Summer 7-12-2024

Ergonomics and Musculoskeletal Disorders: An Evaluation of Self-Assessment using Surveys

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by

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B.S., DENTAL HYGIENE, HERZING UNIVERSITY, 2019

THESIS

Submitted in Partial Fulfillment of the
Requirements for the Degree of

Master of Science
Dental Hygiene

The University of New Mexico
Albuquerque, New Mexico

July 2024

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ABSTRACT

Musculoskeletal disorders, MSDs, are a serious issue many dental professionals experience. It is understood that improper ergonomics are a contributing factor to developing MSDs. Several factors can be implemented into a dental hygienist's everyday routine to help decrease the risk of developing musculoskeletal disorders. The purpose of this study was to investigate how many practicing dental hygienists experience musculoskeletal pain from daily hygiene practice and how ergonomics contributes to their level of pain. The study also discovered through self-assessment, areas participating dental hygienists would be willing to improve on in their daily ergonomic practice to potentially help decrease or prevent future pain. A total of 25 surveys were completed. The results determined that nearly all (n=21) participants experience some level of pain due to clinical dental hygiene, with the most common location being the neck.

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Chapter I: Introduction

Introduction

Musculoskeletal disorders are a significant concern in the dental profession. Approximately 92% of oral health professionals experience MSDs, with dental hygienists being the most affected, impacting career longevity and satisfaction.[1] A musculoskeletal disorder can be described as soft tissue injuries caused by sudden or sustained exposure to repetitive motion, force vibration, and awkward positions. These disorders can affect the muscles, nerves, tendons, joints and cartilage.[2] One of the leading causes of these musculoskeletal disorders is poor ergonomics. Problematic posture, force, repetitive motion and vibration are all contributing factors to these MSDs, all of which are very prominent factors in dental hygiene.[1] These risk factors are the leading cause of carpel tunnel syndrome, tension neck syndrome, tendonitis, low back injuries, trapezius myalgia, vibration-induced neuropathy, muscle strains and trigger finger in dental hygienists.[1]

As a result of poor ergonomics, pain is most frequently reported in the neck, back and shoulder regions followed by the thumbs, wrists, arms and hips.[3] Oftentimes, this pain can be triggered by equipment placement, equipment selection, operator chair position, patient chair position or clinician posture, all of which can be controlled by the operating hygienist. The combination of poor ergonomics and MSD conditions often lead to early retirement, disability, surgery, injury, reduced quality of life and pain present in dental hygienists. Developing a foundation in evidence-based ergonomic principles is imperative for a long-lasting career as a dental hygienist.[4] The objective of this research is to assess if the pain that is felt by clinically working dental hygienists is related to ergonomics and if the use of self-assessment to improve ergonomics can help motivate clinicians to practice proper ergonomic principles to prevent future pain or musculoskeletal disorders.

Statement of the Problem

How prevalent are musculoskeletal disorders in the work place? Do clinical dental hygienists recognize the ergonomics with which they practice dental hygiene? Do dental hygienists take into consideration methods to address musculoskeletal disorders and improve

their ergonomics? With self-assessment, can an improvement be made in a dental hygienist's ergonomics?

Significance of the Problem

Musculoskeletal disorders are serious issues many dental hygienists face at some point in their careers. Usually, the most affected muscular areas are the neck, back and upper limbs, although in some rare cases lower limbs may be affected too. Symptoms of MSDs include discomfort, aching, numbness, tingling, burning, stiffness and fatigue.[5] There are several risk factors that can play a role in the formation of these MSDs. Repetitive movements, awkward/static postures, lack of task variety, lack of breaks throughout the workday, cumulative practice hours, vibration, incorrect clinical position, patient, and equipment are all contributing factors to MSDs.[1]

Ergonomics is one of the leading causes of musculoskeletal disorders in the dental profession. Ergonomics is the study of people at work with the goal of preventing MSDs and soft tissue damage produced by acute or chronic exposure to problematic posture, force, repetitive motion, and vibration.[4] Proper ergonomics will help decrease muscle fatigue, increase productivity, and reduce the number and severity of work-related MSDs. To decrease the risk of forming MSDs, practicing dental hygiene with proper ergonomics principals is essential for a long-lasting career. Preventive strategies are critical for dental hygienists to maintain their musculoskeletal health and enjoy longevity in clinical practice. Dental hygienists must continuously assess their posture, instruments, and equipment.[1] In order for this to happen it is important that dental hygienists are educated on ergonomics and aware of how they incorporate ergonomics into their clinical hygiene practice. It is crucial that dental hygienists listen to their body and take action if they begin to feel discomfort while fulfilling their clinical responsibilities.

Dental hygienists can incorporate several interventions for musculoskeletal disorders in their everyday routine. The use of dental loupes, which are magnification devices used to see small detail more closely, are one of those interventions. With the increased magnification, clinicians sit more upright. Equipment selection interventions include the use of cordless handpieces, ultrasonic scalers, lightweight, sharp and large diameter hand

instruments. Exercise, stretching, yoga, massage therapy, chiropractic services and acupuncture can also make a huge difference in the reduction of MSDs.[6] A clinician can incorporate correct equipment placement for easy to reach access, patient and clinician chair position for the best direct and indirect vision, thereby resulting in less distortion of the clinician position. Lastly, frequent breaks to help reduce the muscle load in addition to self-assessment are all ways to reduce musculoskeletal disorders.

Self-assessment is a key component to good ergonomics, which in turn reduces the risk of developing musculoskeletal disorders. Self-assessing allows for oneself to evaluate their ergonomic methods and discover what could be improved on or changed. The dental hygienist then has the opportunity to look back and assess their strengths and weaknesses and determine what can be done to make a change for the better. This allows for improved ergonomic awareness.[4] It is important to recognize if self-assessment can make a difference and improve dental hygiene ergonomics. Creating this self-awareness is a critical part of dental hygiene and is why it is important to study the impact it has on decreasing musculoskeletal disorders and improving ergonomics.

Operational Definitions

Ergonomics: The study of the relationship between people and their working environment, especially the equipment they use.

Musculoskeletal Disorders (MSDs): soft tissue injuries caused by sudden or sustained exposure to repetitive motion, force vibration, and awkward positions. These disorders can affect the muscles, nerves, tendons, joints and cartilage.

Loupes: A magnification device used to see small details more closely.

Operator Chair Position: The position at which the dental hygienist sits while working clinically.

Patient Chair Position: The position at which the dental hygienist has the patient sit while in the dental chair.

Chapter II: Literature Review

Introduction

This literature review looks at musculoskeletal disorders and their association with ergonomics in dental hygiene. Ultimately, the prevalence of musculoskeletal disorders along with the effects of age and different interventions that can be implemented into routine clinical hygiene are explored throughout this literature review. Dental hygiene ergonomics is discussed, exploring the anatomy of the head, neck and back, proper ergonomic characteristics, common errors and goals of good ergonomics. Lastly, self-assessment using survey methodology to help improve dental hygiene ergonomics is addressed. Articles for this literature review have been searched through PubMed database, The National Library of Medicine, The Journal of Dental Hygiene and the CDC website.

Musculoskeletal Disorders Defined

Musculoskeletal disorders (MSDs) encompass a range of injuries that can affect both hard and soft tissues of the body. These MSDs typically result from repetitive strain and cumulative trauma to muscles, ligaments, tendons, nerves, bones, and joints.[1] In a recent study to evaluate MSDs among dental hygienists, 92% of dental professionals reported symptoms in at least one anatomical region within one year.[7] Of those 92%, 80% of dental hygienists had experienced discomfort in their neck, 75% in the hands, 71% in the shoulders, 64% in the upper back, 59% in the lower back, 45% in the mid-back, and 40% in their arms.[7] Symptoms of these musculoskeletal disorders can result in pain, spasms, tingling, numbness, and weakness in the affected regions. The pain felt can be acute, meaning it is sudden and severe, or it can be chronic and long-lasting.[8] It can be localized (in one area of the body) or it may affect the entire body. [8] Often times the development of MSDs is not easily recognized, as there are no outwardly visible signs. [9] In other words, a dental hygienist may not feel pain in the early stages of this disease, but this does not mean they aren't affected. The damage caused by MSDs is subtle. [9] As seen in dental hygiene, this disorder is typically caused by repetitive movements, awkward and static postures, pinch-grasp, forceful exertions, vibration, and insufficient breaks.[1] In addition to these factors, poor ergonomics is

one of the leading causes of musculoskeletal disorders seen in dental hygienists. Due to these MSDs, it is not uncommon to see early retirement, disability, injury, surgery, reduced quality of life and pain among dental hygienists.[1,3]

Proper Positioning

Ergonomics refers to the designing and arranging of objects people use so that the people and the objects interact most efficiently and safely. The oral cavity is a small and narrow space, limiting dental hygienists' field of vision. As a result, it encourages them to work in awkward, inflexible positions, causing them to reach and twist in undesirable directions to facilitate a better visual working area. The first way dental hygienists can reduce the risk of MSDs is by developing a healthy working posture. Understanding operator chair position is the basis of ergonomics for dental hygienists. To demonstrate proper ergonomics, the clinician is to sit with the back and spinal cord straight, weight evenly balanced, forearms and thighs parallel to the floor, and the hips at a 90° angle.[10] The seat height should be positioned low enough so the clinician can rest the heels of their feet flat on the floor with the hips slightly higher than the knees. Equally important, shoulders should be relaxed and parallel with the hips and the floor, while the elbows should remain close to the body.[10] In addition to the clinician's chair position, it is important that the patient is also positioned correctly to help the dental hygienist maintain their proper chairside ergonomics. The dental hygienist should adjust the patient's headrest until the patient's mouth is at the clinician's elbow height. Operators may vary the placement of patients in a semi-supine position for mandibular procedures and in a supine position for maxillary procedures or use a chin-up and chin-down method when working on different arches.[10] It is also important to have the patients turn their head to the right or the left depending on what surface is being worked on. This will allow for better vision of surfaces without the distortion of the operator position. Utilizing the clock positions through the appointment is necessary to better maintain good ergonomic posture, while allowing oneself the best visual of the oral cavity.[10]

Loupes

Dental loupes are a magnification tool that allow hygienists to maintain a greater working distance, improve neck posture by preventing the clinician from leaning forward towards the patient, and provide clearer vision.[11] Maintaining a neutral neck position while scaling can be difficult, as many areas of the mouth are hidden in shadows, exist outside of the direct line of sight, or are covered by soft tissue.[12] Clinicians need to make sure they maintain a head tilt of only zero to twenty degrees, ensuring the line from the eyes to the treatment area is as near vertical as possible.[12] The use of loupes can help clinicians achieve this correct posture. Dental loupes are designed to help keep the head straight forward in a neutral position. Neck flexion of more than twenty degrees can produce a postural problem.[13] The head's center of gravity typically falls slightly forward to the ear. With each inch that the head falls from the center of gravity, an additional load is placed on the cervical vertebra and related components.[13] When the head is bent forward 2 inches toward the top portion of the sternum, 20 lbs is added to the load—10 lbs for the head and 10 lbs for the forward posture.[13] Thirty degrees or more creates a too-heavy load on the cervical muscles.[12] Neck flexion of more than thirty degrees can also impair blood flow.[13] In a survey done with 1,769 dental hygienists, 80.38% indicated that they currently wear dental loupes all of the time.[11] Of those 80.38%, studies showed that the use of the loupes improved their working posture and significantly reduced the symptoms of MSDs.[11] In a different study conducted by Plessas and Delgado, two groups of hygienist were utilized. One group wore loupes and the other group did not.[11] The dental hygienists who wore dental loupes reported relieved shoulder, arm and hand pain compared to those who did not wear loupes.[11] Through endless studies, it was suggested that considering the ergonomic and patient care benefits of wearing loupes, nearly all hygienists should be wearing loupes unless advised otherwise.

Physical Ergonomic Interventions

In addition to the use of dental loupes, there are several other interventions that can be implemented to decrease the risk of forming MSDs. First, the selection of cordless handpieces and the use of ultrasonic scalers for the removal of moderate to heavy deposit. When selecting hand instruments, it is crucial to choose large handle diameter, tapered cross-

sectional shapes and lightweight with padding.[4] Choosing the correct tools and making sure the instruments are always sharp, will reduce the amount of pinch force necessary.[4] Operator gloves must be of proper size, lightweight and pliable. Poor fitting gloves can cause pain in the hands, particularly at the base of the thumb and is a potential contributor to carpal tunnel syndrome.[6] Another aspect to consider is equipment placement. As a general rule, it is important to keep the most used instruments and equipment close to the hygienist's body to decrease the need for reaching and leaning.[14] This means the instruments, air/water, suction, and ultrasonic are close at hand. There are 5 classifications of movement for a dental professional. The first classification, I, consists of movements of the fingers only. [15] Class II, involves finger and wrist motion.[15] Class III, fingers, wrist, and elbow as when reaching for a handpiece.[15] Class IV, the entire arm and shoulder as when reaching to change the light position.[15] Class V, the entire torso as when turning around to reach for equipment.[15] The ultimate goal is to avoid Class IV and V motions.[15] In addition, since a typical hygiene appointment involves utilizing different clock positions, hygienists must adjust the placement of their equipment in order to keep it close.[14] Regular exercises, stretching, relaxation techniques such as meditation, yoga, acupuncture, massage therapy and chiropractic services help prevent injuries & combat stress thereby improving the quality of life.[6] Incorporating frequent breaks throughout the day while at work can help reduce the muscle load. Lastly, self-assessing throughout the day can help improve ergonomic awareness.[4] Many interventions can be implemented into a dental hygienist's career to decrease the risk of forming musculoskeletal disorders.

Goal of Ergonomics

The goal of ergonomics in dental hygiene is to reduce the risk of musculoskeletal disorders, improve worker safety, increase worker comfort, minimize worker fatigue and improve the quality of work done by the dental hygienist.[6] Incorporating good ergonomics into the dental hygienist's daily routine will allow for these goals to be achieved. As a result of good ergonomics, hygienists will have longer and happier working careers. Well said by Das, Motghare and Singh, "Prevention is better than cure".[6] Prevention of any disease saves time, money and pain. The problem (disease) prevailing amongst dental hygienists is

musculoskeletal disorders (MSDs) and the solution to the problem is ergonomics.[6] More awareness about good ergonomics is necessary for better health of dental professionals. Design of the work system based on ergonomically sound principles in relation to body posture, body movement, muscular strength and body dimensions is the secret to a healthy practice through various ergonomic applications in dentistry.[6]

Common Ergonomic Errors

There are several common ergonomic errors seen in practicing dental hygienists. Most hygienists are provided a fixed operatory and a patient, which they adjust their bodies to what is provided. This leads to the clinician holding static, awkward postures, bending, twisting, reaching, and performing repetitive motions during patient care.[14] Often times this includes, leaning forward, bending to the side creating a "C" shape down the spine, protruding the arms away from the body creating a "chicken wing" or propping the feet up on the clinician chair. These common ergonomic errors become habits over time. As a result, the hygienist does not recognize the poor postures that they practice with. Another common mistake by dental hygienists is not adjusting the patient chair or the patient depending on the area they're treating. Taking the time to properly position the patient chair and patient will significantly reduce fatigue and pain. In addition, proper patient positioning will allow greater adoption of neutral posture and reduce harmful body movements, such as bending and twisting, that increase the likelihood of MSDs.[14] Research has shown that these common ergonomic errors can expedite the risk of forming MSDs.

Self-Assessment

Self-assessment is the ability of the dental hygienist to accurately assess one's strengths and weaknesses and is an underlying feature of self-directed lifelong learning.[16] The key to good ergonomics is being self-aware. Self-assessment gives the dental hygienist a chance to reflect on their day's work. They can then evaluate how they feel after that day's work and look at ways they could improve or change. In a study done evaluating the effects of self-assessment among dental hygienist, participants felt that the use of this tool helped to effectively evaluate their performance, improve their skillset, increase engagement, and

strengthen self-awareness, confidence, and critical thinking.[17] Self-assessment is a critical tool that dental hygienists need to implement in their clinical hygiene to better themselves and their careers.

Head and Neck Anatomy

When analyzing ergonomics among dental hygienists, it is important to understand the anatomy of the different parts of the body repeatedly used in dental hygiene. The human spine has four natural curves; cervical lordosis, thoracic kyphosis, lumbar lordosis & sacral kyphosis.[6] These spinal curves provide stability and support the human torso and the weight of the head and arms. Issues arise when the human body is subjected to static postures or awkward positions for hours on end. Our musculoskeletal system is not designed for continuous stress. Over time, muscles get sore and stiff, bones begin to remodel, tendons and ligaments get damaged, and the intervertebral discs in the spine fail to provide adequate support.[18] Inadequate rest or insufficient breaks further compound the problem. In response to poor upper body postures, the vertebrae in the spinal column begin to compensate. As the disc space changes, the intervertebral pressures become uneven, resulting in stiffness and pain, setting the stage for a compromised airway.[19] To compensate for these imbalances, muscles and ligaments either become tight and short or are stretched beyond their natural limits. This sets the stage for the remodeling process. The vertebrae shift position, discs herniate, and bone spurs develop.[18] Over time, the cervical curve in the neck is lost as the vertebrae move and the neck becomes straighter. With continuous wear over time, hygienists will often form a hump on the back of their neck, which is a perfect example of how the body responds to repeated trauma over time. By the time this hump or bulge appears, significant damage is already occurring. In addition to muscle fatigue, research indicates a huge range of problems that can include a reduction in respiratory volume as high as 30%.[20] Digestion can also be impacted, and headaches are a frequent complaint.[18]

The Effects of Age and Musculoskeletal Disorders

As hygienists age and more clinical hours and years are put in, an increased risk of forming MSDs arise. A study done evaluating the association between age and presence of

MSDs showed that the lumbosacral region is the most negatively influenced by age: 43.20% in the 51–65 age range, 16.50% in the 36–50 age range and 23.20% in the 25–35 age range. While for the other affected regions, the presence of MSDs was similarly distributed in the different age ranges.[5] Cumulative practice time is also associated with MSD development. Johnson and Kanji determined that dental hygienists who practiced more than 10 years reported more MSD pain than other practitioners.[1] However, the data for those practicing 10 years or fewer revealed startling information. Those who had practiced less than 1 year were already reporting pain in these areas, and the relative risk for developing issues doubled or tripled during the first 10 years.[1] Assessing different pieces of literature, studies show that age and the amount of time practicing dental hygiene can be a contributing factor to the formation of musculoskeletal disorders.

Summary

Through literature and studies performed, it has been shown that there is a very high prevalence of musculoskeletal disorders among dental hygienists. The most common occurring places dental hygienists experience these MSDs are the neck, shoulder, wrist, hands and back. One of the leading causes of this disorder is poor ergonomics. It has been shown that there are several factors that can be implemented to improve the overall ergonomics of dental hygienists such as equipment placement, equipment selection, operator chair position, patient chair position and clinician posture, all of which can be controlled by the operating hygienist. Studies have also investigated the effects that age has on the prevalence of MSDs and ergonomics. Studies have shown that age and the amount of time spent practicing dental hygiene can be a contributing factor to forming MSDs. With the implementation of these factors and proper self-assessment, studies have shown a decrease in musculoskeletal disorders in dental hygienists. Literature shows that practicing good ergonomics decreases the risk of forming musculoskeletal disorders.

Chapter III: Methods and Materials

Introduction

This research focused on ergonomics and its connection to musculoskeletal disorders. The purpose of this study was to assess ergonomics practiced by dental hygienists while also using self-assessment on willingness to make changes. A detailed questionnaire was utilized for gathering data. Surveying methods were distributed to a Facebook group for dental hygienists in Minnesota. The Facebook group was named "Minnesota Dental Hygienists Connect". Hygienists who agreed to participate completed the questionnaire after one clinical shift. The questionnaire was compiled of various questions revolving around each clinician's ergonomic practice. The goal of this research was if with self-assessment, hygienists would recognize ways they can improve their ergonomics while working clinically resulting in the reduction or prevention of pain.

Sample Defined

The sample population for this study was practicing dental hygienists in Minnesota who are members of a specific social media Facebook group. The Facebook forum "Minnesota Dental Hygienists Connect" is a group where Minnesota dental hygienists can connect, share ideas, mentor, post questions/concerns and ask for input on hygiene-related topics.

Research Design

The research design applied was a survey questionnaire to dental hygienists. This research was conducted by an online survey program, Microsoft Forms, which hygienists answered after the completion of a dental hygiene clinical shift. It was recommended that the survey be completed after the last shift of their work week. The survey was posted to the Facebook forum, "Minnesota Dental Hygienists Connect" as the initial post and with a duplicate post after one week. Participation was voluntary and anonymous. The survey was available for two weeks and took approximately 5-10 minutes to complete. The questionnaire

was compiled of twenty multiple choice, multiple answer, and branching logic questions revolving around each clinician's age, years practicing dental hygiene, daily routines and practice, ergonomic principles, and participants amount of pain (Appendix B).

Data was collected from survey results once participants completed the survey and the survey was closed. Informed consent was garnered when opening the link and with completion of the survey. Participants were asked to fully complete the survey to completion to help compile more accurate data, however was not mandatory. Participants also had the choice to participate or decline involvement in this study. Prior to and during the administration of the survey, the University of New Mexico's Human Research Review Committee (HHRC), which acts as the UNM Health Science Center Institutional Review Board (IRB), reviewed, and approved this study under EXEMPT status for non-identifiable survey research.

Data Collection and Analysis

Microsoft Forms was used to create and collect surveys from the participants. Microsoft Forms is an online tool that can create surveys, invite others to respond to it using any web browser or mobile device, see real-time results as they're submitted, use built in analytics to evaluate responses, and export results to Excel for additional analysis.[21] Microsoft forms is a free online survey tool; therefore, no budget allowance was necessary. Descriptive analysis and cross tabulations were used when analyzing data.

Chapter IV: Results, Discussion, Limitations and Conclusion

Results

The survey was posted to the Facebook group page, "Minnesota Dental Hygienists Connect" and was open for two weeks. A reminder, duplicate, post was posted at the halfway point (7 days after the survey opened). Twenty-five surveys were completed in their entirety and captured via Microsoft forms. Respondents were of various ages with the majority of responders (96%) aging from 30 years old to over 60 years old, (Figure 1). Participants have practiced dental hygiene for various amounts of time with 30+ years being the most popular. (Figure 2). When participants were asked about their average hours worked throughout their hygiene careers, 76% of participants reported working 30-40 hours per week on average throughout their careers and the other 24% of participants reported working 20-29 hours per week. Participants were also asked about the number of hours they worked for their clinical work week prior to taking the completed survey and 64% responded with between 20-40 hours (Figure 3).

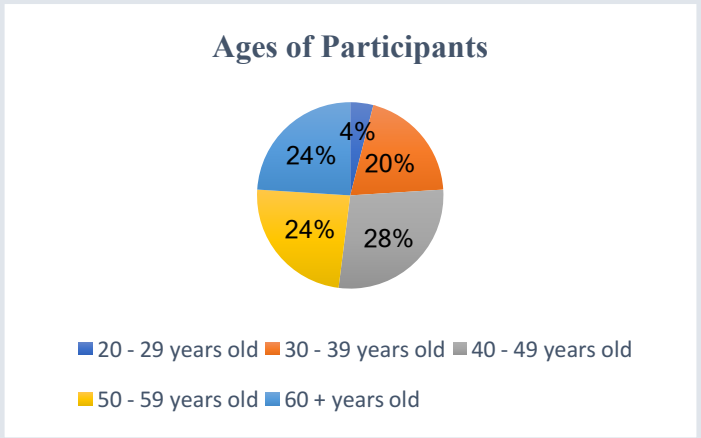

Figure 1: Age ranges of participating dental hygienists

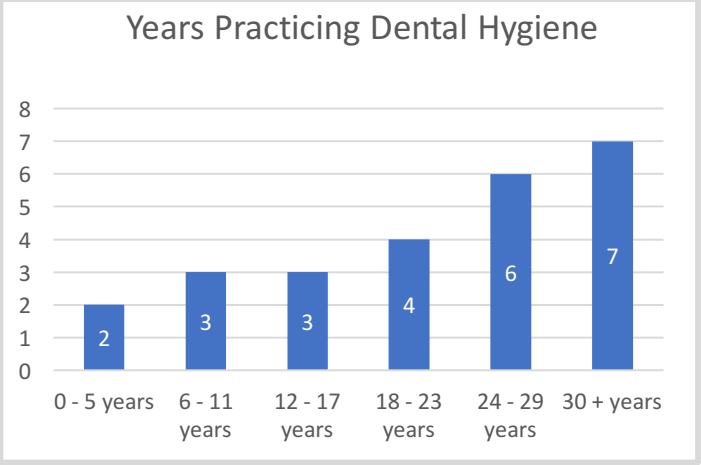

Figure 2: Number of years practicing dental hygiene

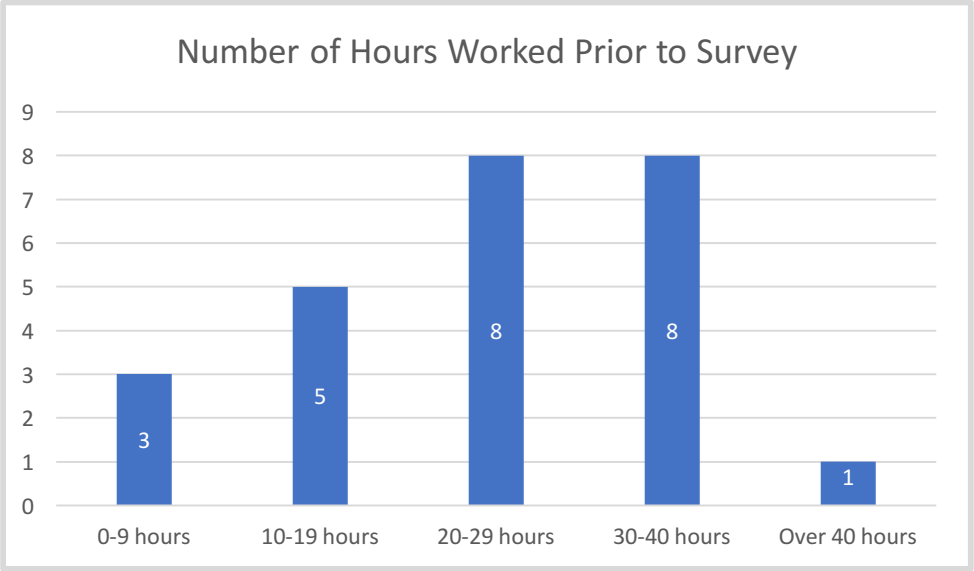

Figure 3: Number of hours worked prior to (the week of) taking the survey

Of the 25 participants who responded, 84% received one scheduled break, including lunch. The other 16% of respondents received no scheduled breaks. Participants explained how their bodies were feeling as a whole after their days work as being good (44%), fair (48%), and poor (8%). Eighty-four percent of participants reported experiencing body pain and 16% reported experiencing no body pain. Of those participants (n=21) experiencing pain, a wide range of areas were noted where the pain was being felt. The most common answer reported was neck pain by 81% of these participants reporting pain. Participants who answered 'Other' from selected areas of pain, responded with, finger numbness, hip, headaches and sciatic nerve pain (Figure 4).

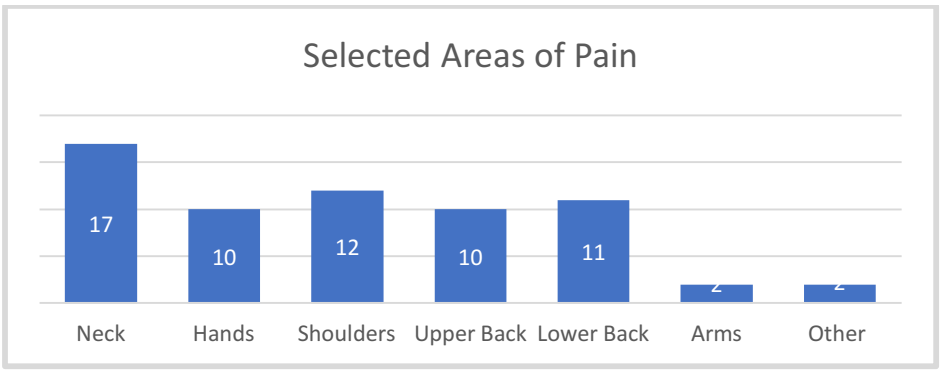

Figure 4: Areas pain is observed

When analyzing the cross tabulations between the various factors and pain, it was found that there was no noticeable difference in pain felt by the different age groups. Majority of the respondents in each group indicated that they were experiencing pain due to their dental hygiene work (6-29 years) while those with the least experience (0-5 years) and those with the most experience (30+ years) were split on whether they experienced pain due to their work (Table 1).

Table 1: Number of Years Practicing in Relationship to Pain

Years Practicing	Pain			
	No		Yes	
	#	%	#	%
0-5 years	1	50%	1	50%
6-11 years	--	--	3	100%
12-17 years	--	--	3	100%
18-23 years	--	--	4	100%
24-29 years	--	--	6	100%
30+ years	3	43%	4	57%

Forty-eight percent of participants report recognizing pain or discomfort in dental hygiene school and 0-5 years working clinically. The other 52% of participants report recognizing this pain after 6 years of working clinically. Of the participants experiencing pain, 62% report a mild level of pain or discomfort and 38% reporting a moderate level of pain or discomfort. Those participants in their 50s were more likely to experience the moderate level of pain while all other age groups were likely to experience a mild level of pain.

When statistically analyzing cross tabulations for the areas pain is most felt, it was found that dental hygienists of all ages were likely to experience neck pain. Those in the 30+ age range were also likely to experience shoulder, lower back, upper back, finger pain and headaches. Those who had been practicing longest (18+ years) were most likely to report pain in their neck, shoulders, upper back and hands. There were no noticeable differences on pain felt in other areas by the number of years practicing (Table 2).

Table 2: Pain Cross Tabulations for Age and Years of Practice

	Pain Areas									
Age (Years Old)	**Neck**	**Shoulders**	**Lower Back**	**Upper Back**	**Hands**	**Arms**	**Sciatic Nerve**	**Fingers**	**Head**	**Hips**
20-29	1	--	--	--	1	--	--	--	--	--
30-39	2	2	1	2	--	1	--	1	1	--
40-49	6	5	5	4	2	1	--	--	--	1
50-59	3	2	2	1	2	--	1	--	--	--
60+	5	3	3	2	2	--	--	--	--	--
Years of Practice	**Neck**	**Shoulders**	**Lower Back**	**Upper Back**	**Hands**	**Arms**	**Sciatic Nerve**	**Fingers**	**Head**	**Hips**
0-5	--	--	--	1	--	--	--	--	--	--
6-11	2	1	--	1	1	--	--	--	1	--
12-17	2	3	2	1	1	2	--	1	--	1
18-23	3	3	--	2	2	--	--	--	--	--
24-29	6	3	--	2	1	--	1	--	--	--
30+	4	2	--	2	2	--	--	--	--	--

Seventy-six percent of all participants reported wearing dental loupes. Of these participants, 56% wore dental loupes all of the time and 20% wore loupes most of the time. The most common type of loupe design selected as being worn by 79% of participants was the Standard 2.5x or 3.0x through the lens magnification. Eleven percent wears the Standard Flip up, 5% wears the Prism Ergo Design through the lens, and another 5% did not know the type of loupe being worn. In terms of the frequency of loupes wearing, hygienists were more likely to feel pain if they did not wear loupes. Those who did not wear loupes were more likely to experience pain in the arms, lower back and shoulders versus those who wore loupes most or all of the time were more likely to experience pain in the neck, upper back, hands, and each of the additional pain areas (sciatic nerve, fingers, head and hips).

Majority (88%) of participants kept all equipment within arm's reach. Hand instruments with large handles, tapered cross-sectional shapes, were lightweight with padding and sharp were used by 64% of participants and 36% of participants reported that

half of their instruments used were of proper ergonomic design. Those who keep all equipment within arms' reach experienced neck, hand and upper back pain, but do not report pain in any other area.

The majority (80%) of participants reported they try to sit in the correct ergonomic position such as back and spinal cord straight, forearms and thighs parallel to the floor, hips slightly above the knees, feet flat on the floor and elbows close to the body, but often do not and a small portion (16%) of participants reported they sit in an ergonomically correct position. When asked about correct patient positioning such as using semi-supine for mandibular arch, supine for maxillary arch, chin up, chin down and turning head to right or left for better direct vision, 64% of participants report sometimes adjusting their patients and other times will not. Twenty-eight percent keep their patient in the same position and 8% make sure to adjust their patient. For those who always adjust their patient's position throughout the appointment report neck, shoulder, upper and lower back pain. Those who do not adjust their patients report pain in every area. Those who sometimes adjust their patient most often feel pain in the neck and arms, but may also report pain in the hands, shoulders, and upper and lower back (Figure 5).

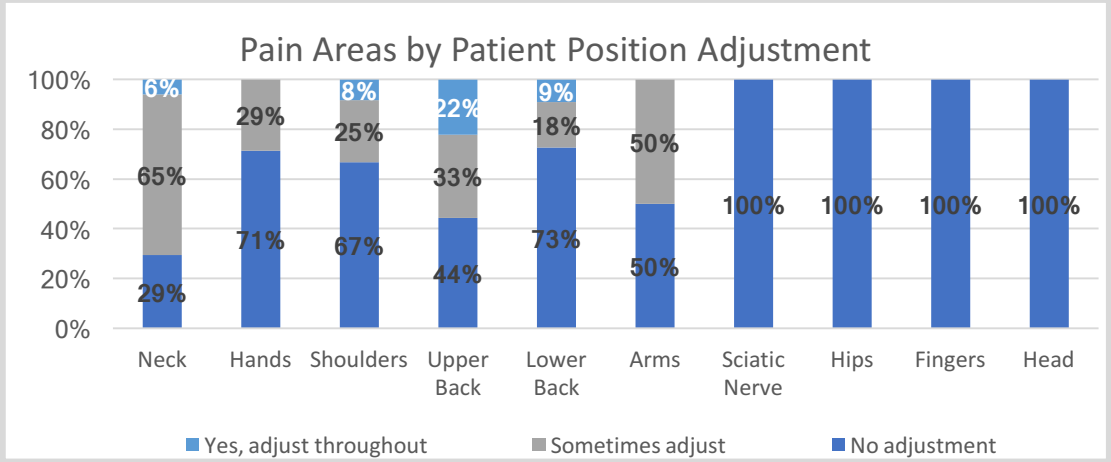

Figure 5: Areas of pain as a result of patient positioning

At the conclusion of the survey, participants were asked to reflect on their answers. The components that they felt contributed most to the pain or discomfort they were feeling were operator and patient positioning, which mirrored the results of the components that participants would be willing to improve on to help reduce or prevent pain (Figure 6).

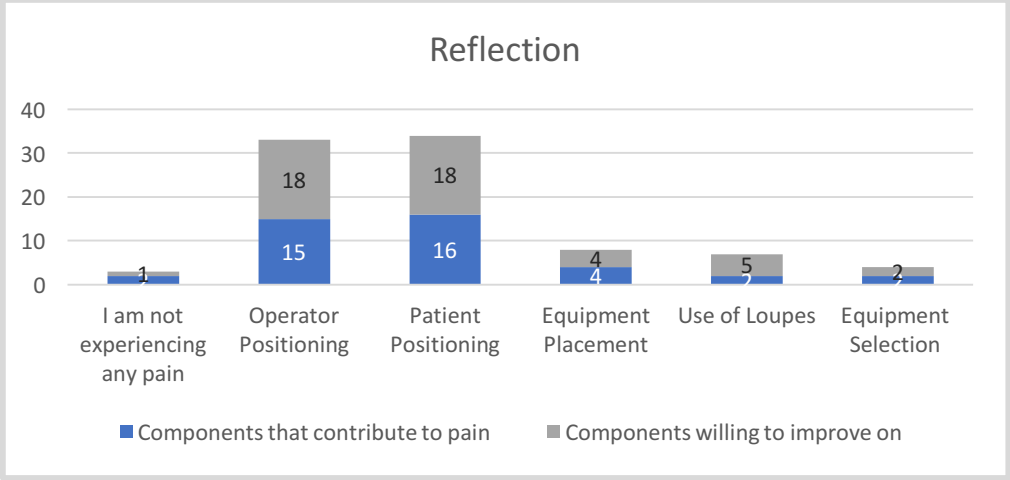

Figure 6: Components participants believe are contributing to pain/discomfort and components that participants would be willing to improve on to help reduce pain/discomfort

Discussion

The purpose of this study was to investigate how many practicing dental hygienists experience musculoskeletal pain from daily hygiene practice and how ergonomics contributes to the level of pain that they feel. Additionally, this study discovered through self-assessment the areas participating dental hygienists would be willing to improve on in their daily ergonomic practice to potentially help decrease or prevent future pain. The study found that nearly all hygienists that participated are experiencing some level of pain that could be contributed to clinical dental hygiene. Forty-eight percent recognized this pain 0 to 5 years of practicing. Zero participants who selected that they do experience pain rated their pain as severe. Those in their 50s were more likely to experience moderate pain than any other group.

This study reflects what literature suggests, that dental hygienists experience more pain in their neck than any other part of their body. In this study, 80% of participants (n=17) who are experiencing pain, noted that they experience pain in their neck. Followed by the neck, the next most reported region was the shoulders, then lower back, upper back, hands and arms. A previous study done to evaluate pain felt among dental hygienists found that, 92% of dental professionals reported symptoms in at least one anatomical region within one year, with 80% of dental hygienists had experienced discomfort in their neck 75% in the

hands, 71% in the shoulders, 64% in the upper back, 59% in the lower back, 45% in the mid-back, and 40% in their arms.[1,7] Comparing both studies, it is evident that the neck is the most common location for dental hygienists to feel pain.

In this study, 14 participants reported wearing loupes all of the time, 5 wore them most of the time and 6 did not wear loupes. Of the participants who wore loupes, most wore standard through the lens magnification. In terms of the frequency of loupes wearing, hygienists were more likely to feel pain if they did not wear loupes. Dental loupes are a magnification tool that allow hygienists to maintain a greater working distance, improve neck posture by preventing the clinician from leaning forward towards the patient, and providing clearer vision.[11] In this study, most participants wore loupes, but musculoskeletal pain was still present. It is uncertain if more pain would be felt if hygienists did not wear the dental loupes. A factor to consider is inadequately fitted loupes or improper clinician and patient positioning while wearing the loupes. No conclusions can be drawn from the use of loupes in this study.

Majority of participants reported following proper ergonomic principles while practicing dental hygiene which involves keeping their equipment within arms-reach using well designed ergonomic instruments during patient care. Those who kept all equipment within arms' reach experienced neck, hand and upper back pain, but did not report pain in any other area. As for operator positioning, majority of participants try to sit in the correct operator position, but often times do not. When analyzing operatory positioning, majority of participants would try to remain in the correct position and sometimes would adjust their patient. Those who do not adjust their patients report pain in every area. It is evident in this study, that the area hygienists struggle most, is maintaining good operator and patient positioning. Maintaining proper positioning for both the operator and patient is important in good ergonomic practice. Literature shows that incorrect clinical and patient positions are contributing factors to MSDs.[1]

When participants were asked to reflect on their answers, most hygienists thought that their improper operator and patient positioning could be what is contributing to some of the pain or discomfort that they are experiencing and that it would also be an area they were willing to improve on. Data analysis shows that the most common trend that could be causing pain or discomfort in dental hygienists is not sitting in an ergonomically correct operator

position and not adjusting the patient throughout the appointment. As a result of not using these correct techniques, hygienists tend to distort their bodies in undesirable ways, resulting in pain or discomfort.

Limitations

Limitations to this study include a small sample size. A sample size of 25 is small and therefore limiting generalizations of ergonomic principles in dental hygienists. Another limitation in this study is related to the use of dental loupes. As discussed, loupes must be properly fitted to the individual in order to maintain proper position and ergonomics. If loupes are fitted incorrectly, improper positioning and distortion of the clinician's body can occur, resulting in pain. It cannot be determined through this study if participants had correctly fitted loupes.

Although participants reported how many hours worked prior to taking the survey, they were asked to complete the survey at the end of their work week, but it cannot be certain if participants obliged by that criterion for taking the survey.

A small number of participants selected experiencing hand pain/discomfort, but a limitation can be found in the absence of asking about proper glove wearing including size or material during practice.

Conclusion

Results from this study highlighted most hygienists are experiencing some level of pain due to clinical hygiene practice. Most hygienists report experiencing pain in their neck followed by their shoulders, back and hands. From the results of this study, it does not appear that hygienists have an issue with equipment placement or instrument selection. Results showed that clinicians are not sitting in the correct operator position and are not always adjusting their patients as they should. Using self-reflection, participants found that their operator and patient positioning could be what is contributing to their pain/discomfort that they are experiencing. Moving forward in their careers, these two factors are areas they would be willing to improve on. Future research on this topic should investigate on a larger sample size to get more conclusive results.

Chapter V: Article for Submission

Journal of Dental Hygiene

Title: Ergonomics and Musculoskeletal Disorders: An Evaluation of Self-Assessment using Surveys

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Abstract

Purpose: The purpose of this study was to assess ergonomics practiced by dental hygienists while also using self-assessment on willingness to make changes.

Methods: A detailed questionnaire compiled of various questions revolving around each clinician's ergonomic practices was utilized. Surveying methods were distributed to a Facebook group for dental hygienists in Minnesota named "Minnesota Dental Hygienists Connect". The survey was available for two weeks. Descriptive analysis and cross tabulations were used when analyzing data.

Results: Twenty-five surveys were completed in their entirety. Nearly all participants (n=21) report experiencing a mild to moderate level of pain due to clinical hygiene practice. The most common area of pain reported was the neck with most recognizing this pain from 0-5 years of practicing. Most participants report not sitting in a correct operator position and do not adjust their patients throughout the course of the dental appointment. Nearly all participants, felt that their improper operator and patient positioning could be what is contributing to their pain or discomfort and were also the areas they would be willing to improve on to help reduce or prevent pain.

Conclusion: Musculoskeletal disorders are an issue many dental professionals experience, with poor ergonomic practicing being a contributing factor. This study shows that most participating dental hygienists are experiencing pain due to clinical dental hygiene with the most common location being the neck (n=17). The area participants tend to struggle with are maintaining proper operator and patient positioning, which area also components dental hygienists report they would like to improve on.

Introduction

Musculoskeletal disorders are a significant concern in the dental profession. Approximately 92% of oral health professionals experience MSDs, with dental hygienists being the most affected.[1] A musculoskeletal disorder can be described as soft tissue injuries caused by sudden or sustained exposure to repetitive motion, force vibration, and awkward positions. These disorders can affect the muscles, nerves, tendons, joints and cartilage.[2] In a recent study to evaluate MSDs among dental hygienists, 92% of dental professionals reported symptoms in at least one anatomical region within one year.[7] Of those 92%, 80% of dental hygienists had experienced discomfort in their neck, 75% in the hands, 71% in the shoulders, 64% in the upper back, 59% in the lower back, 45% in the mid-back, and 40% in their arms.[7] Due to these factors, the most common MSDs seen in dental hygienists are carpel tunnel syndrome, tension neck syndrome, tendonitis, low back injuries, trapezius myalgia, vibration-induced neuropathy, muscle strains and trigger finger.[1] Due to these MSDs, it is not uncommon to see early retirement, disability, injury, surgery, reduced quality of life and pain among dental hygienists.[1,3]

Age is an important factor to take into consideration when analyzing musculoskeletal disorders. As hygienists age and more clinical hours and years are put in, an increased risk of forming MSDs arise. A study done evaluating the association between age and presence of MSDs showed that the lumbosacral region is the most negatively influenced by age: 43.20% in the 51–65 age range, 16.50% in the 36–50 age range and 23.20% in the 25–35 age range. While for the other affected regions, the presence of MSDs was similarly distributed in the different age ranges.[5] Cumulative practice time is also associated with MSD development. Johnson and Kanji determined that dental hygienists who practiced more than 10 years reported more MSD pain than other practitioners.[1] However, the data for those practicing 10 years or fewer revealed startling information. Those who had practiced less than 1 year were already reporting pain in these areas, and the relative risk for developing issues doubled or tripled during the first 10 years.[1]

One of the leading causes of musculoskeletal disorders is poor ergonomics. Practicing good ergonomics is a key component in a long-lasting dental hygiene career. Proper ergonomics will help decrease muscle fatigue, increase productivity, and reduce the number

and severity of work-related MSDs. Preventive strategies are critical for dental hygienists to maintain their musculoskeletal health and enjoy longevity in clinical practice. For this to happen it is important that dental hygienists are educated on ergonomics and aware of how they incorporate ergonomics into their clinical hygiene practice

The use of dental loupes are one of many interventions for musculoskeletal disorders that hygienists can incorporate in their everyday routine. The use of dental loupes, which are a magnification tool that allow hygienists to maintain a greater working distance, improve neck posture by preventing the clinician from leaning forward towards the patient, and provide clearer vision.[11] Dental loupes are designed to help clinicians maintain a neutral neck position of 20 degrees or less. [13] In a survey done with 1,769 dental hygienists, 80.38% indicated that they currently wear dental loupes all of the time.[11] Of those 80.38%, studies showed that the use of the loupes improved their working posture and significantly reduced the symptoms of MSDs in those hygienists wearing the loupes.[11] Through endless studies, it was suggested that considering the ergonomic and patient care benefits of wearing loupes, nearly all hygienists should be wearing loupes unless advised otherwise.

There are several other interventions that can be implemented to help decrease the risk of MSDs. Equipment selection interventions include the use of cordless handpieces, ultrasonic scalers, lightweight, sharp and large handle diameter hand instruments. A clinician can incorporate correct equipment placement for easy to reach access, patient and clinician chair position for the best direct and indirect vision, thereby resulting in less distortion of the clinician position. Regular exercises, stretching, relaxation techniques such as meditation, yoga, acupuncture, massage therapy and chiropractic services help prevent injuries & combat stress thereby improving the quality of life.[6] Incorporating frequent breaks throughout the day while at work can help reduce the muscle load. Lastly, self-assessing throughout the day can help improve ergonomic awareness.[4]

Self-assessment is a key component to good ergonomics, which in turn reduces the risk of developing musculoskeletal disorders. Self-assessment is the ability of the dental hygienist to accurately assess one's strengths and weaknesses and is an underlying feature of self-directed lifelong learning.[16] The key to good ergonomics is being self-aware. Self-assessment gives the dental hygienist a chance to reflect on their day's work. They can then evaluate how they feel after that day's work and look at ways they could improve. Creating

this self-awareness is a critical part of dental hygiene and is why it is important to study the impact it has on decreasing musculoskeletal disorders and improving ergonomics.

Developing a foundation in evidence-based ergonomic principles is imperative for a long-lasting career as a dental hygienist.[4] The objective of this research is to assess if the pain that is felt by clinically working hygienists is related to ergonomics and if the use of self-assessment to improve ergonomics can help reduce or prevent future pain or musculoskeletal disorders.

Methods

This research focused on ergonomics and its correlation with musculoskeletal disorders. The purpose of this study was to assess ergonomics practiced by dental hygienists while also using self-assessment on willingness to make changes. A detailed questionnaire was utilized for gathering data. The questionnaire was compiled of various questions revolving around each clinician's ergonomic practices.

This was a questionnaire conducted by an online survey program, Microsoft Forms, which hygienists who agreed to participate completed at the completion of one clinical shift. It was recommended that the survey be completed after the last shift of their work week. The survey was posted to the Facebook forum "Minnesota Dental Hygienists Connect" as the initial post and with a duplicate post after one week. Participation was voluntary and anonymous. The survey was available for two weeks. Informed consent was garnered when opening the link and with the completion of the survey. Prior to and during the administration of the survey, the University of New Mexico's Human Research Review Committee (HHRC), which acts as the UNM Health Science Center Institutional Review Board (IRB), reviewed, and approved this study under EXEMPT status for non-identifiable survey research. Descriptive analysis and cross tabulations were used when analyzing data.

Results

Twenty-five surveys were completed in their entirety and captured in Microsoft Forms. Demographics show that respondents were of various ages with majority of

responders (96%) aging from 30 years old to over 60 years old. Participants have practiced dental hygiene for various amounts of time with 30+ years being the most popular.

Eighty-four percent of participants reported experiencing body pain and 16% reported experiencing no body pain. Of those participants (n=21) experiencing pain, a wide range of areas were noted where the pain was being felt (Figure 4). The most common answer reported was neck pain, with 81% of those participants reporting pain. Followed by the neck, shoulders, lower back, upper back and hands were the top 5 locations pain was reported. Of the participants experiencing pain, 62% report a mild level of pain or discomfort and 38% report a moderate level of pain. Those in their 50's were more likely to experience the moderate level of pain while all other age groups were likely to experience a mild level of pain. The pain experienced by participants was first recognized at various points in their careers, with 47% recognizing this pain within the first 5 years of working clinically (Table 2).

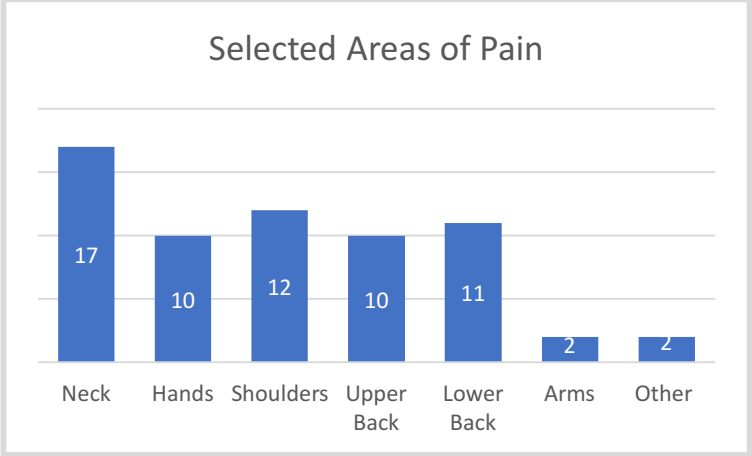


Figure 4: Areas pain is observed

Table 2: Pain Cross Tabulations for Age and Years of Practice

	Pain Areas									
Age (Years Old)	**Neck**	**Shoulders**	**Lower Back**	**Upper Back**	**Hands**	**Arms**	**Sciatic Nerve**	**Fingers**	**Head**	**Hips**
20-29	1	--	--	--	1	--	--	--	--	--
30-39	2	2	1	2	--	1	--	1	1	--
40-49	6	5	5	4	2	1	--	--	--	1
50-59	3	2	2	1	2	--	1	--	--	--
60+	5	3	3	2	2	--	--	--	--	--
Years of Practice	**Neck**	**Shoulders**	**Lower Back**	**Upper Back**	**Hands**	**Arms**	**Sciatic Nerve**	**Fingers**	**Head**	**Hips**
0-5	--	--	--	1	--	--	--	--	--	--
6-11	2	1	--	1	1	--	--	--	1	--
12-17	2	3	2	1	1	2	--	1	--	1
18-23	3	3	--	2	2	--	--	--	--	--
24-29	6	3	--	2	1	--	1	--	--	--
30+	4	2	--	2	2	--	--	--	--	--

When analyzing the cross tabulations between the various factors and pain, it was found that there was no noticeable difference in pain felt by the different age groups. Majority of the respondents in each group indicated that they were experiencing pain due to their dental hygiene work (6-29 years) while those with the least experience (0-5 years) and those with the most experience (30+ years) were split on whether they experienced pain due to their work.

Seventy-six percent of all participants reported wearing dental loupes. Fifty six percent of participants wore dental loupes all of the time and 20% wore loupes most of the time. In terms of the frequency of loupes wearing, hygienists were more likely to feel pain if they did not wear loupes.

When analyzing equipment placement and instrument selection, most participants, kept all equipment within arm's reach. and used hand instruments with large handles, tapered cross-sectional shapes, were lightweight with padding and sharp. On the other hand,

when assessing operator and patient positioning, majority of participants, 80%, reported that they try to sit in the correct ergonomic position such as back and spinal cord straight, forearms and thighs parallel to the floor, hips slightly above the knees, feet flat on the floor and elbows close to the body, but often do not and a small portion (16%) of participants reported they sit in an ergonomically correct position. When asked about correct patient positioning such as using semi-supine for mandibular arch, supine for maxillary arch, chin up, chin down and turning head to right or left for better direct vision, 64% of participants report sometimes adjusting their patients and other times will not. Twenty-eight percent keep their patient in the same position and 8% make sure to adjust their patient. For those who always adjust their patient's position throughout the appointment report neck, shoulder, upper and lower back pain. Those who do not adjust their patients report pain in every area. Those who sometimes adjust their patient most often feel pain in the neck and arms, but may also report pain in the hands, shoulders, and upper and lower back (Figure 5).

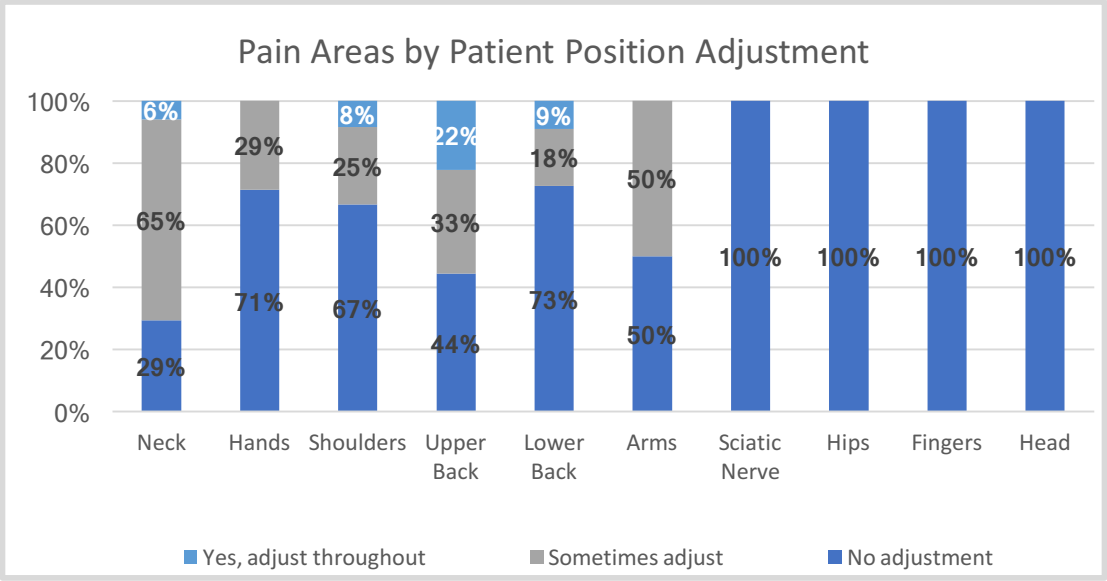


Figure 5: Areas of pain as a result of patient positioning

At the conclusion of the survey, participants were asked to reflect on their answers. The components that they felt contributed most to the pain or discomfort they were feeling were operator and patient positioning, which mirrored the results of the components that participants would be willing to improve on to help reduce or prevent pain (Figure 6).

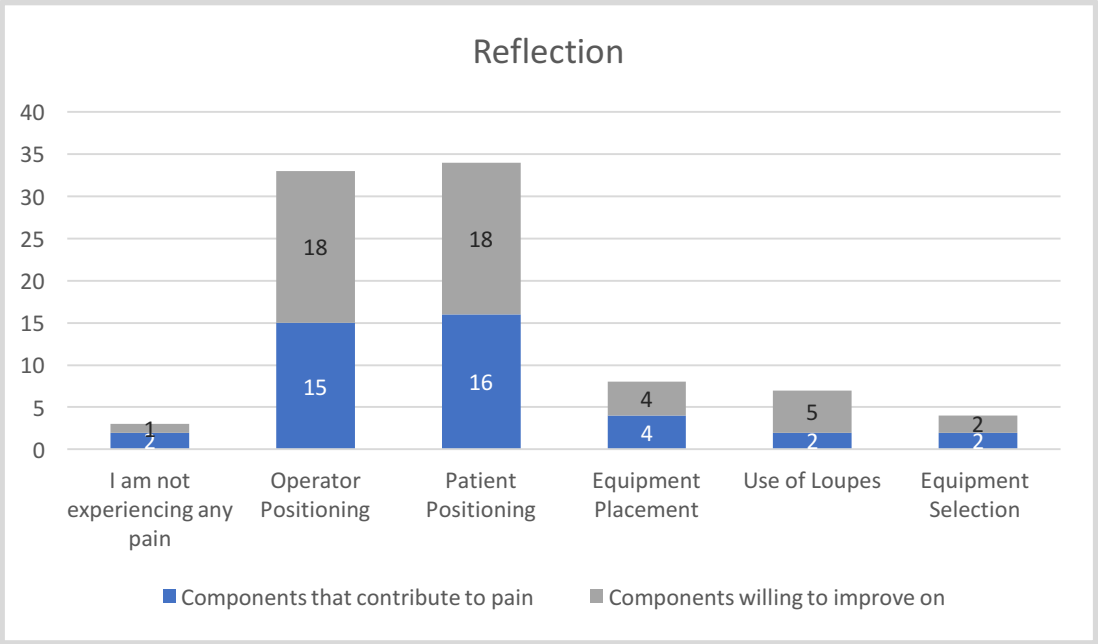


Figure 6: Components participants are contributing to pain/discomfort and components that participants would be willing to improve on to help reduce pain/discomfort

Discussion

The purpose of this study was to investigate how many practicing dental hygienists experience musculoskeletal pain from daily hygiene practice and how ergonomics contributes to the level of pain that they feel. Additionally, this study also discovered through self-assessment the areas participating dental hygienists would be willing to improve on in their daily ergonomic practice to potentially help decrease or prevent future pain. The study found that nearly all hygienists that participated in the study are experiencing some level of pain that could be contributed to clinical dental hygiene. This study shows that pain is noticed early on in hygiene careers. Forty-eight percent of participants recognized pain in as early as dental hygiene school and 0 to 5 years of practicing with hygienists experiencing both mild and moderate pain levels.

This study reflects what literature suggests, that dental hygienists experience more pain in their neck than any other part of their body. In this study, 80% of participants (n=17) who are experiencing pain, noted that they experience pain in their neck. Followed by the neck, the next most reported region was the shoulders (57%), then lower back (52%), upper back (47%), hands (47%) and arms (9%). A previous study done to evaluate pain felt among

dental hygienists found that 92% of dental professionals reported symptoms in at least one anatomical region within one year.[1,7] Of those 92%, 80% of dental hygienists had experienced discomfort in their neck 75% in the hands, 71% in the shoulders, 64% in the upper back, 59% in the lower back, 45% in the mid-back, and 40% in their arms.[1,7] Comparing both studies, it is evident that the neck is the most common location for dental hygienists to feel pain.

In this study, 19 participants reported wearing dental loupes while working clinically. In terms of the frequency of loupes wearing, hygienists were more likely to feel pain if they did not wear loupes, however, pain was still reported in those who wore the loupes. In a previous study performed where a survey was done with 1,769 dental hygienists, 80.38% indicated that they currently wear dental loupes all of the time.[11] Of those 80.38%, studies showed that the use of the loupes improved their working posture and significantly reduced the symptoms of MSDs in those hygienists wearing the loupes.[11] Comparing both studies, the use of dental loupes may help decrease the pain experienced by dental hygienists, but no conclusions can be drawn from this study performed.

Majority of participants reported following proper ergonomic principles while practicing dental hygiene which involves keeping their equipment within arms-reach and using well designed ergonomic instruments during patient care. When analyzing operatory positioning, majority of participants would try to sit in the correct operator position and sometimes would adjust their patients. It is evident in this study, that the area hygienists struggle most, is maintaining good operator and patient positioning. Maintaining proper positioning for both the operator and patient is the basis of good ergonomics for dental hygienists. Literature shows that incorrect clinical and patient positions are contributing factors to MSDs.[1]

When participants were asked to reflect on their answers, most hygienists thought that their operator and patient positioning could be what is contributing to some of the pain or discomfort that they are experiencing and that it would also be an area they were willing to improve on. Data analysis shows that the most common trend that could be causing pain or discomfort in dental hygienists is not sitting in an ergonomically correct operator position and not adjusting the patient throughout the appointment. As a result of not using these

correct techniques, hygienists tend to distort their bodies in undesirable ways, resulting in pain or discomfort.

Limitations

Limitations to this study include a small sample size. A sample size of 25 is small and therefore limiting generalizations of ergonomic principles in dental hygienists. Another limitation in this study is related to the use of dental loupes. As discussed, loupes must be properly fitted to the individual in order to maintain proper position and ergonomics. If loupes are fitted incorrectly, improper positioning and distortion of the clinician's body can occur, resulting in pain. It cannot be determined through this study if participants had correctly fitted loupes.

Although participants reported how many hours worked prior to taking the survey, they were asked to complete the survey at the end of their work week, but it cannot be certain if participants obliged by that criterion for taking the survey.

A small number of participants selected experiencing hand pain/discomfort, but a limitation can be found in the absence of asking about proper glove wearing including size or material during practice.

Conclusion

Results from this study highlights most hygienists are experiencing some level of pain due to clinical hygiene practice. Most hygienists report experiencing pain in their neck followed by their shoulders, back and hands. From the results of this study, it does not appear that hygienists have an issue with equipment placement or instrument selection. Results showed that clinicians are not sitting in the correct operator position and are not always adjusting their patients as they should. Using self-reflection, participants found that their operator and patient positioning could be what is contributing to their pain/discomfort that they are experiencing. Moving forward in their careers, these two factors are areas they would be willing to improve on. Future research on this topic should investigate on a larger sample size to get more conclusive results.

APPENDICES

Appendix A: Facebook Recruitment/Consent Form

Appendix B: Survey

Appendix C: Letter of Support

Appendix D: HRPP Approval Letter

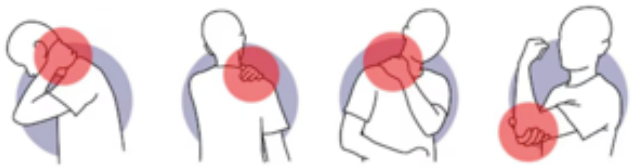
Appendix A: Facebook Recruitment/Consent Form

Hello, Fellow Dental Hygienists,

My name is Shannon Sherman, and I am a current graduate student in the Dental Hygiene Department at the University of New Mexico. I am finishing up my thesis project for my master's degree in dental hygiene and I need your help!

I am inviting you to take part in a survey research opportunity described in full detail in this post.

Survey Link:
https://forms.office.com/Pages/ResponsePage.aspx?id=GOzcUUxfIE6MVfi6ThPv9NO2CTjufo5Gr5J0Nc_wSoVUMzVXUkw0TEVKT0JBRUVKNFJDWFNPTjhDVi4u



Dear prospective participant, I am conducting research involving dental hygienists around the state of Minnesota. Ergonomics and Musculoskeletal Disorders: An Evaluation of Self-Assessment using Surveys HRRC#24-130 is the study being conducted. The purpose of this study is to assess if practicing dental hygienists feel pain or discomfort and if the pain that is felt by clinically working hygienists is related to poor ergonomics. The survey will also question if the participants plan to make better ergonomic decisions to prevent future pain. If you feel you would like to participate in this study, please read this carefully.

Although there is no personal benefit or compensation by completing this survey, your response can help researchers and hygienists with recognition and implementation of proper ergonomics into everyday hygiene practice resulting in the reduction or prevention of pain. If you choose to participate in this study, you will be asked to complete a short survey reflecting on your clinical hygiene routine pertaining to ergonomics.

This survey will take approximately 5-10 minutes to complete and will remain open for two weeks. A duplicate post will appear at mid-point.

Your decision to participate is voluntary and will remain anonymous. There are no risks to participating. After your review, please access the survey by clicking on the survey link attached to this post. By opening and completing the survey you will be providing consent to participate in this survey research. For the best results, completing this survey at the end of your work week is preferred, but not required.

If you would like any additional information about this study please contact Shannon Sherman at slsherman@salud.unm.edu or if you have questions regarding your legal rights as a participant you may call the UNM Human Research Protections Office at (505) 272-1129.

Thank you for considering this research opportunity, your participation is greatly appreciated!

Justine E. Ponce RDH, MS Assistant Professor: Principal Investigator
Department of Dental Hygiene, University of New Mexico
(505)-272-6688 or at jstambaugh@salud.unm.edu

Shannon Sherman RDH, BS Graduate Student

Appendix B: Survey

Dental Hygiene Ergonomics and Pain Survey

1. How old are you?
    a. 20-29
    b. 30-39
    c. 40-49
    d. 50-59
    e. 60+
2. How long have you been practicing dental hygiene?
    a. 0-5 years
    b. 6-11 years
    c. 12-17 years
    d. 18-23 years
    e. 24-29 years
    f. 30+ years
3. Throughout your clinical hygiene career, on average, how many hours have you worked per week?
    a. 0-9 hours
    b. 10-19 hours
    c. 20-29 hours
    d. 30-40 hours
    e. Over 40 hours per week
4. How many hours did you work this week prior to taking this survey?
    a. 0-9 hours
    b. 10-19 hours
    c. 20-29 hours
    d. 30-40 hours
    e. Over 40 hours

5. Did you have any daily scheduled breaks including lunch?
    a. No scheduled breaks
    b. 1 scheduled break
    c. 2 scheduled breaks
    d. 3 scheduled breaks
6. How is your body feeling as a whole after your day's work?
    a. Excellent
    b. Good
    c. Fair
    d. Poor
7. Are you experiencing pain in any part of your body due to clinical dental hygiene?
    a. Yes *<If answered yes, branching to questions 8, 9, 10, 11>*
    b. No *<If answered no, branching to question #12>*
8. Where are you experiencing pain? (Please check all that apply)
    a. Neck
    b. Hands
    c. Shoulders
    d. Upper Back
    e. Lower Back
    f. Arms
    g. Other
9. Please describe 'other' from question # 8 if applicable

    Enter your answer
10. What is the level of pain/discomfort you are experiencing?
    a. Mild
    b. Moderate
    c. Severe
11. When did you first recognize this pain/discomfort?
    a. Dental hygiene school
    b. 0-5 years working clinically

c. 6-11 years working clinically
d. 12-17 years working clinically
e. 18-23 years working clinically
f. 24-29 years working clinically
g. After 30+ years working clinically

12. Did you wear loupes while you were working clinically?
    a. I wore loupes all of the time
    b. I wore loupes most of the time
    c. I did not wear loupes
13. <*Branching if answered a or b from question #12*> Which type of dental loupes do you wear while you are working clinically?
    a. Standard 2.5x or 3.0x through the lens magnification
    b. Standard 2.5x or 3.0x flip-up magnification
    c. Prism ErgoDesign 3.0x or 3.5x through the lens magnification
    d. Prism ErgoDesign 3.0x or 3.5x flip-up magnification
    e. Other
    f. Unknown
14. <*Branching if answered Other from question #13*> Please describe 'other' from question #12

    Enter your answer
15. While practicing dental hygiene do you consider equipment placement. As in, do you keep instruments, air/water, suction and ultrasonic scalers within arm's reach?
    a. Yes, I keep all equipment within arm's reach
    b. I keep some equipment within arm's reach
    c. I keep no equipment within arm's reach
16. When using hand instruments, are you selecting instruments with large handles, tapered cross-sectional shapes, lightweight with padding and are sharp?
    a. Yes, all of my hand instruments are designed this way
    b. Half of my hand instruments are designed this way
    c. No, none of my hand instruments are designed this way

17. When practicing dental hygiene, are you sitting in a proper operator position? (back and spinal cord straight, forearms and thighs parallel to the floor, hips at 90-degree angle, feet flat on the floor with hips slightly higher than the knees and elbows close to the body)
    a. Yes, I sit in this ergonomically correct position when working clinically
    b. No, I do not sit in this position
    c. I try to sit in this position, but find myself moving my body in other positions. (feet on foot rest, hunching/leaning over, elbows protruding away from body)
18. When practicing dental hygiene, are you placing your patient in the correct position? (using semi-supine for mandibular arch, supine for maxillary arch, chin up, chin down and turning head to right or left for better direct vision)
    a. Yes, I make sure to adjust my patients position throughout the appointment
    b. No, I keep my patient in the same position throughout the appointment
    c. I will sometimes adjust my patient and other times I will not
19. Reflecting on your answers above, which components do you feel contribute to the pain or discomfort you are experiencing? (Please check all that apply)
    a. I am not experiencing any pain or discomfort
    b. Operator positioning
    c. Patient positioning
    d. Equipment placement
    e. Use of loupes
    f. Equipment Selection
20. Reflecting on the answers above, which of the following are you willing to improve upon to help prevent or reduce pain? (Please check all that apply)
    a. I am not experiencing any pain or discomfort
    b. Operator positioning
    c. Patient positioning
    d. Equipment placement
    e. Use of loupes

f. Equipment Selection

Appendix C: Letter of Support

FROM: Facebook Group Administrator

TO: HRPO

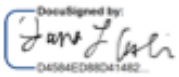
RE: Survey Research

DATE: 3/16/2024

Dear UNM HRPO,

On behalf of the Facebook Group named, *Minnesota Dental Hygienists Connect*, this letter is to assert that Shannon Sherman has asked permission and has been approved to use our group as a platform to distribute her survey to participants. We appreciate her request and are supportive to her and her research study titled, **Ergonomics and Musculoskeletal Disorders: An Evaluation of Self-Assessment using Surveys.**

Sincerely,



Group Administrator
Minnesota Dental Hygienists Connect

Appendix D: HRPP Approval Letter

Human Research Protections Program

April 3, 2024
Justine Ponce
jstambaugh@salud.unm.edu

Dear Justine Ponce:

On 4/3/2024, the HRRC reviewed the following submission:

Type of Review:	Initial Study
Title of Study:	Ergonomics and Musculoskeletal Disorders: An Evaluation of Self-Assessment using Surveys
Investigator:	Justine Ponce
Study ID:	24-130
Submission ID:	24-130
IND, IDE, or HDE:	None
Submission Summary:	Initial Study
Documents Approved:	• Consent material.pdf • Dental Hygiene Ergonomics Survey • HRP - Protocol 583 - IRB Submission..pdf • Letter of Support, Facebook • Letter of Support, Program Director
Review Category:	EXEMPTION: Categories (2)(i) Tests, surveys, interviews, or observation (non-identifiable)
Determinations/Waivers:	Employees. Provisions for Consent are adequate. HIPAA Authorization Addendum Not Applicable.
Submission Approval Date:	4/3/2024
Approval End Date:	None
Effective Date:	4/3/2024

The HRRC approved the study from 4/3/2024 to inclusive. If modifications were required to secure approval, the effective date will be later than the approval date. The "Effective Date" 4/3/2024 is the date the HRRC approved your modifications and, in all cases, represents the date study activities may begin.

Because it has been granted exemption, this research is not subject to continuing review.

505.272.1129 | The University of New Mexico Health Sciences Office of Research Human Research Protections Program
1 University of New Mexico | MSC08 4560 | Albuquerque, NM 87131
hsc.unm.edu/research/hrpo

HEALTH SCIENCES

Human Research Protections Program

Please use the consent documents that were approved by the HRRC. The approved consents are available for your retrieval in the "Documents" tab of the parent study.

If the study meets the definition of an NIH Clinical Trial, the study must be registered in the ClinicalTrials.gov database. Additionally, the approved consent document(s) must be uploaded to the ClinicalTrials.gov database.

This determination applies only to the activities described in this submission and does not apply should you make any changes to these documents. If changes are being considered these must be submitted for review in a study modification to the HRRC for a determination prior to implementation. If there are questions about whether HRRC review is needed, contact the HRPO before implementing changes without approval. A change in the research may disqualify this research from the current review category. You may submit a modification by navigating to the active study and clicking the "Create Modification/CR" button.

If this study is approved for a waiver of HIPAA authorization, the IRB had determined the use or disclosure of protected health information in this study involves no more than a minimal risk to the privacy of individuals because the study contains a plan to protect the identifiers from improper use and disclosure, a process to destroy the identifiers at the earliest opportunity consistent with conduct of the research, and there are written assurances that the protected health information will not be reused or disclosed to any other person or entity, except as required by law, for authorized oversight of the research study, or for other research for which the use or disclosure of protected health information would be permitted. The IRB recognizes that the research could not practicably be conducted without the waiver, and could not practicably be conducted without access to and use of the protected health information.

If your submission indicates you will translate materials post-approval of English materials, you may not recruit or enroll participants in another language, until all translated materials are reviewed and approved.

In conducting this study, you are required to follow the Investigator Manual (HRP-103), which can be found by navigating to the IRB Library.

Sincerely,

Thomas F. Byrd, MD
HRRC Executive Chair

505.272.1129 | The University of New Mexico Health Sciences Office of Research Human Research Protections Program
1 University of New Mexico | MSC08 4560 | Albuquerque, NM 87131
hsc.unm.edu/research/hrpo

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