Content available at: https://www.ipinnovative.com/open-access-journals

IP International Journal of Maxillofacial Imaging

Journal homepage: https://www.ijmi.in/

Review Article

Lesion sterilization and tissue repair - A non-instrumental procedure: A systematic review

Nishi Singh[1], Ramiz Raja Mallick[2], Supreeya Patel[1], Nilotpol Kashyap[1]*, Sreyashi Seth[3], Jaya[1]

[1]*Dept. of Pedodontics and Preventive Dentistry, Vananchal Dental College and Hospital, Garhwa, Jharkhand, India*
[2]*Dept. of Orthodontics and Dentofacial Orthopedics, Vananchal Dental College and Hospital, Garhwa, Jharkhand, India*
[3]*Dept. of Pedodontics and Preventive Dentistry, Hazaribag College of Dental Science and Hospital, Hazaribagh, Jharkhand, India*

ARTICLE INFO

Article history:
Received 14-11-2023
Accepted 09-12-2023
Available online 01-01-2024

Keywords:
Dental Caries
Primary tooth
LSTR
Noninstrumental endodontic treatment

ABSTRACT

A primary tooth affected by dental caries involving the pulp tissues along with periradicular tissues need conventional endodontic treatment. Due to certain factors these treatments may be contraindicated. In that case Lesion Sterilization and Tissue Repair (LSTR) therapy is the better option to be preferred. The process of LSTR is to increase the longevity of the primary tooth. This procedure eliminates, sterilizes the canal system, repairs and regenerates the tissue. It needs minimal instrumentation and includes placement of an antibiotic mixture in the pulp chamber to disinfect the root canals. It is also known as Non-instrumental endodontic treatment (NIET).

1. Introduction

In routine dental practice, clinicians come across a number of cases where a primary tooth affected by dental caries involving the pulp tissues along with periradicular tissues are beyond conservation by traditional endodontic treatment and need conventional endodontic procedures.[1] The ultimate goal of paediatric dentistry is to ensure that the best of oral health care is made available to all children and to maintain and preserve the integrity of the primary dentition until physiologic exfoliation. Despite more knowledge and contemporary methods of caries prevention, dental caries is still very common.[2] Extraction is now the sole recommended course of action in this case. Periodontal disease, excessive root resorption, insufficient bone support, a kid in the pre-cooperative age range, and other conditions might make pulp treatment contraindicated or hampered. The dentist is left perplexed about pulp treatment.[1] The development of occlusion is significantly influenced by primary teeth. Primary teeth that have been successfully cleaned and repaired can be the most promising space maintainers.[3] Therefore, as long as the tooth can be made healthy again and returned to function, its core tooth structure must be preserved.[2]

A new approach that is less intrusive and time-consuming in the present day may provide hope to both the patient and the physician. Lesion Sterilization and Tissue Repair (LSTR) asserts its importance in these kinds of therapeutic situations. The LSTR is an endodontic treatment technique that entails minimum or no instrumentation, followed by the disinfection of root canal systems and periapical diseases using an antibiotic combination dissolved in a propylene glycol carrier. LSTR's guiding principle is to "do not remove or touch and leave it." It is a medicated treatment for root canal infections, caries, and pulpitis.

* *Corresponding author*.
E-mail address: nilkash9365@gmail.com (N. Kashyap).

https://doi.org/10.18231/j.ijmi.2023.028

The idea behind LSTR is that the host's natural defensive systems can restore itself. The bacterial burden can be reduced by medicating the pulp chamber and canals. Using medication to sterilize will result in a 20–40% cleaning and debridement effect. Three mix MP pastes are another name for the mixture of three antibiotics that are most frequently employed in conjunction with propylene glycol and macrogol as solvents. It has also been suggested as a substitute for standard pulpectomies in cases with non-negotiable canals and youngsters who are recalcitrant. Tissue repair is anticipated in the event that the surgery is effective.[1]

2. History

The use of antibiotics in endodontic treatment is not an entirely new concept. Grossman in the year 1951 introduced the poly antibiotic paste which was composed of Penicillin, Bacitracin, Streptomycin and Caprylate sodium. Ledermix paste containing Triamcinolone and Demethylchlortetracycline is a well-known pulp capping agent which was used to control pulpal inflammation in primary teeth. Chloramphenicol-Tetracycline-Zinc Oxide Eugenol (CTZ) paste was the first obturating substance containing an antibiotic, created in 1959 by Sollier and Cappiello using a mixture of zinc oxide eugenol, tetracycline, and chloramphenicol. In 1969, Benfatti and Andrioni employed lancomycin and zinc oxide as an obturating substance. In 1981, Guedes-Pinto paste was later introduced. It contained Rifocort® ointment, a corticosteroid and antibiotic combination of sodium rifamycin and prednisolone acetate. The remaining ingredients were iodoform (powder) and camphorated paramonochlorophenol (liquid). The primary drawback of using guedes-pinto paste was its manipulability; various doctors may change the dosage of each component, changing the biological features that could affect clinical outcomes or increase toxicity.[4] Additional combination pastes that were employed include neomycin, polymyxin, nystatin, calcium hydroxide pastes, and chlorhexidine paste.[1]

Since 1928, root canal treatment has been used, and because of several developments in the area throughout the years, the success rate has significantly grown[4]. However, endodontic treatment of necrotic and abscessed primary molars is still typically complex, and it can be especially tough on uncooperative kids because of issues with behavior control, limited mouth opening, intricate root canal systems, potential for permanent tooth bud damage, and the need for several visits. Thus, the concept of LSTR therapy, or non-instrumentation endodontic treatment (NIET),[4,5] was developed by Hoshino in 1990 and made popular by Takushige[1] at the Cariology Research Unit of the Niigata University School of Dentistry in Japan in response to this need. Triple antibiotic paste is used to disinfect oral infectious lesions, including dentinal, pulpal, and periapical lesions[5]It had three medications: metronidazole, propylene glycol, and macrogol combined with ciprofloxacin, minocycline, and metronidazole. It was referred to as the 3 Mix MP Paste.[4] In 1990, Hoshino et al. employed a 1:1:1 ratio to combine antibiotics such as metronidazole 500 mg, ciprofloxacin 200 mg, and minocycline 100 mg. The aforementioned antibiotics were employed in a 1:3:3 ratio by Takushige et al. in 1998.[1]

3. Preparation of Triple Antibiotic Paste/3 Mix Mp Paste

Composition of the 3 mix Mp paste[3]

Antibiotics:

1. Ciprofloxacin-200 mg
2. Metronidazole– 500 mg
3. Minocycline– 100 mg.
4. Vehicle:
5. Macrogol
6. Propylene glycol.

4. Method of Preparation of 3-Mix Mp Paste

Making triple antibiotic paste is the most crucial step in LSTR.[1] The ratio of the powders is either 1:3:3 by volume (Takushige et al.) or 1:1:1 by volume (Hoshino et al.). The vehicle is made by combining macrogol with propylene glycol at a volumetric ratio of 1:1.[4] The most popular combination consists of metronidazole, ciprofloxacin, and minocycline, and it was suggested by Takushige et al.

The antibiotics that are sold commercially are taken in different dishes. With a blade, the enteric coating of the tablet is scraped off, and the exterior capsular substance of the capsule is removed. Next, using a clean mortar and pestle, each component is individually ground into a powder. Powder should not get wet; this needs to be avoided. If the powder has to be stored at this point, it can be done so individually in porcelain containers with tight lids and kept in the refrigerator or in a dark, dry area to avoid light and moisture exposure.[1] The powders that have been ground are kept in storage at 16°C. However, before beginning to prepare the 3Mix MP paste, the powder needs to be allowed to cool to room temperature.[2] Following the appropriate grinding, each ingredient is placed on a sanitized glass slab or mixing pad. Subsequently, a portion of the solvent is released. When one-part solvent is combined with seven parts powders, the triple antibiotic cocktail works at its best. To achieve a consistent consistency of the mix, the powder is separated into seven pieces after dispensing and blended with the solvent in separate portions. A 1 mm diameter soft ball-like structure will be the ultimate preparation. Add extra three mix powder to the mixture if it seems too soft. Add extra solvent if the mixture is too firm, dry, or flaky. The opaque paste that is produced needs to be kept in sealed

containers. The mixture must be thrown out if it becomes transparent while being stored.[1] In a trial by Takushige et al., the antibiotic powder combination was utilized within a month of production.[4]

5. Rationale of Lesion Sterilisation and Tissue Repair

Despite using appropriate pulpectomy procedures, the presence of bacteria in the deep layer of root canal dentine or on islands and auxiliary canals has been linked to several outbreaks. It could be necessary to provide an antibiotic to sterilize such sores. It has frequently been observed that not all of the bacteria found in root canals can be successfully treated with a single antibiotic. Because the antibiotics would penetrate the root canal dentin, a combination of antibiotics is therefore advised for patients with periapical infections in order to sterilize the deeper layers of infected dentin. To increase the antibiotic mixture's penetrative ability, it is combined with propylene glycol and macrogol to form an ointment.[6]

6. Different Combination of Antibiotics in 3 Mix

1. With the 3mix, Sato et al. conducted a number of in vitro tests both with and without rifampicin. Additionally, they experimented with other combinations of metronidazole and ciprofloxacin with a third antibiotic, such as amoxicillin, cefaclor, cefroxadine, fosfomycin, or rokitamycin.[7]
2. Pinky et al. and Nanda et al. experimented with a combination in which ornidazole was used in place of metronidazole.[8]
3. Ruparel et al. created the "modified 3 mix" by replacing minocycline with cefaclor. They also experimented with a two-mix or double antibiotic paste that included solely metronidazole and ciprofloxacin.[9]

When young permanent teeth were revascularized with minocycline, discolouration resulted. When utilized in a deciduous tooth that was recommended for LSTR, its impact on the growing successor tooth was another topic of concern.[10]

7. Advantages of 2 Mix Over 3 Mix

Ruparel was the first to create the double antibiotic paste, or 2 mix, which is a ciprofloxacin and metronidazole combination. According to Algarni et al., the biofilm inhibition of the 2 mix was equivalent to that of the 3 mix. Additionally, they discovered that two mixes were more biocompatible than three mixes. They came to the conclusion that two mixes had a stronger residual antibacterial effect than three mixes. Kim et al. verified that the attachment and proliferation of dental pulp stem cells (DPSCS) to dentin were less adversely affected by a 1 mg/ml of 2 mix.[11]

Both antibacterial combinations sterilize the infected pulpal and periapical tissues through the same methods.[6]

7.1. Procedure of LSTR

The triple antibiotic paste is made first. The tooth is sealed off with a rubber dam, the access hole is made with a #4 round bur, the necrotic tissue is extracted, and normal saline is irrigated. Dentinal tubules can become clean and patent by using EDTA to remove the smear layer. If haemorrhage occurs, sodium hypochlorite can be used to stop it. Pulp repair is not hampered by sodium hypochlorite. The next step is to prepare the pharmaceutical cavity, which is intended to release the triple antibiotic paste mixture, by employing a circular bur at the canal opening. This burr is 2 mm deep and 1 mm broad. Following adequate drying, a 1 mm ball of the mixture is inserted into the medication cavity that has been made in each canal. GIC is then used to complete the permanent repair, which is followed by the installation of a stainless-steel crown.

8. Overview of LSTR[1,6,12]

8.1. Factors affecting the success of triple antibiotic paste

1. ***Concentration*** - TAP concentration needs to be at its ideal level. Bacteria won't be eliminated if the concentration is lower.
2. ***Biocompatibility*** - The medications utilized have to be safe for the body and not harm the host cells.
3. ***Smear layer*** - To ensure that the medication is properly diffused, the smear layer needs to be removed using EDTA.
4. ***Presence of infection*** - Since pulpal infections are polymicrobial in nature, a combination of medications is necessary.

8.2. Concerns and issues against the use of 3 mix for LSTR

1. Toxicity or allergy.
2. Strains resistant to antibiotics might emerge.
3. The transfer of genes from resistant to non-resistant bacteria may be promoted.
4. The potential for antibiotic paste to seep into the mouth and the ensuing alteration of the oral cavity's microbiota.

8.3. Indications for LSTR

1. Primary teeth affected with pain and tender on percussion
2. Teeth with Grade I and II mobility
3. Presence of abscess
4. Presence of sinus tract

5. Presence of radiolucency in furcation area
6. Pulpless primary teeth in haemophilic patient
7. Immature primary teeth with necrotic pulp and incompletely formed roots
8. A variety of clinical conditions, such as significant bone loss, advanced root resorption, and non-vital teeth
9. Parents not willing for extraction, Strategically important teeth
10. Uncooperative patient.

8.4. Contraindications of LSTR

1. Patient sensitive or allergic to ciprofloxacin, minocycline, or metronidazole
2. Radiographic evidence of excessive internal or external root resorption
3. Primary tooth nearing exfoliation
4. Perforated pulpal floor
5. Excessive bone loss in furcation area involving underlying tooth germ
6. Non-restorable crown of permanent tooth where postplacement and core buildup are not possible
7. LSTR not recommended in children with infective endocarditis

8.5. Advantage of LSTR

1. The technique is easy and simple
2. Treatment time is short, time- saving
3. Economical
4. Relatively painless
5. No instrumentation is needed
6. No obturation is required
7. Materials used are non- irritating to periapical tissues
8. There is no need to use formocresol.
9. It can be completed in one visit
10. Less of a burden to patients both physically and psychologically
11. Bone regeneration occurs when LSTR is done

8.6. Disadvantage of LSTR

1. The hard tissues in the mouth cavity might get discoloured by minocycline. This discolouration might be the result of a response to the picture. The medication generates an insoluble substance with a blue grey colour when it chelates to attach to calcium ions. Clindamycin can be used to fix the issue in place of minocycline.
2. Iodoform can be added to the initial antibiotic combination to counteract its radiolucent appearance on radiographs.
3. The evolution of antibiotic-resistant bacterial strains, pharmacological side effects, the possibility of developmental abnormalities in permanent teeth if used in primary teeth, and cyst formation if the site of persistent infection is left are the risks associated with triple antibiotic paste.
4. Because of the empty roots in teeth treated with LSTR, there is concern over the hollow tube effect. It is unknown if this happens always or if host immunity may prevent it. Unfilled root canals may be infused with tissue fluids, which then stagnate and eventually form a nidus for infection.

9. Conclusion

Lesion sterilization and tissue repair therapy can relieve symptoms in community-based dental programs, for children who are uncooperative, or in situations where primary tooth canals cannot be negotiated. It is easy to use, painless, economical, time-saving, and less taxing on patients' bodies and minds. It can be utilized as a therapeutic alternative when pulpectomies have not worked for a variety of reasons.

This novel idea should be taken into consideration, particularly in primary teeth with substantial bone loss and furcation involvement when the usual pulpectomy surgery has a bad prognosis. Proper case selection and isolation strategies must be used for LSTR to be successful.

10. Source of Funding

None.

11. Conflict of Interest

None.

References

1. Sain S, Reshmi J, Anandaraj S, George S, Issac JS, John SA, et al. Lesion Sterilization and Tissue Repair-Current Concepts and Practices. *Int J Clin Pediatr Dent*. 2018;11(5):446–50.
2. Arangannal P, Muthiah G, Jeevarathan J, Sankar P. 2019.
3. Narayanan LL, Vaishnavi C. Endodontic microbiology. *J Conserv Dent*. 2010;13:233–239.
4. Shetty AA, Geethanjali G, Hegde AM. Lesion Sterilization and Tissue Repair in Primary Teeth. *SRM J Res Dent Sci*. 2020;11:99–105.
5. Gupta T, Sadna G, Aggarwal N. Lesion Sterilization and Tissue Repair- A Recent Novel Approach for the Treatment of very uncooperative Pediatric Patients. *Curr Trends Diagn Treat*. 2018;6:50–3.
6. Kashyap N. LSTR - A New Technique for Treating Deciduous Teeth with Pulpal Infections. *EC Dent Sci*. 2023;22:1–4.
7. Sato T. In vitro antimicrobial susceptibility to combinations of drugs of bacteria from carious and endodontic lesions of human deciduous teeth. *Oral Microbiol Immunol*. 1993;8(3):172–6.
8. Nanda R. Clinical evaluation of 3 Mix and Other Mix in non-instrumental endodontic treatment of necrosed primary teeth". *J Oral Biol Craniofac Res*. 2014;4(2):114–9.
9. Ruparel N. Direct effect of intracanal medicaments on survival of stem cells of the apical papilla. *J Endodontics*. 2012;38(10):1372–5.
10. Kim JH. Tooth discoloration of immature permanent incisor associated with triple antibiotic therapy: A case report. *J Endod*. 2010;36(6):1086–91.
11. Algarni AH. Inhibitory effect of gels loaded with a low concentration of antibiotics against biofilm formation by Enterococcus faecalis and

Porphyromonas gingivalis. *J Oral Sci*. 2015;57(3):213–8.
12. Goswami S. Lesion sterilization and tissue repair in pediatric dentistry. *SRM J Res Dent Sci*. 2018;9:79–82.

Author biography

Nishi Singh, PG Student https://orcid.org/0009-0009-2580-2273

Ramiz Raja Mallick, Senior Lecturer

Supreeya Patel, Reader

Nilotpol Kashyap, Professor and HOD

Sreyashi Seth, PG Student

Jaya, PG Student

Cite this article: Singh N, Mallick RR, Patel S, Kashyap N, Seth S, Jaya. Lesion sterilization and tissue repair - A non-instrumental procedure: A systematic review. *IP Int J Maxillofac Imaging* 2023;9(4):167-171.