and analysis of knowledge, expectations, and motivation, (2) analysis of oral hygiene behaviour, (3) practice of manual dexterity for oral hygiene aids, (4) individual goals for oral hygiene behaviour, (5) continuous self-monitoring, (6) generalization of behaviour, (7) maintenance of

Table 1. Demographic characteristics of the participants

	Experimental group (ITOHEP)	Control group (ST)	Total
No. of participants-baseline examination	57	56	113
No, of participants 12-month follow-up	53	55	108*
Gender (female/male)	32/25	28/28	60/53
Smokers	24	20	44
Mean age (standard deviation)	52.4 (8.4)	50.1 (10.3)	51.2 (9.4)
Periodontal diagnosis			
Slight	2 (4%)	5 (9%)	7 (6%)
Moderate	23 (40%)	21 (37%)	44 (39%)
Advanced	32 (56%)	30 (54%)	62 (55%)
Number of teeth (standard deviation)			
Baseline examination	25.3 (3.9)	25.0 (4.6)	25.1 (4.2)
After pre-treatment (start of non-surgical treatment)	23.3 (4.0)	23.2 (4.6)	23.3 (4.3)

*Five (two females and three males) discontinued treatment during the study.
ITOHEP, individually tailored oral health educational programme; ST, standard oral health educational programme.

oral hygiene behaviour and prevention of relapse. For a more detailed description, see (Jönsson et al. 2009a, b). The control condition included a standard oral hygiene educational programme (ST) with structured information about the periodontal disease, its consequences, the role of careful and correct brushing twice a day and inter-dental cleaning once a day. Oral hygiene instructions were demonstrated after the use of disclosing solution. New instructions and adjustments of aids and technique were discussed, and demonstrated if necessary.

Examinations

The same examiner (a periodontist), blinded to group assignment, performed all clinical measurements throughout the course of the study. Full-mouth clinical examinations were before treatment (baseline) and 3 and 12 months after the non-surgical treatment and oral hygiene intervention. All teeth and tooth sites remaining after pre-treatment actions were included in the examination.

Plaque score: The presence of plaque was recorded according to the Silness and Löe (1964) PlI. In the analyses, all plaque scores of 1 and above, were considered to be a positive indicator of plaque, and the surface was registered as positive.

PPD: PPD was measured using a manual periodontal probe (CC Williams Probe1-2-3-5-7-8-9-10, Hu-Fridy®, Chicago, IL, USA) on six surfaces of each tooth.

BoP: BoP was measured as the presence/absence of bleeding within 15 s after pocket probing.

Definition of diagnosis (*Slight*, *Moderate*, and *Advanced Periodontitis*)*:* After PPD, BoP measurement and radiographic bone level analysis, the individual tooth was diagnosed. The diagnoses were: 1 = inflammation and no indication of loss of supporting tissues; 2 = inflammation with loss of supporting tissues not exceeding 1/3 of the length of the root; 3 = inflammation with loss of supporting tissues exceeding 1/3 of the length of the root; and, 4 = a supplementary diagnosis when an angular bony defect >3 mm was present adjacent to a tooth and for a multi-rooted tooth furcation grades 2 and 3 involvements (Nyman et al. 1984, Nyman & Lindhe 1997). The extent and severity of periodontitis were characterized as: *Slight* = 80% of all teeth with diagnoses 1 and $\leqslant 20\%$ with the diagnoses 2–4; *Moderate* = 80% of all teeth with diagnoses 1 or 2 and $\leqslant 20\%$ with the diagnoses 3 and 4; and *Advanced* $\geq$ 20% of all teeth with diagnoses 3 and 4.

Questionnaire

Education level was assessed by a question with three possible answers: (1) Elementary school, (2) High school, and (3) University. Smoking habits were assessed by the question ''Do you smoke'': yes/no. Global rating of self-perceived oral health at the 12-month re-examination was assessed by the question ''How would you describe your oral health?'' The response rate was a five-point Likert scale (''very poor – very good'').

Treatment procedures

Two experienced dental hygienists, who were trained in the various interventions, carried out the treatment for both the experimental and the control groups. Scaling treatment was integrated into both programmes and undertaken during the initial dental hygiene treatment, mainly performed with hand instruments (LM-dental Gracys curette of five various designs and LM-dental Svärdström 1/3 & 2/4, Turku, Finland). There was some supplementary scaling in all residual pockets above 4 mm, which were equally distributed within both groups, after the 3-month follow-up and during supportive maintenance care. In both groups, the participants visited the dental hygienist once a week until the scaling treatment was finished and there was an oral hygiene control performed after 1 month. Supportive maintenance care was scheduled every third month after the initial dental hygiene treatment i.e. 3 and 6 months after the 3-month follow-up. The number of sessions and the time needed per session and for further details regarding the original study, see Jönsson et al. (2009a).

Preset criteria for treatment success

To conclude whether the interventions had a clinically significant effect i.e. reaching a level of treatment success at the 12-month re-examination, criteria for the outcomes PlI, BoP, and pocket closure were formulated in advance. To reach a success level for non-surgical periodontal treatment (successful-NSPT), a classification based on three classes for the three outcomes were established (Table 2). To be classified as ''successful-NSPT'', at least two of the three outcomes had to be in Class I, but none in Class III. It was assumed all participants would improve after treatment and therefore the individuals not fulfilling the criteria for ''successful-NSPT'' were classified into the group, ''incomplete-NSPT''. All the participants were grouped as either ''successful-NSPT'' or ''incomplete-NSPT''.

Table 2. Classes for the preset criteria for percentage of closed pocket, BoP, and PlI

	Class I (%)	Class II (%)	Class III (%)
% Closed pocket	>75	$\geqslant 65$	<65
% Bleeding on probing	$\leqslant 15$	$\leqslant 25$	>25
% Plaque index	$\leqslant 20$	$\leqslant 29$	>29

BoP, bleeding on probing; successful-NSPT, success level for non-surgical periodontal treatment; PlI, plaque indices.

On a group level for successful-NSPT'', the mean percentage of BoP (for all calculated tooth surfaces) should be reduced to a level of $\leqslant 15\%$ (Lang & Tonetti 2003) and for a high-quality oral hygiene the mean percentage of PlI should be reduced to a level $<20\%$ (Htoon et al. 2007). For clinically significant successful scaling, a mean level of $\geqslant 75\%$ of the periodontal pocket >4 mm at baseline should be closed at the 12-month re-examination.

Statistical analyses

All statistical analyses were performed with SPSS software package (SPSS for Windows, version 15.0, SPSS Inc., Chicago, IL, USA).

Complete baseline data were available for all randomized participants in both groups. Intentions-to-treat analyses were applied where the attrition rates were imputed with a linear interpolation imputation method (according to SPSS 15.0) for BoP, pocket closure, and PlI data, and self-reported oral health was imputed through the last value carried forward method (Twisk & de Wente 2002). Mean values, standard deviations (SD), confidence intervals (CI), and frequency distributions are given. All statistical analyses were performed with the individual as the statistical unit. Treatment effects on BoP were

estimated with separate 2 (experimental group/control group) × 3 (baseline/3-month post-treatment/1-year follow-up) repeated measures analyses of variance (ANOVA repeated measure) and subsequent Bonferroni's post hoc tests. The mean differences in PII, BoP, and percentage of closed pocket at the 12-month follow-up between intervention groups and treatment success groups were analysed by Students *t*-test. ''Successful-NSPT'' on periodontal diagnosis, demographic variables, and reported oral health were validated by cross-tabulation and χ^2 tests. A binary logistic regression analysis was applied to examine variables of importance for reaching treatment success of non-surgical periodontal treatment. An α level of 0.05 or below was considered as statistically significant.

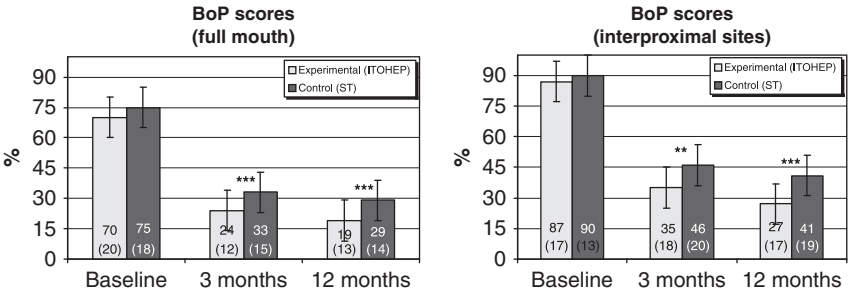

Fig. 1. Mean percentage of bleeding on probing score at the various examination intervals, based on full-mouth scoring and interproximal scores. Mean values and standard deviation are given in the bar charts. Statistical significant differences between the groups are marked in the figure as $^{**}p<0.01$; and $^{***}p<0.001$. BoP, bleeding on probing; ITOHEP, individually tailored oral health educational programme; ST, standard oral health educational programme.

Results

There was no statistically significant difference between groups in the BoP, percentage of pocket, and PII before the experimental interventions (all groups $p>0.19$), indicating successful randomization.

BoP

After the oral hygiene intervention and periodontal debridement, a marked reduction of both full-mouth and proximal scores was observed in both treatment groups and the supportive periodontal treatment resulted in a further reduction of BoP scores (Fig. 1). The repeated measures ANOVA with a subsequent Bonferroni's post hoc test revealed a significant time × group interaction for both full-mouth BoP [$F(2)=11.9$; $p<0.001$] and proximal BoP [$F(2)=12.6$; $p<0.001$], demonstrating that the groups developed differently over time. Post hoc analyses revealed mean differences between groups over time for both full-mouth BoP (mean difference 8.24%; 95% CI: 3.5–12.9; $p=0.001$), and proximal BoP (mean difference 9.65%; 95% CI: 4.25–15.0; $p=0.001$).

The ITOHEP group had lower full-mouth BoP scores at both the 3-month re-examination (95% CI: 4–15; $p<0.001$) and the 12-month post-treatment examination (95% CI: 5–15; $p<0.001$) than the ST group (*p*-value marked with stars in the Fig. 1). For the interproximal sites, the ITOHEP group had lower BoP at both 3-month post-treatment (95% CI: 4–18; $p=0.002$) and 12-month post-treatment examination (95% CI: 7–21; $p<0.001$).

Periodontal pocket assessment

At the baseline examination, the mean percentage (all sites) varied between 31% and 32% for PPD 4–5 mm and between 9.2% and 9.3% for PPD ⩾ 6 mm. For interproximal sites, the mean percentage of PPD > 4 mm varied between 25% and 28% (Table 3). At the 3-month re-examination, the mean percentage for PPD 4–5 mm was reduced to 12% in the ITOHEP group and to 14% in the ST group, and for PPD ⩾ 6 mm the mean percentage reduced to 1.6% (ITOHEP group) and 1.7% (ST group). The mean percentage of interproximal sites with PPD > 4 mm reduced to 6.7% (SD 6.9–10.0) in both groups at the 3-month re-examination. At the 12-month re-examination, there was further reduction in PPD in both groups, especially for the interproximal sites 6.7% and PPD 4–5 mm. No statistically significant differences between the two groups at any of the examination intervals were determined.

The mean proportion of sites (on individual level), reaching the endpoint of ''pocket closure'' i.e. a PPD of ⩽ 4 mm after treatment that was > 4 mm before treatment is presented in Table 4. The initial treatment phase i.e. oral health education and scaling treatment, resulted in ''pocket closure'' at the mean frequency of 69% for the ITOHEP group and 66% for the ST group: for the interproximal sites, the ''pocket closure'' was 68% (ITOHEP group) and 67% (ST group). After some re-scaling during the maintenance period, the mean percentage of closed pockets increased to 75% for the ITOHEP group and between 76% and 77% for the ST group. No statistically significant difference between the two groups was observed at any of the examination intervals.

Plaque scores

The oral hygiene status during the study is presented in Fig. 2. At baseline, the mean full mouth plaque score varied between 57% and 59% in the two study groups, and 79–83% of the proximal sites harboured plaque. Oral hygiene improved in both groups between baseline and 3-month post-treatment ($t=20.8$; $p<0.001$) and between baseline and 12-month post-treatment ($t=22.8$; $p<0.001$). The greatest reduction was between baseline and 3-month post-treatment i.e. immediately after the oral hygiene intervention and scaling treatment. The PII score was then maintained at almost the same level for both groups. The ITOHEP group had lower PII, both 3-month post-treatment (95% CI: 6–16; $p<0.001$) and 12-month post-treatment (95% CI: 9–18; $p<0.001$) than the ST group. The greatest difference was for interproximal sites at 12-month post-treatment, where the control group (45%) had twice as many sites with plaque than the experimental (22%) group (95% CI: 16–29; $p<0.001$).

Treatment success

At 12-month re-examination, the ''successful-NSPT'' level, based on the variables PII, BoP, and pocket closure for each participant was 54 (47.8%): the remaining 59 (52.2%) were classified

Table 3. Mean percentage of PPD 4–5 mm, ⩾6 mm, and for interproximal >4 mm at baseline, 3- and 12-month post-treatment for individuals in the ITOHEP and ST group, respectively

(mm)	Baseline examination		3-month re-examination		12-month re-examination	
	ITOHEP	ST	ITOHEP	ST	ITOHEP	ST
PPD 4–5	31.0%	33.0%	12.7%	14.6%	10.4%	12.2%
All sites	(14.3)	(14.0)	(8.1)	(11.4)	(7.9)	(10.8)
PPD⩾6	9.2%	9.3%	1.6%	1.7%	1.6%	1.5%
All sites	(9.3)	(11.0)	(2.8)	(3.5)	(2.9)	(3.2)
PPD>4	24.8%	27.7%	7.9%	8.5%	6.7%	6.7%
Interproximal	(17.2)	(20.7)	(6.9)	(10.0)	(6.9)	(8.4)

No statistical differences between the groups either at baseline or at 3- and 12-month post-treatment. ITOHEP ($n = 56$) and ST ($n = 57$).
SD, standard deviation; ITOHEP, individually tailored oral health educational programme; PPD, probing pocket depth; ST, standard oral health educational programme.

Table 4. Proportion (%) of pockets closed (PPD⩽4 mm) at 3- and 12-month post-treatment

	3-month post-treatment		12-month post-treatment	
	all sites	interproximal	all sites	interproximal
ITOHEP group	69% (21)	68% (22)	75% (20)	75% (21)
ST group	66% (32)	67% (31)	76% (17)	77% (17)

Mean values and SD.
No statistical differences between the groups either at baseline or at 3- and 12-month post-treatment. ITOHEP ($n = 56$) and ST ($n = 57$).
SD, standard deviation; ITOHEP, individually tailored oral health educational programme; PPD, probing pocket depth; ST, standard oral health educational programme.

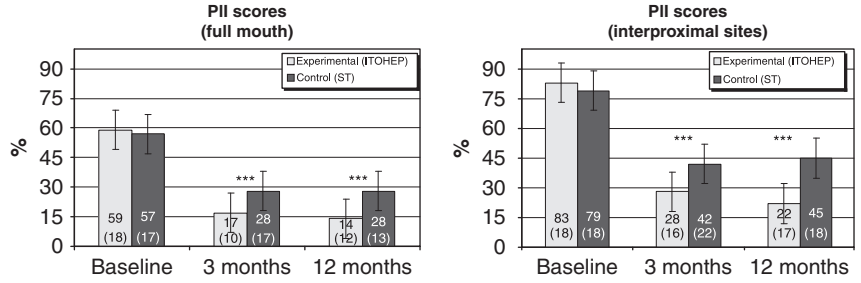

Fig. 2. Mean plaque scores at various examination intervals, based on full mouth scoring and interproximal scoring. Mean values and standard deviation are given in the bar charts. Statistical significant differences between the groups are marked in the figure as $^{***}p < 0.001$. ITOHEP, individually tailored oral health educational programme; ST, standard oral health educational programme; PII, plaque indices.

as ''incomplete-NSPT''. Mean values for each treatment success outcome variables between the two groups (''successful-NSPT''/''incomplete-NSPT'') are presented in Table 5. *T*-test revealed differences between ''successful-NSPT'' and ''incomplete-NSPT'' groups for PII, BoP, and closed pocket, which validated the preset criteria. There were no statistically significant differences between treatment success groups for variables of periodontal diagnosis, age, sex, education, smoking, or medication (all $p = 0.23$–0.90). One difference between the two treatment success groups was for the variable self-report of oral health at 12-month re-examination (χ^2 (df 1) 6.02, $p = 0.014$). More participants in the ''successful-NSPT'' group reported good or very good oral health. For Oral health educational treatment groups, there were more in the ITOHEP group who reached the ''successful-NSPT'' level than in the ST group [ITOHEP ($n = 35$) *versus* ST ($n = 19$); χ^2 (df 1) 8.54, $p = 0.003$].

Factors influencing treatment success (''successful-NSPT'')

The selected variables in the logistic regression analysis were Oral health educational treatment groups, PII, and BoP at baseline examination, although for closed pocket, the percentage PPD>5 mm was used.

In the binary logistic regression model, the odds ratio (OR) of attaining ''successful-NSPT'' in subjects with a lower plaque score at baseline [OR, 0.95; 95% CI; 0.92–0.97; $p < 0.001$] (Table 6) was higher. Similarly, the OR of attaining ''successful-NSPT'' in subjects treated with the ITOHEP intervention (OR, 4.22; 95% CI; 1.77–10.1, $p = 0.001$) was higher than with the ST intervention. No significant relations for percentage of PPD>5 mm or levels of BoP at baseline examination were identified. The percentage predictability of attaining ''successful-NSPT'' level 12-month post-treatment in relation to PII at baseline for the different treatment groups (ITOHEP *versus* ST) is illustrated in Fig. 3. A PII score of about 30% at baseline increased the probability to reach a ''successful-NSPT'' to 75–90%; for a PII over 80%, the probability is 10–20%. With a PII score of 60% at baseline, the probability to reach ''successful-NSPT'' level is 60% if treated with ITOHEP intervention compared with 30% if treated with the ST intervention.

Discussion

The present study aimed to evaluate two different oral hygiene behavioural change programmes in non-surgical periodontal treatment regarding periodontal health. After treatment, the individually ITOHEP group had lower BoP scores than the standard health educational programme group with the largest differences being for the interproximal surfaces. For the clinical outcome variable PPD reduction, both groups improved equally. When all clinical variables were considered, more individuals in the individually tailored oral health educational group attained ''successful-NSPT'' level (due to lower plaque and BoP scores), and more individuals attaining this ''successful-NSPT'' level reported good or very good oral health after treatment than the ''incomplete-NSPT'' group.

To evaluate the clinical significance of the programmes preset criteria were

Table 5. Mean values for the two classified groups, based on the 12-month re-examination

	Mean % (SD)		*p*-value
	''successful-NSPT'' ($N = 54$)	''incomplete-NSPT'' ($N = 59$)	
PII % all sites (SD)	13 (7)	28 (15)	<0.001
BoP % all sites (SD)	14 (5)	33 (14)	<0.001
Closed pocket % all sites	86 (11)	66 (19)	<0.001

Independent group *t*-test between treatment success level on the independent variables for PlI, BoP, and closed pocket.
SD, standard deviation; BoP; bleeding on probing; successful-NSPT, success level for non-surgical periodontal treatment; PlI, plaque indices.

Table 6. Summary of the logistic regression analysis on non-surgical treatment success

Treatment outcome at 12-month re-examination ''successful-NSPT'' *versus* ''incomplete-NSPT''	OR	95% CI	*p*-value
PII (0–100%)	0.95	0.92–0.97	0.001
BoP (0–100%)	1.05	0.03–31.7	0.979
Percentage of PPD > 5 mm (0–100%)	0.98	0.93–1.04	0.624
ITOHEP intervention *versus* ST intervention	4.22	1.77–10.1	0.001

PII scores, BoP scores, and percentage of PPD > 5 mm are all baseline values.
CI, confidence interval; OR, odds ratio; PII, plaque index; BoP, bleeding on probing scores; PPD, probing pocket depth; successful-NSPT, success level for non-surgical periodontal treatment; PII, plaque indices; ST, standard oral health educational programme.

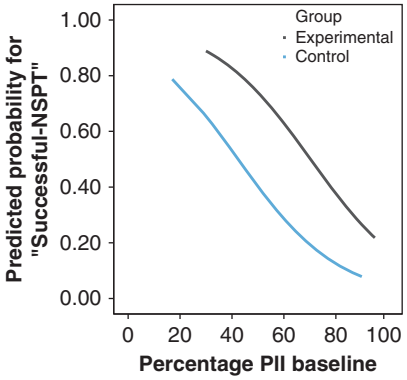

Fig. 3. Odds for reaching a ''successful-NSPT'' level 12-month post-treatment for both treatment groups in relation to plaque indices (PII) scores at baseline. The curve with PII scores before treatment and type of therapy as explanatory variables was constructed from the regression coefficient in the regression analyses. Successful-NSPT, success level for non-surgical periodontal treatment.

set for treatment success following non-surgical periodontal treatment. These criteria were based on statements from previous studies (Lang & Tonetti 2003, Wennström et al. 2005, Htoon et al. 2007). In a study by Lundgren et al. (2001), 52% fulfilled the criteria for treatment success, although only four sites per patient were studied and periodontal surgery was included in the treatment. In the present study, almost half of the participants attained clinical significant level for treatment success and whether the preset criteria were appropriate (too rigorous/too gentle) requires validation in further longitudinally studies and over a longer study period, when change in attachment level also is considered. Even if the ITOHEP group had lower PII and BoP scores than the ST group, both improved considerably. Although there are few comparable studies with the same number of participants and the same design, the BoP score for the ST group was similar to other studies that use a standard oral hygiene programme (Westfelt et al. 1998, Wennström et al. 2005).

An indicator of sufficient removal of biofilm and calculus is ''pocket closure'' (Wennström et al. 2005). In both the ITOHEP and the ST group, there was still about 25% remaining pockets with a PPD ⩾ 4 mm. These results for ''pocket closure'' were almost identical with the results from Wennström et al. (2005), and, the percentage PPD reduction was similar to results from Westfelt et al. (1998). This indicated that scaling treatment for both groups was accomplished with an expected effect. Studies have shown that oral hygiene is important for pocket reduction (Nyman et al. 1977, Westfelt et al. 1998, Tomasi et al. 2007). Both study groups reduced their plaque and BoP levels considerably with greater reduction in the ITOHEP group. However, the difference was not found in pocket reduction. A possible explanation might be the maintenance care with supplementary scaling every third month for both groups, which has been described in several studies to be sufficient to maintain and improve periodontal conditions (Ramfjord et al. 1982, Rosling 1983, Axelsson et al. 1991, 2004). To have a recall system for all patients every third month is both expensive and time consuming. The objective of the experimental intervention ITOHEP was to encourage and empower the patient to take more responsibility for their oral hygiene and periodontal health hopefully resulting in less need for future maintenance care.

In the present study, the baseline plaque scores have a major impact on the successful outcome of non-surgical therapy. However, in all levels, the predicted probability to achieve the proposed level of treatment success was higher for individuals in the ITOHEP group. Lower initial PII scores and group assignment (ITOHEP) were associated with a higher probability of reaching the ''successful-NSPT'' level. There was about a 30% higher chance of an individual with a plaque score around 60% at baseline of attaining a successful level of non-surgical periodontal treatment if treated with an ITOHEP integrated in periodontal debridement session than treated with an ST programme.

A cut-off level for non-surgical treatment success was described and consisted of the maximum mean for PII, BoP, and ''Pocket closure'' suggested in the preset criteria for non-surgical treatment success. PII, BoP, and ''Pocket closure'' were chosen because of clinical relevance. To be as comparable with general practice, this study included all remaining teeth i.e. no exclusion of molars or third molars (if present). The proportion of plaque scores provides information on individual self-care (and skills) and measures such as gingival inflammation and PPD provide information on current periodontal condition (Renvert & Persson 2004). A low BoP score indicates periodontal stability (Lang et al. 1986, Cobb 2002). The aim of the preset criteria for clinical significant level of treatment success in non-surgical periodontal treatment were to be individually related and understandable, and to correspond with professional skill (i.e. scaling performance), patient adherence (i.e. edu-

cational programme), and reduced risk for disease progression and serve as a guidance for the clinician. In behavioural change programmes based on cognitive behavioural strategies, it is important for the patient to identify short- and long-term goals that are explicit, possible to evaluate, and attainable (Gollwitzer 1999). In an attempt to identify the success rate of treatment, Lundgren et al. (2001) proposed an evaluation criteria staircase based on site level, with the highest level of success being PPD $\leqslant$ 4 mm, no signs of gingival inflammation or BoP, and no further loss of clinical attachment or alveolar bone loss. However, in a clinical setting, these criteria might not attainable for all dentition sites. The use of the outcome levels verified by the ''successful-NSPT'' as an indicator for treatment success could be valuable in the evaluation of non-surgical periodontal treatment both for the clinician, in the individual goals set by the patient, and when effects of different interventions are compared. Individuals in the ''successful-NSPT'' group reported a higher level of oral health, and this indicated that the level of treatment success reached included a dimension of individual assessment of oral health. However, patients categorized as successful might have residual disease or higher plaque levels due to the inclusion of Class II outcome, even though the Class II levels must be considered as a low. Further, individuals within the ''successful-NSPT'' group might differ, as some were fully recovered and some individuals and specific sites still required complementary treatment such as periodontal surgery. Therefore, ''successful-NSPT'' should only be considered as the actual endpoint of non-surgical periodontal treatment.

The randomized design, large sample, and low attrition rate strengthened the internal validity and the differences in the results were due to the intervention (ST or ITOHEP). The patients were treated at a specialist clinic where two specially trained dental hygienists performed the treatment. The ITOHEP programme requires complementary training, both for the understanding of cognitive behavioural strategies and motivational interviewing, and whether the programme could be applied by other dental hygienists or dentists in similar clinical settings, or in general dental care, needs confirming in future studies. One challenge for the dental hygienist or dentist is to change strategies from administering prepared solutions to the patient to initiating methods that encourage and empower the patient to play a more active role in her/his decisions throughout the treatment process and maintenance care. The extra gained periodontal health confirmed in this study is certainly of interest, but probably just as important for the individual patient is the acquired authorization for an active participation.

In conclusion, individuals in the individually tailored oral health educational group had lower BoP scores than standard oral health educational group, but no differences were for PPD. More individuals in the ITOHEP group reached a level of non-surgical treatment success. Lower level of plaque at the start of the non-surgical periodontal treatment and ITOHEP intervention increased the probability to reach a level of clinical significant treatment success, ''successful-NSPT''. An individually tailored oral health educational intervention in combination with scaling is preferable to the ST programme in non-surgical periodontal treatment.

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Clinical Relevance

Scientific rationale for the study: An individually tailored oral health educational programme adapted to individual goals and problems improved oral hygiene behaviour. No previous study has evaluated the effectiveness of the programme on periodontal health within non-surgical periodontal treatment.

Principal findings: Both an ITOHEP and a standard treatment programme were effective to improve periodontal health. More individuals in the individually tailored programme reached the level of treatment success (due to lower plaque and BoP scores) than participants receiving standard treatment did.

Practical implications: Non-surgical periodontal treatment is gained through ITOHEP based on cognitive/behavioural strategies in combination with scaling. The patients may benefit more and may require less future maintenance. The treatment programme is possible for special trained dental hygienists to perform in their treatment of patients with chronic periodontitis.