Review Article

OCCUPATIONAL HAZARDS AND THE PRACTICE OF PROSTHETIC DENTISTRY

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The risks to the dental team from the increasingly hostile oral environment are now well recognised and publicized in the dental literature[1,2] principally because of increased public and professional awareness of the potential dangers of cross infection involving HBV and HIV viruses[3,4]. Whilst it is difficult to separate the hazards of prosthetic dentistry from those of dentistry in general, some specific hazards exist. The prosthetic surgery and laboratory are places where there is always some handling of irritant chemicals, high speed rotary equipment and inflammable materials. In addition to these, most if not of all of the hazards applied to dentistry in general also apply to a greater or lesser degree to prosthetics. Although the hazards of general dentistry have received great attention from the profession,[5,6,7] little, if any reference, can be found in the dental literature related to the practice of prosthetics. In a short review article such as this, the subject can not be covered in the detail it deserves, consequently only the most relevant and specific hazards applicable to this speciality will be described. However, it should be noted that the distinction made in this article is an artificial one based on personal experience and that everyone should employ precautionary measures when treating all patients in the surgery and when the related procedures are carried out in the laboratory.

Hazards Involved with Prosthetic Practice

For the purpose of simplicity these hazards can be classified as follows:

A. Physical Hazards
B. Chemical Hazards
C. Biological Hazards

A. Physical Hazards

Physical hazards associated with prosthetics include direct physical trauma, explosions, electric shocks, fire and burns, eye damage, acoustic trauma, entanglements, and bad working posture. The majority of these are preventable through sound working practices, staff education and training. Dentists and laboratory managers are directly responsible for the health and safety of their patients and staff, and are legally bound to provide education and adequate protection to them[8].

Direct physical trauma may be in the form of skin cuts, bruises, abrasions and their most common cause is the misuse of instruments and equipment.

The use of a chisel where a plaster knife should be used or vice versa is a commonly seen event in dentistry. Direct physical trauma could be harmful if of sufficient severity. It can also act as a possible portal of entry for infection or toxic material. Other causes of sustaining direct physical trauma include high speed projectiles from fractured burs, polishing and trimming of dentures.

The prosthetic surgery and laboratory present a fire hazard and burns are not uncommon. These occur from marked flames (e.g. hair over a bunsen burner), careless handing of hot instruments, wax splashes (e.g. sticky wax and greenstick), scalds from boiling water and steam, spontaneous ignition of inflammable materials (e.g. monomers, spirits, gases), solders and molten metals (during casting procedures) and the accidental burning of rubber gloves. Fire is an often ignored risk in dentistry. Risks can be minimised by the use of flameproof materials e.g. benches and worktops, by employing no smoking rules, by provision of accessible and appropriate fire extinguishers, rubbish clearance, utilizing well marked fire exits, and regular practice of routine fire drills. The inspection of premises at regular intervals by a fire safety officer is recommended.

While there is always danger of serious explosion in a prosthetic environment because of storage and handling of inflamable chemicals, very little attention has been paid in the past to prevent these events. The main causes of an explosion are gas leaks, unattended bunsen burners, combustible vapours (e.g. acrylic monomers), poorly supervised portable gas bottles and the injection moulding of polycarbonate denture base material. Incidents such as the death of one technician because of explosion of an accumulated methylmethacrylate monomer and the destruction of the dental laboratory in UK, because of an overnight gas leak which lead to explosion, suggest that members of the dental team are at more risk from explosion than from HIV infection.

Because of the constant need to use electrically powered equipment, the risk of electric shock is an ever present possibility in dentistry. However, these dangers can be avoided and/or reduced by:

1. The intelligent placement of electric sockets, away from wet areas.
2. The isolation of switches in areas where water must be near to electrical supplies e.g. lathes and grinding equipments.
3. The use of circuit breakers and the minimal use of extension cables.
4. The use of rubber soled foot wear.
5. The use of rubber gloves.
6. Education and awareness, including first aid instruction.

Traumatic injury to the eyes can be disabling and can end a dental career. The effects can range from mild irritation through corneal abrasion, ulceration and retinal detachment, to complete blindness. In 1978, the American Dental Association[9] reported 17 cases of dentists suffering major eye damage from contusions, infections and perforations, of which 3 resulted in complete loss of an eye.

The main causes of sustaining injuries to the eyes include:

1. The use of high/medium speed rotary instruments which can generate projectiles at 30 ft/second which are often hot, sharp, irritant and infected. These include restorative materials, fractured burs and denture base and impression tray trimmings.

2. The passing and manipulation of instruments and materials.

3. Polishing and prophylaxis.

4. Bright light sources e.g. light curing and welding.

Every preventive measure should be employed to avoid such incidents. Protective spectacles or eye goggles should be used during work. The risks of eye strain are underestimated and the use of good illumination and regular eye testing are advised. Loupes and other magnification aids are also helpful to prevent eye strain[10]

Hearing

Most published works have mentioned the effects of high speed air turbines on hearing[11]; however, the noise levels and sound frequencies produced in surgery and particularly in the laboratory may also be harmful, when finishing cast metal denture frameworks. Risk depends upon susceptibility, total daily exposure and the make of handpiece used. To avoid any danger ear protection should be worn during these procedures and hearing tests at least once a year are recommended[12,14].

Entanglement

Fatal and serious injuries have arisen from the entanglement of ties, loose clothing and hair in rotary equipment e.g. lathes. Therefore, all long hair and loose clothings should be restrained or covered and protective shields should be fitted to all such equipment.[15]

Posture

Improper working posture is another serious health hazard related to the pracrice of prosthetics. Most dentists undergo bodily strain while working, especially during precise work. This can lead to tiring, musculo-skeletal strain and damage. When body balance is disturbed through forward movement of the arms, the spine and discs can be strained inappropriately as a result of the muscle contractions required for back support. Furthermore, prolonged muscle contractions can impede blood circulation and elicit fatigue and pain. Protective measures include retention of the vertical line of the body and good working posture which can be summarized as follow:

1. As for as possible work while seated.

2. Maintain an upright posture while working in a standing position.

4. Feet should lie flat on the floor.

5. The head should be tilted slightly forwards.

6.The upper arms should hang close to the body.

While seated dentistry has become popular, there is a tendency for many prosthodontists to adopt a standing posture, with varying degrees of stoop and rotation. These may lead to lordosis and kyphosis. Prolonged upright working can lead to venous pooling and varicosities in the legs and feet[16]. Changing position from seated to standing and vice-versa throughout the day with limited spinal rotation seems to be the key to avoiding occupational back trouble. Furthermore, these problems can be reduced by stretching exercises.

B. Chemical Hazards

Most chemicals and materials used in prosthetic dentistry have harmful effects, when ingested or inhaled. They may act locally, systemically or genetically having immediate or delayed effects. They may cause damage to the eyes, irritate skin and muscosal surfaces of the body and can elicit hypersensitive and allergic reactions. Their prolonged contact may even lead to carcinogenesis. The dangers of respiratory disease in dentistry in general and in the laboratory in particular, are greatly underestimated as illustrated by events such as the death of technicians from pneumoconiosis.

Postmortem examination of one lady technician revealed that her lungs contained extensive deposits of aluminum, silica, chromium and cobalt[17,18]. Some of the known materials causing these harmful effects which will be discussed include metal alloys, fluxes, waxes, asbestos, acids, cyanide, impression materials (alginates and elastomers), tissue conditioners and polymeric denture base materials.

The use of metal cast denture framework is becoming increasingly popular. However, they can pose hazards to dentists and technicians during casting and finishing of the frameworks. Two of the most common constituents for these alloys are nickel and chromium and they are present in high proportions in dental alloys. Nickel and chromium are known potential carcinogens. Nickel has been associated with nasal cancer in workers exposed to this metal and similarly hexavalent chromium compounds are associated with lung cancer. In addition to these, both metals can provoke skin irritation, sensitization and hypersensitivity. Although beryllium has now been excluded as an ingredient from most dental alloys, some alloys still have traces of this element. Its particles and fumes are particularly harmfull to respiratory tract, circulatory system, liver and kidneys.

Exposure to airborne metal particles liberated during finishing of the metal denture framework should be minimised by the use of masks, gloves, spectacles and powerful ventilation and extraction systems. Grinding in the mouth should be avoided as should eating, smoking and drinking in the laboratory and surgery[19]. Soldering fluxes used in dentistry contain borax, boric acid, silica and potassium fluoride. They are known irritants to living tissues, particularly potassium fluoride, which evolve fluorides upon heating. When inhaled, they can be very harmful. Similarly asbestos fibres are released into the air when divesting asbestos casting rings liners. Exposure to these fibres over prolonged periods can lead to pulmonary asbestosis and fibrosis and carcinoma of the lungs. It has been recommended to use kaoline type ring liners instead of asbestos containing liners[20] and the use of a closed shield with powerful ventilation during divesting of the castings.

Dental waxes are one of the most commonly used materials in the construction of appliances and are therefore, most frequently handled by the dentists and technicians. Their effects can be harmful to the skin and dermatitis induced by some of these materials such as paraffin, beeswax, carnuba, candelilla and petroleum has been associated with their handling over prolonged period of time.

Chemicals such as phosphoric acid and acid copper sulphate solutions have various uses in the laboratory and surgery. They are used for etching teeth and metal components. Being very toxic and irritant to the living tissues, their mishandling can bring injuries from minor irritation to severe burns of the skin and eyes.

An alkaline solution of silver cyanide and potassium cyanide is commonly used during electroplating of polysulphide and other elastomeric impression materials. If by chance, an acid comes into contact with the above solutions, hydrogen cyanide gas will be produced, the potentially lethal effects of which are very well known. Therefore, these solutions should be kept in fume cupboard well away from all acids. Furthermore, if avoidable, silver plating of impressions should be discouraged.

Occupational hazards associated

with the use of impression materials have also been noted. Every effort should be made to discourage the inhalation of alginate powder dust, because of its tendency to moisten and set on the respiratory epithelium. Some alginate powders have also contained lead as a constituent. Such products should never be used because of the toxic nature of lead. Lead-free and dust-free alginate impression materials are available to the profession. Dust-free alginates have been produced by coating alginate with glycol. Metal compounds are also used in some elastomeric impression materials e.g. lead oxide in polysulphide material and dibutylt in laurate as an activator in some silicones. Prolonged and repeated contact with these materials lead to cause sensitivity.

Similarly, toxic and allergic reactions have been reported with the use of tissue conditioners (Visco-gel), polymeric denture base materials (polycarbonate) and epoxy resins. During mixing, packing and finishing of acrylic resins, unpolymerized monomer vapours are released to the surroundings and are inhaled. Apart from being inflammable and explosive, it is a known causative agent of contact dermatitis. The levels of monomer in the air have been found to be unascceptabbly high in the dental laboratory[8,19,20]. It has been suggested that whilst general laboratory air contains about 8% of the threshold limit value (TLV) of 100 ppm, the operator's breathing air while mixing acrylic contains between 75 -152 % of the TLV. However, the installation of a fume cup-board reduces the ambient monomer level to 2% of the TLV.

C. Biological Hazards

A patient attending the surgery for treatment can be source of harmful micro-organisms for dental personnel and various studies have shown that the risk of hepatitis B infection is very high among the dental profession[21] and some dentists have been infected with HIV virus[22]. The pathogenic micro-organisms present in saliva, blood, gingival exudate and tooth debris from the mouth of a patient can be disseminated by:

1. Direct contact with the dentist's fingers and instruments.
2. Aerosols.
3. Droplet splatter.
4. Impressions.

Miller et al[23] demonstrated that aerosols can arise from coughs and sneezes, the use of air rotors, air water sprays, brushes and ultrasonic equipment. Many types of micro-organisms and their attendant diseases found in the patient's mouth can be transmitted to the dental personnel and this underlines the need for appropriate clinical procedures to prevent cross-infection.

Samples taken from laboratory polishing areas have shown a large reservoir of pathogenic non-oral bacteria and fungi in pumice slurries and on rag wheels. The use of a phenolic disinfectant such as Hycolin (William Pearson Ltd, Hull, England, UK) instead of water is recommended for the preparation of polishing slurries. Hycolin is a phyenolic disinfectant containing 16 percent of a mixture of chloroxylenol, chlorophene, sodium ophenylphenate and sodium pentachlorophenate in a base of anionic emulsifier and alcohol. The use of gloves, spectacles, face masks, effective sterilization, disposable needles, HBV vaccines, and detailed screening of patients by a through medical and dental history are advised in the BDA guidelines[3].

The spread of infection in prosthetics may occur via contaminated impressions and prostheses. Large number of micro-organisms have been isolated from impression materials contaminated impressions and

prostheses. Large number of microorganisms have been isolated from impression materials contaminated with saliva from healthy patients.[1] All impressions should be properly disinfected before sending to the laboratory. The use of a newly available alginate material containing an antiseptic agent has been found very effective compared to impressions taken in the plain alginate and disinfected by immersion in 1% Hycolin solution for one minute.[1] Other impression materials must be properly disinfected in a similar way before they leave the surgery.

CONCLUSION

The nature of prosthetic practice is such that much of our work must in some form leave the surgery and travel to the laboratory, thereby widening the circle of contact of potentially harmful agents. Furthermore, many of the materials and procedures minimized by correct procedures, appropriate laboratory and surgery design and equipment and staff education and training. Decontamination should take at source i.e. at the chairside to eliminate the chance of infection spreading beyond the clinical area in order to protect any one subsequently handling these materials. The dental laboratory and surgery will never be completely safe environments physically, chemically and biologically but dentists and laboratory managers must do all they can, to minimize the hazards.

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