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# Prevalence of respiratory abnormalities and pneumoconiosis in dental laboratory technicians

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## ÖZET

### *Diş teknisyenlerinde solunum bozuklukları ve pnömokonyoz sıklığı*

Önlenebilir bir meslek hastalığı olan pnömokonyoz kuvars, karbon, metal tozları başta olmak üzere bunlara maruz kalınan iş alanlarının birçoğunda yaygın olarak görülmektedir. Diş teknisyenliği de birçok maruziyet nedeniyle riskli iş kollarındandır, ancak bu alanda çalışanlarda pnömokonyoz ve benzeri solunumsal etkilenmeyi gösteren veriler yetersizdir. Bu nedenle çalışmamızda diş teknisyenlerinde pnömokonyoz ve solunumsal etkilenmeyi araştırmayı amaçladık. Bunun için Sivas il merkezinde çalışan tüm diş teknisyenlerinden ikisi hariç, 36 diş teknisyeni kesitsel olarak çalışmaya alındı. Bu kişilere demografik verileri, çalışma şartlarını ve yakınmalarını sorgulayan bir anket uygulandı. Standart yöntemle spirometrik incelemeleri yapıldı; akciğer grafleri biri radyolog, diğeri göğüs hastalıkları uzmanı olmak üzere iki okuyucu tarafından ILO-2000 sınıflamasına göre değerlendirildi. Çalışmaya alınan 36 diş teknisyeninin yarısına yakınında nefes darlığı ve balgam başta olmak üzere solunum sistemi ile ilgili yakınmalar, 5 (%13.8)'inde pnömokonyozla uyumlu radyolojik bulgular saptandı. Solunum semptomları açısından iki grup arasında istatistiksel olarak bir anlamlılık bulunmadı. Diş teknisyenleri grubunun solunum fonksiyon test değerleri FEV<sub>1</sub> dışında kontrol grubundan istatistiksel olarak farklı bulunmadı. Sonuçta diş teknisyenlerinin mesleki akciğer hastalıkları açısından belirgin risk altında olduğu ve bu iş yerlerinde birincil koruma önlemlerinin alınmasının zorunlu olduğu görüşüne varıldı.

**Anahtar Kelimeler:** Diş teknisyenleri, mesleki akciğer hastalıkları, pnömokonyoz.

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## SUMMARY

### *Prevalence of respiratory abnormalities and pneumoconiosis in dental laboratory technicians*

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*A preventable occupational disease, pneumoconiosis that is often widespread on to a very kind of quartz, carbon and metal dust exposed work place. The data for the prevalence of pneumoconiosis and respiratory findings among dental laboratory technician is insufficient. The aim of this study is to determine the prevalence of pneumoconiosis and respiratory findings among dental laboratory technicians, working in province of Sivas. For this reason all the dental technicians (except 2, totally 36) participated in the study. A questionnaire which contains demographic characteristics, work conditions and symptoms were applied to all participants. Also spirometric measurements and chest x-rays were performed. The x-rays of dental technicians were evaluated by a radiologist and a chest disease specialist according to the ILO-2000 classification of pneumoconiosis. Almost half of the all participants have dyspnea and phlegm expectoration. The prevalence of pneumoconiosis was 5 (13.8%) among 36 dental technicians. There were no statistically significant differences between two groups with regard to respiratory symptoms. Values of lung function parameters of the dental technician group were not significantly different from those of control group except FEV<sub>1</sub>. In conclusion, dental laboratory technicians are at significant risks for occupational respiratory diseases so the primary preventions rules are essential for these work places*

**Key Words:** Dental laboratory technicians, occupational lung disease, pneumoconiosis.

Occupational hazard can be defined as a risk to a person usually arising out of employment (1). Occupational diseases are the result of uncontrolled occupational risks. Dental laboratories carry many potential occupational risks for dental technicians. They have multiple occupational exposures, which may have adverse effects on their health (2). This is a job with relatively stable tasks, but the occupational exposure can vary, according to the working conditions and used materials (3). The health problems of dental technicians include: potential adverse respiratory effects from inhalation of dust from grinding and polishing of metal alloys, resins, ceramics, plaster and the abrasives used for polishing or acrylates; dermatitis from contact with acrylates and metals; neurotoxicity or disturbance of olfaction by methyl methacrylate monomer; genotoxic damage in lymphocytes possibly related occupational exposure to chromium, cobalt, and nickel, and health complaints caused by noises, vibration of hand pieces, and long working hours (2).

As expected, occupationally related lung diseases have been documented in this population, including dental technician's pneumoconiosis (due to chromium-cobalt-molybdenum alloys), acrylic resin pneumoconiosis, occupational asthma, and a single case of possible acute berylliosis (1,4). Several studies have been carried out to investigate pneumoconiosis and lung function abnormalities among dental technicians (2,4-19). Several epidemiological studies indicate that a high range of pneumoconiosis (9.8-24.2%) (5,7,8,11,14,17,18). Two studies were conducted to investigate the prevalence of pneumoconiosis in Turkey; and the prevalence was reported as 15.5-24.2%; however, the prevalence of respiratory abnormalities among dental technicians has not been explored yet. The aim of this study is to determine the prevalence of respiratory symptoms and the functional abnormalities and pathological chest X-ray findings among dental technicians in Sivas.

## MATERIALS and METHODS

There are six dental laboratories in Sivas province and 38 self-employed technicians worked there as self-employed. A cross sectional-study was performed among them (dental technician group), and the other 36 people selected as a control group. The control group was similar to the dental technician group with regard to age, sex, height, weight and smoking time, and they are not exposed to dental materials and they work dust free areas. Two dental technicians are excluded from the study because of acute infection and poor spirometric performance. All subjects gave informed consent before starting the study, and the study was approved by the Human Ethics Committee of our university.

The mean working time dental technicians are 14 years. Dental technicians work more than one units of 36 dental technicians, 13 of them (20.4%) work in the modelation unit, 5 (7.8%) in the plaster unit, 16 (25%) in the metal leveling unit, 8(12.5%) in the acrylic molding unit, 7 (10.9%) in the acrylic leveling unit, 8 (12.5%) in the ceramic unit and 7 (10.9%) in the polishing unit.

Information on respiratory symptoms, smoking status, age, and sex are collected by modified Occupational and Environmental Pulmonary Disease Evaluation Questionnaire of the Turkish Thoracic Society Environmental and Occupational Pulmonary Diseases Working Group (20). The questionnaires are applied to subjects by a physician face on face.

All pulmonary function tests (PFT) are performed according to the American Thoracic Society Guidelines (21). Standard spirometry evaluations are performed using a dry-seal spirometer (Minato Autospiro as 600, Japan).

The spirometer is calibrated in every dental laboratory and also temperature and humidity are measured for calibration (Lutron, Taiwan). The Forced Vital Capacity (FVC) maneuver is applied all subjects according to the standard procedure (21).

Posterior-anterior (PA) chest X-rays were taken in the University of Cumhuriyet, Faculty of Medicine Department of Radiology. Short exposure time and high voltage technique are used to take X-rays. (Toshiba, kwo-50F, Tokyo, Japan). X-rays are evaluated according to the ILO-2000 classification by two readers; one of them is a radiologist and another is a chest specialist. By the ILO category 1/0 and upper is considered as pneumoconiosis (22).

### Statistical Analysis

Data are presented as mean  $\pm$  SD and percentage as appropriate. Data analyses are performed with the t test for continuous variables and the  $\chi^2$  test for ratios. The Spearman correlation analyses are performed to examine the relationship of working years and opacity category of the dental technician group. A p value  $<$  0.05 is accepted as significant.

## RESULTS

The characteristics of the dental technician and control groups were shown in the Table 1. The results of the questionnaire demonstrate that dental technicians work for a long period (mean exposure 14 years) with a mean of 76 hours weekly. Only 12 dental technicians (33.4%) use ventilation systems and 5 (13.9 %) persons use face projections maskes and glasses.

**Table 1. Characteristics of dental technician and control groups.**

|                     | Dental technician group (n= 36) | Control group (n= 36) | p     |
|---------------------|---------------------------------|-----------------------|-------|
| Age (year)          | 29.3 $\pm$ 7.7                  | 29.6 $\pm$ 7.9        | 0.869 |
| Height (cm)         | 172.3 $\pm$ 5.5                 | 174.4 $\pm$ 4.9       | 0.090 |
| Weight (kg)         | 71.2 $\pm$ 10.9                 | 75.1 $\pm$ 9.6        | 0.105 |
| Smoking (pack/year) | 9.4 $\pm$ 9.0                   | 9.6 $\pm$ 9.0         | 0.928 |

The prevalence of respiratory symptoms in the dental technician and control groups are in the Table 2 and there are no statistically significant differences between two groups ( $p > 0.05$ ). The results of PFT parameters of the dental technician and the control groups are shown in the Table 3. The values of lung function parameters of the dental technician group are not significantly different from those of control group except  $FEV_1$ .

The prevalence of pneumoconiosis in the dental technician group is 13.8% (5 persons). As seen in the Table 4, the highest category is 2/3 and there is only one case in this category. There is no case at the category 3 and also there is no big opacity. The types of opacities of these five cases are demonstrated in the Table 5. As seen in the Table 5, predominant types of opacities are rounded opacities (r,q and p type). When the

**Table 2. Prevalence of respiratory symptoms in dental technician and control group.**

|                   | Dental technician group (n= 36) | Control group (n= 36) | Significance                 |
|-------------------|---------------------------------|-----------------------|------------------------------|
| Cough<br>n (%)    | 9 (25)                          | 5 (13.9)              | $\chi^2= 0.00$<br>$p > 0.05$ |
| Phlegm<br>n (%)   | 16 (44.4)                       | 16 (44.4)             | $\chi^2= 0.00$<br>$p > 0.05$ |
| Dyspnea<br>n (%)  | 16 (44.4)                       | 10 (27.8)             | $\chi^2= 2.16$<br>$p > 0.05$ |
| Wheezing<br>n (%) | 12 (33.3)                       | 7 (19.4)              | $\chi^2= 1.78$<br>$p > 0.05$ |

**Table 3. Lung function tests of dental technician and control groups.**

| RFT values    | Dental technician group (n= 36) | Control group (n= 36) | Significance     |
|---------------|---------------------------------|-----------------------|------------------|
| FVC           | 4.53 ± 1.1                      | 6.40 ± 6.6            | T= 1.74 p= 0.085 |
| FVC %         | 98.36 ± 17.4                    | 104.55 ± 15.3         | T= 1.59 p= 0.114 |
| $FEV_1$       | 3.97 ± 0.7                      | 4.44 ± 0.6            | T= 2.87 p= 0.005 |
| $FEV_1$ %     | 100.04 ± 17.9                   | 106.86 ± 13.7         | T= 1.81 p= 0.073 |
| $FEV_1/FVC$ % | 85.84 ± 8.3                     | 83.22 ± 7.4           | T= 1.40 p= 0.165 |
| PEF           | 8.60 ± 2.0                      | 8.56 ± 1.8            | T= 0.08 p= 0.930 |
| PEF %         | 92.51 ± 21.6                    | 89.55 ± 18.0          | T= 0.63 p= 0.530 |
| FEF           | 4.91 ± 1.6                      | 4.76 ± 1.3            | T= 0.43 p= 0.667 |
| FEF %         | 105.40 ± 33.0                   | 103.83 ± 23.3         | T= 0.23 p= 0.815 |

FVC: Forced vital capacity,  $FEV_1$ : Forced expiratory volume in 1 second,  $FEV_1/FVC$ : Forced expiration rate, PEF: Peak expiratory flow, FEF: Maximal flow at 25-75 percent expired vital capacity.

**Table 4. Radiographic findings by ILO category in dental technician and control groups.**

|                                | Category  |          |          |         |       |         |         |         |         |
|--------------------------------|-----------|----------|----------|---------|-------|---------|---------|---------|---------|
|                                | 0/-       | 0/0      | 0/1      | 1/0     | 1/1   | 1/2     | 2/1     | 2/2     | 2/3     |
| Dental technician group, n (%) | 16 (44.4) | 7 (19.4) | 8 (22.2) | 1 (2.8) | 0 (0) | 1 (2.8) | 1 (2.8) | 1 (2.8) | 1 (2.8) |
| Control group, n (%)           | 25 (69)   | 6 (17)   | 5 (14)   | 0 (0)   | 0 (0) | 0 (0)   | 0 (0)   | 0 (0)   | 0 (0)   |

ILO: International Labour Organization.

**Table 5. Radiographic, RFT and demographic findings of dental technicians with pneumoconiosis.**

| Dental technicians | Opacity category | Opacity morphology | FVC (%) | FEV <sub>1</sub> (%) | FEV <sub>1</sub> /FVC (%) | PEF (%) | FEF <sub>25-75</sub> (%) | Working time (y) |
|--------------------|------------------|--------------------|---------|----------------------|---------------------------|---------|--------------------------|------------------|
| N-2                | 2/1              | r/q                | 65      | 76                   | 100                       | 103     | 111                      | 13               |
| N-13               | 2/3              | r/q                | 79      | 97                   | 100                       | 102     | 141                      | 33               |
| N-15               | 1/2              | t/q                | 115     | 103                  | 74                        | 61      | 77                       | 30               |
| N-24               | 1/0              | p/s                | 103     | 107                  | 87                        | 94      | 118                      | 13               |
| N-30               | 2/2              | t/q                | 46      | 50                   | 91                        | 97      | 74                       | 17               |

PFT results of these five cases are evaluated; two are normal, two have restrictive patterns and one have obstructive patterns.

At the correlation analysis, there was a statistically significant positive moderate correlation between working period (years) and category of the opacities according to the ILO classification ( $r= 0.49$ ;  $p= 0.002$ ). In the dental technician group, the working period of persons with pneumoconiosis is significantly higher than those of the persons without pneumoconiosis ( $18.43 \pm 6.35$  vs.  $10.60 \pm 6.93$  years;  $p= 0.001$ )

### DISCUSSION

In order to determine the prevalence of pneumoconiosis, this cross-sectional epidemiologic study is conducted. The study groups are similar with regard to age, height, weight, and smoking time, respiratory symptoms and the PFT findings except FEV<sub>1</sub> parameter. In dental technicians, prevalence of pneumoconiosis is 13.8% with a highest the ILO category of 2/3. Five technicians with opacity have normal pattern ( $n= 2$ ), restrictive ( $n= 2$ ) and obstructive ( $n= 1$ ) patterns of the PFT. We found that the working period is an important factor in the development of pneumoconiosis. The working period of dental technicians with pneumoconiosis is higher than the dental technicians without pneumoconiosis (Table 5). Also, at the correlation analysis, there was a statistically significant positive moderate correlation between working period (years) and category of the opacities according to the ILO classification ( $r= 0.49$ ;  $p= 0.002$ ).

Dental laboratory technicians have exposed multiple dust, fume, chemical materials, which

may have adverse effects on their health. The health effects of concern include: potential adverse respiratory effects from inhalation of dust from grinding and polishing of metal alloys, resins, ceramics, plaster and the abrasives used for polishing or acrylates (2). Pneumoconiosis among dental technicians has recently emerged as area of research in interstitial lung disease. There are several papers in the literature about dental technician's pneumoconiosis (10-13).

According to the data collected from 73 dental technicians in Ankara, Fidan et al. find that there is coughing on 19.12%, expectoration on 41%, and dyspnea and respiration problems with growling on 21.9% of these dental technicians (14). Jacobsen et al. shows that respiration problems are present in 16% of 201 Norwegian dental technicians (15). In another similar study, they notice that respiration problems form 31% of general problems in Sweden (16). Radi et al. indicate that coughing and expectoration are major symptoms of dental technicians (8). While Frodorakis demonstrate statistically significant difference in respiration symptoms compared with the control group, Sherson et al. do not indicate any statistically difference but, they noticed higher dyspnea score on dental technicians group (5,7). In our study as shown in the Table 2, the prevalence of respiratory symptoms among dental technicians and controls is high but there are not statistically significant differences between two groups (5,7). We think that this is due to high smoking rate of the persons in control group and it's known that the symptoms and respiratory findings of such cases seen very late periods.

Fisekci et al. and Froudarakis et al. explain that PFT results do not show statistically important difference when compared with the control group (7,17). Woan et al. conducted a study on 11 dental technicians in Taiwan whom are studying more than 10 years, and find a little decrease in FVC and FEV<sub>1</sub> when compared with the control group which is statistically not important (3).

After noticed a silicosis fact on a dental technician, Sherson et al. conducted a study with 31 dental technicians and considered them about silicosis (5). Every subject has normal PFT's results but, the ones who study in this sector have pathologic findings at the PFT. Choudat et al. performed a study in which they examined respiration problems and lung functions on 105 dental technicians living in Paris (16). These subjects' PFT values are not statistically different with control group but 11.8% of the subjects show radiological abnormalities that consistent with dental technicians pneumoconiosis.

Table 6 shows that comparing the studies about the prevalence of pneumoconiosis among dental technicians. As seen in this table there is different prevalence rate among these studies. These differences are due to a lot of factors such as the difference of working time between the studies, ratio of smoking subjects, the difference between the working conditions of subjects, working as free or as a member of a large com-

pany, usage of beryllium ect. It was reported that the factors related with the pathogenesis of dental technicians's pneumoconiosis are; the complex compound of the substances used in this sector. Recently, Karaman et al. reported a case and they concluded that their case may be extrinsic allergic alveolitis due to methyl methacrylate (19).

In conclusion, in our region, the prevalence of pneumoconiosis is 13.8%. Dental technicians work in small and airless places generally. Moreover, since too many procedures is performed in the same room, too many people breathe the environment air at the same time. Dental technicians should be informed to take care about dust measurements of their working places and not to pass through the danger limits. Dental laboratory technicians are at significant risk for occupational respiratory diseases so the primary preventions rules are essential for these work places.

## REFERENCES

1. Fasunloro A, Owotade FJ. Occupational hazards among clinical dental staff. *J Contemp Dent Pract* 2004; 15: 134-52.
2. Woan HS, Lin YY, Wu TC, et al. Workplace air quality and lung function among dental laboratory technicians. *Am J Ind Med* 2006; 49: 85-92.
3. Torbica N, Krstev S. World at work: dental laboratory technicians. *Occup Environ Med* 2006; 63: 145-8.
4. Kotloff RM, Richman PS, Greenacre JK, Rossman MD. Chronic beryllium disease in a dental laboratory technician. *Am Rev Respir Dis* 1993; 147: 205-7.
5. Sherson D, Maltbaek N, Olsen O. Small opacities among dental laboratory technicians in Copenhagen. *Br J Ind Med* 1988; 45: 320-4.
6. Sherson D, Maltbaek N, Heydorn K. A dental technician with pulmonary fibrosis: a case of chromium-cobalt alloy pneumoconiosis. *Eur Respir J* 1990; 3: 1227-9.
7. Froudarakis M, Voloudaki A, Bouros D, et al. Pneumoconiosis among cretan dental technicians. *Respiration* 1999; 66: 338-42.
8. Radi S, Dalphin JC, Manzoni P, et al. Respiratory morbidity in a population of french dental technicians. *Occup Environ Med* 2002; 59: 398-404.
9. Kartaloglu Z, Ilvan A, Aydilek R, et al. Dental technician's pneumoconiosis: mineralogical analysis of two cases. *Yonsei Med J* 2003; 44: 169-73.

**Table 6. Comparing the studies conducted about silicosis.**

|                          | n   | %    | Working time (y) |
|--------------------------|-----|------|------------------|
| Choudat (France) (15)    | 102 | 11.8 | 28.4             |
| Radi (France) (8)        | 134 | -    | 16.5             |
| Sherson (Denmark) (5)    | 31  | 12.9 | 20               |
| Selden (Sweden) (24)     | 37  | 16.2 | -                |
| Froudarakis (Greece) (7) | 58  | 9.8  | 18.6             |
| Fidan (Turkey) (20)      | 73  | 24.2 | 12.5             |
| Fisekci (Turkey) (23)    | 84  | 15.5 | 10               |
| Result of this study     | 36  | 13.8 | 14               |

10. De Vuyst P, Weyer RV, De Coster A, et al. Dental technician's pneumoconiosis. *Am Rev Respir Dis* 1986; 133: 316-20.
11. Choudat D. Occupational lung diseases among dental technicians. *Tubercle Lung Dis* 1994; 75: 99-104.
12. Loeuven GM, Vveiner D, McMahan J. Pneumoconiosis in an elderly dentist. *Chest* 1988; 93: 1312-3.
13. Orriols R, Ferrer J, Tura JM, et al. Sicca Syndrome and silicoproteinosis in a dental technician. *Eur Respir J* 1997; 10: 731-4.
14. Fidan S. Diş protez teknisyenlerinde silikozis görülme sıklığı (tez). Gazi Üniversitesi Sağlık Bilimleri Enstitüsü; 2002
15. Jacobsen N, Pettersen AH. Self-reported occupation-related health complaints among dental laboratory technicians. *Quintess Int* 1993; 24: 409-15.
16. Choudat D, Triem S, Weill B, et al. Respiratory symptoms, lung function, and pneumoconiosis among self employed dental technicians. *Br J Ind Med* 1993; 50: 443-9.
17. Fişekçi F, Özkurt S, Akkoyunlu S, Başer S. Lung disorders among dental technicians. *Eur Respir J* 1998; 12: 140.
18. Selden AI, Persson B, Bornberger-DSI, et al. Exposure to cobalt chromium dust and lung disorders in dental technicians. *Thorax* 1995; 50: 769-72.
19. Karaman Eyüpoğlu C, İtil O, Gülşen A, et al. Dental technician's pneumoconiosis; a case report. *Tuberk Toraks* 2008; 56: 204-9.
20. Toraks derneği çevresel ve mesleki akciğer hastalıkları çalışma grubu: Mesleki ve çevresel akciğer hastalıklarının değerlendirme formu. *Solunum Hastalıkları* 1998; 9: 225-32.
21. American thoracic society. Standardization of spirometry-1987 update. *Am Rev Respir Dis* 1987; 136: 1285-98.
22. Akkurt İ. Pnömokonyozda ILO standartlarında radyolojik değerlendirme. *Toraks* 2001; 2: 62-71.