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Ergonomics: The X- factor for wellness in dentistry

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Abstract
Objective: To identify the awareness about ergonomics and ergonomic factors causing various health hazards in among dentists practicing in Jaipur, Rajasthan.
Materials and methods: A cross sectional survey was conducted among all the 100 practicing dentists at Jaipur, Rajasthan from January 2015 to March 2015 including Post Graduate students of Rajasthan Dental College. Non practicing dentists were excluded. Data collection was done by the means of structured questionnaire for ergonomic factors. The variables evaluated were a) Gender b) Age c) professional background [qualification - undergraduate (BDS) or post-graduate (MDS)] d)Awareness e) no of clinical hours f) Work environment g) Presence of pain h) measures taken to prevent the injury or pain i) number of leaves in a week
Results: The large percentage of dentist adjust their chairs within normal levels (95%). Most of the dentist were familiar with the ergonomic posture (77%) It was observed that 66% of the participants had muscular pain.
Conclusion: The health hazards related to ergonomics are a common affliction in dentist which begins at the time they start their professional studies staying with them during their professional practice affecting various parts of the body.

Keywords: ergonomics, musculoskeletal disorders, health hazards, dentist.

1. Introduction
Ergonomics is derived from two Greek words 'Ergon' meaning work and 'Nomio' meaning natural law or system. The International Ergonomics Association defines ergonomics as follows: 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 [1]. Ergonomics implies the study and analysis of human capabilities and limitations during the professional work including anatomic and psychological aspects. The ergonomic elements in dentistry which must be discussed in relation to the occupational environment are the dental team positioning, the design of the working area, dental equipment and the collaboration between the dentist and the dental assistant within Four Handed Dentistry [2].
Dentistry is associated with several occupational hazards and work-related disorders like musculoskeletal disorders which are seen worldwide amongst most of the dental professionals like dentists, dental assistants, dental hygienists and dental technicians including the dental students. Dental work is often hampered by well-known ergonomic risk factors, like long-lasting static work in awkward postures. There are models explaining how physiological and pathological processes can lead to damage of the muscles and other structures even if the load is low or modest [3, 4]. Among the wide range of musculoskeletal disorders, back pain is the most common among dentists, followed by neck pain, high muscle tension on the trapezoids, tendinitis, carpel tunnel syndrome, nerve trapping, early arthrosis, myopia, and auditive alterations [5]. And it was seen in the studies conducted previously that about 62% of dental practitioners suffer from muscle-skeletal disorders, varying from discomfort and sporadic pain to functional restrictions and loss of working ability [6, 7, 8].
Applying ergonomics to the practice of dentistry not only could provide safety benefits but a practitioner might also improve performance objectives through greater productivity. One of the main goals of ergonomics in dentistry is to minimize the amount of physical and mental

stress that sometimes occurs day to day in a dental practice the pains associated with ergonomics could begin to appear at the beginning of their clinical practice as students and accompany them for the rest of their professional life. Occupational health programs are not being carried out in a satisfactory manner and adequate training activities are not being promoted. Unfortunately, there is not much research evidencing the process of integrating the knowledge acquired during the course and its further transformation into a sustainable healthy professional behaviour. Therefore, the current observational survey was conducted to evaluate the awareness, attitudes, and practice of ergonomics during routine dental procedures among practicing dentists at Jaipur including the postgraduate dental professionals of Rajasthan Dental College and Hospital, Rajasthan, India.

2. Material and methods

Study design and study population:- A cross sectional survey was conducted among all the 100 practicing dentists at Jaipur, Rajasthan from January 2015 to March 2015. Non practicing dentists were excluded. Before the commencement of the study, ethical approval was obtained from the Institutional Ethical Committee and official permission was obtained from the authorities of the dental institutions. Written informed consent was obtained from those who fulfilled the eligibility criteria.

Assessment of content validity was done which reflects a judgment whether the instrument included all the relevant or important domains or not. Mean Content Validity Ratio (CVR) was calculated as 0.87 based on the opinions expressed by a panel of total six academicians. When face validity was assessed, it was observed that 92% of the participants found the questionnaire to be easy.

Prior to finalizing the questionnaire, previously validated questionnaire was tested among a convenience sample of 15 dentists. Upon completion of the pilot study, each subject was interviewed to gain feedback of the questionnaire in terms of length, language, clarity, and on the feasibility of dentists completing and returning it. Cronbach's coefficient was found to be 0.88, which showed a high internal reliability of the questionnaire. Based on this analysis, all necessary changes were introduced before the main study.

Proforma details: -The proforma consisted of a self-administered and structured questionnaire including:

1. Demographic questions including name, age, sex and professional background [qualification - undergraduate (BDS) or post-graduate (MDS)], years of work experience, total clinical hours for work in clinic and number leave in a week
2. Specific research questions: There were close ended questions which were divided into 3 categories: Practice Related questions (11), knowledge (30) and Pain (6). The participant's responses for each question were ranked according to given options.

Methodology: On the pre-decided days, investigator visited the dentists at private dental clinics and dental colleges. The purpose of the study was informed and explained to them and the questionnaires were given. They were requested to fill in the written consent form if they were willing to participate in the survey and return the response format to the surveyor.

Statistically analysis: The recorded data was compiled and entered in a spread sheet computer program (Microsoft Excel 2007) and then exported to data editor of SPSS version 19.0 (IBM SPSS Statistics Inc., Chicago, Illinois, USA). Descriptive statistics were used to summarize the demographic information and the survey data was analyzed using the student`s t- test and one way ANOVA. Linear regression analysis model was used to check relation between independent (age, sex, qualification, work experience, leaves and clinical hours practice) and dependent variables (general, knowledge, use of equipment and pain). Level of significance was fixed at $P \leq 0.05$

3. Results

Table 1: Relation between work experience and dependent variables

		N	Mean	Std. Deviation	P value
General	0-2	7	34.14	2.54	0.42
	2-4	30	33.43	2.06	
	4-6	29	33.93	1.73	
	6-8	20	34.35	2.007	
	8-10	10	32.90	2.13	
	> 10	4	33.75	1.25	
Knowledge	0-2	7	103.80	2.82	0.05*
	2-4	30	104.42	3.44	
	4-6	29	105.62	4.003	
	6-8	20	106.50	2.28	
	8-10	10	106.56	2.8	
	> 10	4	106.90	3.41	
Total	0-2	7	80.14	3.38	0.9
	2-4	30	79.6	4.06	
	4-6	29	79.48	4.31	
	6-8	20	80.6	3.71	
	8-10	10	79.9	4.79	
	> 10	4	81.25	2.06	
Pain	0-2	7	32.57	2.14	0.18
	2-4	30	34.06	2.65	
	4-6	29	34.1	2.67	
	6-8	20	35.15	2.83	
	8-10	10	33.00	1.76	
	> 10	4	34.25	0.95	

Test applied: ANOVA

Table depicts relationship between dependants (general, knowledge, total and pain) and independent variables (work experience). There was no statistically significant results among dependants and independent variables except knowledge score indicating the mean score of knowledge increased with increased year of experiences.

Table 2: Relation between clinical hours for working and dependent variables

	Clinical hours	N	Mean	Std. Deviation	P value
General	0-3	16	33.06	2.26	0.12
	3-6	16	34.12	1.82	
	6-9	31	34.35	1.6	
	9-12	33	33.33	2.16	
	>12	4	34.25	1.50	
Knowledge	0-3	16	105.43	3.88	0.26
	3-6	16	106.50	2.708	
	6-9	31	105.41	3.24	
	9-12	33	105.87	3.75	
	>12	4	102.25	0.95	
Total	0-3	16	80.25	3.37	0.06
	3-6	16	79.37	4.6	
	6-9	31	80.29	3.91	
	9-12	33	79.48	4.33	
	>12	4	81.00	1.41	
Pain	0-3	16	33.8	2.83	0.04*
	3-6	16	34.06	2.61	
	6-9	31	34.18	2.54	
	9-12	33	34.51	2.61	
	>12	4	35.50	1.29	

Test applied: ANOVA

Table depicts relationship between dependants (general, knowledge, total and pain) and independent variables (clinical hours for working). Mean score of pain increased with increased clinical hours which showed statistically significant result (0.04). But mean score of total showed slightly relationship with clinical hours for working which has near to significant result (0.06)

Table 3: Relation between number of leaves in a week and dependent variables

	Leave	N	Mean	Std. Deviation	P value
General	0	60	33.68	2.04	0.59
	1	40	33.90	1.89	
Knowledge	0	60	105.58	3.25	0.89
	1	40	105.67	3.73	
Total	0	60	80.50	3.5	0.06
	1	40	79.00	4.52	
Pain	0	60	34.35	2.62	0.22
	1	40	33.7	2.53	

Test applied: Unpaired t test

Table depicts relationship between dependants (general, knowledge, total and pain) and independent variables (number of leaves in a week). There was none of the statistically significant results among dependants and independent variables. Mean score of total showed slightly relationship with mean number of leaves in a week which has near to significant result (0.06)

Table 4: Relation between education and dependent variables

	Degree	N	Mean	Std. Deviation	P value
General	UG	8	33.75	1.9	0.97
	PG	92	33.77	1.99	
Knowledge	UG	8	105.25	2.12	0.007*
	PG	92	108.4	3.53	
Total	UG	8	81.12	3.48	0.36
	PG	92	79.79	4.03	
Pain	UG	8	33.12	1.64	0.02*
	PG	92	34.17	2.65	

Test applied: Unpaired t test

Table depicts relationship between dependants (general, knowledge, total and pain) and independent variables (education). More number of mean score of knowledge (108.4) and pain (34.17) were found among post-graduates which showed statistically significant result.

Table 5: Correlation among dependent and independent variables

	Age	Gender	Year of Experience	Clinical practice	Leave per week	Level of education
General	-0.1	0.01	-0.005	0.02	0.054	0.003
Knowledge	-0.05	0.101	0.02*	-0.06	0.01	0.03*
Use of equipment	0.17	-0.03	0.07*	-0.01*	-0.18	-0.09
Pain	-0.02	0.03	-0.07*	-0.03*	-0.12	0.11

Table depicts that working experience was an effective variable as compared to all other variables. Working experience showed positive correlation with knowledge and use of equipment but pain showed negative correlation which has statistically significant results. Working hours showed negative correlation with equipment and pain which has statistically significant results. Level of education (degree) showed positive correlation with knowledge which has statistically significant results. Positive correlation means that both variables are increasing or decreasing together but negative correlations don't give the same results.

4. Discussion

A large number of dentists suffer from musculoskeletal problems later in their professional lives. International dental literature shows that about 65% of dentists, have musculoskeletal complaints which vary in severity, but involve one or more of the following: discomfort, pain, hindrance in functioning and loss of working time [9]. Specific character of dental work is connected with and accompanied by onerous and harmful effects.

The percentage of dentists adjusting their chairs within normal levels (95%) strongly suggest that most of the dentists choose positions that are for the most part comfortable for them during the clinical work. These results are in accordance with study conducted by Mohammed K. Yousef and Afnan O. Al-Zain (2009) [10] But in our study only 46% of dentists put their elbows and arms on the rib's side which is lower compared to other studies.

The number of the dentists familiar with the ergonomic posture (77%) is slightly lower than study conducted by Mohammed K. Yousef and Afnan O. Al-Zain (2009) [10] where (85.4%) placed their dental chairs within normal levels.

It was observed that 66% of the participants had muscular pain which is in accordance with various previous studies [11, 12, 13]. Cervical pain was observed in 72% of the study participants which is comparable with studies conducted by Rising DV (2005) [13]. This may be due to dental treatment performed in an inflexible posture. Standing or sitting postures as well as twisting of spine are associated with excessive tightening of some tissue and straining of others, and generates high static loads which are the source of painful disorders and diseases of musculoskeletal system and peripheral nervous system.

In general it was noticed that most of the dentists worked with correct patient position but their backs were not always straight. This was probably due to the fact that students tend to bend their backs in order to have a clearer vision of the operative field, staying with them during their professional practise.

Table 1 and table 2 depicts that there is significant increase in knowledge as well as pain experience with increase in number of years of clinical practise. These results are in accordance with study conducted by Rising DW *et al.* (2005) [13] where significant finding was also found between pain and dental practice. The reason for this may be attributed to compromised operator posture for working on all 4 quadrants in one sitting, working under direct vision in maxillary arch etc with more number of year's clinical practice.

Present study shows 62% pain in neck, 47% pain in shoulder and 28% pain in wrist region. Similar sites of pain were found in a study done by Rabiei *et al.* (2008) but the present results were lower than reported in Queensland Australia, Denmark and Saudi Arabia [14, 15].

5. Conclusion

The health hazards related to ergonomics is a common affliction in dentists which begins at the time they start their professional studies staying with them during their professional practice affecting various parts of the body. The results of this study show that adopting inadequate postures to gain better vision of the oral cavity could produce muscular pain. Having a favourable work environment and adopting adequate postures in clinical practice could reduce the frequency of musculoskeletal problems avoiding an early retirement from the profession. Therefore, it is important to promote occupational health training and prevention programs regarding ergonomic postures which must be acquired by the dentists during their clinical practices, originating in this manner, healthy lifestyles.

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