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# An overview of occupational hazards in dental practice and preventive measures

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### Abstract:

The purpose of this article is to review the occupational hazards related to the practice of Dentistry. The classification of hazards is based on major sources of risk by system or tissue and by dental office area (dental chair, laboratory, sterilization area, x-ray developing area). Potentially hazardous factors relate to the general practice setting; to specific materials and tools that expose the operator to vision and hearing risks; to chemical substances with known allergenic, toxic, or irritating actions; to increased microbial counts and silica particles of the aerosols produced during tooth preparation, removal of restorations; to ergonomic considerations that might have an impact on the provider's musculoskeletal system; and to 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 dental education. Professional organizations can also assist in informing practitioners of potential hazards and methods to deal with them.

**Keywords:** Occupational hazards, infection, musculoskeletal, eye lesion, allergens, prevention.

### Introduction:

Occupational hazard is defined as a risk accepted as a consequence of a particular occupation.<sup>1</sup> Professionals in dentistry are exposed to many occupational hazards; their effects appear as ailments that affect the dental practitioner and tend to intensify with age. These problems include musculoskeletal conditions due to improper body posture; physical hazards from light, noise, and trauma; biological risks from irradiation and microorganisms; and chemical detrimental sources.

### Categories and sources of hazards:

A general classification of potential operator hazards in dentistry includes the following

1. Health hazards impose threats to a person's biological balance from exposure to physical factors (lights, noise, vibration, heat, trauma), chemically irritating, or toxic factors (latex, monomers, sterilization and radiology fluid, aerosols during removal of old restorations), and biological factors (infections from microorganisms).
2. Other hazards include risks to the professional's well-being, associated with physical or psychological factors such as ergonomic considerations (insufficient or inappropriate equipment, inappropriate work area design) and psychological stress (dealing with patients in general, difficult patients, employees, legal action, and work organization). (Table 1).

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### Health hazards:

Health hazards for clinical dentistry include physical factors such as lights, noise, vibration, heat, and trauma. Lights affect the eyes and vision. Office lighting and dental chair, light are critical for optimal working conditions. Additionally, other forms of light are used during daily procedures; The most important is the curing light for polymerization of bonding materials.

## Hazards related to eyes and vision: (Table 2).

Maculopathies can be caused by poor lighting. Photoreceptor cells called rods are responsible for peripheral and dim light vision; they receive light and cones, which provide central, bright light, fine detail, and color vision. The photoreceptors convert light into nerve impulses, which are then processed by the retina and sent through nerve fibers to the brain. Until recently, light sensitivity was believed to depend on the rod and cone photoreceptor cells of retinas. Recent research, however, showed that some of our ganglion cells might perform as a third type of photoreceptor called “intrinsically photosensitive retinal ganglion cells”.<sup>2</sup> These sparsely situated cells are most sensitive to blue light. They seem to exist principally to assist in differentiating between day and night, thus modulating the “sleep/wake” cycles, known as circadian rhythms.<sup>3</sup> When light hits a photoreceptor, the cell bleaches and becomes useless until it recovers through a metabolic process called the “visual cycle.” Absorption of blue light, however, has been shown to reverse the process in rodent models.

The cell becomes unbleached and responsive again to light before it is ready. This greatly increases the potential for oxidative damage, which leads to a buildup of lipofuscin in the retinal pigment epithelium layer.<sup>4</sup>

The eyes of people operating curing lamps are at risk for acute and cumulative effects, mainly due to back reflection of the blue light. Satrom et al evaluated 11 curing light systems that produced visible blue light in the 400 to 500 nm range and found that no unit posed a health risk<sup>5</sup>. A more recent and relevant study, comparing the effects of halogen, plasma, and light-emitting diode units on vision, reported that the exposure time required for plasma and light-emitting diode lamps to achieve curing depth similar to the tungsten-halogen light was longer than the irradiation times recommended by the manufacturers.

Cataract is a condition with clouding or loss of transparency of the lens. Light transmission through the lens is hindered, and thus result in dim, distorted, or blurred images on the retina and decreased vision.

Penetrating injuries (eg, from wire segments or adhesive chips during debonding) and UV light (from photopolymerizing units) are risk factors for cataracts.<sup>6</sup>

Infections can be caused by splashing material, aerosols, and trauma from wires, burs, and other projectiles. Trauma associated with microorganisms could cause various eye infections.

Chemical burns come from acids or alkaline substances. Acids are usually less dangerous than alkalis because they tend to precipitate tissue proteins, which form barriers and inhibit deeper penetration; therefore, lesions are limited to lids, conjunctiva, and cornea. Alkalis saponify lipids in the corneal epithelium and bind to mucoproteins and collagen in the corneal stroma. The risk of eye hazards from acids mostly relates to the patient during bonding; additional eye protection such as glasses might be necessary. The operator must use protective eyewear.<sup>7</sup>

Dry-eye syndrome is related to reduced blinking (prolonged concentration), decreased tear production, or increased tear evaporation caused by excessive lighting, heat, or air-conditioning. Symptoms of dry-eye syndrome include irritation, foreign body sensations, and stringymucous and transient blurred vision. Burning sensation, itching, photophobia, and tired or heavy feeling of the eyelids are less frequently reported.<sup>7</sup>

## Noise

The effects of occupational noise in the dental office can lead to noise-induced hearing loss (NIHL); symptoms can include difficulty with speech communication and other auditory signals, fatigue, and tinnitus. The symptoms of NIHL increase gradually with continual exposure.<sup>8</sup>

NIHL, currently not treatable, occurs when exposure to harmful sounds causes damage to the tiny hair cells in the cochlea and to the acoustic nerve. The greatest damage is usually caused at 3000 to 6000 Hz. NIHL can be caused by repeated exposure to sounds at various loudness levels, measured in decibels (dB), over an extended time or by a 1-time exposure to an intense sound.

Permissible noise exposures according to the Occupational Safety and Health Administration (OSHA) are shown in Table 3.<sup>8</sup> Several studies on used and new dental equipment recorded the sound levels of common sources of noise in dentistry as summarized in Table 4.<sup>9</sup>

## Injuries

Occupational injuries of health professionals are another area of interest, due to the increased awareness of patient-doctor cross contamination.

In 1995, a survey sponsored by the American Dental Association found injuries at a yearly rate of 3.4% among dentists; Among specialists, pedodontists had highest prevalence (5.5%), followed by prosthodontists (4.5%), oral surgeons (2.6%), orthodontists (1.9%) and endodontists had least prevalent (1.3%).<sup>10</sup>

**Table 1: Occupational hazards in dental office classified by working zones.**

	<b>Respiratory</b>	<b>Musculo-skeletal</b>	<b>Hearing</b>	<b>Vision</b>	<b>Skin</b>
<b>Dental chair operator area</b>	-Inhaling of chemicals (composites) -Allergens -Infection	-Neck, shoulder, upper and lower back pain -CTS -Tendinopathies -Repetitive strain injuries	-Handpiece noise -High volume Suction -Ultrasonic scaler	-Dry-eye syndrome -Maculopathies -Cataract -Eye trauma -Eye strain -Infection	-Allergy (chemicals) -Trauma -Infection
<b>Sterilization area</b>	-Inhaling of chemicals -Allergens -Infection	-Neck, shoulder, upper and lower back pain	-Ultrasonic cleaner	-Dry-eye syndrome -Eye trauma -Chemical burn -Infection	-Allergy (chemicals) -Trauma -Infection
<b>Laboratory area</b>	-Inhaling of chemicals -Allergens Infection	-Neck, shoulder, upper and lower back pain -CTS -Tendinopathies -Repetitive strain injuries	-Model trimmer -Vibrators -Low-speed hand pieces	-Dry-eye syndrome -Eye trauma -Chemical burn -Infection	-Allergy (chemicals) -Trauma -Infection -Burning.
<b>X-Ray processing area</b>	-Inhaling of chemicals -Allergens	-Neck, shoulder, upper and lower back pain		-Dry eye syndrome -Eye trauma -Chemical burn -Infection	-Allergy (chemicals) -Trauma

\*CTS-Carpel tunnel syndrome

**Table 2: The various forms of hazards of the eye and vision.**

<b>Eye strain</b>	<b>Dry-eye syndrome</b>	<b>Maculopathies</b>	<b>Cataract</b>	<b>Allergy</b>	<b>Trauma</b>	<b>Infection</b>	<b>Chemical burns</b>
Concentration	Decreased tear production  Increased tear evaporation	Blue-light hazard	Injuries  Ultra-violet lights	Latex glove cornstarch  Other	Burs  Wire  Lab projectiles	Splatter  Aerosol contamination  Trauma  Materials like tissue/body fluid	Radiology and sterilization fluids  Disinfectants

**Table 3: Permissible noise exposure levels (OSHA).**

Duration per day (hours)	Sound level dB (A) slow response
8	85
6	86
4	88
3	89
2	91
1 ½	92
1	94
½	97
¼ or less	100

*dB - Decibels*

**Table 4: Noise levels from dental equipment.**

Device	dB (A)
Air turbine handpiece	65.5-93
Micromotor handpiece	61.9-77
Scaler	73-88
Irrigator	76
Power suction tube	75
Saliva suction tube	73
Ultrasonic scaler	72-81
Gypsum cutting equipment	93.5
Vibrator	98.5
Aspirator and engine	81.7-86.5

*dB - Decibels*

## Chemical Factors

Chemical factors include latex and associated allergies, monomers, and sterilization and radiology fluids. Although gloves enhance the barrier abilities of the skin and help decrease cross contamination, adverse reactions to latex are side effects. According to OSHA, allergy to latex was first recognized in the late 1970s. Since then, it has become a major health concern as an increasing number of people in the workplace are affected.

Natural rubber latex, the main ingredient of protective gloves, occurs naturally and is produced from liquid extracts of the *Hevea brasiliensis* tree. From the extract stage until the final product, latex gloves go through a series of processes that introduce into them agents such as benzothiazol, thiuram disulfide, and carbamate and other groups with strong allergenic potential.

Immediate allergic reactions to latex can appear in those who have been repeatedly exposed to latex proteins through glove wearing and have developed high levels of Immunoglobulin E antibodies.<sup>11</sup> Synthetic gloves (vinyl, nitrile) were introduced as an alternative for latex-sensitive people.

Allergic contact dermatitis caused by methacrylates is common among dental professionals. Researchers demonstrated severe cytotoxicity for some monomers used in dentistry.<sup>12</sup>

Two types of impression dental materials, polyethers and vinyl polysiloxanes, were tested for cytotoxicity, and the polyether materials were found to be more toxic than vinyl polysiloxanes.<sup>13</sup>

Sterilization and radiology fluids are used to decontaminate or sterilize instruments, surfaces, and impressions contaminated with blood and saliva. Sterilant chemicals include aldehydes, phenols, and quaternary ammonium compounds. These chemicals can cause lung problems and dermatitis.<sup>14</sup> Radiology fluids contain chemicals such as ammonium thiosulfate, potassium sulphite, potassium carbonate, hydroquinone, diethylene glycol, acetic acid, and glutaraldehyde. These substances can cause symptoms ranging from skin irritation to allergy and pulmonary edema if mishandled. Careful handling of fluids, according to the manufacturer's directions, and sufficient ventilation are recommended.

## Biologic Factors

Biologic factors include microorganisms and particles. In the dental office, this can occur from direct contact with blood, body fluids, secretions, and excretions (except sweat), regardless of blood presence, non-intact skin and mucous membranes regardless of blood presence.

Infection can occur indirectly by contact with contaminated instruments, surfaces, equipment, and

materials. Other possible sources of infectious contamination are dental unit waterlines, hand pieces, saliva ejectors and suctions, other devices attached to air and water lines, and radiology equipment (especially digital sensors).<sup>15</sup>

Post-exposure management is important to control and avoid further transmission of the infection. Detailed guidelines and information is given in the publication of the Centers for Disease Control and Prevention, "Guidelines for Infection Control in Dental Care Settings"<sup>16</sup>.

The foregoing concerns provoked the investigation of means to minimize bacterial counts in aerosols. Rinsing with antiseptic solutions before treatment was found to significantly reduce the bacterial counts in aerosols during ultrasonic scaling.<sup>17</sup> Thus, ventilation, use of masks and aspirators, and mechanical removal of as much resin as possible before using rotary instruments are suggested. Precautions and measures to reduce the exposure to hazardous materials and procedures are listed in Table 5.

## Musculoskeletal Problems

Dental professionals often develop musculoskeletal problems, which are related to suboptimal work-environment ergonomics that might be responsible for improper sitting postures and movements causing unnecessary musculoskeletal loading, discomfort, and fatigue. Insufficient or inappropriate equipment, inappropriate work-area design, direct injuries, repetitive movements from working with dental instruments, or sitting for extended times with a flexed and twisted back are contributing factors to neck and low-back ailments.<sup>17</sup> Musculoskeletal problems happening outside the work environment can either worsen with work or make work difficult. Various structures can be affected—muscles, ligaments, tendons, nerves, joints, and supporting structures (intervertebral discs). A number of disorders are included under this category: upper and lower back pain, herniated disc, neck pain with or without cervical root problems, carpal tunnel syndrome, tendinopathies, shoulder pain, rotator cuff tendinopathies, and repetitive strain injuries.

The dental chair position and the dentist's stool position and orientation relative to that of the patient, combined with the doctor's effort to maintain visibility of the oral environment, result in awkward positions over long periods of time; these in turn result in back problems. The symptoms include low back pain, stiffness, and sciatica with neurological features such as tingling, paresthesia, and muscle weakness.



**Table 5: Measures to reduce exposure to hazardous materials and procedures.**

	<b>Respiratory</b>	<b>Musculoskeletal</b>	<b>Hearing</b>	<b>Vision</b>	<b>Skin</b>
Dental area	<p>Fresh air access</p> <p>Ventilation</p> <p>Use masks, aspiration during debonding</p> <p>Follow guide lines for infection control</p>	<p>Adopt proper body posture during dental chair work</p> <p>Use ample lighting and in direction that does not produce awkward body posture</p> <p>Arrange intermittent work load</p> <p>Handle instrument properly</p> <p>Use stretching before work</p>	<p>Check noise level of operatory</p>	<p>Avoid prolonged concentration and if necessary use assisting appliances</p> <p>Always use protective shield for photopolymerization</p> <p>Use protective eyewear for bonding and debonding (patient and staff also)</p> <p>Avoid splashes during rinsing and spraying</p>	<p>Use powder-free, silicone gloves if irritated by conventional powdered latex</p> <p>Exercise measures suggested by Centers for Disease Control for infection control</p> <p>Cover cuts in exposed body areas (face) to avoid contamination by splashed liquids</p>
Sterilization area	<p>Use ventilation and masks</p> <p>Follow guide lines for infection control</p>	<p>Ergonomically designed area and appropriate bench height</p> <p>Easy access to instruments/equipment</p>	<p>Use insulation for ultrasonic baths</p>	<p>Use protective eyewear</p>	<p>Cover all skin areas (wear long sleeves, gloves, mask)</p>
Laboratory area	<p>Masks, ventilation (preferably fresh air access)</p> <p>Follow guide lines for infection control</p>	<p>Ergonomically designed area and appropriate bench height</p> <p>Adopt proper body posture</p> <p>Easy access to frequently used instruments and equipment</p> <p>Take frequent breaks</p>	<p>Use insulation when possible</p> <p>Use ear plugs during model preparation and trimming.</p>	<p>Disinfect impressions</p> <p>Exercise measures as in other areas for eye protection</p>	<p>Avoid contact with methacrylates</p> <p>Use ventilation</p>

Carpal tunnel syndrome (CTS) is the most common nerve entrapment syndrome. It involves entrapment of the median nerve at the level of the wrist. In the work environment, CTS results from rapid, repetitive, and daily use of the hand and fingers for many hours at a time. The problem is compounded when working with a bent wrist, exerting force, working with vibratory tools, and in cold environments. Rapid movement of tendons in the synovial tube causes inflammation and fluid buildup. This can result in atrophy of the thenar muscles; tingling in the thumb, index, middle, and half of the ring finger; night pain; and pain when handling tools.

### Psychological Problems:

Several studies identified issues related to finances and job growth, time and scheduling, dentist-patient relations, and staff and technical problems as stress sources in dentistry. High levels of occupational stress among dentists are correlated with hypertension, coronary artery disease, and suicidal tendencies.

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### Conclusion:

Contemporary dentistry involves many potentially hazardous factors related to the general setting of practice; to specific materials and tools that expose the operator to vision and hearing risks; to chemical substances with known allergenic, toxic, or irritating actions; to increased microbial counts and silica particles of the aerosols produced during removal of restoration; to ergonomic considerations that might have an impact on the provider's musculoskeletal system; and to psychological stress with proven undesirable sequelae.

The identification and elimination of the foregoing risk factors should be incorporated in a standard practice management program as an integral part of Dental education. Professional organizations can also assist in informing practitioners of potential hazards and methods to deal with them.

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