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Lesion Sterilization and Tissue Repair: A Review

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Abstract

Pulp therapy in the form of pulpotomy/pulpectomy is the preferred modality of treatment in case of carious lesions of primary teeth involving the pulp. Lesion sterilization and tissue repair (LSTR) seems to be a promising alternative for primary teeth in which pulpectomy has been contra-indicated. The aim of present review of literature is to discuss LSTR in detail.

Keywords*: LSTR, Lesion sterilization and tissue repair, 3-Mix paste*

Introduction

One of the most precious services a pediatric dentist can provide for the pediatric patient is the treatment of pulpally involved primary teeth. (1) Pulp therapy is a method of eliminating the pulpal infection to maintain the tooth, which would otherwise be lost. (2) Early loss of primary teeth can affect the function, proper dental and skeletal form and psychological development of a child. To avoid these problems, many treatment procedures have been proposed such as indirect pulp capping, direct pulp capping, pulpotomy, and pulpectomy. In some clinical situations, pulpectomy results in compromised treatment. The reasons being anatomic complications liked curved roots, the closeness of permanent tooth buds, apparent connection between the coronal floor with the intraradicular area and difficulty in obtaining hermetic seal due to ongoing physiologic root resorption. Another challenge is behavior management of pediatric patients. (3,4,5) Inspite of these limitations, pulpectomy is still preferred over-extraction as a natural tooth act as a superior space maintainer than an appliance. (2) Obturation of primary teeth has been done using various materials. Iodoformized calcium hydroxide pastes like Metapex and Vitapex are preferred over zinc-oxide eugenol. Vitapex is a resorbable obturating material and has shown a high success rate However, Vitapex needs complete removal of the pulp tissue, has a mild antibacterial action and faster rate of resorption leading to reinfection, which questions its long-term success. (6,7)

The Cariology Research Unit of Niigata University School of Dentistry, Japan, has developed the concept of LSTR or non-instrumental endodontic treatment (NIET), in which combination of antibacterial drugs are used for disinfection of root canals and associated periapical lesions. Primary teeth often present with infected root canals, especially with periradicular tissue involvement. LSTR is a feasible treatment option, especially in teeth with poor prognosis or when conventional pulpectomy is undesirable, to preserve such teeth until their exfoliation. In LSTR, a combination of three antibiotics, i.e., ciprofloxacin, metronidazole and minocycline (3 Mix) delivered via vehicle (mixing medium) comprising of macrogol and propylene glycol (MP) together called as 'Triple antibiotic paste', is used for disinfection of root canals1. 3 Mix is found to be effective in sterilizing carious lesions, necrotic pulps and infected root dentine of primary teeth.

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 medi¬caments can decrease the bacterial load. Sterilization with medicaments will lead to 20 to 40% cleansing action and debridement. The aim of present review of literature is to discuss LSTR in detail.

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. (8) Takushige et al. in 1998 used the above antibiotics in the ratio 1:3:3.3 Met¬ronidazole 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 disadvan¬tage 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. (9)

Some other combinations of paste

- Fabricus et al. (1982) (10) used Metronidazole and ciprofloxacin plus amoxicillin. They also tried Metronidazole and ciprofloxacin plus rokitamycin.
- Haapasalo et al. (1987) (11) used Metronidazole and ciprofloxacin plus ceflaclor as combination.
- Metronidazole and ciprofloxacin plus clindamycin was used by Grossman et al. (2001) (12)
- Fouad et al. (2011) (13) took the combination of Metronidazole and ciprofloxacin plus fosfomycin.
- A combination of penicillin, bacitracin or chloramphenicol and streptomycin is generally termed as Grossman's polyantibiotic paste. (12)
- A combination of Chlorhexidine pastes are used by Filho JH et al (2012) (15).
- Jaya et al. (2012) (16) combined three drugs namely, ciprofloxacin, tinidazole and minocycline in 1:3:3 ratio and mixed with propylene glycol and macrogol. The mixture was comparable to the traditional 3Mix MP paste with regards to antimicrobial efficacy when used in deciduous teeth showing physiological root resorption.
- Lokade et al. (2019) (17) Combined three antibacterial agents namely, ciprofloxacin (500 mg), ornidazole (500 mg) and cefaclor (250 mg) in the ratio of 1:1:1 by volume
- Pinky et al. (2011) (18) combined three medications, ciprofloxacin, ornidazole and minocycline were pulverized and mixed in a ratio of 1:3:3 and this mixture was added to propylene glycol to form an ointment

The role of a suitable vehicle for delivering triple antibiotic drugs into infected root canals is imperative for the success of LSTR. Mixing medium plays an important role in determining penetration of medicaments to the deeper inaccessible areas in root canal such as root dentine and cementum, even in the presence of anatomical aberrations such as fins, isthmuses and blocked canal. Diffusion into the

surrounding periradicular tissues may also be an advantage. It also affects the workability of the mix. Propylene glycol (1,2-propanediol), a dihydric alcohol has the potential for use in LSTR. Its chemical formula is CH3CH (OH) CH2OH, and it has a molecular weight of 76.09. (19)

Cruz et al. suggested vehicles like Macrogol-Propylene glycol increases the penetration of antibiotics and carry the medicament deep into the dentinal tubules, thus aid in effective eradication of microbial load. (19,20)

Indication of LSTR (20,21)

1. Uncooperative patients
2. Parents not willing for extraction
3. Strategically important teeth
4. Primary teeth affected with pain and tender on percussion
5. Teeth with Grade I and II mobility
6. Presence of abscess
7. Presence of sinus tract
8. Presence of radiolucency in furcation area
9. Pulpless primary teeth in hemophilic patient
10. Immature primary teeth with necrotic pulp and incompletely formed roots

Contraindication of LSTR (20,21)

1. Allergy to any of the constituent medication of the 3 Mix MP paste
2. LSTR is not recommended in children with infective endocarditis
3. Primary teeth nearing exfoliation
4. Perforation of the pulpal floor
5. Teeth with excessive coronal structure breakdown in which an adequate coronal seal is not feasible
6. Radiographic evidence of excessive internal or external root resorption
7. Excessive bone loss in furcation area involving underlying tooth germ
8. Non restorable crown of permanent tooth where postplacement and core buildup are not possible.

Clinical Procedure (22)

- Isolation with rubber dam
- Administration of Local anaesthetic (optional)
- Removal of caries
- Preparation of access cavity
- Extirpation of necrotic coronal pulp
- Irrigation with normal saline (0.9%) and drying with cotton pellet
- Enlargement of canal orifices. It should be 1 mm in diameter and a depth of 2 mm to receive medication
- The cavity is then filled with 3 antibiotic mix and teeth restored with glass ionomer cement, and stainless-steel crown is given.

Table no. 1 Advantages and Disadvantages of LSTR (21,23,24)

Advantages	Disadvantages
• Easy and simple, one visit technique, painless and economical • Decreased chair-time • No instrumentation needed • No irritation of the periapical tissues • No obturation required • Primary teeth which are not ideal for conventional pulpectomy treatment and those that warrant extraction can be treated using LSTR (Teeth with peri–radicular involvement and extensive root resorption)	• The main drawback of tripleantibiotic paste isbluish-grey hue producing tooth discolouration due to drug of tetracycline family which produces photo induced reaction. • Other drawback is radiolucency which is overcome by the addition of trace amounts of iodoform to the powder component. • Systemic absorption and drug resistance of the drugs used in LSTR therapy has not been evaluated. The long-term effects of the drugs used need to be evaluated

Discussion

LSTR is an acronym for lesion sterilization and tissue repair. It is a process which allows the use of a combination of antibiotics (metronidazole, ciprofloxacin, and minocycline) for controlling of oral infections such as dentinal, pulpal, and periapical lesions. This therapy aims to eliminate causative bacteria from the diseases by disinfecting the lesions and promoting tissue regeneration by the host's natural tissue recovering process. Three types of antibiotics are combined to ensure complete removal of all pathogenic microorganisms in pulpal and periapical lesions. (23)

The LSTR helps to safeguard the deciduous tooth until its exfoliation, reducing the need for unnecessary extraction and placement of a space maintainer. The existence of accessory canals and the porosity and permeability of the pulpal floor region in deciduous teeth indicate a plausible association between pulpal and periodontal tissues. The triple antibiotic paste can be easily distributed through these areas and induce a sterile zone, which is expected to promote tissue repair. (24)

The prime concern regarding the use of triple antibiotic paste is the discoloration caused by minocycline. To overcome this, alternative medications such as clindamycin and cefaclor have been proposed. But, recent studies have shown that, double antibiotic paste has similar antimicrobial activity compared to that of a triple antibiotic paste. Sabrah et al., in their in vitro study comparing the efficacy of Triple antibiotic paste and Double antibiotic paste concluded that both had equal efficacy against Enterococcus faecalis and Porphyromonas gingivalis.25 In the modern era, a new perspective which is less invasive and less time-consuming procedure could be a ray of hope for the patient as well as the clinician.

The future of LSTR therapy in pediatric dentistry seems to be optimistic. In young uncooperative children, extraction can be avoided and LSTR therapy can be opted for, making the dental treatment nontraumatic. (26)

Conclusion

Root canal complexities of deciduous teeth often makes the treatment difficult and makes the child patient uncooperative and sometimes leads to treatment failure. Therefore the non-invasive approach is needed to obtain good cooperation from child patient.

LSTR seems to be a promising alternative for primary teeth in which pulpectomy has been contra-indicated and extraction is warranted.

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