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DISORDERS OF THE MUSCULOSKELETAL SYSTEM AMONG DENTISTS FROM THE ASPECT OF ERGONOMICS AND PROPHYLAXIS

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Abstract: The profession of dentist exposes them during their work to many burdensome and harmful factors. The irrational posture adopted by dentists during their work causes discomfort and disorders of the musculoskeletal system and the peripheral nervous system. The methods and organization of the work of Polish dentists were evaluated from the aspect of ergonomics, with regard to reported by them painful disorders connected with the musculoskeletal system, with the aim of applying proper methods of treatment and prophylaxis. The study showed that dentists worked in conditions which generally produced disorders of the musculoskeletal system. As a result, the long working time in the course of a day was used irrationally from the point of view of ergonomics, which over the years of work consequently increased the number of disorders of the musculoskeletal system. Dentists must make use of various forms of treatment. The effectiveness of prophylaxis concerning the musculoskeletal system were only partly assessed by the respondents through questionnaire. Most dentists are convinced of the effectiveness of physical activity in prophylaxis which they carry out themselves.

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INTRODUCTION

The specific character of dental work is connected with and accompanied by onerous and harmful effects. Uncomfortable positions assumed by dentists during work without doubt cannot remain without effect on health. Standing or sitting positions which are frequently adopted, and twisting of the spine, connected with excessive tightening of some tissues and the straining of others, could be the source of painful disorders and diseases of the musculoskeletal system and the peripheral nervous system [1, 2, 3, 4, 6, 8, 15].

MATERIALS AND METHODS

During the first half of 2002, a dentists' opinion poll was conducted in 4 sections of the Polish Stomatological Association. The study was carried out during their meetings, using original questionnaire [16].

The purpose of the questionnaire and how they should be answered was explained, and whenever necessary further information was provided. The majority of questions allowed for multiple response.

The questionnaire distributed concerned:

- method of work (position assumed during work, work with or without an assistant, load on lower extremities);
- organization of work (working time during the day, working time without a break, number of breaks);
- painful disorders connected with the musculoskeletal system;
- treatment applied in connection with disorders connected with the musculoskeletal system;
- prophylactic activity in connection with the musculoskeletal system (type, effectiveness).

Questionnaire [16] was satisfactorily completed by 268 dentists. Women were in a significantly higher number (89.2%) than men (10.8%), which corresponded to the general tendency of the feminization of the profession of dentistry.

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The biggest group in the study consisted of dentists in practice for up to 10 years - 33.6%. Dentists working from 11–20 years were 27.6%, 21–30 - 25.4%, and over 30 years - 13.4%. Almost half of those questioned (45.1%) were dentists with general specialization of the first degree, and one third - dentists without a specialization (31.0%); the others (23.9%) were specialists of: dental surgery - 7.5%, conservative dentistry - 6.7%, paediatric dentistry - 4.1%, prosthetic dentistry - 4.1%, orthodontics - 1.1%, periodontology - 0.4%.

Statistical analysis. The relationships between musculoskeletal disorders and work practices, treatment, prophylaxis and physical activity were assessed by chi-square test. Values of $p < 0.05$ were considered statistically significant. The obtained results were processed using Microsoft Access and Microsoft Excel.

STUDY RESULTS AND DISCUSSION

It was shown that the majority of dentists in the study work both in standing and sitting positions next to a seated patient - 39.2%, of which almost a half (51/105) always with the help of an assistant. 27.6% of respondents worked in a standing position next to a seated patient, the majority of them (40/74) without any dental assistant. 22.8% worked in a sitting position next to a seated patient, of whom over a half (34/61) had dental assistance. In comparison, Frączak *et al*. [5], who studied dentists working next to seated patients, reported that most of them changed position (sitting/standing) during work - 74.4%; of the rest, 15.4% worked exclusively in the standing position, and 10.2% sitting down.

Only 1.1% of the respondent dentists always worked in the sitting position next to a prone patient and 9.3% - sometimes. Only one dentist among the respondents, generally practiced four-handed dentistry, and seven dentists - sometimes. There are no respondents practising six-handed dentistry.

The replies of dentists to the question about general load on the lower limbs during work in the standing position showed that most of them had strain on the right leg - 51.9%, while 32.8% had changeable strain on the right and left leg, 8.2% had strain on the left leg only, and 7.1% worked without any strain (i.e. in the sitting position next to a prone patient).

The biggest advantage for the musculoskeletal and nervous systems, as well as for the individual dentist and dental team, is four- or six-handed dentistry. This type of work allows the dentists to conserve definite work time, rest the back, back muscles and lower extremities. The optimum from the point of view of ergonomics is six-handed dentistry which allows the spreading of physical expenditure of the dentist, and first and second assistants.

None of respondents is practicing six-handed dentistry; an insignificant percentage is practicing four-handed; and a considerable number of dentists are generally working without a dental assistant (37.3%); consequently, strains on the lower extremities are harmful from the point of view of ergonomics and work organization among the dentists studied. This type of work generally affects the health of the dentists employed and limits their effectiveness.

The majority of dentists work 8 hours daily - 29.1%, more than 8 hours - 19.4%, 7 hours - 18.3%, 6 hours - 21.3%, less than 6 hours - 11.9%. In the study, 46.3% dentists had 1 break in the course of a day, 16.4% had 2 breaks, 7.0% - 3 breaks, and 0.4% - 4 breaks. 29.9% of those questioned had no break at all. The biggest group comprised those dentists who had 1 break per day after 4 hours work - 13.8%.

As is known, the dentists who worked next to a seated patient adopted an irrational posture which resulted in an excess of disorders of the back and lower extremities. 37.7% suffered thus during work [15].

Almost all respondents worked in an irrational position on average for 7.2 hours a day, causing overloading of the musculoskeltal system for a comparatively long time. An additional unfavorable factor among almost 1/3rd of those studied was the lack of a break during the day.

Respondents reported mostly symptoms connected with thoracic-lumbar region of the back – 60.1%, neck pain - 56.3%, lower extremities - 47.8%, and symptoms of the wrist and hand – 44.0%. The disorders among the study population are shown in Table 1. Generally, the study was informative about the co-existence of several disorders: 37.3% of respondents experienced 3–4; 29.1% - 5 or more, 25.0% experienced 1–2. No disorders at all were experienced by 8.6% of dentists. Another Polish study [5] have reported that the majority of respondents reported painful disorders of the sacral region - 76.9%, cervical region - 66.6%, and the lumbar region - 56.4%, which are similar to the results of our studies reporting several disorders. Back pains are common among dentists; pain in the cervical region was experienced by everyone in our study, and slipped disc among every second one, as confirmed radiologically [10]. The study by Marshall *et al*. [7] describes the prevalence and distribution of symptoms of musculoskletal disorders occurring among dentists in New South Wales, Australia, and shows that 82% of respondents reported experiencing 1 or more musculoskeletal symptoms during the previous month. 64% of respondents reported suffering pain (the majority reported back pain), and 58% headaches. The most severe symptoms reported were pain (39%) and headaches (25%). Milerad and Ekenvall [8] studied the symptoms of the neck, shoulders, arms and hands of 99 dentists and a reference group of 100 pharmacists. 44% of the dentists and 29% of the pharmacists reported symptoms of the neck. 51% of dentists and 23% of pharmacists reported symptoms of the shoulders. Musculoskeletal symptoms of the forearm were present almost exclusively among the dentists - 12%, with only 1% among the pharmacists. Numbness and paraesthesia were also more common among the dentists than the pharmacists. The authors concluded that the high frequency of symptoms of neck, shoulders and upper extremities among the dentists was

probably connected with their difficult work positions - cervical flexion and rotation, elevated arms, and repetitive precision-demanding handgrips. Fish and Morris-Allen [4] have shown that in Nebraska, USA, 29% of over 1,000 dentists reported symptoms of peripheral neuropathy in the upper extremities or neck. A cross-sectional study was carried out by Akesson *et al.* [2] among 268 dental staff members and 111 referents. Compared with the referents, the female dentists and female dental hygienists showed a higher prevalence of symptoms of the neck, shoulders and hand/wrist during the previous 12 months. Both dental groups also had higher frequencies of a combination of symptoms in these regions of the body, as well as a longer duration of symptoms in the neck and shoulders during the previous 12-month period. Similarly, male dentists had higher frequencies of neck and shoulder symptoms compared with the referents. The authors note that the high frequency of musculoskeletal disorders probably reflects the specific work load in dentistry with its high demands on vision, precision, fine manipulative hand movements, and work with unsupported elevated arms. A study by Finsen *et al.* [3], based on a questionnaire, showed an estimation of the prevalence of problems of dentists in one year - 65% for neck/shoulder and 59% for the low back.

The analysis of our subgroup of dental personnel who did not report any ailments has revealed that they had the lowest work experience - almost half (48.0%) up to 5 years, and 26.0% 6-10 years. This could suggest the disadvantageous influence of the performance of work on the disposition to ailments of the musculoskeletal system. Akesson *et al.* [9] investigated the natural course of musculoskeletal disorders during a 5-year period among personnel, and found that they had increased risk of developing such disorders, which was verified by the symptoms and diagnoses of the more painful or persistent conditions.

To the question of how many years work elapsed before the occurrence of the first symptoms in the musculoskeletal system, 42.9% of respondents replied that they occurred after 6–10 years, 26.5% - after 11–15 years, 10.1% - after 16–20 years, and 5.2% after more than 20 years work. 8.6% of respondents, experienced no disorders at all and 6.7% did not reply. The most intense disorders, measured in years of work (intense disorders increased with the years in practice), were observed in as many as 77.6% of respondents, of whom almost half (96/208) experienced them for the first time after 6–10 years of work.

A highly statistically significant relationship ($p < 0.001$) was found between work practice and the number of disorders of the musculoskeletal system. The number of disorders increased with the length of time in dental practice (Tab. 2). Almost half the dentists in practice for over 30 years reported 5 or more disorders, while almost half the dentists in practice for up to 10 years - from 0–2 disorders. Other authors have obtained the same results. Frączek *et al.* [5] state that the frequency of prevalence of painful disorders of the back, together with metatarsus and wrists among respondent dentists was significantly greater among the group of dentists with long years in practice. In 1987 and 1990, Rundkrantz *et al*. [14] also studied with the aid of questionnaires the occurrence of pain and disorders among dentists. The prevalence of musculoskeletal pain and discomfort had increased with work time, with the exception of pain of the lower back and headache. The only significant difference was found with respect to the shoulders. Of the 311 dentists studied, 262 had symptoms in 1987 and in 1990. In 1987, 49 dentists were free of any symptoms, while in 1990, 24 reported symptoms in the locomotor system. Of the total of 262 dentists with symptoms in 1987, 24 were without any symptoms at the follow-up study in 1990.

Table 1. Disorders affecting the musculoskeletal system reported by those questioned (N = 268).

Disorder	Percent of dentists*
thoracic-lumbar region of the back	60.1
neck pain	56.3
lower extremities	47.8
wrist and hand	44.0
right shoulder	37.3
headache	34.7
shoulder girdle	27.2
upper extremities	25.4
left shoulder	14.2
none	8.6

*Does not total 100% because of multiple response.

Relationship between length of time at work without a break and the number of disorders experienced was also analysed, but no significant difference was found (Tab. 3). Rundkrantz *et al.* [13], however, report that significantly more dentists without cervico-brachial symptoms were aware of and utilised naturally-occurring breaks in their work than dentists with pain and discomfort.

To the question about whether any treatment taken, 64.6% of respondents replied in the affirmative. Of these, 27.75% utilized 2 types of treatment, 24.86% utilized 3, 20.81% - 1 type of treatment, 17.92% - 4, and 8.67% used 5 types of treatment. A highly statistically significant relationship ($p < 0.001$) was found between years in practice and treatment taken (Tab. 4), which is connected with relationship between years in practice and disorders noted. The majority used physiotherapy - 77.5%, pharmacological treatment - 67.1%, X-ray film of the back - 60.1%, and neurological consultations - 41.0%. 20.2% of respondents used other types of treatment, among others, interchangeable sanatorium treatment, rehabilitation, massage, gymnastics, manual therapy, and non-conventional (alternative) medicine.

To the question concerning whether they used prophylaxis which could treat disorders of the musculoskeletal system, 45.5% (122/268) replied affirmatively. It was interesting that as much as 44.0% (97/146) of the dentists stated that they never used prophylactic treatment, but did undertake physical activity (Tab. 5).

Table 2. Study population by years in dental practice and number of disorders.

Years in practice	N (N = 100%)	Number of disorders		
		0-2	3-4	5 or more
up to 10 years	90	54.4%	30.0%	15.6%
11-20	74	27.0%	45.9%	27.0%
21-30	68	17.6%	44.1%	38.2%
>30	36	25.0%	25.0%	50.0%

Table 3. Study population by length of time without a break and number of disorders.

Work time with no break (h)	N (N = 100%)	Number of disorders		
		0-2	3-4	5 or more
1-3	64	39.1%	40.6%	20.3%
4	53	28.3%	35.8%	35.8%
5	55	38.2%	36.4%	25.5%
6 or more	96	30.2%	36.5%	33.3%

Table 4. Study population by years in dental practice and treatment taken.

Work in practice	Taken treatment (N = 170)	No taken treatment (N = 98)
up to 10 years	20.6%	56.1%
11-20	32.9%	18.4%
21-30	29.4%	18.4%
>30	17.1%	7.1%

Table 5. Study population by use prophylaxis and physical activity.

	N (N = 100%)	Use of prophylaxis	No use of prophylaxis
Exercise	219	56%	44%
No exercise	49	0%	100%

Table 6. Study population by **y**ears in dental practice and use of prophylaxis.

Year in practice	Use of prophylaxis (n = 122)	Do not use prophylaxis (n = 146)
up to 10 years	33.6%	33.6%
11-20	31.1%	24.7%
21-30	18.0%	31.5%
>30	17.2%	10.3%

Table 7. Study population by practice of exercises and appraisal of effectiveness of prophylaxis.

Do you exercise?	N (N = 100%)	Appraisal of prophylaxis	
		non-effective (N = 89)	effective (N = 179)
Yes	219	21.9%	78.1%
No	49	83.7%	16.3%

A statistically significant relationship ($p < 0.05$) was found between years in practice and prophylactic activity undertaken. The proportion of dentists who undertake prophylactic remedies, as opposed to those who did not, was 1.7 times less (18.0% *vs.* 31.5%) among those who had been in practice for 21–30 years but bigger among those who had been in practice for over 30 years (17.2% *vs.* 10.3%) (Tab. 6).

Physical activity was performed by 219 dentists, 122 of whom declared undertaking prophylaxis and 97 who declared the opposite. 5 or more kinds of physical activity practiced 13.3% of those who performed exercises, 3–4 - 20.1%, 2 kinds of physical activity - 26.5%, 1 kind - 30.1%. The most popular kind of exercise was: back exercises - 41.55%, morning stretching exercises - 39.27%, flexion-extensory exercises of spine - 36.99%, swimming - 35.62%, abdomen muscles exercises - 35.16%, shoulder girdle exercises - 31.05%, relaxation techniques - 17.81%, running - 10.05%, and fitness - 7.76%. Among those who exercise, 15.5% stated that they participated in group physical activity. The biggest group which exercised were those who performed physical activity every 2-3 days - 36.1%, 29.2% exercised sporadically, 26.5% exercised once a week, and only 8.2% exercised every day.

All the respondents were asked what they thought about the effectiveness of physical exercises and prophylaxis for disorders of the musculoskeletal system. 66% reported that physical activity prevented or decreased such disorders, and the others had no opinion about the effectiveness or suggested that there was no effect. There was found a highly statistically significant relationship ($p < 0.001$) between physical activity and a positive opinion on the subject of the effectiveness of treatment and prophylaxis for disorders of the musculoskeletal system. Some of the positive opinions about the effectiveness of treatment mentioned prophylaxis; those who treated themselves - 78.1% as opposed to 16.3% who did not (Tab. 7).

No significant relationship was found between the practice of physical activity and the number of disorders ($p > 0.05$).

The respondent dentists worked in conditions which aggravated disorders of the musculoskeletal system. The result of long hours each day were irrational from the point of view of ergonomics. The experience of numerous disorders of the musculoskeletal system increased with the number of years in dental practice. For these ailments, dentists must make use of various forms of treatment. Effective prophylaxis concerning the musculoskeletal system was utilized by only some of the respondents. Physical exercise was frequently used but without associating it with prophylactic meaning. Those who were convinced by physical exercise were mainly those who treated themselves.

The results of our study demonstrate the need for developing ergonomic procedures and practice for safe stomatological work among Polish dentists.

Ergonomics have one primary objective - the prevention of work-related musculoskeletal disorders, or the symptoms

that aggravate these disorders. In dentistry, bad working habits, repetitive tasks - such as scaling, root planning, and uncomfortable physical postures contribute greatly to musculoskeletal disorders, stress, and loss of productivity. The key objective for clinicians is to find a position that allows them to achieve optimum access, visibility, comfort, and control at all times [11]. The results of Rundkrantz [12] show that in this case the dentist positioned the patient carefully so that the direct view obtained resulted in a significantly lower frequency of headaches. The results of Murtomaa [9] also indicate that dental teams need functionally-designed dental equipment and proper training in ergonomic methods. With the professional aim of delivering the highest quality of care for a reasonable profit, the practice of ergonomics becomes the centre of focus in determining how best to achieve success with patients without stress [11].

CONCLUSIONS

1. Knowledge about the scope of ergonomics and prophylaxis, as well as health and safety measures at the place of work, should be imparted professionally during pre-diploma training, and perfected in various forms during post-diploma training.

2. The work place of dentists should be designed and fitted-out in accordance with the principles of ergonomics, with new equipment which ensure the correct method or working (correct position, good view, group work).

3. Dental work should be organized in such a way that it enables a rational distribution of work functions between the dentist and female assistant, taking into account the standard instruments, dental procedures, and suitable for individual work possibilities.

4. In this specific work the dentist has to be aware of physical activity to ensure the efficiency of the organism. Physical exercise increases muscular strength, improves speed and coordination of movement, flexibility of the tendons, connective tissues, and ligaments, and decreases the risk of overburdening and degenerative changes in the locomotor organs. This exercise should be selected individually according to advice and possibilities.

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