

THE SIGNIFICANCE OF DENTAL CAD/CAM SYSTEMS IN ENVIRONMENTAL PROTECTION AND HEALTH CARE

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ABSTRACT

Dental technicians are exposed to various dusts in working laboratories. Contact with particles from dental materials, which have a variety of chemical properties, may be a potential environmental and health risk. There are numerous chemical and physical hazards in the dental restoration procedure: parts of metal filings, solvents, mineral acids, gases and vapors released during polymerization, metal casting, porcelain backing, dust from plaster, ceramic, metal alloys and acrylic resin.

The improvement in the computer aided design and computer aided manufacturing (CAD/CAM), contributed to the health care of a dental technicians.

The aim of this paper was to compare a conventional method and the CAD/CAM method of a dental restoration procedure and in accordance with this method it represents many advantages of CAD/CAM technology and its significance in the environmental and health protection of dental technicians.

Key words: occupational health, environmental protection, dentistry, CAD/CAM

INTRODUCTION

Environmental problems are an important issue of civilization today. They are present at global and local levels [1,2]. One of the issues at the local level is present in dental laboratories. In prosthetic dentistry a wide range of different dental materials are used. Some of them are not biodegradable (impression materials, ceramic, plaster, metal alloy etc.) Contact with the dental materials, which have various chemical properties, may have a potential health risk. There are numerous chemical and physical hazards in a dental restoration procedure.

While grinding the metal framework of fixed and partial dentures, dust and particles of precious and non-precious alloy are dispersed into the air. [1,3] Exposure to dust with high silica concentrations and cobalt–chromium–molybdenum alloys presents a risk of developing pneumoconiosis. The dental technician's pneumoconiosis seems to be the result of the combined effects of hard metal dusts and silica particles. [4,5,6] Main respiratory symptoms and findings among dental technicians are cough and phlegm, as well as decreased respiratory functions. [7]

Chemical hazards include solvents, mineral acids, gases and vapors released during polymerization, metal casting and porcelain backing, as well as dust coming from plaster, metal alloys, ceramic and acrylic resin. [8] Some studies have reported that methacrylate monomers may cause a wide range of adverse health effects, such as irritation to skin, eyes, or mucous membranes, allergic dermatitis, asthma, as well as central and peripheral nervous system disorders (headache, pain in the limbs, nausea, loss of appetite, fatigue, sleep disturbances, neuropathy, loss of memory, etc). The use of gloves, facemasks, and ordinary glasses does not give enough protection against vapors from monomers. [9]

Cobalt–chromium–nickel alloys have some cytogenetic damage potential, regarding lymphocytes and exfoliated nasal cells in dental technicians.[10] These alloys, or methyl methacrylate, or both, could be responsible for occasional development of persistent olfactory disorders in dental laboratory workers. [11]

The carcinogenic risk of dental technicians has not been evaluated, although some of compounds in metal alloys used are carcinogenic, such as chromium, nickel, and beryllium. Long term exposure to crystalline silica at levels higher than those usually occurring in dental technicians is also considered

to increase the risk of lung cancer in humans.[12] Due to the exposure to various allergens and irritants, dental technicians often suffer from dermatitis. [13,14]

Dental technicians are exposed to hand/arm vibrations while working with various appliances and tools. Although the literature data are scarce, it seems that long term exposure may result in “white finger syndrome”. A study of 374 women with diagnosed hand–arm vibration syndrome in Sweden included many dental technicians. On average, the first symptoms appeared after seven years of exposure and the first visit to a doctor occurred after 11 years. [15]

Improvements in the quality of dental materials and the implementation of new manufacturing procedures reduced the negative impact of dental materials and their impact on human health. CAD/CAM technology has been present in dentistry for the last 30 years.

The aim of this paper was to compare a conventional and CAD/CAM method of dental restoration production, and accordingly to this it represents many advantages of CAD/CAM technology and its significance to the health protection of dental technicians.

DENTAL RESTORATION MANUFACTURING BY THE APPLICATION OF CONVENTIONAL METHODOLOGY

The first step in the production of dental restoration with conventional methodology is impression taking. Dentists send to the technicians a specification of the item (that is, crown, bridge, prosthesis, etc) to be made, along with an impression of the patient's mouth or teeth (Fig 1).

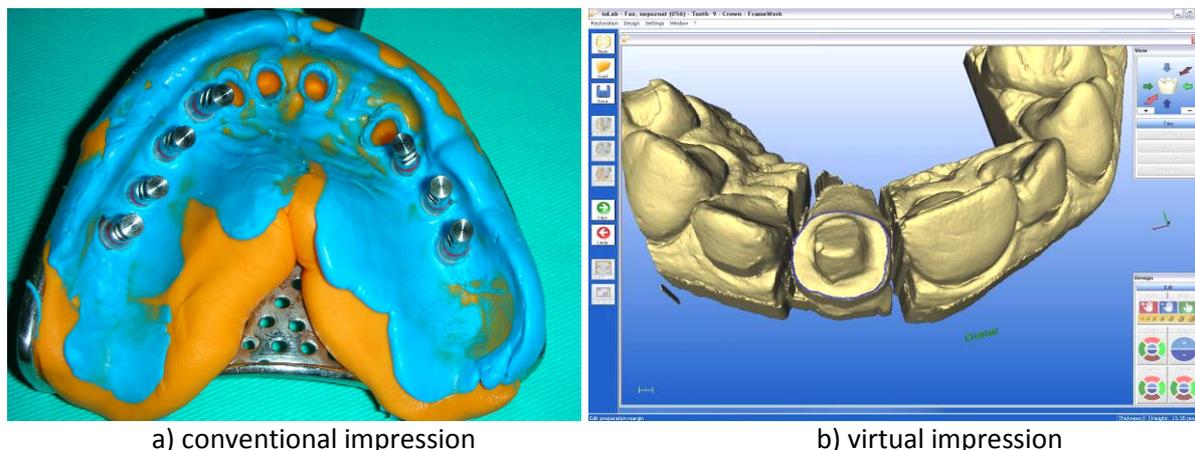


Fig. 1. Impression techniques

Dental technicians create a working plaster model. The next step is to place the working model on to the articulator. Technicians examine the model, and on their observations build a wax model. They use the wax model to cast the metal or ceramic framework.

After the casting dental technicians prepare the metal surface (grinding, sandblasting) to allow the alloy and porcelain to bond. They then apply porcelain in layers, to achieve the desired shape of a tooth (Fig. 2).



a) mechanical processing of metal casting



b) application of porcelain layers

Fig. 2. Dental technician in work

DENTAL RESTORATION MANUFACTURING BY THE APPLICATION OF CAD/CAM METHODOLOGY

CAD/CAM enable creation of virtual three-dimensional models of fixed dental restoration and their manufacturing using the numerically controlled machines. [16] The first segment in the procedure of manufacturing is the spatial digitalization (Fig,1). [17]

All dental CAD/CAM systems integrate three components (Fig 3);

- 3D digitization,
- CAD – computer aided design and
- CAM – computer aided manufacturing .

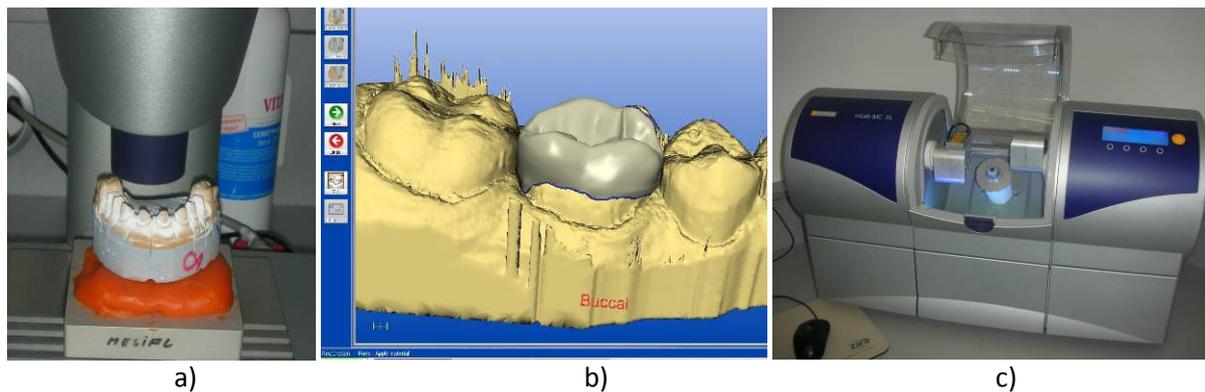


Fig. 3. Three components of dental CAD/CAM systems: a) extraoral scanner ,b) virtual design of the fixed dental restoration, c) milling unit

DISCUSSION

The application of intraoral scanning methods has eliminated the use of impression materials, which protect the environment due to the waste material reductions. There are few data in the literature that deal with the biodegradation of dental materials as well as the storage methods for this particular type of waste. The elimination of the impression procedure excluded the possibility of bacterial and viral contamination of dental technicians that as a result of poor disinfection may be present in a bite impression and on the working models.

Moulding plaster or acrylate working models has been replaced by the computer-aided design model procedure.[18] It has accelerated and simplified the process of making fixed dental restorations. Of course, the influence of dust, small particles and gases harmful for the respiratory system has also been eliminated. The process of wax modeling dental restorations has been replaced by the virtual restoration design.

The preparation of fixed dental restorations in the numerical managed milling machine allowed the elimination of the casting procedures, mechanical processing of metal castings and sandblasting. Milling devices represent closed systems with controlled waste product accumulation.

However, it should be noted that CAD/CAM systems are non-complete substitute for dental technicians. These capabilities provide intraoral CAD/CAM systems, which application was limited to a small number of clinical indications. [19] CAD/CAM systems with the application of the extraoral scanning methods require conventional dental impression and the manufacturing of working models. However, despite limited capabilities of extraoral systems, the importance of their application in dental techniques can not be ignored. In addition to all of the benefits of CAD/CAM systems, protective measures of dental technicians are required to be implemented.

Local ventilation system and general ventilation must be constructed in the dental laboratories to prevent respiratory system from airborne contamination (Fig. 4, 5). Protective masks and eyeglasses should be made available. Properly selected gloves are of vital importance, especially nitrile rubber, synthetic rubber, 4H gloves. [20] Dental technicians must apply standard procedures of manual handling of various materials and objects. Education and check-ups are to be inevitably carried out on a regular basis. [21]



Fig .4. The gases and dust aspirator



Fig .5. Local ventilation system

CONCLUSIONS

The technology improvement in the production of dental restorations should be the basic postulate of modern dentistry. The system application that replaces the manual methods for their producing contributes significantly to the preservation of the health of dental technicians. However, protective measures of dental technicians are required to be implemented inviolably.

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