

OCCUPATIONAL HEALTH & SAFETY IN MODERN DENTISTRY: AN OVERVIEW

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Abstract

The contemporary dental practitioner is exposed to a variety of hazardous materials and surgical procedures on a day to day basis which, if not due taken care of, may have a severely detrimental effect on the operator's wellbeing. In addition to the chronic exposure to various chemicals, dental materials, contaminated aerosol, radiation and noise, the dental surgeon often has to deal with long hours of working in relatively uncomfortable working postures. Add to this the percutaneous risk of serious infections such as HIV and Hepatitis-B and of dermatological, respiratory, musculoskeletal and psychological disorders.

A thorough understanding of the various occupational hazards the dental practitioner is subject to is of great importance. A primary step in this regard is the education of the paramedical & support staff, the onus of which lies with the dental surgeon himself. The recommendations of the Occupational Health & Safety Act (OHSA) established with regard to workplace safety should be strictly adhered to. Not only should the operatory be ergonomically designed but strict emphasis must also be given to the appropriate use of all protective and preventive measures by the dental surgeon and his staff. Sound infection control practices must be employed and the use of protective wear, adequate sterilization & disinfection procedures and immunization should be a mandate for practicing dentist & associated staff. Emphasis should be given to appropriate ventilation, flooring, lighting and waste disposal. It is the responsibility of the dental surgeon to set high standards with regards to occupational safety in order to ensure the wellbeing of his own self as well as the paramedical staff and patients who frequent the clinical setting.

Key words: *Dentistry, Occupational Hazard, Safety.*

Introduction

The contemporary dental surgeon is exposed to a wide variety of hazardous materials and clinical situations, which may adversely affect his social, mental and physical wellbeing. According to World Health Organization, the term "hazard" refers to an inherent property of an agent or a situation having the potential to cause adverse effects when an organism, system or population is exposed to that agent.¹ Occupational hazard refers to any risk to the health of an individual which may arise because of a material, substance, process or situation that predisposes or itself causes accidents or disease at work place.²

Dentistry has in the recent past seen vast improvements in materials, techniques and ergonomics, but dental personnel still face various occupational challenges. Such occupational problems not only affect the health of the dental surgeon himself, but also the associated paramedical staff, patients and technicians, all of whom may come into close contact with contaminated aerosol, sharp surgical instruments, a variety of chemicals, radiation and noise in the enclosed environment of the dental operatory.

Comprehensive knowledge regarding the various hazards which may possibly affect the dental professionals and patients is thus a must. Only if the dental personnel are aware of such potential risks and how to prevent or overcome them, can all necessary precautions and measures be taken so that any such mishaps can be avoided and the safety of patients and paramedical staff can be ensured. The Occupational Health & Safety Act (OHSA) guidelines, which aim to educate employers and employees regarding various hazards at the work place, assess the risk and chart

out the risk management strategies should be strictly adhered to.

The various hazards that dental professionals are exposed to, include biological, physical, environmental and chemical hazards along with musculoskeletal, legal and psychological problems. This article attempts to discuss in a comprehensive manner the various occupational hazards in the field of dentistry.

CLASSIFICATION OF OCCUPATIONAL HAZARDS IN DENTISTRY

Occupational hazards can be classified under the following headings:

1. Biological Hazards
2. Physical hazards
3. Chemical Hazards
4. Musculoskeletal hazards
5. Psychological hazards
6. Environmental Hazards
7. Legal hazards

Biological hazards

Biological hazards to the dental practitioner include various diseases that may occur following infection with bacteria, virus and fungi. In the dental operatory, significant concern exists for infection with Hepatitis B Virus (HBV), Hepatitis C Virus (HCV), Human Immunodeficiency Virus (HIV), Herpes Simplex Virus and Mycobacterium Tuberculosis. These infectious agents can infect the dental personnel either directly through inhalation of infected air and aerosol or indirectly through contamination with infected blood or saliva.

The risk of blood borne infection depends upon the type of exposure, inoculum size, host response, infectious material involved and the amount of blood.³ The fact that the dental surgeon has to work in an area of limited access and restricted visibility (especially when treating posterior teeth) and often uses sharp instruments to perform various dental procedures further adds on the probability of occurrence of such infections. Legnani *et al*⁴ have demonstrated that during working hours the average air bacterial load in the dental operatory tends to increase to over three times as compared to the initial load. It has been reported that among health care workers, risk of transmission of HIV is 0.2 to 0.3% for parenteral exposures and approximately 0.1% for mucosal exposures.⁵

Hepatitis B virus is known to be highly infectious with a 30% risk of sero-conversion. It is recommended that in dental personnel who have not completed a course of Hepatitis B immunization, or who are non-responders to the vaccine, the possible need for prophylaxis with Hepatitis B immunoglobulin following a needle-stick injury must be explored.⁶ Infection with hepatitis C virus is also of high significance since it leads to chronic infection in as many as 85% of individuals.⁷

The risk of encountering such biological hazards can be minimized by following sound infection control practices, proper sterilization & disinfection, appropriate disposal of the sharps, use of personal protective equipment and timely immunization of the dental care personnel. A comprehensive medical and dental history is mandatory before initiating any dental procedure. Recommendations issued by the Occupational Safety and Health Administration (OSHA) with regard to infection caused by blood borne pathogens in dentistry must be strictly adhered to. The Needle Safety Act was established in 2001 with an aim to help reduce the risk of infection through blood borne pathogens to the health care workers including the dental personnel. The use of good quality gloves, safety syringes and rubber dams are other suggested preventive methods.^{8,9}

Physical hazards

Physical injuries following percutaneous exposure incidents (PEI) are very common among dental personnel and may occur following needle stick injuries, cuts by scalpels and lacerations by dental burs. Needle stick injury usually occurs while giving an injection, while recapping or disposal of needles or if the patient panics and pushes the dentists' hand. The residual body fluid from the puncture site that remains in the needle acts as the source of infection. The dental surgeon is also very prone to lacerations and abrasions from the use of dental instruments and during surgeries. Careful handling of such instruments is a must and they should be properly sterilized and disinfected after each use. The use of safety syringes in dental practice has shown to dramatically reduce the frequency of needle-stick injuries.¹⁰

Another form of physical hazard is the regular exposure to ionizing and non-ionizing radiation. Ionizing radiation has a

cumulative effect in terms of its potential to cause damage, and chronic exposure to such radiation may result in erythema, dermatitis, cancer or bone marrow suppression. It is highly recommended for the dental care worker to wear a lead apron or stand behind a protective lead shield, to avoid holding the dental x-ray films in the oral cavity while recording the x-rays and to wear a radiation monitoring badge at all times. The X-ray room must be adequately protected by the radiation protection equipment and must be designed as per radiation standards. Regular equipment checks should be carried out to ensure that there is no radiation leakage.

The non-ionizing radiation emitted by the dental lasers and the blue and ultraviolet spectrum of curing lights can cause damage to cornea, lens and retina of the eyes.¹¹ While using light cure equipment and dental lasers, the dental surgeon should avoid looking directly into the light and wear the safety shield and eye protection glasses.

The closed environment of the dental operatory is host to variety of pathogens contained in aerosol and droplet particles which may be inhaled through the small pulmonary passages. Dental personnel are also at a high risk of inhaling airborne particles contained in the splatter that is generated following the use of ultrasonic scalers, air driven high-speed hand pieces, air polishers and air water syringes.^{2,12} The use of standard personal protective equipment such as gloves, mask, head cap, face shield and protective glasses is a must. Installation of HEPA (high efficiency particulate arresting) filters in the operatory and ultraviolet chambers in the ventilation system has proven to be useful. Use of pre-procedural mouth-rinses with an antimicrobial mouthwash is also recommended.¹²

Chemical hazards

The array of materials used in modern dentistry exposes the dental personnel to a various chemical agent that may be inhaled, ingested or enter the body locally. A large number of biomaterials are used for restorative and prosthodontic purposes including polymers, ceramics, restorative materials, etchants, hypochlorite and metals.¹ Though these materials are considered to be biocompatible and safe and have undergone rigorous testing before being introduced in the market, but they still can be harmful if aerosolized and inhaled during high speed cutting and finishing. Some other dental materials are volatile and may cause dermatological and respiratory problems.

Silver amalgam has been widely used as a restorative material in the past. The relatively recent concerns associated with mercury toxicity have however, raised a worldwide alarm, since the dental care provider is exposed to large concentrations of mercury while handling, mixing, storing and disposing amalgam. The high toxicity of mercury is due to the fact that it exists as a volatile gas at room temperature which is readily absorbed by the respiratory system and because it penetrates into tissues with great ease due to its mono-polar atomic configuration. Mercury vapor or methyl-mercury released from dental

amalgam is known to be highly toxic.¹³ Mercury is known to have very high affinity for brain tissue and toxic levels may result in neurological complications such as slurring of speech, reduced concentration levels, sleeping disorders, depression and disorientation and is even known to have a role in Alzheimer's and Parkinson's disease. All such mercury risks can be avoided by careful handling, dispensing and waste disposal of the material and using of proper evacuation system.^{13,14} Concerns with mercury toxicity have resulted in the development and use of safer and more biocompatible materials such as composites.

Chronic exposure to Nitrous oxide, which is used for conscious sedation in pediatric dentistry has also been reported to be of concern. Hematological problems including megaloblastic changes have been cited.¹⁵ It is recommended that the only lowest practical levels of nitrous oxide must be maintained in the dental environment and techniques for system maintenance, scavenging and ventilation must be followed.¹⁶ Other chemicals commonly used in the dental operatory include disinfectants such as glutaraldehyde and formaldehyde, vapors of which, if inhaled, may cause abdominal pain and discomfort, nausea, vomiting and eye irritation.²

The damage caused by exposure to harmful chemicals is not just limited to the dental surgeon himself, but also significantly affects dental technicians who are regularly exposed to methacrylate resins and polymers during the processing, curing, finishing and grinding of acrylic dentures in the laboratory. The polymerization reaction for these resins involves the release of free or unreacted monomer which may cause contact dermatitis, irritation to eyes, skin, mucous membrane, allergic dermatitis, asthma and paresthesia in fingers.¹⁷

Technicians and laboratory personnel are also exposed to the metal fumes and grinding dust of various metals such as chromium, cobalt, nickel, beryllium and gold alloys used for cast metal restorations. The dust that originates from the cobalt-chrome alloy and cobalt-chrome-molybdenum alloy has the potential to cause pneumoconiosis and lung cancer.¹⁸ Chronic exposure to beryllium during the melting, grinding, polishing or finishing of some base metal castings may lead to chronic granulomatous pulmonary disease.¹⁹ To minimize such harm, dental laboratories thus must be well ventilated and be equipped with dust aspirators. The application of recent advanced techniques such as computer aided design and computer aided manufacturing (CAD-CAM) and layer manufacturing process such as selective laser melting (SLM) would further help in minimizing such occupational risks.²⁰

Another common chemical hazard among dental professionals is the allergic reaction caused by the use of latex containing examination and surgical gloves, especially powdered latex gloves. Latex allergy has been widely reported in people who use a lot of rubber products²¹ and can develop either through direct skin contact or through the inhalation of aerosol containing airborne powder. It is now believed that powder in latex gloves is not itself the

allergen and only acts as a site for binding of latex protein, and aids in carrying the protein into the skin. The allergic reaction may range from the more common but less threatening manifestation of contact dermatitis, to the rarer and more serious form of Type – I hypersensitivity, which may even result in anaphylaxis.²² Symptoms may appear in form of urticaria, conjunctivitis associated with lacrimation & swelling of eyelids, rhinitis, bronchial asthma and anaphylactic shock. For all such personnel who are sensitive to the latex products, the use of nitrile or vinyl gloves is recommended.

Musculoskeletal hazards

Considering the relatively long appointment spans and limited accessibility especially when working in the posterior regions of the oral cavity, the dental surgeon tends to attain sustained awkward postures by bending or craning his neck and abducting his arms, often leaving the back unsupported. The high static loads so generated and the associated excessive stressing and shortening of muscles may lead to muscular ischemia and pain and puts undue stress on the spine, elbows & upper arms which, in the long run, can develop musculoskeletal disorders (MSD) of varying kinds.²³ Damage to the fibrous outer layer of the intervertebral disc (the annulus) from the daily stresses of sitting (especially when combined with twisting while seated) can lead to displacement or rupture of the disc.²⁴

Another musculoskeletal problem reported among dental professionals is the Carpal Tunnel Syndrome (CTS) which results from the compression of the median nerve within the carpal tunnel in the wrist. Symptoms include pain, weakness and paresthesia of the thumb and index finger, radiating up to the arm. Repetitive and frequent motions of the wrist and fingers (as is required during various dental procedures) is known to cause this syndrome, hence the propensity of dental surgeons towards this disorder. Prolonged incorrect postures can also lead to other musculoskeletal problems commonly seen in dental professionals such as Cervical Spondylosis, Myofunctional Pain Disorder and problems involving the lumbar discs.²⁵

In order to minimize the chances of developing such MSDs, the dental professionals must make it a habit to work in an ergonomic seating position with the lower back always supported. It is recommended that the feet should be properly supported on the ground and the angle between spine and thighs should be 90-110°. Wearing loupes and using operating microscope can help the operator gain an unrestrained view and adopt a better posture. Breaks between long appointments and frequent stretching exercises should be adopted since these practices help ensure blood supply to the muscles and joints and help reduce the formation of trigger points.²⁵

Psychological hazards

With the ever increasing patient demands, risk of litigation and issues related to practice and staff management, the contemporary dental professional is always under some degree of psychological stress. Dentistry is known to

produce more stress than any other profession, with the major stressors being the dentist-patient relationship (especially when dealing with difficult uncooperative patients), timing and scheduling pressures, technical and administrative problems related to staff and job dissatisfaction.²⁶ The dental surgeon also often finds himself in difficult clinical situations such as when dealing with procedures that do not have a good prognosis and in certain emergency conditions which are life threatening for the patient. There is always the threat of malpractice, financial concerns and limited time for oneself and family.²⁷

Due to the continuous mental stress that the dental professionals may have to bear, problems such as fatigue, sleeplessness, anxiety and depression are relatively common among dentists.²⁸ As documented by Humphris,²⁹ incidences of "Professional Burn out" are more common among the more stressful specialties such as general surgeons and oral surgeons as compared to other specialties.

It is recommended that stress management programmes should be introduced at the level of dental school itself and attempt should be made to modify the curriculum so that students have a chance to work outside the dental school in a general practice environment.²⁸ It has been documented that in dentists who have a teaching role in addition to their clinical practice, stress levels tend to be lower due to the lesser degree of isolation and enhanced self-esteem owing to greater attention received from students.³⁰ A good psychosocial relationship, good communication and understanding of realistic needs and expectations of patients and self are of great importance. Breathing exercises, meditation and physical exercise should be adopted as a routine.

Environmental hazards

The dental clinic, laboratory and especially the sterilizing area should be well lighted with both natural and artificial light. Optimum ambient lighting in the dental operator is significant since poor illumination may cause eye pain, strain and fatigue whereas excessive bright lights may lead to visual discomfort and stress. Good lighting is also necessary in the sterilization area since it ensures critical inspection of the instruments for any debris left on them during sterilization.²⁴

The flooring in the operator should be made up of non-slip, impervious tiles. Uneven areas and areas which may be wetted by spills and splatter pose a threat for slips and falls for both the patients as well as the dental care staff. Carpets need to be avoided in all areas for the risk of accumulation of aerosol and volatile chemicals.

Various dental equipment and machines in the operator and lab are known to produce appreciable degree of noise. The detrimental effects of noise pollution are known to manifest at noise levels of more than 80-90 db and are dependent upon not only the individual's age and sensitivity but also the distance of the sound source and the

total duration of the noise. Although most dental equipment produce noise below these levels, but the closed environment of the dental operator may magnify the effects of such noise, especially when using old and faulty machinery. The common sources of potentially damaging sounds include Ultrasonic scalers, hand pieces, high-velocity evacuation devices, vibrators and other mixing devices, and model trimmers.³¹

Kilpatrick³² has evaluated the decibel ratings for various dental equipments and suggests that since the decibel rating increases as the operator gets closer to the equipment, a distance of about 14 inches must be maintained from the dentist's eye to the patient's mouth. In order to assess the level of hearing damage regular hearing tests should be undertaken. Noise dosimeters should be used to assess the level of noise in the dental operator. The rotary instruments must be activated only when they are ready to be used.

Legal hazards

With increased patient knowledge regarding dental procedures and stricter legislations regarding dental malpractice, any negligence on the part of the dental surgeon makes him susceptible to legal action. Different nations have enforced laws and regulations governing the practice of dentistry, which must be strictly followed.³³ Consumer friendly regulations make it a must on the part of the dental surgeon to train himself and his staff regarding all legal matters. All patient treatment records including the case history sheets, study models and radiograph records should be stored and maintained properly as they serve as medico-legal records if the need arises. It should be a regular practice to take written informed consent from the patients before any surgical procedure.

Conclusion

Even though modern dentistry has undergone various advancements, the contemporary dental surgeon is still exposed to a variety of occupational hazards, prior knowledge of which is must so that all necessary preventive and precautionary measures may be taken. Care needs to be taken at all levels of patient management, material and equipment handling, sterilization and disinfection and waste disposal. The operator design should be ergonomic, with emphasis given towards environmental issues such as radiation, lighting, ventilation and noise.

It is the moral and ethical responsibility of the dental surgeon to ensure safety and well-being of his own self, his support staff and the patients frequenting the clinical setting. In the event of any untoward accident, the incident must be reported immediately so that appropriate measures can be taken. The dentist must keep himself updated with regards to the latest dental materials and techniques and any possible biohazards involved. Continuing dental education programs for dental surgeon and his staff go a long way in keeping all dental personnel up to date with the latest trends and management of occupational concerns.

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