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Mini Review

Review: Biodegradable Materials in Dentistry-Let's Go Green!

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Abstract

This review addresses the use of biodegradable materials in dentistry, focusing on their applicability, effectiveness, and potential use for future development. The review highlights the advantages and challenges associated with biodegradable materials in dental practice and suggests avenues for future research.

Keywords: *Biodegradable Materials; Dentistry; Bioactive Materials*

Introduction

Biodegradable materials have become increasingly crucial in modern dentistry, driven by the ongoing shift from inert to bioactive materials. These materials are progressively favored for their eco-friendly properties and potential to improve clinical outcomes through regenerative and therapeutic purposes [1]. This review aims to address the role of biodegradable materials in dentistry, investigates the recent advancements, and focuses on the future research directions to broaden their application in this field.

Objectives of the Study

The objective of this paper is to identify the types of biodegradable materials used in dentistry, as well as assessing the effectiveness of biodegradable materials in various dental applications along with evaluating the advantages and challenges associated with these materials.

Methods

Search strategy

A systematic search was conducted across multiple databases, including PubMed, Scopus, and Web of Science, to identify relevant studies published between 2000 and 2024. MeSh terms were used including "biodegradable materials," "dentistry", "dental implants", "biomaterials" and "dental restoration" studies published in English were included.

Inclusion and exclusion criteria

Inclusion criteria were studies focusing on biodegradable materials in dental applications, clinical trials either *in vitro* study, and *in vivo* studies, and full papers published in peer-reviewed journals.

Exclusion criteria were studies not directly related to dentistry, studies discussing non-biodegradable materials and articles not available in full text. Papers published in non-English language was excluded.

Data extraction and analysis

Data from selected studies were extracted using a standardized form, recording information on study design, sample size, material type, application, and outcomes. A qualitative synthesis was performed to evaluate the effectiveness of biodegradable materials in dentistry.

Results

Types of biodegradable materials

Several types of biodegradable materials are utilized in dentistry:

- Polylactic acid (PLA): Widely used in dental implants and scaffolds due to its biocompatibility and predictable degradation properties [2].
- Polyglycolic acid (PGA): Often used in sutures and resorbable membranes [3].
- Polycaprolactone (PCL): Employed in guided tissue regeneration and as a scaffold material [4].
- Chitosan: Utilized in wound dressings, dental membranes, and drug delivery systems due to its antimicrobial properties [5].
- Natural polymers: Materials such as cellulose, chitosan, collagen, and hyaluronic acid have garnered attention for their biodegradability and environmental benefits [6].

Applications in dentistry

Biodegradable materials have been applied in various dental procedures:

- Dental implants: Biodegradable scaffolds support bone regeneration and implant integration [7].
- Periodontal therapy: Resorbable membranes made from PLA and PCL are used in guided tissue regeneration [8].
- Orthodontics: Biodegradable materials are utilized in the fabrication of temporary anchorage devices and wires [9].
- Endodontics: Biodegradable sealers and fillers are employed to improve healing and reduce post-operative complications [10].

Effectiveness

Studies show that biodegradable materials usually exhibit acceptable biocompatibility, reduce the need for secondary surgeries, and support tissue regeneration [11]. However, challenges such as varying degradation rates, mechanical strength, and potential inflammatory responses are debated [12].

Discussion

Advantages

Studies show that biodegradable materials might reduce the need for Secondary Surgery in terms of eliminating the need for surgical removal, thus reducing patient morbidity [13]. Additionally, biodegradable materials show Biocompatibility in the sense that they are well-tolerated by the body, minimizing adverse reactions [14]. Moreover, biodegradable materials have shown supportive features for tissue regeneration, i.e. These materials provide a scaffold for new tissue growth, enhancing healing and integration [15].

Challenges

There are some challenges with the use of biodegradables. These include control of degradation rate in the sense that the degradation rate must be carefully controlled to match tissue healing, which can be challenging [16]. Additionally, in terms of mechanical Strength,

some biodegradable materials may lack the necessary strength for certain applications, leading to premature degradation or failure [17]. There are some concerns reported regarding the inflammatory response as it has been hypothesized the degradation products can provoke an inflammatory response, which may complicate healing [18].

Conclusion

Biodegradable materials offer significant promise in dental applications, particularly in terms of biocompatibility and reducing the need for secondary surgeries. However, challenges such as degradation control and mechanical properties need further research. Future studies should focus on optimizing these materials to enhance their performance in clinical settings.

Future Directions

- Development of novel materials: Research should focus on creating new biodegradable materials with improved mechanical properties and controlled degradation rates [19].
- Long-term clinical studies: More extensive clinical trials are needed to evaluate the long-term effectiveness and safety of biodegradable materials in dentistry [20].
- Combination with other therapies: Exploring the combination of biodegradable materials with other regenerative therapies could enhance treatment outcomes [21-23].

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