

# Lesion Sterilization and Tissue Repair (LSTR): A Review

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*Abstract: Lesion Sterilization and Tissue Repair (LSTR) is also called NIET or Non-Instrumental Endodontic Treatment as it claims to be a “new biologic approach in the treatment of carious lesions with periapical involvement using a mixture of 3 antibiotics (3-Mix).” LSTR involves the use of three antibiotics/antibacterial drugs namely, Metronidazole, Ciprofloxacin and Minocycline. This therapy aims to eliminate bacteria from the root canals by sterilizing the lesion and promoting tissue repair and regeneration by the host’s natural tissue responses. Present review of literature aims to discuss LSTR in details.*

*Keywords: Lesion Sterilization and Tissue Repair, LDTR, NIET*

**Introduction:** The major aim of pediatric dentistry is to maintain the integrity of the primary dentition until physiologic exfoliation. Premature loss of primary teeth may leads to several complications, like disturbance in eruption sequence, ectopic eruption and space loss. Hence, the conservation of primary tooth structure is essential, provided that it can be restored to function and remain free from disease.<sup>1</sup>

Pulp therapy in primary teeth at times become contraindicated or compromised due to excessive root resorption, inadequate bone and periodontal support, a child with pre-cooperative age group etc.<sup>2</sup> In the current era, a new perspective which is less invasive and less time consuming procedure could be a spark of hope for the pediatric patient as well as the pedodontist. The LSTR claims its significance in such clinical situation. Hoshino et al. in 1990 developed the concept of LSTR at Cariology Research Unit of Niigata University

School of Dentistry and letter on it was popularized by Takushige (2004). The LSTR is an endodontic treatment procedure that involves non instrumentation or minimal instrumentation followed by placement of antibiotic mixture in a propylene glycol vehicle to disinfect root canal systems, and periapical lesions. The basic concept of LSTR is that "does not remove or touch and leave it." It medicates and treats caries, pulpitis and root canal infection. The principle behind LSTR is repair by natural defence mechanisms of host. Sterilizing the root canals and pulp chamber by medicaments can decrease the bacterial load. Sterilization with medicaments will lead to 20 to 40% cleansing action and debridement. Most commonly a combination of three antibiotics along with solvent macrogol and propylene glycol are used, so it is also known as three mix pastes. If the procedure is successful tissue repair can be expected.<sup>3</sup>

Few studies have reported the successful use of LSTR in primary teeth with periradicular lesions.<sup>4,5</sup> It has also been proposed as an alternative to routine pulpectomies in uncooperative children and in canals which are nonnegotiable.<sup>6</sup>

### **Preparation for LSTR**

Hoshino et al. (1990) used combinations of antibiotics like metronidazole 500mg, ciprofloxacin 200 mg, minocycline 100 mg in 1:1:1 ratio.<sup>7</sup> Takushige et al. in 1998 used the above antibiotics in the ratio 1:3:3.<sup>3</sup> Metronidazole belonging to the nitroimidazole group, it binds to DNA and acts against gram positive and gram negative anaerobes. Ciprofloxacin is categorized under fluoroquinolone group acts by the inhibition of DNA Gyrase and facilitates the destruction of gram-negative organisms. Minocycline is a broad spectrum antibiotic that acts by inhibiting protein synthesis, collagenases, and matrix metalloproteinase. It destroys gram-positive as well as gram-negative microorganisms and also Spirochetes. Discolouration of teeth being a disadvantage of minocycline, antibiotics like amoxicillin, cefaclor, cefroxadine, fosfomycin or rokitamycin can be used as alternatives. Discoloration is due to the photo-induced reaction. Minocycline forms insoluble complexes by chelation reactions with calcium ions.<sup>8</sup>

Other combination pastes which were used are Grossman's polyantibiotic paste (Penicillin, Bacitracin, and Streptomycin) and Ledermixpaste (Triamcinolone and Demeclocycline), Calcium hydroxide pastes, chlorhexidine paste, neomycin, polymyxin, and nystatin.<sup>9</sup>

Organic solvents like macrogol or propylene glycol are specifically used because of their increased penetration into the dentinal tubules.<sup>10</sup>

### **Preparation of triple antibiotic paste**

The most important step in LSTR is the preparation of triple antibiotic paste. The most common combination is the one proposed by Takushige et al. which includes metronidazole, ciprofloxacin, and minocycline.<sup>11</sup>

The enteric coating of the tablet is removed by scraping the coating with a blade, and for the capsule the outer capsular material is removed. Then each of the components is powdered separately in clean mortar and pestle. Care should be taken to avoid wetting of powder. At this stage, if the powder has to be stored, it can be stored separately in tightly capped porcelain containers and stored in dark place or in the refrigerator to prevent exposure

to light and moisture. After proper pulverization, each of the components is taken in a clean glass slab/mixing pad. Then a part of the solvent is dispensed. The triple antibiotic mixture has maximum effect when seven parts of powder are mixed with one part of solvent. So after dispensing, the powder is divided into seven parts and each part mixed separately with the solvent to ensure uniform consistency of the mix. The final preparation will be a soft ball-like structure of 1 mm diameter. If the mix is soft add more three mix powder to this. If the preparation becomes flaky, dry and too hard, then add more solvent. Resultant opaque paste has to be stored in airtight containers. If the mix turns translucent on storage, it has to be discarded.<sup>12</sup>

**Table no 1: Some other combination used in literature**

Author	Combination
Vijayaraghavan R et al. (2012)	Metronidazole, Ciprofloxacin, Minocycline <sup>13</sup>
Windley W et al. (2005)	Metronidazole, Ciprofloxacin, Amoxicillin <sup>14</sup>
Triveni MN et al. (2019)	Ciprofloxacin and Metronidazole <sup>15</sup>
Grieve AR et al. (1973)	Neomycin, Polymyxin, Nystatin <sup>16</sup>
Jaya AR et al. (2012)	Ciprofloxacin, Minocycline, Tinidazole <sup>17</sup>
Pinky C et al. (2011)	Ciprofloxacin, Ornidazole, Minocycline <sup>18</sup>
Kaufman AY et al. (2014)	Ledermix paste (Triamcinolone-a corticosteroid and demeclocycline-a tetracycline antibiotic) <sup>19</sup>

### Procedure

After preparation of triple antibiotic paste, the next step is access cavity preparation. Rubber dam isolation is done after achieving local anesthesia. The access cavity is prepared using #4 round bur and the necrotic tissue is removed followed by irrigation with saline and sodium hypochlorite. The ethylenediaminetetraacetic acid (EDTA) is a better choice as it removes the smear layer leading to clean and patented dentinal tubules, which could allow deeper penetration of antibiotics into the dentinal tubules. If haemorrhage is present, it can be controlled by using sodium hypochlorite, an effective haemostatic agent. It does not interfere with pulpal healing and clots can be removed moreover it stops the pulpal haemorrhage that compromises pulpal healing and is nontoxic to pulpal tissue. Next step is the preparation of medication cavity using a round bur at the canal orifice which is 2 mm deep, and 1 mm wide, and is meant for retaining the triple antibiotic paste at the canal orifice. After proper drying, the paste is placed in the cavity, and permanent restoration is done using glass ionomer cement followed by stainless steel crown placement.<sup>11</sup>

### Factor affecting the action of triple antibiotic paste

1. **Amount of drug-** The amount of drug should be enough so as to cause adequate sterilization. An inadequate concentration means either less or no elimination of microbes. The drug should possess the ability to diffuse periapically from the canal and produce sterilization in cases where regenerative techniques are especially contemplated.<sup>20</sup>
2. **Biocompatibility:** The medicaments used in root canals should cause the least damage to the host cells in spite of possessing antimicrobial properties, and should not

cause any sensitivity/allergy to the patient. The medicaments used should be biocompatible.<sup>9</sup>

3. **Smear layer:** Presence of smear layer acts as a barrier to the diffusion of irrigants. Hence removal of smear layer has shown proper diffusion of medicaments bringing about better disinfection. This can be achieved either by using EDTA or ultrasonic cleansing or both which can open up the dentinal tubules and increase penetration.<sup>9</sup>
4. **Presence of infection:** Pulpal infection is polymicrobial in nature; hence combinations of medicaments are required for this purpose

**Table no 2: Review of literature**

Author	Observation
Nakornchai S et al. (2010)	Compared the clinical and radiographic success of 3Mix and Vitapex for root canal treatment of pulpally involved primary molars in 37 children he concluded that 3Mix can be used as a root canal treatment agent in pulpally involved primary teeth. <sup>21</sup>
Pinky et al. (2011)	Conducted a study on 4 to 10 year-olds patients with 40 infected primary teeth to evaluate the clinical and radiographic success of endodontic treatment using combinations of antibacterial drugs. In Group A, antibacterial paste containing Ciprofloxacin, Metronidazole, and Minocycline and in Group B, antibacterial paste containing Ciprofloxacin, Ornidazole, and Minocycline mixed with propylene glycol were used. Medication cavities were filled with antibiotic pastes, depending on the groups followed by glass ionomer cement restorations and stainless steel crown placement. Clinical and radiographic evaluation was carried out at 3, 6, and 12 months intervals. The result showed no statistically significant differences between the groups, suggesting 100% success with these combinations in treating necrosed primary teeth. <sup>18</sup>
Takushige T et al. (2004)	Used mixture of Metronidazole, Ciprofloxacin, Minocycline for LSTR and found that the primary teeth with or without physiologic root resorption can be treated successfully with LSTR <sup>3</sup>
Gupta T et al. (2018)	Used Metronidazole, Minocycline, and Ciprofloxacin (3Mix), and propylene glycol as pulp medicament on a necrosed primary molar and found positive clinical and radiographic response on necrosed primary molars in an uncooperative patient. <sup>22</sup>
Chakraborty B et al. (2018)	In young uncooperative children, extraction can be avoided and LSTR therapy can be opted for, making the dental treatment nontraumatic. <sup>6</sup>

**Conclusion:** Lesion sterilization and tissue repair (LSTR) treatment involves the use of a triple antibiotic mixture in a suitable vehicle, which is used to disinfect root canal systems. It is also called NIET or Non-Instrumental Endodontic Treatment as it claims to be a “new

biologic approach in the treatment of carious lesions with periapical involvement using a mixture of 3 antibiotics (3-Mix).” It is a simple, time-saving, cost-effective method for relief of symptoms in necrotic abscessed primary molars which is complicated and more challenging in uncooperative children due to behavior management problems, restricted mouth opening, root canal system complexities, a risk of damaging the permanent tooth bud and require multiple visits

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