

Occupational Hazards in Modern Dentistry

Naheeda Shaik Mohammed, Mohammed Asif Shaik

ABSTRACT

Dentists, as well as other dental personnel are constantly exposed to a number of specific occupational hazards. These cause the appearance of various ailments, specific to the profession, which develop and intensify with years. Despite numerous technical advances in recent years, many occupational health problems still persist in modern dentistry. These include percutaneous exposure incidents (PEI), exposure to infectious diseases, radiation, dental materials, musculoskeletal disorders (MSD), dermatitis, respiratory disorders, eye injuries and psychological problems. PEI remains a particular concern, as there is an almost constant risk of exposure to serious infectious agents. Aside from biological hazards, dentists continue to suffer a high prevalence of MSD, especially of the back, neck and shoulders. Awareness regarding these occupational hazards and implementation of preventive strategies can provide a safe working environment for all the dental personnel. There is also a need for continuing dental education programs in dentistry so that dentists can update themselves with the latest and newer techniques and materials.

Keywords: Dental professional, Occupational hazards, Infectious disease, Biohazards, Allergy.

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INTRODUCTION

The history of occupational hazard awareness can be traced back to the 18th century when Bernardino Ramazzini, who is referred to as the 'Father of Occupational Medicine', recognized the role of occupation in the dynamics of health and diseases.¹ Although modern dentistry has been cited as the least hazardous of the all the occupations,² many risks still challenge the status of this occupation. Studies have shown that dentists report more frequent and worse health problems than other high risk medical professionals.³ Dental personnel are exposed to various occupational hazards like stress, allergic reactions, higher noise levels, percutaneous exposure incidents (PEI), radiation, musculoskeletal disorders (MSD), legal hazards, etc. A part from this, dental environment is also associated with a significant risk of exposure to various microorganisms. Infectious agents may be present in blood or saliva, as a consequence of bacteremia or viremia which cause systemic infections. Dental patients and dental health care workers (DHCW) may be exposed to variety of microorganisms via blood or oral or respiratory secretions.⁴ The microbes penetrate the body through a cut

on the skin while performing either a medical procedure, or a dental procedure, either resulting in an accidental biting by the patient, or through a needle wound created while imparting anesthesia. The current paper reviews various studies relating to occupational health hazards in dental profession.

MATERIALS AND METHODS

An extensive review of literature was done which engaged most of the articles published in peer-reviewed journals relating to the subject of occupational health hazards in dentistry. Reports published only in English language were included in the review. The present review noted that apart from these hazards there are also other occupational hazards which were not seen in the past like legal hazards and suicidal tendencies in dentists.

Prevalence of Occupational Health Problems

A wide variety of workplace risks are known to exist in dental profession at a global level. In India, an investigation among Navy dentists revealed that 47% of them experienced an injury from a sharp instrument during the past 6 months and backache was the commonest hazard in 70.6% of the personnel followed by occasional anxiety and wrist ache.⁵ A survey from the Norway found that public health dentist reported occupational health complaints such as dermatoses (40%), eye, respiratory and systemic complaints (13%) and musculoskeletal problems (3%).⁶ In a study conducted among dentists and dental auxiliaries in Riyadh, Saudi Arabia about the prevalence of hearing problems in the last 5 years, 16.6% of subjects reported to be suffering from tinnitus, 30% of the subjects had difficulty in speech discrimination and 30.8% of the subjects had speech discrimination in a background noise.⁷ Latex allergy and glove dermatitis were reported in 9 and 22% of dental personnel respectively in a dental school in Australia.⁸ Some studies suggest that the prevalence and location of pain and other symptoms such as headache, may be influenced by posture and work habits, as well as various demographic factors.⁹ A study carried out among the dental students studying at University of Cartagena reported that 80% of the students suffered from muscular pain due to the clinical practice; the clinical areas where more pain was found were surgery and periodontics and 15% of the students reported pain in the neck and lumbar zone.¹⁰ Another study conducted

among dentist in Southern Iran reported that, 33% of the dentists were suffering from lower back pain while 28% had neck pain.¹¹ Some of the studies from Australia indicated that burns were the common workplace injuries among the dental assistants and percutaneous injuries were relatively frequent among dental students.¹²

Percutaneous Exposure Incidents

It represents the most efficient method of transmitting blood born infections between patients and health care workers. It could be related to the fact that, dentists work in a limited-access and restricted-visibility field and frequently use sharp devices. Several studies suggest that about half of the dentists report PEI due to needle stick injuries or due to drilling instruments.^{13,14} Of concern in needle stick injuries, is the fact that they often occur while giving injections, when there is usually some residual bodily fluid in the needle from the puncture site. The contact of the contaminated blood to the doctor depends on various factors, such as: Type of exposure, inoculum size, host response, infectious agents and the amount of blood.¹⁵ Prevention of PEI remains the key. Introduction of syringes, although costly, have been shown to reduce needle stick injuries dramatically in this regard.¹⁶ Glove damage is commonly reported by dentists, particularly recent study in Queensland, Australia (79% over 12 months),¹⁷ a result which is supported by other studies from the United Kingdom, where 2% of latex gloves and 5% of nitrile gloves sustained punctures following routine clinical dental procedure.¹⁸ As such, it is important that dentists remain vigilant for these types of exposures, so that the potentially contaminated instruments and devices are not subsequently used on patients.

Musculoskeletal Disorders

Muscular pain is a common affliction for dentists which begins at the time they start their studies and it stays with them during their professional practice affecting the spine, neck, shoulders and hands.¹⁹ It has been proven that postures which may exert a higher pressure on the intervertebral disk and a prolonged spinal hypomobility are the important factors which lead to degenerative changes on the lumbar spine and subsequently causes lower back pain. Musculoskeletal pain, particularly back pain has been found to be a major occupational health hazard in dental profession.²⁰ A survey of dentist in Israel reported that 83% of the dentist had experienced the lower back pain and neck pain respectively.²¹ A study from the New South Wales (NSW), Australia, found a higher prevalence of MSD among dentists, with 82% reporting at least one musculoskeletal symptom in the past month and 64% reporting backache

during the previous month.⁹ Similar health problems have been reported during studies of dentists in the United States of America⁶ and among Norwegian dental hygienists.²² A Saudi study, however, reported a slight high rate of MSD among their subjects 74%.²³ Some investigations suggest that the prevalence and location of pain and other symptoms may be influenced by posture and work habits, as well as other demographic factors. Part-time dentists for example, were found in one Thai study to have a high proportion of MSD when compared to their full-time counterparts.¹⁴ The number of years since graduation has also been shown to be negatively correlated with musculoskeletal pain. The finding that younger and less experienced dentists were more likely to report MSD of the neck, upper back and shoulders was also found in a study of dentists in Queensland, Australia.¹⁷ Possible explanations was that experienced dentists are probably better at adjusting their working position and techniques in order to avoid musculoskeletal problems, when compared to their less experienced counterparts or, they simply develop coping strategies to help deal with the pain. A more likely explanation; however, is simply that those dentists with severe musculoskeletal problems would have ceased working and would have not been captured in a cross-sectional survey of dentists. This later hypothesis is partially supported by a 5-year follow-up study of dentists in Sweden.²⁴ Regarding biomechanics, a previous Swedish study found that dentists were exposed to a high load on the trapezius muscles bilaterally, as well as prolonged forward bending of the head.²⁵ At work, the dentist works in a strained posture (both while standing and sitting close to a patient), which eventually leads to overstress of the spine and limbs. This overstress produces a negative effect on the musculoskeletal system and the peripheral nervous system.²⁶ Spine degeneration and neck discopathy result in back pain and neck pain.²⁷ The posture which the dentist assumes at work with the neck bent and twisted, an arm abducted, repetitive and precise movements of the hand, are a frequent cause of the neck syndrome and of pain within the shoulder and upper extremities.²⁸ Lumbar and lumbosacral discopathy arouses pain in the loins and the lower back radiating to the lower extremities, more often right than left. This can be explained by a greater stress on the right side of the body when the doctor works with a sitting patient. The dentist makes constant monotonous movements, which stress the wrist and elbow joints. Also of consequence are mechanical vibrations which are produced by some dental equipment like ultrasonic scalers and hand pieces and are transmitted to hands and arms. In addition, the extensive use of hand tools in dentistry work can cause a chronic extrinsic compression of the nerves in the hand, and therefore may cause an entrapment of digital

nerves.²⁹ Median nerve and cubital nerve defects are seen in a number of dental doctors. A consequence of the defected median nerve in the carpal nerve is the so-called tunnel syndrome. Its early phase is dominated by paroxysmal paresthesia of the thumb and the index finger, which occurs almost without exception at night and which is accompanied by sensomotor disorders of the thumb and the index finger.³⁰ Operations carried out during extractions stress not only the elbow joint and the wrist joint but may result in chronic tendon sheath inflammation. The long-term effect of all those adverse circumstances occurring in the work of the dental doctor may lead to diseases described as cumulative trauma disorders.³⁰

Infectious Diseases

Various infectious diseases, including viruses,³¹ such as hepatitis,³² herpes,³³ HIV,³⁴ bacteria, fungi and prions may be transmitted during dental procedures³⁵ (Table 1). These agents may be present in the saliva, blood and expired air of infected individuals. The following are the main entry points of infection for a dentist: Epidermis of hands, oral epithelium, nasal epithelium and epithelium of upper airways, epithelium of bronchial tubes, epithelium of alveoli, and conjunctival epithelium.^{36,37} Dental procedures cause major changes in the microbiological environment of a dentist's surgery. Legnani et al³⁸ made an assessment of the aerosol contamination resulting from dental procedures.

Table 1: Infectious agents causing health hazard

Category	Name	Transmission to humans	Effect on humans
Viruses (Coronaviridae)	Coronaviridae	Air-droplet	I—mild upper airways diseases
Viruses (Flaviviridae)	Virus of hepatitis C (HCV)	Directly (cut, infection), through blood and other human body fluids	I—hepatitis, cirrhosis; C—hepatic carcinoma
Viruses (Flaviviridae)	Virus of hepatitis G (HGV)	Directly (cut, infection), through blood, blood serum and other human body fluids	I—hepatitis
Viruses (Hepadnaviridae)	Virus of hepatitis B (HBV)	Directly (cut, infection), through blood, vaginal secretion; through sexual intercourse, from mother to fetus	I—hepatitis, cirrhosis C—hepatic carcinoma
Viruses (Hepadnaviridae)	Virus of hepatitis D (HDV = Delta + HBV)	Directly (cut, infection), through blood, blood serum and other human body fluids	I—hepatitis, frequently in the form of a chronic cirrhosis
Viruses (Herpesviridae)	Herpes simplex virus (HSV)/simple herpes virus (type 1 and 2)	Directly: Through kissing (most frequently—type 1), through sexual intercourse (most frequently—type 2), through a cut in the skin, through hand contact	I—vesicular inflammation of oral cavity and sexual organs, keratitis, encephalitis
Viruses (Reoviridae)	Reoviruses	Air-droplet, directly	I—reoviral fevers
Viruses (Retroviridae)	Human immunodeficiency virus (type HIV-1, HIV-2)	Directly (through blood, sexual intercourse—homo and heterosexual), through placenta to fetus	I—AIDS death; C—neoplasm
Viruses (Retroviridae)	Human leukemia viruses from T cells (HTLV-1, HTLV-2, HTLV-5)	Directly through blood, sexual intercourse), food (with mother's milk)	I, C—leukemia of adults, encephalitis
Bacteria (Actinomycetes)	<i>Actinomyces israelii</i>	Orally, directly (cuts)	I—actinomycosis, nodular suppurative lymphadenitis
Bacteria (Gram-negative anaerobic bacteria)	<i>Bacteroides fragilis</i>	From cuts, operation, bites	I—pneumonia, periodontitis, dermatitis, inflammation of female genitals
Bacteria (Gram-negative aerobic coccus bacteria)	<i>Neisseria meningitidis</i>	Air-droplet, directly	I—meningitis
Fungi (imperfect fungi, anascogenic yeasts)	<i>Candida albicans</i> and <i>Candida tropicalis</i>	Directly	I—candidiasis of skin, nails, oral cavity, vagina, rarely internal organ candidiasis
Bacteria (Gram-negative anaerobic bacteria)	<i>Fusobacterium necrophorum</i>	Directly, endogenic (resulting from damaged tissues)	I—infections of oral cavity, skin, connective tissue, bone
Prions	Creutzfeldt-Jakob's disease (progressive subcortical degenerative encephalopathy in humans)	Directly (cut, infection)	I—Creutzfeldt-Jakob's disease

I: Infectious or invasive activity; C: Carcinogenic activity^{3,31-37,39,41}

Air contamination was measured by means of the surface air system method and the 'plate' method (air microbial index). It was proved that during working hours the average air bacterial load increased over three times, and the air load levels were 1.5 times (aerobic bacteria) and two times (anaerobes) greater as compared to the initial load. Infection control procedures such as, attention to general hygiene, appropriate sharp disposal, personal protective measures, sterilization or high level disinfection remains the best defense, not only to the dentist, but also to help transmission of infectious agents between dental patients.³⁹ Previous studies suggest that these infection control procedures are now being more widely adopted by dentists.⁴⁰ However, needle stick injuries continue to occur especially in young dentists.⁴¹ Which is particularly concerning for workplace environments given that no HCV or HIV immunization is available.⁴¹

Latex Hypersensitivity

An intrinsic part of dentist's protective equipment includes gloves and mask. Latex gloves have been worn routinely in dental profession for more than two decades and are basis of good infection control strategies. However, the residual or integral chemical components pose a potential health hazard to some dental staff and patients.⁴² Latex gloves dusted with corn-starch powder are most often used. The gloves and mask form an inbuilt barrier against most pathogens, and as recently proven, they also constitute a very good barrier against viruses, provided that the gloves and mask are intact.⁴³ However, they may produce allergic reactions primarily in those persons who use rubber products on regular basis and dentists fall in this category. The most important risk factor of immediate allergies is frequent exposure to latex products.⁴⁴ Sensitization may occur through inhalation of air borne powder or through the skin. Inhaled glove powder is capable of inducing type I hypersensitivity response but the most common type of allergic reaction is the delayed hypersensitivity or allergic contact dermatitis.⁴⁵ Atopy is another essential factor contributing to the increased number of allergic cases. A study reported that atopy was 2.2 to 4.5 times more frequent in those health service employees who were allergic to latex than in those who were not allergic. It is estimated that 2.8 to 17% of the employees of health service are allergic to latex.⁴⁶ The clinical symptoms of latex allergies include: Urticaria, conjunctivitis accompanied by lacrimation and swelling of eyelids, mucous rhinitis, bronchial asthma and anaphylactic shock.⁴⁷ Corn starch is not biologically neutral, as was previously thought. It is allergenic and takes part in immediate allergic reactions. The powder does not include

detectable proteins but, as some studies demonstrated, the health service employees who had an anaphylactic reaction to the dusting powder were positive in skin tests.⁴⁰ Starch particles combined with latex protein allergens become airborne, and consequently they are inhaled, or absorbed by the skin.^{47,48} The intensity of aerosol effect grows with the increased use of rubber gloves.⁴⁷

Dental Biomaterials

There are many potentially toxic materials that are used in dentistry that may pose a health hazard in the absence of appropriate precautionary measures. Most of the dental materials undergo an extensive range of tests both before and after use. Even so, some dental materials are aerosolized during high speed cutting and may thereby be inhaled by dental staff. Other dental materials are volatile and may give rise to dermatological and respiratory effects. Dental polymer materials based on methacrylate, its polymer, and polyelectrolytes, seem to be a major cause of contact dermatitis in dental personnel.⁴⁹ Dentistry uses variety of different polymer materials. The setting of restorative materials and adhesives is initiated chemically by mixing two components or by visible light. In both cases, polymerization is incomplete and monomers which are nonreactive are released in atmosphere.⁵⁰ These free monomers may cause a wide range of adverse health effects such as irritation to skin, eyes, mucous membranes, asthma and paresthesia of the fingers. Additionally, disturbances of the central nervous system such as headache, pain in the extremities, nausea, loss of appetite, fatigue, sleep disturbances, irritability, loss of memory and changes in blood parameters may also be noted. If acrylate sensitivity is suspected, an acrylate patch test may be performed. However, this test may not give an immediate result.⁵¹ Respiratory problem due to dental materials is also an important occupational hazard. There are few studies which reported asthma, conjunctival symptoms and allergic contact dermatitis among dental technicians who were exposed to acrylate compounds.⁵² It suggested that the use of a local exhaust ventilation system significantly reduces the peak concentration of methyl methacrylate vapor in the breathing zone of dental technicians. However, the local exhaust ventilation was not efficient in reducing the concentration of airborne acrylic dusts.⁵³ The dangers of chronic exposure to mercury are well documented.⁵³ The greatest exposure of mercury to dentist comes from inhalation of mercury vapors which represent an important source of exposure.⁵⁴ New filling materials have been developed to help reduce the dependence on mercury-based substances, such as composite resins, although these may be less durable and

clinically less effective than amalgam.⁵⁴ Chemicals used in radiology can also lead to occasional health problems. Mixing of processor chemical components will cause the release of sulphur dioxide into atmosphere. Chronic exposure to sulphur dioxide may result in bronchospasm. Ammonia, a highly soluble respiratory irritant, is another potential by-product released from the breakdown of processing chemicals. Another source of vapor release is the silver recovery unit. It is important that the lid be tightly secured and only opened in a well-ventilated area.

Hazards from Physical Agents

Dental personnel are exposed to noise of different sound levels while working in dental clinics or laboratories. As reported in a study, 16.6% of subjects reported of tinnitus, 30% had difficulty in speech discrimination and 30.8% had speech discrimination due to background noise.¹⁰ The noise levels of modern dental equipment is below 85 db and up to this point the risk of hearing loss is negligible.⁵⁵ Ultrasonic scalers sometimes may be a potential hazard to the auditory system of the clinician and the patient. Damage to operator hearing is possible through air-borne subharmonics of the ultrasonic scaler. For the patient, damage can occur through the transmission of ultrasound through the tooth contact to the inner ear via the bones of the skull. This later hazard is possible during the scaling of molar teeth.⁵⁶ Tinnitus is an early sign of hearing loss and may occur following ultrasonic scaling in some individuals. A small number of dentists have experienced tinnitus or numbness of the ear after the prolonged use of ultrasonic scaler, which indicates a small potential risk to hearing. The topic of occupational eye injuries in dentistry is one that clearly requires further study. Previous studies suggest that, eye injuries among dentists may be as high as 10%,¹³ although a Saudi investigation found a 1 month prevalence of 42%.⁵⁷ A study in Australia suggested a low prevalence of eye injuries among dental students and dental assistants.¹² From a preventive point of view, the regular use of eye shields and goggles has been shown to reduce this problem.⁵⁸

Radiation

Exposure to both ionizing and nonionizing radiation may occur in dental practice. Radiographic equipment is a common place in dental practice and the radiographs are an integral part of clinical assessment.⁵⁹ As such it is important that good radiation practice be employed to protect the patient and the staff. Dental staff should take steps to protect themselves during exposures by standing behind protective barriers, use of radiation monitoring badges and regular equipment checks.⁵⁹ Nonionizing radiation has become an

increasing concern among dentists with the use of ultraviolet and blue light to cure or polymerize various dental materials. Exposure of these wavelengths can cause damage to various structures of the eyes, including the cornea, lens and retina.⁶⁰ Safety shields and glasses have been shown to be protective in this regard when used correctly. A study conducted among Canadian dentists reported that occupational doses of ionizing radiation among dentists and dental workers have decreased markedly since the 1950s.⁶¹ However, the potential effects of whole-body radiation remain of concern, with secondary radiation scattered from bones of the patient's head now representing the greatest source of radiation received by dentists and dental workers.⁶²

General Health and Stress

Dentists tend to have a lower mortality rate than comparable profession. They continue to succumb to similar causes of death, namely cardiovascular disease, cancer and suicide.² The risk of mortality from these conditions is probably slightly higher than the general population. The most common causes of impairment among dentists are believed to be cognitive impairment, physical disability, chemical dependency and mental illness.⁶³ The common cause of morbidity in dentists related to their occupation includes MSD, stress, alcohol and drug abuse. It has been noted that, poorer general physical fitness has been associated with musculoskeletal symptoms and that physical exercise is generally recommended to dentists and other professionals with similar work load.⁶⁴ Stress among dentists is thought to result from many sources, including job satisfaction, business income, working hours and staff vs patient interactions.² Dentists have been shown to be dissatisfied with aspects such as their level of stress, threat of malpractice and a limited amount of personal time.⁶⁵ Working hours also tend to be longer among dentists than the standard working week of around 35 hours.⁶⁶ The working hours may have increased from what was reported to be an average working week for dentists more than 30 years ago.⁶⁷ It is highly recommended that, the dentist should tread a fine line between maintaining income and maintaining professional and technical standards. Regarding substance use, the most commonly reported cause of impairment among dentists is chemical dependence.⁶³ The rate of alcoholism in the dental profession estimated to be about 8% and the dependency of other drugs is becoming a growing concern in dental practice.²

Hazard due to Nitrous Oxide Gas

The National Institute for Occupational Safety and Health (NIOSH) in 1994 issued a warning to hundreds of thousands

of medical, dental and veterinary professionals working with nitrous oxide (N₂O).³⁶ The institute warns that even with preventive measures such as scavenging systems in place these workers may be at risk for serious health effects due to their exposure. Workers are exposed to N₂O while administering the anesthetic gas to patients. To protect workers from the health risks associated with N₂O, operating rooms are often equipped with scavenging systems that vent unused and exhaled gas away from the work area. Recent research shows that these systems can significantly reduce the risk of impaired fertility among female dental assistants exposed to N₂O.^{36,68} Several human studies have shown that occupational exposure to N₂O may cause reduced fertility, spontaneous abortions, and neurologic, renal, and liver disease as well as documented decreases in mental performance, audiovisual ability, and mental dexterity in susceptible individuals.⁶⁸

Legal Hazards

In every country there are relevant statutes and regulations which apply to the practice of dentistry.^{36,69} The contravention of any of these may warrant that legal actions be brought against a dental practitioner particularly in developed countries where the citizens appear more aware of their rights. To help assure a safe work environment in dental treatment, the hazard awareness and prevention of legal risks should be made known to all clinical workers of the dental hospital.³⁶ Many dentists in different part of the world graduate from the dental schools heavily in debt because of the high costs of their education and thus have a strong incentive to begin showing profits soon after they begin practice. Failure to meet the overhead expenses and unable to pay the above mentioned debts, creates a tension situation in the minds of the dentist.³⁶ Many cases of suicidal tendencies are noted because of the above mentioned reasons.⁶⁹ Failure to earn more also creates a stress situation in the families of the concerned dentists. Therefore, proper and sound earning is also very essential for a good living and good relationship.

CONCLUSION

It is very clear from the above discussion that despite numerous advancements, many occupational hazards are still prevailing in current dental profession. High production demands in combination with stressful working conditions affect the health. One thing should be kept in mind that every technology, no matter how beneficial, can exert a negative impact on some members of the population. The reality of public health will always involve balancing maximum benefit and minimum harm to the public health

and well-being. Immunization against various infectious diseases like HIV, HBV, etc. is very essential for every DHCW. It is very essential to maintain an adequate work posture to prevent from MSDs. Dentists should control their working hours, pace of work, be aware of occupational hazards and observe their mental health. Strategies for improving mental health and reducing the effects of occupational hazards should be developed and implemented in order to secure the well being of dentists. Serious infections due to PEI can be avoided by use of appropriate barrier techniques and high level sterilization. Dental personnel should be familiar with the major signs and symptoms of allergic reactions, including anaphylaxis various continuing dental education programs should be organized so that dental professionals can gain knowledge about various newer methods and developments.

REFERENCES

1. Adebola FA, Owotade FJ. Occupational hazards among clinical dental staff. *J Contemp Dent Pract* 2004;5:134-52.
2. Scully C, Cawson RA, Griffiths M. Chapter 1: Mortality and some aspects of morbidity. In: *Occupational Hazards to Dental Staff*. London 1990;1-21.
3. Brooks SL, Rowe NH, Drach JC, Shipman C Jr, Young SK. Prevalence of herpes simplex virus disease in a professional population. *J Am Dent Assoc* 1981;102:31-34.
4. Hagberg M, Wegman DH. Prevalence rates and odds ratios of shoulder-neck diseases in different occupational groups. *Br J Ind Med* 1987;44:602-10.
5. Chopra SS, Pandey SS. Occupational hazards among dental surgeons. *MJAFI* 2007;63:3-25.
6. Jacobsen N, Aasenden R, Hensten-Pettersen A. Occupational health complaints and adverse patient reactions as perceived by personal in public dentistry. *Community Dent Oral Epidemiol* 1991;19:155-59.
7. Al Wazzan KA, Al Qahtani MQ, Al Shethri SE, Al Muhaimed HS, Khan N. Hearing problems among dental personnel. *J Pak Dent Assoc* 2005;14:210-14.
8. Katelaris CH, Widmer RP, Lazarus RM. Prevalence of latex allergy in a dental school. *Med J Aust* 1996;164:711-14.
9. Marshall ED, Duncombe LM, Robinson RQ, Kilbreath SL. Musculoskeletal symptoms in New South Wales dentists. *Aust Dent J* 1997;42:240-46.
10. Caballero AJ, Palencia IP, Cardenas SD. Ergonomic factors that cause the presence of pain muscle in students of dentistry. *Med Oral Patol Oral Cir Bucal* 2010;15:e906-11.
11. Pargali N, Jowkar N. Prevalence of musculoskeletal pain among dentists in Shiraz, Southern Iran. *International J Occup Environ Med* 2010;1:69-74.
12. McDonald RI, Walsh LJ, Savage NW. Analysis of workplace injuries in a dental school environment. *Aust Dent J* 1997;42:109-13.
13. Porter K, Scully C, Theyer Y, Porter S. Occupational injuries to dental personnel. *J Dent* 1990;18:258-62.
14. Chowanadisai S, Leggat PA, Yapong B, Kedjarune U. Occupational health problems of dentists in southern Thailand. *Int Dent J* 2000;50:36-40.

15. Haiduven DJ, Simpkins SM, Phillips ES, Stevens DA. A survey of percutaneous mucocutaneous injury reporting in a public teaching hospital. *J Hosp Infect* 1999;41:151-54.
16. Zakrzewska JM, Greenwood J, Jackson J. Introducing safety syringes into a UK dental school – a controlled study. *Br Dent J* 2001;190:88-92.
17. Leggat PA, Smith DR. Prevalence of percutaneous exposure incidents among dentists in Queensland. *Aust Dent J* 2006;51:158-61.
18. Murray CA, Burke FJ, McHugh S. An assessment of the incidence of punctures in latex and non latex dental examination gloves in routine clinical practice. *Br Dent J* 2001;190:377-80.
19. Bassett S. Back problems among dentists. *J Can Dent Assoc* 1983;49:251-56.
20. Moen BE, Bjorvatn K. Musculoskeletal symptoms among dentists in a dental school. *Occup Med* 1996;46:65-66.
21. Ratzon NZ, Yaros T, Mizilik A, Kanner T. Musculoskeletal symptoms among dentists in relation to work posture. *Work* 2000;15:153-58.
22. Rice VJ, Nind B, Penkis JS. Dental workers, musculoskeletal cumulative trauma, and carpal tunnel syndrome, who is at risk? A pilot study. *Int J Occup Saf Ergon* 1990;2:218-33.
23. Al Wazzan KA, Al Qahtani MQ, Al Shethri SE, Almas K. Back and neck problems among dentists and dental auxiliaries. *J Contemp Dent Pract* 2001;2:17-30.
24. Akesson I, Johnson B, Rylander L, Moritz U. Musculoskeletal disorders among female dental personnel-clinical examination and a 5 years follow-up study of symptoms. *Int Arch Occup Environ health* 1999;72:395-403.
25. Akesson I, Hansson GA, Balogh I, Moritz U. Quantifying work load in neck, shoulders and wrists in female dentists. *Int Arch Occup Environ Health* 1997;69:461-74.
26. Rundcrantz BL, Johnsson B, Moritz U. Cervical pain and discomfort among in dentist. Epidemiological, clinical and therapeutic aspects. Part 1. A survey of pain and discomfort. *Swed Dent J* 1990;14:71-80.
27. Rundcrantz BL, Johnsson B, Moritz U. Pain and discomfort in the musculoskeletal system among dentists: A prospective study. *Swed Dent J* 1991;15:219-28.
28. Rundcrantz BL, Johnsson B, Moritz U, Roxendal G. Cervicobrachial disorders in dentists: A comparison between two kinds of physiotherapeutic interventions. *Scand J Rehabil Med* 1991;23:11-17.
29. Milerad E, Ekenvall L. Symptoms of the neck and upper extremities in dentists. *Scand J Work Environ Health* 1990;16:129-34.
30. Ostrem CT. Carpal tunnel syndrome. A look at causes, symptoms, remedies. *Dent Teamwork* 1996;9:11-15.
31. Provvisionato CA, Monaco A, Provvisionato M, Cazzella F. Incidence of some infectious diseases in odontostomatology-section I. *Boll Ist Sieroter Milan* 1990;69:379-84.
32. Bocharov EF, Pukhaev VI, Bystrova LA. The problem of hepatitis infection in dentistry. *Stomatologija* 1997;76:72-74.
33. Merchant VA. An update on the herpesviruses. *J Calif Dent Assoc* 1996;24:38-46.
34. Asher RS, McDowell J, Acs G, Belanger G. Pediatric infection with the human immunodeficiency virus. *J Colo Dent Assoc* 1993;72:25-28.
35. Eggert FM, McLeod MH, Flowerdew G, McIntyre EW, Wasylyk J, Koschzcek L. Periodontitis-associated marker bacteria in an urban North American patient population: Application of a commercial immunoassay. *J Periodontol* 1998;69:1382-91.
36. Gambhir RS, Singh G, Sharma S, Brar R. Occupational health hazards in current dental profession—A review. *Open Occupational Health Safety J* 2011;3:57-64.
37. Bleicher JN, Blinn DL, Massop D. Hand infections in dental personnel. *Plast Reconstr Surg* 1987;80:420-22.
38. Legnani P, Checchi L, Pelliccioni GA, D'Achille C. Atmospheric contamination during dental procedures. *Quintessence Int* 1994;25:435-39.
39. Epstein JB, Porter SR, Scully C. Non-A, non-B hepatitis and dentistry: A status report for the American Journal of Dentistry. *Am J Dent* 1992;5:49-55.
40. Verrusio C, Neidle SA, Nash, DD, Silverman S, Horowitz AM, et al. The dentist and infectious diseases: National survey of attitudes and behavior. *J Am Dent Assoc* 1989;118:553-62.
41. Capilouto EI, Weinstein MC, Hemenway D, Cotton D. What is the dentist's occupational risk of becoming infected with hepatitis B or the human immunodeficiency virus? *Am J Public Health* 1992;82:587-89.
42. Leggat PA, Kedjarune U, Smith DR. Occupational health problems in modern dentistry: A review. *J Indus Health* 2007;45:611-21.
43. Jacobsen N, Hensten-Petersen A. Occupational health problems among dental hygienists. *Commun Dent Oral Epidemiol* 1995;23:177-81.
44. Charpin D, Vervollet D. Epidemiology of immediate-type allergic reactions to latex. *Clin Rev Allergy* 1993;11:385-90.
45. Hamann CP. Natural rubber latex hypersensitivity: Incidence and prevalence of type I allergy in dental profession. *J Am Dent Assoc* 1998;129:43-54.
46. Turjanamaa K, Alenius H, Mäkinen-Kiljunen S, Reunala T, Palosuo T. Natural rubber latex allergy. *Allergy* 1996;51:593-602.
47. Tarlo SM, Sussman G, Contala A, Swanson MC. Control of airborne latex by use of powder-free gloves. *J Allergy Clin Immunol* 1994;93:985-89.
48. Seggev JS, Mawhinney TP, Yunginger JW, Raum SR. Anaphylaxis due to cornstarch surgical glove powder. *Ann Allergy* 1990;65:152-55.
49. Tosic G. Occupational hazards in dentistry-part one: Allergic reactions to dental restorative materials and latex sensitivity. *Facta Universitatis* 2004;2:317-24.
50. Lonroth EC, Shahnnavaz H. Use of polymer materials in dental clinics. *Swed Dent J* 1997;21:149-50.
51. Fowler JF. Late patch test reaction to acrylate in a dental worker. *Am J Contact Dermatitis*. 1999;10:224-25.
52. Piirila P, Kanerva L, Keskinen H. Occupational respiratory hypersensitivity caused by preparations in dental personnel. *Clin Exp Allergy* 1998;28:1404-11.
53. Nayebzadeh A, Dufresne A. Evaluation of exposure to methyl methacrylate among dental laboratory technicians. *Am Ind Hyg Assoc J* 1999;60:625-28.
54. Pohl L, Bergman M. The dentist's exposure to elemental mercury vapor during clinical work with amalgam. *Acta Odontol Scand* 1995;53:44-48.
55. Bahannan S, el-Hamid AA, Bahnassy A. Noise level of dental hand pieces and laboratory engines. *J Prosthet Dent* 1993;70:356-60.
56. Trenter SC, Walmsley AD. Ultrasonic dental scaler: Associated hazards. *J Clin Periodontol* 2003;30:95-101.

57. Al Wazzan KA, Almas K, Qahtani MQ, Khan N. Prevalence of ocular injuries, conjunctivitis and use of eye protection among dental personal in Riyadh, Saudi Arabia. *Int Dent J* 2001;51:88-94.
58. Chadwick RG, Alatsaris M, Ranka M. Eye care habits of dentists registered in United Kingdom. *Br Dent J* 2007;203:198-99.
59. Smith NJ. Risk assessment: The philosophy underlying radiation protection. *Int Dent J* 1987;37:43-51.
60. Yengopal V, Naidoo S, Chikte UM. Infection control among dentists in private practice in Durban. *SADJ* 2001;56:580-84.
61. Zielinski JM, Garner MJ, Krewski D, et al. Decreases in occupational exposure to ionizing radiation among Canadian dental workers. *J Can Dent Assoc* 2005;71:29-33.
62. Kuroyanagi K, Hayakawa Y, Fujimori H, Sugiyama T. Distribution of scattered radiation during intraoral radiography with the patient in supine position. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 1998;85:736-41.
63. Giannandrea PF. Types of impairment amongst dentists. *MSDA J* 1996;39:73-76.
64. Lehto TU, Helenius HY, Alaranta HT. Musculoskeletal symptoms of dentists assessed by a multidisciplinary approach. *Community Dent Oral Epidemiol* 1991;19:38-44.
65. Wells A, Winter PA. Influence of practice and personal characteristics on dental job satisfaction. *J Dent Educ* 1999;63:805-12.
66. De Wet E, Truter M, Ligthelm AJ. Working patterns of male and female dentists in South Africa. *J Dent Assoc S Afr* 1997;52:15-17.
67. Deverall A. The health of dentists in South Africa. *J Dent Assoc S Afr* 1969;24:368-71.
68. Samaranayake LP, Anil S, Scully C. Occupational Hazards in Dentistry: Part 1. *FDI* 2001;10:8-12.
69. Burt BA, Eklund SA. *Dentistry, dental practice and the community* (6th ed). Missouri: Elsevier Saunders 2005:p.425.

ABOUT THE AUTHORS

Naheeda Shaik Mohammed (Corresponding Author)

Postgraduate Student, Department of Periodontics, Mamata Dental College, Khammam, Andhra Pradesh, India, e-mail: drnaheeda@gmail.com

Mohammed Asif Shaik

Assistant Professor, Department of Maxillofacial Diagnostic Sciences College of Dentistry, King Khalid University, Aseer Region, Saudi Arabia