

Dental Hygienists' Evaluation of Local Anesthesia Education and Administration in the United States

Sean G. Boynes, DMD; Jayme Zovko, RDH, BS; Meghan R. Bastin; Michele A. Grillo; Brianna D. Shingledecker

Introduction

Previous studies have examined various aspects of local anesthesia administration by dental hygienists, and provide support for the administration of this pain control modality by these providers.¹ Reporting on such issues as overall frequency of use, delegation, implementation, rates of successful administration, incidence of complications and dental practice impact, these evaluations suggest that employers are allocating local anesthesia administration and dental hygienists are providing effectual injections that have presented positive practice outcomes.¹⁻⁵

Although several studies have been conducted, there has been minimal information reported on perceptions of educational preparedness, the use of specific administration techniques and acuity of need. Since a majority of the U.S. dental boards currently have regulations delegating local anesthesia administration by dental hygienists, the intent of this study was to investigate practice characteristics and educational experiences of dental hygiene providers in the U.S.⁶⁻⁷

Review of the Literature

Administration of local anesthesia by dental hygienists has been studied and reported in the literature for approximately 30 years.¹⁻⁵ These studies have examined the characteristics associated with the utilization of local anesthesia by dental hygienists in various practice settings. They reveal that local anesthetic administration is being delegated to dental hygien-

Abstract

Purpose: The goal of this project was to investigate the educational experiences and the use of local anesthesia by dental hygiene providers in the U.S.

Methods: Approved by the Institutional Review Board at the University of Pittsburgh and undertaken from February to May 2009, this study was designed using a questionnaire-based survey. Using a randomized list obtained via the American Dental Hygienists' Association (ADHA), the survey questionnaires were sent via mail to 1,200 dental hygienists in the U.S. Quantitative evaluations were confined to descriptive statistics including standard summation, an estimation of means and a valid percent for identified variables.

Results: A total of 432 (n=432) of the 1,200 survey questionnaires were returned, which represents a 36% response rate. The respondents represented a total of 296 dental hygiene educational programs, and included practice sites that span all 50 states. Findings indicate that the majority of responding dental hygienists perceive a need for the use of this pain control modality in their practice and administer local anesthetic injections. Additionally, the majority of respondents that administer local anesthetic injections reported that they perform local anesthetic administration for cases in which the dentist provides total care. Furthermore, the results revealed that the hygienists that received training in the administration of local anesthesia injections reported a higher rate of educational preparedness in 6 of the 7 educational topics listed in this survey: local anesthesia related topics (local anesthesia administration, local anesthetic pharmacology and local anesthetic complications), basic pharmacology, medical emergency management and special needs care.

Conclusion: This examination parallels the results presented in previous studies, while offering new data relating to local anesthesia administration by dental hygienists. With the majority of dental hygienists reporting a perceived need and the use of this method of pain control, this practice appears to be a significant addition to overall dental care and dental hygiene education.

Keywords: anesthesia, education, preparedness, local anesthetic, pain management

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ists by their employers and that dental hygienists are administering successful injections, which have resulted in positive practice outcomes.

The delegation of local anesthesia administration by dental hygiene employers has been frequently reported using survey model research within individual states. In 1980, based on their survey of dental hygiene graduates from California, Rich and Smorang reported that 100% of periodontists and 86% of general dentists delegated the administration of local anesthesia to dental hygienists.³ In a survey of dentists and dental hygienists in Arkansas, DeAngelis and Goral found that 94% of dentists delegated this responsibility to their dental hygienists.⁴ Additionally, Anderson reported that 95% of dental hygienists who completed a Minnesota continuing education course reported their employer delegated responsibility for administering local anesthesia.¹

Previous studies have also demonstrated that utilization of local anesthesia administration by dental hygienists varies by practice type, with the highest frequency of usage occurring in periodontal practices. In a survey of Minnesota dental hygienists, Anderson found that 47.6% of dental hygienists working in periodontal offices reported administering local anesthesia for 3 to 6 patients each week, while 63% of hygienists working in general practice administered local anesthesia for 1 or 2 patients each week. In the same report, Anderson also revealed that, overall, 92% of hygienists were frequently using local anesthesia for periodontal root planing and debridement.¹

The impact on dental practices following the integration of local anesthesia administration by dental hygienists has been examined by Anderson,¹ Cross-Poline et al² and DeAngelis and Goral.⁴ Anderson reported that 58% of respondents revealed that their ability to administer local anesthesia was very valuable to their practice, while 64.4% reported that their practice ran more smoothly.¹ Following their 1992 survey of dentists and dental hygienists from Colorado, Cross-Poline et al reported that a majority of dentists identified benefits to both their practices and their patients as a result of the administration of local anesthesia by their dental hygienist.² In addition, DeAngelis and Goral reported their findings from a survey of all Arkansas dental hygienists certified in the administration of local anesthesia, as well as dentist employers.⁴ Their results indicate that the survey respondents perceived local anesthesia as beneficial for both dental hygiene patients and clinicians. Arkansas dental hygienists and dentists reported that this function has a positive impact on scheduling, production, patient satisfaction and comfort and quality of care.

Methods and Materials

Approved by the Institutional Review Board at the University of Pittsburgh and undertaken from February to May 2009, this study was designed using a questionnaire-based survey to investigate the educational experiences and the use of local anesthesia by dental hygiene providers in the U.S. Questions were formulated to determine common practice characteristics, utilization of various local anesthesia techniques, local anesthesia education satisfaction and preparedness and the perception of need for the provision of local anesthesia by dental hygienists.

The survey questionnaire was pilot tested with 12 dental hygienists, revised and sent via mail to 1,200 dental hygienists in the U.S. using a randomized list obtained via the American Dental Hygienists' Association (ADHA). All prospective respondents possessed a current dental hygiene license in the U.S., and respondents currently in dental hygiene training programs were not included. Completed questionnaires were returned to a central site at the University of Pittsburgh School of Dental Medicine for processing and data entry. All survey-participation requests were accompanied by a letter containing the following: a description of the purpose of the study, an explanation on how to complete and return the questionnaire and directions on how to ensure anonymity. A total of 432 (n=432) survey questionnaires were returned, which represents a 36% response rate. In statistical terms, a population of 200,000 is considered to be infinite and a randomized sample of 386 people is required to achieve a representative sample of the population using the method of this study.⁸⁻¹⁰

Data from the returned questionnaires was entered into an Excel spreadsheet and imported into a JMP Statistical Discovery Software™ program for analysis. Quantitative evaluations were confined to descriptive statistics including standard summation, an estimation of means and a valid percent for identified variables.

Results

Demographics

Evaluation of the survey's demographic data explored the respondents training, current practice setting and employment background. The respondents represented a total of 296 dental hygiene training programs and included practice sites that span all 50 states. Prior to data analysis, each returned questionnaire was also categorized according to a respondent's region of practice using 5 geographic

regions that demonstrate similar population aspects via the United States Census Bureau's 9 U.S. regional divisions (Figure 1). The evaluation of each region's representation demonstrated a similar pattern of distribution throughout the U.S. as follows: Region 1 – 17.8%, Region 2 – 16.2%, Region 3 – 25.2%, Region 4 – 14.8% and Region 5 – 26.0%. In addition, the respondents' year of dental hygiene program completion was reported by each respondent with a mean year of 1990 (range of training completion – 1961 to 2008).

Evaluation of the survey's demographic data also explored the respondents main practice type. Data analysis of this set revealed that the majority of respondents (76.1%) considered general dentistry as their primary practice identification, with academics/university setting (8.4%), periodontology (7.8%), public health (5.2%), pediatric dentistry (2.2%) and prosthodontics (0.3%) reported with lesser frequency. It should be noted that 38 respondents reported working in multiple practice settings, with general dentistry and academics (50.0%) being the most common combination, followed by general dentistry and periodontology (28.9%), general dentistry and public health (15.8%), public health and periodontology (4.9%) and pediatric dentistry and periodontology (0.4%).

The study investigators also included questions to determine the total number of hours worked per week, as well as the total number of offices in which the respondents were employed. The work-hour evaluation revealed a range of 5 to 41 hours per week and a mean of 28.9 hours per week. Further analysis of the total number of offices in which the respondents were currently employed demonstrated that the majority worked in 1 office (76.1%). The remaining distribution of office employment was determined as follows: 2 offices (18.9%), 3 offices (2.6%), 4 offices (0.7%) and 5 or more (1.7%).

Administration of Local Anesthesia

Several survey questions were devised to evaluate the hygiene provider's practice of local anesthesia administration. The intent of these questions was to ascertain the frequency with which hygienists are performing injections, to identify the types of organizations that provided local anesthesia training and to determine customary practices.

The study found that 257 respondents (59.5%) currently administer local anesthesia in their hygiene practice, while 175 (40.5%) do not. As shown in Figure 1, regional differences were observed in all geographic sections. Dental hygienists located in Region 5 reported the most frequent use of lo-

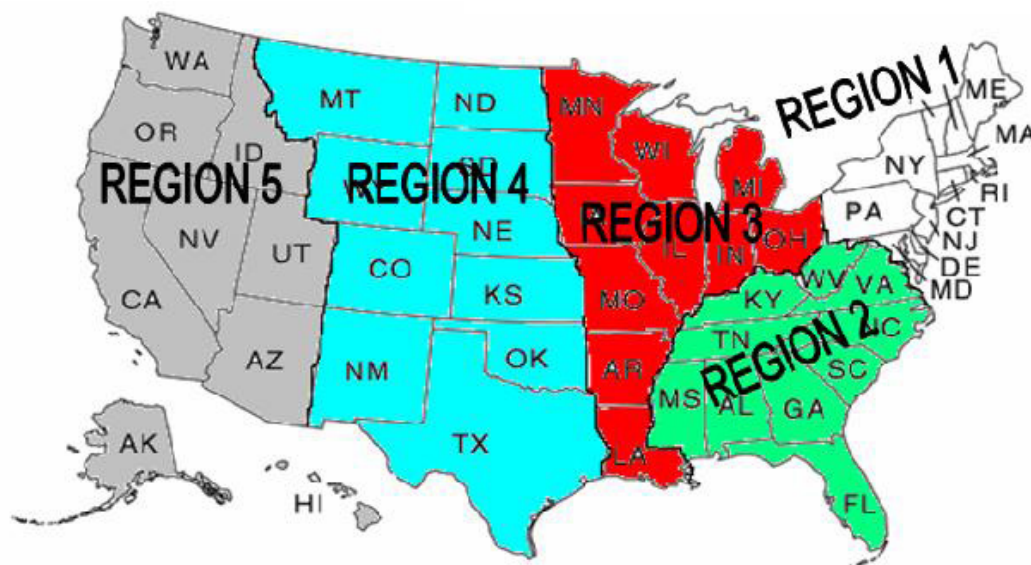
cal anesthesia administration (93.8%), followed by Region 4 (78.1%), Region 3 (55.0%) and Region 1 (31.2%). Region 2 (25.7%) demonstrated the lowest response for hygienists that administer local anesthesia injections. This is most likely the result of a significant portion of state dental boards located in Region 2 (5 states out of 10) not currently endorsing legislation permitting the use of local anesthesia by dental hygienists.^{6,7}

Additional analysis was also completed to compare the mean-year difference between hygienists administering local anesthesia against those who do not. The evaluation revealed a difference between the dental hygiene program/training completion mean-year of the 2 groups – those administering local anesthesia (mean year – 1995) and those not currently administering local anesthesia (mean year – 1986).

Evaluation of how the group administering local anesthesia was trained revealed that the majority of hygienists (67.3%) were educated while students at dental hygiene schools. The remaining responses were as follows: a dental hygiene school administered continuing education course (21.0%), a dental or dental hygiene organization administered continuing education course (7.8%), a dental school administered continuing education course (3.5%) and a post graduate training program (0.4%).

As demonstrated in Table I, analysis was also completed to determine the type of local anesthetic injections used by the respondents administering local anesthesia. The questions were grouped into 4 categories: infiltration/supraperiosteal injections (the injection of local anesthetic to affect the terminal nerve endings), nerve block injections (the injection of local anesthetic at or near the nerve trunk), field block injections (the injection of local anesthetic in the area of the direct branches of a specific nerve, such as the anterior superior alveolar nerve injection) and topical anesthetic application without injection (surface application of local anesthetic to block the free nerve endings of the oral mucosa). The respondent was asked to select a single numeric answer for the frequency of administration of each local anesthesia modality performed each week from the following choices: 0=never, 1=rarely (1 to 2 times per week), 2=occasionally (2 to 3 times per week), 3=often (4 to 5 times per week) and 4=most often (more than 5 times per week). Analysis was performed on each category of local anesthesia injection type response to provide a mean number depicting the quantity of use. The results demonstrated that nerve block injections (mean=-2.12, 2 to 3 times per week) and infiltration/supraperiosteal injections (mean=-2.02,

Figure 1: Regional Distribution of Dental Hygienist Respondents



Region	Total Response (n=432)	Hygienists Administering Local Anesthesia	Hygienists That Do Not Administer Local Anesthesia
1 (n=77)	17.8%	32.1%	68.8%
2 (n=70)	16.2%	25.7%	74.3%
3 (n=109)	25.2%	55.0%	45.0%
4 (n=64)	14.8%	78.1%	21.9%
5 (n=112)	26.0%	93.8%	6.2%

2 to 3 times per week) were the most commonly administered injection techniques, while field block injections (mean – 1.52, 1 to 2 times per week) were administered by the respondents with lesser frequency.

It should be noted that topical anesthetic application without injection was the most common response (mean=2.38, 2 to 3 times per week) among dental hygienists administering local anesthesia injections. When compared to dental hygienists that do not administer local anesthesia injections, the data demonstrates that the group administering injections uses topical anesthetic application at a higher rate – a mean of 2.38 compared to a mean of 1.64 for the group not administering local anesthesia injections.

In addition, an analysis was completed to compare a respondent's main practice setting to the mean quantity of each local anesthetic injection used. This evaluation revealed that hygienists identifying periodontology as their main practice setting administered a greater mean number of infiltration (x=2.87) and nerve block injections (x=2.38), as well as a higher use of topical anesthesia without in-

jection (x=2.65). Conversely, respondents classifying an academic/university practice setting administer the greatest amount of field block injections (x=2.25). Table I displays the complete distribution of injection techniques and practice settings.

Respondents that reported administering local anesthetic injections were also asked if they administered local anesthesia for the procedures in which the dentist was to perform total care. The majority of these hygienists responded yes (58.4%, n=150). Additional regional analysis demonstrated that it was more common for dental hygienists in the western-half of the country to administer injections in this manner. The regional distribution analysis was reported according to the percentage that administers local anesthesia for the dentist. The percentages are as follows: Region 1 – 30.4%, Region 2 – 50%, Region 3 – 53.3%, Region 4 – 72% and Region 5: 61%.

Educational Preparedness

As part of this survey, respondents were asked to evaluate their educational preparedness in topics relating to local anesthesia administration and educa-

Table I: Mean distribution of local anesthetic injection type used according to the dental hygiene respondents' main practice activity.

Local Anesthesia Modality	Total Response (n=257)	General Dentistry Setting	Periodontal Setting	Pediatric Setting	Academic/ University Setting	Public Health Setting
Infiltration Injection	2.02	1.64	2.87	0.75	1.62	2.33
Nerve Block Injection	2.12	1.72	2.38	0.67	2.25	1.64
Field Block Injection	1.52	1.15	2.06	0.67	2.25	1.64
Topical Anesthesia without Injection	2.38	2.09	2.65	1.75	2.62	2.17

Table II: Mean distribution of the respondents' evaluation of their dental hygiene training

Educational Topic	Those Administering Local Anesthesia Injections (n=257)	Those Not Administering Local Anesthesia Injections (n=175)
Local Anesthesia Administration	4.37	2.06
Local Anesthesia Pharmacology	4.16	2.89
Local Anesthesia Complications	4.20	2.78
Basic Pharmacology	4.15	3.03
Medical Emergency Management	4.29	3.04
Special Needs Care	3.86	2.65
Basic Life Support Training (CPR/BLS)	4.28	4.33

tion. The questionnaire provided a numerical value to their self-reported rating of education: 1=Very Poorly Prepared, 2=Poorly Prepared, 3=Prepared, 4=Well Prepared and 5=Very Well Prepared. A total of 7 topics were listed and 2 categories of comparison were created: hygienists administering local anesthesia injections and hygienists not administering local anesthesia injections.

As demonstrated in Table II, analysis revealed that the dental hygienists administering local anesthesia injections reported a higher rate of educational preparedness in 6 of the 7 educational topics listed in this survey. This group demonstrated a higher mean score for educational preparedness in all 3 directly-related local anesthesia topics (local anesthesia administration, local anesthetic pharmacology and local anesthetic complications), as well as basic pharmacology, medical emergency management and special needs care. The mean distribution of preparedness scores for basic life support training proved evenly reported, with a mean score of 4.33 for dental hygienists not administering local anesthesia injections and 4.28 for dental hygienists

that do administer local anesthesia injections.

In addition to the evaluation of educational preparedness, the investigators also included a question relating to a dental hygienist's desired training. Each survey participant was asked, "Would you support an increase in tuition and/or fees, or would have attended a more expensive dental hygiene program if the institution were to offer more efficient local anesthesia training or the ability to attain a local anesthesia permit?" A high percentage (68.9%, n=426) of respondents indicated that they would have paid higher tuition and/or fees for more efficient local anesthesia instruction.

Perceived Need for Services

As a means to determine the participating dental hygienists' perception of the overall need, questions were included within the survey that addressed local anesthesia injection services. Calculation of the response demonstrated that the majority of respondents perceive a need for dental hygienists to administer local anesthesia injections in the office(s)

they were employed (86.4%, n=431). Additionally, 96.7% (n=432) expressed the belief that dental hygienists should be able to provide local anesthesia injections in their current practice setting.

Discussion

Local anesthesia administration by dental hygienists is validated by the literature. Previous studies suggest that employers are allocating this pain control modality to dental hygienists and these providers are administering effectual injections that have presented positive practice outcomes.^{1-5,11} Given that the overall distribution of this study's demographics presented an even distribution across all regions within the U.S., the results of this current assessment offer new data while paralleling the findings of previous studies relating to this topic.

Regional differences in the number of dental hygienists providing local anesthesia care across the U.S. was noted. This difference seems to coincide with the legality in the use of local anesthesia administration, as well as the date of implementation of hygiene related local anesthesia regulations. It was revealed that an earlier mean year of implementation resulted in a greater number of hygienists providing local anesthesia administration. Additionally, this regional pattern was demonstrated in the number of dental hygienists who provide local anesthesia for the dentists' patients. Dental hygienists in the western-half of the country reported administering injections for the dentist's patients more frequently than those in the eastern regions, with 61 and 72% of dental hygienists in Regions 4 and 5, respectively, answering in the affirmative, and 50 to 69.6% of dental hygienists in Regions 1 and 2 answering in the negative. This could be attributed to the fact that the western part of the country, in general, adopted the administration of local anesthesia by dental hygienists much earlier than their counterparts in the east.⁶ Given that dental practices in the western U.S. have implemented this practice modality for a longer period of time, dentists in these regions may have developed greater confidence in their hygienists' ability to safely administer effective local anesthetic injections.

Earlier studies have examined the utilization of local anesthesia by dental hygienists in various practice settings.^{1,3,11} The authors' data analysis revealed that dental hygienists who classified a periodontal office as their primary practice identification reported administering local anesthesia more frequently compared to those working in other practice settings. This result was not unexpected, as this has been reported in previous studies.^{1,3-5} The types of

procedures performed, along with the severity of periodontal disease encountered in a periodontal office, would be expected to require more frequent pain control techniques for comfortable treatment. Of interest was the finding that dental hygienists who identified an academic venue for their practice activity reported using a field block technique much more frequently than dental hygienists practicing in other settings. This may be attributable to the nature of the academic environment, where education is of prime importance and field blocks may be used more frequently in order to provide exposure to the broad range of available techniques. However, since it may be rarely used in other practice settings, it may be advisable for educators to reevaluate the usefulness of employing and teaching this technique to dental hygienists.

The study also determined that topical anesthetic application without injection was the most common form of local anesthesia to be employed. Higher frequency of employment of this modality is expected, as it is likely to be considered the easiest to use and is likely to provide adequate anesthesia for the types of procedures dental hygienists perform, which may only require soft tissue anesthesia for patient comfort. Another consideration for this observed frequency would be patient preference. Studies have shown that patients rank needles as one of the most fear producing elements of their dental care.¹² Additional studies may be warranted to explore patient satisfaction rates between these 2 modalities and their integrated use.

Few areas of dental patient care require a more inclusive understanding of medicine and patient management than the safe and efficient administration of local anesthesia. As has been recognized previously, teaching the principles of dental anesthesia provides an excellent opportunity to integrate the clinical and basic science curriculum.^{13,14} The results of this study reveal a higher rate of educational preparedness in 6 of the 7 educational topics listed in this survey by hygienists administering injections and have received local anesthesia training. The participants in the current study reported a higher mean score for educational preparedness in all 3 directly-related local anesthesia topics (local anesthesia administration, local anesthetic pharmacology and local anesthetic complications), as well as basic pharmacology, medical emergency management and special needs care. It was not surprising that dental hygienists who do not administer local anesthesia injections reported lower scores of educational preparedness in the 3 directly-related anesthesia topics, as they likely only received minimal or no training in these areas. Of interest is the possibility that education and experience in the admin-

istration of local anesthesia contributed to better preparedness of dental hygienists in basic pharmacology, medical emergency management and special needs care. These positive outcomes can enable educators to meet some of the Dental Hygiene Program accreditation standards as set forth by the Commission on Dental Accreditation, which requires that graduates be competent in the following: providing appropriate life support measures for medical emergencies that may be encountered in dental hygiene practice, having knowledge in pain management procedures and assessing the treatment needs of patients with special health care needs.¹⁵

Another surprising finding was that respondents reported they would support an increase in tuition and/or fees, or would have attended a more expensive dental hygiene school, if the institution were to offer more efficient local anesthesia training or the ability to attain a local anesthesia permit. This may reflect the importance that hygienists place on their ability to provide effective pain control through the administration of local anesthesia. The value this pain control modality brings to dental practices can enable dental care providers to consistently provide high quality care as well as lend to higher patient satisfaction.

Conclusion

This study parallels the results presented in previous studies, as well as provides additional data that demonstrates a true value for local anesthesia administration by dental hygienists. With the majority of dental hygienists reporting the use of and a perceived need for this modality, the use of this practice appears to be a significant adjunct to total dental care. In addition, if training in the administration of local anesthesia contributes to better-prepared dental hygienists in basic pharmacology, medical emergency management and special needs care, then patient care and overall educational experiences of dental hygienists would be positively impacted by the complete inclusion of this modality.

Sean G. Boynes, DMD, is Director of Anesthesia Research, Department of Anesthesiology and Jayme Zovko, RDH, BS, is the Faculty Research Associate, Department of Anesthesiology. At the time of submission, both work at the University of Pittsburgh, School of Dental Medicine. Meghan R. Bastin, Michele A. Grillo and Brianna D. Shingledecker are students at the University of Pittsburgh School of Dental Medicine, Dental Hygiene.

References

1. Anderson JM. Use of local anesthesia by dental hygienists who completed a Minnesota CE course. *J Dent Hyg.* 2002;76(1):35-46.
2. Cross-Poline GN, Passon JC, Tillis TS, Stach DJ. Effectiveness of a continuing education course in local anesthesia for dental hygienists. *J Dent Hyg.* 1992;66(3):130-136.
3. Rich SK, Smorang J. Survey of 1980 California dental hygiene graduates to determine expanded-function utilization. *J Public Health Dent.* 1984;44(1):22-27.
4. DeAngelis S, Goral V. Utilization of local anesthesia by Arkansas dental hygienists, and dentists' delegation/satisfaction relative to this function. *J Dent Hyg.* 2000; 74(3):196-204.
5. Sisty-LePeau N, Nielson-Thompson N, Lutjen D. Use, need and desire for pain control by Iowa hygienists. *J Dent Hyg.* 1992;66(3):137-146.
6. States Where Dental Hygienists May Administer Local Anesthesia: Reference Map. American Dental Hygienists' Association [Internet]. [cited 2009 Aug 19]. Available from: http://www.adha.org/governmental_affairs/downloads/localanesthesiamap.pdf
7. Local Anesthesia Administration by Dental Hygienists: State Chart. American Dental Hygienists' Association [Internet]. [cited 2009 Aug 19]. Available from: http://www.adha.org/governmental_affairs/downloads/localanesthesia.pdf
8. Lavrakis PJ. Telephone survey methods: sampling, selection, and supervision. Newbury Park, Calif. Sage Publications. 1987. p. 28-52.
9. Locker D. Effects of non-response on estimates derived from an oral health survey of older adults. *Community Dent Oral Epidemiol.* 1993;21(2):108-13.

10. Abdulwahab M, Al-Sayegh F, Boynes SG, Abdulwahab H, Zovko J, Close J. Assessing the Need for Anesthesia and Sedation Services in Kuwaiti Dental Practice. *Anesth Prog.* 2010;57(3):91-95
11. Minervini R, Harrington M, Stindt D. Assessing expanded functions performed by hygienists in Missouri. *J Dent Hyg.* 1981;55(5):36-41.
12. Rothen M, Spadafora A. Local anesthesia for dental professionals. 1st ed. Bassett KB, DiMarco AC, Naughton DK, ed. New Jersey. Pearson Education. 2010. p. 369-370.
13. Hiatt NW. Correlation of teaching local anesthesia, neuroanatomy, pharmacology, and psychology. *J Dent Educ.* 1970;34(2):179-181.
14. Moore PA, Boynes SG, Cuddy MA, Giovannitti JA Jr, Zovko J. Educational Experiences and Preparedness in Dental Anesthesia: Five-Year Outcome Assessment and Conclusions. *J Dent Educ.* 2009;73(12):1379-1386.
15. Accreditation Standards for Dental Hygiene Education Programs. Commission on Dental Accreditation (CODA) [Internet]. [cited 2009 Sep 8]. Available from: <http://www.ada.org/sections/educationAndCareers/pdfs/dh.pdf>