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WORK-RELATED VISION HAZARDS IN THE DENTAL OFFICE

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Abstract: Among the numerous threats to the dentist's health there is one relating to the eye. The paper discusses the impact of selected adverse factors on the eye in connection with dental practice in the surgery.

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INJURIES

Dental routine requires the use of normal-speed and high-speed drills for purposes like removing old fillings, preparing carious defects, removing the excess of filling materials, polishing fillings, orthodontic and prosthetic operations or performing surgery on bone tissue. Drilling seriously increases the possibility of injuring the eyes of the operator with materials or fragments of tissue. In most cases the foreign body locates itself in the conjunctival sac or the cornea, causing acute pain, lacrimation and a reddening of the eyeball. Deeper penetration of the body may result in a perforation of the cornea and a consequent injury to the lens [25, 44, 55].

Nonsurgical treatment of periodontal diseases involves the use of manual or mechanical instruments for removal of bacterial plaque and tartar from tooth surfaces [9, 40]. Typical of the mechanical instruments are ultrasonic scalers or air scalers [5, 34]. These, while working, sprinkle copiously with water the surfaces of teeth currently under operation. In this way characteristic aerosols are produced which consist of saliva, gingival liquid, organic dust particles (plaque, tartar, remnants of tissues) and rich bacterial flora. The aerosols can cause mechanical injury by penetrating the respiratory and conjunctival tracts of the doctor and the chairside assistants [6, 13, 15, 16, 21, 22, 24, 25, 29, 32, 35, 39, 54]. A simple method of screening the eyes is wearing protective glasses [7, 14, 23, 43, 49, 50, 55]. The majority of doctors use glasses of a classical design in the belief that they give sufficient protection. According to Burton *et al.* [10], effective protective glasses ought to have hard plastic lenses and be designed like goggles or glasses with edges fitting against the skin. Only glasses of that type offer complete security from sprays, droplets and solid bodies. It must be emphasized that, in order to maintain their function, such glasses should be frequently cleaned from any impurities settling on them which could disturb the dentist's vision.

FATIGUE

Natural and artificial lighting is one of the basic factors determining the safety, efficiency and quality of dental practice [31, 53]. Long, debilitating work, which is the norm among dental operators, leads to the exhaustion of the organism. Among its many symptoms the foremost is eye fatigue. It reveals itself as the sensation of heavy eyelids, burning and stinging under the eyelids and deteriorated vision. This is usually accompanied by bloodshot eyes, blinking, lacrimation and increased sensitivity of the eyeball to touch. Very often headaches and eye pain join in. Temporally, visual acuity decreases and the boundaries of visibility areas become blurred. Eye fatigue causes a decrease in critical fusion frequency, a delayed accomodative reflex, a reduced accommodation width and a shift of refraction towards myopia or hypermetropia [19, 20, 33].

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The degree of eye fatigue depends first of all on how difficult the visual work is and on the kind of lighting in which the work is performed. Tiredness affects the condition of the visual organ in such a way that some of its functions deteriorate. Eye fatigue may be of muscular origin – muscle fatigue stems from accommodation and convergence; it may have a sensory character – the sensitivity of the retina is lower; and it may arise from the central nervous system – the vision-related brain parts may demonstrate a lower efficiency [19, 20, 33].

It is impossible to distinguish between symptoms of general fatigue and fatigue of the eye. The acuity and sharpness of vision as well as the time of visual reactions depend to a far greater degree on the condition of the central nervous system than on the eye efficiency. Prolonged visual strain leads to overall exhaustion of the organism.

LASERS

General stomatology makes frequent use of laser radiation of low and medium intensity. Exposure of biological tissue to light of low and medium intensity initiates in the cells specific chemical and metabolic reactions which are usually described as biostimulating. The effect is absence of pain, elimination of inflammation and stimulation [8, 18, 36, 37, 38, 41, 42, 46, 47, 48, 51]. The light of typical biostimulating lasers has the strength ranging from 1–500 mW. The mean strength of dental equipment does not exceed 50 mW. In clinical practice good results are obtained by using the biostimulating laser to treat diseases of the tooth pulp, hypersensitivity of the dentin, diseases of periapical tissues, recurrent aphthosis, maxillary sinusitis, postextraction wounds, alveolitis, maleruption of wisdom teeth, inflammation and neuralgia of the trigeminal nerve, replantation of permanent teeth, diseases of the maxillary joint, gingivitis, peridontitis and diseases of oral mucosa.

However, laser radiation can be a hazard to health. The eye and the skin are the organs most exposed to the light. This refers both to the patient and to doctor, as well as to the assistant personnel who are using laser apparatus. Especially hazardous is the intensity of radiation (W/cm^2) of a particular colour which falls on the skin or on a particular type of eye tissue. It should be noted that while using lasers not only the light beam emerging from the source of light and hitting the patient's eye is dangerous but also any reflected and diffused light. The lens concentrates the beams entering the eye and in this way optical density increases many times, raising the possibility of eye injury [8, 48, 26, 30, 41].

All the optical elements of the eyeball are susceptible to ultraviolet radiation. Radiation in the range of 300 nm is completely absorbed by the cornea, while that between 300–400 nm by the lens of the eye. In absorbing UV, the cornea and the lens first fall victim to its harmful effect [11, 45, 58]. Epidemiological data demonstrate a close connection of such eye diseases as cataract, cancer of the eyeball or retinitis [3, 4, 17, 28]. It is commonly acknowledged that UV causes mainly cortical cataract [11]. UV radiation causes in the eye lens a number of biochemical and morphological changes, thus leading to the degeneration of its function [52] and a destruction of the cytoskeletal apparatus of the lens cells [57]. Particularly sensitive are young people's lenses as they have a much greater ability to transmit UV radiation. UV also exerts a powerful phototoxic effect on the cornea, resulting in numerous degenerative changes [11].

Firstly, practitioners should rely on top quality, professionally made equipment. In particular they must see that the optical elements in the equipment are professionally made, so that a safe and effective area of operation is guaranteed. Secondly, they should examine the risk degree, which is indicated by the class of the lasers, and take the right safety measures. Thirdly, doctors, patients and all the persons assisting in the surgery should at all times wear protective glasses to save the eyes from excessive radiation. The glasses should be professionally made, in accordance with international safety standards [8, 30, 38, 48].

LIGHT-CURING UNITS

Among the most common materials in use today which are alternative to amalgam we find composite resins and glass ionomers. Their polymerization is obtained chemically or by using light [2]. Dental materials cured with visible light in order to be polymerized need a blue light spectrum in the range of 400–500 nm, which is emitted by special lamps. These can be stationary lamps with a long light pipe, pistol lamps or light-emitting terminals mounted directly on dental units [56].

Polymerization is particularly effective in the case of base or lining materials, restoratives for the anterior and posterior regions, luting materials and sealing varnishes [1]. One of the commonest polymerization apparatuses is the halogen light polymerization apparatus in the 400–500 nm range in which the light source is a 12V/75 watt halogen bulb and in which the optimum wave length is produced by a special dichroic band filter [27].

Even though polymerization units for light-curing restoratives are equipped with filters reducing ultraviolet, infrared and any other undesirable kind of light, care should be taken to protect the operator's eyes from direct or indirect light issuing from the unit. The operator should avoid looking directly into the light probe or do so from a necessary distance, otherwise serious damage to the eyesight may follow. Also, staring at reflecting surfaces without anti-glare protection may prove unpleasant or even dangerous, particularly after exposure to prolonged glare. For this reason enclosed anti-glare cones and protective goggles that absorb light below the range of 500 nm should be worn, especially by unit operators or those working near the units over extensive periods of time and by eye surgery convalescents. The light of such units should be avoided by individuals sensitive to light or treated for the same, or those who take photosensitizing drugs.

The correct intensity of the light emitted by curing lamps is over 300 mW/cm^2. The intensity between 200–300 mW/cm^2 involves a prolonged time of curing, while the intensity below 200 mW/cm^2 is incorrect and even harmful because emission of infrared and ultraviolet radiation may occur. This latter case concerns old generation lamps, which nevertheless continue to be used in dental surgeries [56].

Dentists and dental assistants are usually the first to manifest unwelcome effects of surgeries involving the employment of various filling materials because of high exposure to them in the operating room. WHO lists five categories of reactions caused by dental materials:

1) irritation contact dermatitis,
2) allergic dermatitis,
3) contact urticaria,
4) hyperreactivity,
5) light-dependent reactions.

The latter are caused by light and may have a toxic or allergic effect. The toxic effect consists in hypersensitivity to light, which manifests itself in a burning sensation, a reddening of the eye or the appearance of urticaria. As a result of a photoimmunological reaction eczema might occur. WHO studies suggest that, although these types of reactions have not been reported too often, they can become a problem because of the growing popularity of light-curing units [12, 2].

CONCLUSIONS

The factors discussed in the paper all pose a serious danger to the dentist's eyesight and relate directly to the kind of work she/he performs. They can be eliminated only by raising the consciousness of their adverse effect on the eye, by an expert implementation of prophylaxis, ergonomics as well as health and safety precautions at the workplace.

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