Dentistry
ISSN: 2161-1122

Chugh, Dentistry 2017, 7:2
DOI: 10.4172/2161-1122.1000410

Review Article OMICS International

Occupational Hazards in Prosthetic Dentistry

Anshul Chugh*

Department of Prosthodontics and Implantology, Government Dental College, Medical Campus, Rohtak, Haryana India

***Corresponding author:** Anshul Chugh, Assistant Professor, Department of Prosthodontics and Implantology, Government Dental College, Medical Campus, Rohtak, Haryana, India, Tel: +911262213009; E-mail: dr.anshulchugh@rediffmail.com

Received date: January 17, 2017; **Accepted date:** January 28, 2017; **Published date:** February 04, 2017

Copyright: © 2017 Chugh A. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Abstract

Dental and dental personnel's are constantly exposed to a number of specific occupational hazards. This article analyze the potential hazards and various risks involved in persons exposed to prosthodontic practice mainly prosthodontist and the laboratory technicians. These risks include exposure to chemical, physical hazards, infectious environment, psychosocial hazards and various others. Personnel's working in the prosthodontic clinic should be aware of the specific risk factors and take necessary measures to prevent and overcome these hazards.

Keywords: Health hazards; Occupational hazards; Stress; Infectious disease; Control measures

Introduction

Dentists are usually exposed to a number of occupational hazards during their professional work. Occupational hazards can be defined as a risk to a person usually arising out of employment. It can also refer to a work material, substance, process or situation that predisposes or itself causes accidents or diseases.

Dental work setup poses many risks to the dentist and other employees. The developments happening in the Prosthodontics is characterized by an increasing number of new prosthetic materials. Prosthodontics practice requires contact with restorative and auxillary dental materials of widely different composition such as metals, resin based synthetic polymers, dental ceramics etc.

The nature of prosthetic practice is such that much of the work must leave the clinic in some form and travel to the laboratories, thereby widening the circle of potentially harmful agents [1,2].

The potential risk to irritant chemicals, inhalation of vapours, dust particles, injury from high speed rotary equipments and flammable materials always exist in prosthodontic practice. Thermal injuries from autoclaves, Bunsen burners, furnaces can happen very commonly. Methacrylates, rubber gloves, allergens, natural rubber latex, gluteraldehyde etc. are potential allergens that leads to various dermatological reactions and respiratory illnesses in susceptible individuals [3-5].

Materials and Method

An electronic search of dental literature was done through Google Scholar and PubMed to obtain all the essential studies and reviews containing information regarding prosthodontic health hazards and risks. The key words used for the search were occupational hazards, risk to various dental materials, noise pollution, biological hazards, ergonomic hazards. In this paper all the information collected from studies and reviews is arranged in a contextual manner for better understanding of potential hazards ad risks in Prosthodontics [6,7].

Occupational hazards in prosthodontic practice may be broadly classified as infectious, non infectious, psychosocial and ergonomic (Figure 1).

Physical Hazards

Physical hazards associated with prosthodontic practice include direct physical trauma, fire and burns, acoustic trauma, eye damage and various problems associated with bad working posture. The direct physical trauma includes accidental skin cuts, abrasion which is mostly due to the misuse of instruments and equipments. This kind of trauma can act as portal entry for infections or toxic materials.

According to a study, Prosthodontists has the second highest prevelance rate of 4.5% annually for the percutaneous injuries [8].

The second most common injury in a prosthodontic clinic or laboratory are burns from Bunsen burners, spirit lamps, blow torches, careless handling of hot instruments, wax splashes, spontaneous ignition of inflammable materials, use of solders and molten metals [9-11]. This can be minimized by the use of flameproof material by provision of accessible and appropriate fire extinguishers and regular practice of routine fire drills.

Eye injury is another associated hazard that has been attributed to the use of high speed cutting tools. The effect can range from mild irritation through corneal abrasion, ulceration to complete blindness [12]. Common causes include use of high speed of rotary instruments which generates the projectiles at 39 m/second which are very hot, sharp and infected [13]. Painful reactions are elicited when materials like methyl methacrylate monomer, spirit are accidently splashed into the eye. Pumice containing lime or quartz can also lead to pain and corneal abrasion.

Blue curing light used for polymerization of restorative resin material range from 400-500 nm wavelength which is also associated with corneal damage and abrasion. The effect of blue light can be cumulative or acute depending upon its nature and duration of use [14,15]. Exposure to blue light usually leads to acute injuries. According to a report, there is increase ocular injury risk at 440 nm of wavelength. Possible precautions which can be taken to protect one self is use of protective glasses, goggles and loupes [16].

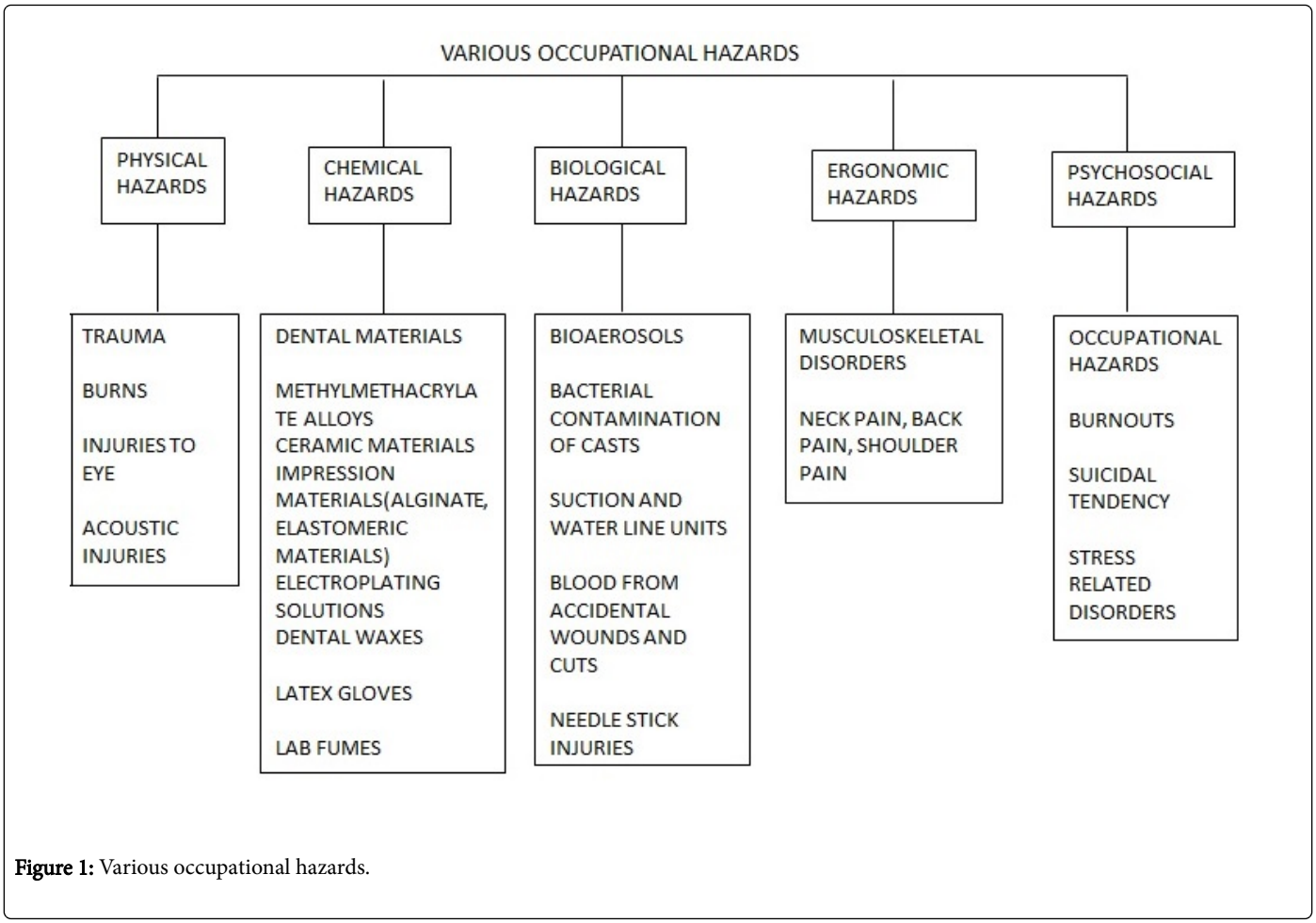

Figure 1: Various occupational hazards.

Acoustic Injuries

Dentist had always been an occupational interest in the subject of of Noise Induced Hearing Loss (NIHL). This is due to use of high speed turbine dental drills used during surgeries, Ultrasonic instruments, high velocity suctions, cleaners, model trimmers etc. [17]. They emit sound ranging from 66 db to 91 db. The first conclusive evidence that damage to hearing can result from exposure to this noise was published by Taylor and co-workers in 1965 in a carefully controlled study of dentists. It has also been estimated that most turbine users are exposed to high speed hand pieces ranging from total on times of 12 min or 12-45 min to 10 min per hour. It is estimated that sound energy contribution of a typical dental practice is about 8% of dentists average 24 hours noise exposure [18,19].

Loss of hearing and tinnitus are the common side effect of noise beyond the permissible levels in a setup. Risk depends upon the susceptibility of a particular individual, total daily exposure and type of instruments used. Ear protection should be worn during the procedures and hearing test atleast once a year should be recommended.

Chemical Hazards

Prosthodontists deals with new materials everyday. A wide variety of materials are available used in dentistry today. Most chemicals and materials used in clinical prosthodontic practice and in the laboratory have harmful effects when ingested or inhaled. They may act locally, systemically having immediate or delayed effect (Figure 2).

Methylmethacrylate

Polymethyl methacrylate resin contains accelerators, co-polymer like butyl methacrylate, plasticizers like di-butyl phthalate and cadmium salt based colouring agents. This usually do not pose a threat to the patient but often have deleterious effect on the dentists and technicians during packing, grinding and finishing prosthesis.

Methylmethacrylate enters body in vapour form during inhalation or from direct contact through skin. Most common side effect is irriatation to eyes, skin, throat, lungs or even our nervous system. Methyl methacrylate vapour in the air at the level of 125 ppm may cause teary eyes, sore throat and coughing [10,20]. Direct skin contact can cause itching, burning, redness, swelling and cracking of the skin. There are various reports that prolong skin contact with MMA may cause tingling, numbness or whitening of the fingers. MMA can easily penetrate clothing and even surgical gloves [21].

Overexposure to MMA can effect our brain and symptoms include headache, drowsiness, nausea, weakness, fatigue, irritability and dizziness. In recent studies on animals, MMA did not cause cancer and whether it can cause cancer in humans is not known.

Legal exposure limits-California Division of Occupational Safety and Health has adopted a Permissible limit for the amount of Methyl

methacrylate that is 100 parts of MMA per million parts of air which is equal to 410 milligram of MMA per cubic metre of air (410 mg/m^3). Average exposure for any 8 hour work shift is 100 ppm or less [22,23].

Methods to reduce the exposure-Substitution- The most effective way to reduce effect of any chemical is to substitute it with a safer chemical.

Engineering controls: These include installing ventilation system at the workplace and laboratory. Containers should be tightly covered and can be installed enclosed to reduce exposure.

Personal protective equipments: If frequent or prolonged skin contact with MMA is necessary then protective equipments such as gloves, goggles or face shield should be worn. Even the most resistant materials will be penetrated quickly, so gloves should be replaced often.

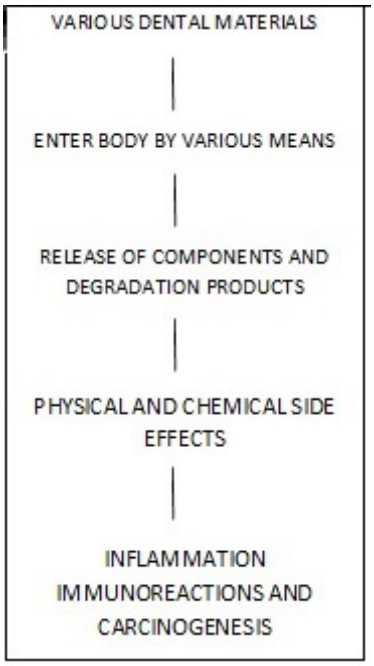

Figure 2: Chemical hazards.

Metal alloys

Metal alloys pose hazards to dentist and technicians during casting and finishing of the metal restoration and frameworks. Two of the most common constituent for these alloys are nickel and chromium which are known to be potential carcinogens. Nickel is associated with nasal cancer and chromium with lung cancer in workers exposed to these metals [24]. Both of these metals can provoke skin irritation sensitization or hypersensitivity reactions. A study reported that 53 out of 70 dental technicians were affected by pneumoconiosis which could be due to dust from processing of these dental materials [25].

Beryllium one of the metal in base metal alloys used to lower the melting temperature, lower the surface tension and increase the porcelain metal bond strength. Exposure to its particle or fumes is associated with contact dermatitis and chronical granulomatous lung disease called as Chronic Beryllium disease (CBD) [26,27]. It has also shown to be carcinogenic based on human epidemiologic models and tumors like lung carcinoma and osteosarcoma are linked to it. The risk is greater during casting process in the absence of adequate exhaust and filteration system.

Exposure to these airborne particles liberated during melting, grinding, polishing and finishing procedures should be minimized by the use of gloves, protective glasses and powerfull ventilation systems.

Dental waxes

It is one of the most commonly used material for construction of appliances in prosthodontic dentistry. Skin irritation and dermatitis can be induced by prolonged handling of some materials such as paraffin, beewax, carnuba wax.

Ceramic materials

These are generally considered as inert but dust from these materials during handling, manipulating and finishing the restoration represent a potential problem for laboratory and clinical personnel. NOISH recommend exposure limit to these particles as limit of 0.05 mg/m^3. Inhalation of these particles may lead to silicosis [20].

Impression materials

Irriversible hydrocolloids: It consist of about 60% of diatomaceous earth. These particles of less than 3 μm in diameter and greater than 20 μm in length can be inhaled while manipulation and may prove to be carcinogenic over a long time span. So dust free and lead free alginate materials should be used [28,29].

Elastomeric impression materials: Roberta et al. tested polyethers and vinyl polysiloxanes for cytotoxicity and showed polyerhers to be more cytotoxic than vinylsiloxanes.

Electroplating solutions

An alkaline solution of potassium cyanide and silver cyanide is commonly used for electroplating of polysulphide and other elastomeric impression materials. Cyanide is known harmful agent to the body and if it comes in contact with acids by any chance will lead to production of hydrogen cyanide gas which is potentially lethal. These solutions should be kept away from all acids and if avoidable silver plating of impressions should be discouraged.

Latex gloves

Latex gloves are more often used in dental practice. They are dusted with cornstarch powder which is often allergenic and give immediate allergic reactions. In vitro evaluation of natural latex, synthetic rubber and polymeric glove material showed various degrees of cytotoxicity. Nitrile gloves or polyvinyl gloves should be used which possess lesser risk [26].

Dental cements

Eugenol is one of the most cytotoxic and allergic substances known used in dentistry. Clinical reports have indicated high frequency of postulating sensitivity with Glass Ionomer cements. A recent clinical study of pulp sensitivity following cementation with zinc phosphate and glass ionomer cements showed less sensitivity to zinc phosphate than glass ionomer during the first 2 weeks, but after 3 months there

are no differences. Modern resin based luting cements are also well tolerated to pulp.

Biological Hazards

Bacterial contamination from spatter and aerosol dissemination generated at high speed instrumentation remains as a significant risk to dental personnelsApart from the microorganism contamination, the composition of the aerosol produced is also great concern. The size of particles ranges between 2 to 30 µm and can lead to many respiratory ailments as they can reach to alveoli [27,28].

The common entry point of infection for a dentist include epidermis of hand, oral and nasal epithelium conjunctival epithelium and epithelium of respiratory tract including trachea, bronchus and alveoli.

Contaminated impressions are another common site of infection in Prosthodontic practice. McNeil et al. stated that impression material act as a vehicle for the transfer of both pathogenic bacteria and virus and cause cross contamination in the clinic and the laboratory.

Other possible sources of infectious contamination are dental unit waterlines, hand pieces, saliva ejectors, suction tubes, airotors and hand pieces and radiological instruments. Dental unit waterlines pose as a threat as it may harbor opportunistic and respiratory pathogens such as Legionella species, mycobacterium species and Pseudomonas species.

Ergonomic Hazards

Ergonomic hazards constitute a physical factor within the environment that harms the musculoskeletal system. Dental professionals are commonly affected with musculoskeletal disorders in their career. Common symptoms of MSD's are presence of discomfort, disability or persistent pain in joints, muscles, tendons and other soft tissues.

Prosthdontists are at high risk of neck and back problems due to limited work ared associated with oral cavity. These working restrictions cause them to assume stressful body positions to achieve good access and period of time which in turn lead to symptoms like low back pain, stiffness, tingling sensation and parasthesia and muscle weakness. Repetitive and forceful use of vibrating tools increases the fluid accumulation and inflammation.

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 [30-32].

Psychosocial Hazards

Dentist encounter numerous sources of professional stress, beginning in the dental clinic. Important risk factors contributing to 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. Various physical and emotional demands result in physical and mental burnout. Stress management workshops, deep breathing exercises, relaxation, hypnosis and desensitization techniques help to manage these psychosocial hazards [33,34].

Conclusion

The nature of prosthetic practice is such that it widens the circle of contact of potentially harmful agents thereby increasing the susceptibility to a number of occupational hazards [35]. Modern prosthodontic practice is equipped with sophisticated work area designs with adequate ventilation and advanced armamentarium that could possibly reduce noise pollution and risks associated with chemical and ergonomic hazards. Use of masks and aspirators, and mechanical removal of as much resin as possible before using rotary instruments may reduce the biological exposures. An orange shield used with the curing equipment adequately filters blue light between 350 nm to 500 nm. The integration of the use of ozone into a dental unit extends a system of disinfection and sterilization for DUWL into the clinical management and patient arena. Measures to combat stress by relaxation, exercise, meditation, hobbies are recommended. It is the responsibility of Prosthodontist and dental technicians to understand the specific risks or hazard agents and formulate an effective management protocols. Understanding the various risk will educate the professional for a better work practice and care of personal health. A mere knowledge of such hazard and familiarity with its characteristics is not sufficient for an individual to assess the potential threat. Although a dental clinic will probably never be free of these dangers and threat but necessary measures should be taken to eliminate them as much as possible. Also, it is ones responsibility to report the biological side effects associated with use of various dental materials to certifying bodies or health authorities so that reliable research can be done to clarify various safety issues and frequency of adverse reactions with the use of these materials in general dentistry including prosthodontic treatment.

References

1. van Noort R, Gjerdet NR, Schedle A, Björkman L, Berglund A (2004) An overview of the current status of national reporting systems for adverse reactions to dental materials. J Dent 32: 351-358.
2. Tillberg A, Järvholm B, Berglund A (2008) Risks with dental materials. Dent Mater 24: 940-943.
3. St John KR (2007) Biocompatibility of dental materials. Dent Clin North Am 51: 747-760.
4. Moffa JF, Beck W, Hake A (1977) Allergic response to nickel-containing alloys. J Dent Res 56: B78.
5. Axéll T, Björkner B, Fregert S, Niklasson B (1983) Standard patch test series for screening of contact allergy to dental materials. Contact Dermatitis 9: 82-84.
6. Mjör IA, Christensen GJ (1993) Assessment of local side effects of casting alloys. Quintessence Int 24: 343-351.
7. Kallus T, Mjör IA (1991) Incidence of adverse effects of dental materials. Scand J Dent Res 99: 236-240.
8. Hensten-Pettersen A (1992) Casting alloys: side-effects. Adv Dent Res 6: 38-43.
9. Jacobsen N, Aasenden R, Hensten- Pettersen A (1991) Occupational health complaints and adverse patient reactions as perceived by personnel in public dentistry. Community Dent Oral Epidemiol 19: 155-159.
10. Hamann CP, Rodgers PA, Sullivan KM (2004) Occupational allergens in dentistry. Curr Opin Allergy Clin Immunol 4: 403-409.
11. Siew C, Chang SB, Gruninger SE, Verrusio AC, Neidle EA (1992) Self-reported percutaneous injuries in dentists: implications for HBV, HIV, transmission risk. J Am Dent Assoc 123: 36-44.
12. Szymanska J (2001) Dentist's hand symptoms and high-frequency vibration. Ann Agric Environ Med 8: 7-10.
13. Farrier SL, Farrier JN, Gilmour AS (2006) Eye safety in operative dentistry - a study in general dental practice. Br Dent J 200: 218-223.

14. Scully C, Cawson RA, Griffiths MJ (1990) Mortality and some aspects of morbidity: Ch.1. In: Occupational hazard to dental staff. BMJ 2: 1-21.
15. Gasyna EM, Rezaei KA, Mieler WF (2006) Blue light induces apoptosis in human fetal retinal pigment epithelium (abstract 3813). Invest Ophthalmol Vis Sci 47: 180.
16. Bruzell Roll EM, Jacobsen N, Hensten-Pettersen A (2004) Health hazards associated with curing light in the dental clinic. Clin Oral Investig 8: 113-117.
17. Work related hearing loss (2012) NIOSH publication number 2001-103. Centers for disease control and prevention.
18. Szymanska J (2000) Work-related noise hazards in the dental surgery. Ann Agric Environ Med 7: 67-70.
19. Hensten-Pettersen A, Jacobsen N (1991) Perceived side effects of biomaterials in prosthetic dentistry. J Prosthet Dent 65: 138-144.
20. Haberman AL, Pratt M, Storrs FJ (1993) Contact dermatitis from beryllium in dental alloys. Contact Dermatitis 28: 157-162.
21. Kim TS, Kim HA, Heo Y, Park Y, Park CY, et al. (2002) Level of silica in the respirable dust inhaled by dental technicians with demonstration of respirable symptoms. Ind Health 40: 260-265.
22. Choudat D (1994) Occupational lung diseases among dental technicians. Tuber Lung Dis 75: 99-104.
23. Woody RD, Huget EF, Cutright DE (1977) Characterization of airborne particles from irreversible hydrocolloids. J Am Dent Assoc 94: 501-504.
24. Roberta T, Federico M, Federica B, Antonietta CM, Sergio B, et al. (2003) Study of the potential cytotoxicity of dental impression materials. Toxicol In Vitro 17: 657-662.
25. Turjanmaa K, Alenius H, Mäkinen-Kiljunen S, Reunala T, Palosuo T (1996) Natural rubber latex allergy. Allergy 51: 593-602.
26. Bentley CD, Burkhart NW, Crawford JJ (1994) Evaluating spatter andaerosol contamination during dental procedures. J Am Dent Assoc 125: 579-584.
27. Jennings KJ, Samaranayake LP (1991) The persistence of microorganisms on impression materials following disinfection. Int J Prosthodont 4: 382-387.
28. McNeill MR, Coulter WA, Hussey DL (1992) Disinfection of irreversible hydrocolloid impressions: a comparative study. Int J Prosthodont 5: 563-567.
29. Alexopoulos EC, Stathi IC, Charizani F (2004) Prevalence of musculoskeletal disorders in dentists. BMC Musculoskelet Disord 5: 16.
30. Milerad E, Ericson MO, Nisell R, Kilbom A (1991) An electromyographic study of dental work. See comment in PubMed Commons below Ergonomics 34: 953-962.
31. Fish DR, Morris-Allen DM (1998) Musculoskeletal disorders in dentists. N Y State Dent J 64: 44-48.
32. Kay EJ, Lowe JC (2008) A survey of stress levels, self-perceived health and health-related behaviours of UK dental practitioners in 2005. Br Dent J 204: E19.
33. Rankin JA, Harris MB (1990) Comparison of stress and coping in male and female dentists. J Dent Pract Adm 7: 166-172.
34. Atlas RM, Williams JF, Huntington MK (1995) Legionella contaminationof dental-unit waters. Appl Environ Microbiol 61: 1208-1213.
35. Harutunian K, Gargallo-Albiol J, Figueiredo R, Gay-Escoda C (2011) Ergonomics and musculoskeletal pain among postgraduate students and faculty members of the School of Dentistry of theUniversity of Barcelona (Spain). A cross-sectional study. MedOral Patol Oral Cir Bucal 16: e425-e429.