

WORK-RELATED MUSCULOSKELETAL DISORDERS AMONG DENTISTS – A QUESTIONNAIRE SURVEY

Anna Kierklo, Agnieszka Kobus, Małgorzata Jaworska, Bartłomiej Botuliński

Department of Dentistry Propaedeutics, Medical University of Białystok, Białystok, Poland

Kierklo A, Kobus A, Jaworska M, Botuliński B: Work-related musculoskeletal disorders among dentists – a questionnaire survey. *Ann Agric Environ Med* 2011, **18**, 79–84.

Abstract: Dentists at work are susceptible to the development of health disorders. Bad working habits, repetitive tasks and uncomfortable posture contribute to musculoskeletal disorders (MSDs), stress and loss of production. The paper deals with the assessment of health status among dentists in Poland regarding the symptoms of musculoskeletal pain. The survey was conducted among 220 dentists. The questionnaire was concerned with demographic details, work duration and acquired specialization, organization and methods of work in the surgery, and also disorders connected with the musculoskeletal system and physical prophylactic activity. It was found that over 92% of the surveyed dentists experienced MSDs, especially in the neck (47%) and lower back (35%). More than 29% of the dentists experienced trouble with fingers, 23% with hip, whereas 20% demonstrated problems in the midback, and also in the shoulders (20%). Pain in the wrists was reported by 18.3%, and pain in the knees, feet or elbows by 15–16% of respondents. Statistical dependence was shown between the years of practice and the period of time when disorders occurred. Moreover, significance relationships were found between MSDs and both standing work position and non-use of rest breaks. It was concluded that limited ergonomics in the work environment of dentists results in MSDs, and its prevalence is very high. The symptoms of MSDs increased with the number of years of practice.

Address for correspondence: Anna Kierklo, Department of Dentistry Propaedeutics, Medical University of Białystok, Waszyngtona 15A, 15-274 Białystok, Poland.
E-mail: ankierklo@op.pl

Key words: musculoskeletal disorders, dentistry, health of dentists, dental ergonomics, occupational hazard.

INTRODUCTION

The common risk factors which contribute to the development of health disorders can be categorized as those related to personal background variables (e.g. anthropometric characteristics, age, hereditary factors) and those related to work (e.g. repetitive motion, static posture, force, awkward position, vibration, temperature, biological factors, chemical irritating or toxic factors, radiation) [9, 13, 16, 19, 20].

Dentists at work are susceptible to the occupational health hazards and the development of cumulative trauma disorders. They often assume static positions that are uncomfortable and asymmetric. The dental operators sit or stand for prolonged periods and maintain the head, neck and shoulders in fixed positions for long intervals. In den-

tistry, improper working habits, inconvenient posture as well as repetitive tasks, such as: root canal instrumentation, cavities preparation and filling, scaling or root planing, contribute greatly to both, musculoskeletal disorders (MSDs) and psychological stress, and finally cause fatigue [2, 20]. This condition can result in the decrease of productivity and quality of work. Moreover, the monotony of work, work in noise and artificial light are disadvantageous for dental personnel [13].

Approximately 81% of American dentists suffer from neck, shoulder and lower back pain [20]. Similar results were reported by Kerosuo *et al.* [7], who discovered that 70% of surveyed Scandinavian general dental practitioners and 72% of orthodontists experienced musculoskeletal symptoms. Psychological stress, when dealing with pa-

tients as well as high concentration and precision, is associated with an increased risk of MSDs [13]. It is a well-known fact that stress can elicit muscular contraction and pain, especially in the trapezius muscle [2, 5, 13]. The other complaints caused by overstressed muscles and joints are headache and backache [11]. As shown by the end of the 90s studies, the frequent work-related disorders are a great problem, since the possibilities of changing work conditions are very limited [1]. The dental professionals are at a significantly high risk of developing work-related MSDs [12].

Comparing the prevalence of upper body symptoms of pathological conditions in dentists and subjects working in a different environment, such as farmers, pharmacists and office employees, the symptoms occurred more often among dentists [5, 6, 11].

The aim of this study was to survey the health status among dentists from Podlaskie Voivodeship in northeast Poland regarding the symptoms of musculoskeletal pain.

MATERIAL AND METHODS

A total of 220 dentists (194 females – 88.2% and 26 males – 11.8%) in Podlaskie Voivodeship completed an anonymous questionnaire focused on MSDs. The questionnaire was divided into 3 sections. The first section included demographic questions regarding gender, age, work duration and acquired specialization. Section two dealt with the work conditions (working posture, work with or without an assistant) and the organization of dentist's work (number of breaks and their purpose). The third section concerned MSDs and also prophylactic physical activities (type, effectiveness). Some questions allowed for multiple response.

The study group presented various specializations in different fields of dentistry: 40% of respondents were general practitioners of dentistry (without speciality), while only 22.27% of dentists specialized in: conservative dentistry 10.91%, prosthetic dentistry 6.36%, maxillofacial surgery 1.82%, paediatric dentistry 1.82%, periodontology 0.91%, and orthodontics 0.45%. Dentists with the first degree of general dental speciality constituted about 37.73%.

The mean number of years employed in the dental profession among the study group was 16 years. The dentists with over 20 years in practice and those in the profession for between 11–15 years accounted for the highest percentage of the study group, 31% and 23.74%, respectively. The percentage of dentists working between 1–5 years and 6–10 years was on the same level, 15.53%. The data presented above was calculated for 219 respondents as one person did not answer a relevant question.

Statistical analysis of the obtained results was performed. To analyze the relationships between nominal variables, the Fisher exact tests, also called the Fisher-Freeman-Halton tests were used (for contingency tables larger than 2 by 2). Additionally, standardized residuals were calculated to estimate the contribution of individual cells in the result of the statistical test for the whole table. The

calculations were performed using Statsoft's Statistica 8.0 computer software, except for the Fisher-Freeman-Halton tests, which were calculated using the network algorithm developed by Mehta and Patel [10]. To calculate the standardized residuals we used Microsoft Excel 2003. Since the standardized residuals are random variables following the standard normal distribution [17], one can calculate the corresponding p-value with the following formula: $p = 2 \times F(-|R|)$ where p is the p-value of the 2-sided test that compares the given standardized residual R against 0, and F is a cumulative standard normal distribution function.

All statistical hypotheses were verified at significance level equal to 0.05.

RESULTS

It was found that the majority of the surveyed dentists work without an assistant (63.6%) in a sitting position (66.8%), but 87.3% of the dentists working in a sitting position sit beside a lying down patient only occasionally. Only 8% of all surveyed dentists declared treating patients when these are in a supine position, although more than 60% of the respondents know that the preferred position for most dental procedures is the sitting position when the subject is lying horizontally. Only 3.64% of the dentists practice four-handed dentistry. The present research proves incorrect organization of work. Our results show that as many as 33% of the dentists worked without any break, 36.4% had one break, and only 8% had a short rest break after every patient. Additionally, 10% of the surveyed dentists exercise regularly to reduce MSDs and nearly 68% exercise only occasionally or when the disorders appear. As many as 23% of the respondents claim that they do not need any kind of exercise. It was also found that due

Table 1. Dentists who suffered from musculoskeletal disorders (MSDs); N=219 (100%). One subject might have multiple symptoms.

MSDs	Number of dentists according to the duration of employment (n)					Total n (%)
	1–5	6–10	11–15	16–20	>20 yrs	
Back/spine						
neck	10	13	26	13	41	103 (47.0) ^a
sacral area	18	17	20	11	26	82 (37.4)
lumbar area	11	8	17	9	27	72 (32.9)
thoracic area	5	10	9	6	14	44 (20.0)
Upper limb						
fingers/hand	5	8	16	13	22	64 (29.2)
shoulder	3	3	11	4	23 ^f	44 (20.1) ^b
wrist	7	5	7	3	18	40 (18.3)
elbow	1	1	5	4	22 ^g	33 (15.1) ^c
Lower limb						
hip	5	4	12	3	28 ^h	51 (23.3) ^d
knee	3	6	6	4	16	35 (16.0)
foot	2	4	4	4	20 ⁱ	34 (15.5) ^e

Fisher-Freeman-Halton test: $p^a=0.024$, $p^b=0.008$, $p^c=0.00007$, $p^d=0.001$, $p^e=0.006$; standardized residuals test: $p^f=0.012$, $p^g=0.0002$, $p^h=0.002$, $p^i=0.004$.

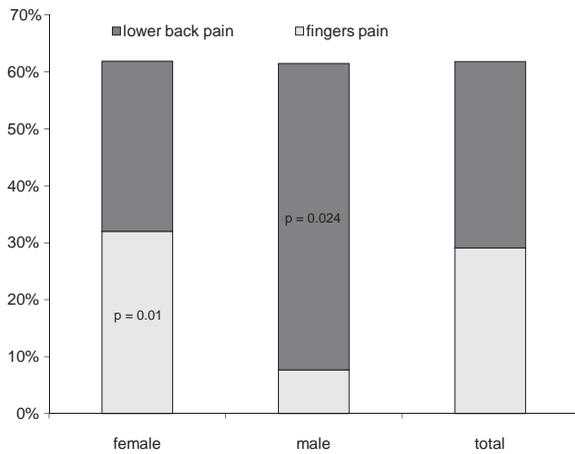


Figure 1. Relationship between gender of dentist and finger and lower back pain; N=220 (100%); p – Fisher-Freeman-Halton test.

to MSDs 32.3% of the dentists received rehabilitation or stayed in health resorts.

The detailed list of MSDs reported in the study group is presented in Table 1. In general, the respondents declared several co-existing MSDs. It was found that over 92% of the surveyed dentists experienced pain and disability of the musculoskeletal system, especially in the neck (47%) and lower back, i.e. the lumbar and sacral region of the spine (average of the two regions of the spine is 35.1%). Over 29% of the dentists experienced discomfort in their hands and fingers. They complained of paresthesia, pain or difficulty with movement. Another 23.3% of the dentists reported hip joint disorders, whereas 20% demonstrated problems in the thoracic region of spine (midback), and also in the shoulders (20.1%). The prevalence of disorders in wrists was found in 18.3% of the studied group. Pain in knees, feet or elbows was reported by 15–16% of respondents.

We analyzed the relationships between musculoskeletal symptoms and occupational factors. No statistically significant correlation was found between the development of MSDs and working with or without an assistant, patient position, using rest breaks, awareness and practice of different forms of physical activity and also the knowledge of professional preventive exercises that reduce physical disorders.

However, it was found that statistically significantly more females experienced pain in their fingers, while significantly more males felt pain in the lower back (Fig. 1). Furthermore, a certain degree of correlation was found between the professional speciality and the type of MSDs, their location, and when they occurred. Seventy-five percent of dental surgeons suffered from feet and hip pain, which was found to be statistically significant ($p=0.035$ for the Fisher test; $p=0.002$ for standardized residuals). However, no statistical significance was found with regards to pain in fingers when using a more specific test for standardized residuals. The dentists with the first degree of

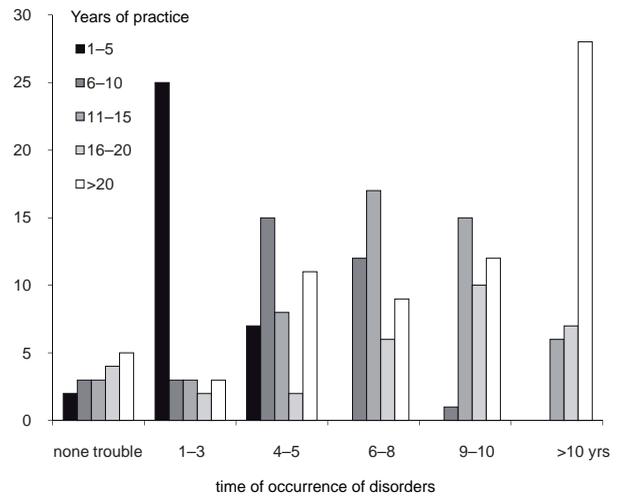


Figure 2. Relationship between years of practice and time of occurrence of musculoskeletal disorders; N=219 (100%); $p=0.00001$; p – Fisher-Freeman-Halton test.

general dental specialty, when compared to other specialties, reported significantly less pain in the first 3 years of work ($p=0.004$), as did specialists in conservative dentistry ($p=0.048$), the most disorders were reported after 9 and 10 years of practice ($p=0.043$). General dental practitioners declared experiencing the symptoms and discomfort in the musculoskeletal system within the first 5 years of work practice (p between 0.000–0.025), the disorders escalated after 9 years of practice ($p=0.002$).

The Fisher test showed a high statistical dependence ($p=0.00001$) between the years of practice and the period of time when the disorders occurred, although it was not confirmed in a more detailed statistical analysis (Fig. 2). However, we found that the dentists with 20 years of practice presented a statistically significantly higher incidence of pain in the hips, feet, shoulders and elbows (p between 0.012–0.0002 for standardized residuals). No statistical significance was found with regards to cervical spine (Tab. 1).

Over 27% of dentists working in a standing position declared the occurrence of MSDs after 9–10 years of practice ($p=0.038$, $p=0.037$ for standardized residuals). In addition, it was stated that the standing position while treating a patient was significantly more often ($p=0.01$) related to pain in the knees and feet, as reported by 25% of the surveyed dentists working in a standing position. The influence of work posture on MSDs is presented in Figures 3–5.

Organizing work and prophylactic physical activity also influenced the occurrence of MSDs. We found that the frequency of using rest breaks influenced the occurrence of hip pain ($p=0.002$). Hip pain was significantly more often ($p=0.004$ for standardized residuals) reported by dentists who did not use rest breaks during work. The results were relevant for over 40% of the non-resting dentists (Fig. 5). However, more specific tests did not confirm the relationship between the occurrence of neck and back pain, and the knowledge and using (or not using) relaxation exercises ($p=0.027$ for Fisher test).

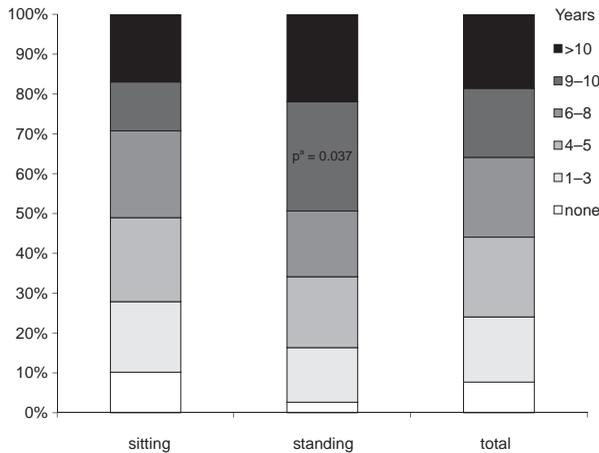


Figure 3. Relationship between dentist's working position and time of occurrence of musculoskeletal disorders; N=220 (100%); $p=0.038$; p – Fisher-Freeman-Halton test, p^a – standardized residuals test.

DISCUSSION

The results obtained in this study indicate that the surveyed dentists demonstrated improper working habits and deficiency of basic knowledge of ergonomics. However, no correlation was found between work and MSDs, apart from the influence of standing work position on pain in knees and feet, and also, the influence of no rest breaks on hip pain. Thus, the present study did not allow for finding direct relationships between the causes and the effects. Regardless of the above, poor ergonomic work habits such as prolonged constrained work position with e.g. neck or spine flexion, may imply a risk factor [5].

Åkesson *et al.* [2] assumed that the work posture of dentists plays an important role as a risk factor for the development of work-related disorders. A high frequency of MSDs among dentists was confirmed in numerous subsequent studies [12, 13, 15]. As it is commonly known, maintaining poor posture for long periods of time can result in chronic muscular fatigue, discomfort or pain, even if the soft tissues are not structurally altered. More significantly, prolonged exposure to high static muscle and joint load may lead to pathological effects and permanent disability [13, 20, 21]. Finsen *et al.* [5] presume that an increased variation in work postures may reduce the risk of overloaded spine and lower and upper limbs.

Newell and Kumar [12] confirmed that in recent years attention and awareness of MSDs in the dental profession has noticeably increased due to a rise in the number of reported MSDs. However, in Poland, it is still necessary to develop ergonomic procedures and practices for safety at work among dentists to prevent work-related disorders. Studies concerning ergonomic work and investigating the relationship between working postures of dental operators, and the health hazard or occupational diseases in a population of Polish dentists were conducted by Szymańska [18].

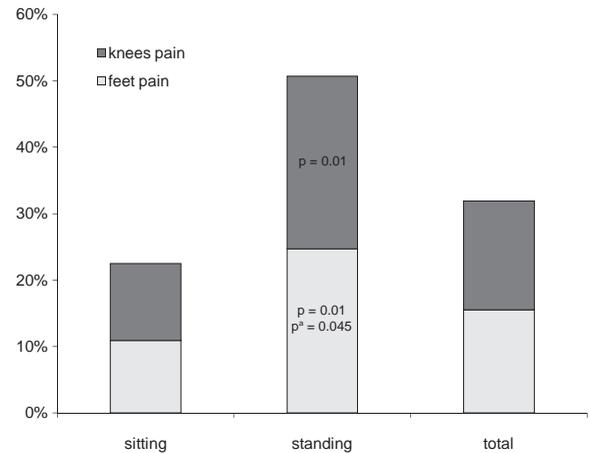


Figure 4. Relationship between dentist's working position and feet and knee pain; N=220 (100%); p – Fisher-Freeman-Halton test, p^a – standardized residuals test.

Similar to the results obtained in the present survey, the most frequent MSDs were located in the upper and lower back region. Also, the findings regarding work position and four-handed dentistry reported by Szymańska [18] are consistent with our results.

In general, the MSDs in the study group were consistent with those reported by dentists in other countries, both in previous and current investigations [3, 4, 7, 9, 12]. Earlier studies show that neck and shoulder disorders, and a combination of both, are common among Swedish and Danish dentists [1, 5]. In recent years, for Canadian orthodontists in Alberta, low back pain was the most prevalent of MSDs (59%), followed by neck (56%) and shoulder pain (47%) [12]. The MSDs predominant in Italian dental professionals occur in the spine, shoulder, elbow and hand [15]. According to Guay, cited by Newell and Kumar [12], dental workers reported hand and wrist disorders less often than symptoms in the neck and/or back. Moreover, the symptoms reported in the hands and wrists are more common among female than among male dentists [2]. The above results are in accordance with the findings presented in this study. Additionally, our findings, regarding the lack of significant differences between genders, except for the ones discussed above, are consistent with the studies by Newell and Kumar [12].

The prevalence of MSDs stated in other studies was slightly lower than presented here. For example only 62% of Greek dentists [3] and 54–92% of Italian dentists [15] reported at least one musculoskeletal complaint. Our analysis showed that over 90% of the surveyed dentists reported more than one MSD.

The number of years of practice plays an important role in the occurrence of MSDs, although both younger and older dentists report the same symptoms, as confirmed in other studies [4]. Our findings show that pain in the hip, feet, shoulders and elbows is reported significantly more often after 20 years of practice. However, dentists working

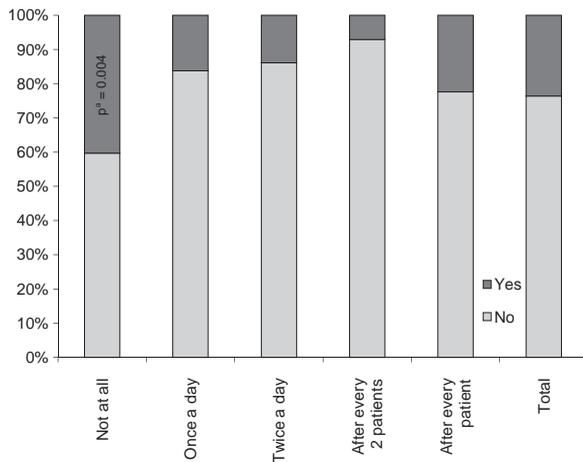


Figure 5. Relationship between rest breaks and hip pain; N=220 (100%); p=0.002; p – Fisher-Freeman-Halton test, p* – standardizet residuals test.

in a standing position experience pain significantly earlier, that is, after approximately 10 years of practice. The above findings should not be surprising since bad habits result in cumulated effects. Young general dental practitioners work very intensively in the first years of practice, often over 8 hours a day, which causes an early occurrence of MSDs, even within 3 years. Possibly due to experiencing pain and muscle stiffness they start to keep fit and work less intensively, this is why they do not experience the pain in the next few years. Another explanation could be that over months and years, the body adapts to the abnormal posture caused by these muscle imbalances and maintains this unbalanced posture not only at work, but in leisure activities as well [20]. Nevertheless, after the next 9–10 years the pain recurs.

Meanwhile, some reports show the prevalence and distribution of symptoms of MSDs occurring even among dental students [11, 14]. Findings suggest that by raising awareness of these problems among students, the risk of MSDs can be reduced. It has been recommend that as a preventive measure, students should be taught, from the beginning of their undergraduate studies, about optimal working postures and good work habits [21].

In order to protect their health, all dentists, regardless of their dental speciality, should receive education about all aspects of dental ergonomics, including rest breaks. Regular rest breaks and physical exercise are recommended to prevent the accumulation of harmful agents [13, 21]. A detailed analysis concerning the rest breaks in the dental practice in Podlaskie Voivodeship has been presented in other studies [8]; the results were consistent with the studies by Szymańska [18], who discovered that more than 30% of the dentists work without breaks. As a result, nearly one-third of the dentists are not aware of the preventive role of rest breaks, and therefore risk the occurrence of fatigue and disorders. Short rest breaks used in dental practice at regular intervals can lessen the discomfort in

the musculoskeletal and nervous system. Nevertheless, Szymańska [18] found no significant relationship between the lack of rest breaks and presence of physical activity, and the number of MSDs. In our study, we observed that the respondents who did not use rest breaks, statistically more often experienced hip pain, and the respondents who did not use physical exercise reducing MSDs felt pain in the neck and spine. Although almost 20% of the surveyed dentists know the relaxation exercises, only 10% of them exercise regularly.

Summarizing the above, it is indispensable to change the poor work habits. According to Newell and Kumar [12], dentists can reduce the risk of developing MSDs by using proper body posture and positioning during clinical procedures, incorporating regular rest breaks, maintaining good general health, and performing exercises for the affected regions of the body.

The presented results are based on the self-reported experiences of the respondents. Using physical examinations in this study would provide more detailed information. The study allowed for a general assessment of the occupational health hazards among the dentists and further research will follow.

CONCLUSION

In conclusion, it was recognized that limited ergonomics in the work environment of the dentists results in MSDs, and its prevalence is very high. The symptoms of MSDs increase with the number of years of practice. The prevention and reduction of MSDs among dentists should include their education in dental ergonomics and awareness regarding the importance of work-related risk factors.

REFERENCES

- Åkesson I, Johnsson B, Rylander L, Moritz U: Musculoskeletal disorders among female dental personnel – clinical examination and a 5-year follow-up study of symptoms. *Int Arch Occup Environ Health* 1999, **72**, 395–403.
- Åkesson I, Hansson GA, Balogh I, Moritz U, Skerfving S: Quantifying work load in neck, shoulders and wrists in female dentists. *Int Arch Occup Environ Health* 1997, **69**, 461–474.
- Alexopoulos EC, Stathi IC, Charizani F: Prevalence of musculoskeletal disorders in dentists. *BMC Musculoskelet Disord* 2004, **5**, 1–8. Available from: <http://www.biomedcentral.com/1471-2474/5/16>.
- Al Wazzan K, Almas K, Al Shethri SE: Back and neck problems among dentists and dental auxiliaries. *J Contemp Dent Pract* 2001, **2**, 17–30.
- Finsen L, Christensen H, Bakke M: Musculoskeletal disorders among dentists and variation in dental work. *Appl Ergon* 1998, **29**, 119–125.
- Johnston V, Souvlis T, Jimmieson NL, Jull G: Associations between individual and workplace risk factors for self-reported neck pain and disability among female office workers. *Appl Ergon* 2008, **39**, 171–182.
- Kerosuo E, Kerosuo H, Kanerva L: Self-reported health complaints among general dental practitioners, orthodontics, and office employees. *Acta Odontol Scand* 2000, **58**, 207–212.
- Kierklo A, Kobus A, Jaworska M, Botuliński B, Pawińska M: Przerwy spoczynkowe jako element profilaktyki zagrożeń zdrowotnych lekarzy stomatologów. Analiza w województwie podlaskim. *Implantoprot Stom Klin* 2008, **9**, 39–42.

9. Leggat PA, Kedjarune U, Smith DR: Occupational health problems in modern dentistry: a review. *Ind Health* 2007, **45**, 611–621.
10. Mehta CR, Patel NR: Algorithm 643: FEXACT: a FORTRAN subroutine for Fisher's exact test on unordered r x c contingency tables. *ACM Trans Math Softw* 1986, **12**, 154–161.
11. Melis M, Abou-Atme YS, Cottogno L, Pittau R: Upper body musculoskeletal symptoms in Sardinian dental students. *J Can Dent Assoc* 2004, **70**, 306–310.
12. Newell TM, Kumar S: Prevalence of musculoskeletal disorders among orthodontics in Alberta. *Int J Ind Ergon* 2004, **33**, 99–107.
13. Pandis N, Pandis BD, Pandis V, Eliades T: Occupational hazards in orthodontics: A review of risks and associated pathology. *Am J Orthod Dentofacial Orthop* 2007, **132**, 280–292.
14. Rising DW, Bennett BC, Hursh K, Plesh O: Reports of body pain in a dental student population. *J Am Dent Assoc* 2005, **136**, 81–86.
15. Sartorio F, Vercelli S, Ferriero G, Angelo FD, Migliaro M, Franchignoni M: Disturbi musculo-scheletrici di natura lavorativa negli operatori sanitari dentali. 1 – Prevalenza e fattori di rischio. *G Ital Med Lav Erg* 2005, **27**, 165–169.
16. Shenkar O, Mann J, Shevach A, Ever-Hadani P, Weiss PL: Prevalence and risk factors of upper extremity cumulative trauma disorder in dental hygienists. *Work* 1998, **11**, 263–275.
17. Sheskin DJ: *Parametric and nonparametric statistical procedures*. Chapman and Hall/CRC, New York 2000, 402–410.
18. Szymańska J: Disorders of the musculoskeletal system among dentists from the aspects of ergonomics and prophylaxis. *Ann Agric Environ Med* 2002, **9**, 169–173.
19. Szymańska J: Microbiological risk factors in dentistry. Current status of knowledge. *Ann Agric Environ Med* 2005, **12**, 157–163.
20. Valachi B, Valachi K: Mechanism leading to musculoskeletal disorders in dentistry. *J Am Dent Assoc* 2003, **134**, 1344–1350.
21. Valachi B, Valachi K: Preventing musculoskeletal disorders in clinical dentistry. *J Am Dent Assoc* 2003, **134**, 1604–1612.