

EYE- RELATED TRAUMA AND INFECTION IN DENTISTRY

Diş Hekimliğinde Gözle İlgili Yaralanmalar ve Enfeksiyonlar

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ABSTRACT

Despite numerous technological and medical developments achieved in recent years, a significant amount of occupational health problems still exist in modern dentistry. The risk of eye injury is mostly attributed to the use of high-speed hand pieces and ultrasonic devices. A dental clinic may be the source of eye-related infection and injury because of mechanical, chemical, microbiological and electromagnetic irritants. Accidents may cause facial injuries that involve eyes of the clinicians, patients as well as dental assistants. Eye injuries can vary from mild irritation to blindness. The use of eye protection tools, such as protective goggles and visors, reduces the risk of eye damage or complete loss of vision while working with dangerous and floating materials. Therefore, all precautions should be taken, even when performing common procedures for which the risk expectancy is relatively low. Clinicians should be aware that they are also responsible for providing adequate protection for their assistants and patients, as well as themselves.

Keywords: Eye infection; protective equipment; corneal trauma; dental settings; prevention

ÖZ

Son yıllarda elde edilen birçok teknolojik ve tıbbi gelişmelere rağmen, modern dişhekimliğinde halen dikkate değer sayıda mesleki sağlık sorunları yaşanabilmektedir. Göz yaralanmalarına yol açan risk etkenleri içerisinde en önde gelenleri yüksek hızlı el aletleri ve ultrasonik cihazların kullanımı sırasında ortaya çıkan travmalardır. Dişhekimliği klinikleri, mekanik, kimyasal, mikrobiyolojik ve elektromanyetik iritanların yaygın olarak kullanılmalari nedeniyle göz yaralanmalarına ve enfeksiyonlarına sık rastlanan ortamlardır. Bu ortamda yaşanan kazalar, hekimlerin, hastaların ve yardımcı sağlık personelinin yüz bölgesinde gözleri de içeren yaralanmalara sebep olabilirler. Bu yaralanmalar sonucunda gözlerde hafif iritasyon bulgularından kalıcı körlüğe kadar değişen klinik tablolar ortaya çıkabilir. Özel gözlükler ve yüz maskeleri gibi koruyucu malzemelerin kullanımı, tehlikeli ve fırlayan maddelerin etkilerine bağlı olan göz hasarlarının ve görme kayıplarının ortaya çıkma riskini azaltır. Bu yüzden, risk beklentisi düşük olan sıradan günlük işlemlerde bile bütün önlemler alınmalıdır. Dişhekimleri, hem kendilerine hem de hastalara ve yardımcı sağlık personeline yönelik koruyucu önlemleri almaktan sorumlu olduklarını unutmamalıdır.

Anahtar kelimeler: Göz enfeksiyonları; koruyucu ekipmanlar; kornea travması; dişhekimliği; korunma



Introduction

According to the World Health Organization's description of health, health is a state of complete physical, mental and social well-being, and not merely the absence of disease or infirmity (1). Eye health is becoming an increasingly important subject both for the health care system and the society (Figure 1, Figure 2). Since infections and injuries in the eyes may go unnoticed, partial loss of vision or even blindness may occur (2). On the other hand; there are some protective and preventive measures which could easily provide good visibility while maintaining the integrity of eye health. The use of eye protection gear, such as protective goggles and visors, reduces the risk of eye damage or complete loss of vision while working with dangerous floating materials or performing sportive activities (3).

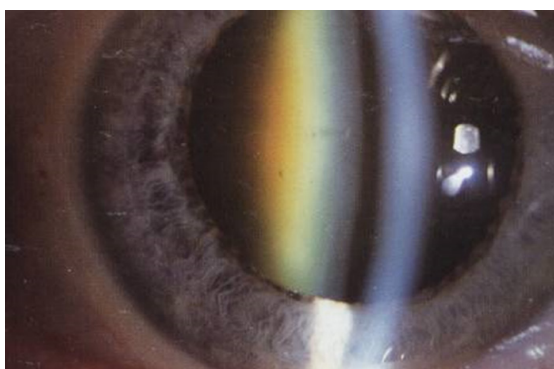


Figure 1. A close-up picture of the front segment of eye.

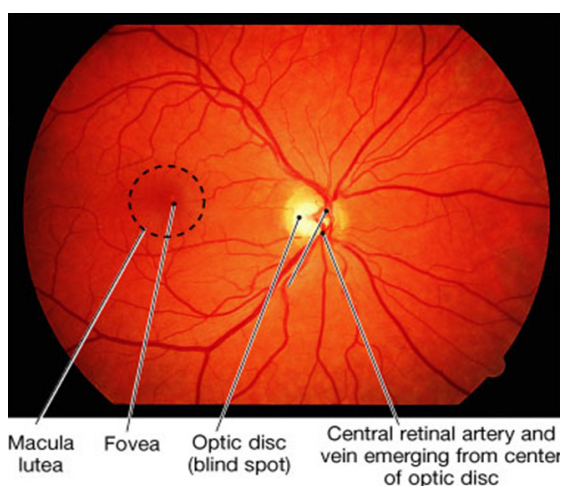


Figure 2. Anatomical components of the retina described on a picture taken with the technique called fundus photography.

Dentistry is one of the professions in which the practitioners and patients both became exposed to eye-related injuries which may result in ocular infections during daily routine (2). Therefore, all necessary precautions should be taken to prevent the occurrence of eye related injuries. Dental professionals must have their own protective safety equipment in order to protect their health and to maintain their active career (4). A dental clinic may be a source of eye-related injuries because of the constant risk of mechanical trauma as well as the possibility of being exposed to various chemicals and electromagnetic activity. Accidents resulting in injuries related to face and eyes may occur at any time during the treatment, and dentists, dental assistants as well as patients may be involved (4, 5). In 1991, the use of protective goggles was made compulsory in United States as they reduce the risk of blood borne pathogens to be transmitted by splashing or with aerosols during dental procedures. In the recent publication of Centers for Disease Control and Prevention (CDC), it is stated that "Protective eyewear for patients can protect their eyes from spatter or debris generated during dental procedures." (Figure 3) (4). Porter et al. (6) investigated occupational injuries reported in dental hospitals over a period of 9 years. They found out that eye injuries accounted for 10% of incidents. Similarly, Wazzan et al. (7) examined the 1-month prevalence of ocular injuries and infections among dental personnel which consists of dental assistants, dentists and technicians. The foreign body related injury prevalence of dental personnel, the dentists and the technicians was found to be 42.3%. The reported conjunctivitis prevalence of the dentists was, respectively, 7.1% and 42.8% (7). In a research conducted at the University of Queensland Dental School in Australia between 1992 and 1994, it has been found that eye-related injuries can occur very often but they have low severity (181 person in two years) (8). From an objective perspective, it has been reported that regular use of protective goggles reduces these kinds of problems (7). The aim of this article is to provide an overview of the current knowledge of eye-related injuries in dentistry while emphasizing the importance of routinely using protective gear.



Figure 3. Protective eyewear with side shields can protect the eyes from spatter or debris generated during dental procedures.

Materials and Methods

An extensive literature review was conducted which targeted all articles published in peer-reviewed journals relating to the topic of occupational eye injuries in dentistry. Only articles written in English language were considered. The review itself began with a search of relevant Medical Subject Headings such as ‘ocular injuries dentistry, eye protection in dental practice, occupational injuries, eye related accidents, occupational hazards, occupational health, work related injuries in PubMed/Medline, Scopus, Google Scholar, Tubitak Ulakbim EKUAL and the Cochrane Library databases. A hand search of references was also performed.

Results

When search results are combined and duplicates removed, the total number of relevant literature was found to be 3072 abstracts and 798 full-text articles. Abstracts were not included and about one-third of full-text articles were not related to dental practice. 468 of the articles did not contain eye-related injuries in dentistry. 14 articles were excluded as they had not been written in English.

Discussion

Causes of eye-trauma and contamination

The harmful effects and contamination concerning the eyes most commonly occur in two ways. The first one is the development of contamination in the areas recently traumatized

by infected solid materials such as tooth corpuscles, calculus, bone particles, parts of steel, gold, and amalgam particles which may fly off from dental tools or materials and hit the eyes with a speed up to 96 km per hour (5). The second cause is the presence of micro-organisms in the blood and saliva mixture, which may be transferred into the conjunctiva by the absorption of aerosol effect created by high-speed turbine and micro motors. It has been reported that microorganisms emerging from the mouth can hang in the air for 30 minutes. If they reach a high concentration, they may overcome the defense mechanisms of the eye and lay the background for subsequent infection (5) (Table 1).

Injuries caused by infection and trauma

Two broad categories of eye related injuries can be distinguished: those caused by infection or trauma. Infection-related injuries are usually the result of direct contact between the eye and some splashing material such as aerosols, saliva, gum liquor, organic dust particles (plaque, calculus, and tissue residues) and bacteria-rich flora. Indirect contact includes the interaction between the eye and regions where the effects of splashing still persist. As a result of infection-related injuries, a wide variety of bacterial as well as viral diseases and conditions may occur, such as bacterial conjunctivitis, bacterial keratitis, viral conjunctivitis, viral keratitis, Hepatitis B, Hepatitis C and HIV contamination. Although goggles are protective against the effects of direct splashing liquids, even those with side shields cannot provide complete protection against aerosols with viral contaminants (10). Herpes Simplex type 1 virus has been found even in the saliva of asymptomatic individuals (11, 12) and poses a significant risk for cross-infection (12). Herpes keratitis typically occurs when a person touches the herpes labialis and rubs his/her eyes. Another path of contamination occurs when the dental assistants touch their eyes after working on a patient with active herpetic lesions (13). Among bacterial and viral infections, herpetic keratitis tends to demonstrate the worst prognosis (14). Transmission of other conjunctival pathogens such as Chlamydia trachomatis is also possible in dental settings although their incidence is rare (15).

Table 1. Possible adverse effects affecting eyes (from Farrier SL, Farrier JN, Gilmour AS. Eye safety in operative dentistry - a study in general dental practice. *Br Dent J.* 2006 Feb 25;200(4):218-23. Reprinted with permission of Nature Publishing Group, license number: 4125541091762) (9).

Infective/ Trauma	Adverse Effect	Cause	Symptoms	Treatment	Outcome
Trauma	Corneal abrasion	Foreign Body	Acutely Painful	Self limiting	Heals rapidly, Recurrent corneal erosion, Secondary infection
	Haemorrhage into anterior chamber	Penetrating foreign body	Acute Pain	Remove foreign body, Suturing	Cataracts
	Torn iris		Altered vision Altered appearance		Pupil distortion Detached retina Uveitis
	Lacerations	Blunt / Sharp object	Laceration, may involve lid margin	Anatomical repair	Scarring
	Chemical Injury	Acid / Alkali	Mild conjunctivitis Epithelial erosions Superficial punctuate keratopathy	Copious irrigation Remove any particles pH with litmus paper Topical antibiotics Lubricants Topical steroids Vitamin C	Usually recovers Corneal defects (opacities and perforation)
Infective	Bacterial Conjunctivitis	Staphylococcus, Streptococcus, Pneumococcus Haemophilus	Redness, Discharge, Ocular irritation	Usually self limiting	Heals
	Bacterial keratitis	Staphylococcus epidermidis, Staphylococcus aureus, Streptococcus pneumoniae, Coliforms, Pseudomonas, Haemophilus	Pain, Purulent discharge, Ciliary injection, Visual impairment, White corneal opacity	Topical antibiotics	Heals
	Viral conjunctivitis	Adenovirus, Coxsackie, Picornavirus	Watery, Purulent discharge, Chemosis, Excess lacrimation	Self limiting but highly contagious	Heals
	Viral keratitis	Herpes simplex	Dendritic ulcers on the cornea, May involve the stoma		Ulcers heal without scarring, Risk of permanent scarring and blindness
	Hepatitis B & C	Hepatitis virus	Systemic infection	Interferon treatment	Possible chronic hepatitis, cirrhosis, Risk of hepatocellular carcinoma
	HIV	HIV	Systemic infection	Supportive drug therapy	Poor long term prognosis

Risk management strategies for patients with active oral herpes infection

Only urgent treatments should be performed. Treatments without urgency should be postponed until the lesions heal. As widespread presence of aerosols is inevitable when using dental equipment such as high-speed drills, extra precautions should be taken during treatment. Dental professionals and assisting staff should cover their body completely, wear protective goggles and use face shields. All equipment must be disinfected properly after use. Extra measures should be taken to protect the arms, hands and face, even if the aerosol hazard is minimal. Instantaneous movements of the patient against

the pain should be taken into consideration. If the procedure takes too long, gloves should be changed frequently, and hands should be washed with soap between glove changes. Eye protection should be provided for the patients and they should be advised to wash their hands and faces after treatment. Patient should also be informed about the causes and transmission ways of herpes labialis (16).

Risk management strategies for dentists and assistant staff with herpes infection around the mouth

The lesion area should be thoroughly covered with a suitable mask. In addition, patient protection should be provided with protectors such as face

shields. It should be remembered that the gloves protect the patient from the clinician as well as the clinician from the patient. If contact is made with any assistant staff, gloves must be changed immediately. And finally, the patient should be informed about this situation and his/her written approval be obtained before the treatment (16).

Risk management strategies in dentist and assistant staff with herpes keratitis

Viral rash is potentially high; therefore, the face and eyes should be covered to protect the patient. Face shield and goggles must be worn always, not only for protection but for preventing the clinician from scratching his/her itchy eye, which requires a considerable effort and conscious thinking if the protective gear has not been worn. If an accidental contact with the eyes occurs, gloves should be changed immediately. Hands should be washed with hot water and soap between glove changing procedures. The patient should also be informed about clinician's and/or dental assistant's condition and informed consent should be obtained before the procedure (16).

Injuries caused by trauma

Standard or high speed drills are widely used in nearly every dental treatment such as removal of old fillings, cleaning of caries, polishing, orthodontic applications, prosthetic preparations or bone removal. Tissue particles or excess materials flying off in every direction during cavity preparation significantly increase the risk of eye injury for dental professionals. When the injury occurs, foreign body is located in the conjunctival sac or cornea in most of the cases. This causes acute pain, lacrimation and erythema in the eyeball. Deeper penetrations may result in corneal perforation and lens injuries (17-19). Eye injuries constitute about 10% of all the injuries that occur during dental treatment and oral surgery. They are mostly caused by aerosols and foreign bodies (20, 21). Slight injuries may lead to relatively low-risk conditions such as conjunctivitis, whereas severe trauma may result in corneal abrasion, penetration and even blindness in some cases (21). Matsuzaki et al. (22) presented a 27 year old assistant staff who had suffered from an eye injury due to a fractured bur fragment that flew off during the use of high-speed drilling equipment. They reported that

the dental assistant was not wearing any safety goggles or face masks during the procedure. The broken instrument had not harmed the eyeball by chance and, it had stopped after perforating the medial orbital wall.

Lasers

Lasers and light devices can cause visual impairment if protective measures are not taken. Low and medium intensity laser beams are frequently used in general dentistry. When tissue is exposed to low or medium intensity laser, cells initiate a series of chemical and metabolic reactions; this process is usually described as biostimulation. Effective pain control and elimination of inflammation have been reported as positive clinical effects (19, 23-30). The output power of typical biostimulation lasers range from 1 mW to 500 mW. The average power of dental equipment does not exceed 50 mW. In clinical practice, biostimulation effect of lasers is mainly used in dentin hypersensitivity, periapical tissue diseases, recurrent aphthous lesions, maxillary sinusitis, post-extraction pain, alveolitis, pericoronitis, trigeminal nerve inflammation, permanent tooth replantation, temporomandibular joint diseases, gingival inflammation, periodontitis and oral mucosa diseases, with acceptable clinical outcomes. These lasers, on the other hand, can also pose health hazards. Eyes and skin are the most exposed organs to the light. Not only does the visible light reach to the patient's eye but also the reflected and scattered lights. Concentration of the beams entering the eye is increased by the focusing effects of the cornea and lens. Thus, both the total optical density and the risk of eye injury increase considerably (19, 23, 27).

Anatomical structures of the visual system are sensitive to ultraviolet radiation (UV). Cornea absorbs the radiation at 300 nm level, while lens at 300-400 nm. Accordingly, both cornea and the lens are exposed to the harmful effects of the absorbed UV. Laser light in the ultraviolet (290 - 400 nm) or far infrared (1400 - 10,600 nm) spectrum can cause damage to the cornea and/or to the lens (19, 31). Epidemiological data suggest a close link between retinitis or eyeball cancer and eye diseases (32-35). UV-B has been particularly associated with increased risk of cortical cataract (19). UV radiation causes biochemical and morphological changes in the eye which may lead to functional degeneration (36)

and cellular destruction in the lens (37). Accordingly, dentists should only trust and use highest quality eye protection equipment to protect themselves and their patients from the harmful effects of laser beams. In addition, condition of the protective equipment must be checked regularly to ensure its structural integrity (Figure 4). Potential risk level indicated

by the laser class sign must be known and, based on the risk assessment; corresponding safety precautions should be taken. Clinicians, patients and other personnel in the operating room should always wear protective goggles to protect their eyes from the harmful effects of radiation (Figure 5) (19, 29).



Figure 4. Goggles with visible scratches on the surface (left) or those which are broken (right) should not be used as they are unable to provide sufficient protection.



Figure 5. Protective measures taken, patient ready for laser procedure.

Light-curing units

Special blue light devices, whose wavelength range changes between 400-500 nm, are used in dentistry to polymerize composite materials. Different types of portable or chair-mounted light-curing units are widely available in the market. Although light-curing units are equipped with adjustable orange protection filters to block the harmful effects of blue light, precautions should be taken to protect the operator's eyes from direct or indirect light emission (Figure 6). The dentists should avoid looking directly at the light probe or look at it from a safe distance (min 25 cm). Otherwise, continuous exposure to short wavelength of blue light may cause cellular damage in retina which is directly exposed to these effects.



Figure 6. Protection filters to block the harmful effects of blue light.

Looking at reflective surfaces without anti-reflective protection causes undesirable effects, especially after prolonged exposure to reflections. Therefore; especially dentists whose eyes are recovering from eye surgery or dental staff working near the light source for long periods of time should wear anti-glare goggles that absorb light below 500 nm. Besides, light may cause allergic or toxic effects. Toxic effect may occur as hypersensitivity to light, a burning sensation in the eye, eye redness or urticaria. According to the World Health Organization (WHO) studies, even though these reactions are not reported very often, the increased popularity of light devices can cause such problems (38-40).

Safety precautions

Dentists should be conscious and careful to protect their eye health against injuries and infections. They should take the necessary precautions to protect the eye health of themselves, assistants and patients. Eyeglasses used as protective goggle are not sufficient to protect eye health as these equipment have no side shields to protect the side regions of the face. Dentists should prefer glasses with side shields that can be combined with prescription glasses, compatible with prescription lenses or visor holders (41-45). Prescription glasses do not provide sufficient protection by itself. Therefore, it is absolutely necessary to use the visor during the use of these glasses (46). The Organization for Safety and Health Administration requires that all employers supply their employees with equipment such as eyeglasses or face masks that protect their eye health. These equipment must be made of impact and strong plastic that conforms to ANSI Z87.1-1989 / ANSI Z87.1-2003 / ANSI /

ISEA Z87.1-2010 standards, in accordance with the regulations of “American National Standard Practice for Occupational and Educational Eye and Face Protection” (47). In order to reuse these protection devices, cleaning and disinfection must be performed in accordance with specific procedures. The manufacturer’s recommendations can be consulted for the disinfection of the relevant products. Contaminated eye protection devices should be disinfected where other contaminated equipment is cleaned. The equipment must be cleaned and disinfected physically, and should be cleaned with the disinfectant specified by the standard rules of that establishment, rinsed and left to air dry. Gloves should be used during disinfection of these devices (48). Strong suction and surgical aspirators should be used to minimize the negative effects of aerosols. The rubber-dam which is routinely used during dental procedures, reduces microbiological contamination caused by aerosols by 95% (44, 49). Also, the use of mouthwashes significantly reduces pathogenicity by reducing the number of bacteria in the mouth flora (50).

Conclusion

This review article revealed that eye-related infections frequently occur in dentistry. These injuries can develop at various levels. The use of

eye protection tools, such as protective goggles and visors, reduces the risk of eye damage or complete loss of vision while working with dangerous and floating materials. Therefore, all precautions should be taken, even when performing common procedures for which the risk expectancy is relatively low. Clinicians should be aware that they are also responsible for providing adequate protection for their assistants and patients, as well as themselves.

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Conflict of interest

None declared.

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