Texila International Journal of Public Health
ISSN: 2520-3134
DOI: 10.21522/TIJPH.2013.11.02.Art014

Biocompatibility of Restorative Materials- A Review

Shilpa Bhandi[1]*, Oladapo Titus Okareh[2], Shankargouda Patil[3-4]
[1]Phd Department of Public health, Texila American University; Georgetown Guana College of Dental Medicine, Roseman University of Health Sciences, South Jordan, Utah, USA
[2]University of Ibadan, Nigeria
[3]College of Dental Medicine, Roseman University of Health Sciences, South Jordan, UTAH – 84095, USA
[4]Centre of Molecular Medicine and Diagnostics (COMManD), Saveetha Dental College & Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai - 600 077, India (S.P.)

Abstract

The word "biocompatibility" has been gaining popularity, primarily in the field of dentistry but also in other fields of medicine. In essence, it means that biocompatible materials shouldn't harm the recipient. The materials used in typical dental operations currently consist of literally hundreds of different components, and more are being developed every year. The relevance of using the patient's most biocompatible material is increasingly being reported in scientific literature. According to research, choosing the least reactive material is crucial, but so is considering how that material might interact with any other implants that may already be in the mouth cavity. The application of these techniques may also result in a deeper comprehension of the biological reactions' underlying mechanisms (mechanistic approach) when describing the biocompatibility of dental restorative materials. This review article aims to summarize the biocompatibility of restorative materials in general and the effects on immunological reaction caused by them.

Keywords: *Biocompatibility; Host response; Restorative materials; Immunity.*

Introduction

A biological network called the immune system constitutes of defending host from its external threats and preserving homeostasis.[1] The two elements that make up the human immune system are the innate immune system, which initiates a non-specific inflammatory response after the immediate recognition of foreign material, and the adaptive immune system, which carries out highly specific antigen responses and creates a long-term memory. Different cell populations make up each component [1, 2].

Basic requirements for dental restorative materials include similarity to the tooth structure in their characteristics. Even though the qualities of dental restorative materials vary greatly, they are always put through the rigorous circumstances of the oral cavity after they are installed as replacements [3].

Dental restorative materials are constantly interacting with the tissues around them after being placed. These materials must not only keep their integrity in such trying circumstances, but they must also keep these features intact while functioning for an extended period of time [3, 4].

Received: 08.02.2023 ***Accepted: 24.02.2023*** ***Published on: 30.06.2023***
****Corresponding Author: shilpa.bhandi@gmail.com***

Biological reactions to materials with comparable composition are the starting point for literature surveys used in risk studies of potential negative biological reactions to new compounds. Lack of pertinent information may call for extra biocompatibility testing, which is frequently carried out using various techniques. Traditional, well-recognized preclinical studies, on the other hand, are mostly appropriate for assessing local irritating effects to oral mucosa, skin tissues, tissues of the pulp and immune mediated reactions [5].

Since most products could come with some risks when used, cautionary comments concerning patient contraindications and safe handling techniques have become more prevalent. Where the exposure is greatest, which is in a workplace, reactions produced adversely by novel chemicals and the sorts of reactions provoked are typically initially detected.

So, this review article aims to summarize the biocompatibility of the restorative materials in general and the immune response of our body towards it.

Chemical Reaction Mechanism

Although they are fundamentally distinct from toxic reactions, allergic reactions and toxic reactions can have the same or very similar clinical symptoms. The majority of dental materials' constituent parts have modest molecular weights. They may create full antigens that can cause the sensitization of immune-competent cells by functioning as haptens and fusing with body proteins. The likelihood of sensitization varies with the substance's nature and concentration as well as the kind and health of the tissues it comes into contact with. The fundamental mechanisms underlying the development, manifestation, and control of allergic contact dermatitis are well understood [6].

Contact Mucositis

Clinical symptoms typically begin to manifest at the actual location of allergen exposure. Sensitized individuals, however, might have a range of symptoms when exposed to the allergen systemically through ingestion, inhalation, infusion, transcutaneous absorption, or transmucosal absorption. According to a new analysis, the issues with systemic allergic reactions are complicated [7-9]. Patients and dental professionals using dental materials may experience allergic reactions to every component of those products [10-16].

Irritant Contact Dermatitis and Mucositis

Acute toxic reaction is an inflammatory response to primary irritants on the skin or mucous membranes. If a major irritant is present in enough concentration for long enough, it has the potential to harm everyone. It is caused by a physical or chemical reaction, such as one brought on by heat, ionising radiation, shock, bases, acids, or other reactive substances. The reaction might range from erythema to necrosis depending on the dose and duration of exposure [17].

The assessment of potential negative effects from particular chemicals should be thoroughly explored. Prior to conducting a systematic examination of adverse events, it is necessary to have complete knowledge of the chemical makeup of the numerous materials that patients and staff are exposed to. It is crucial to record information on the materials used in patients' records. With alloys, elemental analysis can be performed rather easily by removing a tiny portion of the repair; however, analytical methods for resin-based materials do not yet permit this [17].

Symptoms like paresthesia may be linked to neurotoxic effects of substances. When using methylmethacrylate monomer, orthopaedic surgeons and dental technicians may have dermatitis, which frequently manifests as skin that is noticeably dry and fissured. A peculiar aspect of irritating contact dermatitis brought on by methylmethacrylate monomer is paresthesia

in the fingertips, which manifests as a burning, tingling, and faintly numbing sensation [18, 19].

Saliva, calcified dentin, and the dentinal fluid all contain enzymes that aid in the destruction of restorative materials in addition to those found in bacteria.

Effects of Mastication

Restorative materials experience continual loading and unloading while they are in use. The amount and direction of the loading have an impact on the material's surface. Both of these factors lead to internal stress and strain as well as surface abrasion. Restorative materials are continuously subjected to mechanical and thermal cycles during mastication; as a result, they experience fatigue and may release different components from the bulk material [3].

Effect of Saliva

Saliva acts as a fluid coating between the surfaces that slide, reducing the resistance experienced during mastication [20]. Additionally, human saliva aids in digestion, acts as a buffer, and is biocompatible with and effective for dental restorative materials. Saliva's charged, extended macromolecules, such as glycoproteins and high-molecular-weight proteins, are what give saliva its lubricating characteristics [21]. These salivary components create a coating that coats the repair material and creates surface endurance against substances sliding on it, hence decreasing wear-related biocompatibility changes [22].

Dental amalgam restorations have generated controversy over the past century, in part because of the dangerous mercury they contain [23]. As a result, there is a global movement to replace amalgam fillings with materials that are tooth-colored, sticky, and mercury-free.

Resin Based Restorative Materials

After the restoration has been installed, resin-based filling materials may release a number of different components. These components, which may be released at first due to incomplete polymerization and later due to degradation, include nonpolymerized monomer, filler, and additives [24]. Dimethacrylates can polymerize by either chemical or visible light initiating processes. Due of the tighter control over the entire polymerization process, light curing is used [25]. However, because complete conversion is never possible, there are always free monomers. Sadly, the resin composite materials currently on the market have conversion rates ranging from 40% to 70%, [26] with even lower levels of polymerization occurring right after light curing [27].

Restorative Materials and Immune Response

When a biomaterial is implanted, the host's response to the implant dictates how well it will integrate and function biologically. The immune system is activated by the degradation products that are generated by devices (such as tissue engineered scaffolds, orthopaedic implants, and biomedical devices) and the consequent surface alterations of the degrading biomaterials.[28] The tissue surrounding the implant is what drives tissue-specific innate defences and the subsequent activation of adaptive immune responses, which determines how the host immune system interacts with the biomaterial [28].

In reality, it is clearer that macrophages found in tissues or drawn from other locations perform specific roles in the healing process. Similarly, the implantation of the same substance causes diverse reactions in various locations.

Conclusion

As more and more dental materials are developed, it is believed that the potential adverse effects won't be realised until the materials can be investigated several years or even decades down the road. This is why it is wise to employ the cautious principle and avoid assuming what the patient needs in terms of "best" restorative materials.

Knowing which materials to utilise before treatment and how to safeguard the patient when

removing any dental material, especially any kind of metal restoration due to the exposure of particle matter are crucial.

Conflict of Interest

There is no conflict of interest.

Acknowledgement

The authors acknowledge the support of Dr. Anadha Gujar, for supporting data collection and Language editing.

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