



Occupational Hazards in Dentistry and Preventing Them

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Abstract

Every profession has its own unavoidable occupational risks. Dentists, being in a highly professional occupation today, encounter many hazards related to their habitations. Some of the risks they face are within the scope of knowledge of dental surgeons, while others are somehow skipped. It is mandatory to have a thorough knowledge of professional hazards one may encounter while working, and proper measures must be taken to prevent them. A dental surgeon works around many perils in the business environment while being a prosthodontist, periodontist, endodontist, orthodontist, etc. There are many risk factors specific to any particular specialty. Hazards most commonly encountered are musculoskeletal disorders (MSDs), latex hypersensitivity, and professional burnout. Dental surgeons are also exposed to many bloodborne pathogens, sharp instrument injuries, ocular and hearing problems, neuromuscular disorders, cross-contamination, dental material allergies, mercury poisoning, radiation hazards, chemical injuries, etc. Some problems may cause the death of dentistry personnel if proper care is not taken. Thus, it is crucial to conduct awareness programs on early diagnosis, health education, and prevention modalities.

Keywords: Diseases, Occupational, Professional Burnout, Dentistry, Musculoskeletal Diseases

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Introduction

According to the World Health Organization (WHO), the term “hazard” refers to “an inherent property of an agent or situation having the potential to cause adverse affects when an organism, system, or population is exposed to that agent.”¹ Under the Occupational Health and Safety Act, occupational illness is defined as “a condition that results from exposure in a workplace to a physical, chemical, or biological agent to the extent that the normal physiological mechanisms are affected and the health of the worker is impaired.”²

A dentist and his team members are exposed to various hazards particular to the dental profession. Many occupational health problems still persist in modern dentistry despite numerous technical advances.

Objective

Dentistry is a noble profession in an extremely complex field with a wide variety of specialties providing services to people around the globe. Therefore, knowing the various occupational hazards that dentists encounter during their daily routine is of utmost importance, because these hazards may affect their outcome of their treatments and can even lead to disabilities. This review gives insight into various possible

hazards that dentists may face during their daily routine. Furthermore, it provides various measures for preventing and limiting disabilities.

Occupational hazards can occur in different forms, like biohazards, neuromuscular problems, musculoskeletal disorders (MSDs), visual problems, allergies, skin diseases, hearing defects, respiratory disruption, or stress related disorders.

Bernidino Ramazzini, popularly known as the “father of occupational medicine,” wrote the book “*De Morbis Artificum Diatriba*” in 1713, in which he discussed the diseases of workers.³

He mentioned 3 principle causes for the occupational hazards:

1. Posture
2. Repetitive motion
3. Stress

Some occupational hazards are seen mainly in specific departments because of long-term exposure to particular risk factors. However, some hazards are commonly encountered by all professionals, even under-graduates, at some point in their careers. Table 1 shows specialty wise illustration of common hazards encountered and preventive strategies.

Common Hazards in Dentistry

1. Musculoskeletal Disorders

MSDs⁴ comprise the predominant hazard affecting the majority of dentists and dental hygienists. Compared to older and experienced dentists, those who are young and less experienced might have more MSDs.² Back pain in particular has been found to be a major hazard.⁵

The posture with which a dentist works, twisted and neck bent, an arm abducted, repetitive and precise movements of hand can cause neck syndrome and pain in the shoulder and upper extremities.⁶

Working for long hours without regular break intervals, repeated hand, wrist, and shoulder motions (like flexion, extension, and twisted movements), maintaining a static sitting posture for a long period, or improper technique usage for short periods are the main reasons for MSDs.

MSDs⁴ are injuries or pain in the human musculoskeletal system, including joints, muscles, tendons, nerves, ligaments and structures that support limbs, neck and back. These include lower and upper back pain, neck pain, shoulder pain, cervical spondylosis, tendinitis, carpal tunnel syndrome, herniated disc, repeated strain injuries, cervical root problems, and other issues.

Carpel tunnel syndrome results in numbness and tenderness in the thumb and wrist while working or grasping an instrument. It starts as a feeling of pins in the ring and middle fingers. Spondylosis gives a painful trigger point upon touch and permanent posture damage. It causes pain, tenderness, and stiffness in the arm, shoulder, neck, and lower back muscles, which may eventually lead to atrophy of the muscle.

MSDs may sometimes cause permanent physical damage that could force a dentist to stop working. Thus, it is advised that sufferers get diagnosis and treatment before the condition leads to a career-ending disability.

Prevention

Ways to prevent musculoskeletal problems include:

1. Taking periodic breaks and stretching between appointments;
2. Avoiding static postures for long periods and shifting the workload from one group of muscles to another⁵;
3. Observing proper posture techniques during procedures;
4. Acquiring education about musculoskeletal health and disorder prevention;
5. Sharing the workload with team members.

2. Psychological Hazards

The dental profession stands third among the top eleven professions with the highest suicide rates. This indicates that stress-related problems are quite common among dentistry professionals and need to be considered as serious issues. Today, dentists experience the highest levels of job-related stress and disorders that affect their health.

Stress among dentists is mainly caused by work overload, running behind schedule, working with inefficient assistants, managing pediatric and anxious patients, high expectations from patients, and time management. "Professional burnout"

is one possible consequence of chronic occupational stress. Burnout is best described as the gradual erosion of a person. It affects the dentist's quality of treatment, sleep, and communication with the patient. It can cause the dentist to look sad or possibly become habituated to alcoholism and drug intake.

Anxiety and Depression Are 2 Main Disorders Associated With Stress

Depression is the leading cause of disability as it is a psychological illness that involves the body, mood, and thoughts of a person. It disturbs the personal life and daily routines of dentists, like sleeping and eating, and results in insomnia or hypersomnia, weight loss or gain, frequent fatigue and loss of energy, and finally thoughts of death or suicide. Panic and generalized anxiety disorder (GAD) are 2 anxiety disorders. Symptoms of anxiety include sweating, cool extremities, pounding heart, numbness in the hands, nausea, fear, dizziness, headache, trembling, irritability, and loss of control. Chronic exaggerated worry and tension are main reasons for GAD.⁸

Prevention

Ways to prevent anxiety disorders include the following:

1. Anxiety management programs, which should be directed at 2 levels: dental students and dentists;
2. Stress management workshops for stress-relieving exercises like deep breathing, listening to audiotapes, and effective relaxation of body parts;
3. Regular physical activity or exercises, meditation, and desensitization;
4. The use of antidepressants or anti-anxiety drugs in extreme conditions;
5. Practicing positive thinking in negative situations;
6. Learning interpersonal communication skills or how to deal with conflict.⁹

3. Latex Allergy

Gloves and masks are integral parts of a dentist's protective equipment. Latex is a common component in many medical and dental supplies, including disposable gloves, airway tubing, dental dams, intravenous tubing, syringes, dressings, catheters, stethoscopes, and bandages. Masks and gloves are basic infection control strategies and have been routinely used by the dental profession for more than 2 decades. However, it is estimated that 8.8% of dentists are allergic to latex.¹⁰ Moreover, the residual or chemical component causes a potential health hazard to patients and dental staff.⁸ Latex contains cornstarch as a key ingredient, and cornstarch is a main cause of allergic reactions. Frequent exposure to latex products is a main factor in immediate allergies.¹¹⁻¹³ Sensitization can occur through inhalation of or direct contact with cornstarch powder. Clinical symptoms include rash, hives, itching, stuffy or runny nose, urticaria, and conjunctivitis accompanied by lacrimation and swelling of eyelids. Severe cases may result in bronchial asthma or anaphylactic shock.

Varying degrees of toxicity have been reported in in-vitro

Table 1. Specialty Wise Illustration of Common Hazards Encountered and Preventive Strategies

Department	Common Hazards Encountered	Prevention
Orthodontics	<p>Ocular Problems: Orthodontists work mainly with lasers and curing lights for bonding material polymerization. Other than that, office and dental chair lighting are critical for optimal work conditions. In orthodontics, lasers are mainly used for the bonding of ceramic brackets and cosmetic gingival contouring.¹⁵ Due to the reflection of blue light, the eyes are at risk from both acute and cumulative effects. Blue light is emitted in the wavelength range of 400-500nm. According to previous reports, there is an increased ocular risk at about 440nm. When blue light strikes the retina, it inhibits cytochrome c oxidase, without which degeneration of the retina will occur. Potential ocular damage occurs after cumulative viewing of light for about 6sec from a distance of 30 cm with high power curing units. Penetrating injuries and UV lights are risk factors of cataracts.¹⁶ The risk from acids that are hazardous to the eyes are mostly related to bonding procedures.¹⁷Alkalis cause cataracts and secondary glaucoma. Dry-eye syndrome is related to reduced blinking, decreased tear production, and increased tear evaporation caused by excessive lighting, heat, or air-conditioning.¹⁸</p> <p>Hearing Problems The noise produced from the suction motor, saliva ejectors, amalgamators, and compressors may lead to impaired hearing.</p> <p>Aerosol contamination Impression materials and orthodontic appliances are transferred between clinic and laboratory areas and could be sources of infection. Apart from ultrasonic scaling, orthodontists are exposed to high levels of aerosol contamination during debonding procedures (concluded by Toroglu).¹⁹</p>	<ol style="list-style-type: none"> 1. Protective eye glasses and plastic face shields prevent the entry of light into the eyes and also prevent sharp object injuries. 2. The use of a high velocity evacuator and high-speed instruments decrease the amount of aerosol. 3. Rinsing with antiseptic solutions before treatment is recommended for bacterial aerosol control during scaling. 4. Proper autoclaving of instruments and wearing single-use sterile gloves will control the infection contamination.
Oral and Maxillo Facial Surgery	<p>Infections Surgeons mainly come into contact with body fluids like blood. Infections are easily transmitted through the blood and through the use of contaminated instruments, direct touch with an infectious part, splatters, aerosols, and trauma/injury. Improper sterilization may lead to cross-contamination and infection. Herpetic infections and HIV are a big concern in dentistry, most being hepatitis-B, hepatitis-C, hepatitis-D, non-A, and non-B. Hepatitis-B is most common among those viruses. The risk for HIV infection after per-cutaneous and mucous membrane exposure to HIV-infected blood is approximately 0.3% to 0.09%.²⁰ Herpetic infections can cause primary herpetic stomatitis or herpetic whitlow. Such a virus may remain dormant for years, and re-activation can result in cases of the shingles. Chicken pox is highly contagious and spreads easily through the airborne route. Tuberculous bacilli mostly appear and contaminate through the saliva and sputum. If it is active and untreated, it is a possible hazard to dentistry staff members.</p> <p>Physical Injuries: Maxillo facial surgeons usually work with sharp and complex armamentarium in performing procedures. This creates opportunities for surgeons to injure their fingers, hands, or wrists. Although many occupational hazards are there, sharp instrument injuries remain the most common among surgeons' practices. Around 4,00,000 sharp instrument injuries happen every year in the U.S., with around a quarter of them being sustained by surgeons.²¹ Lifting or moving equipment also creates chances for accidents, injuries to arms, backs, or legs.^{22,23}</p> <p>Chemical Injuries Surgeons are at high risk of exposure to iodine and isopropyl alcohol, both of which cause skin irritation. Exposure to formaldehyde is associated with nasopharyngeal tumors. Exposure to anesthetic gases may cause a wide range of health issues, like renal, neurological, or hepatic diseases. It also leads to decreased mental performance and mental dexterity.²⁴</p>	<ol style="list-style-type: none"> 1. Proper handling of instruments aids in reducing sharp instrument injuries. 2. Careful disposal of sharp objects and needles should be ensured. 3. Prior vaccination for hepatitis and other infections should be obtained. 4. Sterilization of instruments, gloves, masks, full gowns, and operation theaters should be carried out for proper infection control. 5. WHO guidelines for infection control should be followed while treating HIV-positive patients. 6. Careful handling of chemicals prevents chemical injuries.

Table 1. Continued

Department	Common Hazards Encountered	Prevention
Conservative Dentistry and Endodontics	<p>Mercury Poisoning: Mercury poisoning is a frequently encountered hazard. Mercury present in dental amalgam has hazardous effects on dental personnel. The maximum level of exposure considered to be safe is 50microgram/cc of air.²⁵ Mercury shows its effects through direct contact, inhalation, or ingestion. Of these routes, inhalation is more common and dangerous. Mercury poisoning leads to permanent damage of the brain, kidney, immune system, and the growth of children. It has also been found that dental fillings affect the DNA and cause cancer. Exposure to mercury leads to the formation of neuro fibrillary tangles which is one cause of Alzheimer's disease. Mercury poisoning may cause tumors of the face, arms, or legs and may also be associated with slurred speech and tremulous illegible handwriting.⁴</p> <p>The WHO review of inorganic mercury in 1991 estimated that mercury absorption was approximately four times higher from amalgam fillings than from fish consumption.²⁶</p> <p>Hearing Problems While working in clinics and laboratories, dental personnel are exposed to different levels of sound. Dental laboratory machinery, like the dental hand piece, amalgamators, high-speed evacuation devices, and other items, produce sound at different, appreciable levels.</p> <p>A study conducted among dentists and dental auxiliaries reported that 16.6% of the study participants had tinnitus, 30% had speech discrimination, and 30.8% had speech discrimination in a background noise.²⁷</p> <p>Longer exposure to higher noise levels produces harmful effects on dentists. Harmful effects can occur if noise levels are above 80 db, depending on the intensity, distance from the source, and total duration of the noise.²⁸ The effect starts as tinnitus and over time may lead to permanent hearing loss.</p> <p>Radiation Hazards Endodontists are frequently exposed to radiation. Dental radiographs play an important role in conservative dentistry and endodontics. The use of intraoral periapical radiographs and bitewing radiographs starts from diagnosis and occurs throughout treatment as well as after post-treatment evaluation. This radiation has numerous consequences, like deterministic and stochastic effects. It may start as simple mucositis, which is an inflammation of the mucosa, and lead to carcinomas and sarcomas. Radiation sometimes directly affects DNA, leading to chromosomal abnormalities and changes in gene structure.</p>	<ol style="list-style-type: none"> 1. Disposal of excessive mercury into mercury disposable bottles for recycling should be carried out . 2. OSHA safety standards, which state that maximum permissible exposure should not exceed 90DbA SPL (decibel sound pressure level) in an 8-hour day, should be strictly observed. 3. Wearing thyroid collars and full gown, standing behind a barrier during x-ray projections will prevent radiation-induced problems.
Periodontics	<p>Hearing Problems Dental hygienists and dental auxiliaries deal mainly with scaling and root planning procedures. They continuously use sonic and ultrasonic units which generate a moderate level of noise. If they are used for prolonged periods, hearing defects may result. Using old ultrasonic units results in more noise production and affects the quality of treatment.</p> <p>Ocular Problems Concentrating on a specific area for long periods may cause eye strain. Lasers are used for crown lengthening procedures, depigmentation of gingiva, and cosmetic recontouring of gingival. Lasers emit blue light which is very harmful if one is exposed to it for long periods. Blue light results in retinal problems and vision impairment.</p> <p>Infections During regular scaling procedures, the dentist comes into contact with blood through aerosols. Moreover, flap surgeries and gingivectomy procedures may also result in contact with blood. This results in the easy spread of infection.</p>	<ol style="list-style-type: none"> 1. Using new ultrasonic units will decrease noise-induced hearing loss and observing OSHA guidelines will also help in noise control. 2. Regular break intervals between treatments; eye exercises will help reduce eye strain. 3. Sterilization of gloves, instruments, operating area, and masks should be done to control infection. 4. Control of aerosols will also aid in reducing contamination.

Table 1. Continued

Department	Common Hazards Encountered	Prevention
Oral Medicine and Radiology	<p>Radiation Hazards Radiography is a principle diagnostic method used in dentistry. X-rays are ionizing radiation capable of initiating and inducing damage to body cells as well as causing carcinogenic and genetic changes. In dentistry, low levels of radiation are used, which causes less cell damage; however, exposure even to low levels of radiation over a prolonged period of time may cause potential hazards to health. The most important hazard from radiation is cancer.²⁷ The adverse effects of radiation are grouped into 2 categories: deterministic and stochastic effects. Deterministic effects are taste loss, sterility, mucositis, radiation sickness, xerostomia, osteoradionecrosis, and decrease in fetal development.²⁸ Examples of stochastic effects are cataracts, cancer, leukemia, salivary gland tumors, and hereditary defects like down syndrome. The frequent use of x-ray machines exposes dental workers to ionizing radiation. The occupational dose of ionizing radiation has decreased markedly since 1950 with the use of protective barriers.²⁹ The lens of the eye is recognized as the most radio-sensitive tissue in the body. It is known that cataracts can be induced by acute doses of less than 2 Gy. A dose of 5 Gy of ionizing radiation, which is deterministic effect of radiation exposure. X-rays can trigger heart strokes and diseases. The research states that radiation kills more monocytes, resulting in higher levels of monocyte chemo-attractor protein-1 and leading to cardio-vascular diseases.</p>	<ol style="list-style-type: none"> 1. Radiation safety rules should be provided to personnel and personnel should be advised of monitoring devices. 2. Standing in the path of the x-ray beam should not be allowed. 3. The ALARA (as low as reasonably achievable) principle and position-distance rule should be used. 4. Collimators and filters should be used to reduce the emission of radiation. 5. Protective eyeglasses, lead aprons, and thyroid collars should be worn.
Pedodontics	<p>Nitrous Oxide Hazards During dental procedures, nitrous oxide is used as general anesthetic agent for children. It decreases the perception of pain and allows the patient to relax and cooperate during dental procedures. In this way dentists encounter nitrous oxide hazards. Chronic exposure to nitrous oxide may cause many severe affects. The potential detrimental action on the neurological system, reproductive system, hematological, hepatic, and renal systems, and the possibility of increased risk have been the subject of active research, although absolute effects are uncertain.³⁰ Exposure to nitrous oxide for more than eight hours per week shows higher incidence of kidney, liver, and neurological problems in male dentists. In female dentists and chair assistants, nitrous oxide exposure shows an increased number of spontaneous abortions. Other affects of nitrous oxide are infertility, congenital anomalies, cervical cancer, fetal growth retardation, and neurological problems. *Pediatric dentistry deals with all sorts of work performed by all other departments. Hazards related to any respective department also appear in pediatric dentistry.</p>	<ol style="list-style-type: none"> 1. Exposure to nitrous oxide should be reduced to a minimum. 2. Preventive measures should be implemented to provide a safer workplace for those who are at high risk for exposure to anesthetic gases. 3. Effective scavenging and monitoring devices should be used.
Prosthodontic Dentistry	<p>Physical Injuries The usage of blunt and broken instruments can cause direct physical trauma, including accidental skin cuts and abrasions. High-speed projectiles during trimming and polishing can also cause injury. These kinds of injuries act as a portal of entry for infections or other toxic materials. According to a study done by Siew et al in 1992, percutaneous injuries among dental specialists and prosthodontists had the second highest prevalence rate of 4.5%, and among pedodontists, oral surgeons, orthodontists, and endodontists prevalence rates were 5.5%, 2.6%, 1.9%, and 1.3%, respectively.³¹ The cleaning of sharp instruments like probes, two-handed injection needle recapping, and burs left in the handpieces are main causes of sharp injuries.³⁴ Other injuries include those from autoclaves, Bunsen burners, and hot furnaces. Allergies Dermatological reactions like urticaria and dermatitis are caused by methacrylates, glutaraldehyde, rubber gloves, etc. The inhalation of these may cause occupational asthma in susceptible people. Exposure to beryllium vapor or particles may cause dermatitis or a chronic lung disease known as Chronic Beryllium Disease (CBD). A 1985 study by Morgenroth et al. reported that 53%-70% of dental technicians were affected by pneumoconiosis caused by dust from the processing of dental materials.³⁵</p> <p>Ocular Injuries Eye injuries are frequently seen in this department. The effect can range from mild irritation to corneal abrasion, ulceration, and ultimately to complete blindness.³⁶ This is mainly due to the high-speed rotary instruments that generate projectiles traveling at 39m/sec which are very sharp, hot, and contaminated. Such injuries can lead to permanent eye damage.³⁸</p>	<ol style="list-style-type: none"> 1. Shatter resistant eye glasses, face shields, ear plugs, and splash guards should be used to reduce physical injuries. 2. A local exhaust ventilation system, adequate fume extraction system, and aerosol evacuation hood should be used to prevent chemical hazards. 3. For infection control, universal precautions, laundry procedures, mandatory vaccinations, and waste disposal regulations should be strictly followed.

Table 1. Continued

Department	Common Hazards Encountered	Prevention
Oral Pathology	<p>Formaldehyde Hazards Oral pathology deals with the accurate diagnosis of diseases with tissue sections. The tissue is sectioned and processed through several steps for tissue fixation. Formaldehyde is widely used in tissue fixation steps. In this process, the dentistry personnel are exposed to formaldehyde for longer periods. The international research center IARC has declared formaldehyde to be a carcinogenic agent.³⁸ People may experience headaches, minor eye and airway irritation even at relatively low levels of exposure to formaldehyde. It also affects the central nervous system, causing depression, mood changes, insomnia, irritability, and memory loss in case of longer exposures. Formalin-affected persons mainly show eye, nose, and throat irritation, a loss of the sense of smell, chest pain, wheezing, and shortness of breath.³⁹</p>	<ol style="list-style-type: none"> 1. Exposure limits should be monitored as established by OSHA. 2. Formaldehyde protection and training programs should be provided. 3. Closed circuit tissue processors should be used and charcoal filters should be implemented for the absorption of fumes. 4. Alternating solutions can be used like glutaraldehyde and a combination of propylene glycol, ethylene glycol, phenyl ether, and phenol.
Department of Public Health Dentistry	<p>Outreach Programs 1) Dental camps are organized as a part of public oral healthcare delivery. Dental camps are conducted to create realization among the public so that dental diseases can be prevented or treated. The availability and adaptability of portable dental equipment facilitate the delivery of dental treatment in diverse nontraditional settings. A lack of infection control in these settings can be hazardous for both the patient and the dental professional and requires more endeavoring than treating diseases like dental caries and periodontal disease. 2) The mobile dental unit (MDU) used for dental camps is of great help in providing care to the deprived. On the other hand, in the closed operatory area of the MDU with its restricted space and ventilation, there is a greater risk for acquiring infections during various treatments. Dental personnel who are operating in the MDU are found to be more susceptible to cross-infections, because of the restricted space of the MDU and the poor ventilation. Hence, extreme wariness should be taken to prevent cross-contamination.⁴⁰</p>	<ol style="list-style-type: none"> 1. Unimpeachable observance of disinfection protocol should be required. 2. Dental instruments in untraditional settings are sterilized mostly by boiling, as it is a time-tested technique among field medics; though not the gold standard, it is an only option. 3) The use of a household pressure cooker can be an alternative for the standard autoclave for sterilization of dental instruments in untraditional settings. 4) As suggested by infection control guidelines, it is essential to follow universal protocol that all dental personnel wear a mouth mask, head cap, gloves, protective shield, and eye glasses and follow aseptic precautions at all times. 5) Pre-procedural mouth rinsing with an antiseptic mouthwash should be advised as it significantly minimizes the airborne microorganisms in the MDU. 6) The MDU should be fumigated a minimum of once every month. 7) Items that cannot withstand sterilization temperatures can be disinfected with antimicrobial chemicals validated by the appropriate governmental agencies.

evaluations of natural latex, synthetic rubber, and synthetic polymeric gloves. Because of this, silicone, powder free gloves which are less toxic have been introduced.¹⁴

Prevention

There are some ways to prevent allergic reactions to latex.

1. Avoid repeated exposure to latex;
2. Use cornstarch powder-free gloves;
3. Take antihistamines and corticosteroids to help control inflammatory reactions;
4. In the case of anaphylactic shock, epinephrine is the drug of choice along with intra-venous fluids.

Conclusions

This review clearly demonstrates the various health hazards faced by dentists. Prevention is always better than cure. Proper knowledge about occupational hazards and the prevention of injury or infection improve the health of the dentist and the quality of treatment the patient receives. Government with the help of local organizations must periodically conduct workshops and seminars on this particular topic and the proper guidelines to be followed.

Authors' Contributions

All authors have contributed equally to this study and have reviewed the manuscript before the submission.

Conflict of Interest Disclosures

The authors declare they have no conflicts of interest.

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