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Original Research Article

A study on the influence of ergonomics on the prevalence of chronic pain disorders among dentists

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ABSTRACT

Background: Dentists are prone for chronic pain especially neck and back pain owing to the following risk factors as a part of their practice-repetitive movements, maintenance of awkward body postures for a long time and tasks that require fine motor skills and close visual focus. The term - Musculoskeletal Disorders (MSDs), which result from poor ergonomics, refers to conditions that involve the nerves, tendons, muscles and supporting structures of the body.
Methods: 248 dentists in Bangalore were asked to respond to a questionnaire about their practice pattern (years of practice, hours of work, specialization, two-handed/four handed dentistry, use of magnifications etc), their general lifestyle including exercise, fitness patterns, prevalence of MSDs and their general awareness regarding MSDs. The responses were analyzed using descriptive statistics, univariate analysis and Chi-square tests.
Results: In our study 95.16% (n=236) and 90.32% (n=224) respondents reported MSDs in the past and in the previous 12 months of the study respectively. 54.84% (n=136) reported at least one episode of backache, 51.61% (n=128) reported neck pain, 19.35% (n=48) reported pain in the shoulder and 32.25% (n=80) reported pain in the wrist and/or hand in the previous 12 months. Our study found considerable influence of the hours of work, use of assistant and magnification on Backache, Neck pain and wrist/hand pain.
Conclusions: Work-related pain being common and multifactorial, any possible solution should also be multifactorial and can be managed effectively using a multifaceted approach and the strategies for prevention and care are also discussed.

Keywords: Backache, Chronic pain, Dental practice, Musculoskeletal disorders, Neck pain ergonomics

INTRODUCTION

The World Health Organization has characterized "work-related" diseases as multi-factorial to indicate that a number of risk factors (e.g., physical, work organizational, psychosocial, individual, and socio-cultural) contribute to causing these diseases.[1] Other factors include poor positioning, genetic predisposition, mental stress, physical conditioning and age-related degeneration.[2-4] The term-Musculoskeletal Disorders (MSDs)- refers to conditions that involve the nerves, tendons, muscles and supporting structures of the body. There is strong evidence that extreme posture during work and high levels of static contraction cause neck pain. There is also some evidence to suggest repetitive movements cause neck pain, shoulder pain and hand and wrist disorders.[5]

Dentists are prone for musculoskeletal disorders especially neck and back pain owing to the following risk factors as a part of their practice-repetitive movements, maintenance of awkward body postures for a long time-

prolonged static postures (PSPs), and tasks that require fine motor skills and close visual focus.[6] Eighty two percent of the dentists reported at least one musculoskeletal symptom and 64% reported backache during the previous month in a study by Marshall.[7] Similarly, a 12-month period prevalence of 54% for low back pain and 58% for neck-related pain was reported.[8] Szymanska examined 268 Polish dentists and reported presence of backache in 60.1%, neck pain in 56.3%, lower extremity pain in 47.8, wrist and hand pain in 44% and shoulder pain in 37.3% of the respondents.[9] Back ache and neck pain have been found to be the most common of the MSDs among dentists in various other studies too.[10-13] No large-scale study has been hitherto published about the practice patterns of Indian dentists and their effect on the prevalence of MSDs.

METHODS

Considering the fact that no large-scale study was hither to conducted in Indian dentists, the authors developed a questionnaire based on work patterns. This observational study was carried out in 248 dentists practicing in Bangalore. In order to study the prevalence and incidence of risk factors contributing to chronic pain due work related musculo-skeletal disorders, all the relevant details regarding ergonomics were included in the questionnaire.

All of them received this questionnaire which was mailed to them. They were asked to provide details about their practice pattern (years of practice, hours of work, specialization, two-handed/four handed dentistry, use of magnifications etc), their general lifestyle including exercise and fitness patterns, prevalence of MSDs (backache, neck pain, shoulder and wrist/hand pain) and their general awareness regarding MSDs.

The authors, in association with the Indian Dental Association, Bangalore chapter also conducted an introductory seminar to sensitize its members about work related musculo-skeletal disorders and this study. The forms were then mailed back by the dentists after which the responses were analyzed.

Inclusion criteria

Dentists presently practicing in Bangalore Area; Members of Indian Dental Association (IDA), Bangalore Chapter.

Exclusion criteria

Prior known history of surgery for musculoskeletal disorders including prior spinal surgery, Carpal Tunnel release etc.

Statistical analysis

The reported responses were analyzed using descriptive statistics, univariate analysis and Chi-square tests for independence. The Data Analysis Toolpak of Microsoft Excel (Microsoft Inc, Redmond, WA, USA) was used for statistical analysis.

RESULTS

A total of 248 dentists responded to the questionnaire provided. Out of them, 35.48% of the respondents were female, and 59.67% were males. Age of the respondents varied from 20 years to 64 years with average age of 36.86 years (standard deviation=9.34). 62.9% had completed their BDS, while 37.1% had completed MDS.

66.13% of our respondents were in private practice alone, and 8.06% were in academic positions only while 24.2% were both in private practice and in academic positions. 95.16% of the respondents were right handed, while 1.16% were left handed, out of whom one left handed dentist practiced right handed dentistry. Years of practice varied from 1 year to 38 years with average age of 12.73 years (standard deviation=8.99). Specialization of our respondents is given in Table 1.

Table 1: Specialization of our respondent.

Specialization	No. of respondents
Periodontics	12
Prosthodontics and implantology	32
Conservative dentistry	12
General dentistry	132
Orthodontics	12
Maxillofacial surgery	8
Oral medicine	8
Pediatric dentistry	4
Endodontics	16
Oral and maxillofacial pathology	8
Aesthetic dentistry	4

Practice patterns

Position

The position of the respondents during work is given in Table 2.

Table 2: Position of the respondents during work.

Position of the respondents	
36	Sitting only
80	Rarely standing
68	Sometimes standing
44	Mostly standing
4	Standing only
8	Standing in theatre for maxillofacial surgery

Two handed/four handed dentistry: Fifty percent of our respondents (n=124) worked with assistants more than

50% of the time, and 37.1% of them worked with assistants less than 50% of the time, while 11.3% worked without any assistants.

Hours of work

About a quarter of the respondents (n=60, 24.2%) worked more than 8 hours on any given day, 46.8% (n=116) worked for six to eight hours a day, 22.6% (n=56) worked for four to six hours a day and about 5% (n=12) worked for two to four hours a day.

Use of magnification

Majority of the respondents (n=168, 67.74%) did not use any magnification (loupes or microscope) in their practice, while 14.5% (n=36) did not respond to this question. Only 3.22% (n=8) used the operating microscope and 14.5% used loupes in their practice.

Among dentists who used magnifications, only four (9.99%) used them during all their interventions, while 45.45% used them for few of their surgeries and/or occasionally.

Musculoskeletal disorders and their prevalence

In our study 95.16% (n=236) and 90.32% (n=224) respondents reported MSDs in the past and in the previous 12 months of the study respectively. Among the study population, 54.84% (n=136) reported at least one episode of backache, 51.61% (n=128) reported neck pain, 19.35% (n=48) reported pain in the shoulder and 32.25% (n=80) reported pain in the wrist and/or hand in the previous 12 months (Table 3).

Table 3: Prevalence of musculoskeletal disorders.

No of symptoms	MSD in respondents in the past	MSD in respondents in the previous 12 months
0	8	16
1	88	116
2	84	68
3	44	24
4	12	12
5	8	4
Total	244	240

Univariate analysis of the number of symptoms in the respondents showed a mean of 1.633 symptoms with a standard deviation of 1.034.

The respondents also gave feedback on the severity of these symptoms as given in Table 4. 32.25% (n=80) of the dentists took breaks to stretch during their working hours while 41.93% (n=104) did not. 43.54% (n=108) of the dentists exercised regularly while 33.87% (n=84) did not.

53.22% (n=132) of the study population felt that they maintained an appropriate posture while working while 30.64% (n=76) felt they did not. Only about 9.67% (n=24) of our respondents had lost workdays due to MSDs.

Table 4: Severity of the symptoms.

	Backache	Neck pain	Shoulder	Wrist and hand
Mild	56	32	13	40
Moderate	56	76	26	28
Severe	24	20	9	12

25.8% (n=64) of the study population had sought opinion and taken treatments from specialists (Orthopedic surgeons/physiotherapists etc) for their MSDs. They were also questioned on their opinion with regard to the most painful procedures in their opinion and the results are in Table 5.

We examined the degree of dependence of backache, neck pain, pain in the shoulder and wrist/hand pain on the numbers of hours of work, use of assistants, magnification and breaks during regular work. The results are given in Table 6. Chi square test of independence was used for the same.

Table 5: Dental Procedures causing pain.

Most painful procedures	No. of respondents
Endodontics	76
Scaling	24
Molar extractions and impactions	60
Long procedures	8
Restorative/conservative	24
No response	56

Table 6: Degree of dependence based on Chi square test.

	Backache	Neck pain	Shoulder	Wrist/Hand
Hours of work	7.912 (0.048)	9.051 (0.029)	26.165 (8.80574e-06)	19.555 (0.0002)
Assistant	10.891 (0.004)	15.066 (0.0005)	10.205 (0.0061)	27.098 (1.30504e-06)
Magnification	7.355 (0.025)	9.896 (0.0071)	3.025 (0.220)	10.578 (0.005)
Breaks	1.078 (0.299)	2.531 (0.117)	5.382 (0.020)	0.438 (0.508)

Values of $\chi 2$ are given. P values are given in parentheses. e is Euler's number which is a mathematical constant.

DISCUSSION

Valachi and Valachi have proposed a series of events to explain the onset of pain and MSDs following PSPs6. Imbalances occur between muscles that are chronically contracted and those that are stretched. Continual work in front of and below the surgeon's eyes leads to contraction of scalene, sternocleidomastoid and the pectoralis and elongation of the trapezius, rhomboid and the serratus anterior muscles. Similar imbalance develops between the abdominal muscles and the low back muscles during prolonged sitting. As a consequence, tighter muscles remain tight and weaker muscles remain weak which leads to muscle ischemia and formation of trigger points and joint hypomobility. Also based on studies on measurement of pressure in the intervertebral discs in humans, it has been found that the intradiscal pressure in the sitting position is higher than that in the standing or lying down position.[14,15] Moreover, movement is required to nourish the nucleus pulposus of the intervertebral disc.[16] Under static, sustained pressure, nutrition to the disc is diminished placing the disc at an increased risk for injury leading to spinal disc degeneration.[17]

In addition, poor positioning of arms, elbows and wrist while working with a patient, or using a computer could result in prolonged stretch on the tendons and ligaments and could result in tendinitis in the shoulder, elbow or the wrist, and nerve entrapments at the carpal tunnel or at the forearm.

In our study, most dentists worked in seated position (n=116, 46.77%) predominantly, while 27.41% (n=68) stood sometime during the procedures and 19.35% (n=48) stood predominantly. Among 268 dentists studied by Szymanska, 39.2% work both in standing and sitting positions next to a seated patient, 27.6% of respondents worked in a standing position next to a seated patient and 22.8% worked in a sitting position next to a seated patient.[9]

Majority of our respondents (50%) worked with assistants during more than 50% of their practice hours, and only 11.3% worked without assistants, while in the study by Szymanska, 37.3% of 268 Polish dentists worked without a dental assistant.[9] According to the author, this type of work allows the dentists to conserve definite work time, rest the back, back muscles and lower extremities.

In this study, as many as 95.16% (n=236) and about 90.32% (n=224) respondents reported MSDs in the past and in the previous 12 months of the study respectively. This indicates the high prevalence of MSDs in the study population. In a study on Australian dentists by Leggat et al 87.2% experienced musculoskeletal pain at least once in a year.[8] Moreover, co-morbidity was also common in our study, with 28.3% experiencing 2 symptoms, 10% experiencing 3 symptoms, and 5% experiencing 4 symptoms. Marshall reported that 82% of their study population experienced one or more symptoms in the previous month.[7] Similar findings were also seen in a study on 430 Polish dentists where 37.3% of respondents experienced 3-4 symptoms and 29.1% experienced 5 or more symptoms 9 and in a study on dentists in Greece where 35% of respondents experienced 2 symptoms, 15% experienced 3 symptoms and 6 % experienced 4 symptoms.[18] Univariate analysis of the number of symptoms in the respondents showed a mean of 1.633 symptoms with a standard deviation of 1.034. This implies that there is a probability of a given dentist having more than one symptom at any given point of time. Szymanska is of the opinion that the number of disorders increased with the length of time in dental practice. Almost half the dentists in practice for over 30 years reported 5 or more disorders, while almost half the dentists in practice for up to 10 years reported 0-2 disorders.[9]

53.22% (n=132) of the study population felt that they maintained an appropriate posture while working while 30.64% (n=76) felt they did not. In a similar study 73.5% thought they practiced the right posture and 26.5% thought they did not.[13] We could infer that in spite of their apparent perception of maintenance of the right posture, there is a high prevalence of MSDs and this identifies the scope for interventions for postural corrections.

Respondents in our study reported back ache as the most common complaint (54.84%, n=136). Of them, 41.2% reported mild and moderate degree of pain each, while 17.6% reported severe pain. Several previous studies have also reported backache as the most common musculoskeletal disorder (46% to 79.4%).[7–10,12,13,18] A

similar study reported 55.9% with mild pain, 19.4% with moderate pain and only 3% with severe pain.[13]

51.61% (n=128) of our respondents reported neck pain of whom 25% reported mild pain, 59.4% reported moderate pain and 15.6% reported severe pain. Other studies have reported prevalence of neck pain as high as 61.2% and neck pain as being the most common of the MSDs.[8,19] Our findings are similar to other studies described.[2,9,10,13] Shrestha reported significantly higher mean days of neck pain among males while Rundcrantz that more women experienced neck pain.[2,13]

Among the study population, 19.35% (n=48) reported pain in the shoulder and 32.25% (n=80) reported pain in the wrist and/or hand in the previous 12 months. Shoulder pain has been reported between 20% to 53% in various other studies.[8,13,18,19] Shrestha reported that the frequency of shoulder pain among female dentists was nearly double that of males.[13] Wrist and hand pain has been reported between 26% to 44% in various other studies.[8,9,18,19] One study found that Neck and hand/wrist pain 26.04% was strongly associated since 50% of subjects with neck pain also experienced hand/wrist pain in the past 12 months.[18]

Our study found significant influence of the Hours of work, use of assistant and use of magnification on Backache. Similar influence was found with respect to Neck pain and wrist/hand pain. Hours of work, use of assistant and breaks during a working day had significant influence over shoulder pain. However, breaks during procedures did not have a significant effect over backache, neck pain and wrist/hand pain (Table 6).

Dental position/posture against patients showed a significant influence on musculoskeletal pain. ($p<0.05$) in a study by Aarabi.[19] But, they did not find any significant correlation between musculoskeletal pain and age, height, weight, exercise, using assistant, using mirror, rest breaks or sitting or standing while working. Similar to our study, breaks during work did not influence frequency of back ache or neck pain in a study by Shrestha.[13] Though Al Wassan et al observed that increase in working hours increased prevalence of back pain, but they did not find a significant difference.[10]

Thirty percent of our respondents (n=76) considered Endodontic procedures to be the most painful dental procedure and impacted molars and their extractions (24.2%, n=60) to be the second most painful procedure for themselves. Similar results were elucidated by Shrestha et al.[13] Higher prevalence of hand/wrist complaints was found in Greek orthododists.[18]

Only about 9.67% (n=24) of our respondents had lost workdays due to MSDs. This might be due to relatively higher proportion of respondents suffering from only mild or moderate degree of pain. In comparison, 24.66% of respondents with back pain and 21.62% of those with neck pain missed work in a study by Al Wassan10, while 10% and 4% missed work due to back pain and neck pain respectively in Alexopoulos's study.[18] According to the latter study, family situation (living alone) was the single most important risk factor for sickness absence due to shoulder pain and hand/ wrist pain.

25.8% (n=64) of the study population had sought opinion and taken treatments from specialists, in contrast to 64.6% Polish dentists9, 25.32% and 37.33% for neck and back pain respectively in Al Wassan's Study10 and 31.62% in Alexopoulos's study.[18] A highly statistically significant relationship ($p < 0.001$) was found between years in practice and treatment taken in the Polish study.[9]

43.54% (n=108) of the dentists exercised regularly while 33.87% (n=84) did not, while in a similar study 30.9% said they exercised regularly and majority 51.5% did not.[13]

Strategies and care[20]

The authors suggest dental professionals to gain awareness regarding proper ergonomics and suggest the same to be included in the undergraduate curriculum. Stratergies for posturing for themselves and their patients to avoid static postures, elevation of the shoulders and abduction of the arms and twisting while working with patients and to ensure that muscle groups are relaxed periodically, need to be adopted.

Stretches could be performed during micro breaks and need to be included into the daily routine. Stretches should involve the neck, low back, shoulder, upper arm and the wrist. Stretching increases blood flow to muscles, increases production of joint synovial fluid, maintains normal joint range of motion, increases nutrient supply to vertebral disks and warms up the muscle before beginning to work.[20] Strengthening exercises for the trunk, back, neck and shoulder girdle along with aerobic conditioning are also important.[21]

CONCLUSION

Chronic pain compromising quality of life and work is common among dentists. Proper seating pattern, modification of the work environment including their chairs, the patient's chair, table, armrests and maintenance of proper working distance including the use of appropriate magnifications are essential. Because this problem is multifactorial, any possible solution should be multifactorial as well and can be managed or alleviated effectively using a multifaceted approach that includes preventive education, proper selection and use of ergonomic equipment and frequent breaks with stretching and postural strengthening techniques.

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