Occupational shoulder pain in the dental profession—orthodontists, oral and maxillofacial surgeons, and general dental practitioners

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ABSTRACT Objectives. To investigate and compare the prevalence of occupational shoulder pain among different dental specialties: orthodontists, oral and maxillofacial surgeons, and general dental practitioners. The risk factors for occupational shoulder pain were identified, with particular emphasis on the role of the specific dental treatments provided. Methods. A cross-sectional self-administered questionnaire survey was adopted. All 36 oral and maxillofacial surgeons and 44 orthodontists, together with 520 randomly sampled general dental practitioners registered in Hong Kong were selected for the study. Results. The overall response rate was 62.4%. Based on the 368 observations, the lifetime prevalence of occupational shoulder pain among dentists in Hong Kong was 65.2%, and the 1-year prevalence was 51.3%. There was no statistically significant difference in lifetime and 1-year prevalence between different specialties. Practice experience was the only risk factor found to be associated with the occurrence of occupational shoulder pain. Dental treatments such as root canal therapy, extraction, crown preparation, and scaling were found to predispose to shoulder pain of similar magnitude. Conclusions. This study has demonstrated a high prevalence of occupational shoulder pain in the dental profession in Hong Kong. Occupational shoulder pain may be a fact of life for local dental practitioners. These findings suggest control measures are needed to help lower the risk of occupational shoulder pain among dental practitioners in Hong Kong.

Introduction

Shoulder pain is a multi-factorial condition 1-3 and there are several risk factors contributing to its development. The etiological factors leading to neck and shoulder symptoms are largely occupational, such as static work and posture and psychosomatic factors 2,4-6. Some studies found that the biggest risk factors are awkward, prolonged seated postures with no back support and the limited range of motion and isometric contraction created by working in a confined area such as the mouth 7.

Musculoskeletal complaints are common work-related problems among dentists 8,9. One study found that 36% of 224 dentists experienced pain frequently or even daily. It was also noted that the high prevalence of musculoskeletal symptoms in dentists is a common feature of visually dependent occupations in which visual demands require the adoption of fixed postures for extended periods of time 10. Prolonged shoulder flexion and upper arm abduction, as well as high static muscle activity levels during common dentistry tasks were considered the major factors leading to neck and shoulder discomfort in dentists 11.

Dentists reported more problems in the neck and shoulder region than the low back 11. Occupational shoulder symptoms can also cause significant morbidity and working distress among dentists 12,13. It was found that 65% of dentists reported neck and shoulder problems 13. Dental practitioners, who use a sedentary working posture with repetitive movements accompanied by twisting or bending of the trunk whilst treating patients, were therefore classified as having a high risk of developing shoulder problems 11,12. This widespread problem, shoulder pain in dental practitioners, may require substantial medical care, cause absenteeism from work, or even lead to disability. It was reported that 42% of dentists experienced pain or became disabled due to neck and shoulder problems during preceding years 8. Swedish insurance data show that 18% of disability payments made for musculoskeletal disorders were spent on neck and shoulder problems. In
monetary terms, the total cost of neck and shoulder pain in the Netherlands was estimated at US$686.2 million. Thus, shoulder pain is widespread and imposes a considerable burden on both the affected person and society.

There is no previous formal research or available data on occupational shoulder disorders among dentists in Hong Kong. The prevalence of and factors contributing to occupational shoulder pain in Hong Kong dental practitioners remain unknown. General practicing dentists and specialists may have different risks of occupational shoulder pain due to the different nature of their jobs. By raising awareness of occupational shoulder symptoms, early preventive measures and interventions can be introduced to alleviate or stop further deterioration of the problem. There is an apparent need to investigate the prevalence of occupational shoulder pain among dental practitioners in order to raise their awareness of occupational health. Proper implementation of preventive practices can prolong their career lives and reduce absenteeism due to sick leave. Substantial socio-economic loss and insurance claims arising from occupational injuries in the dental profession can ultimately be minimized.

Methods

A cross-sectional self-administered questionnaire was used as the instrument for data collection because it costs less in terms of both money and manpower compared with personal interview or telephone surveys. The major advantages of a self-administered questionnaire lie in its better protection of respondents’ identities, making them more likely to respond to sensitive questions, and that all variables can be measured at a single point in time. Its main drawbacks are a relatively low response rate and high non-response bias. The following procedures were adopted to increase the response rate:

1. The questionnaire was kept short and clear to encourage participation.
2. A pilot study was conducted to test the validity, feasibility, applicability, and quality of the questionnaire.
3. A self-administered questionnaire with a statement outlining the objectives of the study assuring respondents’ anonymity was sent to dentists in the target sample. Self-addressed stamped envelopes were provided.
4. All the dental practitioners who were sent questionnaires were followed up with a reminder telephone call.
5. An advertisement was placed in the Hong Kong Dental Association Newsletter to raise awareness of the survey.
6. A metric measuring tape was enclosed in the envelope as a compliment and as a standard measuring tool.

Inclusion criteria

The study target population consisted of all orthodontists, oral and maxillofacial surgeons, and general dental practitioners registered with the Hong Kong Dental Council up to July 2003. The study population included a random sample of general dental practitioners plus all orthodontists and oral and maxillofacial surgeons in Hong Kong. Only dental practitioners with a clear practice address on the Hong Kong Dental Council’s ‘List of Hong Kong Registered Dentists’ up to July 2003, who had been practicing in the past year and who had been in practice for at least 1 year, were considered. Orthodontists and oral and maxillofacial surgeons who were on the ‘Lists of Registered Dentists Who Have Been Granted Approval by the Dental Council to Use Specialist Titles’ up to July 2003, or practiced their specialties at Hospital Authority or Department of Health institutions or at the Prince Philip Dental Hospital, were included.

Exclusion criteria

Dental practitioners without practice addresses on the registration list, those who had not practiced between August 2002 and July 2003 or those who had been in practice for less than 1 year were excluded from the survey. Dentists who had ever injured their shoulders in an accident were also excluded.

Instrument

The self-administered questionnaire was adopted from a modified English version of the standardized Nordic questionnaire. Additional questions concerning demographic data, occupational activities, lifestyle, and other possible risk factors for occupational shoulder pain were included. The Nordic questionnaire was developed to assess musculoskeletal complaints and disorders.

To solve the problem of the poor specificity associated with symptom-based definitions, it is useful to incorporate a pain drawing diagram to restrict the definition. A shoulder complex diagram (Figure 1) that had been recommended for a survey assessing shoulders symptoms in the general population was included in the questionnaire.

Outcome measures

Shoulder pain was defined as aches, pain, or discomfort in the area specified by a shoulder complex diagram.
Occupational shoulder pain among dentists

The lifetime prevalence and 1-year prevalence of occupational shoulder pain were assessed. Demographic factors, occupational factors, and lifestyle factors (Table) were investigated as predictor variables.

**Statistical methods**

All the questionnaires received were systematically checked for completeness. The Statistical Package for the Social Sciences (Version 10.0, SPSS Inc., Chicago [IL], US) was used for data analyses.

The Student’s t test was used to test the significance of association between the risk factors measured as numerical data and occupational shoulder pain. Risk factors including age, length of the dominant arm, practicing experience, and clinical hours per week were measured as numerical data. A Chi squared test was used to test the significance of association between the risk factors measured as ordinal or categorical data and occupational shoulder pain. Risk factors including gender, specialty, dental treatment, and regular exercise habits were measured as categorical data. Body mass index (BMI) was measured as ordinal data. A P value of less than 0.05 was considered statistically significant.

A multiple logistic regression analysis was used to explore the possible risk factors and to estimate the magnitude of the association with shoulder pain after adjusting for the confounding effect of other variables. A P value of less than 0.05 was considered statistically significant.

**Results**

**Response rate**

A total of 510 questionnaires were mailed to the general dental practitioners, and 323 of these questionnaires were returned giving a response rate of 63.3%. Of 44 questionnaires mailed to orthodontists, 27 were returned giving a response rate of 61.4%. Of 36 questionnaires mailed to oral and maxillofacial surgeons, 18 questionnaires were returned. A response rate of 50% was recorded. In total, 590 questionnaires were sent out and 368 were returned, giving an overall response rate of 62.4%.

**Prevalence of occupational shoulder pain**

The lifetime prevalence of occupational shoulder pain among dental professionals in Hong Kong was found to be 65.2%. Meanwhile, the 1-year prevalence of occupational shoulder pain was 51.3%.

**Risk factors for occupational shoulder pain**

**Demographic factors**

Sex

The respondents were 28.4% female and 71.3% male. One respondent did not specify gender. The lifetime prevalence of occupational shoulder pain for females was 72.7% and for males was 62.4%. The 1-year prevalence for females was 61.4% and 47.5% for males (Figure 2). For 1-year

Two multiple logistic regression analyses were performed using lifetime prevalence and 1-year prevalence of occupational shoulder pain separately as the dependent variables. A forward stepwise regression strategy was adopted to determine the association between the dependent variables and the independent variables after adjusting for confounders.
prevalence, a significant difference was found between female and male dentists (P=0.029).

Age
The age of the respondents ranged from 25 to 65 years. The mean age was 41.2 years (standard deviation [SD], 7.77 years). The majority (76.4%) were aged between 30 and 49 years. Figure 3 presents the prevalence of occupational shoulder pain in different age-groups. A significant association was found between age and both the lifetime and 1-year prevalence of occupational shoulder pain with P values of 0.005 and 0.027, respectively.

Body mass index
The BMI was calculated as the ratio of body weight to the square of the body height using kilograms and meters. Values for BMI were divided into three groups according to the recommendations from the World Health Organization for Asian populations: <18.5=underweight, 18.5-22.95=normal, and >22.95=overweight. Around half of the dental practitioners in Hong Kong (51.8%) had a normal BMI. No significant association was found between BMI and both the lifetime and 1-year prevalence of occupational shoulder pain (P=0.060 and 0.105, respectively).

Length of dominant arm
Arm length was measured from the tip of the little finger to the olecranon process. The length of respondents’ dominant arms ranged from 35.5 to 50.0 cm with a mean of 40.4 (SD, 4.81) cm. No significant association was found between the length of the dominant arm and both the lifetime and 1-year prevalence of occupational shoulder pain (P=0.126 and 0.114, respectively).

Occupational factors

Specialty
The lifetime prevalence and 1-year prevalence of occupational shoulder pain among different dental specialties including general dental practice, orthodontics, and oral and maxillofacial surgery, are shown in Figure 4. There were no significant differences in the lifetime and 1-year prevalence of occupational shoulder pain among general dental practitioners, orthodontists, and oral and maxillofacial surgeons (P=0.359 and 0.176, respectively).

Practicing experience
Respondents’ practicing experience ranged from 1.0 to 40.0 years with a mean of 15.5 (SD, 6.79) years. The majority (80.6%) had been working in the dental profession for 10 to 29 years. Figure 5 presents the prevalence of occupational shoulder pain by years of practicing experience. A significant association was found between years of practicing experience and both lifetime and 1-year prevalence of occupational shoulder pain by years of practicing experience. A significant association was found between years of practicing experience and both lifetime and 1-year prevalence of occupational shoulder pain (P=0.003 and 0.009, respectively). It is worth noting that the years in practice and occurrence of shoulder pain exhibited an
inverse relationship. It was shown that the longer one practiced dentistry, the less likely one is to suffer from shoulder pain.

Clinical hours per week
Respondent’s chairside time ranged from 5.0 to 90.0 hours per week with a mean of 41.7 (SD, 12.0) hours per week. No significant association was found between clinical hours per week and both the lifetime and 1-year prevalence of occupational shoulder pain (P=0.519 and 0.654, respectively).

Dental treatment
As there were too few subjects in the orthodontist and oral and maxillofacial surgeon groups, statistical analyses of the effects of different dental treatments were only performed on the 270 complete questionnaires from general dental practitioners. Different dental treatments including root canal treatment (RCT), crown preparation, scaling, and surgery/extraction were compared. The distribution and prevalence of occupational shoulder pain provoked by various dental treatments provided are shown in Figure 6.

In this category, respondents could choose more than one answer. No significant association was found between the types of dental treatments provided and both the lifetime and 1-year prevalence of occupational shoulder pain (P=0.837 and 0.334, respectively).

Lifestyle factors
Regular exercise habits
Respondents who exercised at least once a week for not less than 30 minutes each time were classified as having
regular exercise habits. Over half of the respondents (61.6%) had regular exercise habits. No significant association was found between having regular exercise habits and both the lifetime and 1-year prevalence of occupational shoulder pain (P=0.756 and 0.620, respectively).

**Multivariate analyses of proposed risk factors**

A multiple logistic regression was applied to explore the possible risk factors and the magnitude of association with occupational shoulder pain after adjusting for the confounding effect of other variables. A forward stepwise regression strategy was adopted. Practicing experience was the only risk factor that was significantly associated with both lifetime and 1-year occupational shoulder pain.

**Discussion**

This is the first survey of occupational shoulder pain among dental professionals in Hong Kong. The response rate was 62.4% while those of previous similar questionnaire surveys among dentists in Hong Kong have been between 57% and 63% 27-29. Thus, the survey response rate was considered satisfactory compared with previous studies.

The occupational medicine division of the Hong Kong Labour Department was consulted on the prevalence of occupational shoulder pain in both the general population and different occupations. As occupational shoulder pain is not considered a notifiable occupational disease in the Occupational Safety and Health Ordinance, they do not have any such statistics available.

Other countries 8-13 report prevalence rates ranging from 36% to 65%, making the prevalence rates of occupational shoulder pain among Hong Kong dental professionals found by this study on the high side (65.2% for lifetime and 51.3% for 1-year). This might be attributed to the greater psychological stress experienced and longer clinical hours worked by dental practitioners in Hong Kong 28-31.

In Sweden, female dental personnel were found to have a higher prevalence of musculoskeletal disorders 32. In the present study, gender was significantly associated with occupational shoulder discomfort using univariate analysis but it was not a significant risk factor when analyzed with a multiple regression analysis. This indicates that gender might have a lower magnitude of association with occupational shoulder discomfort or acted as a confounding factor.

A significant association was detected between age and both lifetime and 1-year occupational shoulder pain by univariate analysis but this was not the case after multiple regression analysis. As age strongly correlates with years of practicing experience, it acted as a confounding factor and its effect was adjusted for by using stepwise regression strategy.

Practicing experience was found to be a risk factor for both lifetime and 1-year occupational shoulder pain for local dentists using both univariate and multivariate analyses. Years of practicing experience were negatively associated with the prevalence of occupational shoulder pain. These findings are similar to those of several studies on musculoskeletal or occupational disorders 33,34. A study reported that younger dentists experienced more pain and discomfort in the musculoskeletal system than did their older counterparts. Higher psychological stress was also associated with less experience in dentists 29. This might be because they are less skillful or less aware of the physical strain on the musculoskeletal system. In addition, a 'healthy worker effect' might exist in the dental professional. Those who suffer from shoulder pain tend to leave their jobs, whereas the healthy workers stay in the profession. Further research is thus required to elicit the real reason for this effect.

Both lifetime and 1-year occupational shoulder pain prevalence were not associated with BMI, length of the dominant arm, specialties, clinical hours per week, types of dental treatment provided, or regular exercise habits. A study of wheel-chair users found that arm length was a risk factor for developing shoulder pain. Wheel-chair users with shorter arms were more likely to suffer from shoulder pain, as they had to stretch their arms more vigorously and frequently 35. As most of the dental operational units, such as bracket tables, operator chairs, and dental chairs, are adjustable in position and height, dentists can modify the setup according to their body build. Good ergonomic design might help minimize the strain on shoulders and arms.

It was suggested that a high and prolonged static muscle load could induce shoulder discomfort among dentists 11. A high BMI and long clinical hours closely related to heavy muscle load, yet in this study no association was detected between these two factors and occupational shoulder pain.

In this study, general dental practitioners, orthodontists, and oral and maxillofacial surgeons had similar risks of occupational shoulder pain regardless of their differing natures of their jobs. Nevertheless, they have similar working environments: using monotonous, repetitive actions throughout the working day, and suffering a limited range of motion and isometric contraction created by operating in a confined area, the mouth. Those conditions
are considered occupational risk factors for shoulder symptoms 2,4,7.

Dental treatments including RCT, crown preparation, scaling, and surgery/extraction were found to have no significant association with both the lifetime and 1-year prevalence of occupational shoulder pain. This was also so when dental examination, tooth cleaning, and dental filling therapies were compared. There were no differences detected between these work tasks regarding posture, frequency of movement, or muscle activity. Shifting between those work tasks will not generate the variation needed to reduce the load on the shoulders, thus the discomfort might not be alleviated 11.

Many studies have stated that strength, endurance or coordination training of neck and shoulder muscles might alleviate pain in work-related myalgia, as the upper body muscles usually get over-stretched by daily activities and work 36,37. No significant association was detected between regular exercise habits and occupational shoulder pain in this study. As the type and frequency of exercise programs were not specified in the questionnaires, further clinical research is essential to investigate the effect of regular exercise on shoulder discomfort for local dental practitioners.

Limitations and potential biases

The overall response rate of this survey was 62.4%, while those of previous questionnaire surveys among dental practitioners in Hong Kong 27-29 were between 57% and 63%. In this respect, the response rate of this survey was considered satisfactory. Nonetheless, the prevalence of occupational shoulder pain, among the non-respondents i.e. more than 30% of the sample, was unknown. As such, the real prevalence of occupational shoulder pain might be under- or over-estimated. A further reminder call to initial non-respondents may improve the response rate but that could not be done in this study due to limited manpower and because the need for anonymity meant non-responders were not linked by name to telephone numbers. Earlier studies have found that non-respondents usually do not cause significant bias in studies conducted in the well-educated, homogeneous populations to which dentists belong 38.

As this is a cross-sectional study, causal inferences could not be drawn from the results. The causal relationship should be evaluated by a cohort study. Another limitation of this study was the reliance on self-reported data. With all self-reported data, there was a possibility that individuals with symptoms tend to overestimate their exposure, thus inflating the risk estimates 39,40. Some of the respondents might not remember exactly what happened, leading to recall bias. There may be bias caused by illness as those dentists who had ever experienced occupational shoulder pain might be more eager to respond while those who had suffered severe shoulder pain might have left the profession already.

Conclusions

The present survey targeted the entire population of local orthodontists, and oral and maxillofacial surgeons, and a representative sample of general dental practitioners, thus the study outcomes reflect the prevalence of occupational shoulder pain in Hong Kong dental practitioners.

The study confirmed that there was no significant difference in the prevalence of occupational shoulder pain between the three specialty groups. This indicates that while the scope of service is different for general dental practitioners and the other types of dental specialists, all are equally vulnerable to occupational shoulder pain. The prevalence of occupational shoulder pain among dental practitioners in Hong Kong is on the high side compared with other countries. This might be attributed to greater psychological stress and the longer clinical hours worked by dental practitioners in Hong Kong compared with dentists in other countries. Various dental treatments such as RCT, crown preparation, scaling, and surgery/extraction were found to have no significant association with both the lifetime and 1-year prevalence of occupational shoulder pain. This showed that shifting or rotation of tasks would not significantly reduce the load on the shoulders or alleviate discomfort for dental practitioners.

Dental practitioners, particularly those in the initial stages of their careers, should pay more attention to occupational health and safety. Regular exercise may help lessen the occurrence of occupational shoulder pain, though this factor was not statistically significant in the present study. The only risk factor found in this study was years of practice. As occupational shoulder pain is a fact of life for dental practitioners, what we have to consider is how to minimize or alleviate it. Prevention is always better than cure and more attention should be paid to occupational health and safety. Health education is thus considered important in preventing occupational shoulder pain among dentists.

These findings provide a basis for stimulating further research into risk factors and preventive measures for occupational shoulder pain among dental practitioners. A cohort study is needed to evaluate the causal relationships between risk factors and occupational shoulder pain. The
results also throw light on the need to develop control measures to help lower the risk of occupational shoulder pain among dental practitioners in Hong Kong. Various occupational safety programs should be stepped up to prevent the occurrence of occupational shoulder pain. This should reduce the cost of absenteeism, prolonged sick leave, and insurance claims.

Acknowledgment

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References