

Lesion Sterilization and Tissue Repair (LSTR) Method in Irreversible Dental Pulp Changes of Primary Teeth

SUMMARY

Background/Aim: Deep carious lesions on primary teeth usually have been causing infectious dental pulp changes. If indicated, traditional endodontic root canal treatment for these kinds of pulpal infections in primary teeth usually should involve the performing of pulpectomy methods, but often with questionable prognosis. The lesion sterilization and tissue repair (LSTR) approach is one of the good endodontic therapeutic alternatives for affected primary teeth with a poor prognosis, which could otherwise be condemned to premature extraction. **Aim** was to evaluate the medium-term clinical success in everyday practice of the LSTR method applied in affected primary teeth with irreversible pulpal tissue infections by observation of reduction/absence of their clinical symptoms. **Material and methods:** The study sample included child patients who had one or more of their affected primary molars with irreversible pulpal tissue changes of poor prognosis treated with the LSTR method. For each patient whose primary molar tooth was endodontically treated with the LSTR method a clinical evaluation of treated tooth was performed at intervals of 1 and 12 months afterwards. **Results:** Study sample was consisted of 40 child patients aged 4 to 9 years, with 45 primary molars included in total. It was obvious that the symptoms related to affected sample teeth have already been decreased almost immediately after initial action of triple antibiotic paste. Final outcome after 12-months follow-up period was success of applied LSTR method in 43 (95.6%) affected sample teeth in a way that initial clinical symptoms completely decreased and disappeared. **Conclusions:** LSTR method has been shown as successful pulpotomy technique for non-instrumental endodontic approach in non-vital pulp treatment of primary molar teeth in a 12-months follow-up period.

Keywords: Paediatric Dentistry, Endodontics, Primary Teeth, LSTR

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Introduction

Deep carious lesions on primary teeth usually have been causing infectious dental pulp changes, due to thinner and more permeable mineralized dentine tissue, and weaker defensive potential of its dentin-pulp complex as well. The most common diagnoses of dental pulp diseases included purulent, necrotic, chronic hypertrophic and/or gangrenous forms¹⁻⁵.

If indicated, traditional endodontic root canal treatment for these kinds of pulpal infections in primary teeth usually should involve the performing of pulpectomy methods, but often with questionable prognosis. Furthermore, cooperation in child patients has often been absent, which usually made it impossible to perform these kinds of more demanding endodontic treatments in dental office. So, it often happens that the indicated procedures were abandoned and premature extraction was only possible therapeutic choice in everyday practice. Furthermore, the extractions by

themselves could not always be the proper solutions, but often could only open more problems for those children with behaviour problems in dental office. These situations were the most stressful paths which enormously in long term could interfere with child oral and general health, and with their quality of life as well¹⁻⁶.

In endodontics of primary teeth, the treatment of irreversibly changed dental pulp tissue with antibiotic pastes has been present in the last more than 30 years. Endodontic treatment of irreversibly changed pulp of primary teeth, with the use of paste composed of a combination of antibiotics, was first presented by Hoshino and Sato et al. back in 1990 and 1992, respectively^{5,8-10}. Over time, therapeutic approaches have been changed in terms of partial or complete removal of irreversibly changed pulpal tissue, with the use of combinations of different kinds of antibiotics, in order to improve the prognosis of these procedures as much as possible¹¹⁻¹⁵. The therapeutic approach was described as lesion sterilization and tissue repair (LSTR) method and was based on the reparation of pulpal and/or periodontal tissue of primary teeth under the action of the applied antibiotic combination. Validation of the LSTR method on multi-rooted primary teeth has shown very good prognostic results so far, with the reduction and/or disappearance of previously present clinical and radiographic symptoms, without any interference with the eruption of permanent replacement teeth. Also, considering the fact that the LSTR method showed equally good results whether it was performed within pulpotomy, high amputation or pulpectomy, it greatly facilitated the treatment of affected primary teeth with a poor prognosis. When used within pulpotomy form, LSTR method also greatly facilitated and simplified the process of endodontic treatment, made it faster and feasible even for very young child patients, with reduced number of visits. This have given the LSTR method a significant advantage over conventional pulpectomy methods, especially in child patients with a poor level of cooperation in dental office. Thus, the LSTR approach is one of the good endodontic therapeutic alternatives for affected primary teeth with a poor prognosis, which could otherwise be condemned to premature extraction¹⁶⁻²⁷.

The goal of this study was to evaluate the medium-term clinical success in everyday practice of the LSTR method applied in affected primary teeth with irreversible pulpal tissue infections by observation of reduction/absence of their clinical symptoms.

Material and Methods

Ethical considerations

This longitudinal observational non-randomized clinical study was approved by the Ethics Committee of the Faculty of Dentistry with Clinics of the University

of Sarajevo, and conducted according to the Helsinki Declaration²⁸. Informed consent was requested from the parents of the minor respondents, and the content of the study was briefly explained to the child patients and their parent's prior conduction of the study research.

Clinical sample

The study sample included child patients, who visited the Clinic for Preventive and Paediatric Dentistry of the Faculty of Dentistry with Clinics of the University of Sarajevo, who had one or more of their affected primary molars with irreversible pulpal tissue changes treated with the LSTR method in the period from October 2020 until June 2021. Child patients had to be of good general health without diagnosed chronic systemic diseases, and also without diagnoses of allergies of any kind to the materials or medicals used for LSTR method. The method was performed on affected teeth following clinical diagnoses of irreversible pulpitis, pulp necrosis or chronic pulp infection with/without haemorrhage, suppuration or purulence, and with/without signs of pain, sensitivity to percussion, swelling, appearance of fistula and/or pathological mobility. The crowns of affected teeth had to be in restorable conditions. Radiographic inclusive criteria were: presence/absence of root resorptions (if resorption existed, only those of exfoliation up to the one third of root size were acceptable), and with/without apical periodontal lesions. Non-restorable teeth, teeth with clinical or radiographic signs of perforated root furcation, presence of extensive external (more than one third of root size) and/or internal root resorption, and/or presence of apical radicular cysts were excluded from the study^{27,29}.

Clinical procedure

After clinical examination and radiographic evaluation and diagnosis, the LSTR method included the following clinical protocol during the first visit. If the therapeutic procedure was painful for the child patient, local anaesthesia in the vestibular gingival area of affected tooth root was administered (Orabloc®, Pierrel S.P.A., Italy; with articaine hydrochloride 40mg/L and 1:100,000 adrenaline 0.01mg/L). After removal of carious dentine, followed with removal of infected pulpal tissue from chamber and root canal entrances of indicated affected primary molar, pulpotomy was finally performed. The pulp chamber was then irrigated with 3% Na-hypochlorite and saline solution afterwards and dried with cotton pellets. Then the triple antibiotic paste was placed at the entrances of the root canals. The paste had the following antibiotic composition: amoxicillin (Amoksicilin HF® capsules a 500 mg; Hemofarm AD, Vršac, Srbija), doxycycline (Doksiciklin HF® capsules a 100 mg; Hemofarm AD, Vršac, Srbija) and metronidazole (Metrozol® tablets a 500 mg; Bosnalijek, Sarajevo, Bosnia and Herzegovina). Antibiotic powders from capsules and tablets were properly pulverized and

stored in as described previously¹⁷. The powders were mixed together in 1:1:1 ratio and prepared together with glycerine vehicle in paste form immediately prior to its use. The tooth is then temporarily closed with a Zinc Oxide Eugenol (ZOE) cement filling for 10 days.

After 10 days, the ZOE temporary filling was removed altogether with the contents of the antibiotic paste from the chamber. The chamber was washed with saline solution and dried with cotton pellets. ZOE cement was then placed on the bottom of the chamber and the entrances of the root canals, followed by placing of a permanent filling.

Clinical follow-up

For each patient whose primary molar tooth was endodontically treated with the LSTR method a clinical evaluation of treated tooth was performed at intervals of 1 and 12 months afterwards. During these visits, the presence/absence of following clinical parameters was monitored: pain, sensitivity to percussion, swelling, appearance of fistula and/or pathological mobility.

Statistical analyses

Obtained results were analysed descriptively and presented in absolute and relative values in tables. Data

analyses were performed with IBM SPSS statistical software package v. 17. for Windows operative system.

Results

Study sample was consisted of 40 child patients aged 4 to 9 years (M=6.66 years, SD= ± 1.49 years), with 45 primary molars included in total (Table 1).

Table 1. Affected primary molars treated with LSTR method in study sample

Primary Tooth	n	%
maxillar first right molar	5	11.1
maxillar second right molar	2	4.4
maxillar first left molar	5	11.1
maxillar second left molar	7	15.6
mandibular first left molar	3	6.7
mandibular second left molar	10	22.2
mandibular first right molar	4	8.9
mandibular first right molar	9	20.0
Total	45	100.0

Table 2. Presentation of recorded clinical symptoms in affected primary molars during applying of LSTR method

recorded symptoms	first visit			second visit		
	presence n (%)	absence n (%)	total n (%)	presence n (%)	absence n (%)	total n (%)
pain	23 (51.1)	22 (48.9)	45 (100)	3 (6.81)	41 (93.18)	44 (100)
percussion sensitivity	25 (55.6)	20 (44.4)	45 (100)	4 (9.09)	40 (90.90)	44 (100)
swelling	5 (11.1)	40 (88.9)	45 (100)	2 (4.54)	42 (95.45)	44 (100)
fistula	12 (26.7)	33 (73.3)	45 (100)	4 (9.09)	40 (90.90)	44 (100)
mobility	10 (22.2)	35 (77.8)	45 (100)	5 (11.36)	39 (88.63)	44 (100)

Table 3. Presentation of recorded clinical symptoms in affected primary molars during follow-up periods

recorded symptoms	after 1 month			after 12 months		
	presence n (%)	absence n (%)	total n (%)	presence n (%)	absence n (%)	total n (%)
pain	2 (6.1)	31 (93.9)	33 (100)	0 (0)	41 (100)	41 (100)
percussion sensitivity	1 (3.0)	32 (97.0)	33 (100)	2 (4.9)	39 (95.1)	41 (100)
swelling	0 (0)	33 (100)	33 (100)	0 (0)	41 (100)	41 (100)
fistula	1 (3.0)	32 (97.0)	33 (100)	0 (0)	41 (100)	41 (100)
mobility	0 (0)	33 (100)	33 (100)	4 (9.8)	37 (90.2)	41 (100)

Clinical symptoms recorded during clinical examination of affected teeth while applying LSTR method were presented in Table 2. It was obvious that the symptoms related to affected sample teeth have already been decreased almost immediately after initial action of triple antibiotic paste. But, in the final second visit (after 10 days) of clinical procedure there were 39 patients and 44 teeth included, due to extraction of one tooth from sample on child parent's request.

After clinical follow-up recorded symptoms related to affected sample teeth were presented in Table 3.

Further continuous decrease and disappearance of previously recorded clinical symptoms were noted. Twenty-eight patients (70% out of total sample) with 33 affected teeth treated initially with LSTR method were present in the first follow-up period after 1 month. LSTR method was considered as successful in 26 patients (92%) and 29 teeth. One more child had symptoms of persistent

pain and fistula related to affected sample tooth, which had to be extracted upon parent's request.

In the final follow-up after 12 months there were 38 patients (95%) present with 41 affected sample teeth. Percussion sensitivity and mobility were only recorded in affected sample teeth which were within the process of exfoliation. Furthermore, primary teeth were regularly exfoliated by their permanent successors in another 2 patients, with sound enamel and no clinical signs of any kind regarding developmental disturbances on their crowns.

Final outcome after 12-months follow-up period was success of applied LSTR method in 38 patients and 43 (95.6%) affected sample teeth in a way that initial clinical symptoms completely decreased and disappeared. In 2 patients with 2 (4.4%) affected sample teeth applied LSTR method was considered as unsuccessful and ended up with extractions upon their parents' requests.

Discussion

Application of LSTR method as non-instrumental form of endodontic treatment for non-vital pulp in primary teeth has been shown as successful technique in most of the reported related papers so far. Indeed, the success rates in the last five years were high but variable (mainly higher than 80%), as for the method itself, and compared to the other performed pulpotomy techniques^{23, 29-34}. Furthermore, this method was even more time consuming than some of other methods³⁵. Pretty high success rate in our study sample corresponded to these results.

When compared to the pulpectomy, LSTR approach as more convenient method was more successful in affected teeth with root resorption in the first 12 months after its application^{25,26}. Our final clinical follow up period was up until 12 months and without clinical findings to compare these claims due to the fact that our observational period was not longer than a year.

LSTR method itself has experienced many modifications regarding the antibiotic compositions and concentrations with intention to cover as much of different kinds of microorganisms as possible within infected pulp tissue and surrounding dentinal walls of root canals. The idea was to disinfect those affected soft and hard dental tissues in order to sterilize them from microorganisms, and to consequently let the surrounding tissues to regenerate³⁶⁻³⁸. The combination of antibiotics in our study included specific members of penicillins, macrolides and nitroimidazoles with their equal ratio, and the final form of paste was prepared with glycerine vehicle. It seemed that this antibiotic paste has enabled profound penetration rate for disinfection and sterilization of infected soft and hard dental tissues within affected

root canals of primary molars during 12-months follow-up period.

LSTR method was substantially based on the idea of regenerative endodontics in permanent teeth, where, after performed pulpectomy, temporarily applied antibiotic paste root fillings intended to disinfect remained root canal space and root dentin, and at the same time to re-initiate the potential of surrounding soft and/or hard dental tissues to regenerate. The idea of not removing infected pulpal tissue from the root canals of affected tooth was only present in primary teeth for a long time, but with various kinds of therapeutic approaches applied. They all intended to minimize or exclude further infectious pulpal tissue potential to apical direction. Otherwise, these non-vital pulpotomy procedures were judged to failure, and, with endangering of local, oral and general health, could only lead to premature extraction^{5-8, 39}.

In paediatric dentistry there are several basic indications for every kind of dental treatment related to its invasiveness, and also to child general and mental health regarding their capabilities for understanding and cooperate during planned dental treatments. The more invasive the treatment was, in combination with the more invasive dental treatment could be, would result in uncooperative dental behaviour. That is why everyday paediatric dental practice needs those kind of therapeutic solutions, even in situations that usually would have poor prognosis, in order to preserve and improve poor oral health. Otherwise, in everyday oral pathology in children of preschool and young middle childhood age, where indications for non instrumental endodontic non-vital treatment in primary teeth were numerous, we usually could have consequent disturbed orofacial development and developed dental fear and anxiety in child patients as long-term outcomes. These outcomes could have great potential to be pretty reduced with LSTR method applied^{1-5, 24, 27}.

LSTR method basically used combination of three antibiotics in order to cover and eliminate as much bacterial strains and types that were present in infected pulpal tissue. Some of these antibiotics, like nitroimidazoles and macrolides classes, could have various side-effects in their more usual non-dental use in adults. Furthermore, there were also some doubts present regarding their profound long-term disinfection and sterilization potential, which could result in microbial recolonization and therapeutic failures, and consequent harm to oral and general health of child patients. But, proper specific antibiotic usage in LSTR method within determined indications could result in several evidence based benefits only, which would eliminate these opponent opinions for their dental use. Although LSTR method was first introduced in Japan pretty long time ago, and mostly applied sporadically afterwards, the American Academy of Paediatric Dentistry have adopted it recently and included in the guidelines of non vital pulp

non-instrumentation endodontic treatment for primary teeth with poor prognosis^{24, 25, 27, 40, 41}. The best indicator whether this method is completely successful in primary teeth was to show if its application could interfere normal exfoliation process of their permanent successors in any way. One longitudinal study has been conducted so far, where all of 87 affected primary teeth completed their exfoliation process with the mean function time of 680 days (range 68-2390 days), and replaced afterwards with permanent successors without signs of developmental or any other disturbances of any kind¹⁴. In our 12-months follow-up period natural exfoliation process has ended up successful with undisturbed permanent succession in two cases.

There were several limitations of this study. First of all, intention of this paper was to show cases with LSTR method applied from our everyday practice, which have resulted in observational non-randomized study, where control and/or other comparative experimental groups of patients were not established. Also, study protocol followed our everyday clinical routine in the dental office, where final restorations after second visit usually were not stainless steel crowns (SSC), but rather mostly glass-ionomer cement fillings. This fact could have more potential to compromise the sealing after final restoration than SSC. But, our follow-up results did not show these potential filling microleakage problems. Various methodology approaches of other compared authors and papers were present during data comparing process regarding clinical diagnoses of affected primary teeth, combination and dosage of used antibiotics, follow-up periods and outcomes. These facts should be considered in the future studies, in order to avoid potential problems in establishing the strictest evidence based clinical guidelines for LSTR method in primary teeth for everyday practice.

Conclusions

LSTR method has been shown as successful pulpotomy technique for non-instrumental endodontic approach in non-vital pulp treatment of primary molar teeth in a 12-months follow-up period. This method proved as the most convenient and time consuming technique for the affected primary molars with irreversible pulp infections of poor prognosis, which enabled delay/cancellation of their premature extractions, and decrease of appearance of dental fear and anxiety and behaviour problems in child patients in the dental office.

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References

1. Cameron AC, Widmer RP (eds.). Handbook of Pediatric Dentistry. 4th Edition. Mosby; 2013.
2. Nowak AC, Christensen J, Mabry T, Townsed J, Wells M (eds.) Pediatric Dentistry Infancy Through Adolescence. 6th edition. Saunders; 2018.
3. Dean JA, Jones JE, Walker Vinson LA (eds.). McDonald and Avery's Dentistry for the Child and Adolescent. 10th edition. Elsevier; 2016.
4. Welbury R, Duggal MS, Hosey MT (eds.). Paediatric dentistry. 5th edition. Oxford University Press; 2018.
5. Fuks AB, Benjamin P. Pediatric Endodontics-Current Concepts in Pulp Therapy for Primary and Young Permanent Teeth. Springer; 2016.
6. Ritwik P. A review of pulp therapy for primary and immature permanent teeth. J Calif Dent Assoc, 2013;41:585-595.
7. Hamed MH, Gul M, Ghafoor R, Badar SB. Management of immature necrotic permanent teeth with regenerative endodontic procedures - a review of literature. J Pak Med Assoc, 2019;69:1514-1520.
8. Nicoloso GF, Potter IG, de Oliveira Rocha R, Montagner F, Casagrande L. A comparative evaluation of endodontic treatments for immature necrotic permanent teeth based on clinical and radiographic outcomes: a systematic review and meta-analysis. Int J Paediatr Dent, 2017;27:217-227.
9. Sato T, Hoshino E, Uematsu H, Kota K, Iwaku M, Noda T. Bactericidal Efficacy of a Mixture of Ciprofloxacin, Metronidazole, Minocycline and Rifampicin against Bacteria of Carious and Endodontic Lesions of Human Deciduous Teeth In Vitro. Microb Ecol Health Dis, 1992;5:171-1717.
10. Hoshino E. Sterilization of carious lesions by drugs. JJADS, 1990;9:32-37.
11. Sato T, Hoshino E, Uematsu H, Noda T. In vitro antimicrobial susceptibility to combinations of drugs of bacteria from carious and endodontic lesions of human deciduous teeth. Oral Microbiol Immunol, 1993;8:172-176.
12. Hoshino E, Kurihara-Ando N, Sato I, Uematsu H, Sato M, Kota K, et al. In-vitro antibacterial susceptibility of bacteria taken from infected root dentine to a mixture of ciprofloxacin, metronidazole and minocycline. Int Endod J, 1996;29:125-130.
13. Sato I, Kurihara-Ando N, Kota K, Iwaku M, Hoshino E. Sterilization of infected root-canal dentine by topical application of a mixture of ciprofloxacin, metronidazole and minocycline in situ. Int Endod J, 1996;29:118-124.
14. Takushige T, Cruz EV, Asgor Moral A, Hoshino E. Endodontic treatment of primary teeth using a combination of antibacterial drugs. Int Endod J, 2004;37:132-138.
15. Anila B, Murali H, Cheranjeevi J, Kapil RS. Lesion Sterilization and Tissue Repair (LSTR): A Review. J Sci Dent, 2014;4:49-55.
16. Prabhakar AR, Sridevi E, Raju OS, Satish V. Endodontic treatment of primary teeth using combination of antibacterial drugs: An in vivo study. J Indian Soc Pedod Prevent Dent, 2008;26:S5-10.
17. Nakornchai S, Banditsing P, Visetratana N. Clinical evaluation of 3Mix and Vitapex as treatment options for pulpally involved primary molars. Int J Paediatr Dent, 2010;20:214-221.

18. Agarwal M, Das UM, Vishwanath D. A Comparative Evaluation of Noninstrumentation Endodontic Techniques with Conventional ZOE Pulpectomy in Deciduous Molars: An *in vivo* Study. *World J Dent*, 2011;2:187-192.
19. Pinky C, Shashibhushan KK, Subbareddy VV. Endodontic treatment of necrosed primary teeth using two different combinations of antibacterial drugs: An *in vivo* study. *J Indian Soc Pedod Prev Dent*, 2011;29:121-127.
20. Trairatvorakul C, Detsomboonrat P. Success rates of a mixture of ciprofloxacin, metronidazole, and minocycline antibiotics used in the non-instrumentation endodontic treatment of mandibular primary molars with carious pulpal involvement. *Int J Paediatr Dent*, 2012;22:217-227.
21. Bansal R, Jain A. Overview on the Current Antibiotic Containing Agents Used in Endodontics. *N Am J Med Sci*, 2014;6:351-358.
22. Doneria D, Thakur S, Singhal P, Chauhan D. Comparative evaluation of clinical and radiological success of zinc oxide-ozonated oil, modified 3mix-mp antibiotic paste, and vitapex as treatment options in primary molars requiring pulpectomy: An *in vivo* study. *J Indian Soc Pedod Prev Dent*, 2017;35:346-352.
23. Lokade A, Thakur S, Singhal P, Chauhan D, Jayam C. Comparative evaluation of clinical and radiographic success of three different lesion sterilization and tissue repair techniques as treatment options in primary molars requiring pulpectomy: An *in vivo* study. *J Indian Soc Pedod Prev Dent*, 2019;37:185-191.
24. Coll JA, Dhar V, Vargas K, Chen CY, Crystal YO, AlShamali S, et al. Use of Non-Vital Pulp Therapies in Primary Teeth. *Pediatr Dent*, 2020;42:337-349.
25. Coll JA, Vargas K, Marghalani AA, Chen CY, AlShamali S, Dhar V, et al. A Systematic Review and Meta-Analysis of Nonvital Pulp Therapy for Primary Teeth. *Pediatr Dent*, 2020;42:256-272.
26. Duarte ML, Pires PM, Masterson Ferreira DM, Vaz Braga Pintor A, de Almeida Neves A, Cople Maia LC, et al. Is there evidence for the use of lesion sterilization and tissue repair therapy in the endodontic treatment of primary teeth? A systematic review and meta-analyses. *Clin Oral Invest*, 2020;24:2959-2972.
27. American Academy of Pediatric Dentistry. Pulp therapy for primary and immature permanent teeth. The Reference Manual of Pediatric Dentistry. Chicago, Ill.: American Academy of Pediatric Dentistry, 2021:399-407.
28. World Medical Association. World Medical Association Declaration of Helsinki: ethical principles for medical research involving human subjects. *JAMA*, 2013;310:2191-2194.
29. Sijini OT, Sabbagh HJ, Baghlaif KK, Bagher AM, El-Housseiny AA, Alamoudi NM, Bagher SM. Clinical and radiographic evaluation of triple antibiotic paste pulp therapy compared to Vitapex pulpectomy in non-vital primary molars. *Clin Exp Dent Res*, 2021;7:819-828.
30. Zacharczuk GA, Toscano MA, López GE, Ortolani AM. Evaluation of 3Mix-MP and pulpectomies in non-vital primary molars. *Acta Odontol Latinoam*, 2019;32:22-28.
31. Raslan N, Mansour O, Assfoura L. Evaluation of antibiotic mix in Non-instrumentation Endodontic Treatment of necrotic primary molars. *Eur J Paediatr Dent*, 2017;18:285-290.
32. Chouchene F, Masmoudi F, Baaziz A, Maatouk F, Ghedira H. Antibiotic Mixtures in Noninstrumental Endodontic Treatment of Primary Teeth with Necrotic Pulp: A Systematic Review. *Int J Dent*, 2021;2021:5518599.
33. Garrocho-Rangel A, Jalomo-Ávila C, Rosales-Berber MÁ, Pozos-Guillén A. Lesion Sterilization Tissue Repair (LSTR) Approach Of Non-Vital Primary Molars With A Chloramphenicol-Tetracycline-ZOE Antibiotic Paste: A Scoping Review. *J Clin Pediatr Dent*, 2021;45:369-375.
34. Agarwal SR, Bendgude VD, Kakodkar P. Evaluation of Success Rate of Lesion Sterilization and Tissue Repair Compared to Vitapex in Pulpally Involved Primary Teeth: A Systematic Review. *J Conserv Dent*, 2019;22:510-515.
35. Moura J, Lima M, Nogueira N, Castro M, Lima C, Moura M, Moura L. LSTR Antibiotic Paste Versus Zinc Oxide and Eugenol Pulpectomy for the Treatment of Primary Molars with Pulp Necrosis: A Randomized Controlled Trial. *Pediatr Dent*, 2021;43:435-442.
36. Nalawade TM, Parikh D and Mallikarjuna RM. Lesion Sterilization and Tissue Repair (LSTR) Technique and its Clinical Application in Primary and Permanent Teeth: A Review. *Ann Essence Dent*, 2019;11:1-6.
37. Satenahalli SB, Vardhana BS, Surana P, Gopal R, Ranjan AP, et al. Lesion Sterilization and Tissue Repair (LSTR): A Review. *Eur J Mol Clin Med*, 2020;7:7909-7914.
38. Shankar K, Ramkumar H, Dhakshinamoorthy S, Paulindraraj S, Jayakaran TG, Bommareddy CS. Comparison of Modified Triple Antibiotic Paste in Two Concentrations for Lesion Sterilization and Tissue Repair in Primary Molars: An *In Vivo* Interventional Randomized Clinical Trial. *Int J Clin Pediatr Dent*, 2021;14:388-392.
39. Arslan H, Ahmed HMA, Şahin Y, Doğanay Yıldız E, Gündoğdu EC, Güven Y, et al. Regenerative Endodontic Procedures in Necrotic Mature Teeth with Periapical Radiolucencies: A Preliminary Randomized Clinical Study. *J Endod*, 2019;45:863-872.
40. Cross R, Ling C, Day NP, McGready R, Paris DH. Revisiting doxycycline in pregnancy and early childhood-time to rebuild its reputation? *Expert Opin Drug Saf*, 2016;15:367-382.
41. Dille M, Geng B. Immediate and Delayed Hypersensitivity Reactions to Antibiotics: Aminoglycosides, Clindamycin, Linezolid, and Metronidazole. *Clin Rev Allergy Immunol*. 2022 Jun;62(3):463-475.

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