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Hand Function Evaluation for Dental Hygiene Students

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Hand Function Evaluation for Dental Hygiene Students

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ABSTRACT

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Dental hygiene students may struggle in dental hygiene curriculum in regards to hand function. Currently, this is not an aspect dental hygiene programs screen for or have protocol in place to help students. The research in the study examined if hand function could improve with hand function exercises and if exercises improved instrumentation scores. During a 6-week pilot study, an occupational therapist tested the hand function of a cohort of dental hygiene students. The results were recorded and the students began a 6-week hand function exercise regimen. After 6 weeks the same evaluations were preformed and the pre- and posttest data were compared. Statistical tests showed a significant improvement in hand function. After the hand function testing was complete, the scores of the cohort on the periodontal probe and 11/12 explorer were compared to students in the previous 5 cohorts. No significant improvement was made on the instrumentation scores.

DEDICATION

I would like to dedicate this thesis to Pamela Brilowski. Her leadership over the last few years has been priceless. Pam has been an inspiration with her knowledge of dental hygiene, education, and leadership. Pam identified the need for a research project such as this, and I hope that this study can help future students achieve their goal to become licensed dental hygienists.

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CHAPTER 1

INTRODUCTION

Dental hygienists are licensed health care providers whose care focuses on preventing and treating oral diseases. According to the American Dental Hygienists' Association (ADHA) (ADHA, 2012b), dental hygienists perform oral health care assessments, expose dental radiographs, remove plaque and calculus, apply fluoride and sealants, administer local anesthetics, and provide patient education on numerous health care issues. Dental hygienists use a variety of small instruments including dental hygiene scalers, curettes and ultrasonic scalers to perform their job successfully.

Dental hygienists must be skilled in working with their hands and using very precise tools (Bureau of Labor Statistics, 2012a). Dental hygienists rely on hand function to detect and remove calculus, polish teeth, operate an ultrasonic scaler, manipulate clinical and laboratory instruments, and floss teeth. Dental hygienists' hand function is a necessity to ensure safe and effective patient care. Hand function is a continuum of activities that include fine sensory function to those that include a strong motor component (Jones & Lederman, 2006). Hand function includes strength to move muscles, dexterity to perform precise movements, and eye-hand coordination when manipulating objects. The motor component of hand function refers to motor control. Motor control is the coordination of muscles, bones, and nerves to produce small, precise movements (MedlinePlus, 2012).

Dental hygienists learn very early in the dental hygiene curriculum to use instruments such as periodontal probes and explorers. Dental hygienists use these instruments both above the gum line where the clinician can visually assess their movements and below the gum line where visual access is not available. The dental hygiene student must rely on vibrations transmitted to

their hand from the tip of the instrument to discern the topography of the tooth, calculus, and root surface (Daniel & Harst, 2004). Daniel and Harst (2004) wrote "The fundamentals of instrumentation include grasp, fulcrum, adaptation, insertion, angulation, and activation" (p. 150). Hand function is essential to manipulate the dental hygiene instruments to be successful when completing these steps.

Dental hygiene students are expected to apply cognitive, affective, and psychomotor skills throughout their learning process. Although all three of the domains are important, psychomotor skills are critical. Dental hygiene students are expected to demonstrate sufficient hand function to skillfully and safely apply psychomotor skills. Examples of psychomotor skills that dental hygiene students should possess are hand-arm strength to control manual and power-operated hand instruments and tools, ability to perform complex motor skills and manipulative skills with fine instruments and devices, and effective eye-hand coordination (Lansing Community College, 2012).

Statement of the Problem

Dental hygiene students may possess sufficient affective and cognitive skills needed to be successful in the rigorous didactic portion of a dental hygiene program. However, those same students they may be deficient in the hand function component of psychomotor skills needed to successfully complete a dental hygiene program and become a licensed professional. The purpose of this study was to evaluate whether hand function testing and exercises would be beneficial tools to improve dental hygiene students' use of equipment and to enhance student success.

Research Questions

The following questions guided this study:

1. Was hand function of dental hygiene students improved after recommended hand function exercises were completed?
2. Did students who completed hand function exercises have higher final scores on the periodontal probe and 11/12 explorer evaluations than students in the 5 previous years?

Significance of the Study

Early detection of deficient or weak hand function may be beneficial for dental hygiene students. Better hand function could improve the student's ability to perform necessary tasks when using dental hygiene instruments. Improved hand function could lead to less frustration for both students and faculty. As a result, improved hand function could lead to less student attrition in dental hygiene programs.

Delimitation and Limitations

Several delimitations were identified for this study. The delimitations included the geographic location, a single community college in southeastern Wisconsin. The socioeconomic level of the residents of the county in which the community college is located is considered to be middle-to-high income. All participants who were accepted to the dental hygiene school and participated in this study were 18 years of age or older. The data for this study were collected from August 2013 through October 2013.

Limitations for this study include any dental hygiene students who declined to participate in the study and students who were not compliant, defined as not completing the hand funtion occupational therapy exercises recommended to improve hand function.

Also competency based education does not reflect the number of attempts a student made to achieve competency when comparing scores from participants of this study to those in previous years.

Assumptions

It is assumed that the data collected by the occupational therapist were complete and accurate for each dental hygiene student.

Operational Definitions

Hand function: Hand function includes range of motion, sensation, coordination, dexterity, and fine motor skills, as well as grip (Schwartz, 2005).

Fine motor control: "Fine motor control is the coordination of muscles, bones, and nerves to produce small, precise movements" (MedlinePlus Medical Encyclopedia, 2012, para. 1).

Norm: Norm used in education is defined as "a designated standard of average performance of people of a given age, background, etc." (Dictionary.com, 2012).

CHAPTER 2

REVIEW OF LITERATURE

Dental Hygienists

Dental hygienists are licensed health care providers who focus care on preventing and treating oral diseases. Approximately 67% of dental hygiene graduates have earned an associate's degree before licensure, 31% earned a bachelor's degree, and 2% doctoral or professional degree (O*NET, 2011). To initially obtain a dental hygiene license, all students must pass a national written exam and a regional clinical exam. Once licensed, continuing education and licensure maintenance requirements vary from state-to-state. After initial licensure, some dental hygienists continue their education and seek a bachelor's or master's degree to work in dental research, dental sales, or to teach dental hygiene in accredited schools. There are currently 340 dental hygiene schools in the United States (ADHA, 2012a). In 2010 there were approximately 182,000 dental hygienists working in the United States and the projected growth from 2010 to 2020 is 29%, much higher than the growth projected for other careers (O*NET, 2011).

According to the American Dental Hygienists' Association (ADHA, 2012b) dental hygienists perform oral health care assessments, expose dental radiographs, remove plaque and calculus, apply fluoride and sealants, administer local anesthetic, and provide patient education on numerous health care issues. Dental hygienists use a variety of small instruments including dental hygiene scalers, curettes, and ultrasonic scalers to perform their job successfully. Dental hygienists must be skilled working with their hands and using very precise tools (Bureau of Labor Statistics, 2012a). Hygienists rely on hand function to detect and remove calculus, polish

teeth, operate ultrasonic scalers, manipulate clinical and laboratory instruments, and floss teeth. Dental hygienists' hand function is a necessity to ensure safe and effective patient care.

The literature review was based on information gathered primarily from East Tennessee State University's Sherrod Library. The databases from within the library that were accessed include CINAHL, PubMed, and Cochrane Database of Systematic Reviews. In addition, keywords used to search the databases for this literature review included dental hygiene, hand function, motor skills, hand strength, and occupational therapy.

Anatomy of the Hand

The anatomy of the hand is very complex. The wrist and hand are made up of 27 bones. These 27 bones are classified as carpals, metacarpals, or phalanges. Each hand has five metacarpal bones that have a base, a shaft, a neck, and a head. The hand has 14 phalanges, each finger consisting of three and the thumb having two. The wrist consists of eight carpal bones and is the most complex joint in the body (Medscape Reference, 2013).

The skin on the dorsum or top of the hand differs from the skin on the palm. The dorsum skin is thin and pliable and is more prone to injury versus the thicker skin covering the palm. The thicker skin on the palm is not as pliable and is more stable for grasping objects. There is a high concentration of sensory nerves on the palm side of the hand to aid in the hand's functions (Medscape Reference, 2013).

Three nerves innervate the hand, the median, ulnar, and the radial nerves. All three branches of these nerves have sensory and motor functions. Nerve distribution varies from person to person. The median nerve innervates the muscles involved in fine precision and pinch function. Power grasping function of the hand provided by the muscles innervated by the ulnar

nerve. The radial nerve innervates the muscles that control the position of the hand (Medscape Reference, 2013).

Hand Function

Schwartz (2005) wrote "Hand function includes range of motion, sensation, coordination, dexterity, fine motor skills, as well as grip" (para. 3). Individuals who suffer from reduced hand function find it hard to use their hands for everyday activities (Bland, Beebe, Hardwick, & Land, 2008). Hand function includes strength to move muscles, dexterity to perform precise movements, and eye-hand coordination when manipulating objects (Jones & Lederman, 2006).

There are hand function tests readily available and their reliability and validity have been confirmed. Occupational therapists across the United States have the tools and resources to test dental hygiene students' hand function (Atwood-Sanders & Michalak-Turcotte, 2002).

Motor Control

Motor control is the coordination of muscles, bones, and nerves to produce small, precise movements (MedlinePlus, 2012). Bland et al. (as cited in Lang & Schieber, 2003) wrote that intact sensation with finger control and manipulation is required by the hand in order for it to function. O*NET (2012) indicated that dental hygienists must have finger dexterity, manual dexterity, and arm-hand steadiness. Dexterity is fine, voluntary movements used to manipulate small objects when doing a specific task. The concept of dexterity can be also broken down further and is described in terms of manual dexterity, which is the ability to handle objects, and fine motor dexterity, which refers to in-hand manipulations (Yancosek & Howell, 2008).

Manual dexterity and fine motor dexterity are imperative to the hand function of dental hygienists. The proper technique for holding instruments is called a modified pen grasp. This may be described as the hygienist grasping the instrument between the thumb and radial aspects

of the index and middle fingers in a tripod fashion. Next, the fingers gently guide the instrument to sense how much pressure is needed to navigate the anatomy of the tooth and remove any deposits (Atwood-Sanders & Michalak-Turcotte, 2002). Eye-hand coordination is also important because this critical information is relayed from eye-to-brain-to-hand so the hygienist understands the aspects of the object's shape, weight, and texture (Anderson-Hammond, Shay, & Szturm, 2008).

Hand Strength

There are 38 muscles that control movements in the hand. Muscles that originate and insert in the hand are known as intrinsic muscles. Muscles that move the hand but originate in the forearm are called extrinsic muscles (Jones & Lederman, 2006). Hand strength is essential to dental hygienists. Millar (2009) wrote, "Hand strength is important to successfully implement extraoral fulcrums" (para. 8). Fulcrums allow dental hygienists to stabilize their hands for control when maneuvering instruments.

Along with using hand strength for applying fulcrums, power grasps and finger contact forces are also important. A power grasp is used for holding tools for water evacuation, grasping the overhead light, and holding various equipment (Atwood-Sanders & Michalak-Turcotte, 2002). Finger contact forces are used for varying load or torque to prevent slips while using instruments (Anderson-Hammond et al., 2008). When the modified pen grasp is used correctly, the dental hygienist holds the instruments firmly while the wrist and forearm provide the direction and power for the stroke (Atwood-Sanders & Michalak-Turcotte, 2002).

Musculoskeletal Disorders Concerns for Dental Hygiene Students

Limited studies have been done to determine how musculoskeletal disorders (MSD) affect dental hygiene students. MSD are considered injuries to the human body that affect the muscles,

ligaments, tendons, nerves, blood vessels, bones, or joints. The injuries may affect one or more of these body parts. Symptoms of MSD include pain, swelling, tenderness, numbness, tingling sensation, and loss of strength (Michalak-Turcotte, 2000).

In 2001 Morse and colleagues conducted a study to evaluate the frequency of MSD in dental hygiene students and how it related to their increased exposure to vibrating instruments such as ultrasonic scalers and slow speed hand pieces. The symptoms of MSD that were noted in the study were pain in cold weather, numbness, aching, stiffness, and tingling. As the students progressed through the dental hygiene program, the number of hours using vibrating instruments increased. At the beginning of the program, the students estimated that they used high frequency vibrating instruments 0.2 hours per week. After the first year the number increased to 2.8 hours per week and 7.3 hours per week after the second year. The number of hours using regular dental hygiene instruments also increased each year. At the beginning of the program, 0.5 hours of hand instruments were used per week, 5.6 hours after the first year, and 9.8 hours per week after the second year. At the beginning of the study 46% of students reported some pain. This number increased to 62% after their first year of dental hygiene school rose to 70% after their second clinical year. Upper extremity pain increased from 42% when the students entered school to 62% after the first year. Tingling pain increased from 0% at the beginning of school to 30% after their second year. However, 81% of those 30% having tingling pain had a second job that might have attributed to the reported numbness. This study did conclude that MSD can occur while in dental hygiene school and the onset may be rapid (Morse et al., 2003).

A more recent study conducted on Australian dental hygiene students also found that dental hygiene students were at risk for MSD. In a 12-month period 64.3% of students experienced neck pain, 57.9% reported lower back pain, and 42.0% complained of wrist or hand pain. The

study found that lack of exercise and prolonged computer use could be factors contributing to MSD. Only 5% of the students responding to the survey used magnifying loupes. The study concluded that MSD problems began while students were in dental hygiene school (Hayes, Smith, & Cockrell, 2009).

Musculoskeletal Disorders Concerns for Experienced Dental Hygienists

Experienced dental hygienists can also succumb to hand function issues after years of work. The prevalence of MSD, also known as work-related musculoskeletal disorders (WMSD) among dentists, dental hygienists, and dental students ranges from 64% to 93% (Hayes et al., 2009). According to Hayes et al. (2009) dentists' pain generally settles in their back (36.3%-60.1%) and neck (19.8%-85%), while dental hygienists experience more hand and wrist pain (60%-69.5%). In 1987 it was estimated that the annual loss of income to oral health care providers was over $41 million due to musculoskeletal pain (Michalak-Turcotte, 2000). Musculoskeletal problems pose a significant burden to those working in the dental profession.

Although dentists and dental assistants experience MSD, dental hygienists are affected for several reasons. Dental hygienists are often in static and awkward positions. They are exposed to vibrations from ultrasonic and polishing instruments. They use repetitive extension and flexion of their wrists, and they are constantly grasping and pinching small diameter instruments. Instruments that are not sharp, poor fitting gloves, and equipment that is not ergonomic can also increase their risk of MSD (Michalak-Turcotte, 2000). In a study of 6,320 dental providers in the United States Army, 75.1% of dental hygienists reported having repeated hand problems and 56.5% reported having carpal tunnel like-symptoms (Lalumandier & McPhee, 2001). Carpal Tunnel Syndrome (CTS) is consistently higher in dental hygienists than in the general population (Simmer-Beck & Branson, 2010). Dental hygienists are susceptible to CTS and other hand

function problems because of the movement and use of their hands. It is common for dental hygienists to use different wrist movements 30 times or more per minute; this also puts dental hygienists at a higher risk for wrist tendon disorders (Michalak-Turcotte, 2000).

Throughout a work day, dental hygienists can be placed into awkward positions to gain visual access of oral anatomy. These awkward positions increase the risk of MSD to the back, neck, shoulders, and arms of dental hygienists (Michalak-Turcotte, 2000). Dental hygienist also use repetitive motions while scaling calculus, biofilm, and stain off teeth. Seventy-nine percent of dental hygienists reported using repetitive motion and 65% reported having a history of CTS (Simmer-Beck & Branson, 2010).

Pinch grip, which is used by the subordinate and dominant hands of the clinician, increases the risk of hand and wrist problems. The subordinate hand of the dental hygienist is used to hold a mirror for indirect vision and to retract tissues and the tongue. At times much force in the subordinate hand is needed to ensure safety of the tissues and tongue of the patient. The dominant hand of the dental hygienist is used to hold various instruments throughout the appointment. Calculus and stain can be tenacious, and significant muscle force is needed to remove it. When using a pinch grip and pressure with either or both hands, carpal tunnel pressure is increased (Simmer-Beck & Branson, 2010).

Ultrasonic scalers are used by dental hygienists to remove calculus, biofilm, and stain. Although less hand force and flexion is needed when using an ultrasonic scaler, small sweeping motions are needed and vibrations from the instrument may have a negative impact on MSD. Dental hygienists use slow speed hand pieces to polish teeth. These hand pieces give off vibrations and have cord torque that may also cause MSD (Michalak-Turcotte, 2000).

In recent years some dental offices have employed dental hygiene assistants. These assistants are used to increase the production of the dental hygiene department of dental offices. The dental assistant's duties can include seating a patient, reviewing medical history, taking any necessary radiographs, and taking the patient's blood pressure. After these tasks are completed, the dental hygienist will enter the room to scale and polish the patient's teeth. While the dental hygienist is treating the patient, the dental hygiene assistant will start to seat the second patient in a separate room. Once the dental hygienist is done treating the first patient, the dental hygienist moves to the next room to scale and polish the second patient who has already been seated in the next room. The hygiene assistant will then go back into the first patient's room to sterilize it and seat the third patient of the day. Although this is a productive way to see many patients in a day, a heavy workload and repetitive action throughout the day increases a dental hygienist's risk of developing MSD (Hayes, Taylor, & Smith, 2012).

The impact of MSD on dental hygienists is significant. MSD has been cited by dental hygienists as resulting in sick leave, reducing productivity, lost wages, increasing medical expenses, increases in worker's compensation, early retirement, reducing job satisfaction and a reason for leaving the profession. Some dental hygienists do not have a choice but to leave the clinical dental hygiene profession due to pain and loss of motion and tactile sensitivity from MSD (Michalak-Turcotte, 2000). Other dental hygienists have left clinical practice to work as teachers or researchers because of MSD (Hayes et al., 2012).

Dental hygienists can reduce their risk for developing MSD. Ways to minimize risk include using lighter weight instruments, instruments that have a handle with a wider diameter, sharp instruments, extraoral fulcrums, proper indirect visualization with a mirror, magnification loupes, stretching, and using ergonomic equipment (Michalak-Turcotte, 2000).

Dental hygiene instruments that reduce the chance of developing a MSD should weigh no more than 15.0 grams and have a handle diameter of at least 10 mm (Simmer-Beck & Branson, 2008). Instruments should also be kept sharp so less force is needed to remove calculus and stain from teeth. Extraoral fulcrums can be used to reduce the extension and flexion of the wrist. Proper indirect visualization with a mirror should be used so the dental hygienist is not in an awkward position (Michalak-Turcotte, 2000). Dental hygienists who used magnification loupes were less likely to have wrist and hand pain. Shoulder, neck, and back pain was also experienced less by dental hygienists who used loupes. This relationship is believed to exist because dental hygienists who use loupes have better posture (Hayes et al., 2012). Each time a hygienist sets down an instrument and picks up another, he or she should take that opportunity to stretch out his or her hand. Ergonomic equipment allows the dental hygienist to reach things more effectively without compromising his or her body (Michalak-Turcotte, 2000).

To help dental hygienists increase their job satisfaction and body safety, techniques to reduce MSD should be taught within the dental hygiene curriculum. Morse et al. (2003) wrote while ergonomic education is important, "less than 4% of 216 accredited dental hygiene programs employed a person with specialized training in ergonomics to disseminate this information" (p. 174). Dental hygiene continuing education courses and seminars should also be easily available for dental hygienists who are interested in this important aspect of their career (Michalak-Turcotte, 2000).

Occupational Therapists

Occupational therapists are health care providers who use their expertise to help "people across the lifespan participate in the things they want and need to do through therapeutic use of everyday activities (occupations)" (American Occupational Therapy Association, Inc. (AOTA),

2012, para. 1). As of 2007 all occupational therapists were required to complete either a master's degree or a professional doctoral degree as the requisite educational entry requirement. After completion of their program work, all occupational therapy graduates are required to take a written exam to be certified to practice as an occupational therapist. Postlicensure state-by-state license renewal is defined according to each state's statute (AOTA, 2012).

Many occupational therapists prefer to gain experience before treating people who require hand therapy. Some occupational therapists choose to specialize in hand therapy and become certified by the Hand Therapy Certification Commission (AOTA, 2012). Occupational therapists often treat dental hygienists who have tendonitis, arthritis, or carpal tunnel syndrome. Techniques including muscle strengthening, simulated activities, and recommendations of splints are used to help treat such afflicted dental hygienists (Atwood-Sanders & Michalak-Turcotte, 2002).

Improving Hand Function

The purpose of improving hand function is to build up the small muscles in the hand and repair or develop the pinching and thumb motion to improve the quality of life (Hooker et al., 2011). Deficiencies in hand function can affect people in different age groups and with various health conditions. Young children to people who have suffered strokes and those who have been diagnosed with cerebral palsy all can have hand function issues to varying degrees. Occupational therapists use different resources and exercises to help improve hand function (Bureau of Labor Statistics, 2012d).

Depending on a person's weakness or disability, occupational therapists customize treatments to help rehabilitate their patients. For example, 30% to 60% of daily activities of elementary aged school children include using hand function. These activities include cutting,

coloring, and handwriting (McHale & Cermak, 1992). To improve hand function occupational therapists work with students by doing activities such as threading beads, placing pegs in boards, and screwing nuts and bolts together. Activities to improve hand function using pencil and paper include connecting dots and arrows and tracing mazes (Ratzon, Efraim, & Bart, 2007).

Occupational therapists also customize therapy for stroke patients. Some stroke patients suffer from paresis on one side of their body, and this may affect their coordination of fine motor skills (Hooker, Libbe, Park, & Paul, 2011). Helping to improve hand function, occupational therapists allow stroke patients to gain independence by allowing them to open lids to jars, open doors and do household chores such as fold laundry (Bureau of Labor Statistics, 2012d). The American Stroke Association (2013) has exercises listed on its website to improve fine motor skills at home. These exercises include timing yourself placing pegs in a board and removing them, shooting marbles into a cardboard box several times a day, and squeezing a rubber ball to strengthen the affected hand. These same therapies that are used to improve hand function for children and stroke patients are used also used for patients with generalized weakness and people who need to improve their coordination. Dental hygienists who have undergone surgery for Carpal Tunnel Syndrome or other hand function issues may be prescribed these same exercises.

Occupational therapists use preventative, nonoperative treatments to improve hand function. These treatments can also help manage acute or chronic pain, encourage sensory re-education after nerve injury, fabricate splints to prevent or correct injuries, and design and implement home exercise programs to increase motion, dexterity, and strength (American Society for Surgery of the Hand, 2013).

Functional activities should be included for occupational hand function exercises because they provide excellent means of increasing strength, fine motor skills and endurance (Skirven,

Osterman, Fedorczyk, & Amadio, 2011). To improve grip and pinch strength for generalized weakness, exercises using graded Norco Putty are recommended. The putty is graded from super soft to firm and the patient is issued a Norco Exercise Putty Instructions handbook that includes pictures and descriptions of exercises. The occupational therapist will recommend the patient do particular exercises to increase grip and/or pinch strength depending on the patient's needs. Hand and pinch grips and foam squeeze balls in different resistances are also used to help patients increase their strength. The patient generally starts with easy graded putty to grip or squeeze ball and squeezes these as directed doing 15 to 20 repetitions three times a day. The occupational therapist will increase the tension or the grade of the exercise apparatus as the patient becomes stronger (Norco Exercise Putty Instruction Handbook, 2013).

To improve gross and fine motor skills, occupational therapists recommend exercises that use common household items. Patients can practice picking up coins from a table without sliding them off the side. They can also practicing hand writing, manipulating a pen, opening and closing a safety pin. Exercises include practicing grasping objects of various shapes, sizes, and textures such as beads and nuts and bolts. Patients are encouraged to construct wooden model cars and planes. Games such as Jenga, Legos, and Connect Four are also ways patients can improve their motor skills (Skirven et al., 2011).

Similarities Between Dental Hygiene and other Allied Health Professions Admission Processes

Allied health is a term used to encompass various health care professionals across the United States and the world. There are an estimated 5 million allied health care providers working within more than 80 professions in the United States alone (Explore Health Careers, 2013). Professionals working in allied health fields are directly involved in patient care. Allied health

professionals are educated as a technician or assistant or a therapist or technologist. They are trained to perform specific procedures, and their education or training is generally less than 2 years. Each technician or assistant is required to work under the supervision of a therapist or technologist (Explore Health Careers, 2013).

Allied health care professionals working as therapists or technologists are required to complete more extensive education and training. They are involved in delivering health-related services that identify, evaluate, and prevent diseases and disorders (Explore Health Careers, 2013). Allied health includes professionals working as dental hygienists, radiologic technologists, and respiratory therapists (Association of Schools of Allied Health Professions, n.d.).

Admission to Dental Hygiene Programs

The Commission on Dental Accreditation sets the accreditations standards for dental hygiene education programs. The Commission has guidelines that must to be followed concerning admissions processes for dental hygiene programs. These guidelines dictate that admission of students must be based on specific written criteria and documented in policies and procedures decided on by each school. The Commission suggests that the program administrator, faculty, and institutional personnel establish procedures whereby the most qualified students are chosen to complete the rigorous program. All applicants must be informed of the criteria for admissions, course content, and the scope of dental hygiene practice (ADA, 2013).

Currently, the state of Wisconsin has seven dental hygiene programs that award an associate degree of applied science in dental hygiene. Wisconsin does not have a school that awards a bachelor degree in dental hygiene (ADHA, 2012a). Waukesha County Technical College

(WCTC) uses a weighted point system to select students its their dental hygiene program. The WCTC program implemented this weighted point system to try to reduce the attrition rate the program has experienced in recent years. Twenty students are admitted to the program each fall based on several factors. These factors include grades in prerequisite science classes, at which college the classes were taken, and previous dental assistant work experience. The fall semester of 2012 was the first time this weighted system was used.

Admissions to the other six associate degree programs located in Wisconsin require candidates to take entrance exams such as COMPASS, ACT, SAT, Accuplacer, ASSET, or Health Education System Exam. Along with minimum test scores determined by certain colleges (Madison Area Technical College, n.d., Northeast Wisconsin Technical College, n.d.(a)., Chippewa Valley Technical College, 2013a, Fox Valley Technical College, 2013, Milwaukee Area Technical College, 2013, Northcentral Technical College, n.d.(a), a minimum grade of a "C" in liberal arts classes and a "B-" or "C" in science classes also is required depending on the college. Northcentral Technical College further requires students to take the Health Education Systems Exam. Prospective students with the highest scores were accepted to the program first (Northcentral Technical College, n.d.). Northeast Wisconsin Technical College gives priority to students who complete General Anatomy and Physiology courses with a grade of "B" or better (Northeast Wisconsin Technical College, n.d.(a). Other Wisconsin dental hygiene schools have minimum scores required on placement tests; however, none stated that those with the highest scores would be admitted first. Many of the schools, including Waukesha County Technical College, require a 4-hour job shadow prior to admission, a criminal background test, and CPR certification (Waukesha County Technical College, 2013).

To compare the admissions process for dental hygiene students in Wisconsin to those across the United States, several dental hygiene programs' admission requirements were reviewed. Mesa Community College in Mesa, Arizona, requires prospective students to have a GPA of 3.25 or higher in general education courses and a GPA of 3.50 or higher in science classes. Forty hours of job shadowing is required, as well as a criminal background check (Mesa Community College, 2013). Grand Rapids Community College in Michigan requires students to first obtain a "C-" or better in four prerequisite science classes and then the students are usually put on a waiting list for 2 years before they start the program (Grand Rapids Community College, 2011). Wiregrass Georgia Technical College admission's process information states that prospective dental hygiene students need to present "acceptable" SAT, ACT, CPE, COMPASS, or ASSET scores on tests taken within the last 60 months (Wiregrass Georgia Technical College, 2010).

Once students complete their academic curriculum, each dental hygiene student across the United States takes the same written National Board Dental Hygiene Exam for licensure. A clinical exam is also required. The clinical exams are offered by the Council of Interstate Testing Agencies, Central Regional Dental Testing Service, North East Regional Board of Dental Examiners, Southern Regional Testing Agency and Western Regional Examining Board. Students are required to pass the exam in the region in which they wish to practice. If a student wishes to be licensed in another region, he or she must pass the clinical exam in that region as well (ADHA, 2012b).

All of the above colleges operate under the guidelines of the Commission on Dental Accreditation for their admissions process. No dental hygiene program researched here requires hand function testing or exercises as an admissions requirement.

Competency-Based Education in Dental Hygiene Education

Competency-based education is used in Waukesha County Technical College's (WCTC) dental hygiene program. Albanese, Mejicano, Mullan, Kokotailo, and Gruppen (2008) wrote that "Competency-based and out-come based medical education focus on the result of the education, not the process itself" (p. 249). The purpose of a competency-based education is to make sure that each student can meet a performance standard as defined by the dental hygiene curriculum.

Albanese et al., (2008) suggested that a competency-based education should have five characteristics. Those characteristics are: that the focus should be on the end-product of the learning, it should reflect applications of what is being learned in that program or class, it should be measurable, measured competence should not be affected by the performance of other learners, and learners should know what is expected of them.

WCTC's dental hygiene program sets minimum competencies standards for each of its four clinical semesters. Semesters are named Process I, Process II, Process III, and Process IV. As the student moves through each Process, the minimum competencies increase to ensure the student reaches the needed result for graduation requirements. Minimum competencies scores need to be met for certain skills required for each of the Processes. If the student does not meet a minimum competency level the first time, he or she is allowed to repeat the required evaluation until the minimum competency level is met (Brilowski, 2012). This is individualized learning. Competency-based education focuses on individualized learning instead of the traditional, one-size-fits-all learning (U.S. Department of Education, n.d.).

Radiography

Other allied health professions that follow very specific admission guidelines include radiology technicians. Radiologic technologists are allied health professionals who perform diagnostic imaging examinations on patients. They follow physicians' orders to expose radiographs for their patients, place the patient in correct position to acquire an x-ray that is diagnostic, and protect the patient from unnecessary radiation exposure (Bureau of Labor Statistics, 2012b). Education to become a radiologic technologist includes classroom and clinical training. A minimum of an associate's degree must be earned to work as a radiologic technologist. Each technologist is also required to pass a certification exam for licensure in the state in which he or she wants to work (Bureau of Labor Statistics, 2012b).

Colleges that offer a radiologic technologists program are accredited by the Joint Review Committee on Education in Radiologic Technology (JRCERT, 2013). JRCERT regulates program admission. Their guidelines include that the admissions policies are available and accurate and that the admissions practices are nondiscriminatory regarding race, religion, gender, age, and disability (JRCERT, 2013).

Chippewa Valley Technical College in Wisconsin requires its prospective radiologic technologist students to take either the COMPASS or ACT test, with minimum required scores needed for acceptance to the program. Once a student has obtained the minimum required score, the student is either admitted to the program or placed on a waiting list (Chippewa Valley Technical College, 2013b). This is the same admissions procedure the college listed for its dental hygiene program.

Northcentral Technical College requires its prospective radiologic technologist students to take the Health Education System Exam. Prospective students with the highest scores are

accepted to the program (Northcentral Technical College, n.d.(b). This also is the same admission procedure the college requires for its dental hygiene program.

Dalton State College in Michigan has a competitive admissions program. The college website lists admission factors of college GPA, number of college credits completed, completion of prerequisite courses, and number of apprenticeship hours. Taken into consideration also are the evaluations of the apprenticeship from clinical instructors, work experience, program assessment scores, technical skills evaluation, and for the top 35 applicants an interview is conducted (Dalton State College, n.d.).

Respiratory Therapists

Allied health professionals who treat patients having difficulty breathing are respiratory therapists. Respiratory therapists consult with physicians to develop treatment plans, measure lung capacity, monitor and record patients' progress, and teach patients how to use at-home medications (Bureau of Labor Statistics, 2012c). Education to become a respiratory therapist includes classroom and clinical training. A minimum of an associate's degree must be earned to work as a respiratory therapist. The student is also required to pass a certification exam for licensure in the state in which he or she wants to work; respiratory therapists are not licensed in the state of Alaska (Bureau of Labor Statistics, 2012c).

Colleges that offer the respiratory technologists programs are accredited by the Commission on Accreditation for Respiratory Care (CoARC). CoARC states that admission of students into the college must follow clearly defined and published practices of the institution and program (CoARC, 2013).

Chippewa Valley Technical College in Wisconsin requires its prospective respiratory therapist students to take either the COMPASS or ACT test, with minimum required scores

needed for acceptance to the program. Students also must submit proof of a minimum of a "C" in algebra, biology, and chemistry from either high school or a postsecondary level course. Once these two steps are completed, prospective students must submit proof of nursing assistant training that includes a clinical component. Then, the student is either admitted to the program or placed on a waiting list (Chippewa Valley Technical College, 2013c). This admission procedure does vary from its dental hygiene and radiologic technologist programs admissions criteria.

Northeast Wisconsin Technical College has the same admissions procedure for its respiratory therapist and its dental hygiene programs. High school science classes must be completed with a grade of "C" or better. An admissions test such as the ACT or Accuplacer also must be completed and benchmarks met for acceptance into these allied health programs. Northeast Wisconsin Technical College gives priority to students who complete General Anatomy and Physiology classes with a "B" grade or better (Northeast Wisconsin Technical College, n.d.(b).

Foothill College in Los Altos Hills, California provides a 2-year associate degree in respiratory therapy. Prospective students must have a high school diploma or G.E.D. with a GPA of 2.5 or higher. Algebra, chemistry, biology, medical terminology, English, or equivalent college-level courses taken need to have a grade of "C" or better for the student to be considered for admission to this program (Foothill College, 2012).

Summary

Dental hygienists are one of many allied health professions. Educational requirements to enroll into dental hygiene programs are similar to other professions in allied health. Dental hygiene students must achieve competency using dental hygiene instruments to graduate from an accredited dental hygiene program. Licensure is granted after written and clinical exams are

successfully completed. Didactic classes prepare the student for success on the national written exam. Preparation for the clinical exam is done in the laboratory part of the curriculum. The clinical aspect of dental hygiene includes the ability to possess sufficient hand function to control instruments that are a necessary part of the career of a dental hygienist. Hand strength, grip strength, and motor skills are all important aspects of hand function. Currently in Wisconsin, no dental hygiene schools are requiring a hand function test prior to admission.

As dental hygienists moves through their career, they are at a high risk of musculoskeletal disorders (MSD). Repetitive motions and force used by their hands can have negative effects on their careers. Following suggested ergonomic tips may lengthen their career and job satisfaction. Occupational therapists can also help dental hygienists who are experiencing MSD.

CHAPTER 3

DESIGN AND METHODOLOGY

Overview

Dental hygienists must be skilled in working with their hands and using very precise tools (Bureau of Labor Statistics, 2012a). This research is an evaluation of the hand function of 20 first-semester dental hygiene students. Hand function testing was completed by an occupational therapist certified in hand therapy. Hand function exercises were assigned to the participants for 6 weeks after the testing is complete. After 6 weeks, hand function was re-evaluated to assess if improvement was made. Selected dental hygiene instrument scores of these 20 students was compared to those of students from the 5 previous years to determine if hand function exercises improved dental hygiene performance.

Research Design

A longitudinal quantitative research design using a panel study was conducted to determine if hand function can improve after hand function exercises are completed and if they had a positive impact on instrumentation usage skills. A longitudinal research design using a panel study evaluates the same group of people over time and allows the researcher to track changes (Cottrell & McKenzie, 2011). This study followed the same 20 students over a 6-week period to evaluate if hand function can improve with hand function exercises. Their hand function was measured prior to the exercises and again after the exercises were completed. To evaluate if their possible hand function improvement had an impact on their dental hygiene performance, selected instrument scores were compared to students in the 5 previous years. The longitudinal research design using a panel study allowed the researcher compare if hand function testing and exercises are beneficial for dental hygiene students.

Validity

The four hand function tests were conducted by a single licensed occupational therapist, Vickie Alba, who holds certificates in Orthopedic Manual Therapy (Upper Quadrant) and Hand Therapy. Mrs. Alba graduated from the University of Wisconsin-Milwaukee in 1988 [Appendix A]. In 1999 she earned her Certificate of Hand Therapy and has been a certified Orthopedic Manual Therapist since 2008. Mrs. Alba received Wisconsin Occupational Therapy Association Service Awards in 2004, 2007, and 2010. She has presented several continuing education programs beginning in 2004. Some of those presentations include: (1) Systematic Approach to Examination, Diagnosis and Manual Therapy of the Hand, (2) Systematic Approach to Examination, Diagnosis and Manual Therapy of the Wrist I and II, and (3) Anatomy, Differential Evaluation, and Treatment of the Wrist/Hand. She is currently employed by Hand Surgery, Limited.

The first hand function test that was performed is the Purdue Pegboard Test, manufactured by the Lafayette Instrument Company [Appendix B]. The test was developed in 1948 and its purpose is to measure fine finger dexterity (Yancosek & Howell, 2009).

The reliability of the Purdue Pegboard Test has been tested since its creation in 1948. One of the most recent tests was conducted on a study of 47 junior occupational therapy students. In the study standard directions were given and the test taken; participants returned in a week to complete the testing again. Both one-and three-trial sets were completed to evaluate reliability. The one-trial testing had a weak reliability ranging from “Poor” to “Adequate”. The three-trial testing of the Purdue Pegboard Test had a reliability of “Excellent” (Buddenberg & Davis, 2000).

In this research study for dental hygiene students the three-trial test was used. Yancosek and Howell (2009) wrote that six studies of the Purdue Pegboard Test established its reliability, as

well as criterion, construct, discriminate, and content validity. The norms used for this research project were the most current ones published in the Purdue Pegboard Manual dated 2012. Validity of the test was established from testing done in 1948 with over 7,800 participants (Tiffin & Asher, 1948). Coefficients from the testing range from .07 to .76. The researchers found the differences in the coefficients to be based on the myriad tasks that can be considered manual dexterity. Currently, the exact nature of manual dexterity for dental hygienists has not been defined by studies.

The second test that was completed is the Box and Block Test [Appendix C]. This test is manufactured by Sammons Preston Rolyan. It is used to evaluate manual dexterity.

Yancosek and Howell (2009) wrote that the Box and Block Test is recommended as the assessment of choice to evaluate manual dexterity because five Level 2b studies established its reliability and validity. Test-retest reliability at 6 month intervals had coefficients of .937 and .976. Norms for this test were developed by a research study that involved 310 males and 318 females from southeast Wisconsin (Mathiowetz, Volland, Kashman, & Weber, 1985). This study also used the 15-second practice and two 1-minute tests; one test per hand was recorded.

Validity of the Box and Block Test has been established by two previous studies. These studies correlated the test with the Minnesota Rate of Manipulation Test (with a result of $r = .91$) and with the General Aptitude Test Battery, part 10 (with a result of $r = .86$) (Mathiowetz, Volland, et al., 1985).

The third and fourth hand function tests measured pinch and grip strength. The first test administered by the occupational therapist is the three-point prehension pinch test. The instrument used for this test is a B & L Pinch Gauge [Appendix D]. Before using the pinch

gauge to test students, the meter was calibrated by the occupational therapist using weights suspended by the finger grooves.

In the final test the students' grip strength was evaluated. Grip strength is important for dental hygienists when using a fulcrum during instrumentation. Grip strength was tested using a JAMAR Hand Dynamometer [Appendix E]. This tool has been employed for over 40 years and is manufactured by Sammons Preston Rolyan. Prior to conducting the test, the occupational therapist calibrated the JAMAR Hand Dynamometer by hanging known weights from the center of the hand pieces.

The reliability and validity of grip and pinch strength evaluations were studied by evaluating 27 college women in Milwaukee, Wisconsin. The article published in 1984 found that there was very high inter-rater reliability and that test-retest was highest when the mean scores of all three trials were used. Validity of the Jamar Dynamometer was tested by suspending known weights from the center of the hand pieces; the calibration accuracy was +-3%. This was determined to be the best measure for grip strength. Validity of the B & L Pinch Gauge was also tested by suspending known weights from the finger groove of each gauge; accuracy of +-1% was achieved. The B & L Pinch Gauge was found to be the most accurate for pinch strength tests (Mathiowetz, Weber, Volland, & Kashman, 1983).

The most recent norms for pinch and grip tests were found in a study published in 1985. The primary purpose of that study was to establish norms for adults aged 20-75+ years. The study took place in southeastern Wisconsin. A pinch guage and dynamometer were used to evaluate the hand strength of 310 males and 328 females. The researchers concluded that grip strength levels peaks for individuals in the 25-39 age range for both sexes and then gradually declines. In contrast, measured pinch strength levels did not begin to drop for

individuals until they reached the age of 60 (Mathiowetz, Kashman, et al., 1985). The norms established by this study for grip and pinch strength were the norms that the participating dental hygiene students were compared to.

The second research question of this study compared the participants' instrument scores of the periodontal probe [Appendix I] and the 11/12 explorer [Appendix J] to students in the 5 previous years at WCTC. Hand function issues of dental hygiene students from 2008-2012 at WCTC that resulted in attrition from the program was 13.4% (P. Brilowski, personal communication, April 3, 2013). The periodontal probe and 11/12 explorer evaluations at WCTC have not changed in the last 5 years and all evaluating faculty were the same.

Population

The population for this study included 20 dental hygiene students who began the dental hygiene program at Waukesha County Technical College, Pewaukee, Wisconsin in August, 2013. The dental hygiene students selected for this study are over the age of 18.

Informed Consent Consideration

Each participant was given a copy of an informed consent document and after their consent to participate in the study is given, a copy of the document was provided for participants to keep [Appendix K]. All students read the information presented to them and were provided an opportunity to ask any questions concerning the study. Questions were answered by the primary researcher and consent was obtained from the students before any testing began. It was reiterated to the students by the primary researched that the results of the testing had no effect on their enrollment or retention in the dental hygiene program at Waukesha County Technical College.

Data Collection Procedures

Confidentiality was important to this study so that no preconceived notions of any individual student's ability can be used to discriminate. Each student was assigned a confidential number generated from the random number generator in Excel so the anonymity of the student is maintained when the faculty at the dental hygiene program reviews this study. The occupational therapist was the only person in the room, and she recorded the information produced by the hand function evaluations. There was no information anywhere identifying the participant to their randomly assigned number. All evaluation information was password protected and kept on the researcher's laptop computer.

All testing was completed at Waukesha County Technical College in a classroom setting. The occupational therapist began the testing with the Purdue Pegboard. This test is composed of four evaluations. In each of the evaluations, the occupational therapist conducting the test demonstrated to the student what to do and the student was given a chance to practice and ask questions. Each student started with her dominant hand and had 30 seconds to place as many pegs as she could in the holes on her dominant side only, starting from the top of the row and taking pegs out of the cup on her dominant side only. Then, the same test was performed on her subordinate side. Next, the student was asked to use both hands at the same time, picking up pegs from the right side cup with her right hand and pegs from the left side cup with her left hand. Then the student placed the pegs in the holes in unison starting on the top row and worked her way down the vertical rows. For each of the above tests, the numbers of rows that had pegs was counted and recorded in the Excel spreadsheet using only identification numbers [Appendix F]. These three tests supply the first three scores. The fourth number was calculated by totaling the numbers of the first three tests.

The last part of the Purdue Pegboard Test had the students assemble units by picking up a peg with their dominant hand, placing it in the top hole in the row of their dominant hand, and then picking up a washer from their subordinate hand. The washer is then placed over the peg. Next, the student picked up a collar with her dominant hand, placed that over the washer, and then proceeded to pick up another washer with her subordinate hand and drop that washer over the collar. This is all counted as "one assembly."

Each student was given 60 seconds to complete as many assemblies as she was able. The student receives credit for the total parts that were on the board correctly. Because an "assembly" has four parts, the student received credit for four items per assembly. If assemblies are half completed, she received points for as many parts completed in the 60- second time frame. The totals of four tests listed above were performed three times each, and the test scores were averaged to get the most reliable scores per category (Purdue Pegboard Test Manual, 2012). After each test, the students' scores were recorded in an Excel spreadsheet using only their identification numbers.

The second test that was given is the Box and Block Test. The goal of this test is to move as many blocks from one side over to the other side, with one's fingers breaking the plane of a partition. The Box and Block Test board was placed lengthwise in front of the participant. The occupational therapist demonstrated how the test should be done; the students was able to practice for 15 seconds with each hand before beginning and was given a chance to ask questions. The participant then has 1 minute to move as many blocks as he or she can, moving one block at a time from the side that holds the blocks to the other empty side of the box. Two 1-minute tests were done. In the first 1-minute test, the participant started with her dominant hand. In the second 1 minute test, her subordinate hand was used. Students were instructed to

move only one block at a time, if more than one block is moved across the partition, it will only be counted as one block. Blocks dropped onto the table or floors were still counted as long as the participant's hand crosses the partition. Participants were instructed not to waste time picking up any blocks that fell onto the table or floor. At the end of each minute, the number of blocks moved from one side to the other was counted. The literature states that this test needs to be completed only once for each hand (Mathiowetz et al., 1985). All scores were recorded in the Excel spreadsheet using the students' identification numbers.

Pinch strength was tested next. The occupational therapist demonstrated the test to the student and answered any questions. Students were seated with the shoulder of the hand being tested relaxed and elbow bent at a 90-degree angle. Then, the student was instructed to squeeze the B & L Pinch Gauge as hard as she can for 3 seconds with the thumb, index finger, and long finger. There was a 10-second rest between each set. Each hand was tested three times and the scores were averaged per hand. Both hands were tested using the same procedure. Using their identification number, pinch strength scores were recorded in the Excel spreadsheet for each student.

Last, hand strength was tested. Again, the occupational therapist demonstrated the test to the student and answered any questions. Students were seated with their elbow at a 90-degree angle to their body for the hand that was tested first. The student was instructed to squeeze the Jamar Dynamometer as hard as she can for 3 seconds. There was a 10-second rest between each set. Each hand was tested three times and the scores were averaged per hand. Results for hand strength were recorded in the Excel spreadsheet using the student's identification number.

After all tests are completed, each student was shown by the occupational therapist exercises that help improve hand function. Exercises to improve grip and strength were completed using

Norco Exercise Putty. Norco Exercise Putty is a material recommended by occupational therapists to strengthen muscles and improve dexterity and coordination for their patients (Norco Exercise Putty Instructions, 2013). The occupational therapist in this study recommended medium-soft light (green) putty for all participants; putty was provided by WCTC. Each participant was given written directions on how to use the putty for each grip and pinch exercises. A copy of the Norco Exercise Putty Instructions was provided to the students, and the occupational therapist also demonstrated proper exercise technique.

To improve pinch strength, all participants were instructed to shape the putty into a ball and pinch the putty between their thumb, index, and middle fingertips until the fingers press through the putty. To strengthen grip, it was suggested that participants place the putty in their palms and press their fingers through the putty until their fingertips touched their palms. This action results in a clenched fist. These exercises are listed as 1) Finger Press and 10) Finger Pinch on the Norco Exercise Putty Instructions [Appendix H] (Norco Exercise Putty Instructions, 2013). Participants were instructed to reshape the putty and complete the exercises for 5 minutes each one to two times each day with their dominant hand.

To improve gross and fine motor skills and coordination, the occupational therapist recommended that the participants (1) string various-sized beads on a string and (2) use tweezers to pick up and move uncooked rice kernels from one paper plate to another. All items were provided to the participants by WCTC. For both (1) and (2), it was suggested that each exercise be performed for 5 minutes, one to two times a day with their dominant hand. All participants were shown how to correctly do the exercises by the occupational therapist. The occupational therapist noted that many hand function exercises call for the use of common household items so that exercises have a practical meaning and show purpose to those who perform them.

All students were allowed time during their dental hygiene curriculum courses to complete the exercises. Students completed these exercises once a day, five times a week during their scheduled classes. It was also suggested but not required that students practice the hand function exercises one other time a day when they are not at school during the week and twice on the weekend days. A chart was supplied so that compliance with the recommended exercises could be documented by the student [Appendix G]. The chart was supplied to them in a manila envelope the day they completed their first hand function evaluation. On the inside of the envelope their randomly assigned number was written.

After 6 weeks the four hand function tests were completed again on all 20 students to compare hand function after the hand function exercises were completed. The students were asked to bring their manila envelope with them to this second hand function testing. At this time they turned in their exercise log sheet to the occupational therapist. Their randomly assigned number written inside the manila envelope was used again for the occupational therapist to log their results of the testing for comparison. The same test methods and test equipment were used by the original occupational therapist. Test data were entered into the Excel spreadsheet the same way the first testing procedure was done.

The second research question of this thesis focuses on final scores of the periodontal probe and the 11/12 explorer evaluations of the study participating students compared to students of the previous 5 years. The periodontal probe and 11/12 explorer evaluations are competency-based education evaluations. Students are allowed to retake the evaluations as many times as needed during a semester to meet minimum competency. Minimum competency scores for evaluations in Dental Hygiene Process I is 79%. A student may complete the periodontal probe and 11/12 explorer evaluations and earn a grade of 84%. That student tested competent for that level and

can move onto the next learning objective. However, if the student is not successful the first time, an instructor will spend more time with that student to help him or her understand what needs to be improved to reach minimum competency for the next evaluation. That student was then evaluated again to identify if the student's skills meet minimum competency. Once the student is deemed competent by repeating the evaluation as many times as needed during that semester, the student will move to the next learning objective but will only receive the minimum competency score of 79% for that evaluation.

All 20 students' periodontal probe and 11/12 explorers were recorded in an Excel worksheet [Appendix L]. Student scores from the years 2008-2012 were also recorded on the same type of form for comparison.

Data Analysis Procedures

Results of the tests were transferred to PASW Statistics Student Version 18 for final calculations. The researcher assigned a unique identifier to each student, and a pre-and posttest analysis was done using a paired sample *t*-test using confidence level of 95% (alpha=.05).

To identify whether students who completed hand function exercises had higher final scores on the periodontal probe and 11/12 explorer evaluations than students in the 5 previous years, a logistic regression equation was developed with a 95% confidence level of 95% (alpha=.05).

Research Questions

1. Was hand function of dental hygiene students improved after recommended hand function exercises were completed?
2. Did students who completed hand function exercises have higher final scores on the periodontal probe and 11/12 explorer evaluations than students in the 5 previous years?

CHAPTER 4

PRESENTATION AND ANALYSIS OF THE DATA

The dental hygiene program at Waukesha County Technical College's (WCTC) goal is to retain all students admitted in each fall semester. The average level of attrition for dental hygiene students from 2008-2012 at WCTC attributable to hand function issues was 13.4% (P. Brilowski, personal communication, April 3, 2013). This study was designed to determine whether hand function testing and exercises would be beneficial for assessing dental hygiene students' proficiency in the use of equipment and would support strategies to enhance student success. The study included 20 dental hygiene students admitted to Waukesha County Technical College's dental hygiene program in the fall semester of 2013. At the outset of the program, the study staff evaluated the hand function levels of the 20 first-year students by applying four common hand function evaluations used by occupational therapists. After the students completed 6 weeks of hand function exercises, their hand function level was re-evaluated.

Population

The population for this study was 20 dental hygiene students (the entire cohort), who began the dental hygiene program at Waukesha County Technical College, Pewaukee, Wisconsin, in August, 2013. The dental hygiene students who participated in this study were all females between the ages of 20 and 39. All 20 students participated in an initial evaluation; however, only 17 students completed the 6-week hand exercise regimen and the function re-evaluation. Fifteen of the students who completed the study are right hand dominant; two students are left hand dominant.

Normative Data for Hand Function Evaluations

To determine if there was potential for the dental hygiene students to improve their hand function, individual initial scores were compared to the norms for the evaluations. When comparing the students' scores to Norms of Male and Female Applicants for General Factory Work for the Purdue Pegboard Right Hand Testing, (as recommended by the study's occupational therapist), the highest two students' scores were at the 70th percentile. Three students scored at the 50th percentile, seven at the 30th percentile, and five students were at the 15th percentile or below. The Purdue Pegboard Left Hand Testing results placed four at the 50th percentile, five at the 30th percentile, and eight of the students at the 15th percentile or below. Results compared to the norms for Both Hand Testing for the Purdue Pegboard resulted in two students ranking above the 40th percentile, eight at the 35th percentile, and seven students at the 15th or lower percentile. The fourth part of the Purdue Pegboard is summing the right, left and both hand mean trials. Seven students ranked at the 50th percentile or above, five students ranked at the 45th percentile or below, and five students ranked at the 20th percentile or below with the lowest student score at the 10th percentile.

The students scored higher on the assembly portion of the Purdue Pegboard Test. Six students ranked at the 90th percentile or above. Nine students placed between the 55th and 75th percentiles. Two students were at the 40th percentile (Purdue Pegboard Test User Instructions, 2012).

The mean performance score for the Box and Block Norms for females ages 20-39 for the right hand is 86 (Mathiowetz, et al., 1985). Eight students had scores in the 60s (i.e., moving 60-69 blocks in 1 minute), eight students were at the 70s, and only one student scored at the 80s. The left hand norm for women 20-39 years old is 82 (Mathiowetz et al., 1985). Among the

WCTC students tested, one moved 58 blocks, nine students performed in the 60s, and seven students moved 70-76 blocks. No student moved more than 77 blocks with her left hand in the 1-minute trial. All students scored below the norms on the Box and Block Test.

Eleven students tested at or above the mean norm of 17.925 lbs. for women ages 20-39 years old for the Pinch Test Right Hand (Mathiowetz et al., 1985). Based upon the established norms for the test, two had significantly low scores-testing at 11.33 lbs. and 13.66 lbs. respectively. The left hand mean norm for this age group is 17.125 lbs. (Mathiowetz et al., 1985). Twelve students tested at or above the norm. The same students who were weak on the right pinch test were similarly weak on the left pinch test.

The mean norm for right grip strength for women ages 20-39 is 74.425 lbs. (Mathiowetz et al., 1985). Six students tested at or above the norm, including one testing at 113.6 lbs. The remaining 11 students tested between 60.3 lbs. and 74.3 lbs. The left hand mean norm for grip strength for women ages 20-39 is 64.7 lbs. (Mathiowetz et al., 1985). Nine students met or exceeded the norm; two of these students tested, respectively, at 91 lbs. and 113.6 lbs. The student who tested 91 lbs. is left hand dominant; however, the strongest left hand grip student is right hand dominant. The eight other students tested between 57.6 lbs. and 63.3 lbs.

Students Who Did Not Complete the Study

Three students did not complete the second hand function evaluation. One left the program to pursue a master's degree and because hand function did not factor into her decision to leave the program, her data are not presented below. Another left to enroll in an occupation therapy assistant program because she was weak, clinically, in hand function. The third student who left the program was struggling academically as well as with hand function.

Of the students who elected to leave the program, on the initial hand function evaluations, one student tested well, having similar or better scores than her peers. The other two students struggled especially when having to coordinate fine motor movements with both hands simultaneously. Of these two students, one was right hand dominant, and the other left hand dominant. In the Purdue Pegboard evaluations, the student who was right hand dominant scored at the 1-3 percentiles compared to the test's norms for the first four evaluations. The left hand dominant student scored well with her left hand, rating at the 30th percentile, but scored only between the 1-5th percentiles with her subordinate hand (Purdue Pegboard Test User Instructions, 2012). The last evaluation of Purdue Pegboard evaluates the student as she assemble units with both hands. Of the 17 students who continued on in the study, the lowest scores were 38 and 38.66, with the average of the class being 45.50. The two students who did not continue in the study scored 35.33 and 27.66, respectively.

In the Box and Block Test - right hand side, the right hand dominant student scored the lowest of the right hand participants, moving two fewer blocks than the two weakest students who continued with the testing. The left hand dominant student scored the lowest on the left hand side, moving two fewer blocks than the weakest left handed student who continued with the study. The two students who were weak with hand function testing had scores similar to their peers in pinch strength. For hand strength, one student was at the high end of her classmates' range, while the other was at the low end.

Results

The first research question asked: Was hand function of dental hygiene students improved after recommended hand function exercises were completed? The research hypothesis for this question stated that hand function test scores would increase after hand function exercises had

been completed. The null hypothesis for the first research question was that there would be no difference in hand function test scores after hand function exercises had been completed.

t-Test For Dependent (Paired) Samples

Hand function of 17 first semester dental hygiene students was evaluated. Pretest baseline hand function data were collected by an occupational therapist and compared to posttest data using a *t*-Test for dependent samples. The null hypothesis failed to be rejected at the 95% confidence level (alpha=.05) for the pretest and posttest results of the hand function evaluations for the Purdue Pegboard Both Hands Three Trial Mean (Table 1) and Hand Strength Test Right Hand Three Trial Mean (Table 2).

Table 1.

Purdue Pegboard Both Hands Three Trial Mean

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Posttest - Pretest	.23706	1.41746	.34378	-.49173	.96585	.690	16	.500

Table 2.

Hand Strength Test Right Hand Three Trial Mean

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Posttest - Pretest	3.45059	7.66163	1.85822	-.48866	7.38983	1.857	16	.082

The null hypothesis was rejected at the 95% confidence level (alpha=.05) for the pretest and posttest results of the hand function evaluations for the Purdue Pegboard Right Hand Three Trial Mean (Table 3), Purdue Pegboard Left Hand Three Trial Mean (Table 4), Purdue Pegboard Sum of Right Hand, Left Hand and Both Hands (Table 5), Purdue Pegboard Assembly Three Trial Mean (Table 6), Box and Block Test Right Hand (Table 7), Box and Block Test Left Hand (Table 8), Pinch Strength Test Right Hand Three Trial Mean (Table 9), Pinch Strength Test Left Hand Three Trial Mean (Table 10), and Hand Strength Test Left Hand Three Trial Mean (Table 11).

Table 3.

Purdue Pegboard Right Hand Three Trial Mean

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Posttest - Pretest	.97882	.90252	.21889	.51479	1.44285	4.472	16	.000

Table 4.

Purdue Pegboard Left Hand Three Trial Mean

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Posttest - Pretest	.86353	1.20754	.29287	.24267	1.48439	2.948	16	.009

Table 5.

Purdue Pegboard Sum of Right Hand, Left Hand and Both Hands

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Posttest - Pretest	2.07941	1.89741	.46019	1.10385	3.05497	4.519	16	.000

Table 6.

Purdue Pegboard Assembly Three Trial Mean

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Posttest - Pretest	1.90000	3.22806	.78292	.24029	3.55971	2.427	16	.027

Table 7.

Box and Block Test Right Hand

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Posttest - Pretest	5.17647	5.87617	1.42518	2.15522	8.19772	3.632	16	.002

Table 8.

Box and Block Test Left Hand

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Posttest - Pretest	4.41176	3.87393	.93957	2.41997	6.40356	4.696	16	.000

Table 9.

Pinch Strength Test Right Hand Three Trial Mean

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Posttest - Pretest	1.05824	1.67586	.40646	.19659	1.91988	2.604	16	.019

Table 10.

Pinch Strength Test Left Hand Three Trial Mean

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Posttest - Pretest	1.19529	1.76715	.42860	.28671	2.10388	2.789	16	.013

Table 11.

Hand Strength Test Left Hand Three Trial Mean

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Posttest - Pretest	3.25471	3.67247	.89071	1.36649	5.14292	3.654	16	.002

The second research question asked: Did students who completed hand function exercises have higher final scores on the periodontal probe and 11/12 explorer evaluations than students in the 5 previous years? The research hypothesis for the second research question stated that the final scores of the periodontal probe and 11/12 explorer evaluations would be higher for the students who completed the hand function exercises versus those of students in the 5 previous years. The null hypothesis for the second research question was that there would be no difference in the final scores of the periodontal probe and 11/12 explorer evaluations of students who completed the hand function exercises versus the scores of students in the previous 5 years.

Simple ANOVA

Periodontal probe and 11/12 explorer scores of 17 first semester Fall 2013 dental hygiene students were compared to the scores of students from the fall class of each of the previous 5 years. Evaluations from all six student groups were performed by the same instructors using the same evaluation form. Using a simple ANOVA with the alpha level at 95% confidence level (alpha=.05), the null hypothesis failed to be rejected for the instrumentation scores.

Table 12.

Periodontal Probe Grades 2008-2013

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	162.694	5	32.539	.375	.865
Within Groups	8771.573	101	86.847		
Total	8934.267	106			

Table 13.

11/12 Explorer Grades 2008-2013

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	900.832	5	180.166	2.042	.080
Within Groups	8380.493	95	88.216		
Total	9281.325	100			

Discussion

The hand function evaluations were conducted on August 26, 2013, and October 7, 2013. Seventeen Waukesha County Technical College students participated in both evaluations sessions. Sessions consisted of evaluations using the Purdue Pegboard, Box and Block Test, a B& L Pinchometer, and a JAMAR Hand Dynamometer. In comparing hand function, the *t*-test for dependent means showed evidence at the alpha level of .05 that hand function was improved on 9 components of the 11 of the hand function evaluations after 6 weeks of hand function exercises.

In evaluating whether the hand function exercises had a positive impact on the students' instrumentation proficiency, the 17 participating students' scores for the periodontal probe and 11/12 explorer were compared to the scores of students in the same programs from 2008-2012.

Using simple ANOVA at the alpha level of .05, there was not a significant difference in their final scores.

CHAPTER 5

CONCLUSIONS, DISCUSSIONS, AND RECOMMENDATIONS

Dental hygienists are licensed health care providers whose care focuses on preventing and treating oral diseases. Dental hygienists use a variety of small instruments including dental hygiene scalers, curettes, and ultrasonic scalers to perform their job successfully. Dental hygienists rely on hand function to detect and remove calculus, polish teeth, operate an ultrasonic scaler, manipulate clinical and laboratory instruments, and floss teeth.

Conclusions

Research was conducted during a 10-week study to test hand function levels of 17 dental hygiene students. The purpose of this study was to evaluate whether hand function testing and exercises would be beneficial tools to assess dental hygiene students' use of equipment and if so to put in place strategies to enhance student success. The first research question was: 1.) Was hand function of dental hygiene students improved after recommended hand function exercises were completed?

After 6 weeks of hand function exercises, the study's results confirmed an increase in all hand function scores with the exception of the Purdue Pegboard Both Hands and Right Hand Strength Tests. This indicated the hand function exercises where valuable for students to increase their hand function.

Hand function exercises were recommended to be done twice daily for all students. Students anonymously logged how often they actually completed their exercises. Seven of the students recorded that they did the exercises most days. Six students did them about 50% of the time, and four of the students failed to exercise on more than half of the days. Of the two weakest students who remained in the study, one reported being compliant with the exercises

half of the time, and the other very compliant, missing only a handful of exercises the entire 6 weeks. Both students improved their hand function to a level comparable with that of students ahead of them. This suggests that hand exercises may only have to be complete once daily to improve hand function.

The second research question that guided this study was 2.) Did students who completed hand function exercises have higher final scores on the periodontal probe and 11/12 explorer evaluations than students in the five previous years?

In evaluating whether the hand function exercises had a positive impact on a student's instrumentation proficiency, the researcher concluded that there was not a significant positive impact, i.e., the scores on the periodontal probe and the 11/12 explorer were not higher than those of students in the five previous classes. This suggests that hand function exercises will not have a positive impact for students who are trying to increase their instrumentation scores by performing hand function exercises.

Discussion

This study has determined that hand function exercises would be beneficial for all dental hygiene students. Initial hand function evaluation confirmed that the students' fine and gross motor control levels were poor-to-average and tests scores improved after 6 weeks of hand function exercises. Although hand function improved, this did not have a positive impact on students' instrumentation scores. However, any skill takes time to develop. So, it is possible that the hand exercises helped the students to improve their function to where they were able to handle the instruments well enough to complete tasks at minimum competency. Learning how to use the periodontal probe and 11/12 explorer successfully involves knowledge of tooth anatomy and being able to identify different parts of that anatomy through a sense of touch. Because

dental hygienists do a great deal of their work below the gum line, they must learn to "visualize" with their sense of feel. A highly-developed sense of tactility is important, and this is a part of hand function. These skills are known to take time to develop, and that is why minimum competency in the dental hygiene program at WCTC increases with each semester.

Recommendations

A recommendation for future research is to increase the sample size and to include male participants in the sample. The study's small sample size (due to the small class size of the overall program) and the fact that no males were accepted to the program studied limited how the research could be used to generalize the findings of the pilot study. The Purdue Pegboard Test was very effective as an evaluation tool and thus is an essential tool in any future research on this topic. The Box and Block Test was not supportive in any of the identifying conclusions; future studies could omit the Box and Block Test. The strength test information was valuable, especially if future studies would follow participants over a longer period of time. It would also be helpful to have all participants at the same level of compliance in doing hand function exercises.

It is recommended that studies following this pilot study include hand function evaluations and exercises to be initiated prior to the first week of program classes. The purpose would be to evaluate whether weak students could improve enough to be successful beyond the second week of the program. Because the study here found hand function to improve in a 6-week period, it is recommended that the next study begin 6 weeks prior to the first day of the dental hygiene semester. It may be helpful to do hand function tests after each week to evaluate if 6 weeks of hand function exercises are needed or if improvements could be made with fewer weeks of hand exercises. If fewer weeks are needed, this may also improve compliance with the exercises.

Four of the initial 20 students tested particularly weak, with the two students who ultimately did not complete the semester being the weakest. (Those two students elected to leave the program as a consequence of struggling with hand function and didactic coursework in the first 2 weeks of the semester, while one other student dropped to pursue a master's degree). Hand function weakness was especially evident in the second week of clinic when students were asked to sit in a dental provider chair and use a cotton tip applicator to point to various teeth and tooth surfaces with their dominant hand, as directed by the instructor with their dominant hand while the subordinate retracted the cheek of the dental dummy. The key functions those students had difficulty performing were mainly tasks that required use of both hands as well as tasks that involved doing simultaneous manipulations that were different for each hand (H. Schlei, personal communication, December 26, 2013). This information may be valuable to collect as part of the initial hand function evaluation. However, this information should be collected by a dental hygiene instructor from a different dental hygiene program so that no discriminating information is recorded for any particular student.

Special attention may be given to the Assembly portion of the Purdue Pegboard Test because this test most resembles actual dental hygienist work. (Dental hygienists use their subordinate hand to retract tissues and suction while their dominant hand is used for scaling and polishing and to maneuver an ultrasonic scaler. Even while taking radiographs, subordinate and dominant hands are typically used simultaneously, but in different motions). Across all hand function evaluated, it was on this test that the dental hygiene students did the best in the first hand function test; the majority of students tested well above the norms. All students at the 40^{th} percentile and higher of this test successfully completed the first semester of the dental hygiene curriculum, while the two weakest students, who scored at the 4^{th} and 19^{th} percentiles

respectively, did not complete the semester. Based on this study, we can hypothesize that the 40th percentile may be the floor or cutoff point for students to successfully complete the first semester of the WCTC dental hygiene program-subject, of course, to further review.

To assess if pinch or hand strength relates directly to student performance and ultimately programmatic success, future studies could follow each student through the 2-year dental hygiene curriculum to evaluate how proficient they were in removing tenacious calculus at various points throughout the program. It may also be beneficial to complete individual student hand function evaluations at the end of each semester to determine if his or her hand function has increased or decreased in that semester.

This study suggests that, as evidenced by the two very weak students who decided not to continue in the second week of the program, testing of complex motor skills as a preadmissions screening tool for prospective dental hygiene students may be beneficial. This may help avoid attrition in dental hygiene programs and avoid weak students in regards to hand function unlikely to complete the course from taking spots from students who are likely to succeed.

The research conducted in this study was intended to assess dental hygiene students' performance of one key curriculum criterion vis-à-vis the successful completion of their entire first semester of the program. Future researchers may want to include testing for Carpal Tunnel Syndrome and other MSDs as part of the evaluation of this hand function criterion. It is hoped that any subsequent research in this area will prove beneficial to all students in their efforts to become licensed dental hygienists.

RERFERENCES

Albanese, M., Mejicano, G., Mullan, P., Kokotailo, P., & Gruppen, L. (2008). Defining characteristics of educational competencies. *Medical Education, 42*, 248-255.

Andersen-Hammond, E., Shay, B., & Szturm, T. (2009). Objective evaluation of fine motor manipulation-a new clinical tool. *Journal of Hand Therapy, 22*(1), 28-36.

American Dental Association. (2013). *Commission on Dental Accreditation.* Retrieved from http://www.ada.org/117.aspx

American Dental Hygienists' Association. (2012a). *Dental hygiene programs*. Retrieved from http://www.adha.org/careerinfo/dir_education.htm

American Dental Hygienists' Association. (2012b). *Important facts about dental hygienists.* Retrieved from http://www.adha.org/careerinfo/dhfacts.htm

American Occupational Therapy Association, Inc. (2012.) *About occupational therapy*. Retrieved from http://www.aota.org/consumers.aspx

American Society for Surgery of the Hand. (2013). *Hand therapy.* Retrieved from http://www.assh.org/Public/HandConditions/Pages/HandTherapy.aspx

American Stroke Association. (2013). *Tips for improving fine motor skills.* Retrieved from http://www.strokeassociation.org/STROKEORG/LifeAfterStroke/RegainingIndependence/PhysicalChallenges/Tips-for-Improving-Fine-Motor-Skills_UCM_309776_Article.jsp

Amini, D. (2011). The unique role of occupational therapy in rehabilitation of the hand. *The American Occupational Therapy Association, Inc.* Retrieved from http://www.aota.org/Consumers/Professionals/WhatIsOT/RDP/Facts/Hand-Rehab.aspx?FT=.pdf

Association of Schools of Allied Health Professionals. (n.d.). *Allied health professionals.* Retrieved from http://www.asahp.org/definition.htm

Atwood-Sanders, M., & Michalak-Turcotte, C. (2002). Strategies to reduce work-related musculoskeletal disorders in dental hygienists: two case studies. *Journal of Hand Therapy, 15*(4), 363-374.

Bland, M., Beebe, J., Hardwick, D., & Lang, C. (2008). Restricted active range of motion at the elbow, forearm, wrist, or fingers decreases hand function. *Journal of Hand Therapy, 21*(3), 268-275.

Brilowksi, P. (2012, Fall). *Dental Hygiene Process 1* [Course syllabus]. Department of Dental Hygiene, Waukesha County Technical College, Pewaukee, WI.

Buddenberg, L. & Davis, C. (2000). Test-retest reliability of the Purdue Pegboard Test. *The American Journal of Occupational Therapy, 54*(5), 555-558.

Bureau of Labor Statistics. (2012a). *How to become a dental hygienist.* Retrieved from http://www.bls.gov/ooh/healthcare/dental-hygienists.htm#tab-4

Bureau of Labor Statistics. (2012b). *Radiologic technologists.* Retrieved from http://www.bls.gov/ooh/Healthcare/Radiologic-technologists.htm

Bureau of Labor Statistics. (2012c). *Respiratory therapists.* Retrieved from http://www.bls.gov/ooh/Healthcare/Respiratory-therapists.htm

Bureau of Labor Statistics. (2012d). *What occupational therapist do.* Retrieved from http://www.bls.gov/ooh/Healthcare/Occupational-therapists.htm#tab-2

Chippewa Valley Technical College. (2013a). *Dental hygienist.* Retrieved from http://www.cvtc.edu/programs/program-catalog/Pages/Dental-Hygen.aspx

Chippewa Valley Technical College. (2013b). *Radiography*. Retrieved from http://www.cvtc.edu/programs/program-catalog/Pages/Radiography.aspx

Chippewa Valley Technical College. (2013c). *Respiratory Therapy*. Retrieved from http://www.cvtc.edu/programs/program-catalog/Pages/Resp-Therapy.aspx

Commission on Accreditation for Respiratory Care. (2013). *Accreditation standards.* Retrieved from http://www.coarc.com/29.html

Cottrell, R., & McKenzie, J. (2011) *Health promotion and education research methods.* Sudbury, MA: Jones and Bartlett

Dalton State College. (n.d.). *Radiologic Technology*. Retrieved from http://www.daltonstate.edu/radiologic-technology/index.html

Daniel, S., & Harst, S. (2004). *Mosby's dental hygiene.* St. Louis, MO: Mosby

Dictionary.com. (2012). *Norm*. Retrieved from http://dictionary.reference.com/browse/Norms

Explore Health Careers. (2013). *Overview.* Retrieved from http://explorehealthcareers.org

Foothill College. (2012). *Respiratory Therapy*. Retrieved from http://www.foothill.fhda.edu/programs/programs.php

Fox Valley Technical College. (2013). *Dental hygienist.* Retrieved from http://fvtc.edu/public/academics/degree.aspx?plan=10-508-1

Grand Rapids Community College. (2011). *Dental hygiene.* Retrieved from http://cms.grcc.edu/dental-programs/dental-hygiene

Hayes, M., Smith, D., & Cockrell, D. (2009). Prevalence and correlates of musculoskeletal disorders among Australian dental hygiene students. *International Journal of Dental Hygiene, 7,* 176-181.

Hayes, M., Taylor, J., & Smith, D. (2012). Predictors of work-related musculoskeletal disorders among dental hygienist. *International Journal of Dental Hygiene, 10,* 265-269.

Hooker, J., Libbe, D., Park, S., & Paul, J. (2011). Fine motor friend. *Top Stroke Rehabilitation, 18 (4),* 372-377.

Joint Review Committee on Education in Radiologic Technology. (2013). *Accreditation actions.* Retrieved from http://www.jrcert.org/accreditation-actions/

Jones, L., & Lederman, S. (2006). *Human hand function.* New York, NY. Oxford University Press.

Lafayette Instrument. (2012). Purdue Pegboard Test user instructions. Retrieved from www.lafayetteinstrument.com

Lalumandier, J., & McPhee, S. (2001). Prevalence and risk factors of hand problems and carpal tunnel syndrome among dental hygienists. *Journal of Dental Hygiene,10,* 130-134.

Lansing Community College. (2012). *Dental hygiene program physical guidelines for students.* Retrieved from http://www.lcc.edu/health/dental/physical

Madison Area Technical College. (n.d.). *Dental hygienist admission requirements.* Retrieved from http://madisoncollege.edu/dental-hygienist-admission-requirements

Mathiowetz, V., Kashman, N., Volland, G., Weber, K., Dowe, M., & Rogers, S. (1985). Grip and pinch strength: Normative data for adults. *Physical Medicine and Rehabilitations, 66,* 69-74.

Mathiowetz, V., Volland, G., Kashman, N., & Weber, K. (1985). Adult norms for the box and block test of manual dexterity. *The American Journal of Occupational Therapy,* 39, 6, 386-391.

Mathiowetz, V., Weber, K., Volland, G., & Kashman, N. (1983). Reliability and validity of grip and pinch strength evaluations. *Journal of Hand Surgery, 9A*,(2), 222-226.

McHale, K. & Cermank, S. (1992). Fine motor activities in elementary school: preliminary findings and provisional implications for children with fine motor problems. *American Journal of Occupational Therapy, 46(10)*, 898-903.

MedlinePlus Medical Encyclopedia. (2012). *Fine motor control*. Retrieved from http://www.nlm.nih.gov/medlineplus/ency/article/002364.htm

Medscape Reference. (2013). *Hand anatomy*. Retrieved from http://emedicine.medscape.com/article/1285060-overview#a1

Mesa Community College. (2013). *Dental hygiene*. Retrieved from http://www.mesacc.edu/programs/dental-hygiene

Michalak-Turcotte, C., (2002). Controlling dental hygiene work-related musculoskeletal disorders: The ergonomic process. *Journal of Dental Hygiene, 74 (1),* 41-48.

Millar, D. (2009). *Protective extraoral and reinforced instrumentation strategies*. Dental Tribune. Retrieved from http://www.dental-tribune.com/articles/content/scope/specialities/section/dental_hygiene/id/545

Milwaukee Area Technical College. (2013). *Dental hygiene*. Retrieved from http://www.matc.edu/health_sciences/degrees/dental-hygiene.cfm

Morse, T., Michalak-Turcotte, C., Atwood-Sanders, M., Warren, N., Peterson, D., Bruneau, H., & Cherniack, M. (2003). A pilot study of hand and arm musculoskeletal disorders in dental hygiene students. *Journal of Dental Hygiene, 77(3)*173-179.

Norco Exercise Putty hand exercise instructions. (2013) Retrieved from http://ebookily.org/pdf/norco-putty-exercise-booklet

Northcentral Technical College. (n.d.(a) *Dental hygienist associate degree.* Retrieved from http://www.ntc.edu/programs/105081

Northcentral Technical College. (n.d.(b). *Radiography associate degree.* Retrieved from http://www.ntc.edu/programs/health/105261

Northeast Wisconsin Technical College. (n.d.(a). *Dental hygienist program code 105081.* Retrieved from http://www.nwtc.edu/academics/degrees/health-sciences/dental/Pages/DentalHygienist.aspx

Northeast Wisconsin Technical College. (n.d.(b). *Respiratory therapy program code 105151.* Retrieved from http://www.nwtc.edu/academics/degrees/health-sciences/Medical/Pages/RespiratoryTherapist.aspx

Occupational Information Network (O*NET). 2011. *Summary reports for dental hygienists.* Retrieved from http://www.onetonline.org/link/summary/29-2021.00

Ratzon, N., Efraim, D., & Bart, O. (2007). A short-term graphomotor program for improving writing readiness skills of first-grade students. *American Journal of Occupational Therapy, 61,* 399-405.

Sammons Preston Rolyan. (2003). Jamar Hand Dynamometer owner's manual. Bolingbrook, IL: Sammons Preston Rolyan. Retrieved from http://si-instruments.com

Schwartz, D. (2005). What can handgrip strength tell the therapist about hand function? *Journal of Hand Therapy, 4(*18), 457.

Simmer-Beck, M., & Branson, B. (2008). An evidence-based review of ergonomic features of dental hygiene instruments. IOS Press, 477-485 http://dx.doi.org/10.3233/WOR-2010-0984

Skirven, T., Osterman, A., Fedorczyk, J., & Amadio, P. (2011). *Rehabilitation of the hand and upper extremity*. Philadelphia, PA: Elsevier

Tiffin, J. & Asher, E. (1948). The Purdue Pegboard: norms and studies of reliability and validity. *Journal of Applied Psychology*, *32*(3), 234- 247.

U.S. Department of Education (n.d.) *Competency-based learning or personalized learning*. Retrieved from http://www.ed.gov/oii-news/competency-based-learning-or-personalized-learning

Waukesha County Technical College. (2013). *Dental hygienist.* Retrieved from http://www.wctc.edu/programs-and-courses/health/dental-hygienist/index.php

Wiregrass Georgia Technical College. (2010). *Dental hygiene-DH14.* Retrieved from http://www.wiregrass.edu/academics/program.php?id=669

Yancosek, K., & Howell, D. (2009). A narrative review of dexterity assessments. *Journal of Hand Therapy*, *22*(3), 258-270.

APPENDICES

Appendix A

Occupational Therapist CV

Vickie Alba, OTR CHT

Employment History:
Hand Surgery Ltd.
7/2011- present: Occupational Therapist/Certified Hand Therapist

Waukesha Memorial Hospital- Staff Occupational Therapist/Certified Hand Therapist
1999- 7/2011: Outpatient Orthopedic and Neurological Injuries of the Upper Extremity
1992-1999: Work Rehabilitation Program/Outpatient Orthopedic Upper Extremity Injuries

1989-1992: Columbia Hospital- Staff Occupational Therapist
1990-1992: Work Rehabilitation Program
1989-1990: Inpatient Rehabilitation

1988-1989: New Medico – Staff Occupational Therapist
Residential Head Injury Rehabilitation Facility

Education/Certifications:
Certified Orthopedic Manual Therapist – Upper Quadrant: March 2008 to present
Certified Hand Therapist: November 1999 to present
Bachelor of Science in Occupational Therapy: Graduated in 1988
University of Wisconsin- Milwaukee

Presentations:
November 15, 2011: Wheaton Franciscan Rehabilitation Therapists
Title: How can I use Mirror Therapy and Graded Motor Imagery to Reduce my Patient's Pain

November 2011: IAOM-US (Assistant Presenter: Tennessee)
Title: A Systematic Approach to Examination, Diagnosis and Manual Therapy of the Shoulder

October 2011: Wisconsin Occupational Therapy Association Conference
Steven's Point
Title: Anatomy, Differential Evaluation, and Treatment of the Wrist/Hand

October 2011: IAOM-US (Assistant Presenter: Green Bay)
Title: A Systematic Approach to Examination, Diagnosis and Manual Therapy of the Wrist II

May 2011: Wisconsin Hand Experience Conference

Title: Therapeutic Treatment of Complex Regional Pain Syndrome

December 2010: IAOM-US (Lab Assistant) Hand Surgery Ltd
Title: Evaluation and Treatment of the Shoulder

November 2010: IAOM- US (Assistant Presenter: Pennsylvania)
Title: A Systematic Approach to Examination, Diagnosis and Manual Therapy of the Hand

September 2010: IAOM-US (Assistant Presenter: Kenosha)
Title: A Systematic Approach to Examination, Diagnosis and Manual Therapy of the Wrist II

August 2010: WI-ASHT (Co-Presented)
Title: Digital Anatomy: Assessment, diagnosis and Treatment of Challenging Imbalances and Chronic Stiffness

April 2010: IAOM-US (Assistant Presenter: St. Paul)
Title: A Systematic Approach to Examination, Diagnosis and Manual Therapy of the Hand

October 2009: IAOM-US (Assistant Presenter: Colorado)
Title: A Systematic Approach to Examination, Diagnosis and Manual Therapy of the Wrist I

January 2008: Pro Health Care Consortium
Title: Adverse Neural Tissue Tension and Mobilization/Gliding/Flossing of the Upper Extremity

October 2007: Wisconsin Occupational Therapy Association Conference
Title: Manual Therapy of the Shoulder

October 2004: Wisconsin Occupational Therapy Association Conference
Diagnosis, Management, and Treatment of Complex Regional Pain Syndrome

Plus multiple in house presentations for the Occupational Therapists while working at PHC/Waukesha Memorial Hospital and Hand Surgery Ltd.

Professional Affiliations:
Wisconsin Occupational Therapy Association: Member 1986 – present
*Conference Institute Committee Chair (2010, 2007, 2004)
American Society of Hand Therapists: Member 1999 – present
*Annual Conference Committee (2012)
Wisconsin Chapter of American Society of Hand Therapists: Member 1997 – present
*Secretary: 2002 – 2004
*Newsletter Editor: 2005- 2012

IAOM-US: Member February 2006 to present
*Assistant Instructor for the Upper Extremity Specialty Track: 2009 to present

Awards:
Wisconsin Occupational Therapy Association Service Award *2004, 2007 and 2010

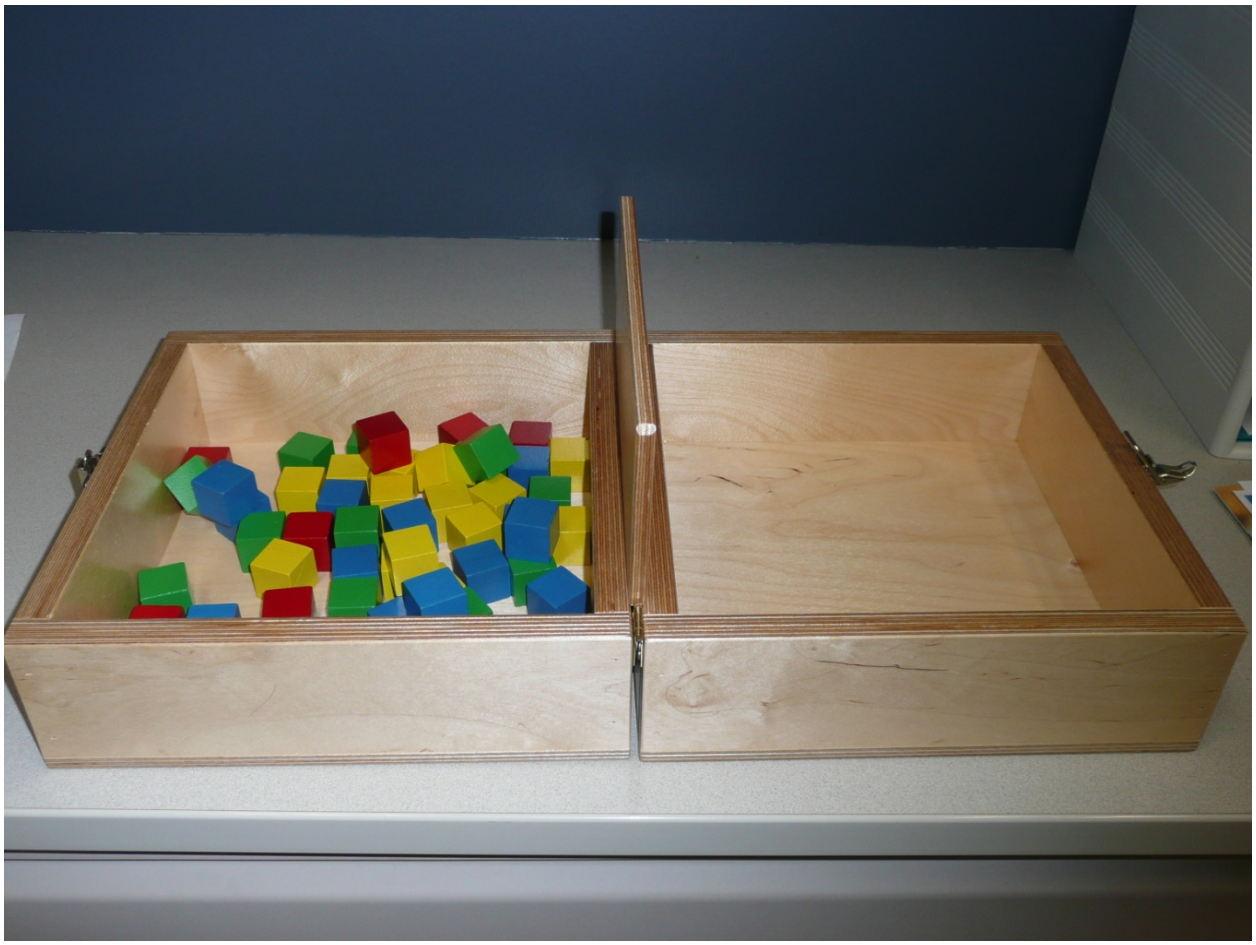
Appendix B

Purdue Pegboard

www.lafayetteinstrument.com

Appendix C

Box and Block Test



Appendix D

B & L Pinch Gauge

PG-30 Pinch Gauge

http://www.bleng.com/pinch-gauge/pg-30

Appendix E

JAMAR Dynamometer

Appendix F

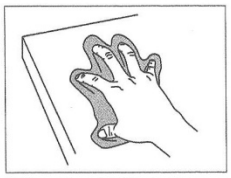
Test Scores of Participants

Student #	Dominant Hand		Test #
Purdue Pegboard Test Results			
Box and Block Test Results			
Pinch strength Test Results			
Hand Strength Test Results			
	Purdue Pegboard Test		
	Trial 1	Trial 2	Trial 3
Right [R] Hand			
Left [L] Hand			
Both [B] Hands			
Mean of 3 trials	(R)	(L)	(B)
Sum of [R+L+B]			
Assembly			
Mean of 3 trials			
	Box and Block Test		
Right [R] Hand			
Left [L] Hand			
	Pinch Strength Test		
	Trial 1	Trial 2	Trial 3
Right [R] Hand			
Left [L] Hand			
Mean of all 3 Trials Right Hand			
Mean of all 3 Trials Left Hand			
	Hand Strength Test		
	Trial 1	Trial 2	Trial 3
Right [R] Hand			
Left [L] Hand			
Mean of all 3 Trials for Right Hand			
Mean of all 3 Trials for Left Hand			

Appendix G

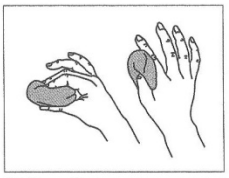
Hand Function Exercise Log for Participants
(This will be recorded for six weeks)

	Week 1						
	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
TheraPutty-Grip							
TheraPutty-Grip							
TheraPutty-Pinch							
TheraPutty-Pinch							
Tweezer Exercise							
Tweezer Exercise							
Stringing Beads							
Stringing Beads							



9) Finger Spread (ABduction)
Form the putty into a thick pancake shape lying on a table. Bunch the fingertips together and place into the putty. Then, spread out all the fingers at once, enlarging the pancake as much as possible.

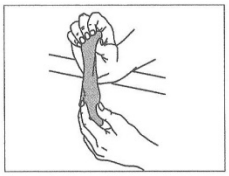
Repetitions _____



10) Finger Pinch
Palmar Pinch: Form the putty into the shape of a ball. Pinch putty between the thumb, index and middle fingertips until the fingers press through the putty.

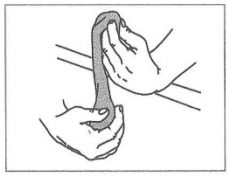
Key Pinch: Form into the shape of a ball. Pinch putty between the tip of the thumb and side of the index finger.

Repetitions _____



11) Wrist Extension
Rest the forearm on a table or arm of a chair, palm down, allowing the hand to hang down over the edge. Grip the putty with the fingertips of the involved hand. While holding the putty steady below with the other hand, straighten and extend the wrist up while keeping the arm on the table.

Repetitions _____



12) Wrist Flexion
Rest the forearm on a table or arm of a chair, palm up, allowing the hand to hang down over the edge. Grip the putty with the fingertips of the involved hand. Straighten and bend the wrist up while holding the putty steady with the other hand.

Repetitions _____

www.ncmedical.com
Gilroy, CA 95020, 800-821-9319 Manufactured by North Coast Medical. REV51010i_0715

North Coast

Norco™ Exercise Putty
Hand Exercise Instructions

Exercises for strengthening the muscles of the fingers, hand and forearm.

Norco™ Exercise Putty can be formed into the various illustrated shapes, providing a balanced exercise program. Strengthening opposing muscles maintains a delicate muscular balance which improves one's dexterity and coordination.

Rehabilitation exercises with Norco™ Exercise Putty should be supervised by your therapist or doctor. They will give you instructions regarding repetitions and intensity of use and notification in case pain is experienced.

Care: Wash hands before use to prevent soiling and to help maintain resistance of the putty. Avoid use of lotion on hands. Norco™ Exercise Putty should be kept in its case when not being used. It should not be placed on rugs or fabrics for a prolonged period of time. Should a cleaner be needed, use isopropyl alcohol (read cleaners precautions prior to use). If any putty should stick to the hand or under a fingernail, blot with the larger ball of putty to remove.

We hope you enjoy Norco™ Exercise Putty and healthy hands.

Patient Name: _____

Therapist Instructions:

_____

_____

_____

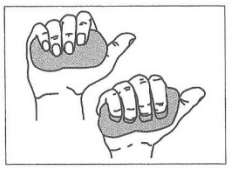
_____

_____

_____

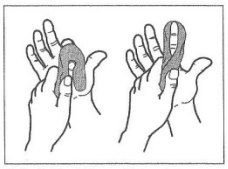
_____

_____



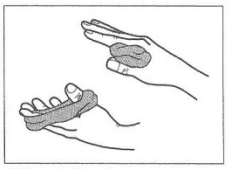
1) Finger Press (Flexion)
Place the putty into the palm of the hand and press fingers through the putty until the fingertips reach the palm, resulting in a fully clenched fist. Release fingers and roll putty in hands to reshape, and repeat exercise.

Repetitions _____



2) Individual Finger Extension
Bend one finger or thumb so that the fingertip is close to the palm of the hand. With the other hand, wrap a strip of the putty over the tip of the bent finger and grasp both ends. Straighten the finger. Repeat exercise on each finger.

Repetitions _____

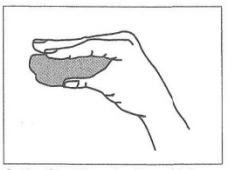


5) Thumb ABduction
Form the putty into a ring. Place ring around the index finger and thumb. Move the thumb away from the index finger. Keep the thumb perpendicular to index finger.

Thumb ADduction
Put a ball of the putty in the thumb web space. Press thumb towards index finger.

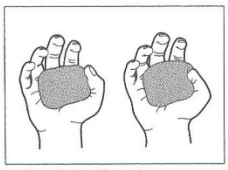
Repetitions

_____



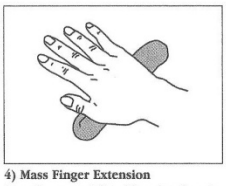
6) "Rooftop" Exercise (Intrensic)
Form the putty into a ball. Place ball between fingers and thumb. Form a "rooftop" using straight fingers, leaving the thumb underneath. Press all fingers down toward the thumb, keeping fingers straight and together. Reshape putty and repeat pressing down one straight finger at a time.

Repetitions _____



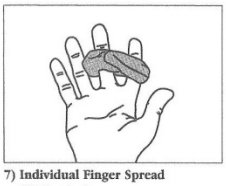
3) Thumb Dig (Flexion)
Roll putty into a cylindrical shape and let it rest in the palm of the hand. Push thumb through putty until it reaches the palm. Reshape putty and repeat.

Repetitions _____



4) Mass Finger Extension
Keep fingers straight while using the palm to roll out a tube of the putty.

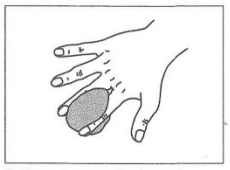
Repetitions _____



7) Individual Finger Spread (ABduction)
Place two fingers together and wrap the putty around them, near the fingertips. Try spreading the fingers apart. Repeat, using different pairs of fingers until all of the fingers have been exercised.

Repetitions

_____



8) Finger Squeeze (ADduction)
Roll the putty into a ball and place between two spread fingers. Using a scissors-like motion, try bringing the two fingers together. Repeat, using different pairs of fingers until all fingers have been exercised.

Repetitions _____

Student _____ First Check_____
Instructor _____ Second Check_____
Date _____ Third Check_____
Total Points Possible_____/ 108

PROBE

Directions: Space has been provided on this checklist for both you and an instructor to evaluate your performance. Place a checkmark in the "N/O" Column or in the appropriate "Tooth Surface" Column if a task is not performed/observed. Comments should be made for each checkmark.
*Indicates critical failure.

TASK ANALYSIS	N/O √	INSTRUCTOR						COMMENTS
		D	Fa	M	D	Li	M	
1. Aseptic technique.....	____							
2 Positioning of operator, client, equipment and supplies.....	____							
3 Personal appearance.....	____							
4. Correct mirror usage.....	____							
5 Uses instrument safely.....	____							
6. Explains procedure to patient.....	____							
7 Indicates correct tooth*.....	____							
Grasp:								
8. Holds with index finger and thumb pads.....	____							
9. Stabilizes with pad of middle finger.....	____							
10. Index and third finger, first knuckles straight.....	____							
11. Index, middle and third finger contact.....	____							
12. Instrument handle rests above second knuckle	____							
13. Instrument extension.....	____							
14. Appropriate tension.....	____							
15. Rotates to aid adaptation.....	____							
Fulcrum:								
16. Established on third finger.....	____							
17. Stable and maintained throughout stroke.....	____							
18. On tooth closest to work area.....	____							
19. Pressure commensurate with a "walking" or "bobbing" stroke.....	____							
20. Pivots for surface adaptation.....		____	____	____	____	____	____	
21. Maintained throughout stroke.....	____							

TASK ANALYSIS	N/O √	INSTRUCTOR						COMMENTS
		D	Fa	M	D	Li	M	
Stroke:								
22. Area is clean and dry.....	___							
23. Initial tooth contact with side of tip.....		___	___		___	___		
24. Inserts in correct area.....		___	___		___	___		
25. Maintains side of tip on tooth.....		___	___	___	___	___	___	
26. Tip tilted toward apex.....		___	___	___	___	___	___	
27. Working end placed against contacts when measuring proximal surfaces.....		___		___	___		___	
28. Rolls into col.....		___		___	___		___	
29. Reaches attachment.....		___	___	___	___	___	___	
30. Short, "walking" strokes around entire sulcus.....		___	___	___	___	___	___	
31. Vertical or oblique strokes.....		___	___	___	___	___	___	
32. Fluid, controlled stroke.....		___	___	___	___	___	___	
33. Rocking motion.....		___	___	___	___	___	___	
34. Modifies angulation for deposits.....		___	___	___	___	___	___	
35. Remains within sulcus during consecutive stroke		___	___	___	___	___	___	
36. Reinsertion--overlaps surface or previous stroke		___	___		___	___		
37. Accurately records readings in six areas.		___	___	___	___	___	___	
38. Systematic sequence.....	___							

6/10

Appendix J

Student _____ First Check_____
Instructor _____ Second Check_____
Date _____ Third Check_____
#23 Total Points Possible ____/27

EXPLORER PROCESS

EXD 11/12: Total Points Possible ____/116

Directions: Space has been provided on this checklist for both you and an instructor to evaluate your performance. Place a checkmark in the "N/O" Column or in the appropriate "Tooth Surface" Column if a task is not performed/observed. Comments should be made for each checkmark. *Indicates critical failure.

TASK ANALYSIS	N/O √	INSTRUCTOR							COMMENTS
		Facial			Lingual				
		D	Fa	M	D	Li	M	O	
1. Aseptic technique	____								____
2 Positioning of operator, client, equipment and supplies	____								____
3. Personal appearance	____								____
4. Correct mirror usage	____								____
5. Uses instrument safely	____								____
6. Explains procedure to patient	____								____
7. Indicates correct tooth*	____								____
8. Selects the correct working end of explorer*	____								____
Grasp:									
9. Holds with index finger and thumb pads	____							____	
10. Stabilizes with pad of middle finger	____							____	
11. Index and third finger, first knuckles straight	____							____	
12. Index, middle, and third finger contact	____							____	
13. Instrument handle rests above second knuckle	____							____	
14. Instrument extension	____							____	
15. Appropriate tension	____							____	
16. Rotates to aid adaptation	____							____	
Fulcrum:									
17. Established on third finger	____							____	
18. Up on fulcrum	____							____	
19. On tooth closest to working area	____							____	
20. Pressure commensurate with stroke	____							____	
21. Pivots for surface adaptation	____							____	
22. Maintained through stroke									

TASK ANALYSIS	N/O √	INSTRUCTOR							COMMENTS
		Facial			Lingual				
		D	Fa	M	D	Li	M	O	
Stroke:									
23. Initial contact with side of tip on tooth--5-20°		___	___	___	___	___	___		
24. Inserts in correct area		___	___	___	___	___	___		
25. Inserts with smallest portion		___	___	___	___	___	___		
26. Inserts tip with short, oblique stroke		___	___	___	___	___	___		
27. Moves in direction tip faces		___	___	___	___	___	___		
28. Side of tip 1/3 diagonal to E.A		___	___	___	___	___	___		
29. Maintains side of tip 1/3 on tooth		___	___	___	___	___	___		
30. Shank is parallel with tooth surface		___	___	___	___	___	___		
31. Vertical and/or oblique strokes		___	___	___	___	___	___		
32. Short strokes		___	___	___	___	___	___		
33. Overlapping strokes		___	___	___	___	___	___		
34. Utilizes a fluid stroke		___	___	___	___	___	___		
35. Rocking motion		___	___	___	___	___	___		
36. Covers sulcular dimension/#23 covers entire tooth		___	___	___	___	___	___		
37. Thoroughly detects col area		___	___	___	___	___	___		
38. Remains in sulcus		___	___	___	___	___	___		
39. Detects pits and fissure caries									
a. Area dry								___	
b. Apically directed								___	
c. Working end parallel with long axis of tooth								___	
d. Appropriatee pressure								___	
40. Detects smooth surface caries (perpendicular to lesion)								___	
41. Systematic sequence	___							___	

Appendix K

Informed Consent for Participants

Informed Consent for Participant

Researcher: Sara Taft
Research Name: Hand function evaluation for dental hygiene students

Introduction:
You have been asked to participate in a research study that will test your hand function**.** Schwartz (2005) wrote "Hand function includes range of motion, sensation, coordination, dexterity, fine motor skills, as well as grip" (para. 3). Hand function is essential to perform tasks as a dental hygienist.

Purpose of this study:
The purpose of this study is to evaluate whether testing hand function would be a beneficial tool to assess dental hygiene students' use of equipment and put in place strategies to enhance student success.

Duration of this study:
The duration of this study will be approximately six weeks. First your hand function will be tested. Then hand function occupational therapy exercises will be recommended for you to do for the next six weeks. After the exercises have been completed over the next six weeks, your hand function will be tested again to see if there has been any improvement. A log will be sent home with you to record when you do your exercises.

Procedures:
Research tests for this study will include four hand function tests. The purpose of these specific tests is to evaluate your hand and finger strength, manual dexterity, motor skills and eye-hand coordination. All of these tests have been found to be reliable, valid and safe (Yancosek & Howell, 2009), (Mathiowetz, Weber, Volland & Kashman, 1984), (Mathiowetz, Kashman, Volland, Weber, Dowe, & Rogers, 1985). The tests include the Purdue Pegboard Test, Box and Block Test, and pinch and grip evaluations tested by using a JAMAR Hand Dynamometer and a B & L Pinchometer.

The Purdue Pegboard will consist of five evaluations. There is a test board that consists of two vertical rows which you will be asked to place pegs in while being timed. Each hand will be tested separately and then together for 30 seconds each time. For the fourth number for this evaluation, the results from the three previous parts will be averaged together. The last part of this evaluation is to make assembly units using both hands for 60 seconds.

The second evaluation is the Box and Block Test. In this test you will be asked to move one inch blocks from one side of the board over to another side separated by a partition. Each hand will be evaluated once and the number of blocks moved will be counted after one-minute.

A B & L Pinchometer will be used to measure your pinch strength. You will be asked to pinch the instrument tool with your thumb, index finger and long finger. The test is performed three times on each hand and the numbers are averaged together. Your grip strength will be measured by a JAMAR Hand Dynamometer. The testing procedure is the same as the pinch tested, however you will be asked to squeeze the testing instrument with your entire hand. Three tests will be completed on each side and the results averaged to get the results.

All results will be compared to the norms determined by other studies.

Alternative procedures:
There are no alternative procedures for this research study.
Foreseeable risks:
There are no foreseeable risks for you as a participant in this study. Your admission to the dental hygiene program for the fall semester of 2013 is already guaranteed. Your test results will be confidential and not shared with the teaching staff at Waukesha County Technical College.
The benefits for you to participate in this study:
The benefits for you to participate in this study include occupational therapy exercises for weak hand function if needed, at no cost to you as a participant. This may help to reduce attrition in the dental hygiene program. The results of this study may help other dental hygiene students who may have weak hand function.
Voluntary Participation:
Participation in this research experiment is voluntary. Your may refuse to participate. You can quit at any time. You do not have to participate and can discontinue your involvement with the testing or hand function exercises at any time. If you choose to discontinue your involvement with this research study, please contact Sara Taft at 262-649-6604.
Contact for questions:
If you have any questions or problems, you may call Sara Taft at 262-649-6604. You may also contact Dr. Byington at 423-547-4914 or byintoR@etsu.edu. You may call the Chairman of the Institutional Review Board at 423-439-6054 for any questions you may have about your rights as a research subject. If you have any questions or concerns about the research and want to talk to someone independent of the research team or you can't reach the study staff, you any call an IRB Coordinator at 423-439-6055 or 423-439-6002
Confidentiality:
The purpose of this study is to evaluate whether testing hand function would be a beneficial tool to assess dental hygiene students' use of equipment and put in place strategies to enhance student success. All the information regarding your tests scores will be kept confidential with regard to your individual identity. Only group information relating to test scores will be reported. Each participant will receive an identification number that will be used on all the reporting forms. At no time will your name be used in the report of the study or to the staff at Waukesha County Technical College.
Results of the study:
Results of this study will be included in a thesis submitted to East Tennessee State University and may be published. Your name will not appear on any documentation.
Consent to participate:
By signing below, you confirm that you have read the information provided and have had all your questions answered. You understand that you do not have to participate in this study and can discontinue your voluntary involvement at any time. You have been given the chance to ask questions and to discuss your participations with the investigator. You do consent to participating in this research study. You will be given a signed copy of this informed consent document.

_____ Date_____
Participant's printed name

_____ Date_____

Participant's Signature

_____ Date_____

Researcher's Signature

Appendix L

Periodontal Probe and 11/12 Explorer Grade Log

	Year	
	periodontal probe	11/12 explorer
Student 1		
Student 2		
Student 3		
Student 4		
Student 5		
Student 6		
Student 7		
Student 8		
Student 9		
Student 10		
Student 11		
Student 12		
Student 13		
Student 14		
Student 15		
Student 16		
Student 17		
Student 18		
Student 19		
Student 20		

VITA

SARA K. TAFT

Education:	M. S. Allied Health, East Tennessee State University, Johnson City, Tennessee, 2014 B.A.S. Dental Hygiene, St. Petersburg College, St. Petersburg, Florida, 2008 A.S. Dental Hygiene, Waukesha County Technical College, Pewaukee, Wisconsin, 2003 Public Schools, Burlington, Wisconsin
Professional Experience:	Dental Hygiene Clinical Instructor, Waukesha County Technical College, Pewaukee, Wisconsin 2008-present Dental Hygienist, Bailey Family Dental Hartland, Wisconsin, 2003-present Dental Hygienist, Progressive Periodontics Greenfield, Wisconsin, 2003-2006
Licensure Credentials:	State of Wisconsin Dental Hygiene License #6640-016