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Original ARTICLE

Ergonomic Application in Dentistry among Dental Students and Practitioners in Rajasthan

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ABSTRACT:

Background: Ergonomics can be defined as 'an applied science concerned with designing and arranging things people use so that the people and things interact most efficiently and safely'. Dental work poses some interesting ergonomic challenges. The current observational survey was conducted to evaluate the awareness, attitudes, and practice of ergonomics during routine dental procedures among undergraduates. **Materials & methods:** The study population consisted total of 260 undergraduates. The questionnaire was investigator developed, self-administered, and closed-ended. Study participants were given a format consisting of informed consent, instructions, and the questionnaire. They were given 30 minutes to complete the questionnaire. Pearson's correlation analysis was used to assess associations between knowledge, attitude, and behaviour of study participants. Chi-square test was used to assess associations of age, sex, religion, and marital status with knowledge, attitude, and behaviour of study participants. **Results:** 95 were III year students, 71 were IV year students and 94 were interns. A questionnaire consisting of 14 questions was given to them and results were recorded. 69.2 percent of the participants were comfortable with chair design. 51.9 percent of the participants always followed the correct operator's position. 76.9 percent of the participants were aware of occupational hazards. 35.4 percent of the participants never heard of stretching exercises for maintaining fitness, while 24.6 percent of the participants occasionally performed these exercises. Higher incidence of pain was seen in females and interns. **Conclusion:** Every dental graduate should receive sufficient information in relation to ergonomics to be used during routine dental procedures. Hence; there is utmost need and requirement for the inclusion of ergonomics in the dental curriculum.

Key words: Ergonomics, Dentistry

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INTRODUCTION

It is well known that dental practitioners are predisposed to a number of different occupational perils during the course of their professional work. These risks can be classified as: physical,

chemical, biological, ergonomic and work-related stress. Physical threats are due to the use of vibrating tools, vibration, non-ionizing (UV) and ionizing (X-rays) radiation. The chemical risks

are the exposure to inorganic agents such as mercury, organic agents such as solvents, resins and anaesthetic gases; caustic agents (formaldehyde and hydrogen peroxide) and allergens (latex) which are also handled. The biological hazards may be caused by airborne microorganisms as well as via body-fluid transmission; the most common pathogens are bacteria, viruses (HIV, HBV, HCV) and fungi. The work-related stress is due to excessive workloads and can lead to psychological disorders, such as tension, depression, emotional exhaustion and demotivation, all with medico-legal consequences. The ergonomic hazards caused by strained posture and prolonged repetitive movements can induce musculoskeletal disorders (MSDs).¹

Ergonomics can be defined as 'an applied science concerned with designing and arranging things people use so that the people and things interact most Efficiently and safely'. Ergonomics (or human factors) is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance. The term ergonomics is derived from the Greek words *ergon* (work) and *nomos* (natural laws), and first entered the modern lexicon when Wojciech Jastrzêbowski used the word in his 1857 article "The Outline of Ergonomics, i.e. Science of Work, Based on the Truths Taken from the Natural Science". The coining of the term Ergonomics, however, is now widely attributed to British psychologist Hywel Murrell, at the 1949 meeting at the United Kingdom's Admiralty, which led to the foundation of The Ergonomics Society. In simple terminology, ERGONOMICS is a way to work smarter-not harder, by designing tools, equipment, work stations and tasks to fit the job to the worker-NOT the worker to the job.²⁻⁴

Musculoskeletal disorders (MSDs) are among the most common causes of long-term disability. Due to spiraling incidences of MSDs over a period of time and their subsequent impact on industrial profits and quality of individual lives, the MSDs have received considerable attention since 1990s from ergonomists, researchers and other healthcare professionals. MSDs were first described in 1700 A.D. and were only documented in the 19th and 20th centuries as many countries worldwide reported a so-called epidemic of MSDs. These epidemics served as the catalyst to investigate the causative factors of MSDs and the extent to which

technological or societal changes may have impacted the occurrences of MSDs.⁵⁻⁷

Musculoskeletal disorders are a wide range of inflammatory and degenerative disorders of muscles, tendons, and nerves. These disorders can result in pain and functional impairment affecting the neck, upper back, lower back, shoulders, elbows, wrists, and hands. Examples are carpal tunnel syndrome, tendonitis, thoracic outlet syndrome, and tension neck syndrome. Epidemiologic literature has grouped these disorders as clinically well-defined (such as tendonitis and carpal tunnel syndrome), less clinically well-defined (such as tension neck syndrome) and nonspecific (such as repetitive strain injury, cumulative trauma disorder, and overuse syndrome).⁵⁻⁷

Modern ergonomics is an interdisciplinary applied science that studies the optimization possibilities of the man-machine system design by knowing the human's physical and mental possibilities and limits, his/her capacity to learn, the factors generating errors, the work, the physiology, the human behavior as an individual and within a team, the managerial possibilities, the organizational culture (interdisciplinary study of anatomy, physiology, psychology, management), and the technical and designing possibilities (engineering, design).^{8,9}

Dental work poses some interesting ergonomic challenges. While performing normal professional work, the dental surgeons have to repeatedly change their positions like sitting, standing, and sometimes in one position (static posture) for long periods. They bend forward or to the side while working on patients. While treating the patients, the dental surgeons are concerned about patients' comfort and pay little attention to their own health till they begin to experience discomfort or pain in their body. With a little attention and creativity, dental surgeons can improve their comfort on the job.^{8,9} In the Indian set-up there is a severe dearth of literature evaluating knowledge, awareness, and practices among dental professionals regarding optimal postures at the time of rendering oral health services. Therefore, the current observational survey was conducted to evaluate the awareness, attitudes, and practice of ergonomics during routine dental procedures among undergraduates of Maharaja Ganga Singh Dental College, Sriganganagar, Rajasthan, India.

MATERIALS & METHODS

The study was conducted among undergraduates of private dental college and cities. The head of the institution and other faculty members were informed about the purpose of the study and their permissions obtained. The study population consisted total of 260 undergraduates. The questionnaire was investigator developed, self-administered, and closed-ended. The undergraduates were gathered in a lecture hall and one of the authors gave instructions regarding the purpose of the survey and completion of the survey questionnaire. Study participants were given a format consisting of informed consent, instructions, and the questionnaire. They were given 30 minutes to complete the questionnaire. The purpose of the survey was explained and those who gave consent for participation in the study were included. The items for the questionnaire were generated from four sources: theory, research, observation, and expert opinion.

The questionnaire consisted of a total of 14 questions on ergonomics that focused on principles of ergonomics in routine dental procedures such as cavity preparation, extraction of teeth, and various complications. Questions related to attitude assessed whether ergonomics should be part of the dental curriculum, if dentists should follow the ergonomic principles in routine dental practice, whether the dental chair and instruments play any role in following ergonomic principles in routine dental practice, whether the dentist should alternate between sitting and standing between patient appointments, and whether various dental institutions should conduct continuing dental education.

Questions pertinent to behavior assessed how frequently the respondents obtained information related to ergonomics in dentistry either from the internet or scientific journals, used dental loupes for magnification purposes, made an effort to maintain neutral posture while working, attended any workshop/lecture on ergonomics in dental career, or performed stretching exercises in between patient appointments. Prior to the start of the study, the questionnaire was pretested on 50 study participants. Cronbach α values for knowledge, attitude, and behavior were 0.684, 0.784, and 0.810, respectively. The splithalfreliability values for knowledge, attitude, and behavior were 0.791, 0.881, and 0.698, respectively. The questions underwent subsequent revisions prior to the main study. The results of the pilot study were not included in the main study; only the reliability and validity was assessed.

The pilot study participants did not take part in the main study. The data were entered into the MS Excel (MS Office version 2007, Microsoft, Redmond, WA, USA) and Intercooled STATA version 9.2 (Stata Corp., College Station, TX, USA) was used to perform statistical analysis. One-way analysis of variance was used to assess the differences in knowledge, attitude, and behavior among academic positions. Scheffe's test was used to assess pair wise differences in the knowledge of study participants with respect to academic positions. Pearson's correlation analysis was used to assess associations between knowledge, attitude, and behaviour of study participants. Chi-square test was used to assess associations of age, sex, religion, and marital status with knowledge, attitude, and behaviour of study participants.

RESULTS

In the present study, a total of 260 participants were analysed. Mean age of the participants was found to be 21.52 years. There were 96 males and 164 females. Out of these 260 participants, 95 were III year students, 71 were IV year students and 94 were interns. A questionnaire consisting of 14 questions was given to them and results were recorded. 69.2 percent of the participants were comfortable with chair design. 51.9 percent of the participants always followed the correct operator's position. 76.9 percent of the participants were aware of occupational hazards. 35.4 percent of the participants never heard of stretching exercises for maintaining fitness, while 24.6 percent of the participants occasionally performed these exercises. According to majority of the participants (35.4%), health issues were the major problem for early retirement. Majority of the participants (40 %) opted for negative posture for better view. According to 65 percent of the participants, four handed dentistry was helpful. According to 51.2 percent of the participants, patient position was the most discomfort in clinical experience. 50.4 percent of the participants were not aware of the recent advancements in their field. Despite of availability of newer technologies, 51.2 percent of the participants preferred using older techniques due to comfortableness. 61.9 percent of the patients were not aware about the fibre optic hand pieces. 70.4 percent of the participants advocated implementation of ergonomic changes in dentistry. 70.4 percent of the participants had expression of muco-skeletal pain during/after working hours. In the present study, significantly

higher proportion of females followed correct operator position in comparison to males. Also, significantly higher proportion of interns followed correct operator position in comparison to males.

Likewise; higher incidence of pain was seen in females and interns.

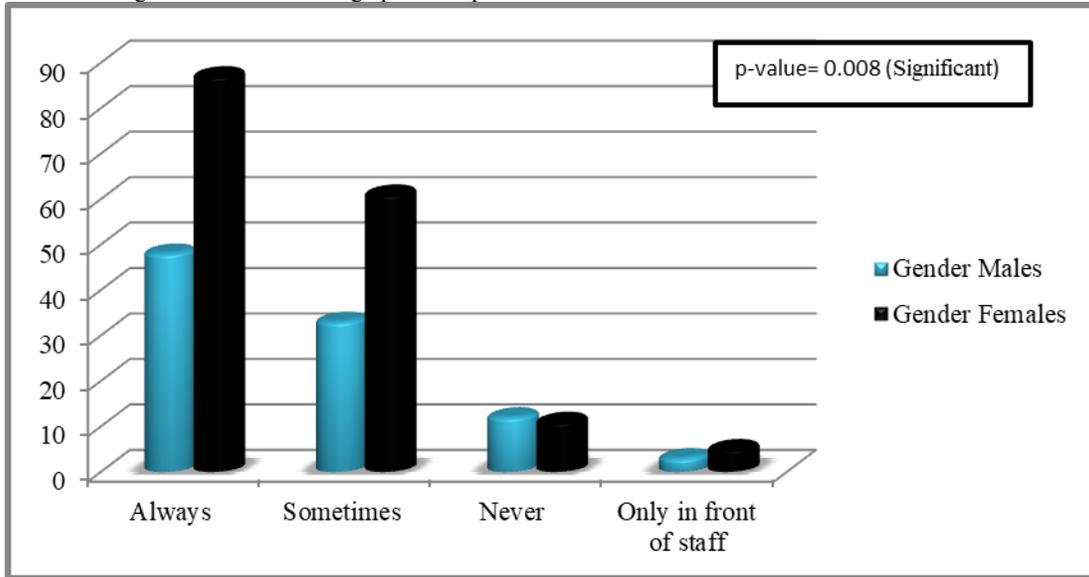
Table 1: Demographic details of the participants

Parameter	Number	
Mean age (years)	21.52	
Gender	Males	96
	Females	164
Participant's year	III	95
	IV	71
	Interns	94

Table 2: Response to questionnaire

Questionnaire		Number of patients	Percentage of patients
Comfortable with chair design	Yes	180	69.2
	No	80	30.8
Following operator's position	Always	135	51.9
	Sometimes	94	36.2
	Never	23	8.8
	In front of staff	8	3.1
Awareness of occupation hazard	Yes	200	76.9
	No	60	23.1
Following stretching exercises to keep fit	Never heard of such exercises	92	35.4
	Occasionally	64	24.6
	Sometimes	84	32.3
	Always	19	7.3
	No answer	1	0.4
Early retirement	Health problems	92	35.4
	Competition	44	16.9
	Economic problem	44	16.9
	All of the above	80	30.8
Negative posture for better view	Yes	104	40
	No	69	26.5
	Sometimes	87	33.5
Most discomfort in clinical experience	Patient's position	133	51.2
	Instrument design	58	22.3
	Operator's position	69	26.5
Opinion about four handed dentistry	Helpful	169	65
	Not very helpful	76	29.2
	Waste of money	15	5.8
Updated with recent advancements	Yes	129	49.6
	No	131	50.4
Following older technologies despite of newer technologies	Not aware of advancements	70	26.9
	More comfortable with older techniques	133	51.2
	High expenditure	52	21.9
Awareness of fibre optic hand pieces	Yes	99	38.1
	No	161	61.9
Homologous design of dental chair suits every dentist who are different in physical status	Yes	124	47.7
	No	136	52.3
Implementation of ergonomic changes in dentistry	Yes	183	70.4
	No	77	29.6
Expression of muco-skeletal pain during/after working hours	Yes	183	70.4
	No	77	29.6

Graph 1: Correlation of gender with “Following operator’s position”



Graph 2: Correlation of year of participants with “Following operator’s position”

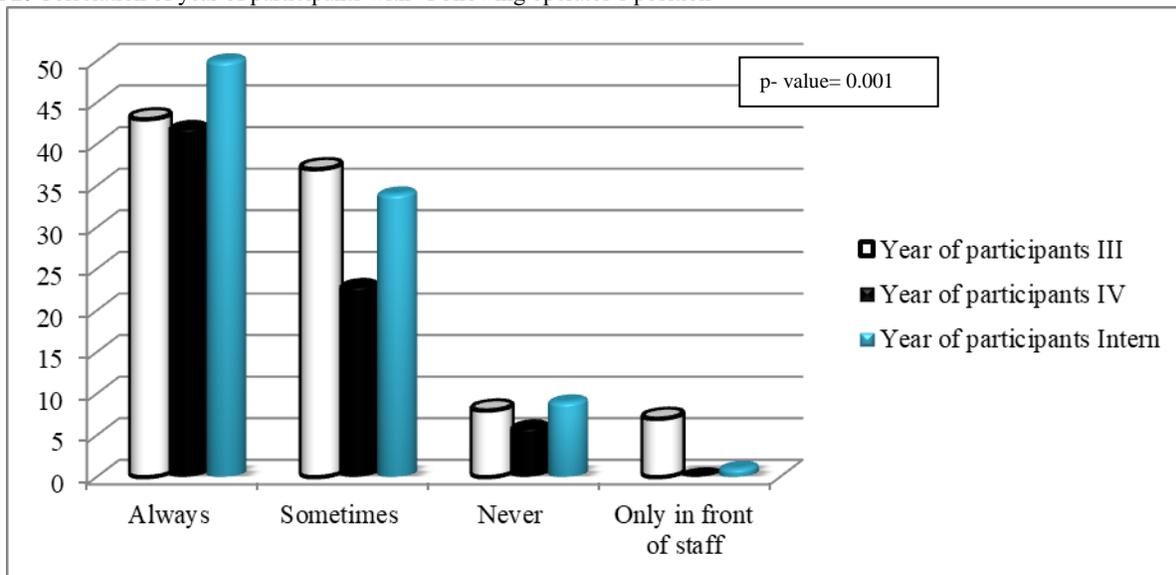


Table 3: Correlation of gender with pain

Pain	Gender		p- value
	Males	Females	
Present	80	131	0.002 (Significant)
Absent	16	33	

Table 4: Correlation of year of participants with “Following operator’s position”

Pain	Year of participants			p- value
	III	IV	Intern	
Present	72	57	82	0.012 (Significant)
Absent	23	14	12	

DISCUSSION

In dentistry, improper body posture along with factors such as prolonged work in a static position with no rest period, use of excessive force and vibrating tools, repetitive work and the need for special precision in a small working field puts dentists at a very high risk of developing musculoskeletal disorders. The prevalence of MSDs in dentists has been reported to be 63% to 92%.⁶⁻⁹

Ergonomics is the scientific study of people and their working conditions, especially done in order to improve effectiveness. In Greek, "Ergo" means work, and "Nomos" means natural laws or systems. Ergonomics, therefore, is an applied science concerned with designing products and procedures for maximum efficiency and safety. Dentistry is a profession that generally produces various musculoskeletal pains and soreness, which are slow to appear; consequently, the symptoms are usually ignored until they become chronic and permanent lesions become evident. It is very important to maintain an adequate work posture and that the instruments and furniture that the dentist is working with have adequate working characteristics.⁹⁻¹¹

The application of ergonomics in dentistry would enhance optimum access, discernibility, relief and control in clinical practice. In order to ameliorate the dental profession's working conditions; the sit-down and four-handed dentistry perceptions have been implemented. Appropriate ergonomic design is essential to avoid repetitive strain injuries, which can progress to long-term disability over time. Dentists are capable to access required equipment and materials through monitoring the patient's mouth position, that aid them to work more accurately, more competently, and with less physical and mental wear and tear on both the patient and the dentist.¹¹⁻¹³ Hence; under the light of above mentioned data, the present study was undertaken for assessing the awareness, attitudes, and practice of ergonomics during routine dental procedures among undergraduates.

In the present study, a total of 260 participants were analysed. Mean age of the participants was found to be 21.52 years. There were 96 males and 164 females. Out of these 260 participants, 95 were III year students, 71 were IV year students and 94 were interns. A questionnaire consisting of 14 questions was given to them and results were recorded. 69.2 percent of the participants were comfortable with chair design. 51.9 percent of the

participants always followed the correct operator's position. 76.9 percent of the participants were aware of occupational hazards. 35.4 percent of the participants never heard of stretching exercises for maintaining fitness, while 24.6 percent of the participants occasionally performed these exercises. According to majority of the participants (35.4%), health issues were the major problem for early retirement. Kalghatgi S et al, in a previous study assessed the knowledge, attitude, and practice of ergonomics among dental professionals of Hubli-Dharwad twin cities, India. Investigator-developed, self-administered, closed-ended questionnaire assessing knowledge, attitude, and practices regarding ergonomics during dental practice was filled in by undergraduates, house surgeons, postgraduates, and faculty members of dental institutions and private practitioners from Hubli-Dharwad twin cities. Data were collected from a total of 250 participants, 50 belonging to each academic group. Overall mean knowledge, attitude, and practice scores were 52%, 75%, and 55%, respectively. Significant correlation was found for age with attitude ($\chi^2 = 10.734$, $p = 0.030$) and behavior ($\chi^2 = 12.984$, $p = 0.011$). Marital status was significantly associated with all the three domains; knowledge ($\chi^2 = 29.369$, $p = 0.000$), attitude ($\chi^2 = 29.023$, $p = 0.000$), and practices ($\chi^2 = 13.648$, $p = 0.009$). Participants had considerable awareness and behavior toward ergonomics in dental practice. The high attitude score indicates stronger acceptance of ergonomics principles and guidelines during routine dental procedures.¹³

In the present study, majority of the participants (40 %) opted for negative posture for better view. According to 65 percent of the participants, four handed dentistry was helpful. According to 51.2 percent of the participants, patient position was the most discomfort in clinical experience. 50.4 percent of the participants were not aware of the recent advancements in their field. Despite of availability of newer technologies, 51.2 percent of the participants preferred using older techniques due to comfortableness. 61.9 percent of the patients were not aware about the fibre optic hand pieces. 70.4 percent of the participants advocated implementation of ergonomic changes in dentistry. 70.4 percent of the participants had expression of muco-skeletal pain during/after working hours. Knowledge, attitudes, and practice of ergonomics during routine dental procedures among undergraduates were assessed in a previous study by El-Sallamy

RM et al. Knowledge, attitude, and practice was assessed by 16, 5, and 6 questions, respectively. The study included 479 dental students, of them, 291 (60.8%) were females, 359 (74.9%) were from urban areas, and 359 students (74.9%) were 22 years old and below. Only one quarter of the students had good knowledge whereas nearly half of the students (48.9%) had fair knowledge concerning ergonomics. Out of the participants, 84.8% had positive attitudes and 95.4% had poor practice of ergonomics. Only 48.9% of the studied students had fair knowledge regarding ergonomics; also 5% only of students practice it. But about 84.8% of students have a positive attitude towards studying ergonomics.¹⁴For the first time in 1946, Biller reported that the prevalence of low back pain in dentists is 65%. In the 1950s, Seyfarth and Carlson found that lower back disorders and neck pain had a high prevalence. In fact, the prevalence of low back pain provided the basis for work in a sitting position. In 1977, a study was conducted using a questionnaire. The results showed that the motor system disorders are often concentrated in the lumbar region and spread to the neck and shoulders. Other studies in the 1980s showed that despite the ergonomic improvements made in the design of dental equipment and work environment, neck and shoulder pain and dysfunction are very common.¹⁵⁻¹⁹

In the present study, significantly higher proportion of females followed correct operator position in comparison to males. Also, significantly higher proportion of interns followed correct operator position in comparison to males. Likewise; higher incidence of pain was seen in females and interns. Awareness of ergonomics and prevalence of musculoskeletal disorders among dental professionals and students was assessed in another study conducted by Alyahya F et al. A self-administered survey was prepared and disseminated to dental professionals and students in Riyadh, Saudi Arabia. The questionnaire was focused on the awareness of ergonomics and musculoskeletal disorders. Five hundred and sixty-one participants were included in this survey. Significant differences were noticed among specialists, general practitioners and undergraduate students. Work load (risk factors) had great influence on musculoskeletal disorders in all dental practitioners, and lower back pain was the most common reported disorder among all practitioners. Most of the respondent dentists seem to work in conditions that aggravate disorders of the musculoskeletal system, the increased prophylactic remedies were

directly associated with the increase of the musculoskeletal disorders symptoms. All dentists regardless of their dental specialties are recommended to apply principles of ergonomics in their daily practice.²⁰

CONCLUSION

Under the light of above obtained results, the authors conclude that every dental graduate should receive sufficient information in relation to ergonomics to be used during routine dental procedures. Hence; there is utmost need and requirement for the inclusion of ergonomics in the dental curriculum.

REFERENCES

1. De Sio S, Traversini V, Rinaldo F, et al. Ergonomic risk and preventive measures of musculoskeletal disorders in the dentistry environment: an umbrella review. *PeerJ*. 2018;6:e4154. Published 2018 Jan 15. doi:10.7717/peerj.4154
2. Murphy DC (NYU College of Dentistry, USA). *Ergonomics and dentistry*. *NY State Dent J*. 1997 Aug-Sep;63(7):30-34.
3. Hayes M, Cockrell D, Smith DR. A systematic review of musculoskeletal disorders among dental professionals. *Int J Dent Hyg* 2009;3:159-65.
4. Lehto TU, Helenius HY, Alaranta HT. Musculoskeletal symptoms of dentists assessed by a multidisciplinary approach. *Community Dent Oral Epidemiol* 1991;19:38-44.
5. Yassi A. Repetitive strain injuries. *Lancet* 1997;349:943-7.
6. Finsen L, Christensen H, Bakke M. Musculoskeletal disorders among dentists and variation in dental work. *ApplErgon* 1998;29:119-25.
7. Valachi B, Valachi K. Preventing musculoskeletal disorders in clinical dentistry: Strategies to address the mechanisms leading to musculoskeletal disorders. *J Am Dent Assoc* 2003;134:1604-12.
8. Pollack R. Dental office ergonomics: How to reduce stress factors and increase efficiency. *J Can Dent Assoc* 1996;62:508-10.
9. Valachi B, Valachi K. Mechanisms leading to musculoskeletal disorders in dentistry. *J Am Dent Assoc* 2003;134:1344-50.
10. Zoidaki A, Riza E, Kastania A, Papadimitriou E, Linos A. Musculoskeletal disorders among dentists in the Greater Athens area, Greece: Risk factors and correlations. *J Public Health*. 2013; 21:163-173.
11. Barghout NH, Al-Habashneh R, Al-Omiri MK. Risk Factors and Prevalence of Musculoskeletal Disorders among Jordanian Dentists. *Jordan Medical Journal*. 2011; 45: 195-204.
12. Rafie F, Zamani Jam A, Shahravan A, Raof M, Eskandarizadeh A. Prevalence of Upper Extremity Musculoskeletal Disorders in Dentists:

- Symptoms and Risk Factors. *J Environ Public Health*. 2015; 2015: 517346.
13. Kalghatgi S, Prasad KV, Chhabra KG, Deolia S, Chhabra C. Insights into ergonomics among dental professionals of a dental institute and private practitioners in hubli-dharwad twin cities, India. *Saf Health Work*. 2014;5(4):181–185. doi:10.1016/j.shaw.2014.09.001
 14. El-Sallamy RM1, Atlam SA2, Kabbash I2, El-Fatah SA2, El-Flaky A3. Knowledge, attitude, and practice towards ergonomics among undergraduates of Faculty of Dentistry, Tanta University, Egypt. *Environ SciPollut Res Int*. 2018 Nov;25(31):30793-30801.
 15. Nordin M, Andersson GB, Pope MH. New York: Mosby-Year Book, Inc; 1997. *Musculoskeletal Disorder in the Workplace: Principles and Practice*; pp. 24–5.
 16. Rundcrantz BL. Pain and discomfort in the musculoskeletal system among dentists. *Swed Dent J Suppl*. 1991;76:1–02.
 17. Diaz-Caballero AJ, Gómez-Palencia IP, Díaz-Cárdenas S. Ergonomic factors that cause the presence of pain muscle in students of dentistry. *Med Oral Patol Oral Cir Bucal*. 2010;15:e906–11.
 18. Marshall ED, Duncombe LM, Robinson RQ, Kilbreath SL. Musculoskeletal symptoms in new south wales dentists. *Aust Dent J*. 1997;42:240–6
 19. Biller FE. The occupational hazards in dental practice. *Oral Hyg*. 1946;36:1194–201
 20. Alyahya F, Algarzaie K, Alsubeh Y, Khounganian R. Awareness of ergonomics & work-related musculoskeletal disorders among dental professionals and students in Riyadh, Saudi Arabia. *J PhysTher Sci*. 2018;30(6):770–776.