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Lesion Sterilization Tissue Repair and Recent Advances: A Review

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Abstract

Lesion sterilization tissue repair (LSTR) is an emerging approach in dentistry, aimed at eliminating infectious microorganisms from the root canals and promoting tissue repair. This review provides a comprehensive overview of the principles, techniques, and recent advances in LSTR. The traditional root canal treatment focuses on complete debridement and disinfection of the root canal system. However, LSTR offers an alternative approach by employing a triple antibiotic paste (TAP) consisting of metronidazole, ciprofloxacin, and minocycline. This antibiotic combination has shown promising results in eliminating the root canal microbiota, particularly in cases of immature teeth with open apices and necrotic pulps.

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1. INTRODUCTION

Lesion Sterilization Tissue Repair is a vital technique in endodontics and dentistry used for the treatment of infected root canals. The approach involves a combination of multiple antibacterial drugs, which, when placed in the root canal system, can disinfect the area, promote healing, and reduce the bacterial load. In recent years, LSTR has undergone significant advancements and modifications to enhance its effectiveness, reduce adverse effects, and improve clinical outcomes. This review also discusses the importance of proper case selection and a thorough understanding of the limitations and potential complications associated with LSTR. While the approach holds promise, careful consideration of patient-specific factors, such as age, systemic health, and the extent of root canal pathology, is essential in achieving successful outcomes.[1]

2. PROCEDURE OF LESION STERILIZATION TISSUE REPAIR

LSTR involves a multistep procedure that aims to disinfect the infected root canal system while promoting regeneration of periapical tissues. The procedure consists of the following steps:[2]

2.1. Access opening: The tooth is isolated, and an access cavity is prepared to gain entry to the infected root canal.

2.2. Canal debridement: The root canal is thoroughly cleaned using hand and rotary instruments, removing necrotic tissues, debris, and microorganisms.

2.3. Medicament placement: In the conventional LSTR approach, a combination of different antibacterial drugs such as triple antibiotic paste (TAP) is placed into the root canal. These commonly include metronidazole, ciprofloxacin, and minocycline. The paste is left in the canal for a specified duration, typically 1-2 weeks.

2.4. Medicament removal: After the desired duration, the TAP is removed, and the canals are irrigated to eliminate any remnants of the medicament.

2.5. Periapical seal: The canals are then sealed using an appropriate root canal filling material to prevent reinfection.

3. PREPARATION OF TRIPLE ANTIBIOTIC PASTE FOR LESION STERILIZATION TISSUE REPAIR

The preparation of the Triple Antibiotic Paste (TAP) is a critical aspect of the LSTR protocol and requires careful attention to ensure the appropriate antimicrobial and tissue-regenerative properties. The standard formulation of TAP consists of three antibiotics: metronidazole, ciprofloxacin, and minocycline, combined with a suitable vehicle such as propylene glycol or distilled water.[2-5]

The following steps outline a typical method for preparing TAP:

3.1. Weighing and Measuring the Antibiotics: Accurately measure the prescribed quantities of metronidazole, ciprofloxacin, and minocycline based on the recommended formulation ratios. Care should be taken to ensure precision in measuring the antibiotic powders to achieve the desired antimicrobial efficacy.

3.2. Mixing with Vehicle: Incorporate the measured antibiotics into the designated vehicle, ensuring thorough mixing to achieve a homogeneous paste. The choice of vehicle may depend on the specific clinical requirements and the desired consistency of the paste.

3.3. Evaluation of Consistency and Color: Assess the consistency and color of the prepared paste to ensure uniformity and homogeneity. The paste should have a smooth and uniform texture, and the color may vary based on the composition, with minocycline contributing to the characteristic dark coloration.

3.4. Sterility and Aseptic Technique: Maintain strict aseptic conditions throughout the preparation process to prevent contamination of the TAP. Proper hand hygiene and the use of sterile equipment and containers are essential to ensure the sterility of the final paste.

It is important to note that variations in the TAP formulation may exist based on the specific clinical requirements and the preferences of the treating endodontist. Additionally, recent advancements have explored alternative antibiotic combinations and vehicles to address the potential drawbacks associated with the traditional TAP formulation, such as tooth discoloration and antibiotic resistance.

The proper preparation and utilization of TAP are integral to the success of LSTR, as it plays a pivotal role in eliminating the root canal microbiota and stimulating tissue repair within the infected root canal system. Endodontic practitioners should adhere to established guidelines and best practices for preparing TAP to optimize its therapeutic effects and minimize potential adverse outcomes.

4. INDICATIONS

LSTR is indicated for the treatment of immature teeth with open apices and necrotic pulps, particularly in cases where conventional root canal therapy may be challenging. It is also considered in teeth with periapical lesions where preservation of the pulp vitality and promotion of tissue repair are desirable.[6,7]

5. CONTRAINDICATIONS

LSTR may not be suitable for cases with established resistance to the antibiotics used in the triple antibiotic paste (TAP), as well as for patients with known allergies to the antibiotic components. Furthermore, LSTR may not be indicated for cases with extensive root canal calcification or when the tooth is deemed non-restorable.[6,7]

6. ADVANTAGES

The use of LSTR offers several advantages, including the elimination of root canal microbiota, promotion of apical closure and dentinal wall thickening, and stimulation of periapical tissue regeneration. It provides an alternative treatment option for teeth with incomplete root development, potentially enhancing the prognosis and preserving the vitality of the pulp tissue. [8,9]

7. LIMITATIONS

LSTR has inherent limitations, including the potential for discoloration of the tooth due to the presence of minocycline in the TAP. Moreover, the reliance on antibiotic therapy raises concerns about the development of antibiotic resistance and potential side effects. Additionally, LSTR may not be applicable in cases where the root canal anatomy poses challenges for adequate disinfection and obturation.[8,9]

8. RECENT ADVANCES IN LESION STERILIZATION TISSUE REPAIR

8.1. Development of alternative medicaments: While the conventional TAP has shown success, recent studies have explored alternative medicaments to enhance the disinfection and regenerative potential of LSTR. For example, calcium hydroxide-based pastes, such as calcium hydroxide mixed with chlorhexidine, have demonstrated promising antibacterial and regenerative properties. Additionally, a mixture of antibiotics with corticosteroids has been investigated to improve tissue repair and reduce adverse effects.[10]

8.2. Nanotechnology in medicament delivery: Nanotechnology has emerged as a promising tool to enhance the efficiency of medicament delivery in LSTR. Researchers have developed nanoscale drug carriers capable of controlled and sustained release of antibacterial agents within the root canal system. These nanocarriers can not only improve the eradication of bacteria but also facilitate periapical tissue regeneration. This represents a significant advancement in the field of LSTR.[11]

8.3. Photodynamic therapy (PDT) in LSTR: PDT involves the activation of a photosensitizer by light of a specific wavelength, leading to the production of singlet oxygen molecules that have potent antibacterial effects. Recent studies have explored the incorporation of PDT as an adjunct to LSTR for enhanced disinfection of the root canal system. PDT has demonstrated promising results in reducing bacterial load and promoting periapical tissue regeneration.[12]

8.4. Biomedical materials for periapical repair: Besides disinfection, LSTR's regenerative potential is crucial for successful treatment outcomes. Researchers have focused on developing biomaterials and scaffolds to aid periapical tissue repair and regeneration. These materials can provide structural support and stimulate cell migration, proliferation, and differentiation. Bioceramics, synthetic polymers, and biocompatible hydrogels are being explored for their potential in tissue engineering and periapical repair during LSTR.[13]

8.5. Microbial profiling and personalized treatment: Advancements in microbial profiling techniques and next-generation sequencing have provided valuable insights into the composition and diversity of microbial communities in infected root canals. This information can aid in tailoring personalized LSTR treatments by identifying the specific bacteria present and their antibiotic susceptibility profiles. This approach offers the potential for more targeted and effective treatment outcomes.[14]

9. CONCLUSION

Lesion Sterilization Tissue Repair has evolved as an effective approach in endodontics for the disinfection and regeneration of infected root canals. Recent advances in this field, including the development of alternative medicaments, nanotechnology-based drug delivery, photodynamic therapy, biomedical materials, and personalized treatment approaches, have shown promising results in enhancing the effectiveness of LSTR. These advancements hold great potential for improving treatment outcomes, reducing adverse effects, and supporting periapical tissue regeneration. Further research and clinical trials are warranted to validate their efficacy and establish standardized protocols for their use in routine endodontic practice.

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