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Non instrumentation endodontic treatment - A review

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Abstract
Dentists treating patients have long been concerned about residual infections in the root canal system. Lesion sterilization and tissue repair (LSTR) therapy is a type of endodontic treatment in which root canal systems are disinfected by placing an antibiotic mixture after minimum or no equipment is used. It is increasingly being used to treat nonvital teeth instead of extractions, root canal treatments, and conventional pulpectomies. The content of this article covers the technique's development, purpose, indications, applications, and clinical steps that are required to use it.

Keywords: Non instrumentation, endodontic treatment, inorganic component

Introduction
According to the American Academy of Pediatric Dentistry, dental caries is the most frequently encountered long-term illness among children [1]. Dental caries is an irreversible microbial illness of the calcified tissues in teeth that is defined by the breakdown of the teeth's organic material and demineralization of their inorganic component, which frequently results in cavitations. Untreated caries can progress through the dentine to the pulp, which becomes inflamed [2].

Root canal infections are caused by a variety of aerobic and anaerobic microorganisms. Antibacterial irrigation, antibacterial filling material, and proper instrumentation (root canal debridement) are some of the methods for removing bacteria from the radicular part.

Any one antibiotic is unlikely to be able to effectively sterilize the canal due to the intricacy of the original root canal infection. To address the varied flora observed, a combination would be required. Antibacterial medications must to strive to eradicate all of these kinds of bacteria [3].

In the present era, a new point of view that involves a quicker and less intrusive process could give both paediatric dentists and their patients optimism. Lesion Sterilization and Tissue Repair argues for its revelance in these kinds of rehabilitative situations [4]. The technique has become more widespread nowadays as a result of its remarkable success and low invasiveness.

Lesion Sterilization and Tissue Repair therapy (LSTR) was put forth by the Cariology Research Unit of Niigata University School of Dentistry. It entails root canal systems and periapical lesions being disinfected by placing an antibiotic mixture in a propylene glycol vehicle, either without instrumentation or with minimal instrumentation [5]. The action of lesion sterilization and tissue repair permits the management of oral infections, including those involving dentinal, pulpal, and periapical lesions, with a combination of antibiotics. This treatment seeks to eradicate the bacterial agents responsible for the illnesses by cleansing the wounds and encouraging the body's own healing mechanisms to regenerate tissue [6].

When furcal radiolucency and/or significant root resorption coexist, pulpectomy may not be the best course of action. In these situations, extraction is the only available therapeutic alternative. To avoid potential space loss, a space maintainer should be provided whenever an extraction is carried out. Lesion sterilization and tissue repair appears to be a to be making a proposal substitute for these circumstances [7].

This review discusses on the various materials used, criteria for case selection, and the procedure to be followed for LSTR.

Materials Used In LSTR

Because of the compromised blood supply in the infected root canal system and necrotic pulp, bio modulated drugs are less able to reach the infected site and become ineffective in the enclosed canals. Consequently, local drug application is more effective, though this depends on the kind of drug and the local drug delivery system used [8].

Some of the different combination of materials used are:

- Metronidazole and ciprofloxacin with either minocycline, amoxicillin, cefaclor, cefroxadine, fosfomycin, rokitamycin
- Penicillin, bacitracin, or chloramphenicol and streptomycin (Grossman's polyantibiotic paste)
- Ledermix paste (triamcinolone-a corticosteroid and demeclocycline-a tetracycline antibiotic)
- Neomycin, polymyxin, and nystatin
- Calcium hydroxide paste
- Chlorhexidine paste

Due of their enhanced ability to enter the dentinal tubules and hence lower infection rates, organic solvents such as propylene glycol and macrogol are employed in particular. Propylene glycol has hygroscopic characteristics, allowing it to absorb water, due to which the intracanal medication will be able to diffuse into dentinal tubules and release the drug continuously over an extended length of time. Hence, propylene glycol due to its potent antimicrobial effect, which makes it useful in medicine [9].

Triple Antibiotic Paste

A zone free of germs cannot be created in the canal by a single empirical antibiotic since oral diseases are caused by several microorganisms. Furthermore, the use of treatment with non-specific antibiotics may disrupt the natural bacterial flora allowing aggressive microorganisms that are still there to flourish again in the canal. Therefore, in order to prevent intolerance to microbes, it is imperative to utilize an array of antibiotics against all endodontic infections [10].

Triple Antibiotic Paste for LSTR-Formulation 1

Metronidazole 33%, Minocycline 34%, Ciprofloxacin 33%.

Triple Antibiotic Paste for LSTR-Formulation 2

Metronidazole 30%, Clindamycin 30%, Ciprofloxacin 30%, Iodoform 10%.

Mode of Action

Ciprofloxacin: It functions by preventing DNA gyrase from acting. Antibacterial effects are seen during recurrent as well as dormant stages of bacterial development phases. It works well against organisms that are gram negative.

Metronidazole: It penetrates the membranes of bacteria, attaches itself to the DNA, causing structural disruption and leading to fast cell death. It is useful against bacilli (both gram positive and gram negative), anaerobic cocci, and a small number of protozoa. When applied topically as well as systemically, effectiveness is evident.

Minocycline: Acts by preventing the production of proteins on ribosome surfaces is not cytotoxic and inhibits matrix metalloproteinase and collagenases. Effective against spirochetes of bacteria, both gram-positive and gram-negative. Apart from that, it promotes the proliferation of host cells on dentin by presenting growth factors or embedded collagen fibers, paving the way for effective revascularization and the root's ongoing development to its normal length [11].

Grossman Polyantibiotic Paste

The first-ever local usage of an antibiotic recorded in endodontics was Penicillin Bacitracin Streptomycin Caprylate sodium (PBSC), which Grossman, the father of endodontics, put forward in 1951 [12].

Although the polyantibiotic paste shown potential for therapeutic use, it was found to have certain limitations, such as inability towards anaerobic species and allergic responses.

Gram-positive organisms were targeted by penicillin in PBSC, gram-negative organisms by streptomycin, yeasts by caprylate sodium, and penicillin-resistant strains by bacitracin. Although the clinical evaluation of PBSC revealed therapeutic effects, the mixture was not very successful in combating anaerobic microbes, which are crucial in endodontic conditions. Because of this, as well as the possibility of penicillin allergic reactions and sensitivity, the USA Food and Drug Administration prohibited the use of PBSC in endodontia in 1975 and later by 1980s it was accepted for endodontic procedures.

If debris in the canal is not carefully removed before starting polyantibiotic treatment, failure is certain. Both are necessary, but one does not replace the other. In order to fit more polyantibiotic paste into the canal, it is actually recommended to enlarge the root canal more than has been done in the past. A larger root canal's capacity allows for the insertion of more paste and increases the possibility that the channel will be successfully sterilized [13].

Ledermix Paste

Ledermix consists of an antibiotic component and a steroid component in a standard formulation [14]. In 1960, Schroeder and Triadan patented Ledermix, which Lederle Pharmaceuticals marketed in 1962. Ledermix paste is made of a polyethylene glycol base with 3.2% antibiotic demeclocycline HCL and 1% corticosteroid triamcinolone acetonide. Corticosteroids are incorporated in the paste to soothe pulp and periapical disease-related discomfort and inflammation. Ledermix entails an antibiotic in order to make up for the apparent decrease in the host immunological response caused by corticoids. Triamcinolone and demeclocycline have the potential to migrate into the peri radicular and periapical tissues by traversing through the cementum and dentinal tubules [15].

Ledermix paste has sufficient quantities of demeclocycline to be effective against bacterial species that are susceptible to it. However, diffusion-achieved concentration is not high enough to render microorganisms within the peri radicular tissues and the periphery of the dentine, especially over a prolonged length of time. Within the first day of treatment, all bacteria immediately proximal to the root canal wall reach suppressive quantity of demeclocycline; yet, after a week equally in mid-root and apical third levels, this level reduces down to about one-tenth of the initial quantity [16].

It has also been hypothesized that Ledermix paste is helpful in lowering the incidence of unease during chemo mechanical root canal preparation. The prolonged therapeutic action of triamcinolone is likely due to its slow-

release mechanism through dentine, which reaches the periodontal tissues. Several other investigations reveal that it also offers more postoperative pain relief than teeth that are treated with calcium hydroxide. After one hour, over 85% of cases experienced total pain relief, and over 93% of patients were pain-free after 24 hours of treatment [17].

Calcium Hydroxide [$Ca(OH)_2$]

The discharge of hydroxyl ions upon interaction with aqueous fluids is linked to the antibacterial activity of $Ca(OH)_2$. Hydroxyl ions exhibit significant reactivity with biomolecules and are highly oxidant free radicals.

Two factors have been identified as responsible for the deadly effect on microorganisms: first, destruction to the DNA and second, denaturation of the bacterial cytoplasmic membrane.

Determining the primary mechanism underlying bacterial mortality is a challenging task. $Ca(OH)_2$ capacity to absorb carbon dioxide might be a factor in its antibacterial properties [18].

Because of its many benefits, calcium hydroxide is frequently utilized in the area of endodontics [19]:

- Encourages tissue healing and repair
- High pH supports fibroblasts
- Stops internal resorption
- Minimizes low pH of acids
- Primarily bactericidal action then bacteriostatic effect
- Cost-effective and simple to use.

Chlorhexidine

A wide-spectrum antimicrobial agent, chlorhexidine works against microorganisms retrieved from persistent endodontic infections that are not susceptible to calcium hydroxide-based conventional therapy. Chlorhexidine antibacterial activity corresponds to the environment turning into alkaline owing to the discharge of hydroxyl ions. As highly active free radicals, these ions provide the bacteria a fatal boost. While other *Enterococci* have a greater degree of tolerance and can survive in situations with a pH range of 9 to 11, *P. gingivalis* exhibits stable growth in pH environments with a range of 8.0 to 8.3.

The quantity of chlorhexidine molecules that are readily accessible to contact with the dentine governs the antimicrobial substantivity. Consequently, the canal becomes more resistant to microbial colonization when medicated with a higher concentrated chlorhexidine solution. It appears that chlorhexidine preparations impede the accessibility of germs into the root canal system via the coronal region of the tooth because of their antibacterial substantivity. The amount of time needed for the root canal system of teeth with coronal restorations to become re-contaminated after being treated with calcium hydroxide, 2% chlorhexidine gel, or a mixture of the two. Of these, 2% chlorhexidine gel has demonstrated the least amount of recontamination in comparison to other medications. Chlorhexidine is therefore a useful root canal medication for root canal sterilization in primary teeth [20].

Indications in Primary Teeth [21]

1. Non-vital teeth.
2. Extensive root resorption.
3. Teeth that are strategically important.
4. Extreme bone loss.
5. Mobility
6. Radiolucency in the furcal area
7. Uncooperative patients
8. Reluctant parents to get their children's teeth extracted, and further clinical issues
9. Tender and painful primary teeth when subjected to percussion
10. Primary teeth with Grade I and II mobility acting as a temporary natural space maintainer till the erupting permanent tooth
11. Primary teeth with a sinus or an abscess
12. Radiolucency in the furcation area of multirooted primary teeth
13. Preserving necrotic primary teeth in haemophiliac patients rather than extracting them
14. Primary teeth that are immature and lack a vital pulp
15. Primary tooth that failed endodontically without the initial zinc-oxide eugenol obturation being removed
16. As an intra-canal medication for persistently infected primary teeth, to be used in conjunction with traditional obturation.
17. Uncooperative kids rather than preferring general anaesthesia
18. Primary tooth root canals that are non-negotiable
19. A deep, pulp-exposed carious lesion.

Radiographic characteristics for case selection [22]

1. Coronal-radiographic indications of lesion resembling pulp or deep carious lesion
2. Lamina dura discontinuity
3. Fracture involvement in the vertical dimension below or equivalent to half of the shortest root
4. Teeth with over one-third of their length involved in physiological root resorption
5. Root canal obliteration
6. High levels of internal resorption
7. Internal calcifications
8. Root perforation

When primary mandibular teeth exhibit irreversible pulpitis, LSTR can be used, especially if the patient's prognosis is poor. LSTR may be the best substitute to maintain the teeth.

Clinical Procedure

The Clinical Procedure according to Rishi Nanda, [23]

- Rubber dam Isolation: for optimal results, the tooth that is to be treated must be well isolated.
- Carious tooth structure can be eliminated with BR-31SC bur and a sharp spoon excavator operated at a slow speed. Access is obtained once all caries have been removed.
- Access Cavity

Access opening to the pulp chamber is done using BR-31SC bur positioned on a water-cooled high-speed handpiece. Once entry is made into the pulp chamber, with the help of sharp spoon excavator the necrotic pulp will be eliminated, and no steps are taken to do radicular preparation. Irrigation is done using normal saline to remove any remaining tissue. 1% sodium hypochlorite solution can be used if bleeding is evident and placed until haemostasis is achieved.

- Extirpation of necrotic coronal pulp: With a number 15 K-file, possible necrotic pulp is taken from the root canal without the need for additional biomechanical preparation.
- Irrigation is done with normal saline (0.9%) and root canals are dried using cotton pellets to guarantee visibility.

- Root canal orifices will be increased up to 1 mm in diameter and 2 mm deep to make the cavity large enough to receive the medicament.
- The pulp chamber will be packed with suitable medicament
- Core build up will be given with GIC and stainless-steel crown will be given.

Prognosis

In the circumstance that LSTR is effective, the sepsis is eradicated and tissue heals itself.

In the Takushige *et al*. investigation, in a total of 87 primary teeth-81 of which had physiologic root resorption-were treated with triple antibiotic paste. For most patients, the treatment was effective. All but a few of the cases showed a reduction in the symptoms of gingival enlargement, sinus tracts, both naturally occurring or induced dull discomfort, and discomfort upon clenching. After receiving the same operation again, a small number of patients showed improvement. Furthermore, every patient subsequently possessed normal, healthy replacement teeth.

The pulp-dentin complex can be efficiently stimulated to develop when primary teeth are treated with triple antibiotic paste.

Impact and shortcomings against the use of 3-Mix for LSTR

Six impacts were found in a research by Pallasch published in the Journal of the California Dental Association. According to him, only the first justification listed below is advantageous. The next five scenarios are all undesirable outcomes that can happen when antibiotics are used improperly. It could happen when using the LSTR with the 3-Mix [22].

The medicines might help the body's defenses fight off the infection

1. There could be toxicity or allergies.
2. A super infection could arise from the selection of already resistant bacteria.
3. The antibiotic might encourage chromosomal alterations in microorganisms.
4. It's possible for genes converting resistant to non-resistant microbial forms
5. Genes encoding latent resistance might manifest.

Conclusion

Lesion Sterilization and Tissue Repair therapy is straightforward to use and uncomplicated, quick, and less challenging on the patient's body and mind. As a result, it is predictable that patients would be cooperative and complied, which is crucial for managing paediatric patients. The highly infected deciduous teeth will be cleaned up throughout the treatment and left to act as a natural space maintainer from then on till the eruption of its permanent replacement. This innovative concept warrants investigation, especially in primary teeth with significant bone loss and involvement of the furcation when the standard lumpectomy procedure has a poor prognosis.

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