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Lesion Sterilization and Tissue Repair: A Literature Review

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Abstract: LSTR, also known as NIET or non-instrumental endodontic treatment, bills itself as "a new biologic technique in the treatment of carious lesions with or without pulpal and periapical involvement employing a mixture of 3 antibiotics." The Niigata University School of Dentistry's Cariology Research Unit created this idea in 1988. The LSTR technique is typically justified by using triple antibiotic paste to eradicate the microbial flora occupying the diseased pulpal cavity. Different writers have substituted the traditional addition of ciprofloxacin, metronidazole, and minocycline in a vehicle of propylene glycol and macrogol. The technique, its indications, usage, and the clinical steps needed to perform the technique are all reviewed in this article.

Keywords: NIET, LSTR, Lesion Sterilization and Tissue Repair

Introduction: The preferred method of treatment for primary teeth with pulp-related carious lesions is pulp therapy in the form of pulpotomy / pulpectomy. However, some circumstances,

such as significant root resorption and/or the presence of furcal radiolucency, may preclude pulpectomy, leaving extraction as the only course of action. If an extraction is carried out, a space maintainer should be issued to stop any potential space loss. The anatomy of the root canals in primary teeth is notoriously complex. The thin, flared-out roots prevent complete mechanical debridement from being done all the time. It is still debatable whether or not to use chelating agents and caustic chemicals. In order to prevent irrigants from penetrating the periapical tissues excessively, the presence of resorbing roots places a premium on careful irrigation practises. All these elements cast doubt on whether the root canal system of primary teeth has been completely disinfected.[3,4]

Lesion sterilization and tissue repair (LSTR) seems to be a promising alternative for primary teeth in which pulpectomy has been contra-indicated. The Cariology Research Unit of the Niigata University School of Dentistry has invented the idea of lesion sterilisation and tissue repair therapy, which makes use of a combination of antibacterial medications to clean up dentinal, pulpal, and periapical lesions on teeth. If lesions are disinfected, it is likely that injured tissues will heal. A single antibiotic is insufficient to disinfect a root canal due to the polymicrobial nature of an infected root canal. Consequently, a mix of antibacterial medications is employed. The choice of antibacterial medications has been made in light of numerous research on the isolation of bacteria from oral sites, including endodontic diseases of primary teeth.[4] The technique, its indications, usage, and the clinical steps needed to perform the technique are all reviewed in this article

Evolution of LSTR: Antibiotic usage in endodontic treatment is not a brand-new idea. In 1951, Grossman developed a poly antibiotic paste including penicillin, bacitracin, streptomycin, and caprylate sodium.[5] Ledermix paste, a well-known pulp capping agent, contains triamcinolone and demethylchlortetracycline and was used to treat pulpal irritation in baby teeth.[6] By using a combination of zinc oxide eugenol, tetracycline, and chloramphenicol, Sollier and Cappiello created the first obturating material with an antibiotic included in its formula in 1959.[7]

In 1990, Hoshino et al. combined antibiotics in a 1:1:1 ratio, including metronidazole 500 mg, ciprofloxacin 200 mg, and minocycline 100 mg.[8] In 1998, Takushige et al. utilised a 1:3:3 ratio of the aforementioned antibiotics.[4] The nitroimidazole group compound metronidazole binds to DNA and inhibits the growth of both gram positive and gram negative anaerobes. The fluoroquinolone group of drugs includes ciprofloxacin, which inhibits DNA gyrase and aids in the

eradication of gram-negative bacteria. The broad range antibiotic minocycline works by preventing the production of new proteins, collagenases, and matrix metalloproteinases. It eliminates spirochetes as well as gram-positive and gram-negative germs.[9-11] Since minocycline has the drawback of causing tooth discoloration, antibiotics like amoxicillin, cefaclor, cefroxadine, fosfomycin, or rokitamycin might be used as substitutes. Discoloration is due to the photo-induced reaction. Minocycline forms insoluble complexes by chelation reactions with calcium ions.[11]

Preparation of triple antibiotic paste: The creation of triple antibiotic paste is LSTR's most crucial phase. Combination of metronidazole, ciprofloxacin, and minocycline is the most widely used.[11] The exterior capsular material of the capsule is removed, and the enteric coating of the tablet is removed by scraping the coating with a blade. Then, in a fresh mortar and pestle, each component is ground individually. Powder should not be wetted, hence care should be given. In order to avoid exposure to light and moisture at this stage, the powder can be stored separately in tightly-capped porcelain containers and kept in a dark area or the refrigerator. To prepare antibiotic paste each ingredient is placed in a clean glass mixing pad or slab after being well ground. The solvent is then released in a portion. A soft ball-like structure with a 1 mm diameter will be the final preparation. If the mixture is too soft, add more three mix powder. More solvent should be used if the preparation starts to flake, dry, or get too hard.[12]

Vehicle for preparation of triple antibiotic paste: For the purpose of disinfecting root canals in LSTR, a mixture of three antibiotics—ciprofloxacin, metronidazole, and minocycline (3 Mix)—is administered via a vehicle (mixing media) made of macrogol and propylene glycol. Propylene glycol and Macrogols are synthetic substances that are used as vehicles in various cosmetic and medicinal products.[13]

Rationale of using antibiotics: Systemic antibiotic therapy has been shown to be beneficial for both surgical and non-surgical dental procedures, but it also has significant drawbacks, including a variety of side effects (toxicities or allergic reactions) and the emergence of resistant microbial strains. Additionally, undergoing systemic antibiotic therapy depends on a variety of variables, such as the patient's compliance with following a specific dosage regimen, the gastrointestinal system's absorption of these medications, and their transportation through the blood circulatory system to the infected area, which implies that the medication-required area has a sufficient blood supply, which is no longer present in teeth with necrotic pulp, a pulpless and infected canal, or a root-canal infection. Therefore, administering antibiotics locally within the canal may be a more

efficient way to provide the medication.[14,15]

Rationale of using antibiotics in combination: Single empirical antibiotics cannot create a bacterial-free zone in the canal due to the polymicrobial nature of tooth infection. Additionally, non-specific antibiotic medication may cause the normal bacterial flora to be destroyed, which would then allow any remaining virulent pathogens to repopulate the canal. To stop the development of microbial resistance, it is crucial to utilise a combination of antibiotics against all endodontic infections.[14,15]

Table no. 1: Various combinations of Triple Antibiotic Paste used by investigators

Author	Combination of antibiotics
Nakornchai et al. (2010)[16]	Metronidazole, Ciprofloxacin, Minocycline
Pinky et al. (2011)[17]	Ciprofloxacin, Ornidazole, Minocycline
Jaya et al. (2012)[18]	Ciprofloxacin, Minocycline, Tinidazole
Burrus D et al. (2014)[19]	Metronidazole, Ciprofloxacin, Clindamycin.
Doneria D et al. (2017)[20]	Ornidazole, Ciprofloxacin, Cefaclor
Lokade A et al. (2019)[21]	Ciprofloxacin, Ornidazole, Cefaclor
Shankar K et al. (2021)[22]	Ciprofloxacin, Metronidazole, Clindamycin

Table no. 2: Indication and Contraindication of LSTR[12,23]

Indication	Contraindication
Patients lacking cooperation	Children with known allergy to the agents used
Strategically important teeth	Radiographic evidence of excessive internal and external resorption
Severe bone loss and mobility	Primary tooth nearing exfoliation
Radiolucency in the furcal area	Cases with perforated pulpal floor
Teeth with Grade I and II mobility	Children with infective endocarditis
Presence of abscess	Non restorable tooth
Presence of sinus tract	
Pulpless primary teeth in hemophilic patient	
Immature primary teeth with necrotic pulp and incompletely formed roots	

Discussion: For a number of reasons, standard endodontic therapies fail when dental caries affects the pulp tooth complex and causes periradicular pathosis. The pulp of the tooth often develops infections that are multimicrobial in nature and comprise both aerobic and anaerobic microorganisms. Endodontic treatment ensures treatment success by thoroughly disinfecting the root canal system and effectively eliminating the causing germs. Despite all of the standard cleaning and irrigation procedures, some bacterial flora may still be present. This can lead to treatment failure and is the primary cause of reinfection. The process of lesion sterilization and tissue repair shows to be the only practical choice through which the damaged tooth can be given a positive prognosis, aiding the dentist and the patient in overcoming such challenging circumstances.[23]

Three antibiotics, metronidazole, ciprofloxacin, and minocycline, are combined in TAP, a "intra-canal medicament," at a specific ratio of 1:1:1 to achieve effective outcomes. Since no single antibiotic has the power to eradicate the entire polymicrobial flora, TAP is used to get the greatest outcomes and completely clean the area. TAP, a tri-antibiotic combination, provides potent antibacterial effects during endodontic regeneration surgery. The canal prepares the way for the cells with the potential to renew by cleaning and sterilizing the area. The three drugs working together in a single mixture is very effective since it significantly lowers the likelihood of germ resistance.[24]

TAP and Vitapex® had substantial results in root canal treatment of infected primary teeth, according to Nakornchai et al. (2010)[16]. The success rate for TAP is 96% at 24-27 months after treatement, researchers looked at the clinical and radiographic success rates of TAP in non-instrumentation endodontic treatment of primary mandibular molars; despite a low success rate based on a two-year radiographic study, the findings demonstrated that this approach had a high success rate.[16]Takushige et al. studied TAP's effect on the clinical outcome of lesion sterilization and tissue repair treatment in primary teeth with peri-radicular lesions. Clinical symptoms such as sinus tracts, gingival swelling, dull soreness, and other symptoms disappeared after treatment. The teeth that were effectively treated appeared and normally erupted on radiographs.[25]

One of the main problems with TAP is the discoloration of the teeth. Comparing TAP to other antibiotic pastes as ledermix, polyantibiotic paste, and septomixine forte, studies have indicated that TAP is more strongly associated with discoloration. Due to this, the use of double antibiotic paste (DAP), which solely contains ciprofloxacin and metronidazole, has been

recommended in specific circumstances.[24]

Conclusion: Complexity of the primary teeth is widely understood. Thin dentinal walls, flaring deciduous roots, the presence of resorbing apices that may create an excessive effect of the irrigant employed, non-negotiable convoluted canals, and reluctant youngsters all contribute to this and may encourage physicians to consider an alternative to hasty extraction. To overcome such difficult situations the procedure of lesion sterilization and tissue repair proves to be the only viable option by which the good prognosis of the affected tooth can be achieved, thus helping the dentist and the patient to overcome such difficult situations.

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