

Occupational Hazards in Orthodontics – A Review Article

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Review Article

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Article History

Received: 10.04.2018

Accepted: 17.04.2018

Published: 30.04.2018

DOI:

10.21276/sjds.2018.5.4.9



Abstract: Occupational hazards refer to a risk or danger arising on a consequence of the nature or working conditions of a particular job. Dental professionals and their patients are exposed to numerous occupational hazards, making them more vulnerable to injury. Besides general occupational hazards affecting the Orthodontist, there are various professional risk factors in Orthodontics that may harm Orthodontist's and their team. The potential areas for occupational hazards are Orthodontic office/clinic, laboratory area and sterilization area. Potentially hazardous factors for dental professionals includes specific materials and tools that expose the operator to vision and auditory risks; chemical substances with known allergenic, toxic, or irritating actions; increased microbial counts and silica particles of the aerosols produced during debonding and psychological stress with proven undesirable sequelae. The identification and elimination of these risk factors should be incorporated into a standard practice management program as an integral part of orthodontic education. This review article will cover general occupational hazards in dentistry as well as specific occupational hazards to the Orthodontist.

Keywords: Occupational hazards, Orthodontist, potential risk factors.

INTRODUCTION

Occupational hazards refer to a risk or danger arising on a consequence of the nature or working conditions of a particular job. Ramazzini [1] the father of occupational medicine was the first one to recognize the role of occupation in dynamics of health and disease. Dental professionals and their patients are exposed to numerous occupational hazards, making them more vulnerable to injury. This review article will cover general occupational hazards in dentistry, specific occupational hazards to the Orthodontist.

Ayatollahi *et al.*, [2] listed occupational hazards to dental staff (1) Infection hazards (2) Psychological hazards (3) Allergic reaction (4) Physical hazards (5) Mercury health hazards (6) Ionizing radiation (7) Non-ionizing radiation.

Besides general occupational hazards affecting the Orthodontist, there are various professional risk factors in Orthodontics that may harm Orthodontist's and their team. The potential areas for occupational

hazards are Orthodontic office/clinic, laboratory area and sterilization area. In Orthodontics, these hazards can be broadly categorized as health hazards imposing threat to a person's biological balance from exposure to physical factors (light, noise, vibrations, heat, trauma) chemical factors (Etching material, monomer, disinfectants and fluids used in radiology) and biological factors (cross infections) and other hazards causing risk to professional's well-being like

musculoskeletal problems and psychological factors [3, 4].

Sheron *et al.*, [5] classified these hazards as –

1. Occupational health hazards from exposure to:

- Physical factors: Lights, noise, vibration, heat, trauma etc.
- Chemical factors: Latex, monomer, sterilization, aerosols, radiology liquids etc.
- Biological factor: Infections (viral and bacterial pathogens)

2. Other occupational hazards include risks to the Orthodontist's well-being, associated with:

- Musculoskeletal problems: muscular pain, stiffness of muscles, restricted movements etc.
- Psychological factors: dealing with patients, work organization, legal action etc.

The identification and elimination of these risk factors should be incorporated into a standard practice management program as an integral part of Orthodontic education.

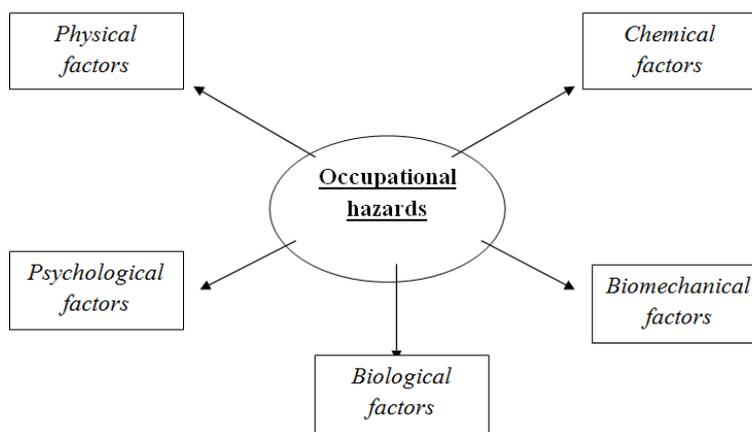


Fig-1: Source of occupational hazards in orthodontic office

PHYSICAL HAZARDS

Physical hazards in dental medicine include lights, noise, vibration, heat, trauma and radiation (ionizing and non-ionizing). Physical hazards can cause sight and hearing disorders and health problems related to radiation, vibration, heat and injuries [6, 7].

Light

Hazardous to eye and vision

Source of light- Work place lights, Dental chair light, Light cure unit and Laser.

Sources of other risk of eye hazards-

- Penetrating injury wire segments or adhesive chips from debonding and acrylic trimming [8].
- Chemical burn from acids or alkalis like bonding etching material, disinfectants or other liquids and sprays.
- Infection caused by splashing materials and infected projectile [9].

Sign and symptoms

Eye strain, dry eye syndrome, cataract, blurred vision, pain, lacrimation, maculopathies and pathological conditions of the macula can be caused by poor lighting in the dental office and by blue curing light [10].

Sims and Roberts-Harry [8] reported that 43% of orthodontists reported instances of ocular injury in

their practices. The majority of these injuries occurred during debonding or trimming acrylic.

Noise- Dental devices cause the most dangerous noise levels and creating disturbance and destructive noise by air conditioner, music system, scalers, gypsum cutting devices, vibrators, aspirators, air turbine handpieces and micromotor handpieces [5].

Sign and symptoms- Tinnitus, hearing loss [2].

Occupational exposure to vibrating tools can result in the occupational disorder named hand-arm vibration syndrome [11]. Among dental professionals the symptoms are mainly developing in upper limbs. Neurological symptoms include tactile sensitivity, finger numbness and tingling. Bagramian and McNamara [12] sponsored by American Association of Orthodontists found that orthodontists showed a low yearly injury rate of less than 1%, with 84% injuries occurred outside the mouth; this is important finding, since doctor – patient contact during injury is minimal. Most common injuries occurred during wire changes. S L Farrier [9] reported risks encountered within the dental environment cause harm to the unprotected eyes of both staff and patients. 48% of general dental practitioners had experience of ocular trauma or infection which occurred during a variety of procedures; 75% of these injuries resulted from not wearing eye protection. Most of the injuries can be treated on site without long term effect. Extra caution

should be used during laboratory procedures, when injuries from projectiles are possible.

Chemical factors

Sources- Latex, polymer materials, acrylic resins, cements, etching material, waxes, and impression materials, sterilization and radiology fluid [5].

Adverse reactions because of allergies (rashes rhinitis, edema, bronchospasmus, and allergic shock.) toxic reactions, hypersensitivity, chemical injuries and burns, reproductive problems, etc [6, 7].

Latex allergy

Although gloves enhance the barrier abilities of the skin and help decrease cross contamination, adverse reaction to latex are side effects. Etiology of latex sensitivity reaction to the plant containing allergenic proteins in natural rubber. It is estimated that 8-12% of health care workers are latex sensitive [10].

How to avoid latex allergy-

A new generation of latex gloves has vastly reduces protein levels associated with latex sensitivity (allergy due to powder used in gloves) [13].

Other chemical factors

- Powder used in alginate contains about 60% diatomaceous earth. When fluffed, these particles in the size of less than 3 µm in diameter and greater than 20 µm in length can be inhaled and may prove to be a health risk (carcinogenic) over a long time span [14].
- Irreversible hydrocolloid materials, alginate, elastomeric impression material [14].
- *Acrylic* based resins are extensively used in dentistry for the fabrication of denture bases, orthodontic removable appliances, temporary crowns, and denture relining. Undesirable effects caused by acrylic based resins have been widely evidenced ranging from skin problem to cytotoxicity [15, 16].
- *Materials used for sterilization-* Ethylene oxide (EtO) is a flammable, highly reactive, colorless gas used for sterilization of dental equipment. Acute exposures to ethylene oxide may result in eye pain and blurred vision, sore throat, respiratory irritation and lung injury, headache, nausea, dizziness, vomiting, diarrhea, shortness of breath, convulsions, skin irritation and cyanosis. Dental health care providers are usually exposed to trace amount of ethylene oxide which would accumulate over their working lifetime. Chronic exposures to ethylene oxide have mutagenic potential and are linked with neurotoxicity, peripheral paralysis, muscle weakness, cancer, reproductive disorders [17, 18]. Sterilizing agents like aldehydes, phenols, and quaternary ammonium compounds can cause lung problems and dermatitis.

- Etching material, monomer, disinfectant and radiology fluids are commonly used in orthodontic practice. Chemical burns come from acids (e.g. bonding etching material) or alkaline (e.g. disinfectant solutions) substances. Acids are usually less harmful than alkalis. Other symptoms occur with chemicals are irritation to skin, mucous membrane, respiratory problem, conjunctival symptoms, headache, irritability etc. There are many potentially toxic materials that are used in dentistry that may pose health hazards in the absence of precautionary measures. Careful handling of chemical materials, according to manufacturer's directions, and sufficient ventilation are recommended [19, 20].

BIOLOGIC AL HAZARDS

Biological hazards or biohazards are biological substances (viruses, bacteria and fungi, as well as parasitic worms and some plants) that are considered as possible threats to the health of living organisms [21-23]. Orthodontist as other healthcare workers confronts a identified risk of occupational exposure to blood-borne pathogens like the Human Immunodeficiency Virus (HIV), the hepatitis B virus (HBV), and the hepatitis C virus (HCV). In dentistry, sharp injuries occur because of a small operating field, frequent patient movement, and the variety of sharp instruments used in dental procedure [24, 25].

Entry of biohazards when they are inhaled, ingestion or absorbed through the skin, eyes, mucous membranes or wounds (bites, injuries, etc).

Route of transmission [26, 27]

- Direct transmission
- Indirect transmit

Direct transmission

When a person is injected or punctured by an infected object, such as a needle and wire. Physical contact between an infected and non-infected person;

Indirect transmission

Attaching infectious agents to food, water, cooking or eating utensils; when an insect carries infectious agents from an infected to a non-infected person; transmission through the air, where infectious agents can be inhaled. Once inside the body, biohazards can multiply quickly, can cause health problems and may be passed from one person to another.

Sources of biohazards in Orthodontics office

Aerosol

In many routine dental procedures, high-speed air-driven dental hand pieces are used for various purposes. Coolant water are needed to cool the tip to prevent heat transfer to the tooth surface. The presence of coolant water or other fluid to cool and lavage the working site is responsible for the negative side effects

of producing a large amount of aerosol and the collection of excess water in the patient's mouth [29, 30]. When a high-speed dental hand piece is used in the presence of blood, it is logical to think that the blood is aerosolized and incorporated into the larger volume of aerosol cloud associated with the coolant water and can remain airborne for a significant time. Toroglu [31] study has shown that orthodontists are exposed to high levels of aerosol and, as a result, are exposed to bacterial contamination during the debonding procedure.

Impression and models

Impression material and orthodontic appliances could be a source of infection. When plaster is poured into a contaminated impression, the microorganisms from its surface spread into the cast, and this infected cast is handled in the dental laboratory. The plaster dust from the infected casts gets into the respiratory tract, settles on clothes and environmental surfaces, and remains viable for a considerable time. For example, *Mycobacterium tuberculosis* remains dangerous for several weeks [19].

Impression material can act as a vehicle for the transfer of both pathogenic bacteria and viruses and cause cross contamination in the clinic and from the clinic to the laboratory. 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 [32, 33]. The risk of exposure to blood-borne infections during the clinical dental training, consequences of non-reporting, and lack of appropriate follow-up or even infection should constantly be evaluated by dental institutions [34].

BIO MECHANICAL HAZARDS (Musculoskeletal)

Biomechanical hazards can be defined as single or repetitive movements and forces imposing stress on the body (including awkward body working posture) with a potential to cause or contribute to injury or disease affecting the musculoskeletal or neurological systems [21, 35].

Bending of neck and back by dentists, especially while treating maxillary teeth can explain why neck and lower back are the most commonly affected sites of musculoskeletal disorders in dentists. According to Alexopoulos [36] neck and shoulder complaints were less prevalent than back pain. Musculoskeletal disturbances was frequent, 62% of dentists reported at least one musculoskeletal complaint, 35% reported at least two musculoskeletal complaints, 15% reported at least three musculoskeletal complaints, and 6% reported spells of all four complaints in the past year. Rambabu and Suneetha [37] compared the prevalence of musculoskeletal

disorders among physicians, surgeons and dental surgeons and found that musculoskeletal pain was most prevalent among dental surgeons, 61%.

PSYCHOLOGICAL HAZARDS

Stress is the leading psychological condition that occurs in the dental profession. Many studies implicate that dentists perceive their profession as more stressful than other jobs. Negative picture induced by the media of dentistry as a profession filled with dangers may be the leading causes. Not only physical impairments, but job-related psychological disorders may also affect dentist's health. Risk factors affect dentist's psychological conditions that include job-related stress, tension, depression, emotional exhaustion, and depersonalization [5].

Cary L. Cooper *et al.*, [38] mentioned a study by Russek (In 60s) which concluded that coronary heart disease among dentists is not linked to heredity or diet, but rather to the relative stressfulness of occupational activity. His research focused on four categories of dentistry; periodontia, orthodontia, oral surgery and general practice. They were ranked in order of stressfulness by seven expert independent judges (all dentists), who determined that the most stressful of the fields was general practice followed by oral surgery, orthodontia, and the least stressful, periodontia. Dental practice is stressful. Dentists have to overcome many stressors in their personal and professional lives. There are some evidences that suggest dentists suffer a high level of job-related stress.

Baran [39] found 83% of dentists believed that dentistry is "very stressful, nearly 60% believed that dentistry is more stressful than other professions. Dentists indicated running behind schedule, causing pain, and heavy work load, late and anxious patients as well as being the most intense stressors in their work. Dentists, who reported that dental anxiety was primarily the result of general psychological problems in patients, usually had solo practices older than 18 years and reported high perceived stress.

There was no difference between levels of stress among dental specialties. Working in the field of pediatric dentistry was related to the highest median levels of stress, though this result was not significant. A large number of factors are responsible for stress situations including low autonomy, work overload, and inappropriate relation between power and responsibility. Teaching role in addition to clinical role may increase the levels of stress, but there is also evidence that this dual role may decline job-related stress.

Understanding and controlling of the underlying physiological mechanisms precisely are necessary to develop and implement a comprehensive approach to minimize the risks of the work-related

injuries. Maintaining good physical and mental health is emphasized to dentists to enjoy and be satisfied with

their professional and personal lives.

Table-1: Occupational hazards in Orthodontic office and routine protocol to reduce exposure [5]

Effect of occupational hazards	Routine protocol to reduce exposure		
	Office area	Laboratory area	Sterilization area
<i>Vision</i>	Always use protective eyewear for all orthodontic procedures, Avoid prolong concentration, splashes during rinsing and spraying, Follow guidelines for infection control	Always use protective eyewear, Good ventilation reduce aerosols and vapor hazards, Follow guidelines for infection control	Always use protective eyewear, Good ventilation reduces aerosols and vapor hazards, Follow guidelines for infection control
<i>Hearing</i>	Check noise level of operator sites, use insulation whenever possible	Check noise level of operator sites, usage of insulation whenever possible, Ear plugs during laboratory procedures	Use insulation whenever possible
<i>Respiratory</i>	Maintain proper ventilation, use masks, Follow guidelines for infection control	Good ventilation reduce aerosols and vapor hazards, Follow guidelines for infection control	Good ventilation reduce aerosols and vapor hazards, Follow guidelines for infection control
<i>Skin</i>	Always use protective barriers like gloves, mask, wear long sleeves, Lead apron and radiation level sensors to deal with radiation hazards, Follow guidelines for infection control	Always use protective barriers like gloves, mask, wear long sleeves, Follow guidelines for infection control	Cover all skin areas, Follow guidelines for infection control
<i>Musculoskeletal</i>	Use ergonomically designed equipment and tools, laboratory area, Easy access to frequently used instruments, Adopt proper body position	Use ergonomically designed equipment and tools, laboratory area, Easy access to frequently used instruments and equipments, Adopt proper body position	Use ergonomically designed equipment and tools etc.

CONCLUSION

Occupational hazards in dental medicine are numerous and can be grouped as biological, biomechanical, chemical, physical and psychological. Unfortunately education on occupational health is not a standard part of the curriculum of dental schools and this should be changed if we want to avoid or diminish the adverse effect of being a dental practitioner. If we all as an Orthodontist can understand these hazards and how we can outcome them, we can be successful long term practitioner.

REFERENCES

1. Franco G, Franco F. Bernardino Ramazzini: The Father of Occupational Medicine. American Journal of Public Health | September 2001, Vol 91, No. 9
2. Ayatollahi J, Ayatollahi F, Ardekani AM, Bahrololoomi R, Ayatollahi J, Ayatollahi A, Owlia MB. Occupational hazards to dental staff. Dental research journal. 2012 Jan;9(1):2.
3. Gupta A, Ankola AV, Hebbal M. Optimizing human factors in dentistry. Dent Res J (Isfahan). 2013;10 (2):254-9.
4. Shaghaghian S, Pardis S, Mansoori Z. Knowledge, attitude and practice of dentists towards prophylaxis after exposure to blood and body fluids. Int J Occup Environ Med, 2014;5(3):146-54.
5. Bhanat S, Patel R, Patel R. The invisible risks: Spotting the hazards in your orthodontic practice: A review. IOSR Journal of Dental and Medical Sciences Volume 13, Issue 3 Ver. V (Mar. 2014), PP 04-08.
6. Vodanovic M, Sović S, Galić I. Occupational Health Problems among Dentists in Croatia. Acta stomatol Croat. 2016;50 (4):310-20.
7. Basic R, Rosic D, Ledinsky I, Lovricevic I. Orthostatics and chronic venous insufficiency in Croatian doctors of dental medicine. Acta Clin Croat. 2014;53(1):3-6.
8. Sims AP, Roberts-Harry TJ, Roberts-Harry DP. The incidence and prevention of ocular injuries in orthodontic practice. British journal of orthodontics. 1993 Nov 1;20(4):339-43.
9. Farrier SL, Farrier JN, Gilmour AS. Eye safety in operative dentistry- a study in general dental practice. Br Dent J. 2006; 200(4):218-23; discussion 08.
10. Pandis N, Pandis BD, Pandis V, Eliades T. Occupational hazards in orthodontics: a review of risks and associated pathology. Am J Orthod Dentofacial Orthop. 2007;132(3):280-92.

11. Mansfield NJ. The European vibration directive-- how will it affect the dental profession? *Br Dent J.* 2005; 199(9):575-7; quiz 608.
12. McNamara JA, Bagramian RA. A prospective survey of percutaneous injuries to orthodontic assistant. *Am J Orthod Dentofacial Ortho*, 115, 1999, 72-76.
13. Field EA. The use of powdered gloves in dental practice: a cause for concern?. *Journal of dentistry.* 1997 May 1;25(3-4):209-14.
14. Tillberg A, Järholm B, Berglund A. Risks with dental materials. *dental materials.* 2008 Jul 1;24(7):940-3.
15. Rashid H, Sheikh Z, Vohra F. Allergic effects of the residual monomer used in denture base acrylic resins. *Eur J Dent.* 2015;9(4):614-9.
16. Lyapina M, Dencheva M, Krasteva A, Tzekova M, Kisselova-Yaneva A. Concomitant contact allergy to formaldehyde and methacrylic monomers in students of dental medicine and dental patients. *International journal of occupational medicine and environmental health.* 2014 Oct 1;27(5):797-807.
17. Olfert SM. Reproductive outcomes among dental personnel: a review of selected exposures. *J Can Dent Assoc.* 2006;72(9):821-5.
18. Liakoni E, Liechti ME. Lachgas in der Zahnmedizin. *Swiss Dent J.* 2015;125(10):1099-104.
19. Torbica N, Krstev S. World at work: Dental laboratory technicians. *Occupational and environmental medicine.* 2006 Feb 1;63(2):145-8.
20. Hensten-Pettersen A, Jacobsen N. The role of biomaterials as occupational hazards in dentistry. *International Dental Journal*, 40, 1990, 159-166.
21. Vodanović M. Profesionalne bolesti i bolesti vezane uz rad stomatologa [Occupational diseases and diseases related to work in dental medicine]. *Jastrebarsko: Naklada Slap*; 2015.
22. Shaghaghian S, Pardis S, Mansoori Z. Knowledge, attitude and practice of dentists towards prophylaxis after exposure to blood and body fluids. *Int J Occup Environ Med.*2014;5(3):146-54.
23. Sacchetto MS, Barros SS, Araripe Tde A, Silva AM, Faustino SK, da Silva JM. Hepatitis B: knowledge, vaccine situation and seroconversion of dentistry students of a public university. *Hepat Mon.* 2013;13(10):e13670.
24. Ayatollahi J, Bahrololoomi R, Ayatollahi F. Vaccination of dentist and other oral health care providers. *J Den Med.* 2005;18:5-14.
25. Ayatollahi J, Sharifi MR, Sabzi F, Zare AR. Blood level anti-HBS due to HB vaccine in health care personnel of Shahid Sadoughi Hospital-Yazd. *Iranian Journal of Obstetrics, Gynecology and Infertility.* 2004;7:48-51.
26. Szymanska J. Microbiological risk factors in dentistry. Current status of knowledge. *Ann Agric Environ Med.* 2005;12(2):157-63.
27. Shaghaghian S, Golkari A, Pardis S, Rezayi A. Occupational Exposure of Shiraz Dental Students to Patients' Blood and Body Fluid. *J Dent (Shiraz).* 2015;16(3):206-13.
28. Corrao CR, Mazzotta A, La Torre G, De Giusti M. Biological risk and occupational health. *Ind Health.* 2012;50(4):326-37.
29. Finkbeiner BL, Claudia SJ. *Comprehensive Dental Assisting: A Clinical Approach.* St. Louis, Mo: Mosby-Year Book Inc; 1995: 148-176, 447-452.
30. Torres HO, Ehrlich A, Bird D, Dietz E. *Modern Dental Assisting.* 5th ed. Philadelphia, Pa: W. B. Saunders Co; 1995:169-181, 279- 292.
31. Toroglu MS, Haytac MC, Koksall F. Evaluation of aerosol contamination during debonding procedures. *Angle Orthod.* 2001; 71:299-306.
32. Greco PM, Lai CH. A new method of assessing aerosolized bacteria generated during orthodontic debonding procedures. *American Journal of Orthodontics and Dentofacial Orthopedics.* 2008 Apr 1;133(4):S79-87.
33. Behroozy A. On dermal exposure assessment. *The international journal of occupational and environmental medicine.* 2013 Jul 16;4(3 July):267-113.
34. Watt RG, Croucher R. Dentists' perceptions of HIV/AIDS as an occupational hazard: a qualitative investigation. *International Dental Journal*, 41, 1991, 259-264.
35. Ritzline PD, Mulvany RD. Ergonomics and posture and pain--oh my! *Cranio.*2012;30(2):82-3.
36. Alexopoulos EC, Stathi IC, Charizani F. Prevalence of musculoskeletal disorders in dentists. *BMC Musculoscelet Disord.* 2004;5:16.
37. Rambabu T, Suneetha K. Prevalence of work related musculoskeletal disorders among physicians, surgeons and dentists: a comparative study. *Ann Med Health Sci Res.*2014;4(4):578-82.
38. Cooper CL, Mallinger M, Kahn RL. Dentistry: what causes it to be a stressful occupation?. *Applied Psychology.* 1980 Jul 1;29(3):307-19.
39. Baran RB. Myers briggs type indicator, burnout, and satisfaction in illinois dentists. *Gen Dent.* 2005;53:228-34. quiz 235.