

Issues in Dental Hygiene Education

Prevention and Reduction of Musculoskeletal Pain Through Chair-Side Stretching among Dental Hygiene Students

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Abstract

Purpose: Musculoskeletal disorders (MSD) are among the most commonly reported injuries in the workforce and there is a particularly high prevalence among dental hygienists. Research has shown that the incidence of MSD may begin during students' academic and clinical training. The purpose of this study was to determine the effectiveness of implementing chair-side stretching exercises on self-reported musculoskeletal (MSK) pain among currently enrolled dental hygiene students.

Methods: A total of 31 senior dental hygiene students were divided into treatment and control groups during the fall semester. The treatment group completed a series of chair-side stretching exercises, prior to beginning each clinic session, for approximately 10.5 weeks. Participants completed a modified version of the Standardized Nordic Questionnaire at the beginning (week 0), midpoint (week 5), and end of the study (week 10.5). Descriptive statistics were used to analyze the data.

Results: There were significant differences in the total MSK pain scores reported between the treatment and control groups ($p=0.03$) in addition to the hand and wrist pain severity scores ($p=0.04$). Hierarchical multiple regression revealed a model explaining the 38.2% variance in MSK pain between the groups ($p=0.021$). A majority of participants in the treatment group felt that chair-side stretching exercises neither improved nor worsened their MSK pain. However, more than one-half of the participants felt that the exercises helped increase their conscious level regarding ergonomic practices while delivering patient care.

Conclusion: Findings from this study suggest that consistent chair-side stretching exercises may be beneficial in reducing and preventing MSK pain, particularly within the hand and wrist region. Future research is needed to determine effective interventions to reduce MSK pain, particularly for the neck, shoulders, and lower back during dental hygiene education.

Keywords: dental hygiene students, dental hygiene education, musculoskeletal disorders, ergonomics, musculoskeletal pain, stretching exercises

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Introduction

Musculoskeletal disorders (MSD), degenerative disorders of the muscles, joints, tendons, nerves and blood vessels that are correlated with repetitive, cumulative trauma occurring over time, are among the most commonly reported injuries in the workforce.¹⁻⁵ Persistent strain on muscles and joints leads to destructive wear, resulting in pain in the limbs of the upper and lower body.^{6,7} Musculoskeletal disorders are often associated with work-related risk factors and affect a variety of professions, including nurses, truck drivers, and musicians.⁷⁻¹⁰ Extensive research studies have addressed the elevated risk and prevalence of MSD among dental personnel.¹¹⁻¹⁷ Dental professionals sit in static positions many hours each day, and

bending the neck, raising the shoulders, and exerting force through the hands and arms are among the associated high risk behaviors associated with MSD.^{6,18-20}

Dental hygienists perform scaling procedures that require repetitive motions of the arms and hands; actions that are major contributors to MSD pain.^{14,19,21} A study of dental hygienists revealed that 93% of respondents reported having some kind of MSD pain within the preceding 12 months and a majority indicated the presence of pain within the wrist or hands, neck, and upper back.¹⁹ A systematic review of the literature by Hayes et al. identified similar results, with neck pain affecting 60% of dentists and dental hygienists.¹³ Comparable results

were noted across studies and hand and wrist pain were found to be more common among dental hygienists as compared to dentists or dental assistants.¹³ Carpal tunnel syndrome (CTS) is a common MSD among dental hygienists.^{19,22} Work-related tasks including repetitive motions combined with powerful exertion of the hands, arms, and wrists are major contributors to its prevalence¹⁹ and CTS has been shown to be the most common MSD diagnosis among dental hygienists and dentists.²² Causes of MSD among dental hygienists are multifactorial, and predictors are difficult to delineate. Hayes et al. evaluated potential contributory elements, including manual vs. ultrasonic instruments, general vs. periodontal practice settings, and physical and psychosocial factors and found each element to be significant MSD risk among the dental hygienists studied.¹⁴

Persistent pain from MSD often leads sufferers to seek medical care. Treatment for work-related MSD costs range between 13 to 20 billion dollars annually across all professions in the US.¹⁵ In one study of dental hygienists, nearly one-third of the respondents reported seeking medical treatment for neck and upper back work-related pain.¹⁹ Two additional studies of dental hygienists found that participants experiencing neck and forearm pain are more likely to take time off, call in sick, or decrease work hours.^{14,20} Additionally, individuals with pain are more likely to contemplate leaving the profession completely.^{14,20} Ultimately, consequences of MSD pain lead to loss in revenue for the practitioner and can negatively impact the profession in general.

Proper ergonomics are vital to avoiding chronic injury and reducing the incidence of MSD among dental professionals and are among the first concepts introduced in clinical dental hygiene education.^{6,23} In addition to learning proper ergonomics, the use of adjunctive devices, such as magnification loupes, has been shown to improve ergonomics and the quality of clinical work.^{14,24–26} Regularly exercising can also help to reduce and prevent MSD incidence.^{27–31} Frequent, periodic work breaks to perform chair-side stretching during the provision of clinical care may reduce the severity of MSD pain.^{6,17,18,23,32} Frequent stretching has been shown to stimulate blood flow, increase synovial fluid for joint lubrication, reduce painful trigger points, relax and prepare muscles for strain, and help sustain an efficient range of motion.^{6,23}

Multiple studies have evaluated the prevalence of MSD among dental and dental hygiene student populations, and have shown the incidence of MSD occurring during clinical education.^{12,27,30,31,33–37} Hayes et al. found that 64% of Australian dental hygiene students reported neck pain, with

the majority of respondents stating that it lasted longer than 2 days and interfered with their daily lives; 30% sought medical attention.²⁸ A subsequent 3-year longitudinal study revealed that pain in these regions increased and became more intense over time during the dental hygiene program.¹² In another study of oral health professionals in Australia, Ng et al. found MSD were prevalent among all participants, was higher in those in their final year of training.³⁷ Morse et al. evaluated MSD pain in a group of US dental hygiene students with comparable results.³⁴ Results from these studies demonstrate the significant impact MSD can have on dental professionals during the early years of clinical education.

While evidence of the prevalence of MSD among dental professionals is overwhelming, there are few studies investigating which ergonomic strategies and preventive methods actually contribute to reducing the incidence of MSD among dental hygiene students.¹⁴ A study of licensed dental hygienists in Mississippi found the majority of respondents reported having received general instruction in ergonomics during training, however less than half stated that they received specific lectures regarding MSD.³⁸ The literature raises concerns regarding the career longevity of future dental professionals, suggesting that dental hygiene educators emphasize proper ergonomics, in addition to other prevention strategies.^{12,20,27} A consensus in the literature indicates a need for intervention through improved education of ergonomics, exercise (including stretching regimens), and overall professional awareness of the risk factors.^{6,12,14,19,20,27,30,36} Studies by Valachi and Nagpal specifically outline the use of stretching exercises as a preventive strategy for MSD.^{6,23} The purpose of this study was to determine the effectiveness of implementing chair-side stretching exercises on musculoskeletal (MSK) pain among dental hygiene students enrolled in an accredited dental hygiene education program.

Methods

Upon IRB approval from The Ohio State University, a randomized control study was designed using a convenience sample of 31 senior dental hygiene students. Fifteen participants were assigned to the treatment group and 16 were assigned to the control group. All participation for the study was voluntary and informed consent was received from the participants. As part of the dental hygiene program clinical rotation schedule, participants had been previously assigned to one of four clinical groups. The investigators used random number assignment software to select two clinic groups as the treatment group and the remaining groups became the control group. The treatment group performed chair-side stretching exercises prior to beginning each clinic session; the control group did not perform any chair-side stretching exercises.

A program of chair-side stretching exercises was created by the principal investigator (PI) and a board-certified physical therapist. The stretches were chosen to exercise the neck, shoulders, back, and hands and wrists. Prior to the study, the treatment group was trained through face-to-face demonstrations by the investigators, to perform the provided set of chair-side stretches. Participants were given written and visual instructions for each stretching exercise as a reference. All of the associated clinical instructors were given the same visual and written instructions in order to familiarize faculty with the study. However, the clinical instructors did not play a role in the study. The series of chair-side stretches took approximately 5 to 7 minutes to complete prior to each clinic session. Examples of the visual instructions provided to the participants are shown in Figures 1a–1c. Treatment group participants were given a log spreadsheet to record the date and time the stretches were performed.

Figure 1a. Scalene stretch: neck



Figure 1b. Wrist extension



Figure 1c. Wrist flexion



Survey instrument

Two questionnaires were used, a modified Standardized Nordic Questionnaire (SNQ) and a qualitative questionnaire regarding the perceptions about the effects of the chair-side stretching exercises. The SNQ was developed by the Nordic Council of Ministers to standardize the evaluation of MSD for epidemiological research, and has been found to be a repeatable, valid resource in measuring MSD.^{39–41} Each participant was assigned a study number and evaluated using a modified SNQ³⁹ three times over the fall semester: beginning (week 0), midpoint (week 5), and end (week 10.5). The modified SNQ evaluated MSK pain in multiple body regions, such as the neck, shoulders, hands and wrists, lower back, and lower extremities using simple “yes/no” responses. An anatomical illustration was provided to help participants answer the questions.³⁹ The questionnaire included items regarding the length of time pain lasted, whether they had trouble in each body region during the last 7 days, if the pain prevented them from completing daily tasks, and if they have sought medical treatment for MSK pain within the last 12 months.³⁹ Modifications were made to include demographic data and information on personal habits including alcohol consumption and tobacco use, hours spent in clinic, stress levels, and weekly hours spent exercising. The modified SNQ had a total of 74 items, including the demographic questions, but the length varied depending on the “yes/no” responses and follow-up questions. Treatment group participants also completed a researcher developed, qualitative questionnaire with items regarding their personal feelings about the effects of the stretches on any related MSK pain, whether positive, negative, or neutral.

Data analysis

Data were analyzed using the SPSS statistical software, version 23 (IBM; Armonk, NY, USA). Musculoskeletal (MSK) pain sums were calculated as the total number of body regions the participant responded to having experienced MSK pain in the last 7 days (stated in the first SNQ) or since the last time the questionnaire was administered (stated in the second and third SNQ). Results for the first SNQ were utilized as the baseline for participants’ responses. These results were analyzed using a t-test to compare the scores between the treatment group and the control group from the first, second, and third questionnaire. Overall pain severity scores were calculated and classified as no pain (0), mild pain (1), moderate pain (2), or severe pain (3), based on the participant’s response to having pain in any body region and the length of time the MSK pain prevented them from doing their normal work. The same calculation and classification was applied for each specific body region, including the

neck, shoulders, hands and wrists, and low back. These results were analyzed using MANOVA to compare the first, second, and third questionnaires among the treatment and control group. A hierarchical multiple regression model was used to analyze the effect of stretching exercises in predicting MSK pain. Demographic and descriptive variables were analyzed to control as possible factors for MSK pain.

Results

Demographics

A total of 31 students participated in the study and completed the SNQ three times throughout the study. Of the total number of participants, 15 students were assigned to the treatment group and 16 assigned to the control group. The majority of the participants were non-smoking females between 21 to 22 years of age. Participants spent an average of 12 to 18 hours in clinic per week; more than half (54.8%) spent an average of 15 hours per week.

MSK pain

Calculations for the sum of MSK Pain were analyzed using a t-test to compare the groups for the first, second, and third SNQ. For each group, the mean scores for the sum of MSK pain was the lowest for the first SNQ and highest among the second SNQ; No statistically significant differences were found between the groups for the first SNQ. Differences in MSK pain score sums were statistically significant between the groups for the second SNQ ($p=0.03$), however no significant differences were found for the third SNQ ($p=0.07$). Results for the sums of MSK pain scores (means and standard deviations) for both groups are shown in Table I.

Table I. Musculoskeletal pain sums on SNQ*

	Control (n=16)		Treatment (n=15)		p-values
	M	SD	M	SD	
SNQ 1 (baseline)	1.44	±2.15	1.40	±1.59	.95
SNQ 2 (5 weeks)	3.25	±2.20	1.73	±1.43	.03
SNQ 3 (10.5 weeks)	2.81	±2.04	1.60	±1.50	.07

* Standard Nordic Questionnaire

Overall and body region pain severity scores

Results for the overall and each body region pain severity scores were analyzed using MANOVA to compare the first, second, and third SNQs among the treatment and control groups. No statistical significances were found for overall body, neck, shoulders, or low back pain severity scores for the second SNQ between the groups. However, the treatment group had significantly lower pain severity scores in the

hands and wrists for the second SNQ ($p=0.04$). No significant differences were found for the overall or body region pain severity scores for the third SNQ between the groups. Results for the overall pain severity scores (means and standard deviations) are shown in Table II.

MSK pain prediction

Hierarchical multiple regression was used to analyze the relative importance of stretching exercises and behaviors in predicting MSK pain. Demographic variables accounted for 8.5% of the variance in MSK pain in the first step of the regression model and was not found to be statistically significant ($\Delta R^2=.085$, $F(2,28)=1.307$) ($p=.287$). Exercise and stress variables were added in the second step, explaining an additional 14.6% of the variance in MSK pain, although this did not indicate a statistically significant improvement ($\Delta R^2=.146$, $F(2,26)=1.958$) ($p=.104$). The final entry of the stretching exercise variable in step three, demonstrated a significant increase in explained variance ($\Delta R^2=.151$, $F(1,25)=3.092$) ($p=.021$). When all independent variables were included into the fourth stage of the regression model, weight, alcohol consumption, stress and general exercise habits were not found to be significant predictors of MSK pain; and only stretching was found to be significant ($p=0.021$). Combined, the independent variables accounted for 38.2% of the variance in reported MSK pain.

Perceptions and frequency of chair-side stretching

In response to the qualitative questionnaire, the majority of students felt that chair-side stretching neither improved nor worsened their reported MSK pain. However, more than half felt that chair-side stretching made them more conscious of their ergonomic practice while treating patients. Additionally, 73.3% of participants in the treatment group stated they planned to continue chair-side stretching on occasion after participation in the study.

The average number of stretches completed by the participants in the treatment group between the first and the second NSQ was 3.84 times per week and the average number of stretches between the second and the third NSQ was 2.92 times per week resulting in a 24% decrease in the average number of stretches per week during the second half of the study.

Table II. Pain severity scores on SNQ

Severity Score	Group				p-values
	Control (n=16)		Treatment (n=15)		
	M	SD	M	SD	
Overall Pain					
SNQ 1 (baseline)	1.88	±.80	1.40	±.91	.13
SNQ 2 (5 weeks)	1.75	±.77	1.27	±.70	.08
SNQ 3 (10.5 weeks)	1.69	±.70	1.27	±.70	.10
Neck Pain					
SNQ 1 (baseline)	.94	±.57	1.13	±.83	.45
SNQ 2 (5 weeks)	.94	±.57	.93	±.79	.98
SNQ 3 (10.5 weeks)	1.25	±.6	1.00	±.84	.39
Shoulder Pain					
SNQ 1 (baseline)	.56	±.62	.73	±.70	.48
SNQ 2 (5 weeks)	.38	±.61	.67	±.61	.20
SNQ 3 (10.5 weeks)	.44	±.62	.60	±.73	.51
Hands/Wrist Pain					
SNQ 1 (baseline)	1.38	±1.02	.73	±.79	.06
SNQ 2 (5 weeks)	1.25	±1.00	.60	±.63	.04
SNQ 3 (10.5 weeks)	1.06	±1.12	.60	±.73	.18
Low Back Pain					
SNQ 1 (baseline)	1.13	±.88	.80	±1.08	.36
SNQ 2 (5 weeks)	.94	±1.12	.67	±.72	.75
SNQ 3 (10.5 weeks)	.69	±.94	.60	±.50	.74

Discussion

Results of this study were in agreement with current literature regarding the high prevalence of MSK pain among dental hygiene students, which manifests early in clinical education.^{12,27,30-32} However, this study was among the first to examine chair-side stretching as an intervention, rather than looking solely at the incidence of MSK pain. Results of the second SNQ showed a statistically significant difference between the groups for the sum of MSK pain ($p=0.03$). However, there was no significant difference observed between the groups at the time of the third SNQ. One explanation for this finding could be related to the decreased compliance of the treatment group in completing the chair-side stretches in the last weeks of the study. The study participants' average number of stretches per week decreased 24% as compared to the first half the study. Participants reported a correspondingly greater reduction in MSK pain during the first half of the study when they reported a greater diligence in completing the stretching exercises and may have been more attentive to participation in the study. These results also suggest that the benefits of chair-side stretching may have been both immediate and transient. Participants expressed perceived benefits of the regimen over the same period of time when stretching was at the

highest level of compliance and positive perceptions diminished when compliance waned. Establishing a more effective leadership role among all of the clinical instructors could help to ensure better compliance throughout the test period in future studies.

Musculoskeletal pain levels in the hands and wrists showed a statistically significant difference between the groups in the second SNQ at five weeks. Again, a reduction in pain at five weeks but not at ten weeks could be due to the fact that participants completed more chair-side stretching between the first and second SNQ. Literature has also shown that dental hygienists are at a particularly high risk for developing MSK pain in the hands and wrists and commonly experience CTS^{13,14,19,22} which could explain the significance of the hands and wrists MSK pain scores. However, another explanation could be that the stretching exercises selected for the hand and wrist region were more suitable for this specific body region in comparison to those chosen for the neck, shoulders, and low back, and were more effective. Several combinations of chair-side stretching exercises exist, but given the conditions of the learning environment for this study, the participants had a limited amount of time to complete the series before each clinic session, restricting the number of stretches selected for the study. Additionally, the allotted 10.5 week timeframe for this study limited the ability to observe the long-term effects of the stretching exercises on MSK pain.

Although the majority of participants did not feel that stretching improved or worsened their MSK pain, two-thirds (66.7%) felt stretching increased their awareness of their ergonomic practices while providing patient care. The ergonomic practices of the study participants were not monitored or altered, as it was an uncontrollable factor that could influence the outcome of

the intervention. However, over the course of their clinical education, the participants had been taught how to practice proper ergonomics and were encouraged to maintain those practices. Research suggests that performing proper ergonomic posture can improve and reduce the development of MSD.^{6,23} However, the body trunk is the focus of these postural suggestions, with few recommendations for hands and wrists.^{6,23} Chair-side stretching exercises may be more effective in the hand and wrist region, than in the body trunk.

The importance of ergonomic practice, including additional workshops or lectures, needs more continual follow-up throughout the education process in order to build good habits among dental hygiene students.^{12,14,19,20,27,30} In contrast to other research studies, no significant differences were identified using the hierarchical regression model, regarding physical exercise and MSK pain, among the participants.^{27,28,31} However, physical exercise was not controlled or included as a study intervention. Future studies may consider including an intervention of chair-side stretching, in combination with a specifically designed exercise program, to evaluate the effects on MSK pain reduction. All participants in this study had been required to purchase and use magnification loupes for patient care. Some research studies have shown that magnification loupes can improve posture for dental personnel, which may ultimately prevent or reduce MSK pain.^{14,24–26} This may also have been a contributory factor to the lack of significance in the neck, shoulders, and low back pain severity scores. Changing or controlling this factor in future research could result in a different outcome.

This study had limitations. The sample population was small and from a single dental hygiene program. Also, in contrast to research by Peros et al., this study could find no differences in MSK pain associated with gender³¹ as there was only on male student in the sample. However, given the predominately female demographic of the profession, it may not be necessary at this point in time to identify gender differences in response to treatment.⁴² Future studies should include a larger and more gender diverse sample.

The length and complexity of the SNQ, which included multiple sections and repetitive content, may have been a barrier. Participants' self-reported responses might not have been consistent in relation to their experienced MSK pain. None of the participants were assessed by a physician for the purpose of this study and none had a documented MSD diagnosis. Future studies should consider including a medical examination to more accurately determine diagnosis of MSD.

Conclusion

The findings from this study suggest that consistent chair-side stretching regimen may be beneficial in reducing MSK pain, particularly within the hand and wrist region. While MSD are common among dental professionals, there has been little focus on MSK pain prevention and reduction strategies. Future research is needed to determine effective interventions to reduce MSK pain, particularly for the neck, shoulders, and lower back beginning during the dental hygiene education process to promote professional health and career longevity.

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