



Research Article

IGNORANCE OF ERGONOMICS IN DENTAL PRACTICE: SYSTEMIC REVIEW

Radhika Thakkar^{1*}, Haritha V. Katragadda², Fenal Shah³, Juhi Patel⁴, Malay Parekh⁵, Almendra Acosta⁶, Jay Patel⁷, Devyani Yadav⁸, Madhuri Gude⁹, Kirandeep Kaur¹⁰, Mandeep Kaur¹¹, Nisha Sheshashayee¹², Ketukumar Patel¹³, Houssein Moussa Robleh¹⁴, Jahanvi Patel¹⁵, Nilang Patel¹⁶, Ashmita Ghosh¹⁷

¹MPH 2nd Year Graduate student in the Department of Pharmacy and Public Health, St John's University, New York, USA
BDS Bachelor of Dental Surgery, Hemchandracharya North Gujarat University, Gujarat, India

²MPH Department of Pharmacy and Public Health, St John's University, New York, USA

MBBS Bachelor of Medicine and Bachelor of Surgery, SRM Medical College Hospital and Research Centre, Tamil Nadu, India

³BDS Bachelor of Dental Surgery, Bharati Vidyapeeth Dental College & Hospital, Mumbai, India

⁴MPH 2nd Year Graduate student in the Department of Public Health, Long Island University, New York, USA

BDS Bachelor of Dental Surgery, Ahmedabad Dental College and Hospital, Gujarat, India

⁵MPH 2nd Year Graduate student in the Department of Public Health, Rutgers's University, New Jersey, USA

BDS Bachelor of Dental Surgery, Ahmedabad Dental College and Hospital, Gujarat, India

⁶Certificate in Pediatric Dentistry, Universidad Autónoma del Paraguay.

DDS Doctor of Dental Science (Odontólogo), Universidad Autónoma de Asunción, Paraguay

⁷MPH Department of Pharmacy and Public Health, St John's University, New York, USA

BDS Bachelor of Dental Surgery, SDM college of Dental science and hospital, Karnataka, India

⁸BDS D.Y Patil Dental College, MUHS University, India

⁹BDS Bachelor of Dental Surgery, Gitam Dental College n Hospital, Andhra Pradesh, India

¹⁰BDS Bachelor of Dental Surgery, Baba Farid University of health sciences, Punjab, India

¹¹BDS Bachelor of Dental Surgery, National Dental College and hospital derabassi, Punjab, India

¹²BDS Government Dental College, Rajiv Gandhi University of Health Sciences, Bangalore, India

¹³BDS Bachelor of Dental Surgery, Hemchandracharya North Gujarat University, Gujarat, India

¹⁴Doctor in Dentistry Government Dental College, La Universidad de Ciencias médicas de Villa Clara, Cuba

¹⁵BDS Ahmedabad Dental College, Gandhinagar, India

¹⁶BDS Government Dental College, Rajiv Gandhi University of Health Sciences, Bangalore, India

¹⁷BDS 4th Year Student of Bachelor of Dental Surgery, West Bengal University of Health Sciences, West Bengal, India

ARTICLE INFO

Article History:

Received 24th December, 2017

Received in revised form 13th

January, 2018 Accepted 8th February, 2018

Published online 28th March, 2018

Key words:

Dentist, occupation hazards, ergonomics, back pain, neck pain

ABSTRACT

Introduction: In Greek, “ergo” refers to work and “nomos” refers to natural systems.^{1,2} Ergonomics is the methodical sphere concerned in conjunction with the indulgent of interactions amongst human being as well as auxiliary fundamentals of a system and the profession that pertains concepts, principles, methods to scheme to augment human well-being by large system performance.^{3,4}

The purpose of this article was to summarize the findings all review articles and present the findings to create awareness of important ergonomic hazards and preventive strategies. Research show that eighty-five percent of the dental specialists complain of pain in at least one body region. This pain is associated with the poor stance and movements during the dental procedures.⁵ However, these predicaments can be evaded by collective mindfulness of the postures used for the duration of the work to encourage examining the impact of instrument use on upper extremity pain and tailing hale and hearty work practices.^{5,6}

Methods: The presentation of this systematic review is done by using COVIDENCE tool. The review included articles published in the last 10 years, on the MEDLINE, SCOPUS, Cochrane Library.^{9,10} The search approach used amalgamation of free text terms-controlled vocabulary based on the following search strings: dentist + prevention + ergonomic, dentistry + neck pain.

Results: Among risk factors for the development of MSD's, the most significant is that 87.5% of studies detected static posture during working hours, followed by repetitive movements (68.8% of reviews), muscle imbalances and individual characteristics including a sedentary lifestyle and obesity (43.8%).

Conclusion: Ergonomic depiction of dental work approaches has revealed various occupational risk factors inherent in dental procedures and their influence on a high degree of MSD observed among dentists. Well planned ergonomic intervention program can reduce the global burden of this problem.

Copyright©2018 Radhika Thakkar et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

*Corresponding author: Radhika Thakkar

MPH 2nd Year Graduate student in the Department of Pharmacy and Public Health, St John's University, New York, USA
BDS Bachelor of Dental Surgery, Hemchandracharya North Gujarat University, Gujarat, India

INTRODUCTION

In Greek, “ergo” refers to work and “nomos” refers to natural systems.^{1,2} Ergonomics is the methodical sphere concerned in conjunction with the indulgent of interactions amongst human being as well as auxiliary fundamentals of a system and the

profession that pertains concepts, principles, methods to scheme to augment human well-being by large system performance.^{3,4}

Research show that eighty-five percent of the dental specialists complain of pain in at least one body region. This pain is associated with the poor stance and movements during the dental procedures.⁵ However, these predicaments can be evaded by collective mindfulness of the postures used for the duration of the work, reforming the work terminal to encourage examining the impact of instrument use on upper extremity pain, neutral postures, and tailing hale and hearty work practices to decrease the stress of dental work on the practitioner’s body.^{5,6}

This article introduces the signs, symptoms, and risk factors of musculoskeletal disorders. (Table-1.1) The article also converses the imperative issue of posture and offers ten recommendations to recuperate your posture to allow you to work with efficiency coupled with comfort.⁶

Table 1 Signs, symptoms and contributory risk factors of Musculoskeletal disorders^{5,6,7,8}

Signs	Symptoms	Dentistry related Risk Factors	Off-the-Job Activities That Can Contribute to MSDs
<ul style="list-style-type: none"> •Decreased range of motion •Loss of normal sensation •Decreased grip strength •Loss of normal movement •Loss of coordination 	<ul style="list-style-type: none"> •Excessive fatigue in the shoulders and neck •Tingling, burning, or other pain in arms •Weak grip, cramping of hands •Numbness in fingers and hands •Clumsiness and dropping of objects •Hypersensitivity in hands and fingers 	<ul style="list-style-type: none"> •Repetition and Forceful exertions •Awkward postures •Poorly designed equipment/workstation • Grasping smaller and thin instruments for longer periods • Prolonged use of vibrating hand tools • Suboptimal lighting •Dentist’s or patient’s chair is too high/low. •Dentist’s chair has no lumbar, thoracic, or arm support. •Instrument table is not positioned properly. 	<ul style="list-style-type: none"> •Repetitive activities using the fingers •Sports activities •Prolonged/awkward postures at home •Use of household tools •Activities involving repeated heavy lifting, bending, twisting, or reaching •Poor fitness level •Physical/mental stress •Lack of rest/recovery •Poor nutrition

MATERIALS AND METHODS⁷

The presentation of this systematic review is done by using COVIDENCE tool. The review included articles published in the last 10 years, on the MEDLINE, SCOPUS, Cochrane Library.^{9,10} The search strategy used a combination of free text terms controlled vocabulary based on the following keywords: ergonomic, dentist, musculoskeletal, posture, prevention, neck pain, used with these search strings: dentist + prevention + ergonomic, dentistry + musculoskeletal + prevention, dentist + prevention + neck pain, dentistry + posture + ergonomic, ergonomics + dentist, neck pain + dentist, posture + dentist, musculoskeletal, ergonomics+ dentistry, work + ergonomics + dentist, occupational + dentists+ ergonomics, musculoskeletal + dentist.¹¹

Additionally, we practiced a hand search on reference lists of the selected articles and reviews for a wider analysis.^{12,14}

Table 2 Full text articles screened for this study
1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22

First author	Year	Study design	Country
DE SIO S	2018	Review	ITALY
AL-SAUD LM	2017	observational study	UK
PRASAD DA	2017	Review	INDIA
PADHYE NM	2017	Review	INDIA
VODANOVIC M	2016	cross-sectional	CROATIA
OHLENDORF D	2016	cross-sectional	GERMANY
DECHARAT S	2016	observational study	THAILAND
LINDEGARD A	2016	cohort study	SWEDEN
NOWAK J	2016	Observational study	GERMANY
BATHAM C	2016	Review	INDIA
AL-MOHREJ OA	2016	Review	SAUDI ARABIA
NOKHOSTIN MR	2016	cross-sectional	IRAN
PERRIN P	2016	Review	SWITZERLAND
PERUSINI DJ	2016	observational study	CANADA
ALI K	2016	A Qualitative Study	UK
MAJOR N	2016	Review	USA
THAKAR S.	2015	cross-sectional	INDIA
JODALLI P.	2015	Review	INDIA
WILLIAMSON R.	2015	Review	USA
KANAPARTHY A	2015	observational study	SAUDI ARABIA
SAFI Y	2015	observational study	IRAN
JODALLI PS	2015	observational study	INDIA
BEDI HS	2015	cross-sectional observational study	INDIA SAUDI ARABIA
ALGADHIR A	2015	Review	INDIA
BARJATYA K	2015	Review	INDIA
KUMAR D.	2014	Review	INDIA
DABLE R.	2014	trial	INDIA
GUPTA A.	2014	Review	INDIA
SAKZEWSKI L.	2014	Review	AUSTRALIA
GOLCHHA V	2014	Review	INDIA
ONETY GC	2014	observational study	BRAZIL
PIRVU C.	2014	Review	Bucharest
KUMAR D.K	2014	Review	INDIA
THYVALIKAKATH TP	2014	observational study	USA
ABICHANDANI S.	2013	Review	INDIA
GUPTA A.	2013	Review	INDIA
PIRVU C.	2013	Review	ROMANIA
GOPINADH A.	2013	cross-sectional	INDIA
RAFEEMANESH E	2013	cross-sectional	IRAN
VYAWAHARE S	2013	Review	INDIA
HADDAD O.	2012	trial	IRAN
DESAI V.	2012	cross-sectional	INDIA
GOSAVI S.	2012	Review	INDIA
CUSTODIO R.	2012	case study	BRASIL
PETROMILLI GARCIA P.	2012	cross-sectional	BRASIL
MEHTA A.	2012	cross-sectional	INDIA
Ayatollahi J	2011	Review	IRAN
PEROS K.	2011	cross-sectional	CROATIA
HARUTUNIAN K.	2011	cross-sectional	SPAIN
GUPTA S.	2011	Review	INDIA
FINKBEINER B.	2011	Review	USA
LEGGAT P.	2007	Review	AUSTRALIA
ANGHEL M.	2007	cross-sectional	ROMANIA
YAMALIK N.	2007	Review	TURKEY
MORSE T.	2007	cross-sectional	USA

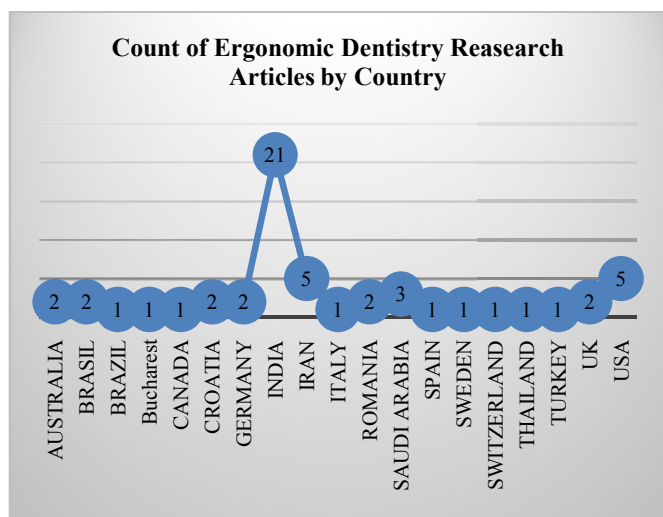


Figure 1 Full text articles screened for this study
1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22

RESULTS

The purpose of this article was to summarize the findings all review articles and present the findings to create awareness of important ergonomic hazards and preventive strategies.

Among risk factors for the development of MSD's, the most significant is that 87.5% of studies detected static posture during working hours, followed by repetitive movements (68.8% of reviews), muscle imbalances and individual characteristics including a sedentary lifestyle and obesity (43.8%). Other variables were workplace environment risk factors including: inadequate and nonergonomic equipment (37.5%), duration and extent of muscle effort (37.5%), vibrating instruments (31.3%). Regarding preventive measures, in narrative reviews stretching exercises after each dental examination and at the end of the working day were deemed most useful and effective in preventing muscular disorders (75% of reviews).

Table 3 Full text articles included in the study^{1,2,3,4,5,6,7,8,9,10,11,12,13}

Title	Author	Year	Study type	Methods	Conclusion
Prevalence of low back pain and carpal tunnel syndrome among dental practitioners in Dakshina Kannada and Coorg District.	Prasad DA	2017	Cross sectional survey	A closed-end questionnaire was distributed to 100 dental practitioners from Dakshina Kannada and Coorg districts of Karnataka, India.	Symptoms of MSDs related to hands, wrists, and low back is widely prevalent among the dentists, which severely impact their work efficiency. Precautionary measures early in the clinical practice such as proper ergonomics in the operating field and few strengthening exercises as described in this study can reduce the onset and progression of the symptoms.
Postural assessment of the students evaluating the need of the ergonomic seat and magnification in dentistry	Rajani A. Dable	2014	Experimental design, randomized trial	Ninety students from second year of dental school were assessed in three groups using three different seats with and without magnification system. The results recorded significantly higher RULA(rapid upper limb assessment) scores for the conventional seats without using the magnification system compared to the SSC (Salli Saddle Chair-an ergonomic seat) with the use of magnification system.	Study recommends the use of an ergonomic seat and magnification system to enhance the visibility and the posture of an operator
Ergonomics in dentistry	Anshul Gupta	2014	Review	This explains background information on ergonomics so that the dental practitioner can have some basis for understanding the ongoing dialogue about ergonomics, its diagnosis, treatment, and regulation	Dental professionals are prone to unique muscle imbalances and require special exercise and ergonomic interventions to maintain optimal health during their career
Ergonomics and musculoskeletal disorders: as an occupational hazard in dentistry	Anne Gopinadh	2013	Cross sectional survey	cross-sectional survey was conducted among 170 dentists. The survey gathered data concerning demographic facts, MSDs, work duration, working position, awareness of ergonomics. The study discovered that 73.9% of the participants stated musculoskeletal pain. 232 participants (59.3%) were aware of precise ergonomic posture.	MSDs are high among dentists and neck was the most common location. The symptoms of MSDs surge with increase in age and working duration.
Dental ergonomics to combat musculoskeletal Disorders	Arpit Gupta	2013	Review	The prevalence of MSDs is on the rise for all types of dental workers. In spite of different patterns of work culture, there are parallel levels of symptoms in dentists across nations. Risk factors for MSDs are multifactorial. Symptoms appear very early in careers, with higher prevalence of MSDs even during educational training. Ergonomics improvements, health promotion and organizational interventions are necessary to reduce the risk. An interdisciplinary approach with progressive efforts should be taken to address MSDs in dental professionals.	Risk factors for MSDs are multifactorial. Symptoms appear very early in careers, with higher prevalence of MSDs even during educational training. Ergonomics improvements, health promotion and organizational interventions are necessary to reduce the risk
Occupational hazards to dental staff	JamshidAyat ollahi	2012	Review	For any infection control strategies, dentists should be aware of individual protective measures and appropriate sterilization or other high-level disinfection utilities. Strained posture at work disturbs the musculoskeletal alignment and leads to stooped spine. The stooped posture also involved certain groups of muscles and joints	It is important for dentists to remain constantly up-to-date about measures on how to deal with newer strategies and dental materials, and implicates the need for special medical care for this professional group.

Musculoskeletal disorders and ergonomic risk factors in dental practice	Rajib Biswas	2012	Review on Musculoskeletal disorders and ergonomic risk factors	Dental profession is not immune from MSD or CTD. Reports of musculoskeletal symptoms among dental professionals are conspicuously high and manifested mainly as neck, shoulder, hand, arm wrist and low back pain.	Pain in lower back, neck, shoulder, hand and wrist are some associated musculoskeletal disorders and injuries are a major health problem for dental practitioners. Ergonomic training and awareness among dental professionals and students is therefore highly recommended.
Ergonomics work analysis applied to dentistry	Custódio, RAR	2012	Case study	This study explains the Ergonomic Work Analysis method in a Brazilian Dentist's office. Five types of treatments performed by the professional have been studied. The frequency and duration of actions in these treatments were accounted for and the standard positions adopted were identified. Study was conducted among the dentists practicing in various parts of Northern India. Convenience sample of 1000 dentists who met the inclusion criteria was taken and those who agreed to participate. The results of the study show that 65.1% samples corresponded to females and 34.9 samples were males. 85% reported muscular pain due to the clinical practice and rest 15% did not report any kind of pain.	The wear and tear from the pursuit of perfection, from scheduling to maintenance of clientele further contributes to the increase of tension existing in static postures.
Ergonomics: a must for dentistry: a cross sectional study in various parts of Northern India	Vela Desai	2012	Cross sectional study	The occurrence of work-related musculoskeletal disorders in oral health care professionals has been documented over the past 10 years.	Ergonomics related health hazards are a common in dentists which begins at the time they start their professional studies and it stays with them during their professional practice affecting various parts of the body.
Reducing the stress in dentistry.	Sulekha S Gosavi	2012	Review in Stress in dentistry	The chair was evaluated in the laboratory during task simulation and EMG analysis on 12 students and subjectively assessed by 30 professional dentists using an 18-item questionnaire. EMG activity of right and left trapezius muscles for 12 male students with no musculoskeletal disorders was measured while simulating common tasks like working on the teeth of the lower jaw. Normalized EMG data showed significant reduction ($p < 0.05$) in all EMG recordings of the trapezius muscle. Dentists also unanimously preferred the ergonomically designed chair.	To protect their own health, dentists should seek out and receive education about musculoskeletal health, injury prevention and dental ergonomics.
Trapezius muscle activity in using ordinary and ergonomically designed dentistry chairs	Haddad O	2012	Case study	In recent years, there has been an increase in reporting WMSDs for dental persons. Risk factors of WMSDs with specific reference to dentistry include - stress, poor flexibility, improper positioning, infrequent breaks, repetitive movements, weak postural muscles, prolonged awkward postures and improper adjustment of equipment. Ergonomics is the science of designing jobs, equipment and workplaces to fit workers	Such ergonomically designed chairs should be introduced as early as possible in student training before bad postural habits are acquired.
Ergonomic applications to dental practice	Shipra Gupta	2011	Review	A total of 74 dentists completed an anonymous questionnaire containing 19 questions. Most of the dentists (79.8%) had experienced some kind of musculoskeletal pain in the last 6 months. On comparing the different locations of pain, the neck was found to be the most commonly affected location (58% of all subjects), and only 34% of the respondents took some preventive measures against musculoskeletal disorders.	The successful application of ergonomics assures high productivity, avoidance of illnesses and injuries, and increased satisfaction among workers.
Ergonomics and musculoskeletal pain among postgraduate students and faculty members of the School of Dentistry of the University of Barcelona (Spain).	Harutunian	2011	Cross sectional study	In dentistry prolonged static postures, repetitive movements, excessive contraction of short muscles could cause musculoskeletal disorders. Each member of the dental team is predisposed to pain or injury in different areas of the body, depending on their tasks and position in relation to the patient.	Women showed a higher frequency of intense pain involving the cervical, lumbar, dorsal and wrist areas. An important incidence of pain symptoms secondary to musculoskeletal disorders was observed, particularly in the cervical region. Therefore, The implementation of preventive measures is necessary
Musculoskeletal disorders consequence of prolonged static posture	Mirella Anghe	2007	Review Musculoskeletal disorders		pain, injury or MSDs are consequences of the working process in dentistry and represent important causes of morbidity

These were followed by the maintenance of proper, neutral and balanced posture by dental practitioners during examinations (56.3%) and the use of an appropriate workstation in terms of temperature, lighting, and magnifying aids (56.3%).

DISCUSSION

Prior to 1985, low back pain was the most commonly reported musculoskeletal disorder or repetitive injury for dentists and dental hygienists. Since then, there has been a rise in MSDs from extended work days, awkward postures, prolonged standing/unsupported sitting, and a host of other problems

caused by poorly designed workstations, improper work habits, and instruments that are difficult to manipulate. The current workstation in most dental offices requires that the practitioner lean forward, flex his neck forward and laterally, hold his shoulders abducted and his arms flexed, with this position being held statically for most of the workday. Dentists need to tightly grip thin, sharp instruments and make a high volume of short, forceful movements with the muscles of their wrists and hands to treat heavy calculus and other conditions. The human body is not built to handle these kinds of stresses, and the positions in which dentists repeatedly put themselves

through their work place them at great risk for developing MSDs.

Repetitive strain injuries are on the rise in dentistry. Many dentists/dental hygienists have been diagnosed with a MSD, and a majority have experienced some type of musculoskeletal pain in their shoulders and neck, hands and wrists, low back, or forearms and elbows. More studies need to be conducted on the impact of dental work on the development of nerve and muscle pathologies, which would prevent dentists from providing the highest quality of service and could threaten their professional careers.

These injuries result in decreasing work performance, job satisfaction, and energy levels. For many dentists, musculoskeletal pain and discomfort have caused them to take a leave of absence, shorten their work hours, reassign their duties to other dental staff or undergo surgery, and some dentists have been forced into premature retirement.

Lesson Learned About Work Practices

In a Dentist's office, the workstation setup plays a vital role, it determines the practitioner's posture during the entire dental procedure and during the retrieval of necessary instruments used in the process.^{28,29} The workstation composes of dentist's/dental hygienist's chair, patient's chair, delivery system and cleaning/charting area. When the workstation is set up improperly or does not meet the individual dentist's needs, it can exert excessive stress on their body with each movement and these positions are repeated during the day.^{30,31,33} By being conscious of what causes you to assume harmful postures, you can begin to work on modifying any misalignments needed to put yourself in the suitable posture to perform your work effectively.³²

Dentists and hygienists are required to perform physically challenging work with the muscles of their arms and hands almost constantly moving during the day, while trying to provide the highest quality of care for each member.^{34,35,36} They are often overstretched with heavy calculus patients scheduled back-to-back, requiring them to use excessive strength with their hands without rest breaks in between. Using the hygiene patient as an instance, the suggested amount of time that should be spent with each patient is 50 to 60 minutes for an adult and 35 minutes for children.^{37,38,39} If there is time left over, the practitioner should do movements and stretches to increase blood circulation, reduce muscle tension, and prepare the body for the next patient.^{40,41,42} The procedures of probing, scaling, root planning, cleaning, polishing, and flossing the teeth are hand intensive and repetitive in nature, and when these are done in an inappropriately set up workstation for that individual practitioner the probabilities of developing similar injuries are multiplied.^{43,44} To avert repetitive injuries, it is better to pace yourself and plan fewer patients per day, with rest pauses in between to allow yourself time to settle. During your break, you should perform less stressful aerobics, take walks, stretch, do stress easing techniques, or just rest your hands.^{45,46} Make sure that no more than half of patients on any given day are heavy calculus patients to extent the stress on your hands over many days.^{47,48}

Dentists must look at the way they work, learn to pace themselves and rotate between a diversity of tasks and positions to give their muscles a break and allow them to slog a full day without causing cumulative harm to their bodies.^{49,50} Inactive work, like that performed in dentistry, ponders work

stress onto certain muscles and builds tension in our bodies.⁵¹ By interchanging between positions, you shift the stress onto different muscles, increase your passage, and lessen the amount of fatigue from your work.^{52,53,54} By swapping sides of the patient and altering the position of your delivery system, you will use your powers in different ways, which will spread the stress over different parts of your body.⁵⁵

Changes in work practices are the stress-free and least expensive alterations that can be made by the practitioner to reduce the pressure of dental work.⁵⁶

Table 4 Work practice related risk factors and how to overcome^{54,55,56,57,58}

Risk factors	How to overcome
<ul style="list-style-type: none"> Inadequate time per patient Overscheduling of patients Repetitive tasks performed without breaks Scheduling heavy calculus patients back-to-back Polishing each patient's teeth Unchanging operator position Unchanging delivery system High pressure for quality care. 	<ul style="list-style-type: none"> Schedule Enough Time for Each Patient Alternate Scheduling of Light/Heavy Calculus Patients; Use Selective Polishing Rotate Between Tasks Schedule Rest Breaks Between Patients Switch Between Positions Throughout the Day Vary Operator Position/Delivery System with Each Patient Gradually Increase Work Tolerance

Lesson Learned About Instrument Usage

The instruments that dentists and hygienists use pretense a special threat to the muscles and tendons of their arms and hands.⁵⁷ They are required to persuasively grip thin instruments and make constant, precise movements with the small muscles of their hands and forearms during various procedures.⁵⁸ Some of the most hand-intensive procedures that must be done by dental practitioners are (1) probing, which involves high forces to be exerted by the hands; (2) scaling, which involves short strokes and the use of strong pressure; and (3) root planning, which requires longer strokes and more all-encompassing ranges of motion in the wrists.

Purchase high-quality instruments with large diameter handles that are easy to control and balanced for less vigorous manipulations. The cost of good instruments pays for itself when you factor this total out over the number of years the instrument will be used.⁵⁹

Many difficulties have been noted with dental instruments, including the small diameter of the handles (usually between 3/16" to 4/16" in diameter), which needs a fitted grip to hold the instrument. Many instruments were designed with function in mind, without thoughtfulness of ergonomic factors or the possible effect on the body, and are deranged and require increased muscular force to handle.⁶⁰

When dental instruments are not regularly upheld and kept sharp, more pressure may need to be applied to remove plaque and clean the teeth. Further, problems are created by tight gloves and wristwatches, which decrease circulation and make it more difficult to operate dental tools. Instruments provides the practitioner/patient edge, but their use involves a number of harmful positions that greatly increase the practitioner's hand stressors and may result in the increase of MSDs.⁶¹

The standard grip that dentists use with their apparatuses, the same as gripping a pen to write, puts strain on the muscles of

the thumb, pointer finger, and wrist. Instead, try placing the shaft of the instrument between your pointer and middle fingers and use your thumb as a controller, which will take the stress away from gripping the instrument and move it to other muscles.^{62,63}

As a dissimilarity on holding your arms above the patient throughout the procedure, lightly rest your fingers on the patient's teeth, using them as a fulcrum to interchange the instrument (intraoral), or relax your elbow on the side of the patient's chair to take some burden off your shoulders and use your elbow as a fulcrum from which to work (extra oral).⁶⁵

Table 5 Instrument usage related risk factors and how to overcome^{60,61}

Risk factors	How to improve
<ul style="list-style-type: none"> • Extreme wrist flexion/extension, ulnar deviation, forearm rotation • Repetitive grasping with thumb and fingers • Excessive finger movements • Firm grasp/excessive force needed to hold instruments • Thumb hyperextension • Pressure from instrument edges on fingers • Vibration damage from vibrating instruments • Tight gloves that constrict wrist/fingers. 	<ul style="list-style-type: none"> • Use of Proper Instrumentation Techniques • Use Larger Diameter, Balanced Instruments • Instrument Handles Should Be Rubber Coated with Waffle Iron Serrations • Keep Instruments Sharp • Use Ultrasonic Scalers and Slim Lines • Alternate Grasp: Tripod and Three Chuck Grasps • Vary Between Intraoral and Extra oral Fulcrums • Wear Properly Fitting Gloves

CONCLUSION

If you apply the principles and suggestions that have been recommended, you will be able to reduce the stresses that you put on your hands and arms and greatly lessen the chances that you will develop an MSD or repetitive strain injury. By making small changes in your work practices, instrument usage, posture, workstation setup, and health practices, you can greatly affect your ability to provide quality care over a long, healthy, and successful career in dentistry.

Begin to make some changes in the way you practice by incorporating some of these suggestions into your regular routine during the workday. You will find that you have less fatigue at the end of the day, you will experience less pain, and you will be able to provide the quality of service that you and your patients demand. Time management is presented as an important strategy to control the tension arising from performing the treatments. Ergonomic characterization of dental work methods has revealed various occupational risk factors inherent in dental procedures and their contribution to a high degree of MSD observed among dentists. Well planned ergonomic intervention program can reduce the overall burden of this problem.

The second part of this article will address the various work practices that dentists perform, the risk factors, and suggestions to make them more hand friendly. Instrument use will be examined, and suggestions will be made to counteract the inherent dangers in using the instruments involved in dental work. Finally, recommendations for maintaining personal health, stress management techniques, as well as exercises and stretches will be covered to promote productivity and health over the life of your career.

Recommendations

Always try to maintain an erect posture. By positioning your chair close to the patient, you can minimize forward bending/excessively leaning over the patient. Keep your feet flat on the floor to promote a neutral or anterior tilt to your pelvis, which keeps your back aligned and promotes the natural curvatures of your back. Remember that your head weighs as much as a bowling ball, and when you lean forward and flex your neck, you force your muscles to hold up the weight of your head, rather than the bones and discs in your spine.

Use an adjustable chair with lumbar, thoracic, and arm support. Having a good chair is essential in maintaining good posture, because what you sit on providing the base of support from which you work all day long. When you think about it, you work 8 or more hours per day, 5 days per week, 4 weeks per month, and about 11 months out of the year, which makes a high-quality chair with adjustable features well worth the cost of saving your back, neck, arms, and hands. You should look for important features like adjustable height, width, tilt, backrest, seat pan, and armrests, because in most dental offices many people of different sizes use the same workstation.

Work close to your body. Position your chair close to your patient, and position your instrument tray close to you. This way, you don't have to overextend yourself to reach your patient or your instruments, putting excessive stress on your back, shoulders, and arms. Think of the 90° rule of having your elbows, hips, knees, and ankles all forming 90° angles. If you find yourself reaching out far beyond these angles too often, then you're not properly positioned and you should adjust the position of your chair/instrument tray.

Minimize excessive wrist movements. Be conscious of how you position and move your wrists, and try to keep them in a neutral position (palms facing each other, shoulder width apart with wrists straight), which puts your muscles and tendons in a much better relationship to perform the work. You will have to move your wrists into various positions as you work on your patients, but try to be aware of these movements so you can minimize potentially damaging hand positions.

Avoid excessive finger movements. When you combine the excessive forces needed to hold your instruments with the number of repetitions that you perform each day, you can see the tremendous toll that this takes on the small muscles of your fingers. Retrain yourself to use your shoulders and arms to position your hands, rather than making the small, forceful movements with your fingers.

Alternate work positions between sitting, standing, and side of patient. Switching positions allow certain muscles to relax while shifting the stress onto other muscles and increasing your circulation. When you work on alternate sides of the patient or rotate the position of your instrument table, you allow each side of your body to share the stress, rather than performing the same motion in the same way, which causes cumulative trauma in the overused side.

Adjust the height of your chair and the patient's chair to a comfortable level. If your chair is too low and the patient's chair is too high, this causes you to elevate your shoulders and can lead to neck problems and pinched nerves. Alternately, if your chair is too high and the patient's chair is too low, you'll have to flex your neck down and bend your wrists back to

compensate, which can lead to neck and hand problems. Remember the 90° rule and keep your elbows at a 90° angle with your wrists straight and shoulders relaxed.

Consider horizontal patient positioning. If your workstation allows the patient to be reclined into a horizontal position, this allows you to sit above the patient's head with good ergonomic posture, and you can use each arm equally in more natural positions. If the workstation does not accommodate this position, consider buying a quality reclining chair for the patient when you replace the old one.

Check the placement of the adjustable light. Position the adjustable light so you don't have to strain your neck to be able to see the patient's mouth. It is important to adjust this light with each new patient because of the different height of each person. The light should be adjusted again when a new dentist uses the workstation because his/her sitting eye height is different, and this will affect his/her ability to see into the patient's mouth.

Check the temperature in the room. Make sure the temperature in your workspace is not too cold because this will decrease the circulation and blood flow to your extremities. Most often, the dental work environment is damp and cold, so be certain to wear gloves and warm up your hands before working on a patient.

References

- Dable, R. A., Wasnik, P. B., Yeshwante, B. J., Musani, S. I., Patil, A. K., & Nagmode, S. N. (2014). Postural assessment of students evaluating the need of ergonomic seat and magnification in dentistry. *The Journal of Indian Prosthodontic Society*, 14(1), 51-58
- Gupta, A., Manohar Bhat, T. M., Bansal, N., & Gupta, G. (2014). Ergonomics in dentistry. *International journal of clinical pediatric dentistry*, 7(1), 30
- Garcia, P. P. N. S., Presoto, C. D., & Campos, J. A. D. B. (2013). Perception of risk of musculoskeletal disorders among Brazilian dental students. *Journal of dental education*, 77(11), 1543-1548.
- Gopinadh, A., Devi, K. N. N., Chiramana, S., Manne, P., Sampath, A., & Babu, M. S. (2013). Ergonomics and musculoskeletal disorder: as an occupational hazard in dentistry. *The journal of contemporary dental practice*, 14(2), 299.
- Ng, A., Hayes, M. J., & Polster, A. (2016). Musculoskeletal Disorders and Working Posture among Dental and Oral Health Students. *Healthcare*, 4(1), 13.
- Ayatollahi, J., Ayatollahi, F., Ardekani, A. M., Bahrololoomi, R., Ayatollahi, J., Ayatollahi, A., & Owlia, M. B. (2012). Occupational hazards to dental staff. *Dental research journal*, 9(1), 2.
- Biswas, R., Sachdev, V., Jindal, V., & Ralhan, S. (2012). Musculoskeletal Disorders and Ergonomic Risk Factors in Dental Practice. *Indian Journal of Dental Sciences*, 4(1)
- Custódio, R. A. R., Silva, C. E. S., & Brandão, J. G. T. (2012). Ergonomics work analysis applied to dentistry—a Brazilian case study. *Work*, 41(Supplement 1), 690-697
- Desai, V., Pratik, P., & Rajeev, S. (2012). Ergonomics: a must for dentistry: a cross sectional study in various parts of Northern India. *Journal of Dentofacial Sciences*, 1(2), 1-5
- Gosavi, S. S., Gosavi, S. Y., & Jawade, R. S. (2012). Posturedontics: reducing the stress in dentistry. *Word journal of dentistry*, 3(4), 335-330
- Harutunian, K., GargalloAlbiol, J., Barbosa de Figueiredo, R. P., & Gay Escoda, C. (2011). Ergonomics and musculoskeletal pain among postgraduate students and faculty members of the School of Dentistry of the University of Barcelona (Spain). A cross-sectional study. *Medicina Oral, Patología Oral y Cirugía Bucal*, 2011, vol. 16, num. 3, p. 425-429.
- Anghel, M., Argesanu, V., Talpos-Niculescu, C., & Lungeanu, D. (2007). Musculoskeletal disorders (MSDs)-consequences of prolonged static postures. *Journal of Experimental Medical & Surgical Research*, 4, 167-172.
- Bravo, I. M., de Plata, M. C., Escalona, L., Perrone, M., Brito, A., Tovar, V., & Rivera, H. (2006). Prevalence of oral lesions in HIV patients related to CD4 cell count and viral load in a Venezuelan population. *Medicina oral, patología oral y cirugiabucal. Ed. inglesa*, 11(1), 8.
- Martin, M. M., Ahearn, D., Gotcher, J., Smith, S. W., Verhagen, C. M., & Michigan Ismail, A. (2004). An introduction to ergonomics: Risk factors, MSDs, approaches and interventions. *American Dental Association*, 1-26.
- Todd, A. I., Bennett, A. I., & Christie, C. J. (2007). Physical implications of prolonged sitting in a confined posture—a literature review. *Ergonomics SA: Journal of the Ergonomics Society of South Africa*, 19(2), 7-21.
- Ye, S. D. (2012). Musculoskeletal dysfunction in dental practice. *Russian Open Medical Journal*, 1(1).
- Hokwerda, O. (2004). Symposim: Ergonomic principles for patient treatment. Syllabus paper.
- Dougherty, M. (2001). Ergonomic Principles in the Dental Setting, Part 1. Dental Products Report, 6.
- Valachi, B. (2008). Ergonomics and injury in the dental office. *RDH*, 28(4), 27.
- Shugars, D., Miller, D., Williams, D., Fishburne, C., & Strickland, D. (1987). Musculoskeletal pain among general dentists. *General Dentistry*, 35(4), 272-276.
- Rundcrantz, B. L., Johnsson, B., & Moritz, U. (1990). Cervical pain and discomfort among dentists. Epidemiological, clinical and therapeutic aspects. Part 1. A survey of pain and discomfort. *Swedish dental journal*, 14(2), 71-80.
- Rundcrantz, B. L., Johnsson, B., & Moritz, U. (1990). Cervical pain and discomfort among dentists. Epidemiological, clinical and therapeutic aspects. Part 1. A survey of pain and discomfort. *Swedish dental journal*, 14(2), 71-80.
- Augustson, T. E., & Morken, T. (1996). Musculoskeletal problems among dental health personnel. A survey of the public dental health services in Hordaland. *Tidsskrift for den Norske laegeforening: tidsskrift for praktiskmedicin, nyraekke*, 116(23), 2776-2780.
- Finsen, L., Christensen, H., & Bakke, M. (1998). Musculoskeletal disorders among dentists and variation in dental work. *Applied ergonomics*, 29(2), 119-125.
- Morris-Alien, D. M. (1998). Musculoskeletal disorders in Dentists. *Ny state Dent J*, 64, 44-48.

26. Lehto, T. U., Helenius, H. Y. M., & Alaranta, H. T. (1991). Musculoskeletal symptoms of dentists assessed by a multidisciplinary approach. *Community dentistry and oral epidemiology*, 19(1), 38-44.
27. Marshall, E. D., Duncombe, L. M., Robinson, R. Q., & Kilbreath, S. L. (1997). Musculoskeletal symptoms in new south wales dentists. *Australian dental journal*, 42(4), 240-246.
28. Marshall, E. D., Duncombe, L. M., Robinson, R. Q., & Kilbreath, S. L. (1997). Musculoskeletal symptoms in new south wales dentists. *Australian dental journal*, 42(4), 240-246.
29. Ratzon, N. Z., Yaros, T., Mizlik, A., & Kanner, T. (2000). Musculoskeletal symptoms among dentists in relation to work posture. *Work*, 15(3), 153-158.
30. Rundcrantz, B. L., Johnsson, B., & Moritz, U. (1991). Occupational cervico-brachial disorders among dentists. Analysis of ergonomics and locomotor functions. *Swedish dental journal*, 15(3), 105-115.
31. Rundcrantz, B. L., Johnsson, B., & Moritz, U. (1991). Occupational cervico-brachial disorders among dentists. Analysis of ergonomics and locomotor functions. *Swedish dental journal*, 15(3), 105-115.
32. Burke, F. J., Main, J. R., & Freeman, R. (1997). The practice of dentistry: an assessment of reasons for premature retirement. *British dental journal*, 182(7), 250.
33. Gehrig, J. S. (2000). *Fundamentals of Periodontal Instrumentation*. Lippincott Williams & Wilkins.
34. Puckett, A. D., Fitchie, J. G., Kirk, P. C., & Gamblin, J. (2007). Direct composite restorative materials. *Dental Clinics*, 51(3), 659-675.
35. Passi, S. (2014). Textbook of Operative Dentistry. *Journal of Conservative Dentistry*, 17(2), 196-196.
36. Richter, H. E., & Behrmeyer, R. D. (1984). Publication Reviews. *The Journal of the American Dental Association*, 108(3), 371-374.
37. Yee, T., Crawford, L., & Harber, P. (2005). Work environment of dental hygienists. *Journal of occupational and environmental medicine*, 47(6), 633-639.
38. Morse, T., Bruneau, H., & Dussetschleger, J. (2010). Musculoskeletal disorders of the neck and shoulder in the dental professions. *Work*, 35(4), 419-429.
39. Punnett, L., Robins, J. M., Wegman, D. H., & Keyserling, W. M. (1985). Soft tissue disorders in the upper limbs of female garment workers. *Scandinavian journal of work, environment & health*, 417-425.
40. Finsen, L., Christensen, H., & Bakke, M. (1998). Musculoskeletal disorders among dentists and variation in dental work. *Applied ergonomics*, 29(2), 119-125.
41. Ratzon, N. Z., Yaros, T., Mizlik, A., & Kanner, T. (2000). Musculoskeletal symptoms among dentists in relation to work posture. *Work*, 15(3), 153-158.
42. Leggat, P. A., & Smith, D. R. (2006). Musculoskeletal disorders self-reported by dentists in Queensland, Australia. *Australian dental journal*, 51(4), 324-327.
43. Gijbels, F., Jacobs, R., Princen, K., Nackaerts, O., & Debruyne, F. (2006). Potential occupational health problems for dentists in Flanders, Belgium. *Clinical oral investigations*, 10(1), 8-16.
44. Marshall, E. D., Duncombe, L. M., Robinson, R. Q., & Kilbreath, S. L. (1997). Musculoskeletal symptoms in new south wales dentists. *Australian dental journal*, 42(4), 240-246
45. Li, T. K. L., Lo, E. C. M., Wong, H. H. A., Mok, W. H., & Leung, J. L. K. (2006). Self-reported occupation-related health problems in Hong Kong dentists. *Hong Kong Dental Journal*.
46. Armstrong, T. J. (1990). Ergonomics and cumulative trauma disorders of the hand and wrist. *Rehabilitation and Surgery of the Hand*, 1175-1191.
47. Keyserling, W. M., Armstrong, T. J., & Punnett, L. (1991). Ergonomic job analysis: A structured approach for identifying risk factors associated with overexertion injuries and disorders. *Applied Occupational and Environmental Hygiene*, 6(5), 353-363.
48. Valachi, B., & Valachi, K. (2003). Mechanisms leading to musculoskeletal disorders in dentistry. *The Journal of the American Dental Association*, 134(10), 1344-1350.
49. Biswas, R., Sachdev, V., Jindal, V., & Ralhan, S. (2012). Musculoskeletal Disorders and Ergonomic Risk Factors in Dental Practice. *Indian Journal of Dental Sciences*, 4(1).
50. Biswas, R., Sachdev, V., Jindal, V., & Ralhan, S. (2012). Musculoskeletal Disorders and Ergonomic Risk Factors in Dental Practice. *Indian Journal of Dental Sciences*, 4(1).
51. Rundcrantz, B. L., Johnsson, B., & Moritz, U. (1991). Occupational cervico-brachial disorders among dentists. Analysis of ergonomics and locomotor functions. *Swedish dental journal*, 15(3), 105-115.
52. Oberg, T., & Oberg, U. (1993). Musculoskeletal complaints in dental hygiene: a survey study from a Swedish county. *Journal of dental hygiene: JDH*, 67(5), 257-261.
53. Barry, R. M., Woodall, W. R., & Mahan, J. M. (1992). Postural changes in dental hygienists. Four-year longitudinal study. *Journal of dental hygiene: JDH*, 66(3), 147-150.
54. Lundström, R., & Lindmark, A. (1982). Effects of local vibration on tactile perception in the hands of dentists. *Journal of Low Frequency Noise, Vibration and Active Control*, 1(1), 1-11.
55. Conrad, J. C., Conrad, K. J., & Osborn, J. S. (1991). Median nerve dysfunction evaluated during dental hygiene education and practice (1986-1989). *Journal of dental hygiene: JDH*, 65(6), 283-288.
56. Conrad, J. C., Osborn, J. B., Conrad, K. J., & Jetzer, T. C. (1990). Peripheral nerve dysfunction in practicing dental hygienists. *Journal of dental hygiene: JDH*, 64(8), 382-387.
57. Anton, D., Rosecrance, J., Merlino, L., & Cook, T. (2002). Prevalence of musculoskeletal symptoms and carpal tunnel syndrome among dental hygienists. *American journal of industrial medicine*, 42(3), 248-257.
58. Jacobsen, N., Aasenden, R., & Hensten-Petersen, A. (1991). Occupational health complaints and adverse patient reactions as perceived by personnel in public dentistry. *Community dentistry and oral epidemiology*, 19(3), 155-159.
59. Chowanadisai, S., Kukiattrakoon, B., Yapong, B., Kedjarune, U., & Leggat, P. A. (2000). Occupational health problems of dentists in southern Thailand. *International dental journal*, 50(1), 36-40.

60. Alexopoulos, E. C., Stathi, I. C., & Charizani, F. (2004). Prevalence of musculoskeletal disorders in dentists. *BMC musculoskeletal disorders*, 5(1), 16.
61. Rundcrantz, B. L., Johnsson, B., & Moritz, U. (1991). Occupational cervico-brachial disorders among dentists. Analysis of ergonomics and locomotor functions. *Swedish dental journal*, 15(3), 105-115.
62. Rucker, L. M., & Sunell, S. (2002). Ergonomic risk factors associated with clinical dentistry. *Journal of the California Dental Association*, 30(2), 139-148.
63. Diaz-Caballero, A. J., Gómez-Palencia, I. P., & Díaz-Cárdenas, S. (2010). Ergonomic factors that cause the presence of pain muscle in students of dentistry. *Med Oral Patol Oral Cir Bucal*, 15(6), e906.
64. Yaghobee, S., & Esmaceli, V. (2010). Evaluation of the effect of the ergonomic principles' instructions on the dental students' postures an ergonomic assessment. *Journal of Dental Medicine*, 23(2), 121-127.
65. Dable, R. A., Wasnik, P. B., Yeshwante, B. J., Musani, S. I., Patil, A. K., & Nagmode, S. N. (2014). Postural assessment of students evaluating the need of ergonomic seat and magnification in dentistry. *The Journal of Indian Prosthodontic Society*, 14(1), 51-58.

How to cite this article:

Radhika Thakkar *et al* (2018) 'Ignorance of Ergonomics in Dental Practice: Systemic Review', *International Journal of Current Advanced Research*, 07(3), pp. 11251-11259. DOI: <http://dx.doi.org/10.24327/ijcar.2018.11259.1945>
