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Periodontal Resident Self-Assessment of Ergonomics Before and After Videotaped Surgeries

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Periodontal Resident Self-Assessment of Ergonomics Before and After Videotaped Surgeries

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in Dentistry at Virginia Commonwealth University.

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PERIODONTAL RESIDENT SELF-ASSESSMENT OF ERGONOMICS BEFORE AND AFTER VIDEOTAPED SURGERIES

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Objective: To examine whether self-assessment of videotaped surgeries helps improve periodontal residents' ergonomics. **Methods:** Residents (n=8) provided self-assessments of their own ergonomics while performing periodontal surgery using a questionnaire with open and closed items. Data collection: (1) immediately after the resident performed surgery; (2) after videotape review (PSV1); (3) after review of a second videotaped surgery (PSV2). Results were analyzed using quantitative and qualitative means. **Results:** Comparison of responses resulted in a change between Pre-video Surgery 1 and PSV1 ($p<0.05$) and between the three occasions for

flat foot and horizontal shoulder positions ($p<0.05$). Resident goals were most numerous for improving positions of shoulder, back and neck and most notable responses for failure to achieve goals were the need for surgical access and being too focused the procedure. **Conclusions:** Videotape review is a valid means of self-assessment. Intervention solely in the form of a questionnaire and videotape review was insufficient in its ability to change the residents' ergonomics. Barriers to implementation of proper ergonomics were identified.

KEY WORDS

Ergonomics; dentistry; surgery; periodontics; self-assessment; videotape review

Text

INTRODUCTION

Ergonomics originates from the Greek word “ergon” meaning work and “nomia” meaning laws – literally the “laws of work”. A more modern definition is: the applied science of designing and arranging the things people use so that the “people” and the “things” interact with the greatest degree of efficiency and safety.[1] According to *Webster’s Dictionary* the term did not enter the lexicon until 1949.[1] Although the word did not exist for nearly one hundred years after the creation of our profession, the practice of dentistry was never immune to the effects of ergonomics and of the ill-effects of not utilizing them correctly.

While the study of ergonomics is not new to dentistry, the bulk of research regarding it is relatively recent. The effects of poor ergonomics have been reported in the literature as far back as 1946, when a survey reported that 65 percent of dentists complained of back pain.[2] The majority of research emerged subsequent to the 1960’s when the practice of dentistry evolved from one where the practitioner stood while working, to the notion of sit down, four-handed dentistry. Even after this development and the fabrication of ergonomic equipment, studies have found back, neck, shoulder or arm pain present in up to 81 percent of dentists.[3-6]

The World Health Organization defines a musculoskeletal disorder (MSD) as a disorder of the muscles, tendons, peripheral nerves or vascular system not directly resulting from an acute or instantaneous event.[7] As dentists, we often assume static postures, which require more than 50 percent of the body's muscles to contract enabling the body to remain motionless.[7] Such force, which results from sustaining a static posture, has been shown to be more taxing than dynamic, or moving, forces.[7] The risk of injury increases whenever work requires a person to perform tasks with body segments outside their neutral range in a deviated posture.

The human body depends on movement for survival.[7] As dental practitioners we often contort ourselves, often for sustained time periods, into whatever position is necessary to obtain access to the oral cavity.[8] While the body has the amazing capacity to adapt to this abnormal posture, such adaptation of posture can lead to muscle necrosis, pain and protective muscle contractions.[7] Furthermore, when we maintain ourselves in an immobile, or semi-immobile, state we put ourselves at risk for development of MSDs.

A review of the literature identifies risk factors that are inherent to the practice of dentistry. Examples of such risk factors include prolonged static posture, repetitive movements, genetic predisposition, mental stress, mechanical stress, extrinsic stress, physical conditioning, age, non-work activities, awkward positions, poor posture, poor postural muscle strength, poor flexibility, infrequent breaks, inappropriate selection and use of dental stools and magnification aids, vibration and cold temperature. The multifactorial nature of MSDs makes it difficult to pinpoint the exact exact etiologic factors.[3,6,8-12]

While the direct etiology of the development of MSDs is difficult to discern, we know that the practice of dentistry is associated with difficulties in visualization of the working area, and

specific clinical tasks that demand concentration and precision.[13] This includes occupational patterns typically displayed by dentists including cervical flexation and rotation, excessive use of small muscles, repetitive precision demanding tasks, tight grips, fixed working conditions, positions with raised arms, limited movements and long-term static load on muscles.[12,14,15] Specifically, periodontists are predisposed to neck, shoulder, and hand/wrist pain due to static postures combined with forceful repetitive movements that are inherent to the job.[3] This may result in decreased function, range of motion, and elasticity of tissue strength as a result of degenerative arthritic changes in the spine related to repetitive micro-trauma.[16]

The effects of working under such conditions have consequences that extend well beyond physical disability. Burke et al. found that MSDs were the most frequent cause of early retirement among dentists.[17] According to various authors, the disability of MSDs account for 1.7 lost work days per dentist of a total of 3.7 days of absenteeism due to illness, and can cost upwards of $45 billion as measured by compensation costs, lost wages and lost productivity.[12,15,18] Droeze et al. found that the mean working hours before complaints started was 34 hours per week.[12] Studies have shown the prevalence of at least one MSD complaint among dentists range from 60 – 93 percent with lower back, neck and shoulder pain being most common.[15,18-25]

As recent as 1995, dental schools have included didactic training in biomechanics and occupational stress as part of the curriculum.[26] However, according to the 2008-09 Survey of Dental Education only one dental school provides such didactic training. This is reinforced by data from an unpublished survey from the American Dental Association which revealed that that 62% of dentists in private practice reported receiving inadequate training on the applications of ergonomics when attending dental school.[11,27] It may be extrapolated from the available literature

that ergonomic training in dental schools is lacking, and that graduates of most programs may be unprepared to face the rigors of clinical dentistry.

A main goal of surgical residency program is to ensure their graduates meet proficient levels of technical and cognitive competence. However, methods utilized to ensure technical competence are not as sophisticated as those used in assessing cognitive ability. Often, residents must rely solely on the visual observation of others to provide feedback on technical skill. Mechanisms that provide the resident the ability to critically evaluate their own work are usually not in place. As the educational system evolves, curriculums have begun to rely less upon lectures and laboratory exercises with scaled assessment, resulting in a shift in responsibility being placed on the student. [28] In this new paradigm, the ability of the student to reflect on, and learn from, experiences is paramount.

"Reflective practice is a recognized pedagogical method which encourages active learning as it allows experiences to be considered not only by thought and feeling, but also by action".[29,30] Schon is often credited with the notion of reflection in which learning occurs when we integrate experience with reflection and the theory of practice.[31] He suggested that reflection is not constant and that reflection on action enables us to spend more time exploring why we act as we do. Furthermore, he studied the efficacy of these methods in the fields of medicine, nursing and education. While various researchers have argued about whether experience is the basis of learning, they agree that it can also occur through reflection.[29]

According to the General Dental Council, "Learning opportunities and experiences should be designed to encourage a questioning, scientific and self-critical approach to dental practice, and to foster the intellectual skills required for future personal and professional development".[32] This

is aligned with Schon's second type of reflection, "reflection on action", where the methodology focuses on getting the students to reflect back on action and their learning in order for them to discover how their "knowing in action" may have contributed to an unexpected outcome.[31] Furthermore, when we examine the methodology used by Kottkamp's view of "working offline" wherein reflection on action can be analyzed at a time when full attention can be given without the need to take any immediate action.[33] We begin to build a foundation of learning centered in reflection, where we learn by doing and realize what came of what we did.[29,34] Reflection is a highly skilled activity that requires the ability to analyze actions and beliefs and the intelligence to make judgments about their effectiveness.[29]

Reflection is only useful if learners know how to properly self-assess. According to Klenowski, the definition of self-assessment is the evaluation or judgment of the worth of one's performance and the identification of one's strengths and weaknesses to improve one's learning.[35,36] This method of learning is currently being evaluated within the dental education literature for efficacy in the dental curriculum. Knight, a leader in dental education self-assessment, has contended that the skill of self-assessment encourages students to assimilate their knowledge and compare their analysis with expert opinion.[37] The result of incorporating self-assessment with reflection on learning leads to an increase critical thinking, problem solving and decision making.[37,38] Perhaps most importantly, self -assessment may help students develop skills necessary to judge their own abilities, both now and in the future, as independent practitioners.[39]

While self-assessment has the potential to play an important role in dental education, it is often underutilized and misunderstood by students. In Gordon's 1999 review of the validity of self-assessment in health profession training, he noted that self-assessment skills remained underdeveloped during training.[40-41] Several studies have documented methods to improve the

effectiveness, validity of and accuracy of self-assessment. They contend that effective programs must have the following characteristics: (1) an expectation that learners would systematically gather and interpret data on their performances and (2) formal requirements to reconcile learners' self-assessment with credible external evaluative sources.[40] Therefore, it is not uncommon for learners to have difficulty adjusting to this new approach to learning. However, once adjusted they tend to show improvements.[42]

In athletics it is not uncommon to critically review video recordings of performances to serve as a guide for future efforts.[43] Building on this methodology, several institutions have sought to improve surgical techniques and medical skills, especially during training exercises.[44-48] There are several possible reasons as to why videotape review enhances performance. First, objective evidence of an individual's performance is often the first step in effecting a change in behavior; second, videotape review provides accurate, real-time data that cannot be disputed and is an effective motivator of change.[44] This builds on the intuitive premise that external feedback and reflection on one's own performance are effective mediators for development of both cognitive and technical processes.[43]

The benefits of utilizing videotape review in dentistry are vast. Foremost, it allows for identification of incongruities in perceived self-efficiency – or the disparity between the behavior participants think they are performing versus the behavior they actually perform.[49] Furthermore, once this behavior is identified as good it can be modeled and reproduced by the participants and likewise, if the behavior is identified as bad it can be corrected.[44] The review of videotapes allows for a real-time review of what can be an anxiety-provoking situation, and thus, providing time for critique that is removed from the actual event and the pressures often encountered while providing patient care.[50]

To be valid, video assessment must allow learners to set their own standards, evaluate whether or not they met their goals, and reward themselves if they performed well.[51,52] Furthermore, the assessment must reflect the learning objectives of the teaching, and be based on guidelines that are well-accepted and reflect real-life situations.[53,54] The assessment must also be reliable. Winckel et al. suggested the use of a checklist and multiple observations of the performance in an effort to reduce inter-rater variability.[55] Utilizing these measures, researchers have noted that self-evaluation using video enhances knowledge retention, promotes critical thinking and motivates learners to become more engaged in their learning.[56-60]

Given the significant impact that improper ergonomics may have on a clinician's ability to practice dentistry, we have sought to provide the periodontal resident with the ability to self-assess their ergonomics. Specifically, we examined whether self-assessment of videotaped surgeries helped to improve periodontal residents' ergonomics. Furthermore, we focused on (1) the resident's perceptions of their ergonomics in real-time following periodontal surgical procedures, (2) the residents' perceptions of their ergonomics following review of videotaped surgeries, (3) how the residents' assessments correlated to one another, (4) the typical ergonomics flaws made by periodontal residents, (5) specific goals periodontal residents establish to improve their ergonomics, and (6) whether periodontal residents sought to improve their ergonomics.

METHODS

This study was conducted between September 2010 and January 2012 at the Virginia Commonwealth University (VCU) School of Dentistry within the Department of Graduate

Periodontics. Informed consent was obtained from participating residents according to guidelines set forth by the University's Institutional Review Board.

Case Selection

Surgical cases were selected from the schedules of the first, second and third year periodontal residents (class years 2011, 2012, 2013, 2014). Inclusion criteria for case selection included flap surgeries, soft tissue grafting/augmentation, gingivectomy, hard tissue grafting procedures and impacted tooth exposure. Exclusion criteria consisted of examination/consultation visits, scaling and root planing, implant placement, esthetic crown lengthening and extractions without site preservation. An attempt was made to exclude procedures and clinical situations where provider ergonomics may be compromised. For example, during implant placement surgery the surgeon must check for parallelism. This may involve contorting or repositioning themselves thereby temporarily displaying improper ergonomics. Surgical cases meeting the above requirements were selected from the residents' surgical schedules by the author (CM) at least one day before the actual surgery so that appropriate arrangements could be made for videotaping.

Video Recording and Editing

Surgeries were videotaped using pre-existing video recording equipment installed in a single operatory at the Graduate Periodontal Clinic. A single overhead color, fully adjustable camera was used to record each surgical procedure from a fixed vantage point. Camera zoom level was fixed to include the right handed operator's feet, legs, hips, torso, arms, hands and head (see Figure 2 for a screen shot of a participant video). Video was captured and stored in standard Digital Video Disc (DVD) format. Editing was accomplished utilizing standard video editing software (Adobe Premier Pro CS5.5, Adobe Systems Incorporated, San Jose, CA, USA).

Surgical procedures were edited to exclude the following content: (a) all times when the operator was not present; (b) administration of local anesthesia; (c) taking of intra-operative radiographs; (d) faculty observation/consultation; (e) patient restroom breaks; (f) patient consultation. Following initial editing, the remaining recorded material was further subdivided into three 3-minute segments representing the beginning, middle and end of the surgery. We elected to have the participants view a nine minute portion of the video as opposed to the entire procedure as it occurred in real-time. We felt this was appropriate because it was not feasible to expect the participants to view and assess a procedure that may last as long as three hours. Furthermore, a review of the literature suggests that including video corresponding to a portion of the procedure is representative of the procedure in total.[53] Initial editing was performed by dental student TG and final editing by CM. Final editing was to be completed within 2 weeks for each procedure.

Experimental design, Assessment and Videotape Review

A graphical representation of the experimental design may be seen in Figure 1. Each participant was provided with a one-time pre-study questionnaire (Appendix I) that included information on demographics, past MSD experience and perceptions of proper ergonomics. This closed-ended survey was created as a modification from several sources on dental ergonomics and consisted of free answer, yes/no and Likert scale type questions.[2,61] A questionnaire (Appendix II, III, IV) was utilized by participants to assess their ergonomics. The questionnaire served as a guide to performing ideal ergonomics as well as a tool for self-assessment.[62] The questionnaire was designed as a modification of several papers on dental ergonomics.[2,7,61,63,54] Questions were framed as closed ended, Likert scale and multiple choice. Both the pre-study questionnaire and

self-assessment questionnaire were verified by a panel of four active dentists on staff at the VCU School of Dentistry for feasibility, appropriateness and clarity.

The questionnaire was provided to each participant for review before the surgery to be assessed. This review was allowed because it served as a learning guide towards proper ergonomics and the same questionnaire was used by the participant throughout the study. Immediately following the completion of Surgery 1, each participant was asked to assess their ergonomics utilizing the questionnaire (Appendix II). Each participant was provided with detailed instructions on how to perform the assessment. After a minimum of two weeks following Surgery 1, each participant was provided with a DVD corresponding to his/her surgical procedure (PSV1). This time frame was chosen so that answers to the previous self-assessment questionnaire could not easily be recalled from memory. Each participant was provided with detailed instructions on how to view the DVD video and perform the assessment utilizing the questionnaire (Appendix III). In addition, each participant was asked to provide three ergonomic-specific goals they wish to achieve by the end of the study.

Following video review of Surgery 1, each participant was allotted four weeks for self-reflection and unassessed practice of proper ergonomics.[62] Thereafter each participant was videotaped again for Surgery 2. Within two weeks following the completion of Surgery 2 each participant was provided with a DVD corresponding to his/her surgical procedure (PSV2), along with detailed instructions on how to view the DVD video and perform the assessment utilizing the questionnaire (Appendix IV). Each participant was also provided with their individual ergonomic-specific goals (provided after video assessment of Surgery 1), and asked questions regarding their progress.

Statistical Analysis

Analysis of participant responses occurring before and after videotape review was assessed using Pearson's Chi Square test. A two-tailed p-value less than 0.05 was considered as evidence of a significant difference.

Thematic analysis was used to analyze the participants' hand-written responses. The technique used for thematic representation and data coding was based on a protocol recommended by Taylor and Bogdan.[65] This protocol (1) looks for words or phrases that capture the meaning of what is said (2) identifies themes, and compares statements with other subjects seeing if there is a concept that unites them, and (3) looks for similarities between themes.[53] In this study, participants were asked if they achieved their goals, how they sought to achieve them and if not achieved, the reason why not. Narrative comments were read by two authors (CM and SL) who agreed on categories. Comments related to each category were tallied and percentages were calculated.

RESULTS

Study population

A total of twelve periodontal residents (class years 2011-2014) were eligible to participate in the study. Four residents did not complete the study due to (a) two residents withdrawing from the program prior to completion of data gathering, (b) insufficient amount of scheduled surgeries, (c) technical errors in video recording and editing. Eight periodontal residents completed the study. All data from participants who do not complete the study were excluded from interpretation.

Participant surgeries consisted of 14 procedures in the maxilla and 14 in the mandible, with 4 consisting of surgery to both arches simultaneously. Surgical quadrant location was less evenly

distributed with 10 for the lower right, 12 for the upper left, 4 for the upper right and the lower left, and 6 consisting of surgery to two arches simultaneously. Due to the small number of subjects no association between surgical arch and quadrant could be identified.

Demographics

Table 1 summarizes the pre-survey questionnaire (Appendix I) gathered from the participants. The average experience was 3.12 years. Eighty-seven and one-half percent of participants agreed that ergonomics play a critical role in dentistry and that they are knowledgeable regarding proper ergonomics. Sixty-two and one-half percent reported that proper ergonomics were part of the curriculum in dental school or residency, and seventy-five percent reported they have received critical feedback on their ergonomics. When questioned regarding lower back pain/stiffness, neck pain/stiffness and shoulder pain/stiffness while performing periodontal procedures, participants responded with 62.50%, 62.50% and 12.50% respectively. With respect to pain experienced at the end of the day in the lower back, neck and shoulders, the participants reported that 87.50%, 50.00% and 12.50% experienced mild pain, respectively. While 87.50% of participants reported they were knowledgeable in the implementation of proper ergonomics, only 50.00% felt strongly confident, or confident, in their ability to properly establish ergonomics. One-hundred percent of participants reported they adjust the height of the operator's chair, 25.00% adjust the lumber support and 12.50% adjust the hip angulation.

Participants' Perceptions of Their Ergonomics Prior to Videotape Review

Table 2, column 1 depicts the cumulative responses of the participants' perceptions of their ergonomics immediately following surgery and before reviewing a video of the procedure. While it is beyond the scope of this paper to review and discuss the design and utilization of proper

ergonomics in dentistry, the participant's questionnaire (Appendix II-IV) included questions in the areas of (a) torso/hip position, (b) foot/leg/knee position, (c) shoulder position, (d) elbow position, (e) orbiting range and (f) neck position.

When asked questions regarding torso position, no participants perceived their torso to be in the correct position at any time point. Furthermore, participants reported that between 50.00-75.00% of the time they were rotating, forward bending or twisting their torsos throughout the procedure. Half of the participants reported they perceived their hip/torso angle to be correct throughout the procedure. With respect to foot/leg/knee position, 25.00% of participants reported correct foot orientation, 37.50% of participants reported correct foot/leg angle and 12.50% of participants reported having a correct leg/knee angle. Shoulder position within the vertical, horizontal and lateral planes was also questioned. Thirty-seven and one-half percent of participants perceived correct vertical and lateral shoulder positions, and 12.50% of participants perceived correct horizontal shoulder position. A majority of participants reported their shoulders to be elevated, right elevated more than left and shoulders adducted throughout the procedure. When asked questions regarding elbow lateral elevation and flexure during the procedure, 37.50% of participants responded with a normal lateral elbow elevation and 12.50% of participants a normal elbow flexure. Moreover, 62.50% of participants reported having a greater than normal lateral elbow elevation and 37.50% of participants greater than normal elbow flexure. When asked questions regarding neck flexure and lateral position, 12.50% of participants reported normal flexure and no participants reported correct lateral position. Seventy-five percent of participants perceived hyperextending their necks, and 75.00% of participants reported having an incorrect lateral neck position at some point during the procedure. Two-thirds of participants reported operating within the correct orbiting range during the procedure.

Participant Perceptions of Their Ergonomics Following Videotape Review

Table 2, column 2 and 3 illustrate the cumulative responses of the participants' perceptions of their ergonomics after reviewing their videotaped surgeries, which were accomplished no earlier than two weeks from the date of surgery 1 (PVS1) and four weeks from surgery 2 (PVS2). The survey categories are the same as in the previous section.

When asked questions regarding the position of their torso position, 12.50% (PSV1) and 0.00% (PSV2) reported no twisting, 37.50% (PSV1) and 12.50% (PSV2) no bending and 12.50% (PVS1, PSV2) no rotation. However, the majority of participants still reported that torso twisting, bending and rotation were apparent throughout the majority of their respective procedures. The hip/torso angle responses did not differ much from the pre-video to each of the post-videos. With respect to foot/leg/knee position, 87.50% (PSV1) and 75.00% (PSV2) of participants reported correct foot orientation, 50.00% (PSV1) and 62.50% (PSV2) reported correct foot/leg angle and 37.50% (PSV1) and 25.00% (PSV2) reported having a correct leg/knee angle. With respect to shoulder vertical, horizontal and lateral position, 75.00% (PSV1) and 62.50% (PSV2) perceived correct vertical, 25.00% (PSV1) and 37.50% (PSV2) correct horizontal and 50.00% (PSV1) and 62.50% (PSV2) correct lateral position. When asked questions regarding elbow lateral elevation and flexure during the procedure, 50.00% (PVS1, PVS2) responded they perceived a normal lateral elbow elevation and 50.00% (PSV1) and 25.00% (PSV2) perceived a normal elbow flexure. When asked questions regarding neck flexure and lateral position, 0.00% (PVS1) and 12.50% (PSV2) of participants reported normal flexure and only a single participant from PVS2 described a normal lateral position. The majority of participants, 87.50% (PSV1) and 100.00% (PSV2), reported operating within a normal orbiting range during the procedure.

Correlation of Pre-video to Post-video Responses

Analysis of the frequency of normal responses from the pre-video to PSV1 and PVS2 using Pearson's Chi Square test showed a significant change occurred between pre-video and PVS1 with p=0.007. Examining Table 2, columns 1 and 2, it is evident that the participants' perception of their ergonomics (pre-video) differed when reviewing a videotape of their surgery. With the exception of the hip/torso angle and neck flexure, every other category showed improvement between time periods.

Analysis of the cumulative responses to each categorical outcome (Table 2) from pre-video to both PVS1 and PVS2 using Pearson's Chi Square test shows a significant change for foot flat position, p=0.024, and for shoulder horizontal position, p=0.043. Therefore, with exception of the two aforementioned outcomes, the participants in this study did not show vast improvement in all categories of their ergonomics by the end of the study period.

Common Ergonomic Errors

Figures 3-6 depict the participants' normal responses for the torso, lower extremity, shoulder, elbow, and neck positions. Figure 3 shows that with the exception of hip/torso angle, aberrant torso positions were either perceived, or noted, by the participants for bending, twisting and rotating. Figure 4 shows that most participants, on average, perceived, or rated, they displayed incorrect knee/leg angle position. Figure 5 shows that most participants perceived, or rated, increasing normal responses in shoulder vertical, horizontal and lateral positions. However, only the change in shoulder horizontal position was found to be statistically significant from the pre-video to PVS1 and PVS2 assessments. It may also be noted from the cumulative responses that most participants perceived or rated their horizontal shoulder position as abnormal more often

than both vertical and lateral positions. While this is not a significant finding, it is of interest to note that participants perceived, or rated, their left shoulder to be elevated more often than their right shoulder (Table 2). Figure 6 shows that elbow flexure was on average more often incorrect than lateral elbow position. Figure 7 shows that the majority of participants perceived, or rated, their neck flexure or lateral position as incorrect across the various assessments.

Thematic Analysis

Tables 3 depicts each of the participant's goals classified and correlated to the appropriate survey categories of: (a) torso bending, twisting, and rotation positions, (b) neck lateral and flexure position, (c) shoulder horizontal and vertical position, (d) lower extremity goals for foot, leg and knee position, and (e) elbow lateral and flexure position. The greatest frequency of participant responses included 37.50% for goals pertaining to torso position, 25.00% for neck position, and 25.00% for shoulder position.

Table 4 depicts the methodology utilized by the participants to achieve their goals. Responses, when provided, were analyzed for commonality and stratified into the following categories: (1) cognitive, (2) equipment modification, (3) patient modification, (4) assistant interaction and (5) other. It is of interest to note that 50.00% of goal implementing strategy was cognitive in nature, suggesting that participants sought to change their behavior solely by thinking about their actions. The remaining 50.00% of responses encompassed the abovementioned categories (2-5), suggesting participants took various actions to modify their behavior. The most frequent of these actions was 27.77% associated with modification of dental equipment. Examining Table 4 as a whole, we can extrapolate various themes as to how the participants sought to achieve their goals. Responses can be classified into (a) thinking about their ergonomics during the procedure,

(b) moving and adjusting the provider chair, (c) keeping their backs straight and sitting back in the chair and (d) adjusting the patient so proper ergonomics could be achieved. No association between participants' responses and questionnaire categories of body position could be identified.

Table 5 depicts the responses provided by the participants, when provided, as to why they did not achieve their respective goals. Responses were analyzed for commonality and stratified into the following categories: (1) access/visualization, (2) equipment, (3) attempt with need for improvement, (4) instrument control and (5) no response provided. It is of interest to note that 52.94% of barriers to goal implementation centered on issues of access and visualization of the surgical site. While the remaining 47.06% of barriers to goal implementation centered on categories 2-5 mentioned above. Moreover, from Table 5 we can see that a single participant was unable to articulate any reason for failure to achieve their goals. Examining table 5 in total, various commonalities can be identified as to why the participants failed to achieve their respective goals. Responses were classified into the following categories: (a) necessity for surgical access and visualization, (b) more focus on the procedure than ergonomics, (c) the realization that the provider chair or patient chair needs to be adjusted and (d) the need for proper instrument control. No association between participants' responses and questionnaire categories of body position could be identified.

DISCUSSION

For dentists, proper implementation of ergonomic principles is of upmost importance in ensuring a long, productive, healthy, and pain free career. However, implementation of these principles often goes underutilized by practicing dentists. To our knowledge, this is the first study to utilize

videotaped self-assessment of a practitioner's ergonomics within the confines of a post-doctoral periodontal program. Most studies examining dentist-related ergonomics are aimed at risk-identification, with some offering recommendations.[12] In its purest form, the goal of this study was to determine if self-assessment of videotaped surgeries can help improve the participant's ergonomics. With the small, heterogeneous subject population used in this study, our findings may not allow for definitive conclusions regarding our hypothesis, nor definitive conclusions that the null hypothesis is indeed correct. That said, however, many insightful and useful conclusions may still be drawn.

Various works on the prevalence of MSDs among dental care providers place the range between 60.00-90.00% with lower back, neck and shoulder pain being most common.[15,18-25] From our demographic data, it is noted that 87.50% of participants reported they experienced lower back pain/stiffness, 50.00% neck pain/stiffness and 12.50% shoulder pain/stiffness. While our finding of lower back and neck pain coincides with the available literature, the prevalence of shoulder pain is below the averages found elsewhere. This may be due to the small sample size, the young age of the participants and the fact that participants have only had an average of 3.12 years of clinical experience beyond dental school.

The participants in this study graduated from six different accredited dental schools within the United States and Canada. On average, 62.50% reported that dental ergonomics were part of the curriculum within dental school or residency. It is unknown whether the training the participants received was didactic in nature, as an ancillary part of a dental school course, or verbal recommendations from an instructor. However, it is clear the training was inadequate as only a single participant (12.50%) felt strongly confident in their ability to establish proper ergonomics.

These results are the unfortunate consequence of training programs placing emphasis on what is done as opposed to how it is accomplished. In a study by Thorton et al, a properly implemented ergonomic awareness program within the dental academic environment must be designed to evaluate specific tasks and provide diagnostic feedback to students.[11] The components include: (a) information gathered by assessing student behavior. This is accomplished by direct observation of behavior in order to outline the scope of the problem and developing and implementing a program; (b) obtaining administrative support such as committing resources to training and research, with the assumption that with such administrative support the student support will follow; (c) performing a job analysis that includes identification of specific job tasks that place students at risk, determination of the existence of symptoms and most importantly, the determination if a relationship exists between MSDs and symptoms; (d) faculty development including obtaining appropriate training from professionals experienced in the application of biomechanics that may allow faculty to identify job tasks that predispose students to develop MSDs and (e) proactive ergonomics, which includes implementing control strategies such as changing workstation layout, work positions and training students to identify risk factors.

In our study, the primary method of ergonomic intervention was a questionnaire-guided self-assessment that served not only as a means to evaluate participant ergonomics, but also as a learning tool, or guide, to performing proper ergonomics. The questionnaire was based upon various works in the dental ergonomic literature, as well as a derivation of the Standardized Nordic Questionnaire for the analysis of musculoskeletal symptoms.[61] The use of questionnaires in self-assessment programs have been noted throughout the available literature. Ward et al., in a study of medical resident self-assessment of a surgical procedure, used a global rating scale that was based on previously published and validated material pertaining to the surgical procedure.[57]

Similarly, Watts et al. and Yoo et al., used a checklist questionnaire in a study of nursing students ability to self-assess their psychomotor abilities.[35, 62] In these studies, similar to ours, the questionnaire served not only as means to self-assess, but also as a guide to performing the procedure. On the contrary, Zick et al. noted that most studies on self-assessment use a scale or questionnaire that allows comparison of participant answers to a standardized value.[72] They noted value in using an open-ended self-assessment to better gauge strengths and weaknesses, even if it offers a somewhat less comprehensive overview. Our study utilized a standardized questionnaire as well as a qualitative, open-ended portion allowing participants to freely note their strengths and weaknesses. We found this combination of quantitative and qualitative methodology allowed for a more complete overview of the participant's self-assessment.

The second method of ergonomic intervention utilized in this study was the use of videotape for participants to review and assess their performance. Participants were videotaped twice. The first videotape review (PSV1) allowed for a direct comparison of a participant's perceptions of their ergonomic performance to their actual performance. As noted, analysis of the data comparing the participants' responses from pre-video surgery 1 to PSV1 resulted in a significant difference between the two time periods. This provides additional evidence for the notion that videotape review of one's actions lends irrefutable evidence from what one thinks they did to what they actually did. This trend is seen throughout the self-assessment, self-reflection literature. According to Winters et al., self-assessment using videotape offers a way to promote self-awareness and self-evaluation of both positive and negative behaviors, and improve self-efficacy of students.[66]

A number of challenges may account for the participant's difficulties in performing the self-assessment. Rees and Shepard studied medical students and they found they perceived self-

assessment to be a difficult skill.[67] While the students were found to be reflective, they were not objective in assessing their strengths and weaknesses. Watts et al., regarded that early socialization to the significance and process of self-assessment is a critical aspect of students becoming self-regulated learners.[62] In our study, participants were not introduced to the notion of self-assessment until they were involved in the study. Additionally, it is unknown whether the participants had prior experience with self-assessment over the course of their dental education. Therefore, an introductory lecture directed towards introducing participants to the methods involved in proper self-assessment may have been beneficial. Moreover, several studies examining videotaped skills performance have allowed students multiple opportunities to be videotaped and self-assess until they were satisfied with their performance.[66,68-69] This study allowed participants to self-assess their performance on three occasions, with only two being videotaped. It is possible that participants were academically ill-prepared for self-assessment and given too few opportunities to be videotaped and assess their performance. Although, it is possible that no matter how many opportunities they had they still would have demonstrated improper ergonomics due to the nature of the task at hand.

The Hawthorne Effect was a possible confounder in this type of study. It stands to reason that if the participants knew they were being studied they would intentionally attempt to display proper ergonomics. We sought to extinguish this by providing the participants with the checklist questionnaire at the same time as gaining participant consent. We did this with the assumption that if the participants already knew the goals of the study and were familiar with proper ergonomics, this would be yet another way to provide them with an ergonomic learning opportunity. In effect, the participants began the study with an idea of how to properly perform ergonomics. If they attempted to display proper ergonomics while enrolled in the study, this

would afford us the ability to see if the questionnaire and videotape review was an appropriate method of ergonomic intervention.

While MSDs are multifactorial in nature, so too should be the approach to correcting or preventing them. The qualitative portion of our study was aimed at identifying not only the goals participants made towards improving their ergonomics, but also how they sought to achieve them, and what barriers prevented them from success. We identified that 50.00% of the goal-implementing strategy used by the participants was cognitive in nature. This suggests that the participants simply thought about their ergonomic actions. This is in comparison to nearly 30.00% of responses where participants sought to improve their ergonomics by modifying their equipment. Furthermore, we identified that 52.94% of barriers to goal implementation centered on issues of surgical access and visualization and being too focused on the procedure rather than on ergonomics. Perhaps, additional education pertaining to the benefits of ergonomics would have benefited the participants. Yoser et al. and Goldstep et al. have noted that ergonomics: (1) maximizes efficiency in time, space and motion, (2) aims to minimize the amount of physical and mental stress during practice, and (3) ease the physical challenges of the profession.[3,16, 70] Furthermore, Rucker et al. noted that dentists who spent more time working with their torsos rotated are more likely to experience pain in the lower and upper back, neck and shoulders. To the contrary, dentists with clinical ergonomic education are less likely to have lower back pain.[71] In an effort to prepare dentists for the physical rigors of the profession, programs should be aimed at (a) identification of physical and psychosocial stress factors, (b) reinforcing the didactic training in the clinical environment, (c) training faculty to identify the student's application of ergonomic principles, and (d) developing controls to reduce or eliminate risk factors.[11]

We can identify flaws in study design that may have led to the findings in this study. As mentioned previously, we sought to modify the participant's ergonomic behavior solely by self-assessment using a questionnaire and videotape review. In this context, we were unable to alter the behavior of the participants' ergonomics. In an effort to improve future methodology, intervention programs should consist of didactic instruction in self-assessment and proper ergonomics, administrative support in implementing and funding faculty training and development, and a system designed to encourage student learning, implementation of ergonomic strategies and overcoming barriers to proper ergonomics. Furthermore, a system involving outside observation and rating of provider's ergonomics would have also been helpful. This would help reduce possible inaccuracies in intra-rater variability, as well as adding an additional level of assessment of participant's ergonomics.

In conclusion, this study has identified specific barriers to the implementation of ergonomics in a clinical, dental education setting. In addition, this study lent credence to the notion of self-assessment and self-reflection using videotape review of one's actions. However, methodology using a questionnaire and videotape review alone was not able to effectively change the ergonomic behavior of the participants. Future studies involving ergonomic intervention are necessary and should include a well-defined infrastructure geared towards participant learning as well as overcoming barriers to ergonomic implementation.

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Tables

Table 1: Demographic Questionnaire

Demographic Questionnaire	**N=8 – Summation of Participant Answers**
Age	30.37 years
Gender	5M/3F
Years of dental experience	3.12 years
Ergonomics play a critical role in dentistry‡	87.50% strongly agree 12.50% agree
I am knowledgeable regarding proper ergonomics‡	87.50% agree 12.50% neither agree nor disagree
Have proper ergonomics ever been part of the curriculum in dental school or residency±	62.50% ergonomics part of curriculum
Have you ever receive critical feedback regarding your ergonomics during dental school or residency±	75.00% received feedback
I normally take breaks between patient encounters‡	25.00% take breaks between encounters 50.00% do not take breaks 25.00% neither agree nor disagree
I normally take breaks during long procedures‡	12.50% take breaks 50.00% do not take breaks 25.00% neither agree nor disagree
While performing surgery do you experience lower back pain/stiffness±	62.50% back pain/stiffness
While performing surgery do you experience neck pain/stiffness±	62.50% neck pain/stiffness
While performing surgery do you experience shoulder pain/stiffness±	12.50% shoulder pain/stiffness
By the end of the day my lower back can best be described as¶	87.50% mild back pain
By the end of the day my neck can best be described as¶	50.00% mild neck pain
By the end of the day my shoulders can best be described as¶	12.50% mild shoulder pain
I am confident in my ability to establish proper ergonomics‡	12.50% strongly agree 37.50% agree 25.00% neither agree nor disagree 25.00% disagree
How would you rate your overall ergonomics¶	25.00% good 75.00% average
Do you use magnification for surgical procedures¶	100.00% use magnification
My dental chair is able to be maneuvered so that the patient can be positioned in such a way as to provide patient comfort and provider access with proper ergonomics‡	25.00% strongly agree 37.50% agree 37.50% neither agree nor disagree
Do you adjust the operator chair prior to beginning a procedure for height±	100.00% adjust the height
Do you adjust the operator chair prior to beginning a procedure for lumbar support±	25.00% adjust lumbar support
Do you adjust the operator chair prior to beginning a procedure for hip	12.50% adjust hip angulation

angulation[±]	
I am able to proficiently maneuver through the dental operatory during procedures[‡]	12.50% strongly agree 62.50% agree 25.00% neither agree nor disagree
Do you find the size of the operatory to be of sufficient size[±]	87.50% find it to be sufficient size
My operatory is ergonomically designed[‡]	12.50% agree 12.50% neither agree nor disagree 50.00% disagree
The equipment within my operatory is ergonomically designed[‡]	12.50% strongly agree 37.50% agree 37.50% neither agree nor disagree 12.50% disagree

[‡]Likert Scale question: Strongly disagree, disagree, neither agree nor disagree, agree, strongly agree; [¶]Multiple choice question; [±]Yes/No question

Table 2: Cumulative Responses to Participant Surveys

	Pre-video Surgery 1 N=8	**Post-video Surgery 1 N=8**	**Post-video Surgery 2 N=8**
Torso twisting	75.00% sometimes 25.00% always	12.50% normal 87.50% sometimes	87.50% sometimes 12.50% always
Torso bending	75.00% sometimes 25.00% always	37.50% normal 62.50% sometimes	12.50% normal 87.50% sometimes
Torso Rotation	50.00% sometimes 50.00% always	12.50% normal 75.00% sometimes 12.50% always	12.50% normal 87.50% sometimes
Foot flat Position	25.00% normal 75.00% sometimes	87.50% normal 12.50% sometimes	75.00% normal 25.00% sometimes
Foot/Leg angle	37.50% normal 50.00% sometimes 12.50% never	50.00% normal 50.00% sometimes	62.50% normal 37.50% sometimes
Shoulder vertical	37.50% normal 50.00% elevated 12.50% depressed	75.00% normal 25.00% elevated	62.50% normal 37.50% elevated
Shoulder horizontal	12.50% normal 12.50% left elevated 75.00% right elevated	25.00% normal 62.50% left elevated 12.50% right elevated	37.50% normal 50.00% left elevated 12.50% right elevated
Shoulder lateral	37.50% normal 50.00% adducted 12.50% abducted	50.00% normal 37.50% adducted 12.50% abducted	62.50% normal 25.00% adducted 12.50% abducted
Elbow lateral	37.50% normal 62.50% greater	50.00% normal 25.00% greater 25.00% less	50.00% normal 37.50% greater 12.50% less
Elbow flexure	12.50% normal 37.50% greater 50.00% less	50.00% normal 50.00% less	25.00% normal 37.50% greater 37.50% less
Hip/torso angle	50.00% normal 50.00% sometimes	37.50% normal 62.50% sometimes	50.00% normal 50.00% sometimes

Knee/Leg angle	12.50% normal 87.50% sometimes	37.50% normal 50.00% sometimes 12.50% never	25.00% normal 75.00% sometimes
Orbiting range	62.50% normal 37.50% sometimes	87.50% normal 12.50% sometimes	100.00% normal
Neck flexure	12.50% normal 75.00% hyperextended 12.50% hypoentended	62.50% hyperextended 37.50% hypoextended	12.50% normal 37.50% hyperextended 50.00% hypoextended
Neck lateral	75.00% sometimes 25.00% always	100.00% sometimes	12.50% normal 87.50% sometimes

Table 3: Participant Goals

	Frequency	Percentage/Cumulative	Select Goals
Torso Position			
Bending	6	66.67%	"Sit back on chair" "Keep back straighter"
Twisting	1	11.11%	"Don't twist torso so much"
Rotation	2	22.22%	"Use assistant more so I don't rotate as much"
Total	9	37.50% of goals	
Neck Position			
Lateral	3	50.00%	"Try to keep my neck more straight"
Flexure	3	50.00%	"Don't extend neck as much"
Total	6	25.00% of goals	
Shoulder Position			
Horizontal /vertical	6	100%	"Hold left shoulder down more" "Try to keep shoulders more level"
Total	6	25.00% of goals	
Lower Extremity Position			
Foot/Leg Knee	1	100%	"Try to keep neutral knee position"
Total	1	4.17% of goals	
Elbow Position			
Lateral/ Flexure	2	100%	"Keep elbows more neutral" "Have more flexure of elbow"
Total	2	8.33% of goals	

Table 4: Methods to Achieve Goals

	Frequency	Percentage	Select Responses
Cognitive	9	50.00%	"Tried to keep my back straighter" "Tried to be conscious of not over extending my neck"
Equipment Modification	5	27.77%	"Adjusted the chair before I started" " Lowered my chair so my knees could be 90 degrees to the floor"
Patient Modification	2	11.11%	"Sat the patient up more"
Assistant Interaction	1	5.56%	"Communicated more with my assistant"
Other	1	5.56%	"Didn't sit all the way back in the chair"
Total	18	100.00%	

Table 5: Reasons Goals Not Achieved

	Frequency	Percentage	Select Responses
Access Visualization	9	52.94%	"I was working on the mandible and needed access" "More focused on visualizing the surgical site than I was on proper ergonomics"
Equipment	2	11.76%	"I need to see if I can lower my chair or raise the patient chair"
Attempt With Need For Improvement	2	11.76%	"Still ended up working with my elbows way out"
Instrument Control	1	5.88%	"I feel like I have more control over my instruments when my elbows are flexed greater than 90 degrees"
No Reason Provided	3	17.66%	"Not sure"
Total	17	100.00%	

Figures

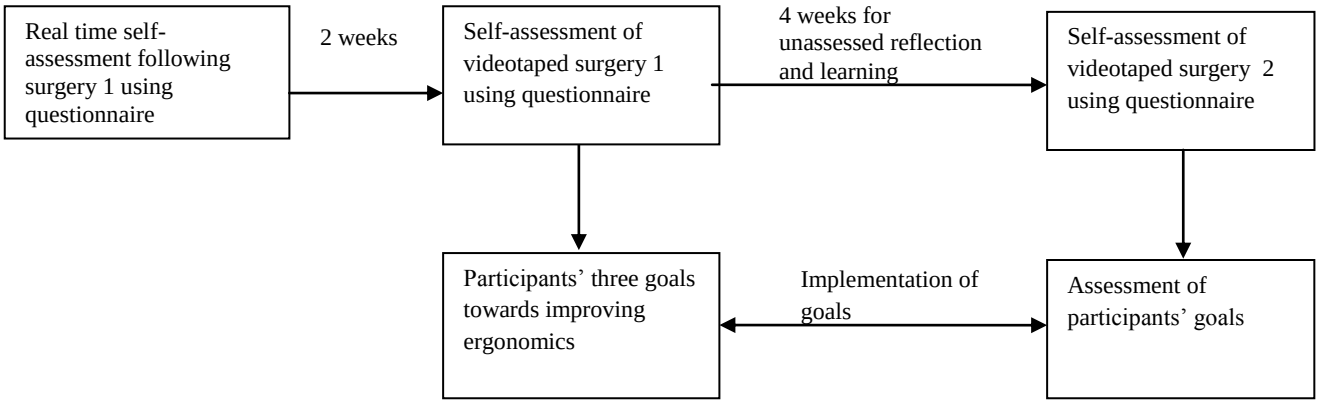

Figure 1: Schematic Diagram of Study Design

Figure 2: Screen Shot of Participant Video

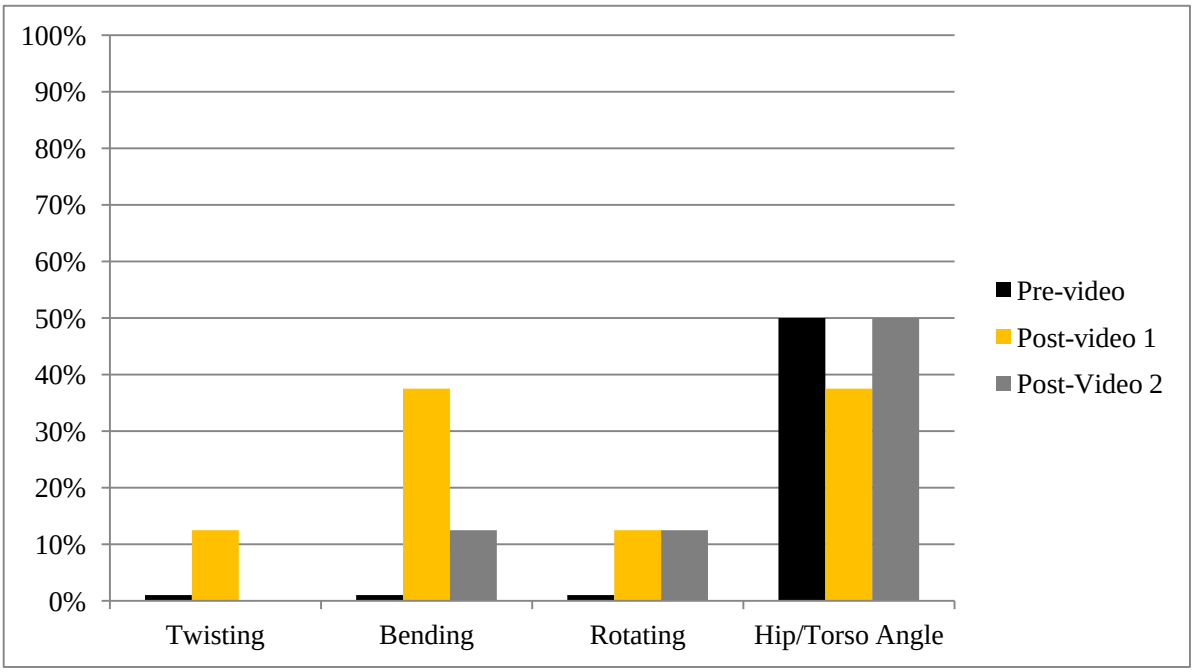

Figure 3: Torso Position Normal Responses

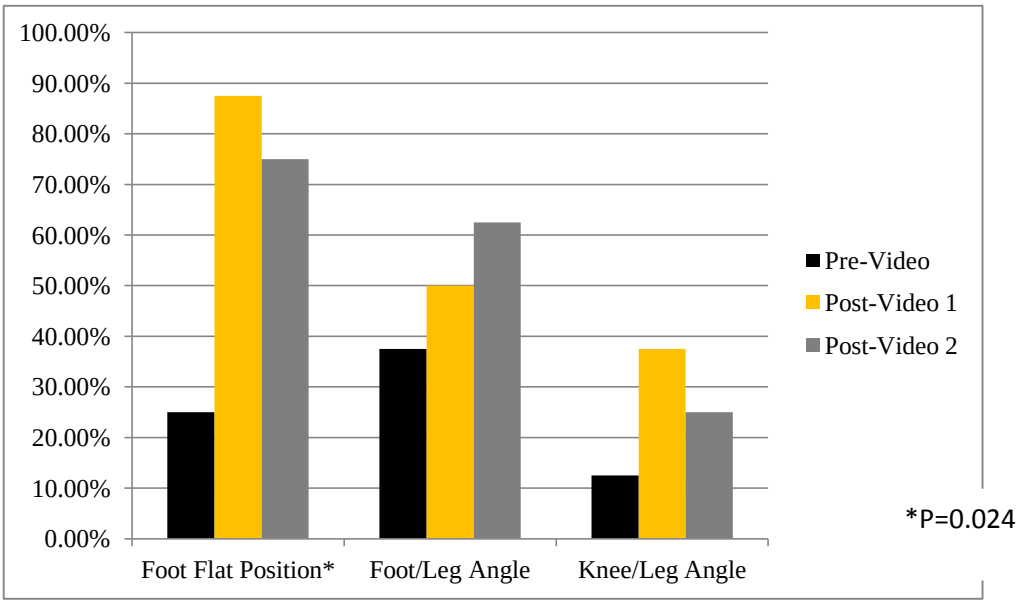

Figure 4: Lower Extremity Position Normal Responses

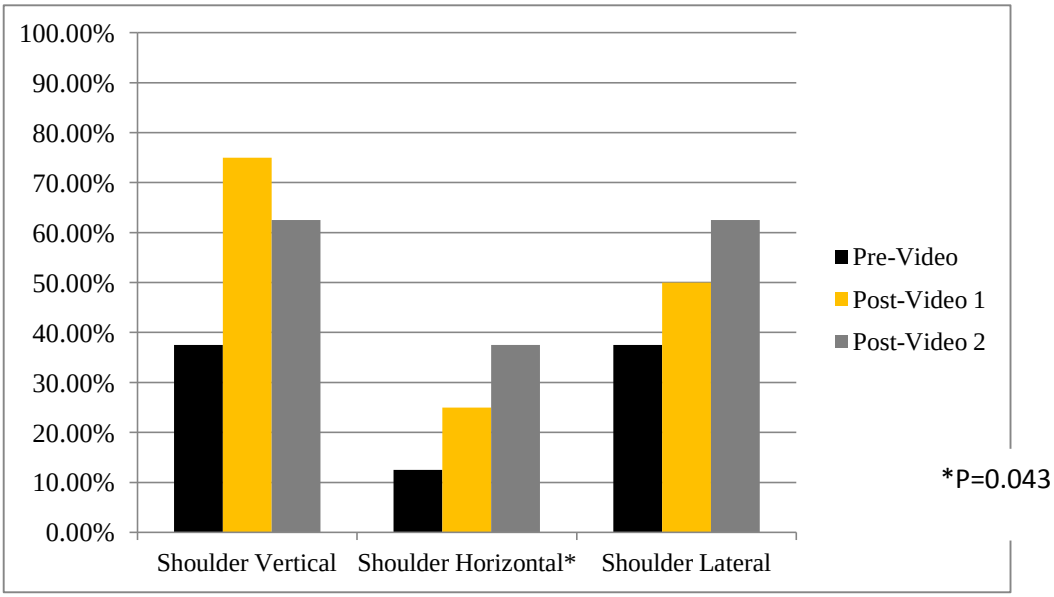

Figure 5: Shoulder Position Normal Responses

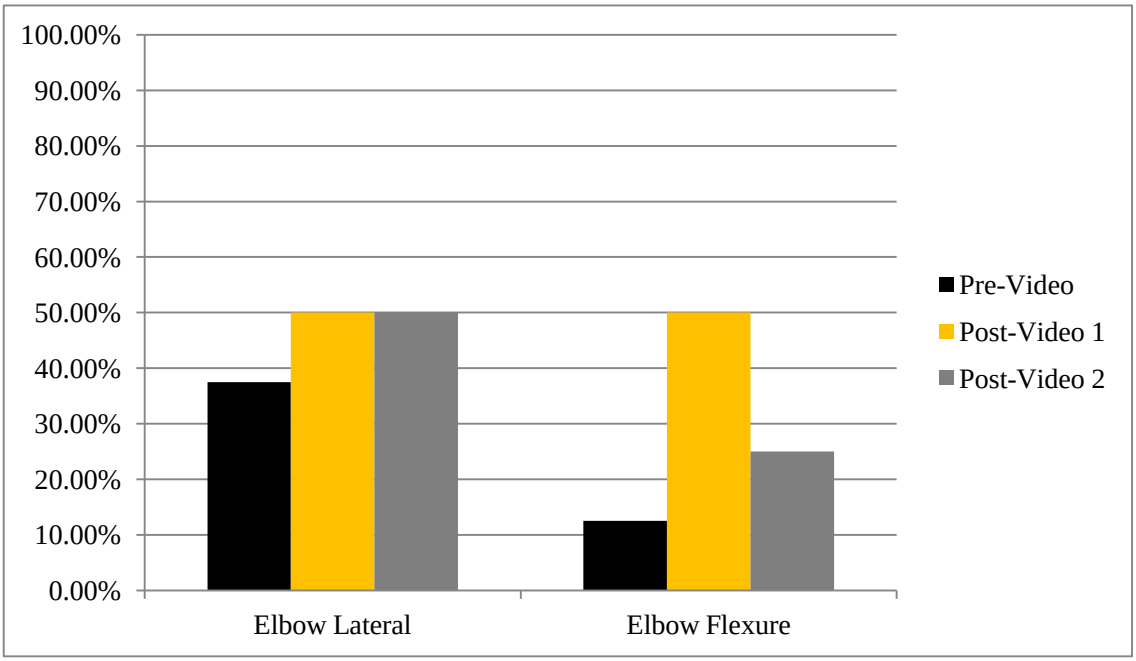

Figure 6: Elbow Position Normal Responses

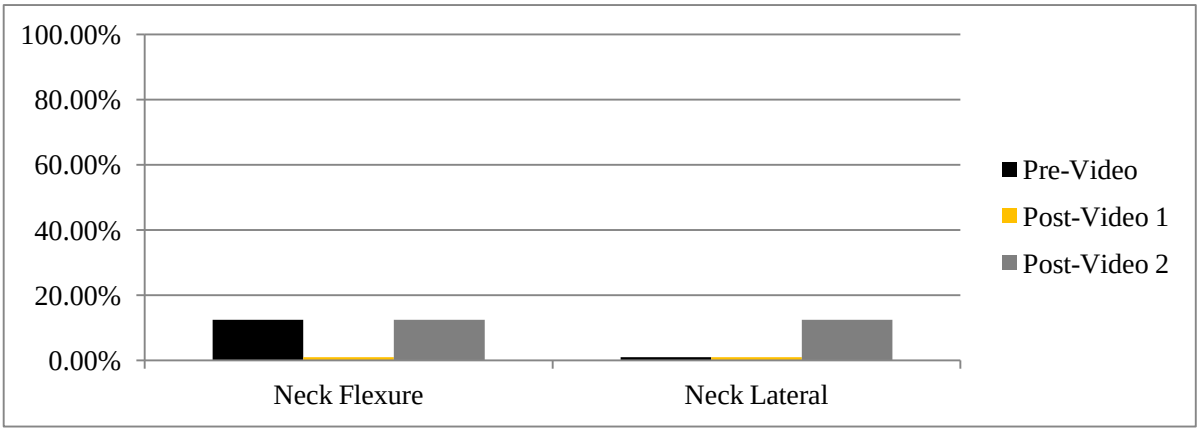

Figure 7: Neck Position Normal Responses

Appendices

Appendix I

Participant #: _____

Pre-surgery questionnaire

Instructions: Please answer the following questions to the best of your ability. Answers should not apply to any one particular event. Your answer should reflect what you do or how you act for the majority of the time. When complete return this form to the appropriate box within the resident office. Please do not discuss your answers with anyone.

1. Age _____
2. Gender _____
3. # years of prior dental experience (excluding dental school) _____
4. Ergonomics play a critical role in clinical dentistry
    1. Strongly disagree
    2. Disagree
    3. Neither agree nor disagree
    4. Agree
    5. Strongly agree
5. I am knowledgeable regarding proper dental ergonomics
    1. Strongly disagree
    2. Disagree
    3. Neither agree nor disagree
    4. Agree
    5. Strongly agree
6. Have proper ergonomics ever been part of the curriculum in dental school or residency?
    1. YES
    2. NO
7. Have you ever receive critical feedback regarding your ergonomics during dental school or residency?
    1. YES
    2. NO
8. I normally take breaks between patient encounters
    1. Strongly disagree
    2. Disagree
    3. Neither agree nor disagree
    4. Agree
    5. Strongly agree
9. I normally take breaks during long procedures
    1. Strongly disagree
    2. Disagree

3. Neither agree nor disagree
4. Agree
5. Strongly agree

10. While performing surgery do you experience lower back pain/stiffness?
    1. YES
    2. NO
11. While performing surgery do you experience neck pain/stiffness?
    1. YES
    2. NO
12. While performing surgery do you experience shoulder pain/stiffness?
    1. YES
    2. NO
13. By the end of the day my lower back can best be described as:
    1. No pain
    2. Mild pain
    3. Moderate pain
    4. Extreme pain
14. By the end of the day my neck can best be described as:
    1. No pain
    2. Mild pain
    3. Moderate pain
    4. Extreme pain
15. By the end of the day my shoulders can best be described as:
    1. No pain
    2. Mild pain
    3. Moderate pain
    4. Extreme pain
16. I am confident in my ability to establish proper ergonomics
    1. Strongly disagree
    2. Disagree
    3. Neither agree nor disagree
    4. Agree
    5. Strongly agree
17. How would you rate your overall ergonomics
    1. Outstanding
    2. Good
    3. Average
    4. Poor
18. Do you use magnification for surgical procedures?
    1. YES
    2. Sometimes
    3. NO
19. My dental chair is able to be maneuvered so that the patient can be positioned in such a way as to provide patient comfort and provider access with proper ergonomics
    1. Strongly disagree
    2. Disagree
    3. Neither agree nor disagree
    4. Agree
    5. Strongly agree

Do you adjust the operator chair prior to beginning a procedure for (assume somebody used the chair before you):

20. Height
    1. YES
    2. NO
21. Lumbar support
    1. YES
    2. NO
22. Hip angulation
    1. YES
    2. NO
23. I am able to proficiently maneuver through the dental operatory during procedures
    1. Strongly disagree
    2. Disagree
    3. Neither agree nor disagree
    4. Agree
    5. Strongly agree
24. Do you find the size of the operatory to be of sufficient size?
    1. YES
    2. NO
25. My operatory is ergonomically designed
    1. Strongly disagree
    2. Disagree
    3. Neither agree nor disagree
    4. Agree
    5. Strongly agree
26. The equipment within my operatory is ergonomically designed
    1. Strongly disagree
    2. Disagree
    3. Neither agree nor disagree
    4. Agree
    5. Strongly agree

Appendix II

Participant #: _____

Surgery 1: Participant real-time assessment of ergonomics following surgery:
Please review statements 1-8 which correspond to correct provider ergonomics. Following each statement is a series of questions that you will answer immediately following your videotaped surgical procedure. Reflect on the surgery just completed responding to each question based on your general ergonomics. Answer all questions to the best of your ability. If you are unable to answer a question leave it blank. When complete return this form to the appropriate box within the resident office. Please do not discuss your answers with other participants.

1. Procedure location
    a. What jaw did you perform surgery on?
        1. Maxilla
        2. Mandible
    b. What quadrant did you perform surgery in?
        1. Upper Right
        2. Lower Right
        3. Upper Left
        4. Lower Left
2. During dental procedures, a neutral torso posture is described as one where there is no consistent twisting, forward bending or rotational movements.
    a. For the majority of the procedure you would describe the twisting of the torso as:
        1. Torso never twisted
        2. Torso sometimes twisted
        3. Torso twisted
    b. For the majority of the procedure you would describe the forward bending of the torso as:
        1. Torso never forward bending
        2. Torso sometimes forward bending
        3. Torso forward bending
    c. For the majority of the procedure you would describe the rotation of the torso as:
        1. Torso never rotated
        2. Torso sometimes rotated
        3. Torso rotated

3. During dental procedures, a neutral ankle/foot posture may be described as one where feet are placed flat on the floor and are 90 degrees to the leg.
    a. For the majority of the procedure you would describe foot position as:
        1. Feet flat on the floor
        2. Feet sometimes flat on the floor
        3. Feet never flat on the floor
    b. For the majority of the procedure you would describe the foot/leg angle position as:
        1. Foot is 90 degrees to leg
        2. Foot sometimes 90 degrees to leg
        3. Foot is never 90 degrees to leg

4. A neutral shoulder position is described as one where the shoulders are neither elevated nor depressed, not abducted or adducted, and have a level relationship to one another.
    a. Which statement best describes the vertical component of the participant's shoulder position during the majority of the procedure?
        1. Shoulders in neutral position
        2. Shoulders elevated
        3. Shoulders depressed
    b. Which statement best describes the participant's horizontal shoulder position during the majority of the procedure?
        1. Right and left shoulder level with the horizontal plane
        2. Right shoulder elevated more than left
        3. Left shoulder elevated more than right
    c. Which statement best described the relationship of shoulders in the sagittal plane for the majority of the procedure?
        1. Shoulders neither abducted nor adducted
        2. Shoulders abducted
        3. Shoulders adducted

5. A neutral elbow position is described as having a flexure of approximately 90 degrees and a lateral elevation of approximately 30 degrees.
    a. Describe the elevated position of elbows for the majority of the procedure
        1. Lateral elbow elevation of 30 degrees
        2. Lateral elbow elevation of >30 degrees
        3. Lateral elbow elevation of < 30
    b. Describe the flexure of elbows for the majority of the procedure
        1. Flexure of 90 degrees
        2. Flexure of >90 degrees
        3. Flexure of <90 degrees

6. An ergonomic hip position is described as one where the hips are anteriorly inclined in relation to the torso.
    a. For the majority of the procedure you would describe the hip/torso angle position as:
        1. Hips always anteriorly inclined
        2. Hips sometimes anteriorly inclined
        3. Hips never anteriorly inclined

7. An ergonomic knee position is described as one where the knees are 90 degrees to the legs.
    a. For the majority of the procedure you would describe the knee/leg angle position as:
        1. Knees always 90 degrees to legs
        2. Knees sometimes 90 degrees to legs
        3. Knees never 90 degrees to legs

8. For a right-handed operator, the correct orbiting range with respect to the patient's head is between 12:30 and 10 o'clock.
    a. How well does this statement describe the participant's orbiting range for the majority of the procedure?

1. Always within orbiting range
2. Sometimes within orbiting range
3. Never within orbiting range

9. An ergonomic neck position is described as one that is not hyperextended nor hypoextended and is balanced with the torso. The neck should remain neutral and not be rotated or twisted for extended periods of time.
    a. Describe the flexure of neck for the majority of this procedure?
        1. Neck was balanced with torso
        2. Neck was hyperextended
        3. Neck was hypoextended
    b. Describe the participant's lateral neck position for the majority of this procedure?
        1. Neck was never rotated
        2. Neck was sometimes rotated
        3. Neck was always rotated

Appendix III

Participant #: _____

Surgery 1: Participant assessment of ergonomics following review of videotaped surgery:
Please review statements 1-8 which correspond to correct provider ergonomics. Following each statement is a series of questions that you will answer following review of the DVD. The accompanying DVD contains nine minutes of video representing the beginning, middle and end of your surgical procedure. After careful review of these instructions you will be asked to watch the video and perform a self-assessment of your ergonomics. It is important that you answer each question based on what you see in the video versus what you thought you did during the procedure. This video may only be watched on the computer with a widescreen monitor in the Periodontal Resident Office. Watch the video from start to finish without interruption. Following completion of the video fill out all sections of this questionnaire and answer all questions to the best of your ability; if you are unable to answer a question leave it blank. You may review any portion of the video you wish as well as watch the video as many times as necessary.

Once you have completed the assessment please provide three ergonomic-specific goals in the space provided below. Each goal should reflect your experience thus far and reflect your realistic expectations regarding your overall ergonomics.

When complete return this form to the appropriate box within the resident office. Please do not discuss your answers with other participants.

1. Procedure location
    a. What jaw did you perform surgery on?
        1. Maxilla
        2. Mandible
    b. What quadrant did you perform surgery in?
        1. Upper Right
        2. Lower Right
        3. Upper Left
        4. Lower Left
2. During dental procedures, a neutral torso posture is described as one where there is no consistent twisting, forward bending or rotational movements.
    a. For the majority of the procedure you would describe the twisting of the torso as:
        1. Torso never twisted
        2. Torso sometimes twisted
        3. Torso twisted
        4. For the majority of the procedure you would describe the forward bending of the torso as:
        5. Torso never forward bending
        6. Torso sometimes forward bending
        7. Torso forward bending
    b. For the majority of the procedure you would describe the rotation of the torso as:
        1. Torso never rotated
        2. Torso sometimes rotated
        3. Torso rotated

3. During dental procedures, a neutral ankle/foot posture may be described as one where feet are placed flat on the floor and are 90 degrees to the leg.
    a. For the majority of the procedure you would describe foot position as:
        1. Feet flat on the floor
        2. Feet sometimes flat on the floor
        3. Feet never flat on the floor
    b. For the majority of the procedure you would describe the foot/leg angle position as:
        1. Foot is 90 degrees to leg
        2. Foot sometimes 90 degrees to leg
        3. Foot is never 90 degrees to leg

4. A neutral shoulder position is described as one where the shoulders are neither elevated nor depressed, not abducted or adducted, and have a level relationship to one another.
    a. Which statement best describes the vertical component of the participant's shoulder position during the majority of the procedure?
        1. Shoulders in neutral position
        2. Shoulders elevated
        3. Shoulders depressed
    b. Which statement best describes the participant's horizontal shoulder position during the majority of the procedure?
        1. Right and left shoulder level with the horizontal plane
        2. Right shoulder elevated more than left
        3. Left shoulder elevated more than right
    c. Which statement best described the relationship of shoulders in the sagittal plane for the majority of the procedure?
        1. Shoulders neither abducted nor adducted
        2. Shoulders abducted
        3. Shoulders adducted

5. A neutral elbow position is described as having a flexure of approximately 90 degrees and a lateral elevation of approximately 30 degrees.
    a. Describe the elevated position of elbows for the majority of the procedure
        1. Lateral elbow elevation of 30 degrees
        2. Lateral elbow elevation of >30 degrees
        3. Lateral elbow elevation of < 30
    b. Describe the flexure of elbows for the majority of the procedure
        1. Flexure of 90 degrees
        2. Flexure of >90 degrees
        3. Flexure of <90 degrees

6. An ergonomic hip position is described as one where the hips are anteriorly inclined in relation to the torso.

    a. For the majority of the procedure you would describe the hip/torso angle position as:
        1. Hips always anteriorly inclined
        2. Hips sometimes anteriorly inclined
        3. Hips never anteriorly inclined

7. An ergonomic knee position is described as one where the knees are 90 degrees to the legs.
    a. For the majority of the procedure you would describe the knee/leg angle position as:
        1. Knees always 90 degrees to legs
        2. Knees sometimes 90 degrees to legs
        3. Knees never 90 degrees to legs

8. For a right-handed operator, the correct orbiting range with respect to the patient's head is between 12:30 and 10 o'clock.
    a. How well does this statement describe the participant's orbiting range for the majority of the procedure?
        1. Always within orbiting range
        2. Sometimes within orbiting range
        3. Never within orbiting range

9. An ergonomic neck position is described as one that is not hyperextended nor hypoextended and is balanced with the torso. The neck should remain neutral and not be rotated or twisted for extended periods of time.
    a. Describe the flexure of neck for the majority of this procedure?
        1. Neck was balanced with torso
        2. Neck was hyperextended
        3. Neck was hypoextended
    b. Describe the participant's lateral neck position for the majority of this procedure?
        1. Neck was never rotated
        2. Neck was sometimes rotated
        3. Neck was always rotated

Participant's goals for improvement of their own ergonomics:

1._____
_____
_____

2._____
_____
_____

3._____
_____
_____

Appendix IV

Participant #: _____

Surgery 2: Participant assessment of ergonomics following review of videotaped surgery:
Please review statements 1-8 which correspond to correct provider ergonomics. Following each statement is a series of questions that you will answer following review of the DVD. The accompanying DVD contains nine minutes of video representing the beginning, middle and end of your surgical procedure. After careful review of these instructions you will be asked to watch the video and perform a self-assessment of your ergonomics. It is important that you answer each question based on what you see in the video versus what you thought you did during the procedure. This video may only be watched on the computer with a widescreen monitor in the Periodontal Resident Office. Watch the video from start to finish without interruption. Following completion of the video fill out all sections of this questionnaire and answer all questions to the best of your ability; if you are unable to answer a question leave it blank. You may review any portion of the video you wish as well as watch the video as many times as necessary.

At the end of this survey you will see the three goals you provided to us following video assessment of surgery 1. Associated with each of your goals is a series of questions. Please answer each question to the best of your ability. If you are unable to answer a question you may leave it blank.

When complete return this form to the appropriate box within the resident office. Please do not discuss your answers with other participants.

1. Procedure location
    a. What jaw did you perform surgery on?
        1. Maxilla
        2. Mandible
    b. What quadrant did you perform surgery in?
        1. Upper Right
        2. Lower Right
        3. Upper Left
        4. Lower Left
2. During dental procedures, a neutral torso posture is described as one where there is no consistent twisting, forward bending or rotational movements.
    a. For the majority of the procedure you would describe the twisting of the torso as:
        1. Torso never twisted
        2. Torso sometimes twisted
        3. Torso twisted
    b. For the majority of the procedure you would describe the forward bending of the torso as:
        1. Torso never forward bending
        2. Torso sometimes forward bending
        3. Torso forward bending
    c. For the majority of the procedure you would describe the rotation of the torso as:
        1. Torso never rotated
        2. Torso sometimes rotated

3. Torso rotated

3. During dental procedures, a neutral ankle/foot posture may be described as one where feet are placed flat on the floor and are 90 degrees to the leg.
    a. For the majority of the procedure you would describe foot position as:
        1. Feet flat on the floor
        2. Feet sometimes flat on the floor
        3. Feet never flat on the floor
    b. For the majority of the procedure you would describe the foot/leg angle position as:
        1. Foot is 90 degrees to leg
        2. Foot sometimes 90 degrees to leg
        3. Foot is never 90 degrees to leg

4. A neutral shoulder position is described as one where the shoulders are neither elevated nor depressed, not abducted or adducted, and have a level relationship to one another.
    a. Which statement best describes the vertical component of the participant's shoulder position during the majority of the procedure?
        1. Shoulders in neutral position
        2. Shoulders elevated
        3. Shoulders depressed
    b. Which statement best describes the participant's horizontal shoulder position during the majority of the procedure?
        1. Right and left shoulder level with the horizontal plane
        2. Right shoulder elevated more than left
        3. Left shoulder elevated more than right
    c. Which statement best described the relationship of shoulders in the sagittal plane for the majority of the procedure?
        1. Shoulders neither abducted nor adducted
        2. Shoulders abducted
        3. Shoulders adducted

5. A neutral elbow position is described as having a flexure of approximately 90 degrees and a lateral elevation of approximately 30 degrees.
    a. Describe the elevated position of elbows for the majority of the procedure
        1. Lateral elbow elevation of 30 degrees
        2. Lateral elbow elevation of >30 degrees
        3. Lateral elbow elevation of < 30
    b. Describe the flexure of elbows for the majority of the procedure
        1. Flexure of 90 degrees
        2. Flexure of >90 degrees
        3. Flexure of <90 degrees

6. An ergonomic hip position is described as one where the hips are anteriorly inclined in relation to the torso.

    a. For the majority of the procedure you would describe the hip/torso angle position as:
        1. Hips always anteriorly inclined
        2. Hips sometimes anteriorly inclined
        3. Hips never anteriorly inclined

7. An ergonomic knee position is described as one where the knees are 90 degrees to the legs.
    a. For the majority of the procedure you would describe the knee/leg angle position as:
        1. Knees always 90 degrees to legs
        2. Knees sometimes 90 degrees to legs
        3. Knees never 90 degrees to legs

8. For a right-handed operator, the correct orbiting range with respect to the patient's head is between 12:30 and 10 o'clock.
    a. How well does this statement describe the participant's orbiting range for the majority of the procedure?
        1. Always within orbiting range
        2. Sometimes within orbiting range
        3. Never within orbiting range

9. An ergonomic neck position is described as one that is not hyperextended nor hypoextended and is balanced with the torso. The neck should remain neutral and not be rotated or twisted for extended periods of time.
    a. Describe the flexure of neck for the majority of this procedure?
        1. Neck was balanced with torso
        2. Neck was hyperextended
        3. Neck was hypoextended
    b. Describe the participant's lateral neck position for the majority of this procedure?
        1. Neck was never rotated
        2. Neck was sometimes rotated
        3. Neck was always rotated

Participant's goals for improvement of their own ergonomics:

Goal:
Did you achieve this goal?
1. YES
2. NO
How did you seek to achieve this goal?
_____
_____
_____
_____
If you have not achieved this goal, why not?
_____
_____
_____
_____

Goal:
Did you achieve this goal?
1. YES

2. NO
How did you seek to achieve this goal?

_____
_____
_____
_____

If you have not achieved this goal, why not?

_____
_____
_____
_____

Goal:
Did you achieve this goal?
1. YES
2. NO
How did you seek to achieve this goal?

_____
_____
_____
_____

If you have not achieved this goal, why not?

_____
_____
_____
_____

Vita

Corin Todd Marantz was born on February 6, 1975, in Bergen County, New Jersey. He graduated from Fair Lawn High School, Fair Lawn, New Jersey in 1993. He received his Bachelor of Science in Business Management with highest honors from Rutgers, The State University of New Jersey, School of Business, Newark, New Jersey in 2005. He received his Doctor of Dental Surgery from the State University of New York, Stony Brook School of Dental Medicine, Stony Brook, New York, in 2009. He is expected to receive his Certificate in Periodontics and Master of Science in Dentistry from Virginia Commonwealth University, School of Dentistry, in June 2012.