

Safety issues with dental materials and its toxicological aspects - An overlooked archetype

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Abstract

Dental materials are categorized as class 2 medical devices associated with moderate risk according to US Food and Drug Administration (USFDA). The aim of dental pharmacology is to understand the scientific aspects of how drugs and dental materials work within body systems. The different materials used in dentistry have their own beneficial as well as adverse effects. In order to make sure the biocompatibility of any material that is used in dentistry there is an organization named International Academy of Oral Medicine and Toxicology (IAOMT) that focuses mainly on making dental practice more biologically acceptable. Depending upon the duration of application, dental materials are classified as, temporary and permanent materials. It could be associated with mild, moderate or severe adverse events that should be reported as per regulatory requirement and materiovigilance. In order to prevent or overcome the toxic effects of these materials or drugs used in dentistry we need to focus more on "Biological dentistry" where in the well-being of the mouth is considered as an integral part of the health of the whole person.

Objective

The purpose of this brief review is to focus on different toxicological effects and other safety issues of dental materials that are used intraorally. It would also give a brief idea about how to prevent these toxicological effects.

Materials and methods

A review of published literature and regulatory guidelines was done along with clinical experience to highlight safety issues related to dental materials.

Observations

Patients visiting the outpatient department of Prosthodontics, of a tertiary care center with implant prosthesis were selected for the study. A total of 15 patients were selected with periimplantitis and under antibiotic treatment for the same since 3-5 months. Intraoral examination of selected patients showed inflammation, bleeding on probing, pocket formation and bone loss around the implant site. Immunocompromised patients, patients with failed implants, and with full mouth implants prosthesis were excluded from the study. Patients with periimplantitis showed more of *Staphylococcus Aureus* and *Candida Albican* on laboratory examination. (Table 1)

Discussion

Different dental materials including, the restorative, reconstructive therapeutic materials used for treatment in dentistry have been categorized in different ways. The temporary materials like medicine, mouth washes, toothpastes, chewing gum etc. are applied for a short period of time, usually to heal a tissue or improve its function. The permanent materials like amalgam, denture base resins, implants etc. are often used to replace a tissue or recover its function and should keep the function as long as

possible. When a biomaterial is placed in contact with the tissues and fluids of the human body, its biocompatibility is of utmost importance.

Most commonly used temporary material is Fluoride as treatment in the form of gel, mouth wash, toothpaste etc. Topical application of fluoride as a measure for caries prevention is widely followed but researches have shown that there are harmful effects of fluoride accumulation in the human body due to repeated applications. The over-the-counter availability of mouth wash also have many side effects that includes staining of teeth, permanent taste alteration and increase in tartar formation. These effects are mostly seen by chlorhexidine containing mouth washes. Teeth whitening toothpaste has more of abrasive material that causes sensitivity in individual. In order to prevent these ill effects, herbal mouth washes are now available.

The materials that cause permanent effect has more toxicogenic effect as compared to materials causing temporary effect. Some of them are Dental Amalgam, Denture based resins, Dental implants etc. Dental Amalgam is used for restoration. Scientific evidence has established that dental amalgam contains approximately 50% of mercury and causes intraoral release of mercury in significant quantities. They might lead to formation of solitary or focal pigmentation in the oral mucosa known as the "Amalgam tattoo". Chronic exposure to mercury in the quantity released by amalgam, increases the risk of physiological harm. Therefore, with the improvement in dental material "Mercury free Amalgams" were introduced that has less of toxicological effect and is more biocompatible.

Similarly, most of removable prosthesis are made up of heat or cold cured denture-based resins. Both the denture base resins contain polymer and monomer that are carcinogenic. The constant leaching out of monomer from cold cure resin is more and has a greater deleterious effect. Recent advances in the denture base materials like introduction of pre-polymerized material, use of PEEK material etc. has reduced adverse effect of resins.

With the increase in awareness among patients, the popularity and use of fixed dental treatment has increased by several folds. Dental Implantology is one of the most innovative treatment modalities for the replacement of lost dentition. Dental implants have been researched and improved widely in the recent years. Tremendous increase in the patients' demands and expectations towards dental implant treatment has made the researchers & clinicians improvise on all aspects of dental implants to provide long-term clinical success. The different materials in which implants are manufactured are Titanium and its alloys, Tantalum, Zirconia etc. Researchers have shown that use of Titanium in implant is most biocompatible and widely acceptable as compared to other materials. Porous tantalum implants show Osseo incorporation in the jawbone in contrast with the titanium implants that show osseointegration. Evidence favors that osseointegration has less bacterial leakage at bone implant interface as compared to porous tantalum

implants. Studies have concluded that *S.aureus* has greater affinity for titanium implant surface as compared to other microorganisms. As implants are almost similar to natural teeth, its maintenance is of utmost importance. If the implant is not maintained properly, it will lead to inflammation of peri implant mucosa (mucositis), that when left untreated will lead to progressive bone loss and loss of the supporting bone as well as the implant (Periimplantitis). The most commonly used treatment for periimplantitis is use of synthetic antimicrobial agents and antibiotics. These agents cause antimicrobial resistance and emergence of opportunistic infections due to their inappropriate or widespread usage.

Conclusion

Safety of dental materials and implants used is utmost important as per growing need and demand. In order to prevent toxic effects related to dental materials, some valuable approaches could be maintenance of dental implant by following different regime for the same and use of herbal products for treatment of periimplantitis with limited topical application of synthetic antimicrobial agents. In addition, strict regulations are required for conduct of clinical trials, approval of dental materials and reporting of long-term safety data as a part of materiovigilance.

Table 1: Clinical examination findings and diagnosis in peri-implantitis patients

No. of Patients	Intraoral examination	Diagnosis
4	No. of Patients	Intraoral examination
6	Titanium dental implants.	Moderate periimplantitis
	Bleeding on probing, periodontal pocket.	
	Bone loss up to 25—50% of implant length	
5	Titanium dental implants	Advanced periimplantitis
	Bleeding on probing, periodontal pocket	
	Bone loss up to 50% of implant length.	