**INTRODUCTION**

Sleep disorders, such as obstructive sleep apnea (OSA), have a deleterious effect on quality of life, not to mention sleep. OSA, a common sleep disorder, is characterized by the blockage of airflow during sleep and includes snoring and daytime sleepiness as its most common symptoms. Several studies indicate that lack of sleep can lead to the development of cardiovascular disease and diabetes by altering the hormonal balance, glucose regulation, and increased inflammatory markers and blood pressure. Primary care physicians are keen to screen, identify and properly refer patients with OSA. Previous studies have focused largely on the physician’s education and attitude regarding sleep disorders.

Sleep-related disorders have also been consistently associated with periodontal disease. OSA has also been linked to cardiovascular disorders such as coronary artery disease, stroke, heart attacks, congestive heart failure, atrial fibrillation, ventricular arrhythmias, impaired quality of life, and increased mortality. Additionally, there is an association between increased lack of sleep and increased incidence of motor vehicle accident.

The field of somnology/sleep medicine, however, is minimally discussed in dental schools, particularly at the predoctoral level. An editorial from 2006 titled “Sleep Disorders and Sleep Deprivation: An Unmet Public Health Problem” reported that an estimated 50 to 70 million Americans have some type of sleep disorder and that without treatment these disorders pose a significant public health threat.

Current gaps in education and research regarding disorders of sleep and wakefulness can be playing an underrecognized role in the rise of metabolic disorders, contributing to a higher economic burden for the population. In one study, the investigators concluded that strategies to increase awareness of dental sleep medicine and the importance of treating sleep-related disorders can play a significant role in advancing patient care. These strategies include incorporating interdisciplinary dental sleep programs in academic hospitals, establishing a clinical network for sleep medicine research, and starting new research training programs across the spectrum of somnology/sleep medicine.

Results from a survey show the current level of medical education as it relates to sleep and sleep disorders in New Zealand and Australian medical schools are somewhat lacking. Surveyed schools reported that an average undergraduate time of 4.5 hours was devoted to dental sleep medicine and appeared to be concentrated in the fifth
A total of 76 US and Canada dental schools were surveyed in this study. An electronic survey was utilized and sent via email. To the 16 schools known to have a dental sleep clinic, the email was sent to the director or faculty member of the dental sleep clinic. The academic dean was approached with the survey in the remaining 60 schools that did not have a dental sleep clinic. Qualtrics was used for sending the electronic survey via email. The survey had 21 multiple-choice items, and some items required an optional written response.
Descriptive statistics (counts and percentages) were calculated. SPSS version 24 was used (Armonk, NY: IBM Corp).

RESULTS

Thirty-seven percent (28/76) of dental schools surveyed in North America responded to this survey. Of the dental schools responding to the survey, 86% (24/28) were in the United States. Among the 86% of dental schools (24/28) in the United States, 4 (16.67%) were from Northeast region, 5 (20.83%) from Southeast, 4 (16.67%) from Midwest, 5 (20.83%) from Southwest, and 6 (25%) from the Western region. Seventy-five percent of respondents (21/28) were affiliated with the public university and 25% (7/28) with a private university.

Twenty-seven survey responders answered whether their institution had a dental sleep medicine clinic. Among the respondents, 45% (12/27) had a dental sleep medicine clinic at their institution whereas 55% (15/27) did not. The dental sleep medicine clinics were incorporated in the following departments: orofacial pain and temporomandibular disorder, 42% (5/12); orthodontics, 8% (1/12); and oral medicine, 8% (1/12). In addition, 42% (5/12) stated that dental sleep medicine clinics were either independent of any department or part of diagnostic services, facial pain and dental sleep clinic, advanced care center, or department of diagnostic sciences (Figure 1).

Forty-two percent of respondents (5/12) did not report any challenges with implementing the dental sleep medicine program at their institution, whereas 25% (3/12) stated not having a sufficient number of faculty members trained in dental sleep medicine. Other challenges stated by 33% (4/12) included difficulty integrating into existing programs, lack of administrative support or space for the clinic, and staffing and billing issues (Figure 2). Eighty-three percent of respondents (10/12) reported one to two board certified dental sleep medicine faculty members whereas 17% (2/12) stated the presence of no board certified dental sleep medicine faculty members at their institution (Figure 3).

Of the 12 institutions with dental sleep medicine clinic, 50% (6/12) stated that only faculty members treated patients and the other 50% (6/12) stated both faculty and residents treat patients.

Regarding the source of patient referrals to the school’s sleep clinic, 83% of respondents (10/12) stated that they get their patient referrals from sleep centers. Nearly 91% of the respondents (11/12) indicated that their referrals came from sleep physicians, 75% (9/12) from within the dental school, 41% (5/12) from dentists, and 16% (2/12) stated their patient referral source as other including area internists, or cardiologists, ear, nose, and throat specialists, etc (Figure 4).

All 12 of the respondents stated that they use a custom fabricated adjustable oral appliance, whereas 25% (3/12) reported using a prefabricated and adjustable oral appliance. In addition, 17% (2/12) and 33% (4/12) used temporary and tongue retainer devices, respectively.

Regarding the type of combination therapy offered to the patients, 75% of responders (9/12) indicated that they offer combination therapy of mandibular advancement device with either positive airway pressure (PAP) or positional therapy to their patients. Only 17% of respondents (2/12) stated that they offer a tongue-retaining device with PAP therapy to their patients.

Regarding techniques used to minimize side effects, of the 12 respondents, 92% (11/12) stated that they use

| Figure 1. Departments integrated with the sleep medicine clinic. |

| Department                          | Percentage |
|-------------------------------------|------------|
| Orofacial pain and Temporomandibular Disorder | 42%        |
| Oral Medicine                       | 8%         |
| Orthodontics                        | 8%         |
| Other*                              | 42%        |

*Other: Diagnostic Services, Facial pain & sleep clinic, Advanced Care Center, Independent of any department and Department of Diagnostic Sciences
Figure 2. Challenges in implementing a dental sleep medicine clinic.

- No challenges (5)
- Understaffed (3)
- Administrative, no space, funds (4)

Figure 3. The presence of board certified trained dental sleep medicine faculty members.

- Do not have board certified trained dental sleep medicine faculty (2)
- 1-2 board certified trained dental sleep medicine faculty (10)

Figure 4. Patient referral sources.

Other*: Area internists, cardiologists, ENTs, self-referred etc.
techniques to minimize bite side effects whereas 8% (1/12) did not. In addition, 75% (9/12) stated that they provided the technique to minimize bite side effects at the time of sleep oral appliance delivery whereas 25% (3/12) provided the technique as needed if bite side effects developed.

Regarding their protocol schedule for short-term follow-up visits, of the 11 respondents, 36% (4/11) stated follow-up visits every 2 weeks and 36% (4/11) stated every 4 weeks. In addition, 27% of respondents (3/11) stated other follow-up schedules including initial follow-up at 2 weeks after delivery of the device followed by every 4 weeks for the first 3 months or initial follow-up at 2 weeks after delivery of the device followed by a visit at 2 to 3 months until resolution of subjective symptoms.

Regarding the schedule for long-term follow-up visits, of the 11 respondents, 64% (7/11) stated follow-up visit at 6 months and 1 year after completion of therapy, 9% (1/11) stated follow-up visits as needed, and 27% (3/11) stated other schedules such as every year.

Among the 11 respondents indicating how many patients are scheduled monthly, 91% (10/11) scheduled 5 to 15 new patients monthly whereas 9% (1/11) scheduled 1 to 5 new patients monthly. Of the 11 responders to question 20, 45% (5/11) stated that fewer than 10% of patients were lost to follow-up, 18% (2/11) stated lost to follow-up of 10% to 20% of patients, and 36% (4/11) stated lost to follow-up of > 20% patients.

Sixty-three percent of the respondents (7/11) stated that they used polysomnography to confirm treatment efficacy, 26% (5/11) used home sleep apnea testing, 10.5% (2/11) assessed treatment efficacy based on patient’s feedback, and 26% (5/11) used other techniques such as cardiopulmonary coupling or referral back to the sleep physician for evaluation and possible home sleep apnea testing or polysomnography per their recommendation.

Ninety-one percent of respondents (10/11) to the question about having a continuing education (CE) program had CE programs in dental sleep medicine at their institution whereas only 9% (1/11) did not have continuing education programs in dental sleep medicine (Figure 5). Of the 10 respondents, on the frequency of dental sleep CE courses, 60% (6/10) stated that courses were offered every 10 to 12 months, 20% (2/10) stated every 4 to 6 months, and 10% (1/10) each stated every 1 to 3 months or every 7 to 9 months (Figure 6).

Regarding whether the dental sleep CE course offered at their institution was a minimum of 25 hours. 60% of respondents (6/10) thought that the CE course was not a minimum of 25 hours whereas 40% (4/10) thought that it was a minimum of 25 hours.

**DISCUSSION**

Several studies have indicated that there is no systematic method to improve clinician practices and/or patient outcomes in dental sleep medicine.\(^{35,36}\) In the current study, only 37% of dental schools (28/76) responded to the survey and most them were located in the United States. According to the data obtained from this survey, only 45% of dental schools responding (12/28) had dental sleep medicine clinic at their institution. This finding highlights the lack of widespread dental sleep medicine practice at academic institutions.

Consistent with the findings of dental Sleep Research Society surveys of 2009 and 2012 indicating a paucity of independent structures in administrative departments of academic institutions for the practice of dental sleep medicine, the dental sleep medicine clinics were in various departments including orofacial pain and temporomandibular disorder, and orthodontics.\(^2\) Because of the absence of a defined organizational structure for dental sleep medicine clinics, respondents stated other challenges such as integrating into existing programs, administrative and billing issues etc. Similarly, a questionnaire-based study by Al-mohaya et al.\(^{37}\) identified two difficulties to increase the time for sleep medicine education: 53% stated that the topic did not have high priority, whereas 47% indicated that there is insufficient time to teach the topic. In a study by Mindell et al.,\(^{38}\) 12 countries were surveyed and these difficulties were recorded: insufficient time, a lack of trained staff and resources, low priority, and irrelevance. It is alarming to note that sleep medicine did not get priority like other topics, and therefore, was understaffed with insufficient funding.

Interestingly, most respondents stated the presence of one to two board certified dental sleep medicine faculty members at their institution. This indicates a trend toward growing importance and presence of dental sleep medicine departments at academic institutions. Strategies such as increased collaboration among faculty members, and interdisciplinary approach between departments in the dental clinic may further aid in the development of a strong dental sleep medicine program.

Also, most respondents reported the presence of CE programs at their institution with courses being offered at least once a year, and show growing levels of involvement in dental sleep medicine practice and education at academic institutions. However, 60% of respondents (6/10) thought that the courses offered were fewer than 25 hours. Hence, increasing the frequency and duration of CE courses on dental sleep medicine could further improve the dental sleep medicine practice. This study suggests that the emergence of mandibular advancement devices have contributed to the rise of dental sleep medicine practice. In line with those findings, many respondents stated that they offer a combination therapy of mandibular advancement device with either PAP or positional therapy to their patients.

The limitations of this study include being limited to the United States and Canada; with the electronic questionnaire other dental schools in Australia and Europe could...
have been included. Another limitation was not supplementing the electronic questioned with a paper one, and that might have affected the response rate.

At this date this paper was written, the American Dental Education Association and the Council on Dental Accreditation had not created or implemented foundational educational protocols for Dental Sleep Medicine in the United States. Furthermore, incorporating more dental sleep medicine in the curriculum depends on the dean and faculty.

The results suggest that academic institutions consider dental sleep medicine an important topic to be included in their curriculums. In addition, respondents stated the presence of board certified dental sleep medicine faculty had a positive effect on their program. The study suggests that strategies such as increased collaboration among faculty members, and an interdisciplinary approach between departments in the dental clinic may further aid in the development of a strong dental sleep medicine program. As a result, the use of dental sleep medicine as a standard of care in dentistry should increase.

We speculate that with the recent development of dental sleep medicine standards of practice by the American Academy of Dental Sleep Medicine and the collaboration between academic institutions and professional associations, the practice and teaching of dental sleep medicine in academia will continue to grow globally.

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DISCLOSURE STATEMENT

The authors have no conflicts of interest to disclose.
ABBREVIATIONS

**PAP**: positive airway pressure

**OSA**: obstructive sleep apnea

**SRBDs**: sleep-related breathing disorders

**CE**: continuing education
APPENDIX

Survey

The Current State of Dental Sleep Medicine Practice in Academic Institution: A Questionnaire-Based Study

Questions:

1. What country is your school in?
   a. Canada
   b. United States

2. What geographic region is your school in?
   a. Northeast
   b. Southeast
   c. Midwest
   d. Southwest
   e. West

3. Is your university private or public?
   a. Private
   b. Public
   c. Other (please specify)

4. Do you have a Dental Sleep Medicine Clinic at your institution?
   a. Yes
   b. No

5. Provide the name of the department where the clinic is incorporated
   a. Orofacial pain and Temporomandibular Disorder
   b. Endodontics
   c. Orthodontics
   d. Prosthodontics/ Preventive and Restorative Science
   e. Pediatric Dentistry
   f. Oral Surgery
   g. Oral Medicine
   h. Periodontics
   i. Other (please specify)
6. What challenges did you have implementing a dental sleep medicine clinic at your institution?
   a. Administrative approval/support
   b. Space for the clinic
   c. Not a sufficient number of faculty members trained in dental sleep medicine
   d. No challenges
   e. Other (please specify)

7. How many board certified trained dental sleep medicine faculty members are at your institution?
   a. 1 to 2
   b. 3 to 5
   c. More than 5

8. Who treats patients at the dental sleep medicine clinic in your institution?
   a. Faculty only
   b. Faculty and residents
   c. Faculty, residents, and dental students

9. Where do you get your patient referral source? (select all that apply)
   a. Sleep centers
   b. Sleep physicians
   c. Within the dental school (referral from other clinics)
   d. Dentists
   e. Other (please specify)

10. What type of oral appliance design do you use? (select all that apply)
    a. Custom fabricated and adjustable
    b. Prefabricated and adjustable
    c. Temporary devices
    d. Tongue retainer devices
11. What type of combination therapy is offered to your patients? (select all that apply)
   a. Mandibular advancement device and positive airway pressure (PAP) therapy
   b. Tongue retaining device and PAP therapy
   c. Mandibular advancement device and positional therapy
   d. None

12. What type of technique do you use to minimize bite side effects? (select all that apply)
   a. Morning (AM) aligner
   b. Jaw exercises
   c. Muscle stretching exercises
   d. Morning repositioning device

13. When do you provide the technique from the previous question?
   a. Provided at the time of sleep oral appliance delivery
   b. As needed if patient develop side effects
   c. Other (please specify)

14. What is your protocol schedule for follow-up visits?
   a. Every 2 weeks
   b. Every 4 weeks
   c. Every 6 weeks
   d. Other (please specify)

15. What is your schedule for long term follow ups?
   a. 6 months and yearly after completion of therapy
   b. As needed
   c. Other (please specify)

16. How many patients are scheduled monthly?
   a. 1 to 5
   b. 5 to 15
   c. 15 to 30
   d. more than 30
17. What percentage of patients are lost to follow up in your patient population?
   a. Fewer than 10%
   b. 10% to 20%
   c. More than 20%

18. What follow up method do you use to confirm treatment efficacy?
   a. Polysomnography
   b. Home Sleep Apnea Testing
   c. Patient’s feedback
   d. Other (please specify)

19. Does your institution have continuing education programs in dental sleep medicine?
   a) Yes
   b) No

20. How often are sleep continuing education courses are offered?
   a. Every 1 to 3 months
   b. Every 4 to 6 months
   c. Every 7 to 9 months
   d. Every 10 to 12 months

21. Is your dental sleep continuing education course(s) program a minimum of 25 hours?
   a. Yes
   b. No