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Editorial

Antimicrobial peptides: Redefining endodontic therapeutics

Vineeta Nikhi[1]*

[1]*Dept. of Conservative Dentistry and Endodontics, Subharti Dental College & Hospital, Meerut, Uttar Pradesh, India*

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Endodontics, the branch of dentistry focusing on the diagnosis, prevention, and treatment of diseases of the dental pulp and surrounding tissues, faces a significant challenge in combating microbial infections. Persistent root canal infections and resistance to conventional antimicrobials are serious concerns and require joint efforts at every level and necessitate innovative therapeutic strategies.[1,2] One such promising solution is the use of antimicrobial peptides (AMPs).

AMPs are naturally occurring oligopeptides found in various organisms, forming an integral part of the innate immune system.[3] These peptides exhibit broad-spectrum antimicrobial activity against bacteria, fungi, and viruses, functioning by disrupting microbial membranes or interfering with intracellular processes.[4–6]

1. Relevance to Endodontics

Microbial biofilms are the primary culprits in endodontic infections, often persisting despite rigorous disinfection protocols during root canal therapy. Conventional treatments, including sodium hypochlorite and calcium hydroxide, have limitations, such as cytotoxicity, resistance, and incomplete eradication of biofilms. AMPs offer a novel alternative due to their:

1.1. Biofilm penetration

AMPs can disrupt and eradicate mature biofilms, ensuring more effective microbial control. Human β-defensins play a crucial role in protecting the host against infectious microbes and contributing to dental pulp production in both healthy individuals and patients.[7] The HBD3 peptide demonstrated greater antibacterial effectiveness against mature multispecies biofilms in vitro compared to calcium hydroxide or chlorhexidine.[8] Additionally, it also demonstrated inhibition of the growth of E. faecalis biofilms in infected dentine blocks.[9]

1.2. Low resistance potential

Unlike traditional antibiotics, AMPs minimize the development of resistant microbial strains. Their ability to target multiple microbial pathways reduces the likelihood of resistance development, making them a game-changer in infection control.[10]

1.3. Biocompatibility

Certain AMPs are biocompatible, ensuring minimal damage to surrounding periapical tissues.

* *Corresponding author.*
E-mail address: endobyvineeta@gmail.com (V. Nikhi).

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2. Applications in Endodontics

2.1. Root canal irrigation

The most commonly used root canal irrigant, sodium hypochlorite is an effective antimicrobial agent and can effectively remove biofilm. However, significant concerns have been raised regarding its relative toxicity, inability to eliminate the smear layer, and unpleasant taste.[11] Additionally, the effectiveness of NaOCl is concentration-dependent; while higher concentrations enhance its antimicrobial properties, they also negatively impact the mechanical strength of dentin.[12] AMPs can be integrated into irrigants to enhance microbial eradication while preserving tissue integrity. DJK-5 effectively and rapidly eliminated most bacteria in all biofilms, showing significant superiority compared to the 8.5% EDTA, and 2% CHX. Higher concentrations of DJK-5 and prolonged exposure (3 minutes) proved more effective than lower concentrations and shorter exposure durations.[13]

2.2. Intracanal medicaments

As medicaments, AMPs can sustain antimicrobial activity between appointments, preventing reinfection.

2.3. Regenerative endodontics

AMPs promote pulp regeneration by providing a conducive environment free from microbial contamination. Additionally AMPs due to their unique abilities, including, stimulating cell migration, promoting angiogenesis, enhancing cell growth, and modulating immune responses facilitates wound-healing.[14,15]

2.4. Coatings for endodontic materials

Incorporating AMPs into gutta-percha or sealers can provide sustained antimicrobial effects.

3. Challenges and Future Directions

Despite their immense potential, the clinical application of AMPs in endodontics faces hurdles such as cost-effective synthesis, stability in the harsh root canal environment, and potential immunogenicity. Future research should focus on:

3.1. Developing synthetic analogs

Enhancing stability and reducing production costs.

3.2. Combination therapies

Integrating AMPs with existing antimicrobials for synergistic effects.

3.3. In vivo studies

Conducting extensive clinical trials to validate safety and efficacy.

4. Conclusion

Antimicrobial peptides represent a paradigm shift in managing endodontic infections. Their unique properties offer a safer, more effective, and innovative approach to microbial control in endodontics. As research progresses, AMPs could redefine treatment standards, enhancing success rates and patient outcomes in root canal therapy.

The road to widespread adoption may be challenging, but the potential of AMPs to transform endodontic care is undeniable. Investing in this frontier is not just an option—it is a necessity for the future of dental therapeutics.

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6. Conflict of Interest

None.

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Author's biography

Vineeta Nikhi, Director PG Studies; Professor and Head
https://orcid.org/0000-0003-3954-5676