Musculoskeletal symptoms among dentists in relation to work posture

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Objective: To determine the effect of work posture on musculosketal complaints in Israeli dentists.

Methods: The population included 60 male dentists mean age was 46.0 ($\pm$ SD 8.66), 30 worked in sitting position and 30 were altering positions. Study population completed the standardized Nordic questionnaire and informative form concerning recipient's practice of dentistry, bio-demographic variables and questions about workloads.

Results: Musculoskeletal symptoms in the last 12 months were localized primarily in the lower back and in the neck (55% and 38.3% respectively). There was a significant correlation between the time spent sitting and the severity of low back pain ($r = 0.41$, $p = 0.01$). On the other hand there was no significant correlation between time spent sitting and other musculoskeletal complaints ($r = -0.16$).

Conclusions: Dentists who work in the sitting position have more severe low back pain than do those who alternate between sitting and standing despite the fact that those who sat at least 80% of the time worked less hours and had less of a workload during their working hours. This suggests that altering position should be recommended to dentists. An intervention study, however, is needed to demonstrate that changing posture will decrease the prevalence of low back pain in dentists.

Keywords: Sitting position, altering position, workload, practice of dentistry

1. Introduction

Workload imposition is an important factor in the occurrence of musculoskeletal symptoms in general and specifically back pain among the working population [12,26].The life-time history of low back pain ranges from 51–80% [13,29]. Throughout western society, low back pain among working population has increased dramatically [5,7,19,20,30].

Studies note a higher incidence and prevalence of musculoskeletal symptoms and back pain among dentists than other occupational groups [7,14,17,19,23,31]. Studies have reported a prevalence of 30 to 70 percent of musculoskeletal pain among dentists [2,16,24,28].

Musculoskeletal symptoms among dentists have been considered a consequence of the workload of dental practice. Dentists' work includes several well-known risk factors for musculoskeletal symptoms in general and specifically for low back pain. The following widespread postures among dentists are considered risk factors: Forward bent sitting posture, accompanied with bending and twisting, and the relative static work [1,22]. Damkot et al. [6] found that not only sitting and twisting postures effect back pain but the amount of sitting and twisting in seat has a great impact on musculoskeletal pain.

There is an agreement that changing position frequently is a key to avoid occupationally related musculoskeletal problems. Static forces require holding the body in one position and have been shown to be much more taxing than dynamic forces. During a static postural position, more than 50% of the body's muscles must be in contraction to sustain the position and resist the force of gravity. Dynamic movements utilize muscles of opposing groups, reducing fatigue and pain [3, 10,34].

While efforts have continued to improve the ergonomic design of the dental furniture, the dentist himself has received less attention [15]. The purpose of this study is to determine the prevalence of musculoskeletal symptoms among Israeli dentists and explore the relationship of work posture, bio-demographic factors, and workload factors with those symptoms.

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2. Materials and methods

The population included 60 male dentists both self employed and salaried dentists who had at least 4 years of experience, worked at least 18 hours per week and had at least five patients per working day. Mean age of study population was 46.0 ($\pm$ 8.66, range of ages 32–67). The dentists were selected by randomly calling 49 of 490 dentists who were listed in the yellow pages of Jerusalem. Thirty dentists reported that they worked at least 80% of the time in a sitting position, 13 reported alternating between sitting and standing positions ($<$ 40% of working time in sitting position and $<$ 90% of working time in standing position). In order to recruit more dentists in the alternating group, we called another 49 dentists at random and found 8 who worked in the alternating position, and finally recruited an additional 9 dentists from the University clinic where the use of the alternating position is universal.

Only 3 dentists refused to attend the study, 2 dentists who worked in sitting position and one who worked in the alternating position. Three dentists did not fit the definition of the two groups.

The investigation consisted partly of the Standardized Nordic Questionnaire for the analysis of musculoskeletal symptoms in nine anatomical regions and for the survey of low back symptoms during the previous 12 months and specifically the previous seven days [14] and partly of specific questions concerning recipient's practice of dentistry, bio-demographic variables and questions about workloads (ergonomic workload, time workload and human workload). The variable ergonomic workload included self report information about the comfort/discomfort of work station in general and chair design specifically, body mechanism (twisting the trunk), and reasonable/poor light and air circulation. The variable time load was the value of multiplying months of experience with mean weekly working hours divided by number of annual weeks. The variable human workload included referral to number of clients per hour, number of sessions in which parallel treatments are given to several clients, control over number of clients and dentists' assistant.

2.1. Data analysis

Independent variables-t-test was used to compare age, BMI, time workload and severity of symptoms of low back pain between sitting position and altering position group. Mann-Whitney test was used to compare physical activity, ergonomic load and human workload between sitting position and altering position groups.

Pearson and Spearman correlations were used to explore the association between musculoskeletal symptoms and low back pain and bio-demographic variables and workload factors. Univariate analyses were carried in order to determine whether musculoskeletal symptoms, low back pain, age, sitting position, and work loads defer on the main three practice areas of dentistry (maxillo-facial surgery, oral rehabilitation and general practice).

A probability level of $p < 0.05$ was accepted as statistically significant.

3. Results

The population included 60 male dentists, mean age of study population was 46.0 ($\pm$ SD 8.66), and mean years of experience 19.24 ($\pm$ SD 5.7). Only a minority of Israeli dentists (22% of the sample) alternated their position (spent less than 40% of their working time in a sitting position and not more than 90% of their working time in standing position).

Reported musculoskeletal symptoms in the last 12 months were predominately localized in the lower back and in the neck (55% and 38.3% respectively). The most frequent reported musculoskeletal symptoms in the last 7 days were the neck and shoulders (28.3% and 15% respectively). The highest percentage of reported pain which prevented dentists from doing normal work in the last 12 months was in the two anatomical regions low back and neck (8.3% each) (Table 1).

There was no statistical difference in the occurrence of symptoms in the last 7 days and in number of days in the last 12 months from which the dentist was prevented from doing normal work between the sitting position group and the altering position group. Only one anatomical region, the low back (in the last twelve months) showed statistical difference between the two groups. The severity of symptoms among dentists with sitting position was higher than among dentists who used the altering position (8.16 ($\pm$ 6.28), 2.73 ($\pm$ 4.52) respectively; $t = 3.84 p = 0.00$).

There was a significant statistical difference between age, time load, and human load between the sitting position group and the altering position group. Altering position group had higher mean scores on all the three variables (Table 2).

The three major practice areas of dentistry among the study population were general practice (36%), Maxillo-Facial Surgery (27%) and Oral Rehabilitation (25%).

Table 1
Occurrence of musculoskeletal symptoms in the last twelve month and at the last 7 days among study population and occurrence of dentists prevented from doing work

Dentists ($N = 60$)	Last 12 month Frequency (%)	Last 12 month prevented from doing normal work Frequency (%)	Last 7 days Frequency (%)
Neck	23 (38.3)	5 (8.3)	17 (28.3)
Shoulders	15 (25)	4 (6.7)	9 (15)
Upper back	12 (20)	2 (3.3)	8 (13.3)
Low back	33 (55)	5 (8.3)	6 (10)
Elbows	4 (6.7)	1 (1.7)	2 (3.3)
Wrists/Hands	4 (6.7)	2 (3.3)	3 (5)
Hips/Thighs	3 (5)	1 (1.7)	1 (1.7)
Knees	6 (10)	1 (1.7)	1 (1.7)
Ankles/Feet	3 (5)	0 (0)	1 (1.7)

Table 2
Comparison of independent sample variables between sitting position dentists and altering position dentists

Variables	Sitting position Mean(SD) ($N = 30$)	Altering position Mean(SD) ($N = 30$)	P values
Age	43.2 (6.5)	48.7 (9.7)	0.01
BMI	25.14 (2.18)	25.31 (2.44)	NS
Physical activity	0.63 (0.49)	0.63 (0.49)	NS
Ergonomic load	2.13 (0.68)	2.13 (0.50)	NS
Time load	190.01 (91.15)	271.86 (138.49)	0.00
Human workload	3.35 (1.07)	4.01 (0.91)	0.01

Analysis of variance was submitted with practice of dentistry and each of the following variables separately: musculoskeletal symptoms, low back pain, sitting position, age and workloads as factors; practice of dentistry being a between subject factor, and each of the others (second effect) being a within subject factor. Three practice areas of dentistry groups did not differ from each other in the dependent variables musculoskeletal symptoms and low back pain and in the independent variable ergonomic workload. Nevertheless, these three groups significantly differed from each other in working position [$F(2, 50) = 15.96$, $p < 0.00$], workload [time load: $F(2, 50) = 5.03$, $p < 0.01$, human load: $F(2, 50) = 7.65$, $p < 0.01$] and age [$F = (2, 50) = 3.33$, $p < 0.04$).

Table 3 showed significant correlations between independent variables age and time load and the dependent variable musculoskeletal pains. Furthermore, low back pain correlated only with working position, meaning that the higher the percentage of time the dentist spent in sitting position the higher he scored on the low back pain.

There was a correlation between low back pain and musculoskeletal pain ($r = 0.38$, $p < 0.01$).

There was a negative correlation between sitting and age ($r = -0.38$, $p < 0.01$), meaning that the younger the dentist is the higher is the percentage of time he was sitting while he treated his patients (was not shown in the table).

Table 3
Correlations between bio-demographic variables and workload and musculoskeletal and low back pain

Variables	Musculoskeletal pain ($n = 60$)	Low back pain ($n = 60$)
Age	0.23*	0.09
BMI	0.03	0.03
Sitting	−0.16	0.41**
Ergonomic load	0.08	−0.01
Time load	0.22*	0.06
Human workload	0.12	0.09

*$p < 0.05$; **$p < 0.01$.

4. Discussion

The most frequent percentage of reported pain and discomfort among Israeli dentists was the occurrence of low back pain in the last twelve months. The second, anatomical region that was reported was the neck. The results support the findings of similar previous studies in other countries like the findings of Marshal et al. [17], Rundcrantz et al. [25] and others who suggested that pain and discomfort were predominately localized in

the lower back and in the neck. The frequency of low back pain among Israeli dentists was 2.29 times more than the frequency of such problems among Israeli industrial workers; regarding the neck region, the frequency of pain among Israeli dentists was 3.48 times more than among industrial workers [27]. Nevertheless, those prevented from doing normal work during last 12 months showed relatively low percentage (8.3% for low back and neck), meaning that the existing of musculoskeletal problems did not interrupt work. This coincides with nowadays-clinical trend which advises patients to stay active in order to reduce back pain [32]. This is in agreement with results obtained by Guay [11] who reported that the severity of back and neck pain is rarely such that it interrupts work.

While the occurrence of low back pain in the last twelve months was the highest, the occurrence of pain in this region in the past 7 days was only the third with a frequency of 10%. It would be expected that the proportion of musculoskeletal symptoms in the nine anatomical regions will diverge more or less identically in the past 12 months and in the past 7 days, but it did not. The frequency of low back symptoms in the last 7 days was even lower than point prevalence of 15% (as it appears in literature) among population who states that they are having low back symptoms [9]. The authors of this article have no explanation for this discrepancy unless there is a seasonal effect over different anatomical regions.

Regarding working position and musculoskeletal symptoms, the fact that only the low back region (in the last twelve months) showed statistical difference between the sitting group and the altering group can be due to the very low frequencies of occurrence in other anatomical regions. The lack of difference between groups concerning the neck was perhaps a result of body mechanism, which enforce dentists in both working positions use neck muscles in an awkward way. In spite of these explanations, it seems that dentists who used sitting positions experienced more severe symptoms than dentists who used altering position, even though altering position dentists were older, and had higher workloads (time and human workload) which would be considered to be more of risk [4]. Although age and workloads were higher among altering position group we did not control for it since it acted against our research hypothesis. Indeed, for dentists, special body techniques like alternating between sitting and standing reduced back pain. These findings support Wagner's [33] article, which recommended altering position to reduce fatigue by shifting muscular support to opposing groups.

A specific causal relationship of occupational requirements to musculoskeletal pain is difficult to establish and it is more accurate to look for multifactorial etiology for musculoskeletal symptoms. Biodemographic variables and environmental variables might give a better perspective for the understanding of musculoskeletal problems.

4.1. Age

Studies note an association between musculoskeletal problems and age [9,24]. Indeed such correlation was found but the correlation coefficient was low, and no correlation was found between low back pain and age. It seems that low correlation on one hand and no correlation on the other was partially due to interfering variables like practice of dentistry, different working positions and ergonomic workloads, all factors which contributed to muscuskeletal symptoms and were indeterminate to the age effect.

4.2. Ergonomic workload

The effectiveness of ergonomic workload is controversial; on one hand the effectiveness of ergonomic work site was proven to avoid recurrent episodes of pain and disability [33] and on the other hand ergonomics variables showed a low predictive value for recovery or for the development of pain and discomfort [25]. Moreover, in spite of improvements of the ergonomic design of dental equipment and in the work environment, musculoskeletal pain and discomfort did not improve [16,24]. Indeed this research did not show a correlation between ergonomic workload and musculoskeletal symptoms. Yet, one should remember that the variable ergonomic workload was self-reported and unlike time workload and human workload, which were informative variables, ergonomics might need to rely on a professional analysis.

4.3. Time workload

Since dentists are working on a fixed schedule which is planned weeks or days in advance we expected time pressure to be a risk factor to low back pain [2]. No significant correlation was found between time workload and back pain in this study but time load did correlate significantly with musculoskeletal symptoms.

4.4. Human workload

The highest human workload score was among maxillo-facial surgeons even though the existence of dental assistance is more common among them, a fact which should minimize stress and fatigue while achieving maximum efficiency in the practice of operative dentistry. In fact, the significant increase in the frequency of musculoskeletal pain reported by maxillo-facial surgeons may be due to the reduction of movement associated with greater utilization of dental assistant or with longer periods working without taking a break [17].

4.5. Practice of dentistry

Although practice of dentistry did not explain the variance of musculoskeletal symptoms and low back pain, still dentists who specialized in maxillo-facial surgery suffered almost twice as much from musculoskeletal pain (3.06) than dentists who specialized in oral rehabilitation (1.60) and general practice (1.86). Maxillo-facial surgeons had more time and human workloads than oral rehabilitation and general practice. The mean scores of low back pain among general dentists (6.63) was approximately twice as much as the mean scores of dentists (3.7) and oral rehabilitation dentists (3.03). The analysis of variance showed that general dentists used the sitting position 3.21 times more than maxillo-facial surgeons and 1.44 times more than oral rehabilitation dentists. These data were reflected in the correlation analysis which was discussed above.

4.6. Limitations

Dentists' population was taken from the Jerusalem district, which initially had been only one district in Israel. To what degree this represents the population of dentists in Israel is not clear. However the distribution of muscoloskeletal complaints is comparable with that found in other studies [17,25,30].

The use of a questionnaire as a diagnostic tool for musculoskeletal symptoms and low back pain is as accurate as any other devices, since rarely are diagnoses for musculoskeletal symptoms and low back pain scientifically valid [20]. The Nordic questionnaire is in common use and yet the Nordic questionnaire has no details about the frequency or duration of the inability to work. Nor does the questionnaire indicate whether the person has been on sick-leave or has just slowed down his speed of work.

Subsequently, this is a retrospective study and the correlation we found does not necessarily represent the cause for the symptoms. A prospective study is needed to confirm the results of this study.

Despite these cautions in the interpretation these data, a number of potentially significant findings do emerge. The severity of low back pain among dentists with sitting position was higher than among dentists who used the altering position.

Practice of dentistry differed from each other in working position, workload and age. As for the association between musculoskeletal symptoms and back pain with bio-demographic and workload factors, age and time load correlated with musculoskeletal symptoms and low back pain correlated significantly only with working posture.

5. Conclusions

Dentists who work in the sitting position have more severe low back pain than do those who alternate between sitting and standing, despite the fact that those who sat at least 80% of the time worked less hours and had less of a workload during their working hours. This suggests that altering position should be recommended to dentists. An intervention study, however, is needed to demonstrate that changing posture will decrease the prevalence of low back pain in dentists.

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