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Respiratory Findings in Dental Laboratory Technicians in Rasht (North of Iran)

Ali Alavi, Maryam Shakiba, Azita Tangestani Nejad, Sara Massahnia, Ali Shiari

Respiratory Diseases and TB Research Center, Guilan University of Medical Sciences (GUMS), Razi Hospital, Rasht- Iran.

ABSTRACT

Background: *There are several occupations that can expose people to some air pollutants. Dental technicians are exposed to inorganic dust and chemical vapors when making dental prosthesis that can put them at risk for respiratory problems. This study was performed to assess respiratory dysfunction in a group of dental technicians.*

Materials and Methods: *This was a cross-sectional study designed to ascertain the prevalence of respiratory disorders in dental laboratory technicians in Rasht, a city located in north of Iran. A Structured questionnaire was adapted according to the European Community Respiratory Health Survey questionnaire and used to elicit information regarding sociodemographic characteristics and medical status of the study participants. The ventilation status, protective measures and direct exposure to materials in the laboratories were directly observed by the observers and subjects underwent respiratory tests and chest x-ray.*

Results: *The mean age of dental technicians was 31.31 yrs (range 18-56 years) and 83% were males with a mean dental work experience of 9.04 years. In 54.8% of cases, the work environment did not have air conditioning system. The most common signs and symptoms were cough (38.1%) and wheezing (16.7%).There was a significant correlation between smoking and respiratory signs. Restrictive airway pattern and air trapping were two prevalent findings which were observed in 85.7% and 33.3% of the subjects. Cigarette smoking had a negative effect on FEV1, $FEF_{25\%-75\%}$, and TLC causing a significant reduction in all three parameters ($p<0.05$). The most prevalent finding was interstitial opacity which was observed in 10 individuals (23.8%).This finding was not significantly associated with age, gender, cigarette smoking, or daily work hours. However, there was a significant statistical association between work experience and interstitial opacity.*

Conclusion: *The prevalence of respiratory dysfunction and chest x-ray findings were high as in several similar studies. In order to reduce the hazards of respiratory disorders in risky occupations and provide dental workers with technical preventive measures, a more comprehensive study should be conducted throughout the country and further evaluations through biopsy and CT-scan need to be performed in suspicious cases when necessary.* ***(Tanaffos2011; 10(2): 44-49)***

Key words: *Dental technicians, Respiratory disorders, Respiratory function test*

INTRODUCTION

Lung diseases such as pneumoconiosis have sometimes been seen in dental technicians. They are frequently exposed to a considerable amount of metallic and acrylic dust during finishing and grinding when making dental prostheses. These hazardous materials increase the risk of pneumoconiosis (1-5), asthma (5), pneumoconiosis hypersensitivity (5-8), chronic obstructive pulmonary diseases (COPD), cancer, fibrosis and pulmonary granulomatosis in dental technicians (5-7,9,10).

Correspondence to: Alavi A

Address: Respiratory Diseases and TB Research Center, Razi Hospital, Rasht, Iran.

Email address: smassahnia@yahoo.com

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Dental prostheses are made by taking a negative impression of the patients' tooth and plaster is used to make a positive mould. A wax model used in the manufacture of ceramic prostheses is filled in with molten nickel-chromium alloy; after the mould is cooled down, it is broken and the prostheses are finished. In Resin prostheses, the negative impression is filled in with methyl methacrylate and the prosthesis is hand finished. Plaster, silica, wax, chromium, nickel and cobalt, ceramic and resin are the main contaminants when manufacturing dental prostheses. Beryllium is added to increase the resistance of nickel-chromium alloys; however, most alloys lack it. Asbestos used to be applied as an isolating film between the cylinder and refractory material but its use has been prohibited in France since 1997.Several studies have been conducted to examine the risks leading to respiratory difficulties in dental laboratory technicians. Such risks can increase by inadequate local exhaust ventilation (11-13).

This study aimed to assess respiratory disorders among dental technicians in Rasht. It also provides strategies to prevent respiratory disorders caused by the work environment in other individuals exposed to the same risk factors.

MATERIALS AND METHODS

This was a cross-sectional study, designed to ascertain the prevalence of respiratory disorders in dental laboratory technicians in Rasht, a city in north of Iran. We obtained a list of dental technicians from Iranian Dental Association, Guilan branch and with the cooperation of an expert in this field, we invited all the eligible subjects to participate in this study. Number of dental technicians working in Rasht was approximately 72 subjects, of whom 30 refused to participate (58 % participation rate). A Structured questionnaire was adapted according to the European Community Respiratory Health Survey questionnaire and used to elicit information regarding sociodemographic characteristics and medical status of the study participants. The ventilation status, protective measures and direct exposure to materials in the laboratories were directly observed by the observers. All subjects underwent clinical examination based on findings and respiratory symptoms. Chest x ray was also done for the subjects. Despite all the efforts and arrangements made, 12 technicians did not undergo chest x-ray .A total of 30 subjects underwent CXR and the results were interpreted by both radiologist and pulmonologist. In addition, pulmonary function test was performed according to the American Thoracic Society Guidelines (14) for 37 individuals. Pulmonary function test was consisted of spirometry and body box, which was performed by an spirometry technician. FVC, $FEV_{1,}$ $FEF_{25-75,}$VC, and RV as well as other important values were measured by spirometry. Then spirometric results were interpreted and type of disorder was identified for each individual. The results were recorded in the questionnaires. All the participating technicians granted consent to participate in this study and the researchers were obliged to follow moral principles during the research project. Clinical examination, respiratory function test and chest radiography were performed free of charge for all individuals. Participants were mostly concerned about the test results and we tried our best to reassure them about the usefulness of the possible findings in this study for their treatment and teach them some preventive measures. Variables were described as mean (SD) and valid and relative frequencies. In order to assess the relationships between variables, t-test and chi-square tests were conducted. A linear regression model was then performed to determine the association of the independent variables with pulmonary function and β coefficient adjusted for all

variables was measured. In all tests, p-value<0.05 was considered significant. Data analysis was conducted using SPSS version 16 software. The Research Vice-chancellorship of Guilan University of Medical Sciences (GUMS) approved the study and funded this survey.

RESULTS

A total of 42 subjects were studied. The study sample comprised of 35(83.3%) men and 7(16.7%) women. Out of 42 subjects, 30 (71.4%) underwent CXR and 37(88.1%) underwent pulmonary function assessment through spirometery. Table 1 shows the demographic characteristics of the subjects. Table 2 shows individuals' exposures to the dangerous materials. The most prevalent materials that technicians were exposed to after plaster were resin, methacrylate, beryllium and nickel.

Table-1 Demographic characteristics of the subjects

Variables	Total participants (n=42)
Age(year) Mean ±SD	31.31(8.83)
Work experience (year) Mean ±SD	9.04(7.19)
Daily work hours (hour) Mean ±SD	2.36(1.38)
Gender N(%)	
Male	35(83.3)
Female	7(16.7)
Ventilation status N(%)	
Yes	19(45.2)
No	23(54.8)
Protection N(%)	
Yes	8(19)
No	34(81)
Cigarette smoking N(%)	
Yes	13(31)
No	29(89)
Direct exposure to material N(%)	
Yes	39(92.9)
No	3(7.1)
Family history of pulmonary diseases N(%)	
Yes	15(35.7)
No	27(64.3)

Table 2. Frequency of exposure to dangerous materials in our study subjects.

	Frequency(%)	95%CI
Cobalt	22(52.4)	37.28-67.48
Chromium	24(57.1)	42.17-72.11
Asbestos	11(26.2)	12.89-39.49
Silica	25(59.5)	44.67-74.37
Nickel	27(64.3)	49.8-78.78
Palladium	17(40.5)	25.63-55.33
Beryllium	27(64.3)	49.8-78.78
Resin	31(73.8)	60.51-87.11
Methyl methacrylate	30 (71.4)	57.77-85.09
Aluminum	8(19)	7.17-30.93
Cobalt – chrome – molybdenum	20(47.6)	32.52-62.72
Plaster	42(100)	

Respiratory disorders assessment:

In order to evaluate respiratory disorders, signs and symptoms, respiratory function and chest radiography were evaluated.

1) Signs and symptoms

Assessment of signs and symptoms was performed for all subjects. Table 3 shows the signs and symptoms in the study subjects. None of the respiratory disorder signs and symptoms (stridor, pleural friction rub, mediastinal shift, abnormal bronchial sound and clubbing) were detected in the subjects. Coughing was the most prevalent symptom reported by 38.1% of the technicians followed by dyspnea and wheezing which were observed in%21.4 and 16.7% of the individuals, respectively. Wheezing and crackle were two of the most prevalent findings reported in 16.7% and 7.1% of the subjects, respectively. Age and gender had no significant statistical association with the occurrence of signs and symptoms. There was a significant statistical association between cigarette smoking and symptoms ($p<0.01$); 46.2% of the smokers and 10.3% of the non-smokers had one of the symptoms (OR = 7.43, 95%CI: 1.47-37.4). Cigarette smoking was not significantly associated with any sign .There was no significant association between proper ventilation,

good protection, exposure to materials and work experience, daily work hours, familial history of allergic diseases and occurrence of signs and symptoms.

Table 3. Clinical findings.

	Frequency(percent)	95%CI
Dyspnea	7(16.7)	5.4-27.94
Cough	16(38.1)	23.41- 52.79
Hemoptysis	2(4.8)	-1.68-11.2
Wheezing	9(21.4)	9.02-33.84
Stridor	1(2.4)	3.71-24.87
Chest pain	6(14.3)	3.71-24.87
Wheezing	7(16.7)	5.4-27.94
Crackle	3(7.1)	-0.65-14.93
Decreased breath sounds	1(2.4)	-2.23-6.99
Intercostal space retraction	1(2.4)	-2.23-6.99

2) Pulmonary function assessment through spirometery

Spirometric assessment was performed for 37 individuals. Table 4 shows spirometric findings in the subjects. Air trapping and restrictive airway pattern were two prevalent findings observed in 85.7% and 33.3% of the subjects, respectively. These two findings had no significant association with the independent variables including demographic characteristics and work environment.

Pulmonary function was assessed in study individuals using a spirometric procedure. Table 5 displays the subjects' pulmonary function correlated with a linear regression test on the basis of demographic data and workplace conditions. Cigarette smoking had a negative effect on FEV1, $FEF_{25\%-75\%}$ and TLC causing a significant reduction in all three parameters ($p<0.05$).There was a negative association between age and RV/TLC. Family history had a negative association with TLC and RV/TLC.

3) Assessment through chest x-ray

Thirty subjects underwent chest radiography examination. Table 6 shows the frequency of the radiologic findings in the subjects. The most prevalent finding was interstitial opacity which was observed in 10 individuals (23.8%).This finding was not significantly associated with age, gender, cigarette smoking or daily work hours. However, there was a significant statistical association between work experience and interstitial opacity. The mean work experience in individuals with radiologic findings was 12.92±7.35 yrs which was significantly higher than those without such findings ($p<0.05$).

Table 4. Spirometric findings of subjects.

	Mean (SD)	95%CI
FEV1	94.97(14.46)	91.3-98.64
FEV1/FVC	88.42(5085)	86.94-89.9
FVC	89.99(12.86)	86.73-93.25
FEF 25%-75%	96.72(22.73)	90.95-96.49
TLC	87.56(14.82)	83.8-91.32
VC	90.55(15.66)	86.27-9433
RV/TLC	26.03(8.58)	23.85-28.27
Air trapping (%)	36 (85.7)	75.13-96.29
Restrictive airway pattern (%)	14 (33.3)	19.07-47.59
Obstructive airway pattern (%)	3 (7.1)	-0.65-14.93
Small airway obstructive pattern (%)	1 (2.4)	-2.23-6.99
Upper airway obstructive pattern (%)	1 (2.4)	-2.23-6.99
Hyperinflation (%)	1 (2.4)	-2.23-6.99

Table 5. Association between study variables and pulmonary function parameters using a linear regression model.

	FEV1	FEV1/FVC	FVC	FEF 25%-75%	TLC	VC	RV/TLC
Age	-0.147	-0.237	-0.081	-0.524	0.3	-0.12	0.62*
Gender	11.93	-1.56	7.46	22.64	4.25	8.14	-0.33
Cigarette smoking	-13.81*	-1.73	-8.28	-20.33*	-11.74*	-10.32	2.27
Protection	-1.14	-0.91	2.29	-3.26	-2.87	-1.03	-4.89
Direct exposure	-9.11	-4.08	-1.06	-9.94	-13.95	-1.07	-11.22
Proper ventilation	-6.43	0.512	-5.27	-5.81	-3.74	-5.61	3.38
Family history	-5.11	-1.05	-6.38	-9.58	-6.98	-6.66	-3.16
Daily work hours	-0.42	0.047	-0.319	0.228	-1.197*	-0.403	-0.788*
Work experience	0.53	0.265	-0.249	0.203	1.09	0.586	0.976

Abbreviations: TLC: Total Lung Capacity, FEF: Forced Expiratory Flow, FEV1: Forced expiratory volume, FVC: Forced Vital Capacity, RV: Residual Volume, VC: Vital Capacity

Values presented are β coefficients

*significant as $p<0.05$

Table 6. Radiological findings.

	Frequency(percent)	95%CI
Interstitial opacity	10(23.8)	10.93-36.69
Calcification	4(9.5)	0.64-18.4
Alveolar opacity	3(7.1)	-0.65-14.93
Congestion	2(4.8)	-1.68-11.2
Hillar lymphnodes path	2(4.8)	-1.68-11.2

DISCUSSION

Dental technicians can be at risk of pulmonary disorders due to exposure to airborne contaminants. The assessment of respiratory disorders in such people may pave the way for preventing such conditions. In this study, respiratory disorders were assessed in 3 levels including signs and symptoms, spirometric findings and radiological evidence. A high prevalence of cough was observed in 38% of the technicians followed by wheezing and dyspnea which were reported in 21.4% and 16.7% of subjects, respectively. In a study conduced by Radi et al., the most prevalent signs were shortness of breath (24%) and cough (17%), respectively (15). Fidan et al. in a study on the data collected from 73 dental technicians in Ankara found cough (19.12%) and expectoration (41%) in dental technicians (16). Cimrin et al. reported that coughing and sputum were major symptoms in dental technicians (17). There was no significant association between smoking, proper ventilation, protection, work experience, daily work hours and symptoms.

In Kartaloglu et al. study, a significant association was observed between work experience and symptoms (18). However, in our survey work experience had no significant association with signs. Froudarakis et al. showed that there was a significant difference between dental technicians and controls in terms of the prevalence of abnormal symptoms (19). Among spirometric findings, the most prevalent disorders were air trapping and restrictive airway pattern which had no association with work experience, protection and etc. In this survey, smoking caused a significant reduction in TLC, FEF_{25-75} and FEV_1. The noticeable finding was the negative effect of work experience on RV/TLC and TLC parameters. Increased work experience caused a significant reduction in these parameters ($p<0.05$). This result was in agreement with Kartaloglu's study which reported negative effect of smoking on spirometric parameters including FVC, FEV_1 and $FEF_{25\%-75\%}$ (18). The most common radiologic

finding was interstitial opacity with a high prevalence of 23.8%. There was a significant association between this finding and work experience. Considering the radiologic findings, occupational respiratory disorders in dental technicians is an important matter requiring attention. Because of the missing data, prevalence of some disorders was underestimated. For example, as some individuals refused to undergo chest x-ray examination, some findings remained unknown. In order to reduce respiratory hazards in high risk occupations and provide dental workers with technical preventive measures, a more comprehensive study should be conducted throughout the country and further medical examinations through biopsy and CT-scan are required in suspicious cases when necessary.

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