

DENTIST'S HAND SYMPTOMS AND HIGH-FREQUENCY VIBRATION

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Abstract: The paper discusses characteristics of mechanical vibration as well as the mechanisms of vibration syndrome. Analysis of the relationship between the high-frequency vibration and the typical symptoms in the hands of the dentists is presented. Suggestions have been offered on how to limit exposure to vibration in the hands of dentists.

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INTRODUCTION

Work-related vibrations are significant health hazards, which may have a number of serious consequences. The danger to the organism results from the transfer of mechanical vibrations from the equipment to the body. The vibrations are felt both directly at the point of application and indirectly through the whole body of the operator [16, 21].

The effect of vibration on the human organism depends on many factors, in particular on the intensity of vibrations, the range of frequency, direction, type, point of penetration, time and kind of daily exposure as well as the total time of exposure [11].

Vibration can be divided into general and local. The latter causes negative effects in the upper limbs, especially when the hands are holding the instruments or processing an element [7, 8].

Mechanical vibrations affecting the organism through the upper limbs cause changes in the vascular, neural and osteoarticular systems. The occurrence of such changes and documented exposure to vibrations exceeding frequencies safe for the organism may lead to diagnosing an occupational disease called the vibration syndrome. Its most common variety is the vascular form, but it also appears in a neural and osteoarticular form. Mixed forms are also possible [9, 11, 17, 23, 31]. Depending on how advanced the vibration syndrome is, the perception of

vibration, pain, touch and temperature deteriorates. When the temperature of the environment falls, hypersensitivity to cold occurs as well as paroxysmal blanching of one or more fingertips. Paroxysmal circulatory disturbances in the fingertips are described as Reynaud's phenomenon, "dead fingers" or the "white finger syndrome." Numbness and tingling in the fingers and hands appear. Neurosensory, vascular and osseous changes may occur independently [6, 20, 32, 33]. Changes in the osteoarticular system of the hand arise mainly as a result of local vibrations at frequencies below 30 Hz. The dynamics of the changes happening in the course of occupational exposure to vibration is usually slow and no acute pains accompany them. There appear, however, deformations of articular spaces, changes in the periosteum and in the osseous texture.

The course of the vibration syndrome can be affected by the history of certain diseases, injuries of the upper limbs, drugs used, smoking and alcohol intake. Among the factors enhancing the syndrome we find inadequate microclimatic conditions such as low temperature, high humidity and intense movement of the air, all of which tend to refrigerate the hands.

It is assumed that the negative effect of local vibrations occurs within the range 5-1400 Hz, the most harmful being low-frequency vibrations, i.e. those below 16 Hz.

Mechanical vibrations arise because the various machines operating at the dentist's workplace contain

moving parts. The main source are vibrating power-driven or air-driven instruments, such as low- and high-speed handpieces as well as ultrasonic instruments. The vibrations emitted by these machines travel directly from the handles to the operator's hand. These are local vibrations.

VIBRATIONS AND THE DENTIST'S HEALTH

Epidemiological research carried out among dental workers concerning symptoms in the motor system, in particular the upper limbs, help to determine complaints which are characteristic of the profession. To these belong back pains along the entire length of the spine, pains in the hip joint and the knee joint, pains of the feet, numbness in the upper limbs, paresthesia of the fingers, decreased efficiency of the hands, morning stiffness, pains and edema of the wrist joint, pains of the elbow and shoulder joint and acute backache [10, 13, 18, 25, 27, 28, 29, 30].

Belicka-Berling and Majdecki claim that more dentists in the age group above 30 have complained of pains, numbness and tingling in the hands than in the reference group [2].

From among 1,738 Polish dental doctors questioned on the matter, 49.3% of women and 42.8% of men have complained of numbness and tingling in the fingers [13].

Milerad found that dentists had neurological symptoms in their hands more often than pharmacists [18]. One investigation claimed that dentists had a slightly higher vibration threshold in the dominant hand, which is exposed to high-frequency vibrations, in comparison with the nondominant hand, whereas there is no respective difference in the reference group [5].

It is not known therefore whether high-frequency vibrations emitted by advanced dental equipment cause symptoms similar to those in the hand-arm vibration syndrome.

In an issue of *The British Dental Journal*, Burke and Jaques described symptoms of the vibration white finger, such as tingling, numbness and blanching of one or more fingertips induced by vibrating or rotating instruments held in the hand, and, at the same time, appealed to dentists to report such problems [3]. As a result 10 doctors suffering from the ailments turned up, six of whom filled out a questionnaire describing the symptoms. Each of them pointed out that Vibration White Finger (VWF) arouses symptoms which can make dental practice more difficult. 80% mentioned numbness, 10% tingling, 60% pain when one or more fingers exhibited a blanched appearance. The first and second fingers in which the handpiece was held were affected in all cases. 80% considered that cold weather was an exacerbating factor, while 40% thought of tight gripping or pressure. As a rule the symptoms continued from 20-45 minutes, but in cold weather they could persevere even for several hours. The data is not exhaustive enough to analyse the incidence of VWF [12]. Nevertheless, the indication may show that,

firstly, the problem is not as prevalent in dentistry as it is in engineering, forestry, shoe manufacturing, mining and metal polishing, and, secondly, frequency levels at which VWF often occurs are lower than those present in dental hand instruments, although experimental work has confirmed that VWF may result from these low frequencies.

Ekenvall *et al.* [5] undertook to look at the possibility of nerve injury to the fingers of dental workers, examining sensitivity to vibration, temperature and pain. Differences were studied between dominant and nondominant hands in the reception of vibration, temperature and heat pain among 26 dentists with long-term exposure to vibration and 18 with short-term exposure. Dentists with long-term exposure had higher vibration thresholds than those with short-term exposure, both for digit II, which is exposed to high vibrations, and for digit V, which is unexposed, while the temperature and pain thresholds were similar. The former group exhibited neurological symptoms in the dominant hand more often than the latter. The differences in the vibration threshold of the exposed digit II and the unexposed digit V were higher for the dentists with the symptoms than for those without. Since the exposed and unexposed finger were similarly affected, the neurological symptoms in the dominant hands of dentists with long-term exposure seem to have some other etiology than high-frequency vibration. The symptoms are probably caused not only by high-frequency vibrations, because the exposed digit II and the unexposed digit V are similarly affected. Paresthesia in the hands has a multifactorial background. The carpal tunnel syndrome, other nerve entrapments or rhizopathy can be common causes. The ailments reported by the dentists affecting the upper limbs are comparable to the vibration syndrome, yet it is difficult to establish whether they are caused by the vibration of dental instruments. First, because there are no distinctive methods for diagnosing the vibration disease [11]; second, because ailments of the upper limbs related to the pathology of the cervical spine, which are common among dentists, can be similar to those occurring in some vibration syndromes [2, 17].

Measurements of vibration parameters transmitted to the hands of the dentist using various types of rotating handpieces did not manifest any hygienic abnormalities [24].

Also the carpal tunnel syndrome must be borne in mind, caused by constant grips or repetitive injury of the median nerve, which is positioned under the flexor retinaculum of the hand next to the wrist. This syndrome produces similar symptoms [4]. It is extremely important to correctly distinguish between these vasomotor disturbances [22, 26]. Repetitive hand grips demanding high precision, with the elbows bent, the shoulders often abducted, and the cervical spine flexed and rotated, characterize the work of the dentist. The carpal tunnel syndrome is overrepresented in occupational groups with repetitive hand movements. Ulnar entrapment at the

elbow is said to be common in people working with repetitive elbow movements. Dentists have a high frequency of neck and shoulder symptoms and a high prevalence of cervical spondylosis [1, 14, 19]. This suggests many possible etiologies for the neurological symptoms in dentists with many years' experience.

It should be stated that symptoms similar to those in the vibration syndrome do not seem to relate exclusively to vibration in the case of dental doctors. Changes in the vascular, neural and osteoarticular systems are caused by other harmful factors connected with the specifics of the profession [15].

LIMITING EXPOSURE TO VIBRATION

Exposure to mechanical vibration is usually limited by reducing vibrations technically, through organizational methods and prophylaxis [16, 21]. These methods are relevant to various work environments and to the work of the dentist, while their practical implementation should take into account the characteristics of stomatology.

The dentist ought to use efficient machines, which should be periodically checked and serviced in accordance with the producer's instructions. Minimizing clearance, improving the balance and eliminating the collision of moving parts in the dental machines will lead to a decrease in noise and vibration levels. The necessary repairs of the rotating equipment should only be undertaken using original parts and by qualified personnel. While purchasing new equipment care must be taken to ensure that it does not emit greater noise and vibration than the old machinery.

In the course of the day's work the dentist should observe the principle that periods of exposure to mechanical vibrations alternate with periods of harmless actions or, if necessary, breaks from work.

Regular medical check-ups are in order, with special attention paid to the vascular, neural and osseous systems of the upper limbs. It frequently happens that a simple examination, if carried out at the right time, leads to a timely discovery of changes caused by exposure to vibration.

Additionally, one must consider preceding symptoms, which manifest themselves in the cold season of the year in the form of acroparesthesiae, felt in the fingertips and diagnosed as a moderate-degree disturbance of vibration perception. If these symptoms appear after a short time of exposure to vibration, extreme sensitivity to vibration may be the cause and such patients may have to be placed under careful medical observation. A quick progress in the preceding symptoms may suggest the need for a temporary or permanent cessation of exposure for prophylactic reasons [11].

Since dentists are particularly predisposed to post-vibration changes, they should take particular care of their hands.

Both at work and at home the hands should be washed only in hot water. The hands should be dried very

carefully, not only with a towel but also in a stream of hot air (from a hand dryer). Water evaporating from hands cools them, which is conducive to the rise and intensification of vascular changes.

It is important to select the right kind of protective gloves, which dentists wear for many hours a day. They should not make hand movements difficult or constrict them, which could affect negatively the vascular system. While choosing the gloves it is essential to ensure that they are the right size and that the material from which they are made is sufficiently elastic.

Only dry protective gloves should be worn. In the course of long dental surgeries, when the gloves become wet and the hands cold, the gloves should be taken off, the hands washed and dried, and a new pair used (see above).

The hands must be protected from loss of heat. Depending on the temperature and humidity of the environment, the gloves should be properly insulated. The dentist should observe this rule also when performing other, non-professional, jobs, and at times free from any kind of work.

CONCLUSIONS

On the basis of the available literature it cannot be decided unequivocally if there exists a direct link between vibrations emitted by the working dental instruments and the incidence of symptoms characteristic of the vibration syndrome. Apart from vibrations, other harmful factors connected with the profession seem to play a role, and they modify the hand-arm symptoms.

REFERENCES

1. Akesson I, Lundborg G, Horstmann V, Skerfving S: Neuropathy in femal dental personnel exposed to high frequency vibrations. *Occup Environ Med* 1995, **52**, 116-123.
2. Belicka-Berling J, Majdecki T: Bóle krzyża i kończyn górnych u stomatologów na podstawie badania ankietowego. *Czas Stom* 1987, **40**, 451-456.
3. Burke FJ, Jaques SA: Vibration white finger. *Br Dent J* 1993, **174**, 194.
4. Delgrosso J, Boillat MA: Carpal tunnel syndrome: role of occupation. *Int Arch Occup Environ Health* 1991, **63**, 267-270.
5. Ekenvall L, Nilsson BY, Falconer C: Sensory perception in the hands of dentists. *Scand J Work Environ Health* 1990, **16**, 334-339.
6. Gemme G, Pyykko I, Taylor W, Pelmeur PL: The Stockholm workshop scale for classification of cold-induced Raynaud's phenomenon in the hand-arm-vibration syndrome (revision of the Taylor-Pelmeur scale). *Scand J Work Environ Health* 1998, **13**, 275-278.
7. Goda DF, Stewart AM: Vibration syndrome. *Br J Ind Med* 1970, **27**, 19-27.
8. Griffin MJ: *Handbook of Human Vibration*. Academic Press, London 1990.
9. Harazin B: Drgania Mechaniczne. Instytut Medycyny Pracy i Zdrowia Środowiskowego, Sosnowiec 1996.
10. Iżycki J, Wągrowka-Koski E: Choroby narządu ruchu u stomatologów - analiza przypadków konsultacyjnych kierowanych do Przychodni Chorób Zawodowych. *Med Pr* 1992, **43**, 525-529.
11. Iżycki J: Obraz kliniczny zespołu wibracyjnego i zasady diagnostyki. *Med Pr* 1996, **47**, 227-283.
12. Jaques SA, Burke FJ: Vibration white finger. *Br Dent J* 1994, **177**, 279.

13. Kaczmarczyk-Hałas K, Gdulewicz T, Szadkowska-Stańczyk I: Dolegliwości ze strony narządu ruchu u lekarzy stomatologów w Polsce. *Czas Stom* 1988, **41**, 19-25.
14. Katevuo K, Aitasalo K, Lehtinen R, Pietilä J: Skeletal changes in dentists and farmers in Finland. *Community Dent Oral Epidemiol* 1985, **13**, 23-25
15. Klyszcz T, Hahn M., Blum A, Steins A, Junger M: Occupational little finger tip necrosis in a dentist with thrombangiitis obliterans. *Dermatosen Beruf Umwelt* 1996, **44**, 169-172 (In German).
16. Koradecka D, Lipowczan A: Drgania mechaniczne (wibracje). In: Koradecka D (Ed): *Bezpieczeństwo Pracy i Ergonomia. T. I*, 323-372. Centralny Instytut Ochrony Pracy, Warszawa 1997.
17. Lewin-Smith RG: Objective testing for vasospasm in the hand-arm vibration syndrome. *Br J In Med* 1993, **50**, 381.
18. Milerad E, Ekenvall L: Symptoms from neck and upper extremities in dentists. *Scand J Work Environ Health* 1990, **16**, 129-134.
19. Murtomaa H: Work-related complaints of dentists and dental assistants. In *Arch Occup Environ Health* 1982, **50**, 231-236.
20. Palmer RA, Collin J: Vibration white finger. *Br J Surg* 1993, **80**, 705-709.
21. Pawlaczyk-Luszczynska M: Wibracje - drgania mechaniczne. In: Indulski JA (Ed): *Higiena Pracy. T. I*, 187-216. Instytut Medycyny Pracy, Łódź 1999.
22. Pelmar PL, Taylor W: Carpal tunnel syndrome and hand-arm vibration syndrome. A diagnostic enigma. *Arch Neurol* 1994, **51**, 416-420.
23. Pelmar PL, Taylor W: The hand-arm vibration syndrome. *J Fam Pract* 1994, **38**, 180-185.
24. Polakowska B, Głuszcz-Zielińska A: Próba oceny neurologicznej stanu zdrowia lekarzy stomatologów. *Med Pr* 1994, **45**, 221-225.
25. Polakowska B, Iżycki J: Choroby narządu ruchu i obwodowego układu nerwowego u stomatologów jako problem diagnostyczny i orzecznicy. *Med Pr* 1993, **44**, 181-185.
26. Rosen I, Stromberg T, Lundborg G: Neurophysiological investigation of hands damaged by vibration: comparison with idiopathic carpal tunnel syndrome. *Scand J Plast Reconstr Surg Hand Surg* 1993, **27**, 209-216.
27. Rundcrantz BL: Pain and discomfort in the musculoskeletal system among dentists. *Swed Dent J Suppl* 1991, **76**, 1-102.
28. Rundcrantz BL, Johnsson B, Moritz U: Cervical pain and discomfort among dentists. Epidemiological, clinical and therapeutic aspects. Part I. A survey of pain and discomfort. *Swed Dent J* 1990, **14**, 71-80.
29. Rundcrantz BL, Johnsson B, Moritz U: Pain and discomfort in the musculoskeletal system among dentists. A prospective study. *Swed Dent J* 1991, **15**, 219-228.
30. Shelerud R: Epidemiology of occupational low back pain. *Occup Med* 1998, **13**, 1-22.
31. Taylor W: The hand-arm vibration syndrome-diagnosis, assessment and objective test: a review. *J R Soc Med* 1993, **86**, 101-103.
32. Ulsen N: Vibration aftereffects on vasoconstrictor response to cold in the normal finger. *Eur J Appl Physiol* 1993, **66**, 246-248.
33. Virokannas H, Rintamaki H: Finger blood pressure and rewarming rate for screening and diagnosis of Raynaud's phenomenon in workers exposed to vibration. *Br J Ind Med* 1991, **48**, 480-484.