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Factors Which Influence the Education of Local Anesthesia in Dental Hygiene

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ABSTRACT

Dental hygienists, like most students, learn according to formal curriculum that is defined by goals, competencies, and required subject matter for examinations.[1] They also learn through an intense socialization process known as "the hidden curriculum". The "hidden curriculum" is not defined in student textbooks nor classroom lectures, but is demonstrated through case studies, research, and an experience shared between colleagues.[1] The purpose of this study was to assess the determining factors that influence what dental hygiene instructors are teaching hygiene students on the use of articaine when administering dental blocks, and to assess if the "hidden curriculum" concerning 4% articaine, raises objections or concerns when teaching the use 4% articaine while administering the inferior alveolar nerve block (IANB). Topics were explored by means of an online survey of which 70 dental hygiene instructors responded. Of the 70 dental hygiene instructor responses, 7-8% (n=10-12) of the participants did not answer all of the survey questions. Some questions were skipped as they were not applicable, and others for reasons unspecified. Results of this study showed that the controversy surrounding the use of 4% articaine when giving the IANB not only influenced what dental hygiene instructors taught dental hygiene students, but it also influenced their personal selection of anesthetic during patient treatment.

Table of Contents

List of Figures

CHAPTER I

INTRODUCTION

Introduction

Numerous studies have shown that the adverse drug reactions in dentistry, particularly paresthesia, may not only be solely due to technique, but can largely be contributed to the type of local anesthetic used during procedures.[2] Local anesthetics have been shown to damage neuronal and Schwann cells via several mechanisms.[3] One mechanism in particular postulates that local anesthetics are toxic to Schwann cells, and that the degree of toxicity is directly related to the concentration of the local anesthetic and duration of exposure.[3] There is a mounting concern regarding direct neurotoxicity related to formulations containing high concentrations such as 4% articaine and prilocaine.[4] Haas and Lennon[5] reported an increased incidence of paresthesias in Canada following the introduction of articaine in the mid-1980s. In 1993 alone, 14 cases of paresthesia were reported, and all were attributed to articaine or prilocaine. When articaine was first submitted for approval to the Food and Drug Administration in the United States, it was identified as having a higher risk for paresthesia than lidocaine. [4] In addition, Garisto et al[2] reviewed claims of paresthesia in the United States during the period of November 1997 through August 2008 and found 248 cases of paresthesia following dental procedures. Most cases (95%) involved mandibular nerve blocks, and in 89% of these, the lingual nerve was affected [4]; Moreover, when compared to other local anesthetics, paresthesia was found to be 7.3 times more likely with 4% articaine and 3.6 times more likely with 4% prilocaine.[4]

Iatrogenic injuries to the third division of the trigeminal nerve remain a common and complex clinical problem. The trigeminal nerve provides sensory information for the teeth and associated tissue as well as for other parts of the upper face. The third division (V_3) of the trigeminal nerve is the mandibular nerve.[6] The anterior trunk of the mandibular nerve is formed by the merger of the (long) buccal nerve, and additional muscular nerve branches. The posterior trunk of the mandibular nerve is formed by the merger of the auriculotemporal, lingual and inferior alveolar nerves.[6] The dental injections associated with the mandibular nerve are the buccal nerve, mental nerve, lingual nerve, and IANB. It is important that dental hygienists have a thorough understanding of trigeminal nerve divisions in order to effectively and safely administer anesthetic.[6] Trigeminal nerve injuries can cause episodes of stabbing, electric shock-like pain in areas of the face where the branches of the trigeminal are distributed: lips, eyes, nose, scalp, forehead, upper and lower jaw.[7] Altered sensation and pain in the orofacial region may interfere with speaking, eating, shaving, placing makeup, and many social interactions that we take for granted.[7]

While there is increasing evidence that associates 4% articaine with an increased incidence of paresthesia, there is still a great controversy of whether this evidence is sufficient to be deemed definitive, [8, 9] Additionally, recent studies suggest that articaine, in the in vitro setting, does not produce a prolonged block of neuronal responsiveness or an increased toxicity when compared with lidocaine in SH-SY5Y cells.[10]

The argument of 4% articaine and its disconcerted results, gives rise to a type of informal education known as the “hidden curriculum.” The hidden curriculum can be defined as informal or unintentional lessons brought forth through case studies and/or physician discussions on personal experiences.[1] The possibility exists that dental hygiene instructors teach anesthetic selection when giving dental injections, specifically IANB, based on the issues associated with the articaine.

Statement of the Problem

What are the determining factors that influence what dental hygiene instructors are teaching dental hygiene students on the use of articaine during dental blocks?

Does the controversial research on 4% articaine influence the anesthetic choices of dental hygiene instructors?

What is the didactic knowledge and attitude of dental hygiene instructors towards teaching the use of 4% articaine with IANB?

Significance of the Problem

Nonsurgical cases of paresthesia in dentistry are almost exclusively related to the IANB and appear to affect the lingual nerve more frequently than the inferior alveolar nerve. Of note, the IANB has a published failure rate between 31-81%. Available data indicate that 85%-94% of such cases resolve spontaneously within 8 weeks; however, about two-thirds of those who do not recover quickly may never fully recover. [11] The exact biological mechanism of injury in cases of post injection paresthesia remains the subject of debate in literature. The three most common and most tenable hypotheses are direct trauma to the nerve from the needle, intraneural hematoma and local anesthetic neurotoxicity.[8, 11]

When the nerve is tense, usually from the patient opening wide, it is possible for the needle to pierce a fascicle and traumatize the nerve.[8] Even though a few studies show probable cause of paresthesia from needle contact, the majority of patients that experience the "electrical shock" sensation, do not experience any form of paresthesia, temporary or permanent.[12] Between 3% and 7% of patients feel an "electrical shock" during the IANB, a result of the needle making contact with the nerve.[8]

Intraneural hematoma is hypothesized to be another cause of paresthesia. Hematomas are caused when the injection needle pierces an intraneural blood vessel. The hemorrhaging compresses the nerve fibers, causing reactive fibrosis and scar tissue formation. The amount of pressure from the hemorrhaging and scar tissue determines the extent of the injury.[8]

The most controversial theory of nerve damage due to the IANB is neurotoxicity. Studies of Haas and Lennon[5], Hillerup and Jensen[12], and Gaffen and Haas[11], suggest that increasing local anesthetic concentrations, increases neurotoxicity in vitro.[12, 8] These studies found that an overall incidence of paresthesia to range from 1:27,762 - 1:785000, with the two drugs most often implicated being 4% prilocaine and 4% articaine. The number of annual cases of paresthesia increased beginning in 1985, shortly after the introduction of articaine into the Canadian market.[2] The detrimental effect of intraneural injections was demonstrated by injecting 50µL of saline, 2% articaine, and 4% articaine into sciatic nerve of thirty Wistar rats, substantiating previous studies that neuropathy of the nerve is dependent on the concentration of the anesthetic used during injections. The myelin sheath thickness of the test rats was significantly reduced with the use of 4% articaine. 4% articaine had a neurotoxic response in 9 of 10 animals, whereas 2% articaine had a response in only 1 of 10 animals.[14] The study also gave validity to previous findings that permanent paresthesia due to direct needle contact to the nerve is unlikely, as the mechanical injury of needle penetration with saline injection had no significant effect on nerve conduction or histomorpholog.[14]

Operational Definitions

Paresthesia: an altered sensation of numbing, tingling or pricking (“pins and needles”), caused chiefly by pressure on or damage to peripheral nerves.

Dysesthesia: impairment of sensation.

Neurotoxicity: the ability of a drug or other agent to destroy or damage nervous tissue.

Peripheral Neuropathy: malfunction to the nerves due to being damage or destruction, may impair sensation, movement, gland or organ function, or other aspects of health, depending on the type of nerve affected.

Intraneural: situated within, occurring within, or administered by entering a nerve or nervous tissue.

Schwann Cell: Any of the cells that cover the nerve fibers in the peripheral nervous system and form the myelin sheath.

Neuronal Cell: a cell that carries messages between the brain and other parts of the body and that is the basic unit of the nervous system, consisting of a nucleated cell body with one or more dendrites and a single axon.

Apoptosis: an essential and well-controlled form of cell death occurring under a variety of physiological conditions.

Hidden Curriculum: refers to the lessons taught informally or unintentionally

Socialization: the process of learning to behave in a way that is acceptable to society

CHAPTER II

REVIEW OF LITERATURE

Introduction

Epidemiologic studies have shown that alterations to normal oral sensory function can occur after restorative and surgical dental procedures.[9] These sensory abnormalities can range from slight to complete loss of sensation, and are more likely to occur when 4% anesthetic solutions are administered.[9] The objective of this pilot-study is to assess the deciding factors of dental hygiene instructors when teaching anesthetic selection to hygiene students, and to learn their perceived knowledge and attitudes towards teaching the use 4% articaine during the IA injection.

Medical and dental literature were obtained using the PubMed/MeSH search engines to access the Medline database focusing on keywords and phrases such as “dental paresthesia,” “local anesthetic and pharmacology,” “local anesthetic AND cell toxicity”, “articaine AND paresthesia”, “peripheral neuropathy”, “hidden curriculum,” “socialization”, among many others.

General information and statistics regarding paresthesia and neurotoxicity using local amide anesthetics of 4% concentration or higher will be discussed. Concentration and time duration of local anesthetic and its relation to paresthesia in dentistry will be explored; as well as an overview of the physiological and pharmacological mechanism of action of anesthetics on the peripheral nerve. The research itself will be defined as informal education known as the “hidden curriculum, and will discuss how this informal learning effects formal education.

Peripheral Nerve: Physiological and Pharmacological

Local anesthetics are a group of compounds that block voltage-gated sodium channels. Their molecular structure shares common features, with a lipophilic aromatic ring, a hydrophilic amino terminal, and a connecting intermediate chain.[4, 15] The elements shared in the group molecular structure is essential for local anesthetic to be effective.

The aromatic ring is vital for diffusion though fatty tissue. Greater lipid solubility enhances diffusion through nerve sheaths, as well as the neural membranes of individual axons comprising a nerve trunk. This property correlates with potency because a greater portion of an administered dose can enter neurons. Because bupivacaine is more lipid soluble than lidocaine, it is more potent and is prepared as a 0.5% concentration (5 mg/mL) rather than a 2% concentration (20 mg/mL).[4]

The terminal amine, or hydrophilic portion of the molecule, may exist in a tertiary form (3 bonds) that is lipid soluble or as a quaternary form (4 bonds) that is positively charged and renders the molecule water soluble. The aromatic ring determines the actual degree of lipid solubility, but the terminal amine acts as an ‘‘on-off switch’’ allowing the local anesthetic to exist in either lipid-soluble or water-soluble conformations.[4] For the local anesthetic base to be stable in solution, hydrochloride salt is added, allowing the anesthetic to become water soluble and injectable.[4]

The onset of local anesthesia is reliant on the rapidity that the agent disseminates through the tissue, the vicinity of site of injection to the nerve being numbed, and the thickness of the nerve fibers.[16] The ionization constant (pKa) for the anesthetic predicts the proportion of molecules that exists in each of these states. By definition, the pKa of a molecule represents the pH at which 50% of the molecules exist in the lipid-soluble tertiary form and 50% in the quaternary, water-soluble form. The pKa of all local anesthetics is 7.4 (physiologic pH), and therefore a greater proportion the molecules exists in the quaternary, water-soluble form when injected into tissue having normal pH of 7.4. Furthermore, the acidic environment associated with inflamed tissues favors the quaternary, water-soluble configuration. Presumably, this accounts for difficulty when attempting to anesthetize inflamed or infected tissues; fewer molecules exist as tertiary lipid-soluble forms that can penetrate nerves. In these situations, bupivacaine (pKa 8.1) would be least effective and mepivicaine (pKa 7.6) would be most likely to provide effective anesthesia. [4] This gives the molecule both hydrophobic and hydrophilic properties.

Local anesthetics are often categorized into ester-linked and amide-linked compounds according to the type of the intermediary chain. They can also be divided into short-acting (e.g. chloroprocaine), intermediate-acting (e.g mepivicaine, lidocaine) and long-acting (e.g. Bupivacaine, Ropivacaine) compounds.[15] Ester-linked local anesthetics are metabolized by plasma cholinesterase and tissue esterase, whereas amide-linked local anesthetics are primarily metabolized in the liver through the mixed function oxidase system.[15] articaine is an intermediate-potency, short-acting (onset) amide local anesthetic, that differs from other amide local anesthetics because it contains a thiophene ring that allows greater lipid solubility.[17] In addition, articaine contains an ester group, so that hydrolyzation occurs in the plasma by nonspecific cholinesterases, furthering metabolism and excretion primarily in the kidneys.[17] A defect at any stage of metabolism has the potential to increase systemic concentrations. All local anesthetics are hypoallergenic and are widely considered to be among the safest perioperative drugs in this regard.[15] All local anesthetics are toxic, in a dose- and time-dependent manner, on virtually all tissues including nerves and muscles.[15]

Paresthesia Defined

Alterations to normal oral sensory function can occur after restorative and surgical dental procedures. These sensory abnormalities, generally described as paresthesia, can range from slight to complete loss of sensation and can be devastating for the patient.

Stedman's Medical Dictionary defines a paresthesia as an abnormal sensation, such as of burning, pricking, tickling, or tingling. Paresthesias are one of the more general groupings of nerve disorders known as neuropathies. Paresthesia may manifest as total loss of sensation (ie, anesthesia), burning or tingling feeling (ie, dysesthesia), pain in response to a normally non-harmful stimulus (ie, allodynia), or increased pain in response to all stimuli (ie, hyperesthesia).[2,9] Depression of nerve function and associated anesthesia are the clinical functions of the local anesthetic agents, and altered sensations, such as dysesthesias, are an expected component of the recovery process following local anesthesia. It is now commonplace to include an element of duration to the definition to permit expected pharmacologic alterations in sensory nerve function to be differentiated from abnormal and potentially permanent adverse reactions. In describing paresthesia as a complication of local anesthesia, the anesthesia or altered sensation is required to "persist beyond the expected duration of action of a local anesthetic injection".[2,9]

Most cases of paresthesia that are reported after dental treatment are transient and resolve within days, weeks, or months. The best data regarding rate of recovery are provided in the article by Queral-Godoy and colleagues, in which survival curves are presented for recovery from surgical paresthesia. These data suggest that complete recovery at 8 weeks had occurred in only 25% to 30% of the patients. [9] When reevaluated at 9 months, complete recovery had occurred in 90% of the patients. The time when a paresthesia should be considered permanent is not absolute and is often not known with certainty. [9] Paresthesia that last beyond 6 to 9 months can be described as persistent and unlikely to recover fully; although, some still can. Reports of recovery of sensory function beyond a year are extremely rare. [9]

Neurotoxicity of Local Anesthetic: Concentration and Duration Dependent

Peripheral nerve blocks are routinely administered to provide pain control for surgical and other procedures, and are most commonly used in dentistry. Ordinarily considered safe, neurological side effects do occasionally develop that could be unending and debilitating. [3,14, 18] In addition to preventing the excitation conduction process in peripheral nerves, local anesthetics (LAs) cause toxic effects on the central nervous system, cardiovascular system, neuromuscular junction, and cell metabolism.[19]

Transient Neurological Syndrome

The cauda equina refers to a bundle of spinal nerve roots that arise from the end of the spinal cord and comprises the roots of all the spinal nerves below the first lumbar vertebra in the lower back. Previous findings indicate that during spinal anesthesia, 5% lidocaine was associated with transient neurological syndrome (TNS) and persistent lumbosacral neuropathy.[19]

Transient neurological symptoms manifest as unilateral or bilateral pain radiating down the legs with or without pain to the back or buttocks. The onset is usually within 24hrs of anesthesia and can last for up to two weeks. [20] TNS is quite common and can occur as often as one in every three patients receiving lidocaine. The risk of persistent lumbosacral neuropathy can be as high as 1 in 200 after continuous lidocaine spinal anesthesia or 1 in 1300 after a single lidocaine injection. The most severe complication, cauda equina syndrome, which is characterized by bowel and bladder sphincter incontinence, sexual dysfunction, paresthesias, and leg muscle weakness, can occur with an incidence from 1 in 1000 to 1 in 10,000 depending on the LA use.[19] These findings also cited surgical positioning as a limitation,[20] but highly suggest that neural injury or apoptosis is probable with increased concentrations of a LA and/or increased duration of exposure.[19,20] Surgeries in the lithotomy position are often short in duration, and resulted as being well suited for the use of 5% lidocaine. Similarly, TNS results were significantly lower during spinal anesthesia with the use of 0.75% bupivacaine.[20]

Neuronal Cytoplasmic Calcium

In in vitro neuronal models (isolated nerves, spinal cord, or neuronal cells), LAs have been shown to cause conduction block, loss of action and/or resting potential, increase of intracellular Ca^{2+}, growth cone inhibition, and cell death. LAs inhibit voltage-dependent Na^{+} channels, as well as K^{+} and Ca^{2+} channels, but at concentrations that are much lower than clinical concentrations during regional anesthesia.[19] A number of studies have shown that LAs may cause mitochondrial dysfunction by collapsing the mitochondrial membrane potential, uncoupling oxygen consumption, and adenosine diphosphate-phosphorylation, releasing cytochrome c, and activating caspases, which may all lead to apoptotic cell death.[19] Tests results reveal that lidocaine greater than 2.5% elevates cytoplasmic calcium ($Ca^{2+}_{(cyt)}$) to toxic levels resulting in cell death. bupivacaine and lower concentrations of lidocaine transiently alter $Ca^{2+}_{(cyt)}$ homeostasis for several minutes, but without an immediate neurotoxic effect with 60 minutes.[21] Additionally the cytotoxicity of six frequently used LAs were compared, using four amide (bupivacaine, ropivacaine, mepivicaine, lidocaine, and two esters (procaine, chloroprocaine) LAs. The comparison concluded that all six LAs decreased cell viability after a 10-minute drug exposure in a concentration-dependent fashion. Based on the LD_{50} (concentration at which 50% of the cells were dead), the potency of these six LAs showed the following order: bupivacaine > ropivacaine > chloroprocaine > lidocaine > mepivicaine > = Procaine. Among these six LAs, only bupivacaine and lidocaine killed all cells with increasing concentration. Both bupivacaine and lidocaine activated caspase-3/-7. Caspase activation required higher levels of lidocaine than Bupivacaine. Moreover, the caspase activation by bupivacaine was slower than by lidocaine. [19] lidocaine at high concentrations caused immediate caspase activation, but did not cause significant caspase activation at concentrations lower than 10 mM. An alternative way to view the data is to compare equivalent concentrations of LAs. For example, 1.2 mM (0.037%) bupivacaine kills 50% of the cells after 10-minute exposure, whereas 1.2 mM (0.030%) lidocaine and 1.2 mM procaine have essentially no effect. At 1.2 mM (0.031%) mepivicaine, 1.2 mM (0.034%) chloroprocaine, and 1.2mM (0.034%), ropivacaine kills approximately 15-25% of the cells.[19]

Dentistry

A case/non-case study of spontaneous adverse events recorded in FAERS (FDA Adverse Event Reporting System) between 2004 and 2011 was performed to evaluate possible alert signals of paresthesia by local anesthetics, focusing on those used in dentistry.[18] Cases were represented by the reports of reactions grouped under the term "paresthesias and dysesthesias" involving local anesthetics. Non-cases were all other reports of the same drugs. Reporting odds ratios (ROR) with the relevant 95% confidence intervals (95CI) were calculated. Alert signal was considered when the number of cases >3 and lower limit of ROR 95CI > 1.[18]

To estimate the specificity of signals for dentistry, the analysis was restricted to the specific term "oral paresthesia" and to reports concerning dental practice. Overall, 528 reports of paresthesias and dysesthesias were retrieved, corresponding to 573 drug–reaction pairs: 247 lidocaine, 99 bupivacaine, 85 articaine, 30 prilocaine, and 112 others. [18] The signal was significant only for articaine (ROR=18.38; 95CI = 13.95–24.21) and prilocaine (ROR=2.66; 95CI=1.82–3.90). Other local anesthetics did not show disproportionate signals according to the defined threshold. [18] The secondary analysis of the specific term “oral paresthesia” retrieved 82 cases corresponding to 90 drug–reaction pairs: 37 articaine, 19 lidocaine, 14 prilocaine, 7 bupivacaine, and 13 others. Disproportionate signals for articaine (ROR= 58.77; 95CI=37.82–91.31) and prilocaine (ROR=8.73; 95CI=4.89–15.57) confirmed the primary analysis and concluded that, among local anesthetics, only articaine and prilocaine generated a signal of paresthesia, especially when used in dentistry.[18]

In 2018, a research was performed that tested the viability of SH-SY5Y cells, after the cells had been exposed to drugs 4% articaine 1:100,000 and 2% lidocaine 1:100,000 for 5 minutes.[10] The experiment was also performed in using the agents in powdered form. Drugs were dissolved in DMEM/Ham F12 medium, and concentrations were chosen so that the maximum levels were approximately the same for drugs in powder and cartridge formulations. After washing, cells were treated with the ratiometric Live/Dead assay. [10] The results showed that articaine had no effect on the survival of SH-SY5Y cells, while lidocaine produced a significant reduction only when used as pure powder. [10] In addition to the study of Farraj et al[10], Stirrup and Crean[22] completed a study that concluded that many of the early studies that implements 4% articaine as posing an increased risk of paresthesia during the IANB, does not present any conclusive evidence, and that several methodological inconsistencies exists throughout these studies.[22] The research explained how some of the studies failed to indicate any comparison between expected and observed out comes, and how several of the studies has a considerable degree of reporting bias.[22]

Dental Hygiene Education

Like medical students, dental hygienists learn according to formal curriculum that is defined by goals, required subject matter for examinations, competencies and so forth. [1] They also learn through an intense socialization process known as “the hidden curriculum”. The “hidden curriculum” is not necessarily defined in student textbooks or classroom lectures, but is essential for the development of the student to participate and function in dental hygiene culture.[1]

The importance of learning through the hidden curriculum should not be underestimated, especially at a time when the notion of “competence-based learning” dominates the training of doctors. [1] The hidden curriculum is demonstrated through case studies, research, and an experience shared between colleagues. It is the part of learning that happens in everyday practice.[1] The hidden curriculum is used to bridge the gap between formal and informal curriculum and can contribute to the self-regulation in the medical world.[1]

The controversial study of 4% articaine is an ideal example of the hidden curriculum. The research gives rise for caution in both the medical and dental world, and yet remains inconclusive and highly debatable.[7,20] While early case studies demonstrate an increased risk of paresthesia with the use of articaine, more recent studies are finding that articaine is relatively equal in toxicity to lidocaine.[22] It is the informal perspectives that give physicians, dentists, and hygienist reason to reconsider anesthetics choices in everyday practice, and provides the basis for dental hygiene instructors to train dental hygiene students to follow suit.[1]

Summary

The exact biological mechanism of injury in cases of post injection paresthesia remains the subject of debate in literature. In addition to preventing the excitation conduction process in peripheral nerves, local anesthetics (LAs) cause toxic effects on the central nervous system, cardiovascular system, neuromuscular junction, and cell metabolism.[19]

Paresthesia may manifest as total loss of sensation (ie, anesthesia), burning or tingling feeling (ie, dysesthesia), or as pain in response to a normally non-harmful stimulus. The most common and most tenable hypotheses of paresthesia in dentistry are direct trauma to the nerve from the injection needle, intraneural hematoma and local anesthetic neurotoxicity.[11] Studies of Haas and Lennon,[5] Hillerup and Jensen,[12] and Gaffen and Haas,[11] suggest that increasing local anesthetic concentrations, increases neurotoxicity in vitro. These studies found that an overall incidence of paresthesia to range from 1:27,762 - 1:785000, with the two drugs most often implicated being 4% articaine and 4% Prilocaine. Additionally, the study of Piccinni et al[18]., 2015 concluded that 4% articaine and 4% Prilocaine, generated the greatest markers for paresthesia when used for dental injections.

Though the controversial research on 4% articaine is not definitive,[8,9] the studies of 4% articaine is an ideal example of the hidden curriculum. The hidden curriculum is used to bridge the gap between formal and informal curriculum and can contribute to the self-regulation in the medical world.[1] It is the informal perspectives that give physicians, dentists, and hygienist reason to reconsider anesthetics choices in everyday practice, and provides the basis for dental hygiene instructors to train dental hygiene students to follow suit.[1]

CHAPTER III

METHODS AND MATERIALS

Introduction

A multiple-choice survey was administered to dental hygiene instructors to access the determining factors that influence what they are teaching hygiene students on the use of 4% articaine for dental blocks. The aim of the survey was to assess how or if the "hidden curriculum" concerning 4% articaine influence what dental hygiene instructors are teaching dental hygiene students when teaching the use 4% articaine while administering the IANB.

Research Design

The survey was designed to explore the didactic methods that the participating dental hygiene instructors have received, and how the received teaching methods influenced their choice of anesthetic when educating their students.

Procedures

An online survey using multiple choice questions was emailed to all dental hygiene programs that were CODA accredited programs and that held an accreditation recognized by the States Department of Education. The survey was sent to dental hygiene program directors, to be forwarded to dental hygiene instructors for completion. The participating instructors gave informed consent by completing a consent form that was administered with the survey. Surveys were delivered and received using the software Survey Monkey. Participants needed to click on the provided link to access the survey.

Time Schedule

All surveys were returned within a three week period. After the three week deadline, all surveys were calculated. The subject enrollment and participation duration were not extended. Extra time to complete the survey was not required.

Sample Defined

A self-administered survey was sent to 332 accredited U.S. dental hygiene program directors via email. The survey was forwarded to the program's hygiene instructors, which is the intended population for this study. The list of dental hygiene programs and email addresses were obtained from the ADHA website. All selected institutions were CODA accredited and included a minimum of two years of college level education. Programs not on the ADHA website were not selected for this survey.

Data Collection

The online survey data were collected through the Survey Monkey software program in the form of multiple choice questions. Descriptive data collected in the survey included demographic information on state of licensure, level of education, and years in practice. The data were then computed through the software's statistical analysis program, and the results were transferred into graphs and tables.

Statistical Analysis

Frequencies and relative frequencies were calculated from surveys. Numerical and graphical summaries were used to display practices among dental hygiene instructors and document the underlining influences that affect their decision making.

CHAPTER IV

RESULTS, DISCUSSION AND CONCLUSION

Results

A recruitment email, consent from, and web link to the study survey was sent to 322 CODA accredited dental hygiene programs. A total of 70 responses were collected through the online survey website. All surveys were filtered for incomplete and illogical answers. Of the 70 surveys, 10 surveys had questions that were left unanswered for reasons unspecified. The education level of the survey participants consisted of 2 Certificate, 10 Associate, 18 Bachelor, 26 Graduate, and 4 Doctorate (Figure 1). Ten out of 70 participants did not answer the education level question.

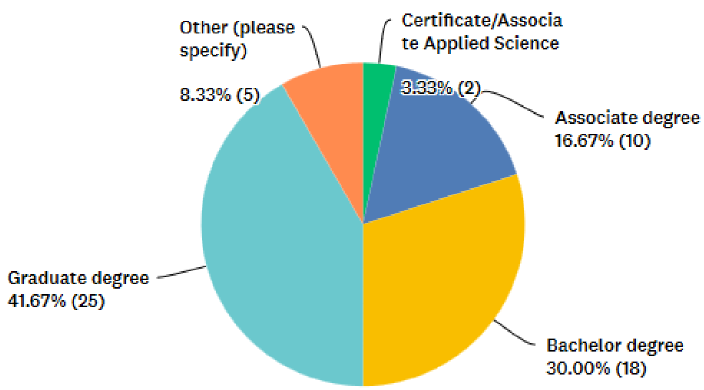


FIGURE 11 NUMBER OF RESPONDENTS BY DEGREE TYPE

Of the participating faculty, 16 listed their faculty position as Professor, 12 Associate Professor, 14 Assistant Professor, 3 Clinical instructor, 4 Adjunct/TA's, and 11 specified themselves under the "other" category that consisted of 5 Program Directors, 2 Coordinators, 3 Instructors (type unknown), and 1 Supervising Dentist (Figure 2). Seventy-five percent (n=43) of the faculty held between 16-30 years of experience (Figure 3). Ten of the respondents did not give a professional title or number of practicing years.

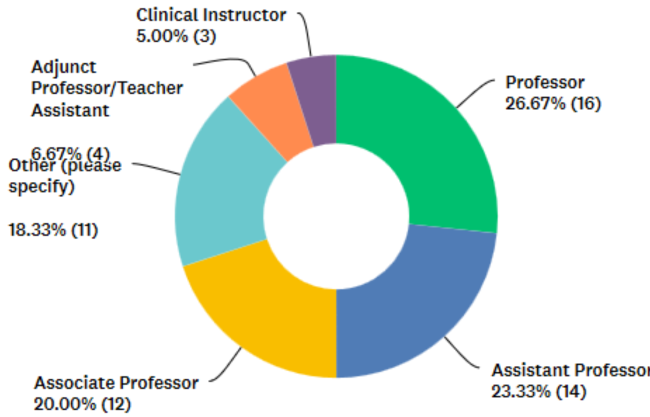


FIGURE 12 FACULTY TITLES/POSITIONS

ANSWER CHOICES	RESPONSES	
less than 5 years	3.33%	2
6-15 years	21.67%	13
16-29 years	36.67%	22
30 years or more	38.33%	23
TOTAL		60

FIGURE 13 PRACTICING YEARS AS A HYGIENIST

All of the participating instructors answered the local anesthetic practice act question relating to the state in which they practiced. The results showed that 91.43% (n=64) of the participants taught in states that allowed hygienist to administer anesthetic, while 8.57% (n=6) taught in states that did not allow anesthetic to be administered by the hygienist (Figure 4).

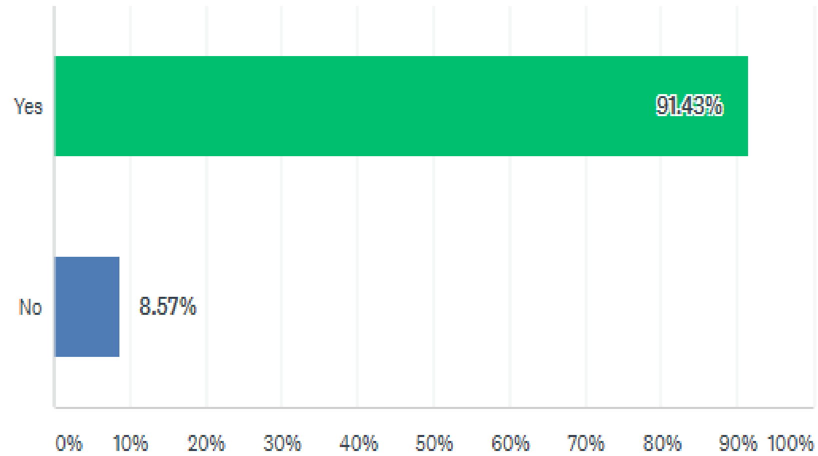


FIGURE 14 HYGIENE ANESTHESIA ALLOWED

The purpose of the study was to assess whether informal training, known as the "hidden curriculum," produced objections or raised concerns of dental hygiene instructors on teaching the use of 4% articaine when administering the inferior alveolar nerve block. Forty instructors (70.18%) reported that they teach the use of 2% lidocaine 1:100,000 as a first choice of anesthesia (Figure 5), and forty-one instructors (75.93%) reported that they use 2% lidocaine most often during patient care (Figure 6 A & B). Thirteen participants did not respond to the stated questions.

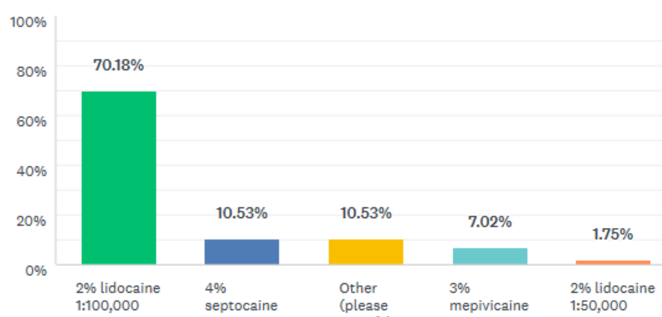
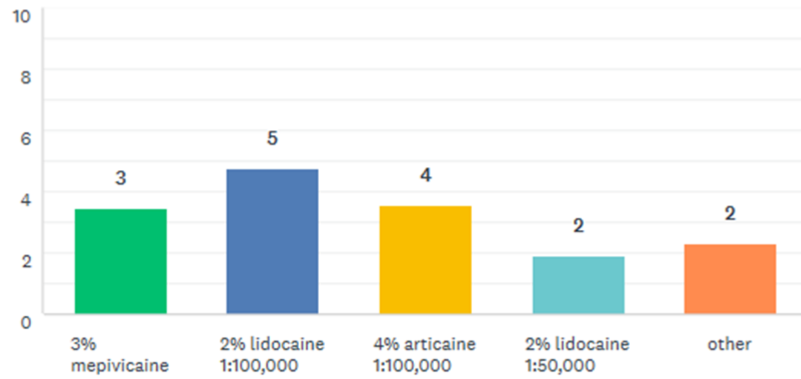


FIGURE 15 FIRST CHOICE OF ANESTHETIC TAUGHT TO HYGIENE STUDENTS

A



B

	1	2	3	4	5	TOTAL	SCORE
3% mepivicaine	7.69% 4	44.23% 23	38.46% 20	5.77% 3	3.85% 2	52	3.46
2% lidocaine 1:100,000	75.93% 41	22.22% 12	1.85% 1	0.00% 0	0.00% 0	54	4.74
4% articaine 1:100,000	13.95% 6	34.88% 15	44.19% 19	4.65% 2	2.33% 1	43	3.53
2% lidocaine 1:50,000	2.70% 1	2.70% 1	2.70% 1	64.86% 24	27.03% 10	37	1.89
other	9.38% 3	12.50% 4	12.50% 4	28.13% 9	37.50% 12	32	2.28

FIGURE 16: (A) AND (B): ANESTHETIC USED MOST OFTEN RANKED

FIGURE A: SHOWS ANESTHETIC MOST OFTEN USED RANKED FROM HIGHEST TO LOWEST, WITH 2% LIDOCAINE 1:100,000 RANKED HIGHEST. FIGURE B: SHOWS PERCENTAGES OF ANESTHETIC MOST OFTEN USED WITH NUMBER OF RESPONDED PARTICIPANTS

The number one explanation for the use of lidocaine 1:100,000, as a first choice of anesthetic, was received from 38 respondents (66.7%), stating that 2% lidocaine is safe for most patient use. The second ranked explanation for choosing 2% lidocaine 1:100,000, was its profound pharmacological properties, stated by 9 respondents (15.79%), followed by 6 respondents (10.53%) that stated 2% lidocaine was chosen because it was the dentist's choice for office use. Four respondents (7.02%) replied "other" and stated that 2% lidocaine 1:100,000 was considered the "Gold Standard" (Figure 7). Thirteen participants did not respond to the stated questions.

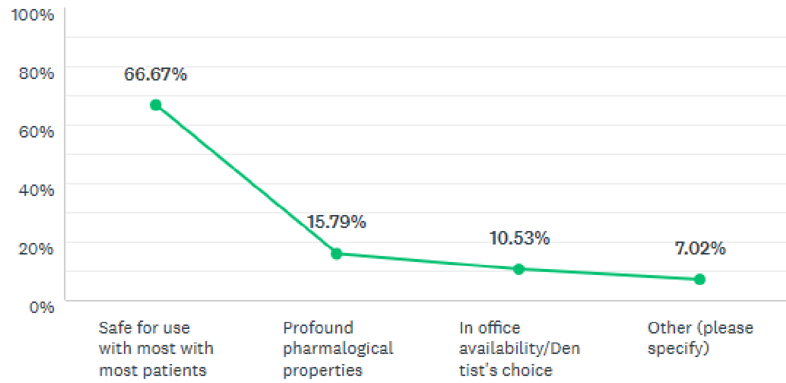


FIGURE 17 RANKED RATIONALE FOR ANESTHETIC CHOICES

When asked which injection(s) was most given to anesthetize teeth #27-32, 82.46% (n=47) of the respondents chose the IANB for at least one of the injections given to anesthetize teeth #27-32. When asked which anesthetic choice was used most often to anesthetize teeth #17-21, a majority of 87.71% (n=48) choose 2% lidocaine 1:100,000, followed by a tie of 3 responses (5.36%) of 3% mepivicaine and 3 responses (5.36%) of 4% articaine 1:100,000 (Figure 8). Fourteen participants skipped or did not answer this question.

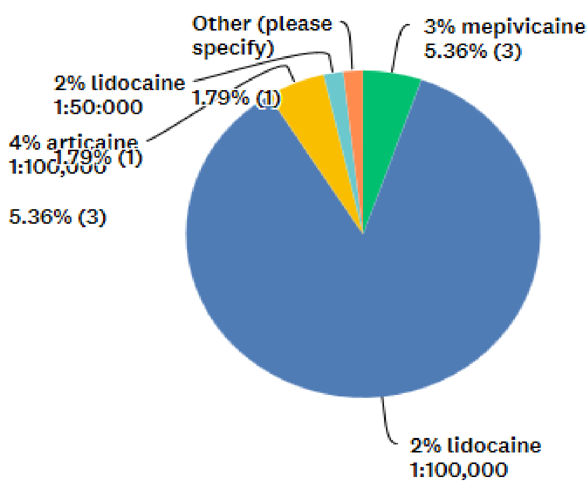


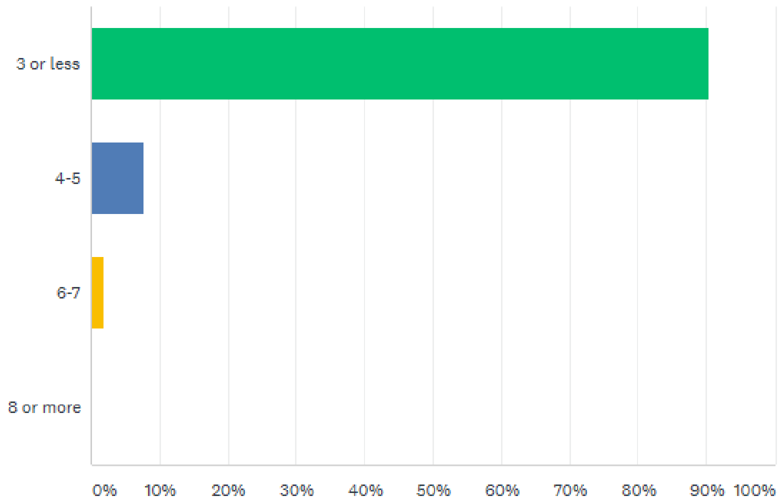
FIGURE 18. ANESTHETIC MOST OFTEN USED FOR TEETH #17-21

On a weighted scale, 25.45% (n=14) of the participating instructors stated that they were not comfortable administering 4% articaine with the inferior alveolar block. About 14.55% (n=8) stated that they were somewhat comfortable, and 25.45% (n=14) stated they were neutral when administering 4% articaine with the IANB. Fifteen participants skipped this question. There was almost an equal amount of instructors that felt comfortable to very comfortable administering articaine with the IANB 35.55% (n=19), as there were of instructors who were somewhat comfortable to not comfortable while administering articaine with the IANB 40% (n=22). Yet, when asked the maximum number of cartridges of 2% lidocaine 1:100,000

NOT COMFORTABLE	SOMEWHAT COMFORTABLE	NEUTRAL	COMFORTABLE	VERY COMFORTABLE	TOTAL	WEIGHTED AVERAGE
25.45% 14	14.55% 8	25.45% 14	14.55% 8	20.00% 11	55	2.89

FIGURE 19. COMFORT LEVEL ADMINISTERING 4% ARTICAINE FOR THE IA INJECTION

administered in a single appointment, in comparison to the maximum number of cartridges of 4% articaine 1:100,000 or 1:200,000 administered in a single appointment, the instructors were less likely to administer more than 3 cartridges of 4% articaine 1:100,000 or 1:200,000, with 4 respondents (7.69%) having administered 4-5 cartridges in a single appointment, and 1 respondent (1.92%) having administered 6-7 cartridges in a single appointment. None of the instructors gave more than 8 cartridges of 4% articaine in a single appointment (Figure 10). Instructor’s responses showed that they were more willing to



ANSWER CHOICES	RESPONSES	
3 or less	90.38%	47
4-5	7.69%	4
6-7	1.92%	1
8 or more	0.00%	0
TOTAL		52

FIGURE 20. 4% ARTICAINE 1:100,000 OR 1:200,000 ADMINISTERED IN A SINGLE APPOINTMENT

administer higher doses of 2% lidocaine 1:100,000 in a single appointment. Twenty-three respondents (40.35%) stated that they administered 4-5 cartridges in a single appointment. Three respondents (5.26%) stated that they administered 6-7 cartridges in a single dose, and 2 respondents (3.51) stated that they administered 8 or more cartridges in a single appointment.

Discussion

Previously referenced Studies of Haas and Lennon,[5] Hillerup and Jensen,[12] and Gaffen and Haas,[11] suggest that increasing local anesthetic concentrations, increases neurotoxicity in vitro. These studies found that an overall incidence of paresthesia to range from 1:27,762 - 1:785000, with the two drugs most often implicated being 4% articaine and 4% prilocaine.

Additionally, the study of Piccinni et al[18]., 2015 concluded that 4% articaine and 4% prilocaine, generated the greatest markers for paresthesia when used for dental injections.

Though the controversial research on 4% articaine is not definitive,[8,9] the studies of 4% articaine is an ideal example of the hidden curriculum. The hidden curriculum is used to bridge the gap between formal and informal curriculum and can contribute to the self-regulation in the medical world.[1] It is the informal perspectives that give physicians, dentists, and hygienist reason to reconsider anesthetics choices in everyday practice, and provides the basis for dental hygiene instructors to train dental hygiene students to follow suit.[1]

Of the 70 dental hygiene respondents, 7-8% (n=10-12) of the participants did not answer all questions. The purpose of the study was to assess whether the informal training, known as the "hidden curriculum," produced objections or raised concerns of dental hygiene instructors on teaching dental hygiene students whether to the administer 4% articaine 1:100,000 when administering the inferior alveolar nerve block . When hygiene instructors were asked which injection(s) was most given to anesthetize teeth #27-32, 82.46% (n=47) of the respondents chose the IA injection for at least one of the injections given to anesthetize teeth #27-32. When asked which anesthetic choice was used most often to anesthetize teeth #17-21, a majority of the instructors, 87.71% (n=48), choose 2% lidocaine 1:100,000, followed by of 3% mepivicaine 5.36 (n=3) and of 4% articaine 1:100,000 5.36% (n=3).

Conclusion

The collected data would suggest that the "hidden curriculum" influences teachings, as well as the practices of the participating instructors. Though the survey results show that 60% (n=33) of the hygiene instructors stated that they felt neutral to very comfortable administering 4% articaine 1:100,000 while giving the IA injection, forty instructors (70.18%) reported that they teach the use of 2% lidocaine 1:100,000 as a first choice of anesthesia, and forty-one instructors (75.93%) reported that they use 2% lidocaine 1:100,000 most often during patient care. Moreover, when actually administering 4% articaine 1:100,000, the survey analysis shows that the dental hygiene instructors were less likely to use 4% articaine in larger amounts, to include both the epinephrine doses of 1:100, 000 and 1:200,000. Results for the use of 4% articaine 1:00,000 or 1:200,000 administered in a single appointment was 3 or less cartridges given by 90.38% of the respondents (n-47), 4-5 cartridges administered by 7.69% (n=4) , and 6-7 cartridges administered by 1.92% (n=1). The results for administering 2% lidocaine 1:100,000 in a single appointment resulted in 40.35% (n=23) of instructors that had given 4-5 injections in a single appointment, 5.26% (n=3) that has given 6-7 cartridges and 3.51% (n=2) that has administered 8 or more cartridges in a single appointment. About 49.12% (n=28) or half of the hygiene instructors gave 4 or more cartridges of 2% lidocaine 1:100,00 in a single appointment (approx. 50%), here 90 % of the instructors were not willing to give more 3 cartridges of articaine in a single appointment.

Chapter V: Article for Submission

Journal of Dental Hygiene

Factors which Influence the Education of Local Anesthesia in Dental Hygiene

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Key Words: Paresthesia, Socialism, Hidden Curriculum

ABSTRACT

Purpose: The purpose of this study was to assess the determining factors that influence what dental hygiene instructors are teaching hygiene students on the use of articaine when administering dental blocks, and to assess if the “hidden curriculum” concerning 4% articaine, raises objections or concerns when teaching the use 4% articaine while administering the inferior alveolar nerve block.

Methods: An online survey using multiple choice questions was emailed to 332 dental hygiene programs that were CODA accredited programs and that held an accreditation recognized by the States Department of Education. The survey answers were grouped by occurrences based on the participant’s responses, to determine the relative frequency. Numerical and graphical summaries were used to display practices among dental hygiene instructors, and to document the underlining influences that affect their decision making.

Results: Of the 70 dental hygiene respondents, 7-8% (n=10-12) of the participants did not answer all questions. When hygiene instructors were asked which injection(s) was most given to anesthetize teeth #27-32, 82.46% (n=47) of the respondents chose the IA injection for at least one of the injections given to anesthetize teeth #27-32. When asked which anesthetic choice was used most often to anesthetize teeth #17-21, a majority of the instructors, 87.71% (n=48), choose 2% lidocaine 1:100,000, followed by of 3% mepivicaine 5.36 (n=3) and of 4% articaine 1:100,000 5.36% (n=3).

Conclusion: The collected data would suggest that the “hidden curriculum” influences teachings, as well as the practices of the participating instructors. Though the survey results show that 60% (n=33) of the hygiene instructors stated that they felt neutral to very comfortable administering 4% articaine 1:100,000 while giving the IA injection, forty instructors (70.18%)

reported that they teach the use of 2% lidocaine 1:100,000 as a first choice of anesthesia, and forty-one instructors (75.93%) reported that they use 2% lidocaine 1:100,000 most often during patient care.

Introduction:

Epidemiologic studies have shown that alterations to normal oral sensory function can occur after restorative and surgical dental procedures.[9] These sensory abnormalities can range from slight to complete loss of sensation, and are more likely to occur when 4% anesthetic solutions are administered.[9] The objective of this pilot-study was to assess the deciding factors of dental hygiene instructors when teaching anesthetic selection to dental hygiene students, and to learn their perceived knowledge and attitudes towards teaching the use 4% articaine during the IA injection.

Numerous studies have shown that the adverse drug reactions in dentistry, particularly paresthesia, may not only be solely due to technique, but can largely be contributed to the type of local anesthetic used during procedures.[2] Local anesthetics have been shown to damage neuronal and Schwann cells via several mechanisms.[3] One mechanism in particular postulates that local anesthetics are toxic to Schwann cells, and that the degree of toxicity is directly related to the concentration of the local anesthetic and duration of exposure.[3] There is a mounting concern regarding direct neurotoxicity related to formulations containing high concentrations such as 4% articaine and Prilocaine.[4] Haas and Lennon[5] reported an increased incidence of paresthesias in Canada following the introduction of articaine in the mid-1980s. In 1993 alone, 14 cases of paresthesia were reported, and all were attributed to articaine or prilocaine. When articaine was first submitted for approval to the Food and Drug Administration in the United States, it was identified as having a higher risk for paresthesia than lidocaine.

Methods and Materials

A multiple-choice survey was administered to dental hygiene instructors to access the determining factors that influence what they are teaching hygiene students on the use of 4% articaine for dental blocks. The aim of the survey was to assess how or if the "hidden curriculum" concerning 4% articaine influence what dental hygiene instructors are teaching dental hygiene students when teaching the use 4% articaine while administering the inferior alveolar nerve block.

The survey was designed to explore the didactic methods that the participating dental hygiene instructors have received, and how the received teaching methods influenced their choice of anesthetic when educating their students.

An online survey using multiple choice questions was emailed to all dental hygiene programs that are CODA accredited programs and that hold an accreditation recognized by the States Department of Education. The survey was sent to dental hygiene program directors, to be forwarded to dental hygiene instructors for completion. The participating instructors gave informed consent by completing a consent form that was administered with the survey.   Surveys were delivered and received using the software Survey Monkey. Participants needed to click on the provided link to access the survey

Results:

A recruitment email, consent from, and web link to the study survey was sent to 322 CODA accredited dental hygiene programs. A total of 70 responses were collected through the online survey website. All surveys were filtered for incomplete and illogical answers. Of the seventy surveys, 10 surveys had questions that were left unanswered for reasons unspecified.

The education level of the survey participants consisted of 2 Certificate, 10 Associate, 18 Bachelor, 26 Graduate, and 4 Doctorate (Figure 1). Ten out of the seventy participants did not answer the education level question.

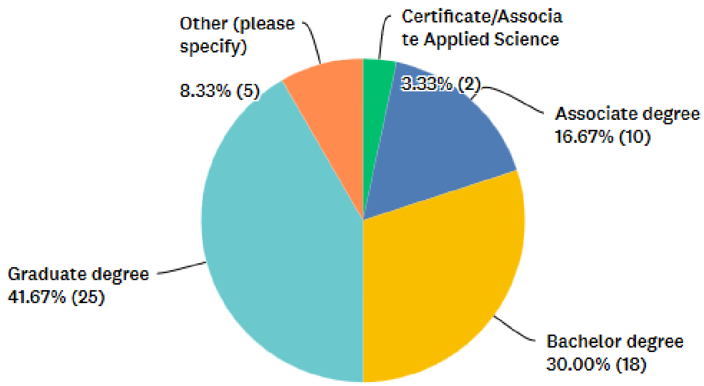


FIGURE 21: NUMBER OF RESPONDENTS BY DEGREE TYPE

Of the participating faculty, 16 listed their faculty position as Professor, 12 Associate Professor, 14 Assistant Professor, 3 Clinical instructor, 4 Adjunct/TA's, and 11 specified themselves under the "other" category that consisted of 5 Program Directors, 2 Coordinators, 3 Instructors (type unknown), and 1 Supervising Dentist (Figure 2). Seventy-five percent (n=43) of the faculty held between 16-30 years of experience (Figure 3). Ten of the respondents did not give a professional title or number of practicing years.

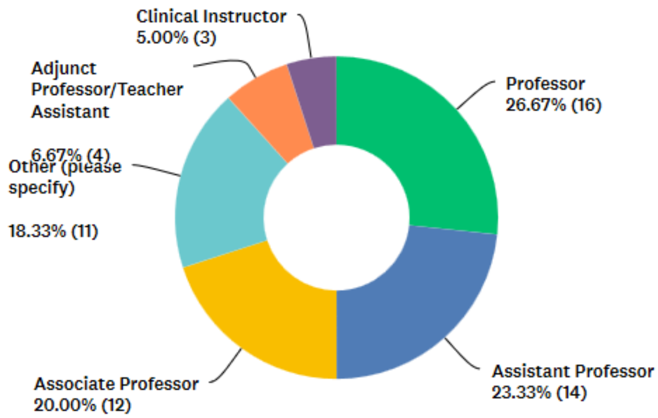


FIGURE 22: FACULTY TITLES/POSITIONS

ANSWER CHOICES	RESPONSES	
less than 5 years	3.33%	2
6-15 years	21.67%	13
16-29 years	36.67%	22
30 years or more	38.33%	23
TOTAL		60

FIGURE 23: PRACTICING YEARS AS A HYGIENIST

All participating instructors answered the local anesthetic practice act question relating to the state in which they practiced. The results showed that 91.43% (n=64) of the participants taught in states that allowed dental hygienists to administer anesthetic, while 8.57% (n=6) taught in states that did not allow anesthetic to be administered by the dental hygienist (Figure 4).

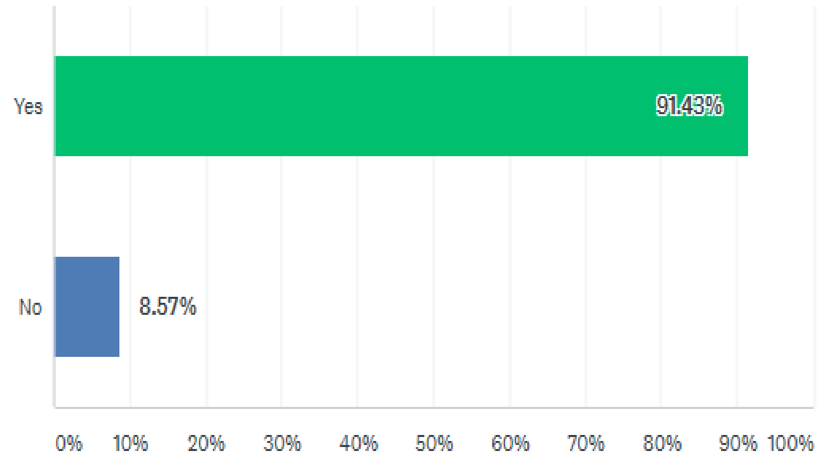


FIGURE 24: HYGIENE ANESTHESIA ALLOWED

Forty instructors (70.18%) reported that they teach the use of 2% lidocaine 1:100,000 as a first choice of anesthesia (Figure 5), and 41instructors (75.93%) reported that they use 2% lidocaine most often during patient care (Figure 6 and Figure 6a). Thirteen participants did not respond to the stated questions.

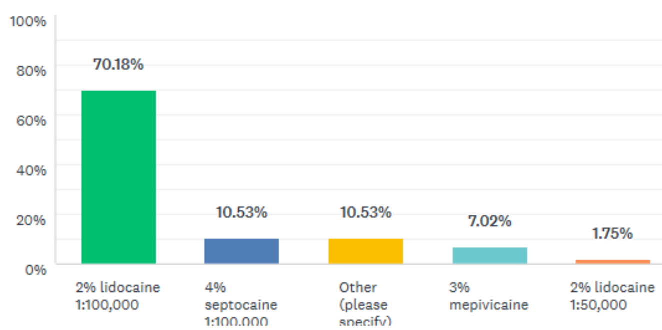


FIGURE 25: FIRST CHOICE OF ANESTHETIC TAUGHT TO HYGIENE STUDENTS

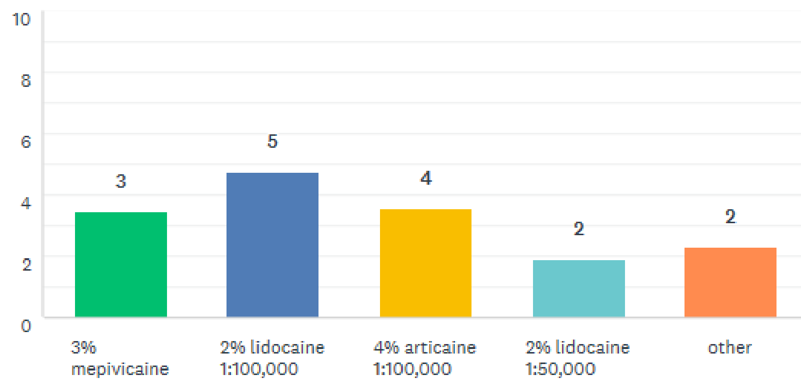


Figure 26A. Anesthetic Used Most Often Ranked

	1	2	3	4	5	TOTAL	SCORE
3% mepivicaine	7.69% 4	44.23% 23	38.46% 20	5.77% 3	3.85% 2	52	3.46
2% lidocaine 1:100,000	75.93% 41	22.22% 12	1.85% 1	0.00% 0	0.00% 0	54	4.74
4% articaine 1:100,000	13.95% 6	34.88% 15	44.19% 19	4.65% 2	2.33% 1	43	3.53
2% lidocaine 1:50,000	2.70% 1	2.70% 1	2.70% 1	64.86% 24	27.03% 10	37	1.89
other	9.38% 3	12.50% 4	12.50% 4	28.13% 9	37.50% 12	32	2.28

Figure 6B: Anesthetic Used Most Often Ranked Table

The number one explanation for the use of lidocaine 1:100,000, as a first choice of anesthetic, was received from 38 respondents (66.7%), stating that 2% lidocaine is safe for most patient use. The second ranked explanation for choosing 2% lidocaine 1:100,000, was its profound pharmacological properties, which was stated by 9 respondents (15.79%), followed by 6 respondents (10.53%) that stated 2% lidocaine was chosen because it was the dentist's choice for office use. Four respondents (7.02%) replied "other" and stated that 2% lidocaine 1:100,000 was considered the "Gold Standard" (Figure 7). Thirteen participants did not respond to the stated questions.

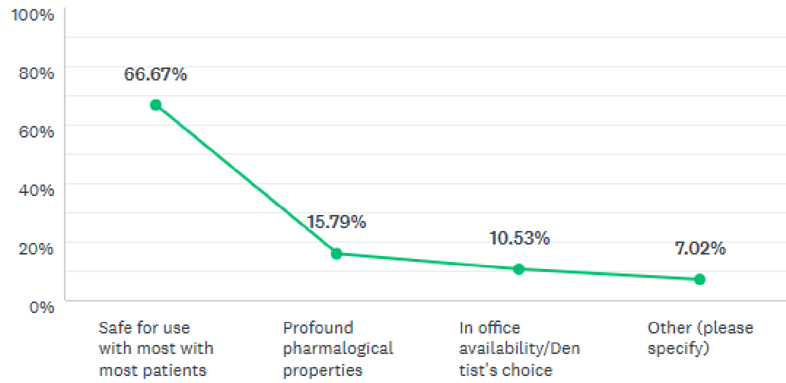


FIGURE 27: RANKED RATIONALE FOR ANESTHETIC CHOICES

When asked which injection(s) was most given to anesthetize teeth #27-32, 82.46% (n=47) of the respondents chose the IA injection for at least one of the injections given to anesthetize teeth #27-32. When asked which anesthetic choice was used most often to anesthetize teeth #17-21, a majority of 87.71% (n=48) choose 2% lidocaine 1:100,000, followed by a tie of 3 responses (5.36%) of 3% mepivicaine and 3 responses (5.36%) of 4% articaine 1:100,000 (Figure 8).

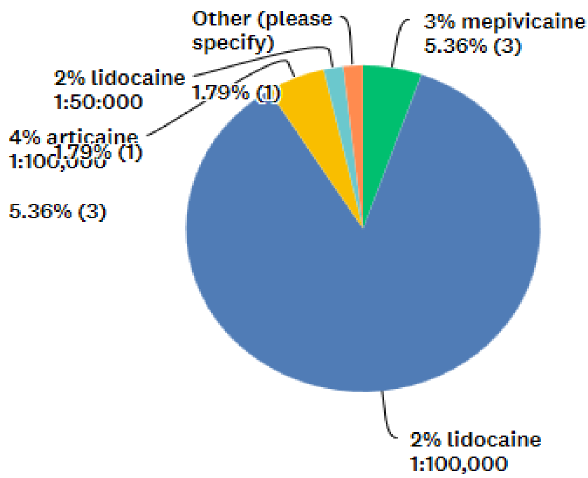


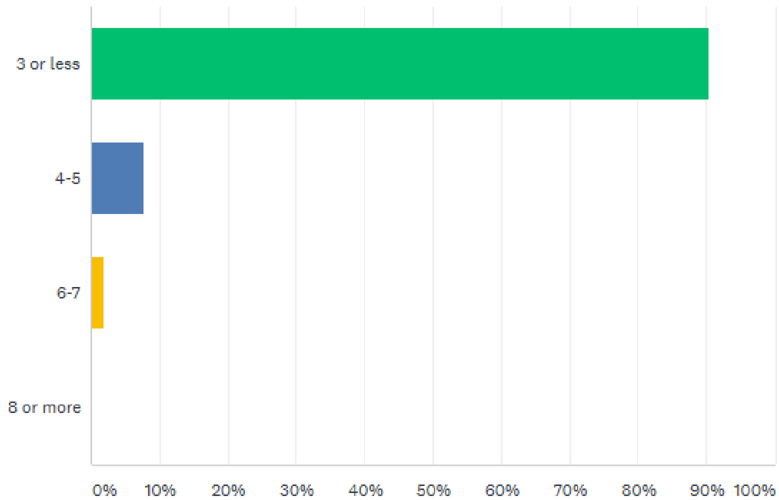
FIGURE 28: ANESTHETIC MOST OFTEN USED FOR TEETH #17-21

On a weighted scale, 25.45% (n=14) of the participating instructors stated that they were not comfortable administering 4% articaine with the inferior alveolar block. About 14.55% (n=8) stated that they were somewhat comfortable, and 25.45% (n=14) stated they were neutral when administering 4% articaine with the inferior alveolar block. While over 70% (n=40) of the hygiene instructors reported that they taught their students to use 2% lidocaine 1:100,000 as their first choice of anesthetic, when giving the IA injection, they also chose 2% lidocaine as a first choice during patient care at 75% (n=41). Over 60% (n=33) of the participants stated that they were neutral to very comfortable using 4% articaine when giving the inferior alveolar injection (Figure 9). Yet, when asked the maximum number of cartridges of 2% lidocaine 1:100,000

NOT COMFORTABLE	SOMEWHAT COMFORTABLE	NEUTRAL	COMFORTABLE	VERY COMFORTABLE	TOTAL	WEIGHTED AVERAGE
25.45% 14	14.55% 8	25.45% 14	14.55% 8	20.00% 11	55	2.89

FIGURE 29: COMFORT LEVEL ADMINISTERING 4% ARTICAINE FOR THE IA INJECTION

administered in a single appointment, in comparison to the maximum number of cartridges of 4% articaine 1:100,000 or 1:200,000 administered in a single appointment, the instructors were less likely to administer more than 3 cartridges of 4% articaine 1:100,000 or 1:200,000, with 4 respondents (7.69%) having administered 4-5 cartridges in a single appointment, and 1 respondent (1.92%) having administered 6-7 cartridges in a single appointment. None of the instructors gave more than 8 cartridges of 4% articaine in a single appointment (Figure 10). Instructor's responses showed that they were more willing to



ANSWER CHOICES	RESPONSES	
3 or less	90.38%	47
4-5	7.69%	4
6-7	1.92%	1
8 or more	0.00%	0
TOTAL		52

FIGURE 30: 4% ARTICAINE 1:100,000 OR 1:200,000 CARTRIDGES ADMINISTERED IN A SINGLE APPOINTMENT

administer higher doses of 2% lidocaine 1:100,000 in a single appointment. Twenty-three respondents (40.35%) stated that they administered 4-5 cartridges in a single appointment. Three respondents (5.26%) stated that they administered 6-7 cartridges in a single dose, and 2 respondents (3.51) stated that they administered 8 or more cartridges in a single appointment.

Discussion:

Previously referenced Studies of Haas and Lennon,[5] Hillerup and Jensen,[12] and Gaffen and Haas,[11] suggest that increasing local anesthetic concentrations, increases neurotoxicity in vitro. These studies found that an overall incidence of paresthesia to range from 1:27,762 - 1:785000, with the two drugs most often implicated being 4% articaine and 4% prilocaine.

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Though the controversial research on 4% articaine is not definitive,[8,9] the studies of 4% articaine is an ideal example of the hidden curriculum. The hidden curriculum is used to bridge the gap between formal and informal curriculum and can contribute to the self-regulation in the medical world.[1] It is the informal perspectives that give physicians, dentists, and hygienist reason to reconsider anesthetics choices in everyday practice, and provides the basis for dental hygiene instructors to train dental hygiene students to follow suit.[1]

Of the 70 dental hygiene respondents, 7-8% (n=10-12) of the participants did not answer all questions. The purpose of the study was to assess whether the informal training, known as the "hidden curriculum," produced objections or raised concerns of dental hygiene instructors on teaching dental hygiene students whether to the administer 4% articaine 1:100,000 when administering the inferior alveolar nerve block . When hygiene instructors were asked which injection(s) was most given to anesthetize teeth #27-32, 82.46% (n=47) of the respondents chose the IA injection for at least one of the injections given to anesthetize teeth #27-32. When asked which anesthetic choice was used most often to anesthetize teeth #17-21, a majority of the instructors, 87.71% (n=48), choose 2% lidocaine 1:100,000, followed by of 3% mepivicaine 5.36 (n=3) and of 4% articaine 1:100,000 5.36% (n=3).

Conclusions:

The collected data would suggest that the "hidden curriculum" influences teachings, as well as the practices of the participating instructors. Though the survey results show that 60% (n=33) of the hygiene instructors stated that they felt neutral to very comfortable administering 4% articaine 1:100,000 while giving the IA injection, forty instructors (70.18%) reported that they teach the use of 2% lidocaine 1:100,000 as a first choice of anesthesia, and forty-one instructors (75.93%) reported that they use 2% lidocaine 1:100,000 most often during patient care. Moreover, when actually administering 4% articaine 1:100,000, the survey analysis shows that the dental hygiene instructors were less likely to use 4% articaine in larger amounts, to include both the epinephrine doses of 1:100, 000 and 1:200,000. Results for the use of 4% articaine 1:00,000 or 1:200,000 administered in a single appointment was 3 or less cartridges given by 90.38% of the respondents (n-47), 4-5 cartridges administered by 7.69% (n=4) , and 6-7 cartridges administered by 1.92% (n=1). The results for administering 2% lidocaine 1:100,000 in a single appointment resulted in 40.35% (n=23) of instructors that had given 4-5 injections in a single appointment, 5.26% (n=3) that has given 6-7 cartridges and 3.51% (n=2) that has administered 8 or more cartridges in a single appointment. About 49.12% (n=28) or half of the hygiene instructors gave 4 or more cartridges of 2% lidocaine 1:100,00 in a single appointment Ninty percent of the instructors were not willing to give more 3 cartridges of 4% articaine in a single appointment.

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