

# Occupational Health Problems in Modern Dentistry: A Review

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**Abstract:** 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 (including bioaerosols), radiation, dental materials, and noise; musculoskeletal disorders; dermatitis and respiratory disorders; eye injuries; and psychological problems. PEI remain a particular concern, as there is an almost constant risk of exposure to serious infectious agents. Strategies to minimise PEI and their consequences should continue to be employed, including sound infection control practices, continuing education and hepatitis B immunisation. As part of any infection control protocols, dentists should continue to utilise personal protective measures and appropriate sterilisation or other high-level disinfection techniques. Aside from biological hazards, dentists continue to suffer a high prevalence of musculoskeletal disorders (MSD), especially of the back, neck and shoulders. To fully understand the nature of these problems, further studies are needed to identify causative factors and other correlates of MSD. Continuing education and investigation of appropriate interventions to help reduce the prevalence of MSD and contact dermatitis are also needed. For these reasons, it is therefore important that dentists remain constantly informed regarding up-to-date measures on how to deal with newer technologies and dental materials.

**Key words:** Dentistry, Infectious diseases, Dermatitis, Musculoskeletal pain

## Introduction

Although modern dentistry has been described as probably among the least hazardous of all occupations<sup>1</sup>, many risks remain in dental practice which continue to challenge this status<sup>1</sup>. These include percutaneous exposure incidents (PEI); exposure to infectious agents, including bioaerosols; musculoskeletal disorders (MSD); eye injuries; vibration induced neuropathy; exposure to radiation, noise, and dental materials; and psychological conditions. Where such risks cannot be engineered out of the dental clinic, appropriate

occupational health and safety measures need to be adopted and adhered to, by dental staff. The current paper reviews studies relating to occupational health problems in dental practice, updating a previous literature review<sup>2</sup>.

## Methods

An extensive literature review was conducted which targeted all manuscripts published in peer-reviewed journals relating to the topic of occupational health problems in dentistry. Only English-language reports were included. The review itself began with a search of relevant Medical Subject Headings such as ‘occupational health’, ‘occupational

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disease', 'dentists', 'dental', 'dental hygienist' and 'dental assistant' in PubMed, the official literature search engine of the National Library of Medicine in the United States<sup>3</sup>. The focus on the present review would be occupational health problems of dentists; however there could be studies that included dentists and other dental staff. After identifying some initial studies, the search was repeated using different occupational hazards or diseases, such as 'dentistry' and 'infectious disease', 'musculoskeletal pain', 'radiation', 'biomaterials', 'dermatitis', 'asthma', 'eye disorders', and 'hearing disorders'. As there were relatively few manuscripts on this topic listed in Medline, the reference lists of journal papers located using our initial criteria were subsequently examined to find additional publications. We noted that there very few references to 'dental hygienists' and 'dental assistants' and we have therefore included these studies for comparison and completeness.

### Prevalence of Occupational Health Problems

Previous studies suggest that a wide variety of workplace risks are known to exist in dental practice (see Table 1). An earlier survey from Norway for example, found that public health dentists reported occupational health complaints such as dermatoses (40%), eye, respiratory and systemic complaints (13%), and musculoskeletal problems (3%)<sup>4</sup>. In Belgium, an investigation of Flemish dentists revealed a similar spectrum of problems but of different frequency, including low back pain (54%), vision problems (52%), allergies (23%), auditory disorders (20%), infections (9%), and diminished sensitivity at the fingertips (6%)<sup>5</sup>. Glove dermatitis and latex allergy were reported at 22% and 9% respectively, in dental personnel at a major dental school in Sydney, Australia<sup>6</sup>. In terms of injuries, percutaneous injuries comprised more than 50% of the injuries reported in a study of hospital dental personnel in Bristol<sup>7</sup>. A study in Australia found a high prevalence of musculoskeletal problems in dentists, with 64% reporting backache and 58% reporting headache during the previous month<sup>8</sup>. Similar health problems have been reported in a study of Norwegian dental hygienists<sup>9</sup>. 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<sup>4, 8</sup>, with a greater proportion of females reporting more frequent and severe symptoms of pain<sup>4</sup>, and more occupation-related health complaints in general<sup>8</sup>. A recent study of occupational accidents in an Australian dental school indicated that burns were a common workplace injury in

dental assistants, whilst percutaneous injuries were relative frequent among dental students<sup>10</sup>.

### Percutaneous Exposure Incidents

Percutaneous exposure incident (PEI) is a broad descriptive term that includes needlestick and sharps injuries, as well as cutaneous and mucous exposures to blood and serum. From an occupational viewpoint, PEI represents the most efficient method for transmitting blood-borne infections between patients and health care workers. It may be a particularly common problem in dental personnel<sup>11</sup>. Previous studies suggest that about half of all dentists report a recent PEI, particularly needlestick and sharps injuries, in both the United Kingdom<sup>7</sup> and in Thailand<sup>12</sup>. Only 14% of dentists reported needlestick injuries in the previous six months in a South African survey<sup>13</sup>. In a recent study in Queensland, Australia, the prevalence of needlestick injury (28%), in particular needlestick injury contaminated by exposure to the patient's bodily fluids (16%)<sup>14</sup>, remains relatively low compared to other published surveys of dentists<sup>7, 12, 13</sup>. Needlestick and sharps injuries were, however, found to be common among dental students in two Australian studies from Brisbane<sup>10</sup> and Sydney<sup>15</sup>, with 72% of dental students in the latter study indicating a "sharps" injury of some description during their clinical training<sup>15</sup>. Dental students and dental assistants were found to have the highest rates of exposure in a US study, mainly due to syringe needles injuries<sup>16</sup>.

The most common "sharps" injuries among dentists continue to arise from needles and drilling instruments, such as burs<sup>7, 12-14</sup>. Of concern in needlestick 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. Therefore, it is important that strict infection control guidelines are adhered to, following any "sharps" injury during dental practice<sup>17</sup>, as this has been an area previously identified as needing more effective management by dental personnel<sup>18</sup>. Prevention of PEI remains the key however, and measures such as the introduction of safety syringes, although costly, have been shown to reduce needlestick injuries dramatically in this regard<sup>19</sup>.

A recently published 10 yr review of the literature indicated that percutaneous injuries may have been steadily declining<sup>20</sup>. Nevertheless, it is important that dentists continue to follow strict infection control guidelines for glove tears, and ensure that skin cuts and grazes are covered by waterproof dressings in the event of bodily fluid penetrating the gloves<sup>17</sup>. Glove damage is commonly reported by dentists, particularly in a

**Table 1. Summary of occupational health problems in modern dentistry**

Type of risk	Occupational health problem	Agents involved
Infection	Infectious bioaerosols (from dental procedures, patients and staff, air-conditioning and the environment)	Bacteria Viruses Fungi Prions
	Infectious body fluid exposures from percutaneous exposure incidents	Hepatitis B, C & D HIV
	Respiratory and other communicable illness from patients and staff, e.g. influenza, warts, cold sores	Influenza, cytomegalovirus, measles, mumps, rubella, wart virus, herpes simplex virus
Chemicals	Toxicity from dental materials, including respiratory hypersensitivity	Mercury Methyl methacrylate Cyanoacrylate
	Toxicity from sterilisation methods	Gluteraldehyde Alcohol Ethylene oxide Iodine
	Toxicity from anaesthetic gases	Nitrous oxide Halothane
	Toxicity from airborne particulates	Mineral/fibrous dusts
	Contact dermatitis	Hand cleaning agents
	Irritation	Solvents Powder
	Allergic or latex dermatitis	Latex Acrylics Mercury Sterilising agents Medicinal agents
Physical	Ionising radiation injury	X-Rays
	Non-ionising radiation injury	Blue/Ultraviolet light
	Noise induced hearing loss	Noise
	Peripheral neuropathy	Vibration
	Burns and scald from autoclaves	Heat
Ergonomic	Musculoskeletal disorders (including back, neck and shoulder disorders)	Poor posture
	Varicose veins, haemorrhoids	Prolonged standing
	Carpel tunnel syndrome and other occupational overuse disorders	Repetitive tasks
Injury	Eye injury, conjunctivitis	Flying debris
Psychological	Stress	Surgery hours Procedural intricacy Staff and patient relationships Financial

recent study in Queensland, Australia (79% over 12 months)<sup>14</sup>, a result which is supported by other studies from the UK, where 2% of latex gloves and 5% of nitrile gloves sustained punctures following routine clinical dental procedures<sup>21</sup>. 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<sup>17</sup>.

**Infectious Diseases**

Various infectious diseases, including viruses, such as

hepatitis B virus (HBV), hepatitis C virus (HCV), Herpes B virus and, more recently, human immunodeficiency virus (HIV), bacterial, fungi, and prions may potentially be transmitted during dental procedures. These agents may be present in the saliva, blood and expired air of infected individuals<sup>22</sup>). Although there is little evidence of transmission of such viruses via aerosols causing disease amongst dentists<sup>23</sup>), viruses could easily be contained amongst the smallest of aerosols<sup>24</sup>). Needlestick and other sharps injuries and contaminated instruments also represent a cause of concern for the transmission of infectious disease, as well as bacterial and other infective splatters and aerosols generated from various sources including dental procedures, which have been reviewed elsewhere<sup>25, 26</sup>). Infection control procedures, outlined elsewhere<sup>22, 27, 28</sup>), such as attention to general hygiene, appropriate “sharps” disposal, personal protective measures, sterilisation or high level disinfection and HBV immunisation remain the best defence, not only for the dentist, but also to help prevent transmission of infectious agents between dental patients. Previous studies suggest that these infection control procedures are now being more widely adopted by dentists<sup>29</sup>); however needlestick injuries continue to occur, especially in younger dentists<sup>12</sup>), which is particularly concerning for workplace environments given that no HCV or HIV immunisation is available. Some studies suggest that about half of dentists, dental students and dental personnel<sup>6, 10, 12</sup>) report a recent percutaneous injury or exposure in the previous year.

## Sterilisation

Sterilisation or high level disinfection of equipment remains a vital part of infection control, and is especially useful to help prevent the spread of infection from patient to patient, when focusing on dental instruments. Steam, particularly via autoclaving, dry heat and chemicals remain the standard means of instrument sterilisation in dentistry, given that other cleaning methods are unlikely to decontaminate the dental instruments<sup>27, 30</sup>).

Sterilisation of hand pieces has been universally reported by dentists in different parts of the world<sup>29, 31–33</sup>). Appropriate autoclaving of dental instruments as a means of sterilisation, widely regarded in guidelines as the gold standard, has been the most commonly reported method of sterilisation reported by dentists in most studies conducted in developed countries<sup>29, 32, 33</sup>). By contrast however, a study of Thai dentists showed that they relied primarily on chemical means of sterilisation, with agents such as alcohol, glutaldehyde and iodine<sup>31</sup>), even though national guidelines

supported the use of autoclaving<sup>34</sup>). Manufacturers’ recommendations for sterilisation may, however, have had some impact on the selection of sterilisation methods, although the issue was not directly investigated in these studies.

## Personal Protective Measures

An earlier investigation of dentists in southern Thailand, where there were more than 7,000 AIDS patients and more than 3,000 symptomatic HIV patients officially reported between 1988 and 1998<sup>35</sup>), showed that the majority did not know if they had been treating patients infected with HIV or HBV<sup>31</sup>). Although not ideal, it is important that an adequate medical and dental history is taken to elucidate conditions such as these, as this has been recommended elsewhere as an integral component of infection control procedures for clinicians<sup>22, 29</sup>). In such a context, it was encouraging however to see that all dentists in the aforementioned Thai study employed personal protective measures, such as gloves, face masks, and eye protection, at least sometimes, and virtually all dentists employed gloves and face masks during dental procedures and changed gloves for each patient<sup>31</sup>). This is similar to data published previously for dentists in the United States of America (USA)<sup>29</sup>). Certified particulate respirators have been shown to have superior filtering protection compared to high quality surgical masks in the dental setting<sup>36</sup>). If masks are used, face seal masks have been shown to protect against and reduce the exposure to aerosolised microorganisms<sup>37</sup>).

The use of personal protective measures is particularly important as it is not always possible to determine HBV or HIV status from a patient’s self-reported history and / or clinical examination. In a recent study from Quebec, Canada, of those dental patients with HIV / AIDS, who had sought dental treatment since becoming aware of their positive status, only 54% reported always disclosing their HIV-positivity to their dentist<sup>38</sup>). A legal and ethical position statement of the American Dental Association suggests that dentists cannot discriminate against HIV / AIDS patients and cannot make HIV testing mandatory for patients<sup>39</sup>). Fortunately however, HIV and HBV transmission from patients to dentists remains fairly uncommon<sup>22</sup>).

Regarding vaccinations, about two thirds of the dentists in a previous Thai study reported having had HBV vaccination<sup>31</sup>), which is higher than that reported from the USA<sup>29</sup>), but lower than that for Canadian general dental practitioners<sup>32</sup>). With about half the dentists continuing to report recent percutaneous injuries<sup>7, 12</sup>), potential disease

transmission remains a concern. Interestingly, the use of eye protection was lower among Thai dentists<sup>31)</sup> compared with dentists from the USA<sup>29)</sup>, but this may be partially explained by the low percentage of Thai dentists reporting the wearing of prescription glasses<sup>31)</sup>.

## Musculoskeletal Pain

Musculoskeletal pain, particularly back pain, has been found to be a major health problem for dental practitioners<sup>8, 12, 40–44)</sup>. Several studies have reported a similar prevalence of musculoskeletal disorders (MSD) amongst dentists. In a survey of Danish dentists for example, 50% and 65% reported a one year prevalence of low back pain and neck/shoulder pain, respectively<sup>45)</sup>. A survey of dentists in Israel, similarly reported that 55% and 38% of them had experienced musculoskeletal symptoms in the lower back and neck, respectively<sup>46)</sup>. A study from New South Wales (NSW), Australia, found an even 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<sup>8)</sup>. Similarly, a 12 month period prevalence of 54% for low back pain was recently reported amongst dentists in Queensland, Australia<sup>47)</sup>. Similar health problems have also been reported during studies of dentists in the United States of America<sup>9)</sup> and amongst Norwegian dental hygienists<sup>48)</sup>. A Saudi study, however, reported a slightly higher rate of MSD among their subjects (74%)<sup>49)</sup>.

The 12 month period-prevalence of neck-related pain among Queensland dentists (58%)<sup>47)</sup>, was similar to that reported by dentists in many other countries, such as Denmark (65%)<sup>45)</sup> and Saudi Arabia (65%)<sup>48)</sup>, but higher than a survey of Israeli dentists (38%)<sup>46)</sup>. The Queensland study also examined MSD at seven other body sites, revealing that the 12 month period-prevalence of shoulder pain (53%) was as prevalent among dentists as lower back or neck pain<sup>47)</sup>. This finding is similar to an investigation of dental workers in the United States (US) military (53%)<sup>9)</sup>, as well as another study of Danish dentists (65%)<sup>45)</sup>. In addition, about one third of Queensland dentists reported hand pain<sup>47)</sup>, which is lower than the 76% of dental workers reporting one or more symptoms of carpal tunnel syndrome in the aforementioned US military study<sup>9)</sup>, although dentists were shown to incur a lower risk than either dental hygienists or dental assistants<sup>9)</sup>.

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<sup>4, 8)</sup>. Part-time dentists for example, were found in one Thai study to have a higher proportion of musculoskeletal

problems, when compared to their full-time counterparts<sup>12)</sup>. The number of years since graduation has also been shown to be negatively correlated with musculoskeletal pain<sup>12)</sup>. 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<sup>47)</sup>. This was not observed in a study of dentists in New South Wales, Australia, however<sup>8)</sup>, although female dentists were found to rate the severity of their most severe symptom higher and to report more frequent pain and headaches<sup>8)</sup>.

Possible explanations were 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 that they simply developed 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 thus not have been captured in a cross-sectional survey of dentists. This latter hypothesis is partially supported by a five year follow-up study of dentists in Sweden<sup>50)</sup>.

The proportion of dentists seeking medical attention for MSD in the previously mentioned Queensland study was 38%, which was very similar to that reported during an investigation of dental personnel in Saudi Arabia (37%)<sup>49)</sup>. Just under 10% of the Queensland dentists were found to have taken sick leave (mean = 2 wk, range 1–72 d)<sup>47)</sup>, which seems to support the findings of a five year follow-up study of Swedish dentists where dentists who had a higher prevalence of MSD were more likely to leave their profession<sup>50)</sup>. As most dentists continue to work in private clinics with regular patients, sick leave may incur a considerable impact on the economics and goodwill of some dental practices.

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<sup>51)</sup>. Prolonged static postures are thought to be associated with various MSD<sup>46)</sup>. Interestingly, analysis of loads on the wrists of Swedish dentists, suggest that their postures were constrained, but that overall dynamic loads were low<sup>51)</sup>. Previous research from the NSW survey has suggested that modification of work practices in dentistry, including taking rest breaks, does not seem to influence the prevalence of reported symptoms associated with MSD<sup>8)</sup>. A more detailed review of musculoskeletal disorders in dentistry has been published elsewhere<sup>52)</sup>.



## Radiation

Exposure to both ionising and non-ionising radiation may occur in dental practice. Radiographic equipment is commonplace in dental clinics and radiographs are an integral part of clinical assessment. As such, it is important that good radiation practice be employed to protect both the dental patient and 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<sup>53</sup>. Non-ionising radiation has become an increasing concern amongst dentists with the use of ultraviolet and blue light to cure or polymerize various dental materials, especially composite resin, bonding agents and sealants. Exposure to these wavelengths can cause damage to various structures of the eyes, including the cornea, lens and the retina<sup>13</sup>. Safety shields and glasses have been shown to be protective in this regard when used correctly<sup>54</sup>.

Risks from ionising and non-ionising radiation appears to have been effectively reduced by most dentists in a previous study from Thailand<sup>31</sup>. Although radiography techniques were not directly studied in the Thai research, most dentists appeared to take standard precautions<sup>31</sup>, as published in the literature<sup>13</sup>, when taking radiographs. Interestingly however, although most Thai dentists took their own radiographs, few knew if or checked to see if their equipment had been recently maintained<sup>31</sup>. While it may be that other members of the dental clinic team attend to these issues, it would nevertheless be in the best interests of both dentists and patients to ensure that radiographic equipment is regularly checked and maintained. As expected, ultraviolet (UV) or blue light is now reported to be universally used by dentists<sup>31</sup>. Use of these wavelengths is now commonplace to help cure or polymerize various dental materials and reduce their toxicity<sup>55</sup>. Most dentists in a recent Thai survey reported protecting their eyes with UV/blue light shields and filters<sup>31</sup>, which is recommended practice<sup>13</sup>.

## Dental Biomaterials

Aside from having adequate clinical properties, it is essential that all dental biomaterials used in restorative dentistry and endodontics be biocompatible and safe for both patients and staff. There are a wide variety of dental materials being used in current dental practice, most of which undergo an extensive range of tests both before and after use. Such items have been reviewed elsewhere<sup>56</sup>. Even so, some dental materials are aerosolised during high speed cutting and finishing and may thereby be inhaled by dental staff. Other

dental materials are volatile and may give rise to dermatological and respiratory effects.

Although amalgam containing mercury is no longer as widely used as it once was, it is nevertheless frequently encountered in dental procedures and remains a hazard for dental staff. Amalgam or “silver filling” contains a “mixture of metals such as silver, copper and tin, in addition to mercury, which chemically binds these components to form a hard, stable and relatively safe substance”<sup>57</sup>. The greatest exposure to mercury for dentists comes from handling amalgam for restorations, although storage and disposal of amalgam and amalgam capsules also represent important sources of exposure<sup>58</sup>. A recent telephone survey in Australia indicated that just over one-third of the general public remained concerned about mercury in dental fillings<sup>59</sup>, although amalgam containing mercury has been used for more than 150 yr and is generally considered safe in this form<sup>60</sup>. While concerns regarding its systemic toxicity have reduced with decreasing urinary mercury levels detected in dentists over recent years, continuing attention to mercury hygiene, particularly proper amalgam storage, handling and disposal, is essential<sup>13</sup>. Storage practices for excess mercury and excess amalgam by dentists were shown to vary in one study<sup>31</sup>, although such practices are not entirely consistent with guidelines published elsewhere, where it was advised that materials be stored in a closed container under a radiographic fixer<sup>13</sup>. Most dentists in a previous Thai study reported using sealed mercury amalgam capsule systems, at least sometimes, however the disposal of these capsules in the bin by nearly half of them, mainly in the older age groups<sup>31</sup>, may warrant further investigation. 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 effective than mercury amalgam<sup>60</sup>.

## Dermatitis and Respiratory Hypersensitivity

Occupational hand dermatitis has been shown to be a particular problem for dental personnel, who are commonly effected<sup>61</sup>. The two main forms of dermatitis are contact dermatitis and atopic dermatitis, and the prevalence of dermatoses among dentists varies across a number of studies from about 15% to 33%. Around 15% of dentists reported hand eczema in a previous Swedish survey<sup>62</sup>. More than one fifth of dentists (22%) reported occupational contact dermatitis in a study from Thailand<sup>12</sup>, while one third of dentists reported symptoms of hand dermatoses during the previous 12 months in New Zealand<sup>63</sup>, UK<sup>64</sup>, and

Queensland, Australia<sup>65</sup>). A study of dental hygienists in Norway also found similar results<sup>9</sup>.

Occupational hand dermatoses are not exclusively related to latex allergy; however, with two recent studies suggesting that only about 4% to 6% of dental personnel actually test positive to latex<sup>66, 67</sup>). Allergy to latex gloves is the most frequently reported cause of dermatitis in dental personnel in various studies around the world<sup>12, 61, 68-70</sup>). A previous American study found a 15% prevalence of adverse reactions to latex gloves in a major dental facility<sup>70</sup>). True latex allergy had been medically diagnosed in only 2% of dentists in a previous study of dentists, which is lower than other investigations where between 4% and 10% of dental personnel and senior dental students tested positive to latex allergy<sup>66, 67, 71</sup>). Even so, formal testing of all dentists for latex allergy, if it were conducted, would probably yield much higher prevalence rates of latex allergy. Dermatitis may also result from exposure to various chemicals and dental materials, such as methyl methacrylate and cyanoacrylate, both of which have been reviewed elsewhere<sup>31, 72</sup>). Potential irritants and allergens used in dentistry have also been described in other articles<sup>73</sup>).

Regarding gender, the prevalence of occupational dermatoses symptoms which occurred more than once over the previous the previous 12 months was found to be higher among females, as well as younger and less experienced dentists, in the aforementioned Queensland study<sup>65</sup>). This is consistent with a New Zealand study<sup>63</sup>). In Queensland Australia, dentists with a history of allergic conditions were shown to have a higher prevalence of hand dermatitis, as defined by the diagnostic criteria described by Smit *et al*<sup>74</sup>). Again, this is consistent with the aforementioned New Zealand dentists' study<sup>63</sup>). Sinclair *et al.* also found that New Zealand dentists, who had hobbies involving the use of solvents, were 11 times more likely to have experienced symptoms<sup>63</sup>). Solvents are known to be important irritants in the investigation of occupational dermatoses in dentists<sup>73</sup>).

A study of adverse glove reactions among dentists in the United Kingdom indicated that most could be managed by self-medication, prescribed medication and / or changing to a different type of glove<sup>75</sup>). Successful preventive programs have also been instituted to reduce the incidence of allergy to latex and dental materials, such as acrylates, in dental personnel<sup>76</sup>). Nevertheless, it is important to accurately diagnose occupational latex allergy, and as such, any dentists with a provisional diagnosis of this condition should be promptly referred for detailed allergy testing. The topic of occupational skin allergy and its management in dental personnel has been reviewed elsewhere<sup>77</sup>).

Respiratory hypersensitivity represents another occupational health issue for dentists, with a Finnish investigation suggesting that its prevalence among dental personnel may be increasing<sup>78</sup>). The causes of respiratory hypersensitivity amongst dentists include MMA, latex, and chloramine-T (sodium-N-chlorine-p-toluene sulphonamide)<sup>78</sup>). Trace toxic metals such as beryllium, may also be generated from dental materials which contain alloys of beryllium<sup>61</sup>). Similar respiratory effects were also noted in a Finish study of dental assistants, who were exposed to methacrylates<sup>79</sup>). In these cases, adequate ventilation of the dental clinic should be employed to help prevent exposure and irritation of the eyes, respiratory tract and skin<sup>61</sup>).

## Eye Problems

Few studies have examined eye problems among dentists, although eye problems were shown to be fairly common among respondents in a study from Thailand<sup>12</sup>). Most eye problems were commonly seen in the general community however, and were probably not occupationally-related<sup>12</sup>). None-the-less, such conditions may affect the work of dentists or at least be aggravated by their occupation. The topic of occupational eye injuries in dentistry is one that clearly requires further study. Some earlier research for example, suggests that eye injuries amongst dentists may be as high as 10%<sup>7</sup>), although a Saudi investigation found a one month prevalence of 42%<sup>79</sup>). A study in Australia suggested a continuing but low prevalence of eye injuries amongst dental students and assistants<sup>10</sup>). From a preventive point of view, the regular use of eye shields and goggles has been shown to reduce this problem<sup>80</sup>). Use of eye protection by dentists was found to be as low as 57% when using laboratory cutting equipment in one UK study<sup>81</sup>).

## Hearing Problems

Few dentists in a recent study reported any hearing problems<sup>12</sup>), and few dentists report using personal protective measures against noise<sup>31</sup>). The noise levels of modern dental equipment have now generally fallen below 85 dB(A), the widely used benchmark standard, below which the risk of hearing loss is believed to be minimal<sup>82</sup>). Even so, some dentists may still be at risk, particularly where older or faulty equipment is used.

## General Health and Stress

Dentists tend to have a lower mortality rate than

comparable professions in western countries, however they continue to succumb to similar causes of death, namely cardiovascular disease, cancer and suicide<sup>1</sup>). The risks of mortality from these conditions is probably slightly higher than the general population<sup>1</sup>). Premature retirement from the dental workforce may also result from conditions such as musculoskeletal disorders, stress and cardiovascular disease<sup>83</sup>). The most common causes of impairment among dentists are believed to be cognitive impairment, physical disability, chemical dependency, other addictions, and mental illnesses<sup>84</sup>). Although dentists are generally regarded as healthy and miss very few workdays during their working life compared to other workers<sup>85, 86</sup>), illnesses and time off for illnesses have been found to increase with age<sup>86</sup>). Common causes of morbidity in dentists, often related to their occupation, include musculoskeletal disorders<sup>12, 87, 88</sup>), stress<sup>85</sup>), alcohol and drug abuse<sup>85</sup>), and headaches, especially amongst female dentists<sup>85</sup>). It has been noted however, 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 workloads<sup>88</sup>). Despite this fact, exercise rates were reported to be quite low in one group of Thai dentists<sup>89</sup>), who also had a high prevalence of musculoskeletal disorders<sup>12</sup>).

Stress amongst dentists is thought to result from many sources, including job satisfaction, business income, working hours, as well as staff / patient interactions<sup>1</sup>). Job dissatisfaction has been described in about one-third of British dentists<sup>1</sup>). A study of Californian dentists suggested that, while dentists were satisfied, levels of satisfaction varied considerably<sup>90</sup>). In a University of Iowa study, where more than half the dentists were apparently satisfied with their career, job satisfaction appeared to be best predicted by factors such as income, respect, and patient relations<sup>90-92</sup>). 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<sup>90-92</sup>). Working hours also tend to be longer amongst dentists than the standard working week of around 35 h<sup>93</sup>), although many female dentists in one South African study helped alleviate this problem by moving to part-time practice once they had started a family<sup>94</sup>). On the other hand, working hours may have increased from what was reported to be an average working week for dentists more than 30 yr ago<sup>94</sup>). As such, dentists tread a fine line between maintaining income and maintaining professional and technical standards<sup>1</sup>).

Regarding substance use, the most commonly reported cause of impairment amongst dentists is chemical

dependence<sup>84</sup>). Cigarette smoking has dropped dramatically amongst health professionals, including dentists, in recent decades<sup>1, 95</sup>), although rates of smoking amongst dentists from some countries still remains very high<sup>95</sup>). Most dentists report use of alcohol and / or other drugs in moderation, although male dentists were more likely to consume alcohol in one previous study<sup>85</sup>). Similar to their community counterparts, rates of alcohol consumption vary greatly between dentists of different countries<sup>1, 89</sup>). Although alcohol is the most widely abused drug reported among dentists and rates of alcoholism in the profession have been estimated at about eight percent<sup>1</sup>), increasing abuse of other drugs of dependence is becoming a growing concern in dental practice<sup>1</sup>). An approach to drug dependent dentists and how to alleviate this problem has been discussed elsewhere<sup>96</sup>).

The reported low prevalence of haemorrhoids (8%) and varicose veins (3%) previously reported among a population of Thai dentists should be interpreted in the context of a relatively younger population<sup>89</sup>). Despite anecdotal evidence of these conditions being more common amongst dentists, there has been little published with specific reference to dentists<sup>97</sup>). Dentists are also prone to contract common illnesses from patients, such as sore throats and common colds, possibly as a result of infective bioaerosols in the dental clinic, which have been discussed in more detail elsewhere<sup>25</sup>). A review of the general health of dentists has also been published elsewhere<sup>98</sup>).

## Other Risks

There are a number of other occupational risks described in the literature. Probably among the best known of these is the risk of waste anesthetic gases in the dental clinic<sup>61</sup>). In this regard, high levels of anesthetic gases, such as nitrous oxide, have been measured in the dental clinic during dental procedures<sup>99</sup>). Concerns have also been raised that high levels of ambient gases may impair performance and the well-being of those exposed<sup>61</sup>). It is important therefore, that appropriate measures be taken to reduce the release of residual gas during dental anaesthesia, all of which have been described elsewhere<sup>61</sup>).

Mild neuropathy among dental personnel has been shown to be associated with exposure to high frequency vibrations from dental equipment<sup>100</sup>), particularly low and high speed hand pieces and ultrasonic scalers. This condition was previously shown to manifest as diminished sensitivity of the fingertips in a study of Flemish dentists<sup>5</sup>). The development of more vibration resistant equipment might help overcome this problem, although reducing vibration



levels is not a panacea in itself, as it may adversely affect tactile feedback from dental hand tools.

## Conclusions

As this review has shown, many occupational health problems remain in modern dentistry, particularly MSD, PEI, and contact dermatitis. PEI remain a particular concern for dentists, who may be exposed to serious infectious agents. Continuing education in the avoidance of PEI and other hazards would be beneficial across the entire dental profession, and dentists should continue to obtain HBV immunisation as well as utilising personal protective measures and appropriate sterilisation or high level disinfection techniques. Further studies are needed to identify causes of MSD and to identify appropriate interventions to help reduce the prevalence of MSD. It is also important that dentists remain up to date regarding clinical guidelines in the safe handling of mercury, radiation, and some of the newer dental materials.

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