The effect of clinical education on optimizing self-care by dental students in Switzerland

SUMMARY
Students, who may begin their dental education with suboptimal oral self-care practices, are taught they should motivate patients to clean interdentally and reduce/stop smoking. To better understand their internalization of these concepts, students were surveyed at two distinct time points.

Student cohorts from four Swiss universities were asked to complete an interdental cleaning and smoking habit questionnaire at the beginning of their preclinical education \((n = 110)\) and again a year later, when beginning treatment of patients \((n = 115)\). A local cohort \((n = 28)\) was observed for comparison. All subjects participated voluntarily and anonymously.

Interdental cleaning ≥ 3 times per week was performed by 48% first-year and 43% second-year students in Basel, 60% and 70% in Geneva, 41% and 49% in Zurich, respectively, and 29% in the local cohort. Logistic regression using gender, class year and school as explanatory variables showed gender \((p < 0.001)\) and school \((p = 0.018)\) influenced cleaning frequency, with the odds being 3.16 [95% CI: 1.76, 5.67] times higher for females to perform interdental cleaning ≥ 3 times per week. The number of smokers in both years was too low to analyze.

Approximately 29% of the local cohort and 52% of the first-year students displayed an interdental cleaning frequency congruent with oral health recommendations. Adequate cleaning frequency increased for second-year students to 58%, which was not significant. Further study is needed to determine why not more dental students perform interdental cleaning themselves.

KEYWORDS
Interdental plaque control
Personal oral health practices
Self-application of clinical education
Introduction
Dental students are taught to be prevention-oriented and work with patients to motivate them. To this end, the causative factors for oral disease are targeted: biofilm on tooth surfaces, smoking, dietary sugars, insufficient sleep, high stress levels (Nyvad & Takahashi 2020; Jiang et al. 2020), and behavior modification is sought to sustain patients’ home care efforts.

When patients follow medical advice from their care-giver(s), in this case the home care regimes suggested by their dentist, they are said to be compliant (Renz et al. 2007). This compliance is based on a number of internal beliefs and perceived benefits/barriers (Kuhner & Raetzke 1989; Wilson 1998). Students, just like patients, may begin their dental education with beliefs and habits that do not necessarily reflect the evidence available for attaining and maintaining optimal oral health. To better understand dental students’ starting point concerning their own health habits and evaluate their internalization of best evidence presented during their dental education, they were asked to complete a short questionnaire concerning their personal health habits of interdental cleaning and smoking. They were asked again, one year later, to complete the same questionnaire, for comparison.

Under the assumption that Swiss dental students would enter dental school with the health care habits of interdental cleaning and smoking similar to those of the local population, we hypothesized that with the internalization of the preventive health concepts taught, the frequency of their interdental cleaning would increase and the frequency of smoking would decrease after their preclinical year.

Materials and Methods

Ethical considerations
The local ethic review board reviewed the study (BASEC-Nr. Req-2017-00492) and provided a certificate of non-objection. All participants in this study were informed according to the principles of Helsinki of the purpose and scope of the study prior to expressing their willingness to take part in the survey. The participants were assured that the data collected would be anonymous. No compensation was offered for participation in this study.

The questionnaire consisted of focused questions on the frequency of interdental cleaning (main question: how often do you clean between your teeth today, yesterday, the day before you clean between your teeth; follow-up questions: did you...) and behavior modification is sought to sustain patients’ home care efforts.

Cohort groups
Students from four dental schools in Switzerland (Basel, Bern, Geneva and Zurich) participated in the survey. All dental schools follow the same curricula standards based on the 1999 Bologna Declaration (to harmonize curricula throughout Europe). The students were questioned at the beginning of their preclinical dental education (first year of dental school; Basel n = 31, Bern n = 30, Geneva n = 20 and Zurich n = 29; total n = 110) and again a year later, when beginning clinical treatment of patients, (second year of dental school; Basel n = 23, Bern n = 29, Geneva n = 20 and Zurich n = 43; total n = 115). A proxy cohort intended to represent the local population (n = 28), customers at a local Zurich hair salon, also completed the survey. All but one of the universities (BE) had smokers present in the first and/or second year but numbers were very low. The salon customers had the largest proportion of smokers. Two further participants, one student and one hair salon customer, submitted incomplete questionnaires and were excluded from the study before analysis. All subjects participated voluntarily and anonymously (Tab. I).

Class size and gender
Since participating students answered the questionnaire on a voluntary basis, the number of questionnaires completed and returned did not necessarily match the respective class sizes. A total of 110 students from all schools in Switzerland were surveyed in the preclinical year, of which 68 were female and 42 males. One year later, when treating their first patients in clinic, the number of students completing a questionnaire increased to 115, of which 73 were female and 42 males (Tab. I). The discrepancy between the number of students who participated in the first versus the second year was due to changing class sizes (students who repeated a course or transferred from/to another school) and/or students who completed a questionnaire in the second, but not the first, year.

Questionnaire
The questionnaire consisted of focused questions on the frequency of interdental cleaning (main question: how often do you clean between your teeth; follow-up questions: did you...).
The participants were also asked to disclose smoking habits, gender and age (Fig. 1).

**Interdental cleaning**

The types of interdental cleaning aids employed were solicited with an open-end question and allowed the subjects several combinations, or conversely, the possibility of not performing interdental cleaning. The frequency was calculated in monthly units, with adequate cleaning behavior considered to be ≥ 12 times per month or three or more times a week, respectively. This calculation is based on an early study showing that use of interdental cleaning aids at least every other day should take place to ensure oral health (Axelsson 1981).

### Statistical analysis

A logistical regression was used to determine whether the factors gender, class year and school had an influence on the adequate frequency of cleaning. Model assumptions were thoroughly checked by means of residual analyses and other diagnostic tools and no major violations could be detected. Pairwise comparisons between the factor levels of gender (male versus female), class year (first versus second year) and school (Basel, Bern, Geneva and Zurich against each other) were conducted using marginal means. All statistical analyses and plots were computed with the statistical software R (R Core Team 1981), including the packages ggplot 2 (Wickham 2016), emmeans (Length 2018) and DHARMa (Hartig 2019).

### Result

**Interdental cleaning frequency**

Interdental cleaning ≥ 3 times per week was performed by 48% first-year and 43% second-year students in Basel, 60% and 76% in Bern, 60% and 70% in Geneva, 41% and 49% in Zurich, respectively, and 29% in the local cohort.

The number of first-year dental students not performing any interdental cleaning ranged from 10% in both Basel and Bern to 15% in Geneva and 14% in Zurich. This, in contrast to the local group, where 29% reported not cleaning interdentally. In general, it was observed that the number of students who did not clean their teeth interdentally in the first year decreased, as more students reported using interdental aids the following year. In addition, the cleaning frequency increased in the second year in Bern (+16% points), Geneva (+10% points) and Zurich (+8% points). In Basel, the cleaning frequency decreased (–5% points) in the second year. Dental floss, interdental brushes, sticks and water jets were specified as cleaning aids of choice, with one not necessarily excluding the other. Bern and Geneva students had the best entry-level interdental cleaning habits, as well as after one year of dental school. Split by gender, males

<table>
<thead>
<tr>
<th>School and class</th>
<th>Floss</th>
<th>IdB</th>
<th>Floss +IdB</th>
<th>Water jet</th>
<th>Stick</th>
<th>Single</th>
<th>No id cleaning</th>
<th>Adequate &gt;12/month (n)</th>
<th>Adequate &gt;12/month (%)</th>
<th>Δ adequate (% points)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BS (1st year)</td>
<td>10</td>
<td>15</td>
<td>0</td>
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<td>4</td>
<td>3</td>
<td>15/31</td>
<td>48</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BS (2nd year)</td>
<td>14</td>
<td>14</td>
<td>7</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>10/23</td>
<td>43</td>
<td>-5</td>
<td></td>
</tr>
<tr>
<td>BE (1st year)</td>
<td>25</td>
<td>9</td>
<td>7</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>18/30</td>
<td>60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BE (2nd year)</td>
<td>24</td>
<td>11</td>
<td>8</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>22/29</td>
<td>76</td>
<td>+16</td>
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<tr>
<td>GE (1st year)</td>
<td>10</td>
<td>6</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>12/20</td>
<td>60</td>
<td></td>
<td></td>
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<tr>
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<td>13</td>
<td>8</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>14/20</td>
<td>70</td>
<td>+10</td>
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<tr>
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<td>3</td>
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<td>4</td>
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<td>12/29</td>
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<tr>
<td>ZH (2nd year)</td>
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<td>4</td>
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<td>3</td>
<td>3</td>
<td>21/43</td>
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<td>Local cohort (ZH)</td>
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<td>0</td>
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<td>1</td>
<td>8</td>
<td>8/28</td>
<td>29</td>
<td></td>
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</tr>
</tbody>
</table>

**Tab. II** Interdental aids used and cleaning frequency (participants may have used more than one cleaning aid)

BS (Basel), BE (Bern), GE (Geneva), ZH (Zurich)

IdB = interdental brush; stick = wood toothpick; single = single-tuft brush; no id cleaning = no interdental cleaning

Adequate cleaning frequency and changes thereof (Δ adequate), presented as percentages, have been rounded to the nearest full percentage point.

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Fig. 1 Questionnaire distributed to participants (in French or German, depending on the language region). Participants were free to self-declare if they cleaned a given number of times per day, week or month. The following three questions allowed us to analyze the accuracy/consistency of their answer. For the statistical analysis, the number provided was calculated up to a monthly amount.

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How often do you clean between your teeth? ______

Have you cleaned between your teeth today?

☐ Yes / ☐ No

Did you clean between your teeth yesterday?

☐ Yes / ☐ No

Did you clean between your teeth the day before yesterday?

☐ Yes / ☐ No

With what? ______________

☐ Smoker / ☐ Non-smoker

Number of cigarettes/day: __________________

☐ Male / ☐ Female
tended to show greater gains in interdental cleaning frequency than females by their second year of dental education in Bern, Geneva and Zurich. However, in these three universities, baseline frequency of cleaning started at a much lower level for the males than that of their female counterparts. Of the salon customers, 29% performed adequate interdental oral hygiene. While approximately 43% of the salon customers reported some interdental cleaning, it was not to a level congruent with maintaining oral health (Tab. II).

Logistic regression using gender, class year and school as explanatory variables showed gender (\(p < 0.001\)) and school (\(p = 0.018\)) influenced cleaning frequency, with the odds being 3.16 [95% CI: 1.76, 5.67] times higher for females to perform interdental cleaning ≥ 3 times per week (Fig. 2).

Smoking status
Due to the low number of students that were smoking at any/all schools, no statistical calculation was conducted.

Discussion
Motivation, whether in a dental or general context, is a highly complex subject. There does not appear to be any definitive guide to motivating people to adopt best health practices. However, success in attaining and/or maintaining oral health is dependent on meticulous oral hygiene self-care. Unfortunately, many patients are unable to translate advice from their dentist into action that will help them achieve this goal. One aspect of this equation that appears to be underinvestigated is the question of whether dentists are invested in the advice they give. Therefore, behavioral change by dental students as they progress in their studies may provide insight into this factor. It was our assumption that dental students in Switzerland start their dental careers with health and preventive behaviors no different than the general population. The data did not support this assumption. Overall, the students at all Swiss universities practiced interdental cleaning upon entry into dental school in higher numbers than the local cohort; indicating a higher level of preventive behaviors/habits by the students than displayed by the salon customers. Once the students entered their second (clinical) year, an increase in interdental cleaning, and especially adequate frequency of at least three times a week, could be observed in Bern, Geneva and Zurich. Surprisingly, in Basel interdental cleaning frequency decreased, for both male and female students. However, overall, female gender was shown to be associated with frequent interdental cleaning. The hypothesis that the students would intensify their cleaning frequency as they learned about the importance of disrupting oral biofilm appeared to be dependent upon in which school that they were studying.

The hypothesis that first-year dental students who smoked would be proportionally equal to the salon customers could not be meaningfully analyzed due to generally low numbers of...
smokers. Only a very low number of students entered dental school as smokers. However, looking at the information descriptively, it is clear that the students entered dental school with a proportionally lower number of smokers (Basel 13%, Bern 0%, Geneva 5% and Zurich 3%) than the proportion of smokers (25%) found in the local cohort.

**Oral hygiene regimes and their benefits**

Oral health, once lost, demands great motivation and effort from both the health care provider and the patient to reattain. Without a doubt, routine oral hygiene instructions and motivation are essential to reduce plaque and bleeding scores as well as arrest disease progression (Axelsson & Lindhe 1981; Galvind et al. 1983). Supportive periodontal treatment is necessary to treat the disease, after which patient compliance determines whether oral health may be maintained or not (Ramfjord et al. 1982; Chase et al. 1993; Stadler et al. 2017). The challenge in supportive periodontal therapy lies not only in maintaining a strict recall schedule, but also adhering to home care recommendations, especially interdental cleaning and thorough daily biofilm removal. Interdental cleaning methods have been shown to reduce bleeding sites by up to 67% as compared to brushing alone, which achieved a reduction of 35% (Graves et al. 1989). In particular, the type of interdental cleaning method employed, plays a role in effectively reducing periodontal inflammation. In particular, the use of interdental brushes showed superior cleaning efficacy and a resulting reduction in periodontal probing depth (PD) when compared to flossing (Jackson et al. 2006). Constant repetition of home care instructions during supportive treatment is another key element to achieving optimal results. Emler and coworkers could demonstrate a beneficial effect on school children in their oral hygiene performance through reinforcement and repetition (Emler et al. 1980).

This compliance is crucial to all dental (and medical) preventive therapies, whether it be adherence to the use of pharmaceutical agents or lifestyle changes. And herein lies the problem: while compliance may be achieved in the short term, it has been shown to deteriorate over time. This holds true for all areas of medicine. In studies measuring patient compliance with taking their medications for chronic diseases, the results show compliance rates as low as 30% for HIV (Lee et al. 2018), 39% for diabetes (Kraus et al. 2015) and 47% for hypertension (Go et al. 2014). In the dental literature, patient compliance with supportive periodontal therapy after completing active treatment (including surgery) has been found to start at approximately 67% (Mendoza et al. 1991), drop off to half or less that number after five years (Novaes et al. 1999; Checchi et al. 1994) and continue downwards to approximately 33% after 20 years (Wilson et al. 1984).

**Preventive behavior of dental students**

A number of studies have examined the self-care behavior of dental students in various parts of the world (McCarrt & Shanley 2005; Khani et al. 2007; Smith & Legatt 2007; Zadik et al. 2008; Peker et al. 2010; Neeraja et al. 2011; Rahman & Kawas 2013; Yao et al. 2019). Most investigate brushing behavior and some included interdental cleaning through the use of dental floss. Further, some studies have examined dental students’ tobacco use. To the best of our knowledge, no published study has examined whether dental students use other interdental cleaning aids in their own self-care. In fact, of the validated questionnaires used, none ask about the use of any interdental cleaning device except dental floss.

The introductory lectures for preventive and periodontal patient treatment, which also include practice sessions with various interdental cleaning devices, provide students with the rationale and mechanisms of self-care at home. The results of this study showed that a majority of the students who clean interdentally use dental floss, while a large minority preferred interdental brushes and a limited number of students used tooth-picks or a single-brush tip. It could be argued that, based on age and oral health status, the majority of students only had room to introduce dental floss into the interdental spaces. Interdental brushes require a degree of papillary recession, or conversely swelling, to find the space necessary for insertion between the teeth. In both cases, most students utilized interdental cleaning devices that they were taught could be best implemented in a given situation. However, it does not explain why some students do not use any interdental cleaning device at all, even after their didactic training.

**Study limitations**

There may also be variations between the curriculum content and teaching methodology employed at the four universities under the general curriculum guidelines, as each Canton (state) in Switzerland has a certain degree of freedom when interpreting the Swiss federal guidelines for university studies. In spite of this, it must be assumed that the curricula at all four universities present students with strategies for interdental biofilm (self) removal. While the focus of this study was to gather self-reported use of interdental cleaning devices (as a means of gauging students’ attitudes toward preventive measures, as shown by their own self-care behavior, before and after their didactic experiences as dental students), it is now clear that a more detailed examination of the four schools’ curricula and teaching methodologies should be included in future studies. By correcting this limitation of the current study, insight may be gained as to the possible reasons for the diverging results observed between schools and to determine the most useful strategies for teaching preventive behavior modification.

Another limitation of this study was that the students were not followed over the entire course of their dental education. It would be enlightening to survey their behavior at the end of their studies (third year of dental school) to ascertain if more patient contact time and in-depth treatment of their patients’ needs would lead to increased recognition of the importance of the interdental aspect of home care, as shown by their own habits and practices. In addition, because the survey was anonymous, it cannot be said with certainty which students changed their behavior either positively or negatively between the two years observed. We also do not know which students changed their smoking habits (again, either positively or negatively) over the course of the study. This also precluded any deeper statistical analyses. Future studies should address these issues for a more complete picture of student behavior and internalization of concepts taught over time.

The salon group may also represent a limitation of this study. This cohort was composed of customers in a Zurich hair salon. As the dental students in the four different cities in Switzerland varied in their initial frequency of interdental cleaning, it may be now postulated that using a general population cohort from just Zurich may, on the one hand, not have provided the most
accurate basis for comparison with incoming dental students in Basel, Bern and Geneva. Regional differences in Switzerland are known to exist and include language, customs and mentality. On the other hand, the hair salon customers were not asked whether they were native to Zurich. Future studies should, therefore, include control groups in each of the four cities where dental schools are located to determine what, if any, differences in interdental cleaning behaviors there might be between the general population in the different regions of the country.

Finally, with the insight gained through this current study, it becomes clear that future studies should also include the clinical faculty in their evaluation. As with regional factors possibly playing a role in the differing results between dental schools in Switzerland, faculty may play a significant role in “motivating” students to evaluate and internalize the concepts that they are teaching. One study performed analyzing the interdental cleaning habits of Finnish dentists found that 35% use dental floss, with 2% using it on a daily basis. Teaching prospective dental professionals oral hygiene, had no correlation with flossing frequency (Murtomaa et al. 1984). If faculty members were found to be lacking in their own interdental self-care, then they may also be a source of ambivalence that trickles down through the students to the patients. This is, of course, only conjecture, but certainly a topic for further study.

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Conflict of interest and source of funding
The authors declare that there is no conflict of interest regarding the publication of this paper.

Zusammenfassung

Einleitung
Um die Verinnerlichung der vermittelten Konzepte besser zu verstehen, wurden Zahnmedizinstudierende in der Schweiz zu zwei verschiedenen Zeitpunkten befragt.

Material und Methoden

Resultate
Eine Interdentalreinigung ≥ 3 Mal pro Woche wurde in Basel von 48% der Studierenden im ersten und 43% im zweiten Studienjahr durchgeführt, in Bern von 60% und 76%, in Genf von 60% und 70%, in Zürich von 41% und 49% und in der lokalen Kohorte von 29%. Eine logistische Regression unter Verwendung von Geschlecht, Klassenjahr und Schule als erklärende Variablen zeigte, dass Geschlecht (p < 0,001) und Schule (p = 0,018) die Putzhäufigkeit beeinflussten, wobei die Wahrscheinlichkeit 3,16-mal [95% CI: 1,76; 5,67] höher war, dass Frauen die Interdentalreinigung ≥ 3 mal pro Woche durchführten. Die Zahl der Rauchenden war in beiden Jahren zu gering, um sie zu analysieren.

Diskussion

Lediglich 29% der einheimischen Kohorte und 52% der Studierenden im ersten Studienjahr wiesen eine regelmäßige Interdentalreinigungshäufigkeit auf, die mit den Empfehlungen zur Mundgesundheit übereinstimmte. Bei den Studierenden im zweiten Studienjahr stieg die Häufigkeit der Reinigung auf 58%, was jedoch nicht signifikant war. Es bedarf weiterer Untersuchungen, um festzustellen, warum nicht mehr Zahnmedizinstudierende selbst interdental reinigen, und um Methoden zu entwickeln, damit dasjenige, was gepredigt wird, letztlich auch praktiziert wird!

Résumé
Les étudiants en médecine dentaire devraient être des modèles en matière de prévention, et motiver leurs patients à adopter une hygiène bucco-dentaire optimale. Cependant, les étudiants commencent leur formation en médecine dentaire avec des convictions et des habitudes qui, tout comme celles des patients, ne reflètent pas forcément les connaissances actuelles permettant d’atteindre et de maintenir une bonne santé bucco-dentaire.

Introduction
Afin de mieux comprendre l’interiorisation des concepts enseignés, des étudiants en médecine dentaire en Suisse ont été interrogés à deux moments différents.
Matériel et méthodes
Des étudiants des quatre facultés suisses de médecine dentaire (Bâle, Berne, Genève et Zurich) ont participé à l’enquête. Les programmes d’études proposés dans ces différents centres sont comparables. Ils sont basés sur la déclaration de Bologne de 1999, relative à l’harmonisation des programmes d’études en Europe. Les étudiants ont été interrogés au début de leur formation préclinique en première année d’études (Bâle n = 31, Berne n = 30, Genève n = 20 et Zurich n = 29 ; n = 110 au total), puis à nouveau un an plus tard, au début de la pratique clinique avec des patients (deuxième année d’études ; Bâle n = 23, Berne n = 29, Genève n = 20 et Zurich n = 43 ; n = 115 au total). Une cohorte dite « Proxy », censée représenter la population locale de profanes (n = 28), était constituée par des clients d’un salon de coiffure zürichois, qui ont également rempli le questionnaire. Le formulaire se composait de questions sur la fréquence du nettoyage interdentaire et le type des ustensiles de nettoyage interdentaire utilisés. En outre, il a été demandé aux participants d’indiquer leurs habitudes tabagiques, leur sexe et leur âge.

Résultats
Un nettoyage interdentaire ≥ 3 fois par semaine a été effectué à Bâle par 48 % des étudiants en première année et 43 % en deuxième année, à Berne par 60 % et 76 %, à Genève par 60 % et 70 %, à Zurich par 41 % et 49 %, et dans la cohorte locale, par 29 %. Une régression logistique fondée sur le sexe, l’année d’études et l’école en tant que variables explicatives a montré que le sexe (p = 0,001) et l’école (p = 0,018) influencent la fréquence de brossage, les femmes étant 3,16 [IC 95 % : 1,76 ; 5,67] fois plus susceptibles d’effectuer le nettoyage interdentaire ≥ 3 fois par semaine. Le nombre de fumeurs était trop faible pour être analysé, et ceci pour les deux années.

Discussion
La motivation est un thème complexe. Il ne semble pas y avoir de fil conducteur universel pour motiver les personnes à prendre des mesures optimales en matière de santé. Cependant, le succès dans l’obtention et/ou le maintien d’une bonne santé bucco-dentaire dépend en grande partie de soins personnels attentifs et adéquats. Malheureusement, de nombreux patients ne sont pas en mesure d’appliquer concrettement les conseils de leur dentiste de façon à atteindre cet objectif. Un aspect de cette équation qui ne semble pas avoir été suffisamment étudié est la question de savoir dans quelle mesure les médecins-dentistes suivent eux-mêmes les conseils qu’ils donnent. Les changements de comportement des étudiants en médecine dentaire au cours de leurs études pourraient donc fournir des informations relatives à ce facteur.

Ainsi, 29 % seulement des membres de la cohorte « Proxy » et 52 % des étudiants de première année ont indiqué une fréquence régulière de nettoyage interdentaire conforme aux recommandations en matière de santé bucco-dentaire. Chez les étudiants de deuxième année, la fréquence du nettoyage a passé à 58 %, mais cette augmentation n’atteint pas le seuil de significativité. Des recherches supplémentaires sont nécessaires afin de déterminer pourquoi les étudiants en médecine dentaire ne sont pas plus nombreux à effectuer eux-mêmes des nettoyages interdentaires suffisamment fréquents, et pour développer des méthodes permettant en définitive de mettre en pratique ce qui est prévu !

References


Discussion
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