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Dental Drug Delivery System Used In Periodontitis

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Abstract

Periodontitis is a chronic infammatory disease that afects the supporting structures of teeth, including the periodontal ligament, alveolar bone, and gingiva. It is a leading cause of tooth loss worldwide and is associated with various systemic conditions such as diabetes and cardiovascular diseases. The traditional treatment of periodontitis involves mechanical debridement, including scaling and root planing, in addition to the use of systemic or local antibiotics. However, the challenges of drug bioavailability, targeting, and sustained release have led to the development of innovative drug delivery systems (DDS). These systems are designed to improve drug concentration at the site of infection while minimizing systemic side efects. This article reviews the various dental drug delivery systems employed in the management of periodontitis, focusing on the mechanisms of action, materials used, and their clinical e f cacy.

K .: Periodontitis; Dental drug delivery systems; Periodontal disease management; Local drug delivery; Controlled release systems; Drug targeting; Nanoparticles; Biodegradable polymers; Antimicrobial agents

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Periodontitis is a prevalent and serious in ammatory disease that a ects the gums and structures supporting the teeth. It is primarily caused by bacterial infection, leading to the breakdown of the so tissue and bone that hold teeth in place. If le untreated, periodontitis can lead to tooth mobility and eventual tooth loss. According to the World Health Organization (WHO), nearly 10% of the global population su ers from severe periodontitis, and its prevalence increases with age. iof .02arren(in4)0 Tw 0 -1. manif153actel

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controlled drug release to the site of infection. e key goals of DDS in periodontitis treatment include:

- **I[illegible]**: DDS allows higher drug concentrations at the infection site compared to systemic delivery, improving treatment e cacy.
- **S[illegible]**: DDS can o er a prolonged release of therapeutic agents, ensuring continuous antimicrobial activity over a longer duration.
- **M[illegible]**: By localizing the drug delivery to the periodontal tissue, DDS minimizes the risk of adverse e ects that may arise from systemic drug exposure.
- **Ta[illegible]**: DDS can be engineered to speci cally target the infected periodontal sites, increasing the speci city and reducing side e ects.

Various DDS technologies have been developed to address these goals, including biodegradable polymers, nanoparticles, hydrogels, and liposomes. ese DDS platforms are designed to deliver various therapeutic agents, such as antibiotics, antimicrobials, enzymes, and growth factors, directly to the site of infection.

T[illegible]

B[illegible] P[illegible]

Biodegradable polymers are one of the most commonly used materials in DDS. ey o er the advantage of releasing the drug over an extended period as they break down within the body. Some of the commonly used biodegradable polymers include poly(lactic acid) (PLA), poly(lactic-co-glycolic acid) (PLGA), and chitosan. ese polymers are biocompatible, biodegradable, and have been extensively studied for local drug delivery.

PLGA-based systems are widely used in periodontitis therapy due to their ability to control the release of drugs. ese systems can be incorporated into various forms, such as microspheres, lms, or sca olds, and are e ective in delivering antibiotics like tetracycline or minocycline directly to the periodontal pocket. Once in place, the polymer degrades over time, releasing the drug in a controlled manner.

Na[illegible]

Nanoparticles have gained signi cant attention in recent years due to their unique properties, such as small size, high surface area, and ability to cross biological barriers. Nanoparticles can be engineered to deliver a variety of drugs, including antibiotics, anti-in ammatory agents, and growth factors. ese particles are o en designed to target speci c cells or tissues and o er sustained release of the drug.

Nanoparticles can be fabricated from a variety of materials, including lipids, polymers, and ceramics. In the treatment of periodontitis, nanoparticles can be used to encapsulate drugs like chlorhexidine, doxycycline, or minocycline, ensuring high local concentrations at the infection site. Additionally, nanoparticles can be surface-modi ed to enhance their stability and improve their interactions with the periodontal tissue.

H[illegible]

Hydrogels are water-based polymers that can absorb large amounts of water and maintain their shape and consistency. Hydrogels can be used to create a matrix for drug delivery, as they are highly exible and can be applied directly to the periodontal tissue. Hydrogels are typically loaded with antimicrobial agents and can provide both a barrier to protect the tissue and a sustained release of drugs.

One of the advantages of hydrogels is their ability to form in situ, meaning they can be applied as a liquid and will gel at body temperature. is makes them easy to apply to periodontal pockets and ensures good retention of the drug. Hydrogels are also highly biocompatible and can be engineered for controlled release, making them an excellent choice for periodontal therapy.

L[illegible]

Liposomes are spherical vesicles made up of lipid bilayers that can encapsulate both hydrophilic and hydrophobic drugs. ey can be used to deliver a wide range of therapeutic agents, including antibiotics, anti-in ammatory drugs, and growth factors. Liposomes are especially advantageous in drug delivery due to their ability to fuse with cell membranes, enhancing drug uptake.

In periodontitis treatment, liposomal formulations have been developed to deliver drugs like tetracycline and clindamycin directly to the periodontal tissue. Liposomes can protect the drug from to the approach for the management of periodontitis, providing a more effective, localized, and controlled treatment modality. As research continues to advance, it is likely that DDS will play an increasingly important role in periodontal therapy, offering improved outcomes