



Review Article

Potential risk factors their management strategies in prosthodontic practice

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ABSTRACT

Prosthodontists, laboratory technicians, students and other people working within the clinical setup and laboratory should be aware of all the potential risk factors and necessary measures to prevent and protect themselves as well as the patient. This article intent to reaserch various hazards and risks involved in prosthodontic practice. These risks include expoure to chemical, physical hazards, infectious environment, psychosocial hazards and various others. Prevention from these hazards and risk factors is also highlighted.

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1. Introduction

Every profession has its own kind of risks and hazards. Occupational health is defined as a multidisciplinary activity aimed at the protection and promotion of health of workers by preventing and controlling occupational diseases and accidents and by eliminating occupational factors and conditions hazardous to health and safety at work (WHO -2015).¹ Occupational hazard is any source of potential damage, harm or adverse health effects on something or someone under conditions at work (BOSH training 2012). Risk refers to the prospect or probability that a person will be harmed or experience an adverse health effect if exposed to a hazard (OSHA 2016).^{1, 2}

The type and degree of exposure is dependent on the various sorts of services, the type of patients and the specific task performed. Even though advanced dentistry has been listed as the least high risk of all the line of work but still many hardships in this occupation. Dental work setup especially of a prosthodontist is not just confined to the

boundaries of the clinics, much of the work often goes out to the laboratory, hereby widening the circle of potentially harmful agents. Prosthodontic practice requires use of various dental materials of idealy different composition such as metals, resins based synthetic polymers, dental ceramics etc. Various allergens like methacrylate, latex gloves, gluteraldehyde etc leads to various dermatological reactions and respiratory illnesses. Burn injuries either through chemicals or from autoclave, Bunsen burner, furnaces can happen very commonly.

Occupational hazards in prosthodontics can be broadly classified as physical, chemical, biological, ergonomic and psychosocial hazards.

2. Materials and Methods

An electronic search of dental literature was conducted through Google Scholar, Ebsco, hinari and PubMed to obtain all the relevant information regarding prosthodontic health hazards and risks and various measures to stop and overcome it. Only English based dental literature published from January 1990 to August 2018 was considered for this

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Table 1: Various occupational hazards in prosthodontics

Type	Subtype	Hazards and risk factors
Non- Infectious	Physical hazards	Trauma Burns Injury to eye Acoustic injuries
	Chemical hazards	Due to various dental materials Methyl methacrylate Dental alloys Ceramic materials Impression materials Electroplating solutions Dental waxes Latex gloves Laboratory fumes Polishing agents
Infectious	Biological hazards	Bio aerosols Non disinfected impressions and contaminated dental casts Suction and water line units Blood from accidental wounds and cuts Needle stick injuries
Psychosocial	-	Psychological burnout of the clinician Burnouts Suicidal tendencies Stress related disorders
Ergonomic	-	Musculoskeletal disorders Neck pain Back pain shoulder pain

review. The keywords and phrases used for the search were occupational hazards, risk, health hazard, noise, ergonomic hazard, risk management in prosthodontics.

2.1. Physical Threats

Physical threats connected with prosthodontic practice include direct physical trauma, fire and burns, acoustic trauma, eye damage and various problems associated with bad working posture.

According to a study, Prosthetics dentists have the second highest preponderance rate of 4.5% yearly for the percutaneous injuries.³ Usual factors include use of high speed of rotary instruments which creates the projectiles at 39 m/second which are very heated, abrupt and infected.⁴ Blue curing light used for polymerization of restorative resin material range from 400-500 nm wavelength which is additionally related to corneal damage and abrasion.⁵ The effect of blue light are often cumulative or acute depending upon its nature and duration of use. Vulnerability to blue light usually results in acute injuries. Consistent with report, there's increase ocular injury risk at 440nm of wavelength.^{5,6,7}

Dentist had always been an occupational interest within the subject of Noise Induced deafness (NIHL). They emit sound measuring from 66 db to 91 db.⁸ The primary conclusive evidence that damage to hearing may result from exposure to the present noise was published by Taylor and associates in 1965 during carefully controlled study of dentists.⁹ It's also been estimated that most turbine users are exposed to high speed hand pieces. It's estimated that sound energy contribution of a typical practice is about 8% of dentists.⁹ However, risk depends upon the susceptibility of a specific individual, total daily exposure and sort of instruments used.

2.2. Chemical Hazards

Various synthetic and natural occurring chemicals has been utilized in both clinical prosthodontic practice also as within the laboratory. These materials include alloys, resin polymers, dental cements, ceramics, waxes, eugenol

containing materials, sodium hypochlorite, elastomeric impression materials etc.^{10,11,12} Many materials are known to cause dermatitis and have harmful effects when ingested or inhaled. They can have local, systemic, immediate or delayed effect. These materials enters inside the body through direct skin absorption, ingestion and inhalation and cause of release of components and various degradation products which causes inflammation, immunological reactions and even carcinogenesis over their prolonged exposure.¹¹

Polymethyl methacrylate resin contain chemicals like butyl methacrylate, di-butyl phthalate and cadmium salt based colouring agents. Methyl methacrylate vapour in surrounding air at the extent of 125 ppm or above may cause teary eyes, pharyngitis and coughing. MMA can easily penetrate clothing and even surgical gloves. Maximum permissible limit for the quantity of methyl methacrylate is 410 mg/m³.^{12,13}

Metal alloys pose hazards to dentist and technicians during casting and finishing of the metal restoration and frameworks. A study reported that 53 out of 70 dental technicians suffering from pneumoconiosis which might be thanks to dust from processing of those dental materials.^{14,15}

NOISH recommend exposure limit to those particles as limit of 0.05 mg/m³. Inhalation of these particles may lead to silicosis.

Roberta et al tested polyethers and vinyl polysiloxanes for cytotoxicity and showed polyethers to be more cytotoxic than vinylsiloxanes.^{16,17}

2.3. Biological Hazards

Biological hazards are constituted by various infectious agents like virus, bacteria and fungi and can be both transmissible and non transmissible diseases. Transmissible diseases of greatest concern to any kind of health care provider are HIV, HBV and tubercle bacillus.¹⁸

A clinician are often infected by a cut or a wound, needle stick injury, aerosols containing saliva, blood and gingival fluid. Aerosol spray and contaminated impressions are common source of infection in Prosthodontic practice. Other

Table 2:

Type of occupational hazard	Effect of the occupational hazard	Risk Management
Direct physical trauma	Includes accidental skin cuts, abrasion etc. It occurs mostly due to the misuse of instruments and equipments. Act as a portal for entry of infection or toxic materials.	Use of sharp instruments and equipments cautiously. Avoid using broken or blunt instruments.
Burns	From Bunsen burners, spirit lamps, blow torches, improper handling of the hot instruments, hot wax splashes, injudicious use of casting and curing units etc. Spontaneous ignition of flammable materials	Can be minimized by the use of flameproof materials. Provision of accessible fire extinguishers. Regular practice of routine fire drills.
Eye injuries	Use of high speed cutting tools. Can lead to mild irritation, corneal abrasion, ulceration to complete blindness. Splashing of dental materials like methymethacrylate monomer or spirit directly into the eye. Pumice used mainly during polishing can also cause pain or corneal abrasion. Blue curing light is in employed within the range of 400-500 nm wavelength for polymerization of restorative resin can cause corneal damage and ulceration.	Use of protective glasses, loupes or goggles for the individual protection.
Acoustic injuries	Use of high speed turbine dental drills, ultrasonic instruments, high velocity suction, cleaners and trimmers. Emit sound within the range of 60 db to 91 db. Loss of hearing and tinnitus are the foremost symptoms.	Ear protection should be worn during the procedures. Hearing test to be done atleast once during a year.

possible sources of infectious contamination are dental unit waterlines, hand pieces, saliva ejectors, suction tubes, airtors, hand pieces and radiological instruments.¹⁹ Dental unit waterlines may harbor opportunistic and respiratory pathogens like Legionella species, mycobacterium species and Pseudomonas species. The dimensions of particles of the aerosols produced is of great concern because it ranges between 2 to 30 μm which can directly reach the alveoli and cause respiratory ailments.

The common path for entry of infection includes skin of hands and face; oral, nasal and conjunctival epithelium and epithelium of airway tract including trachea, bronchus and alveoli. Impressions often travel out of the clinical setup to the laboratories and extends the horizon of the infection.²⁰ It act as a vehicle for the transfer of both pathogenic bacteria and virus and cause cross contamination within the clinic and the laboratory. Dental cast poured from such impressions act as a major source of infection in dental laboratory. Plaster dust from handling of such dental casts gets into the respiratory tracts and settles over the garments for a substantial long period of time.²¹

A thorough knowledge of infections, mode of transmission and various safety measures is vital to beat the spread of infection. Protection are often achieved by the mixture of immunization procedures, use of varied barrier techniques and strict adherence to the infection control guidelines. Rubber dam should be used whenever possible as it will eliminate all contamination arising from blood and saliva. All the members of dental team should be vaccinated for hepatitis B and hepatitis C. Impressions should be disinfected in the suitable medium (2% gluteraldehyde and iodoform solution etc) before sending to the laboratory.

Gloves should be worn while pouring the impressions. Protective coverings in the form of uniforms such as gowns and aprons, gloves, glasses, masks or face shield should be worn by the clinician as well as by the assistant while performing various clinical procedures. Sharp instruments and needles should be handled carefully. In the case of skin puncture by a contaminated instrument should be encouraged to bleed and washed thoroughly under the running water.

All instruments should be thoroughly cleaned before sterilization. High volume aspirators or suction devices are used to reduce any risk of cross infection from aerosols. The risk can be further reduced by good ventilation.

Waste disposal should be considered seriously to prevent the spread of infection. Needles and sharp waste should be placed in the puncture proof containers and securely sealed. Medical waste must be disposed off in red bags and non infective waste should be disposed off via thick black bags.

2.4. Ergonomic Hazards

Ergonomic hazards generally comprises of physical factors that harms the musculoskeletal system. Musculoskeletal disorders are common health issue among the dental professionals. Musculoskeletal Disorders or MSDs are injuries and disorders that affect the human body's movement or musculoskeletal system (i.e. muscles, tendons, ligaments, nerves, discs, blood vessels, etc).²² Common symptoms of MSD's includes discomfort, disability or persistent pain in joints, muscles, tendons and other soft tissues. Common MSD's include Carpal Tunnel syndrome, tendonitis, muscle or tendon strain, tension neck syndrome, epicondylitis, degenerative disc disease etc. risk factors

Table 3:

Type of dental material	Effect of the occupational hazard	Risk management
Methyl methacrylate	It doesn't pose a threat to the patient but often has deleterious effect on the dentist and technicians during packing, grinding and finishing prosthesis. Most common side effect is irritating to eyes, skin, throat, lungs and systema nervosum. Direct skin contact causes itching, burning, redness, swelling and cracking of the skin. Causes tingling, numbness or whitening of the skin. Nervous system symptoms are headache, drowsiness, nausea, weakness, fatigue, irritability and dizziness.	Substitution- To substitute it with a safer material. Installation of effective ventilation at workplace and laboratory. Containers should be tightly closed. Protective equipments like gloves, goggles or face shield should be worn. Gloves should get replaced frequently as methyl methacrylate can penetrate them.
Metal alloys	Nickel and chromium are known to be potential carcinogens. Nickel related to nasal cancer and chromium is usually related to lung carcinoma. Known to cause hypersensitivity. Exposure to the beryllium particle or fumes is related to contact dermatitis and chronic granulomatous lung disease called as Chronic Berillium disease. Berillium is understood to cause lung carcinoma and osteosarcoma.	Harmful effects are often minimized by use of gloves, protective glasses and powerful ventilation systems.
Dental waxes	Waxes like paraffin, beewax, carnauba generally doesn't act as irritants but prolonged use may sometimes cause skin irritation and dermatitis.	Careful handling of the hot waxes.
Ceramic materials	Generally considered as inert but dust during handling, manipulation and finishing of restoration could be liable for silicosis.	Use of mouth mask to stop inhalation of those particles.
Impression materials	Diatomaceous earth present in alginate may convince be carcinogenic if inhaled for a really long span of the time. Polyethers are cytotoxic in nature. Eugenol present in the zinc oxide eugenol impression paste is a known allergen.	Use of dust free alginate. Use of eugenol free impression paste.
Latex gloves	Often dusted with corn starch which often causes dermatitis in susceptible individuals. Natural rubber, synthetic rubber and polymeric glove material often shows various degrees of cytotoxicity.	Use of nitrile or polyvinyl gloves.
Electroplating solutions	Cyanide one among the constituent of the electroplating solution is understood to be harmful to the body. If it accidentally comes in contact of an acid leads to production of hydrogencyanide gas which is potentially lethal.	Silver electroplating should be discouraged.
Dental cements	Eugenol is cytotoxic and a potential allergen. Pulp sensitivity is more with the utilization of zinc phosphate cement.	
Gingival retraction solutions	Ferric sulphate solution used in impregnated gingival retraction cords is understood to cause necrosis and tissue discoloration	Use of safer solutions like aluminum chloride etc.

comprise repeated movements and prolonged awkward or forced body postures.^{22 23}

Prosthodontists are at high risk of neck and back problems. Limited work area and impaired vision in the oral cavity frequently causes the clinicians to assume stressful body postures for long periods of time which in turn leads to lower back pain, stiffness in hands and shoulders, muscle weakness, presence of paresthesia or tingling sensations.

Back pain syndrome diagnosed in dental clinicians occurs due to spine degeneration in its different phases. Due to constant monotonous movements and mechanical vibration there is always some sort of stress on wrist and elbow joint.²⁴

This can be minimized by at least 6 minute of rest from work every hour, proper ergonomic dental unit design, personalized rehabilitation exercises, regular stretching and

aerobic activities.

2.5. Psychosocial Hazards

Dentists perceive dentistry being more stressful than other professions. Important risk factors increasing stress among dentists are coping with difficult or uncooperative patients, over workload, constant drive for technical perfection, underuse of skills, challenging environment and low self esteem.^{25 26} One of the consequence of chronic occupational stress is professional burnout. It is defined as a syndrome of emotional exhaustion, depersonalization and reduced personal accomplishment that occur among professionals. Burnout can be best described as gradual physical, emotional and mental erosion of the person. It may lead to panic disorder or generalized anxiety disorders. In

prosthodontics, elderly patients are difficult to manage and satisfy with the treatment.

It can be managed by attending stress management workshops, doing deep breathing exercises, relaxation, hypnosis and desensitization techniques.

3. Conclusion

Prosthodontic dentistry being a very wide branch increases the susceptibility to the number of health hazards. Some understanding regarding the dental materials, various techniques and other risk factors helps the prosthodontist as well as the laboratory technicians regarding the better work practice and care of the personal health. Necessary measures should be taken in a clinical setup to eliminate various threats as much as possible.

4. Source of Funding

None.

5. Conflict of Interest

None.

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