Abstract

Background: Smoking is one of the world's major health problems and dental professionals are in a unique position to promote smoking cessation. However, according to the current literature, neither dental students nor dentists feel adequately prepared to counsel smokers. The purpose of this study was to develop and implement a teaching intervention on smoking cessation for fourth-year dental students and assess its effectiveness in terms of learning outcome on knowledge, communication skills and attitudes.

Materials and Methods: In this prospective intervention study, students in the intervention group (n=28) participated in a teaching module consisting of a podcast, an interactive lecture, a seminar, and small-group sessions with role-play interactions. Knowledge, communication skills and attitudes were measured using written examinations and an objective structured clinical examination (OSCE) at the end of the module and 6 months later. Results were compared to data from a historical control group (n=27) receiving standard teaching.

Results: Compared with the control group, students in the intervention group had higher scores in the knowledge test (67.1% vs. 41.8%; $p<0.001$; $d=2.8$) as well as in the OSCE (74.9% vs. 44.7%; $p<0.001$; $d=2.3$) and also retained more knowledge (52.7% vs. 36.5%; $p<0.001$; $d=2.0$) and skills (71.8% vs. 47.6%; $p<0.001$; $d=2.5$) over a period of 6 months. Attitudes were similar across groups and time-points.

Conclusion: The teaching intervention equipped dental students with specific knowledge and skills required to effectively counsel smoking patients. Further research is required to assess the transfer of these skills to the clinical setting.

Key words: Dental education, smoking, cessation, counselling, knowledge, practical skills

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Introduction

Smoking constitutes a severe health risk all over the world. According to current data, smoking is responsible for 6 million deaths per year worldwide,[1] 120.000 of which occur in Germany.[2] In addition to smoking being the main reason for preventable morbidity and mortality, the financial burden due to an inability to work and rising healthcare expenditures is considerable.[3] It is for these reasons that the counselling of smokers and the promotion of smoking cessation are a top priority for physicians.[4]

Tobacco smoking has various harmful and well-studied effects on oral health (e.g. precancers which eventually become malignant and turn into oral cancer, increased prevalence and severity of periodontal diseases, failure of dental implants, wound healing deficits, aesthetic impairment because of discolorations of teeth and dental restorations, halitosis),[5] thus giving dentists a vital role in advising and supporting smoking patients.[6,7] Periodontal disease and other tobacco-related diseases can provide important stimuli for a professional discussion about the risks of smoking, as well as identifying a personal motivation for the patient to stop smoking. Findings also show that smokers willing to quit are more likely to present to primary dental care, suggesting that the dental office could provide an appropriate context to reach an audience receptive to smoking cessation advice.[8]

In the course of treatment, the dentist needs to explain the negative effects of tobacco use on oral and general health, as well as encourage the patient to stop smoking, providing support where required. It is especially during follow-up consultations that dentists play a key role in the reinforcement and close support of patients who are attempting to quit, as multiple sessions of counselling have been shown to be more effective in achieving long-term

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cessation success.[9] Therefore, considering that dentists and dental staff have the advantage of seeing their patients on a regular basis, often closely treating them over a long period of time, the role they play in smoking cessation is of major importance.[10]

Accordingly, the European Union Working Group on Tobacco and Oral Health has declared helping patients quit smoking to be part of the responsibility and general practice of dental care professionals.[11] In order to fulfil this task, dental specialists need effective training with regard to smoking prevention and addiction treatment. However, the Global Health Professions Student Survey (GHPSS) showed that most health professional students did not feel sufficiently prepared to counsel smokers in a professional way.[12] At the same time, a majority of dental students appear to be interested in being trained in tobacco cessation.[13] Despite interest and necessity, less than 40 percent of dental students have ever received such training.[14] According to the available evidence, the two main barriers dental professionals face in counselling smoking patients are a lack of training during their education and a subsequent lack of confidence in their ability to help smokers quit.[15] Similar findings emerged from a survey among medical students in Germany and in England.[16] However, dental students appear to be particularly disadvantaged regarding the inclusion of didactic teaching and practical training on issues related to smoking cessation. Thus, a recent study reported that in comparison to dental students, medical students were significantly more confident in asking patients about smoking-related information and counselling patients in tobacco cessation.[17] Taken together, it is not surprising that dentists counsel their smoking patients less often than other healthcare professionals.[18]

While theoretical aspects such as the harmful effects of tobacco use are addressed in undergraduate medical and dental education,[19] courses lack practical training on counselling techniques. As dentists play an important and growing role in risk education and smoking

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cessation, appropriate practical training should be incorporated into the dental curriculum. This would improve the education of dental professionals, allowing them, in turn, to provide better treatment to smoking patients.

This study therefore aimed to develop and evaluate a teaching intervention on tobacco and smoking cessation for undergraduate dental education in Germany. We hypothesized that, compared with students receiving standard didactic teaching, students participating in the novel module would have better short- and long-term learning outcome regarding theoretical knowledge, practical (communication) skills and attitudes.

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Materials and Methods

Design of the teaching intervention

Undergraduate dental education at University Medical Center Göttingen (Germany) consists of a 2.5-year preclinical phase and a 2.5-year clinical phase, followed by one semester of examinations before graduation. The teaching intervention was designed to be included in the mandatory course 'Operative Dentistry I' in the first half of the fourth year ("term 7"; second term of the clinical phase) of the degree. In this patient-centered course, practical training comprises cariology, preventive and restorative dentistry, periodontology and endodontics, accompanied by theoretical lectures and seminars. The course is the first one for students to treat their own patients under the supervision of instructing dentists.

The teaching intervention for dental students was based on a structured smoking cessation training developed for fourth-year medical students at Göttingen University Medical Center. An earlier study had revealed a sustained learning outcome in knowledge, skills and attitudes in this student group.[20] Development of the intervention was guided by the six-step approach suggested by Kern et al.[21] A total of 20 specific learning objectives were identified, based on the needs identified in the German medical student survey.[22] 13 learning objectives referred to knowledge, 6 referred to practical skills and one to attitudes. Four teaching formats congruent to these learning objectives were created and modified in order to meet the needs of dental students:

- Podcast: A recording of a 70-min lecture on epidemiology (including smoking prevalence), the mechanisms of nicotine addiction, withdrawal symptoms, the basic principles of counselling, first-line medication and potential benefits and risks of electronic cigarettes was made available to students via an online platform. This lecture also included an extra chapter on the oral health risks of tobacco use and how this relates to dental surgery, conservative dentistry, prosthodontics and orthodontics. Students were invited to watch the MP4 file in the week leading up to a plenary session and were encouraged to submit any questions they had via E-mail, to be addressed during the lecture.
- Lecture: In this 60-min plenary session, including a live conference call, an international expert on smoking cessation (A.B.) discussed the submitted questions with the dental students.
- Seminar: In this 60-min session, the institution's smoking cessation counsellor coached students on counselling according to the 5A-approach[9]. According to this counselling technique, patients should be *A*sked whether they smoke. Smokers should then be *A*dvised to quit, and have their readiness to quit smoking *A*ssessed. Smokers

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should then be offered *A*ssistance in a quit attempt, and physicians should *A*rrange for a follow-up appointment during which progress and any problems are being addressed. In addition to an in-depth discussion of this approach, indications, contraindications and adverse effects of first-line stop smoking medications (nicotine replacement therapy, bupropion, and varenicline) were presented and students had the opportunity to ask questions.

- Small-group sessions: Small groups consisting of six students each spent 90 min role-playing dentist-patient interactions in which each student had to counsel a smoking patient in a dental setting and play the part of a patient, respectively. Scenarios covered common conditions (e.g. tooth extraction, smoking in pregnancy, mucosal lesion, recall for periodontal maintenance, stained tongue and teeth, consultation for dental implants). Following each role-play interaction, students received individual feedback.

  For preparation purposes, a sample video of a counselling session in a dental environment (9 min) was produced and made available to students throughout the entire duration of the semester via an online platform.

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Study Design

Two student groups participated in this prospective study: the control group (summer term 2017) received standard teaching (discussion of smoking as a risk factor for oral disease but no specific educational intervention on counselling; control group), and the intervention group (winter term 2017/18) was exposed to the module described above. The control group took a written knowledge test as well as an objective structured clinical examination (OSCE) at the end of term 7 (T2) and 6 months later at the end of term 8 (T3), without having ever received any specific teaching regarding smoking cessation. Students in the intervention group took a

written knowledge test at the beginning of the term (T1), before having received any teaching on this topic and another written test as well as an OSCE at the end of the course (T2). Again, retention of knowledge and skills was assessed six months later (T3). Tests performed for this study were formative in nature in order not to confound results by the strong incentive generated by graded exams. [**Figure 1**]

Assessment of Student Performance

In order to assess factual knowledge, students took written examinations at T1 (intervention group only), T2 and T3 (both groups) with identical questions at all time-points. Questions in the written test were formatted as multiple choice questions, short-answer questions, and true/false questions. The maximum possible score was 39 points. As part of the knowledge test, students were also asked to rate the effectiveness of eight different approaches to smoking cessation on a six-point scale. The most positive option referred to a 6-month continuous abstinence rate of 30%. These ratings were used in a descriptive analysis and did not count towards the maximum score of 39 points. With regard to attitudes toward smoking, the statement "I consider smoking to be a chronic disease" was rated by students on a six-point scale from 1 ("completely agree") to 6 ("completely disagree"). In addition to these questions regarding theoretical knowledge and attitudes, students were presented with self-assessment statements on their knowledge and skills and on their current approach to counselling smokers.

In the OSCE, a total of 7 minutes was available for each student to counsel a standardized patient. The case history was displayed on the outside of the door to the consultation room and students were given ample opportunity to read the case history and the task before entering the room. The OSCE consultation was identical for all students at all time-points: A

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60-year-old smoker reported to the dental office for a follow-up appointment for supportive periodontal therapy, in which a deterioration of the periodontal condition was noted. Lay actors who had acted as simulated patients before received special training and instructions for their role. Student performance was assessed by raters specifically trained in the use of a checklist aligned to the 5A approach and yielding a maximum score of 50 points. Written tests and checklists are available from the authors upon request.

Data Collection and Analysis

OSCE raters used tablets to complete checklists during the OSCE examination. For the written examinations at T1, T2 and T3, paper questionnaires were used which were produced with EvaSys 7.0 (Electric Paper, Lüneburg, Germany). Upon completion, paper forms were scanned, and data exported as .cvs files. Data were entered into SPSS 24.0 (IBM SPSS Statistics) and matched using matriculation numbers. Data are presented as mean ± standard error of the mean or percentage (n), as appropriate.

This study aimed to evaluate the effectiveness of the new teaching methods by comparing the performance of the intervention group to that of the control group. This was done by analysing changes in performance scores over time and by comparing performance between the two groups at T2 and T3. Only students with valid and complete data at all relevant time-points were included in the analyses (intervention group: n = 28, control group: n = 27). Differences between groups were assessed using independent t-tests, and differences between time-points within groups were assessed using paired t-tests. Prior to analysis, data regarding self-assessments as well as attitudes towards smoking were dichotomized by collapsing scale options 1 and 2 into a positive answer. Differences in dichotomous variables were assessed using x^2 tests. Significance levels were set to 5%.

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This research project was approved by the Institutional Review Board at Göttingen Hospital Medical School (application number 14/8/17). All students received informed consent forms and provided written consent to participate. The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Results

Description of the Study Samples

In winter term 2017/18, a total of 37 students (response rate: 88%) agreed to participate in the study (intervention group). The number of students providing data differed between data collection points and was lowest at T2 (n=30). Complete data at T1, T2, and T3 were available for 28 students in this group. The majority of these were female (n=18), and six students considered themselves occasional or regular smokers.

Within the control group (summer 2017), 33 out of 37 eligible students agreed to participate in the study (response rate: 89.2%). There was no data collection at T1 in this group. Complete data at T2 and T3 were available for 27 students. Twenty-one of these were female, with a smoking prevalence similar to the intervention group (n=6).

Changes in knowledge, attitudes and reported behaviours over the course of the study

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At T1, students in the intervention group scored 37.7±1.4% in the written knowledge test. Students in the control group who had not received any tobacco-related teaching during term 7 and who were therefore supposed to be at the same knowledge level at T2 (end of term 7), scored 41.8±1.5%. Following exposure to the teaching intervention, students in the intervention group scored 67.1±1.9% (paired t-test: $p < 0.001$). A comparison between the intervention and control group performance at T2 yielded an effect size of the between-group difference of $d = 2.8$. In the written retention test at T3, students in the intervention and control groups achieved a score of 52.7±1.7% and 36.5±1.4%, respectively ($p < 0.001$; $d = 2.0$). A more detailed analysis [**Figure 2**] showed that, within the intervention group, the largest and most sustained increase of knowledge occurred for items related to counselling principles (i.e., the 5A approach). Smaller and mostly transient increases were noted for knowledge on epidemiology, pathophysiology and pharmacotherapy. Students in the control group had virtually no knowledge on counselling at T2 and T3.

Effectiveness ratings for various ways to support a quit attempt are given in **Figure 3**. Students in the control group attributed highest effectiveness to willpower alone as well as to comprehensive smoking cessation programmes including the application of nicotine replacement therapy while all other treatment modalities (e.g., varenicline or acupuncture) were mostly thought to be moderately effective. There was no substantial difference in ratings between T2 and T3 in this group. Ratings obtained from students in the intervention group at T1 resembled these figures. However, a marked change was noted at T2 when options with proven and high effectiveness (e.g., cessation programmes, varenicline, bupropion and nicotine replacement therapy) were also thought to be highly effective while ratings for willpower alone decreased considerably. A similar pattern of results was found at T3.

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With regard to attitudes, the proportion of students agreeing that smoking was a chronic disease was 39.3% in the intervention group at T1. At T2, 25.9% of the control group, compared with 46.4% of the intervention group, agreed with this statement ($p = 0.114$). At T3 the numbers remained similar, with 42.9% of the intervention group and 22.2% of the control group agreeing that smoking is a chronic disease ($p = 0.103$). In both cohorts, there were no significant differences in these proportions between smoking and non-smoking dental students at any time-point.

Behaviours during patient encounters were addressed in two self-assessment statements at T2. In both groups, over 80% of students reported regularly documenting their patients' smoking status (control group 85.2%; intervention group 89.3%; $p = 0.648$). However, while 81.5% of students in the control group stated to also advise every smoking patient to quit, this percentage was only 57.1% in the intervention group ($p = 0.051$).

Changes in practical skills over the course of the study

Student self-assessments of their own competence with regard to counselling smokers are presented in **Table 1**. Student agreement to the five statements was low at T2 in the control group, and similar values were obtained in the intervention group at T1. A between-group comparison of percent agreement at T2 yielded significant and large differences favouring the intervention group. At T3, these differences persisted but their size was halved for three of the five statements. In fact, agreement to these statements decreased significantly between T3 and T2 in the intervention group while there was no change in the control group in any of the items.

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In direct comparison at T2, the OSCE scores were 74.9±1.9% in the intervention and 44.7±3.0% in the control group ($p < 0.001$; $d = 2.3$). As shown in **Figure 4**, the intervention group performed significantly better in all 5A categories than the control group at T2. In the retention OSCE at T3, the intervention group achieved a total score of 71.8±1.7%, performing significantly better than the control group in general (47.6±2.0%, $p < 0.001$; $d = 2.5$), and in all 5A categories. A longitudinal comparison of overall OSCE results revealed that there were no significant changes between T2 and T3 in either group ($p = 0.098$ for the intervention and $p = 0.407$ for the control group, respectively).

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Discussion

This study tested the effectiveness of an innovative teaching intervention on smoking cessation counselling in terms of knowledge and skills acquisition and retention in dental students. In the intervention group, student knowledge increased significantly during the module; students in this group outperformed students in the control group by a large effect size with regard to knowledge as well as counselling skills. This learning outcome was sustained throughout the 6-month follow-up. Findings were paralleled in students' self-ratings of their counselling competence. However, there was no evidence of improved self-reported practice in the intervention compared with the control group. There was also no significant effect on attitudes in that a similarly low proportion of students in both groups considered smoking a chronic disease.

The increase in test scores between T1 and T2 in the intervention group was mainly driven by the acquisition of knowledge regarding the 5A approach (see **Figure 2**). Students in the

control group had virtually no knowledge on this issue at either assessment. Although there were significant and large differences in knowledge scores between the intervention and the control group at T2 and T3, performance in the intervention group was at best moderate at T2, and the learning outcome appeared to be transient as a considerable amount of factual knowledge on epidemiology, pathophysiology, counselling principles and pharmacotherapy was lost at T3. However, students in the intervention group acquired relevant knowledge on the effectiveness of various smoking cessation aids. Compared with students in the control group, students in the intervention group provided more realistic effectiveness estimates at T2 and T3 (see **Figure 3**). For example, following standard teaching, >35% of students believed that acupuncture was highly effective while only 30% believed that nicotine replacement therapy or varenicline were highly effective. This is important as physicians who think that acupuncture is more effective than nicotine replacement therapy or varenicline are less likely to recommend the best available treatment to their patients.

The most striking and sustained differences between the intervention and control group were found in the OSCE (see **Figure 4**). Previous research has shown that greater coverage of the 5A in medical consultations is associated with higher patient satisfaction[23] as well as increased odds of quitting smoking.[24] Arranging follow-up appointments during which smoking (cessation) is discussed once again is particularly important. The intervention used in this study was effective in teaching students to remember this aspect but there is still room for improvement as the percentage of students complying with this recommendation was below 60% at T3. Figures were equally low for the second A ("advise"). Accordingly, there is a need to further improve the teaching intervention with a specific focus on this aspect.

Comparison with Earlier Studies

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Several teaching interventions on tobacco-related diseases and counselling approaches for medical students and, more recently, also for dental students have been described.[25-27] However, the majority of these studies cannot be compared to the data presented here as most of them were implemented in the United States or other non-EU countries whose healthcare systems are considerably different from the situation in Germany, where cessation medication is not covered by health insurance and there is no national network of stop smoking services. This lack of continuity of care entails an enhanced indication for dental health professionals to take over responsibility for counselling and supporting their patients. A recent systematic review about dental students' views on tobacco cessation in a dental setting[13] showed that they were more likely to put the first two As (ask, advise) of the 5A approach into action and did not engage as much in assessing readiness to quit, assisting in a quit attempt and arranging for follow-up. These results were based on surveys rather than objective assessments of behaviours. Our current findings in a sample of German dental students differ from these survey results in that students from both the intervention and the control group got higher scores for 'assess' than for 'advise' at all time-points. These differences may be due to the data collection method but they may also result from the specific intervention used in this trial.

The present study replicated earlier findings from a study evaluating the effectiveness of training on smoking cessation in undergraduate medical education. In contrast to that trial[19], the present study obtained data on communication skills at two different time-points in the control group, thus facilitating direct comparisons of these skills in the two groups at T2 and T3. The initial increase in performance in the intervention group as well as the stability of exam performance in both groups is reassuring with regard to the reliability and validity of the data collection tools.

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The intervention included multiple state-of-the-art methods of teaching such as the flipped classroom approach and the role-play interactions. In our case of the flipped classroom approach, student learning was stimulated with an online video podcast for independent preparation of the learning contents which allowed interaction during the lecture with the smoking cessation expert, thus enabling discussions and more in-depth learning. In fact, the flipped classroom approach has been suggested to be superior to traditional lectures.[28] We did not record whether students actually watched the online video. However, given this was not a validation study of the flipped classroom approach but a real-world application of a complex teaching module, student uptake of specific elements of the intervention was less important than the overall effect of the intervention in its entirety. An assessment of the specific effects of different elements of the teaching intervention could be the focus of future studies.

Within our sample, one in five students reported being occasional or regular smokers. This proportion is within the range of smoking prevalence reported for dental students in various countries (Brazil: 8.9% [29]; India: 17% [30]; Romania: 37% [31]). In 2011, the Global Health Professions Student Survey provided the most comprehensive overview of smoking prevalence in dental students to date. According to this report, smoking rates range from 2.1% (Cambodia) to 65.2% (republic of Moldavia) [14].

Smoking status might affect students' inclination to regard smoking as a chronic disease and to counsel patients who are smoking. We did not find such an effect in the present study. However, this finding needs to be interpreted with caution given the small sample size.

Strengths and Limitations

The teaching intervention was designed according to current recommendations for the implementation of behavior change counseling curricula.[32] Major strengths of the present

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study were the prospective setup with 6-month follow-up and the inclusion of a control group taking the same written and practical examinations (except for the written examination in the intervention group at T1). As participation in the intervention was mandatory for all students of the course "Operative Dentistry I", sufficient data were available for longitudinal analyses of changes in knowledge, attitudes and skills. The size of the two student samples was comparable (intervention group: n = 28, control group: n = 27). Drop-outs were mainly attributable to students having to repeat the course. By design, four students failing the course in summer 2017 (control group) could not be included in the intervention group (winter 2017/18) as this would have confounded results.

While overall OSCE performance was favourable in the intervention group at T2 and T3, scores in the written knowledge test were at best moderate at T2 and unsatisfactory at T3. One potential explanation for this is that the written exam was formative. The lack of exam consequences (e.g., the necessity to repeat the exam) might have caused students not to revise to the same level they would have done for a summative examination.[33] Alternatively, the written knowledge test may not provide an accurate assessment of true student abilities. Moreover, there was a considerable mismatch between student self-assessments of their own competence and actual OSCE performance: While self-assessments indicated a significant decline between T2 and T3 in the intervention group, OSCE scores remained fairly stable. Thus, students might underestimate their abilities as a function of the time that passed since exposure to the teaching intervention. As a consequence, self-assessments cannot be regarded as a reliable measure of true competence in this educational context. The same may apply to the item regarding attitudes. The fact that there were no differences between the two groups and that the intervention did not appear to have an impact on attitudes might be due to the fact that the respective question used in this study had not been validated in previous research.

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Another limitation of our study is the monocentric design as our entire sample is from one dental school which may not be representative for the entirety of German dental schools because every university has its own curriculum for dental education. To examine the impact on different student populations, the teaching intervention should be implemented in the curriculum of other German and European dental schools. This might also facilitate the inclusion of larger samples in future studies. A revised version of the module should put more emphasis on conveying the importance of smoking being a chronic disease and the transfer to clinical practice since we did not find significant between-group differences regarding self-reported behaviours. If anything, T2 data suggest that students in the intervention group provided smoking cessation advice less frequently than students in the control group. It can be hypothesised that students in the control group overestimated their performance as they were unaware of the nature of individual advice as recommended in current guidelines. Students in the intervention group might have changed their internal benchmark for adequate advice; thus, when reflecting on their own behaviour, they might have provided more critical self-assessments. This hypothesis should be tested in future studies by obtaining these self-assessments at several time-points.

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Implications for Future Research

Future studies should aim to assess the transfer of participants' knowledge and skills from teaching environments to subsequent clinical practice, specifically whether students who participated in the new teaching intervention are able to deliver more effective counselling to their patients. Dependent variables to assess include patient satisfaction, quitting success, benefit for patients and an estimation of cost-effectiveness in comparison to the investment in time and resources for the teaching intervention.

Conclusion

The teaching intervention was highly effective in producing a favourable and sustained learning outcome in dental students. Compared with students receiving no specific teaching on the topic, students who received the new teaching intervention gained more knowledge and practical skills and were able to retain both over a period of 6 months. Thus, the newly developed module lends itself for inclusion in the core curriculum of undergraduate dental education. Subsequent trials should address the transfer of these skills to clinical practice as well as the impact of the teaching intervention on patient satisfaction and quitting success.

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Conflict of interest

TR has received honoraria from Pfizer, Novartis, Glaxo Smith Kline, Astra Zeneca and Roche as a speaker in activities related to continuing medical education. He has also received financial support for investigator-initiated trials from Pfizer and Johnson & Johnson. All other authors do not have any conflicts of interest to declare.

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Tables

Table 1:

Statement	Group	T1	T2		T3	
				p value		p value
„I know how to treat tobacco addiction"	Control	-	3.7 (1)	<0.001	3.7 (1)	<0.001
	Intervention	3.6 (1)	78.6 (22)		64.3 (18)	
„I know how to take a patient's full smoking history"	Control	-	7.4 (2)	<0.001	0 (0)	<0.001
	Intervention	0 (0)	89.3 (25)		46.4 (13)*	
„I can explain the addiction mechanism of smoking in detail"	Control	-	7.4 (2)	<0.001	0 (0)	0.001
	Intervention	3.6 (1)	60.7 (17)		32.1 (9)*	
„I am able to competently counsel a smoker who is willing to quit"	Control	-	7.4 (2)	<0.001	0 (0)	0.001
	Intervention	0 (0)	75.0 (21)		35.7 (10)*	
„I know how to develop a recommendation for smoking cessation based on a patient's smoking history"	Control	-	7.4 (2)	0.003	0 (0)	0.001
	Intervention	0 (0)	42.9 (12)		32.1 (9)	

Legend: Student self-assessments with regard to the treatment of tobacco addiction at T1, T2 and T3. Data are given as % agreement (n) derived from scaled items that were collapsed into a positive (options 1 or 2) or negative answer (options 3-6), respectively. p values refer to between-group comparisons and were derived from chi-squared-tests. Asterisks refer to within-group comparisons between T2 and T3 by McNemar tests ($p < 0.05$).

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Figure legends

Figure 1: Study outline. OSCE, objective structured clinical examination. The teaching intervention consisted of a preparatory podcast, a lecture including live discussions with a smoking cessation expert, a seminar on counselling and pharmacotherapy and small-group role-play sessions (90 minutes per group of 6 students).

Figure 2: Knowledge test results in the intervention (black) and the control group (grey), respectively. Test results are visualized in three parts: epidemiology and pathophysiology (10 out of 39 points; plain colour), counselling principles (6 out of 39 points; horizontal lines), and pharmacotherapy (23 out of 39 points; diagonal lines). Error bars indicate standard errors of the mean, related to the total percent score (all three parts combined). **p < 0.001 (independent T test)

Figure 3: Student ratings of the effectiveness of different approaches to smoking cessation; in the corresponding question, high effectiveness was defined as a 30% continuous abstinence rate after 12 months. Student responses on six-point scales were collapsed into high (options 1 & 2; black), moderate (options 3 & 4; grey) and low (options 5 & 6; white) perceived effectiveness. GCP, group cessation program; GP, general practitioner; NRT, nicotine replacement therapy

Figure 4: Percent scores achieved in the objective structured clinical examination by students in the intervention (black) and the control group (grey). Results are broken up according to the five categories of the 5A approach to cessation counselling. Error bars indicate standard errors of the mean. *p < 0.05; **p < 0.001 (independent T test)

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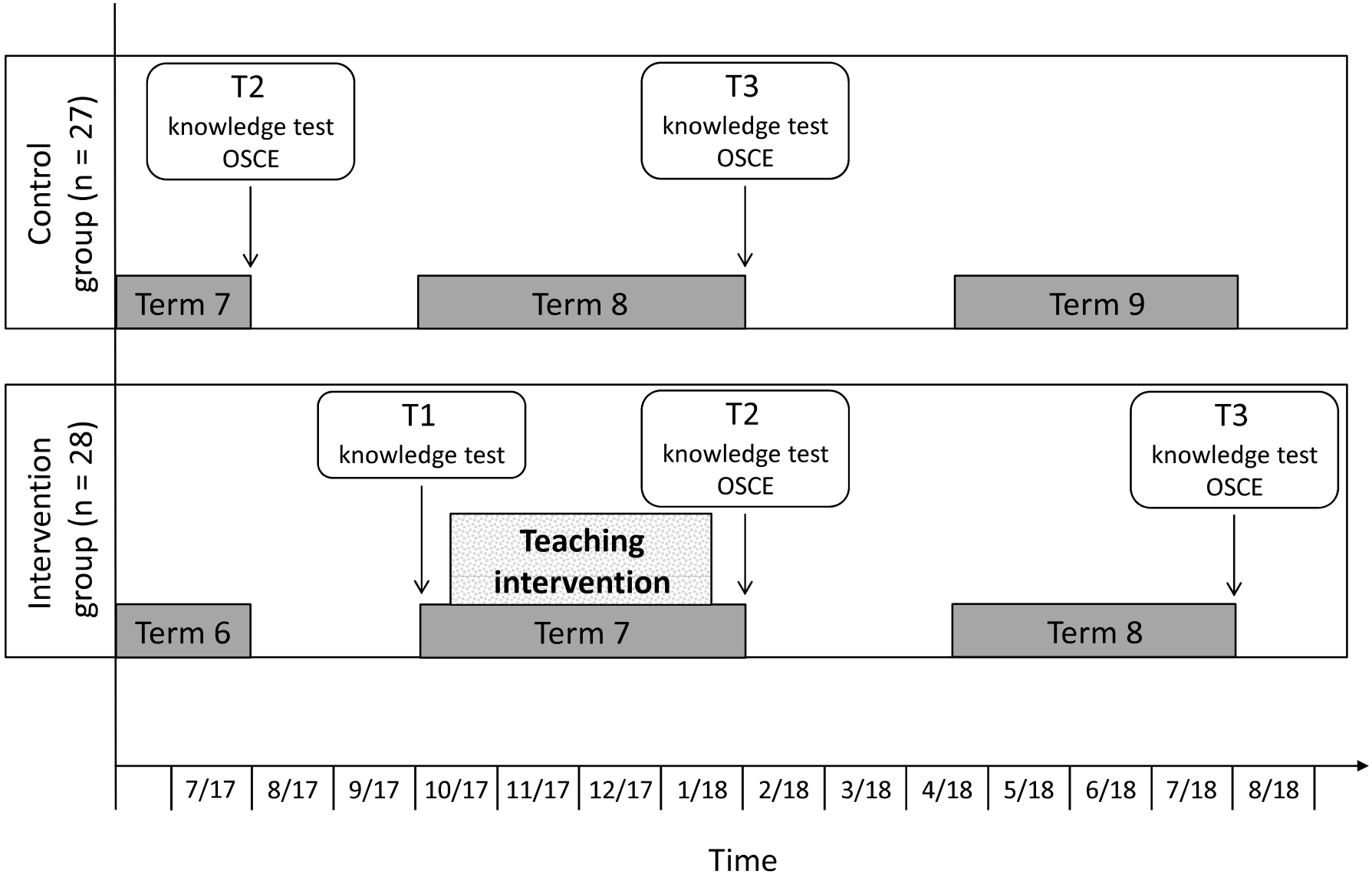
Control group (n = 27)
T2
knowledge test
OSCE
T3
knowledge test
OSCE
Term 7
Term 8
Term 9
Intervention group (n = 28)
T1
knowledge test
T2
knowledge test
OSCE
T3
knowledge test
OSCE
Teaching intervention
Term 6
Term 7
Term 8
7/17
8/17
9/17
10/17
11/17
12/17
1/18
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3/18
4/18
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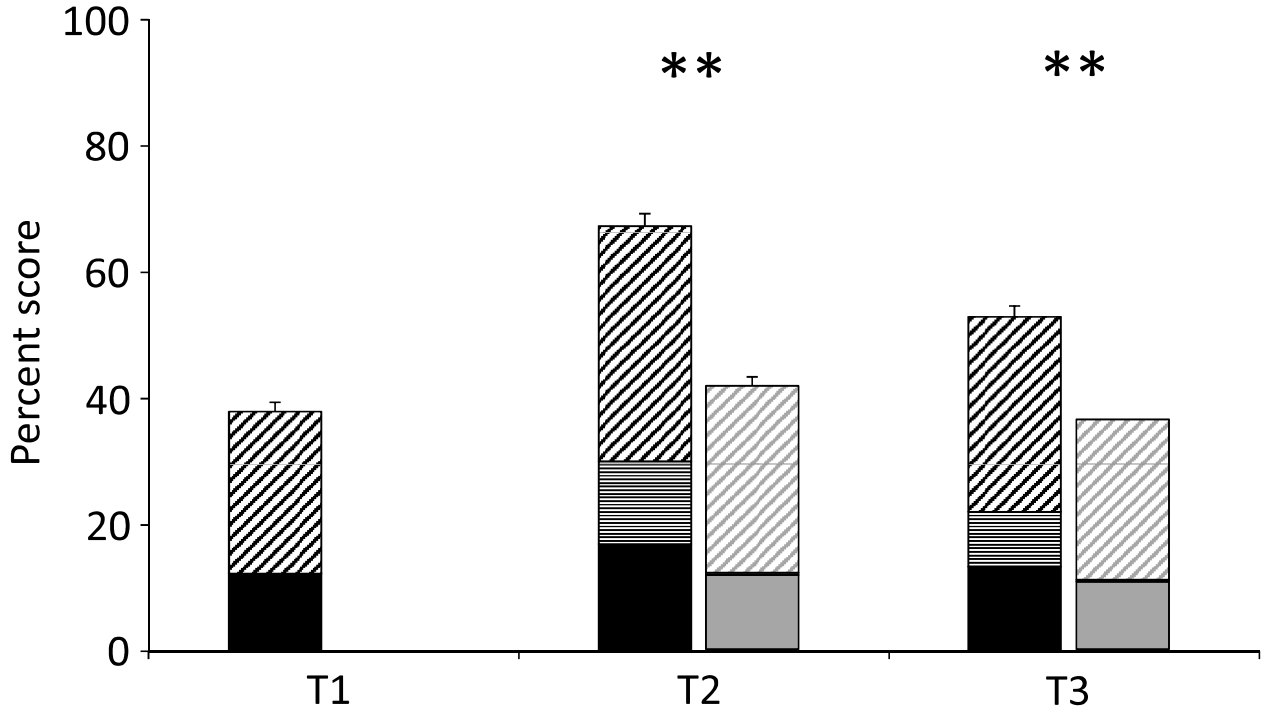
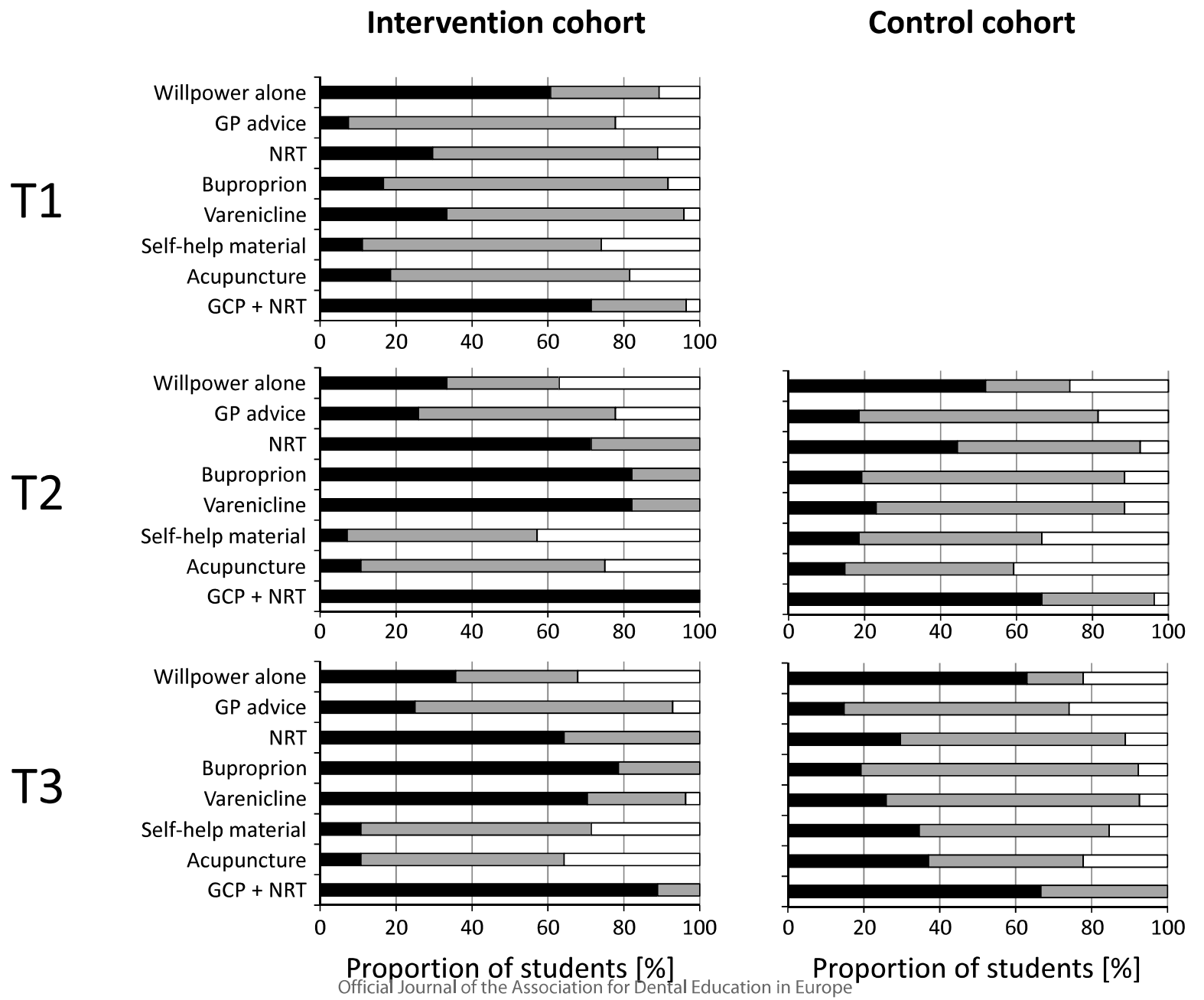
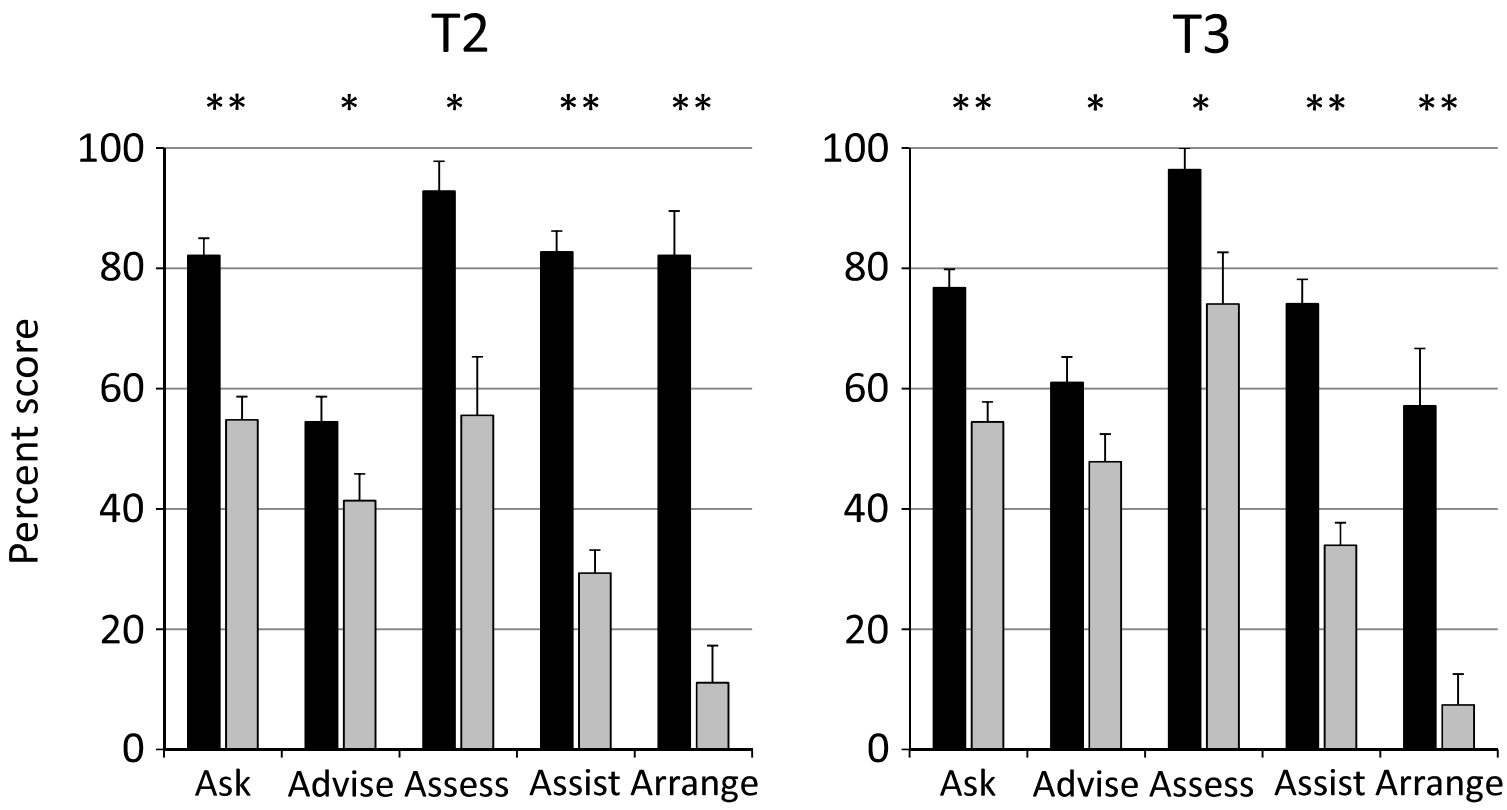
6/18
7/18
8/18
Time


100
80
60
40
20
0
Percent score
**
**
T1
T2
T3


Intervention cohort
Control cohort
T1
T2
T3
Willpower alone
GP advice
NRT
Buproprion
Varenicline
Self-help material
Acupuncture
GCP + NRT
0
20
40
60
80
100
Proportion of students [%]
Proportion of students [%]


T2
T3
** * * ** **
** * * ** **
100
80
60
40
20
0
Percent score
Ask
Advise
Assess
Assist
Arrange