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ORIGINAL RESEARCH

A Comparative Evaluation of Noninstrumentation Endodontic Techniques with Conventional ZOE Pulpectomy in Deciduous Molars: An *in vivo* Study

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ABSTRACT

Pulp exposures secondary to caries are the most common in primary teeth due to the relatively large size of pulp chamber. Pulp in primary teeth is capable of healing, following control of infection and inflammation. Pulpotec and LSTR are the simple noninstrumentation endodontic treatment procedures which are capable of compensating for the inconvenience caused by conventional pulpectomy, and thereby preserve the vitality of the pulp. This study was conducted to assess clinical efficacy of pulpotec and LSTR and compare with that of conventional ZOE pulpectomy at 1, 3, 6 and 12 months postoperatively. Around 34 children in the age group of 4 to 9 years with deep carious lesions affecting the pulps of 60 primary mandibular molars were randomly divided into three groups with 20 teeth in each group.

Results: Clinical evaluation was done at 1 month's interval. Both clinical and radiographic evaluations were done at 3, 6 and 12 months. Data obtained was analyzed statistically using Fisher's exact test. The results concluded that pulpotomy and pulpotec could be a good alternative for conventional ZOE pulpectomy. Long-term radiographic evaluations should be undertaken to further strengthen the efficacy of lesion sterilization and tissue repair (LSTR) as NIET.

Keywords: Vital pulp treatment, ZOE pulpectomy, Pulpotec, LSTR.

INTRODUCTION

One of the most valuable services a pediatric dentist can provide for the child patient is adequate treatment of pulp involved primary teeth.[1] For many years, different principles and techniques for the treatment and preservation of primary teeth have been suggested by the dental profession.[2]

Pulp therapy has been suggested since 1932 as a method for maintaining primary teeth, which would otherwise be lost.[3] Pulpectomy procedure is always just a compromise but which taking proper indication into account, is preferred to an extraction. Still, pulpectomy procedure proves to be long and complicated and has remained controversial for a number of reasons. Mainly, the perceived difficulty of behavior management in the pediatric population and uncertainty about the effects of root canal filling material and instrumentation on the succedaneous teeth. Anatomic situations like the often complicated curved and tortuous shape of root canals and the closeness of the advancing tooth buds make the treatment more difficult.[4] Another limitation is the apparent connection between the coronal floor with the intraradicular area[5] with the presence of multiple accessory canals and ramifications as well as the difficulty in obtaining hermetic seal due to lack of apical closure following physiologic root resorption have surely added reluctance among dentists to use this procedure.[6] Hence, the use of such procedure should be discouraged.[7] The literature on pulpal treatment for primary teeth predicate on the premise that the pulp remains vital or that a portion of it will retain vitality after therapy.[8] The pulp and pulpal reactions in primary teeth differ markedly as it inflames more easily, degenerates more readily and reacts less favorably than that of permanent teeth. The high degree of cellularity and vascularity is an asset to high potential of repair. As such the young pulp lends itself most readily to procedures concerned with preservation of pulp vitality.[9]

This has led to investigate the possibilities of perfecting a material with simplified procedure, capable of compensating for the inconveniences, and thereby preserving the vitality and promote pulp tissue healing.[10] To overcome the difficulties, preparations containing antibiotics and corticosteroids have been proposed as the alternatives with the possibility of active suppression of acute inflammation thereby preserving the vitality of pulp that has been regarded as irreversibly inflamed.[11]

Use of the newer materials and techniques in the recent years, such as that of Pulpotec proposed by A Marmesse[10] for the treatment of pulpitis of deciduous molars by pulpotomy[10-12] and

another alternative, the concept of lesion sterilization and tissue repair (LSTR) therapy proposed by Hoshino[13] and Iwaku et al[14] can prove to be beneficial alternatives to conventional ZOE pulpectomy. They employ the use of minute amounts of corticosteroids and mixture of antibacterial drugs respectively, to sterilize the root canal system but not mechanical procedure. These clinical procedures are simple and do not require multiple visits and have been designated as noninstrumentation endodontic treatment techniques (NIET).[15]

Both the techniques present numerous advantages when compared to conventional pulpectomy. One can mention significant time saving, easy access to the coronal part of the pulp which is treated with simplified procedure.[12]

However, there are few reports in the literature regarding the use and clinical efficacy of these procedures. There are also no previous studies concerning which of these simplified techniques give the higher percentage of success. Moreover, data is also insufficient regarding the clinical efficacy of these noninstrumentation techniques when compared with conventional procedures in primary teeth.

So, this study was conducted to determine the clinical efficacy of Pulpotomy, Pulpotec and LSTR therapy as noninstrumentation endodontic procedures and simultaneously compare their clinical and radiographic results with those of conventional ZOE pulpectomy as control on primary mandibular molars.

METHODOLOGY

A short-term clinical study was conducted on 60 primary mandibular molars, showing signs of pulpal involvement in 4 to 9 years old children free from systemic disease, who reported to the Department of Pedodontics and Preventive Dentistry, VS Dental College and Hospital, Bengaluru, India.

CRITERIA FOR TOOTH SELECTION USING CLINICAL AND RADIOGRAPHIC EXAMINATION

1. Primary molars with vital carious pulp exposure that show evidence of hyperemia with or without partial necrosis or abscess formation
2. No clinical symptom or evidence of radicular pulp degeneration
3. Radiographic features:
   - No radiographic signs of internal/external root resorption
   - No furcation radiolucency
4. No pathologic mobility
5. No sinus or fistula formation
6. Teeth should be restorable.

The selected teeth were divided randomly into:

Group 1 (Fig. 1)

Control

Twenty primary mandibular molars were treated with conventional ZOE pulpectomy procedure according to Payne et al, 2004.[16]

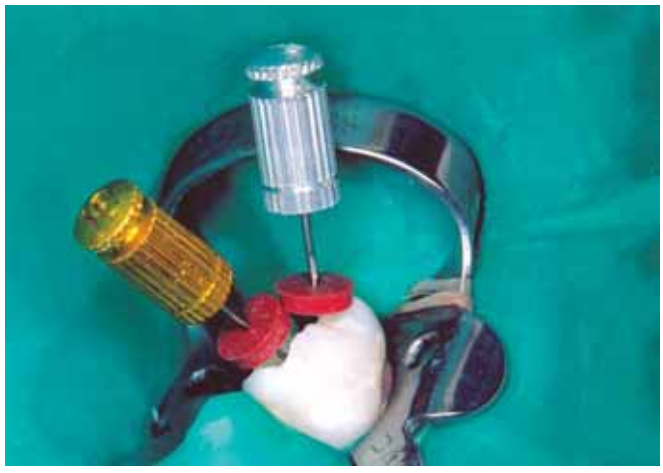


Fig. 1: Conventional ZOE pulpectomy

Local anesthesia was given followed by Rubber dam application. Access cavity was prepared using no. 56 fissure bur in NSK high speed airotor handpiece. Complete amputation of coronal pulp using spoon excavator was done to gain entrance into the root canal identified at the floor of pulp chamber. Pulp tissue extirpation was done using no. 15, 20 H files, one at a time. Working length established 1 mm short of apex by inserting fine files by taking IOPAR. Following which biomechanical preparation was done using H files, rotating them to engage the pulp tissue and removed in a pull back motion with frequent irrigation with normal saline. The canals dried using sterile absorbent paper points for obturation with a paste of ZOE mixed to medium consistency, delivered using lentulospirals and the material was finally condensed using root canal pluggers. Postoperative IOPAR was taken after completion of procedure. The tooth was then restored after 24 hours with stainless steel crown.

Group 2 (Fig. 2)

Experimental

Twenty primary mandibular molars were treated with pulpotomy and pulpotec (Pulpotec kit contains powder and liquid, carbide

Fig. 2: Pulpotomy and Pulpotec

surgical bur, endo bur, diamond pear shaped bur and paste filler) procedure.[10]

After preoperative assessment, local anesthesia was given along with rubber dam placement. Roof of pulp chamber was removed using surgical bur after which vital pulp was excised from the chamber by means of endo bur. Shape the pulp chamber using diamond pear shaped bur. Pulpotec liquid and powder were blended to obtain thick, creamy consistency of the paste which was inserted into the pulp chamber using paste filler. The cavity was then sealed with temporary ZOE cement. The patient was then asked to bite progressively but firmly on the cotton placed between the two dental arches, so that the paste clings to the walls of the pulp cavity as well as to the root canal orifices. Excess cement was eliminated and postoperative IOPAR taken after completion of procedure. Once the initial set has occurred (after 7 hours), second session was undertaken to complete the treatment by seating stainless steel crown.

Group 3 (Fig. 3)

Experimental

Twenty primary mandibular molars were treated with 'lesion sterilization and tissue repair therapy' (LSTR-3 Mix-MP, mixture of drug combination of ciprofloxacin 500, metronidazole 400 and minocycline 100 in a ratio of 1:3:3 prepared with macrogol and propylene glycogol in ointment form) procedure.[15]

Once the preoperative assessment was made, local anesthesia administration and rubber dam application were done. Access cavity was then prepared using no. 56 fissure bur in high speed NSK airotor handpiece. 5% NaOCl immersed in cotton was applied to control the hemorrhage, followed by application of the antibiotic paste to the pulpal floor. The tooth was then sealed with GIC and postoperative IOPAR was taken after completion of procedure. Permanent restoration was done by cementing stainless steel crown in second appointment after 24 hours.

The children were recalled for clinical evaluation at the interval of 1 month; clinical and radiographic 3, 6 and 12 months.

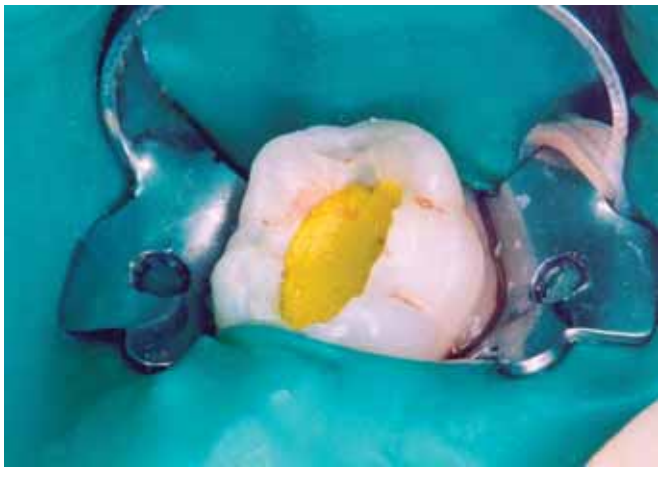


Fig. 3: LSTR (3 Mix-MP placed over the pulp stump)

Scoring Criteria[17]

Scoring for clinical success of teeth:

0. Failure
1. No pain symptoms
2. No tenderness to percussion
3. No swelling
4. No fistula
5. No pathologic mobility.

Scoring for radiographic success of teeth:

0. Failure
1. No radicular radiolucency
2. No internal/external root resorption
3. No periodontal ligament space widening.

[Failure (0): Defined as presence of any one or more of the above clinical and/or radiographic signs and symptoms].

RESULTS

A total of 60 mandibular primary molars, 26 first molars and 34 second molars in 34 children (18 males, 16 females) were endodontically treated in group I (ZOE) and in group 2 (Pulpotec) and 3 (lesion sterilization and tissue repair) where noninstrumentation directed endodontic treatment was carried out. The symptoms of the patients were recorded regarding the status of the pulp and single sitting roof canal procedure was carried out (Table 1).

Statistical Analysis was done using Fisher's exact test to compare the proportion of failure/success (Tables 2 to 5) in the three groups at different time intervals (Graphs 1 to 4). Null hypothesis H0 taken was that there is no significant difference in the proportion of failures among the three groups, i.e. p1 = p2 = p3 and the alternate hypothesis H1 was that at least one pair of the groups differ with level of significance being

Table 1: Distribution of teeth according to presenting symptoms

Group	Teeth with deep carious lesions and exposed pulp	Acute symptoms	Abscess	Asymptomatic
1	20	13	—	7
2	20	12	1	7
3	20	13	—	7

Table 2: Cumulative distribution of failure and success in each group at 1 month

Group	Failures	Success	p-value (Fisher's test)
1 (n = 16)	0	16 (100%)	1.000
2 (n = 20)	0	20 (100%)	
1 (n = 16)	0	16 (100%)	0.024
3 (n = 20)	6 (30%)	14 (70%)	
2 (n = 20)	0	20 (100%)	0.020
3 (n = 20)	6 (30%)	14 (70%)	

Table 3: Cumulative distribution of failure and success in each group at 3 months

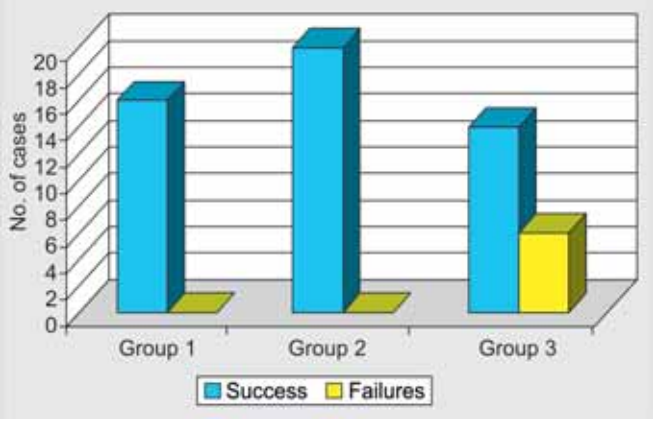
Group	Failures	Success	p-value (Fisher's test)
1 (n = 16)	0	16 (100%)	1.000
2 (n = 20)	1(15%)	19 (95%)	
1 (n = 16)	0	16 (100%)	< 0.001
3 (n = 18)	10 (55.56%)	8 (44.44%)	
2 (n = 20)	0	20 (100%)	0.001
3 (n = 18)	10 (55.56%)	8 (44.44%)	

Table 4: Cumulative distribution of failure and success in each group at 6 months

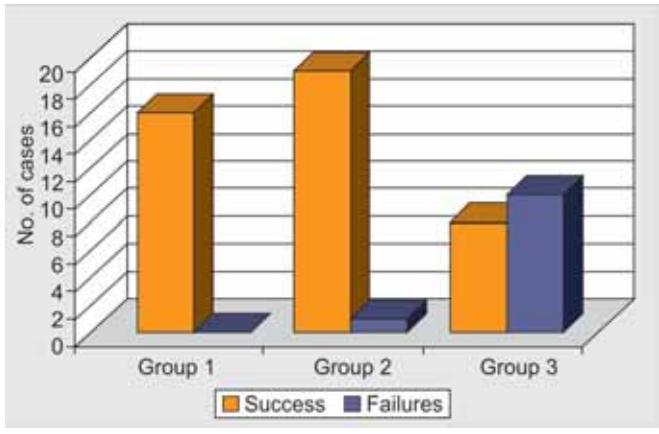
Group	Failures	Success	p-value (Fisher's test)
1 (n = 14)	1 (7.14%)	13 (92.86%)	1.000
2 (n = 19)	1 (5.26%)	18 (94.74%)	
1 (n = 14)	1 (7.14%)	13 (92.86%)	0.003
3 (n = 18)	11 (61.11%)	7 (38.89%)	
2 (n = 19)	1 (5.26%)	18 (97.74%)	< 0.001
3 (n = 18)	11 (61.11%)	7 (38.89%)	

Table 5: Cumulative distribution of failure and success in each group at 12 months

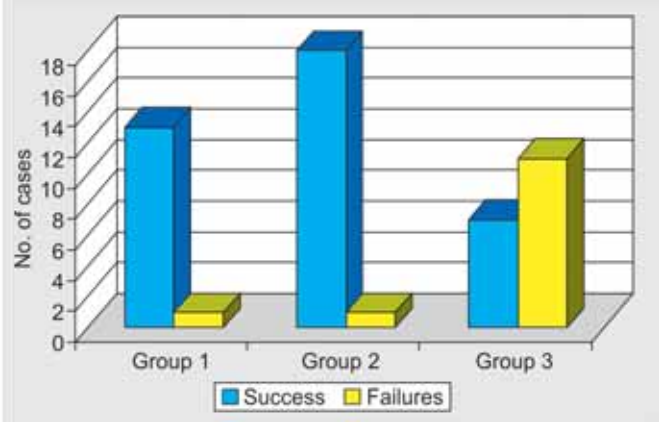
Group	Failures	Success	p-value (Fisher's test)
1 (n = 14)	3 (21.43%)	11 (78.57%)	0.288
2 (n = 19)	1 (5.26%)	18 (94.73%)	
1 (n = 14)	3 (21.43%)	11 (78.57%)	0.016
3 (n = 18)	12 (66.67%)	6 (33.33%)	
2 (n = 19)	1 (5.26%)	18 (94.73%)	< 0.001
3 (n = 18)	12 (66.67%)	6 (33.33%)	



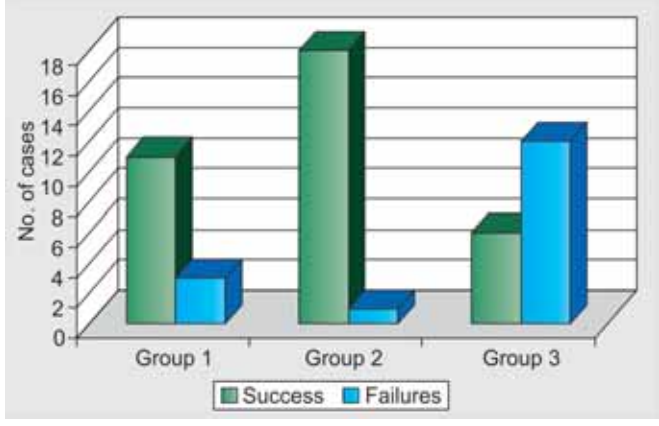
Graph 1: Graphic representation of success and failure in each group at 1 month



Graph 2: Graphic representation of success and failure in each group at 3 months



Graph 3: Graphic representation of success and failure in each group at 6 months



Graph 4: Graphic representation of success and failure in each group at 12 months

$\alpha = 0.05$. The decision criterion was to reject the null hypothesis if $p < 0.05$ and accept the alternate hypothesis. Otherwise we accept H0.

Inference: The following Tables 2 to 5 give us the significance value, i.e. the p-value for various computations. We notice that $p < 0.05$ between group 1, group 3 and group 2, group 3 at all time intervals. Thus, we reject H0 and conclude that there is a significant difference in the proportion of failures/success between group 1, group 3 and group 2, group 3. But for group 1 and group 2, $p > 0.05$, at all time intervals. Therefore, we accept the null hypothesis H0 and conclude that there is no significant difference in the proportion of failures/success between group 1 and group 2.

DISCUSSION

One of the most valuable services a pediatric dentist can provide for the child patient is adequate treatment of pulp involved

primary teeth.[1] Maintaining the integrity and health of oral tissues is the primary objective of pulp treatment.Conservative treatments are recommended for primary teeth whose pulps have the potential to recover once the irritation is removed.

Various techniques have been described for conserving primary molars whose pulps have become nonvital or have degenerated to the extent that they are not good candidates for vital pulp therapy. Most of these techniques can be assigned to one of two major classifications. Representatives of one group advocate removing the contents of pulp chamber and placing some sort of medication over the radicular pulp stump for a varying period of time. Representatives of the second group advocate removing all accessible pulp tissue, controlling the organisms and their toxins with a rotation of drugs, and restoring the canals with an absorbable filling material.[18]

McDonalds R advocates partial pulpectomy technique for deciduous teeth that have hyperemic pulp without painful pulpitis.[19] The usual treatment applied to pulpitis on a vital tooth is pulpectomy.[12] ZOE is the most widely used preparation for primary tooth pulpectomies.[20] Erausqin and Muruzabal used ZOE as a root canal filling material in 141 rats followed from 1 to 90 days. They noted that ZOE irritated the periapical tissues and caused necrosis of bone and cementum.[21]

In 1982, Jerrell and Ronk presented a case report of overfilled ZOE pulpectomy in which succedaneous premolar was malformed.[22] Coll et al in 1985 reported a more than 80% success rate of one-visit ZOE pulpectomy followed a mean time of 70 months. They found ZOE retained in the tissue after eight of 17 molars exfoliated.[23]

Anatomic situations like the often-complicated shape of root canals and the closeness of the advancing tooth bud make root canal treatment difficult.[5] Groter (1967)[24] advocated to avoid the use of instruments completely while Spedding (1973)[25] advocated to use instruments in the root canals to the point of resistance. Yacobi et al (1991)[26] were in favor of minimal biomechanical preparation. Garcia Godoy (1987)[27] preferred to enlarge the root canals only to the level of occlusal plane of the permanent tooth germ.

Hobson 1970[28] found that tubules in the dentinal walls of the root canals, in 70% of the samples of extracted teeth with necrotic in both radicular and coronal pulp, were penetrated by microorganisms. He concluded that it would be desirable, therefore, when treating nonvital infected primary teeth to use an antibacterial drug capable of penetrating the tissues and controlling infection in the dentinal walls.

Several investigators agree that total removal of the pulp tissue from the root canals of primary teeth cannot be achieved because of their complex and variable morphology. It is also difficult to eliminate the wide range of organisms in infected root canals. Thus, the particular quality of the medicament/paste determines the prognosis in the endodontic treatment of infected primary teeth. Identifying the best formulation of ingredients and techniques to predictably produce pulpal healing remains elusive. It is generally agreed that prognosis after any type of the pulp therapy improves in the absence of contamination by pathogenic organisms. Thus, biocompatible neutralization of any existing pulpal contamination and prevention are worthy goals in vital pulp therapy. If the treatment material in direct contact with pulp also has some inherent quality that promotes, stimulates or accelerates a true tissue healing response, so much better, however, it is recognized that vital pulp tissue can recover from a variety of insults spontaneously in a favorable environment.[29]

Noninstrumentation endodontic treatment procedures applied to the use of Pulpotec and lesion sterilization and tissue repair are based on the above concepts.

The overall success rate of ZOE (78.5%) was consistent with the results of Mortazavi M and Mesbahi M (2004)[39] who also reported the overall success rate (clinical and radiographic) of 78.5% for ZOE at the end of 10 to 16 months follow-up period. The results were also in comparison with the study done by Mani, Chawla and Tewari et al (2000)[34] who reported 83.3% clinical and radiographic success rate in the ZOE group followed up to 6 months.

The overall success of 94% in "Pulpotec" at the end of 12 months was also in agreement with the results of Maramesse A (1989)[13] who conducted clinical trials of Pulpotec for long-term and found a success rate of 80% in deciduous teeth. Our results were also consistent with those of Dodeyan SA, Donkaya IP (2003)[36] who reported 100% success rate of Pulpotec during 6 months evaluation.

In this *in vivo* study, the overall (clinical and radiographic) success rates in LSTR at the end of 12 months were not on agreement with those of Hoshino E (2004)[16] who reported 80% clinical success of the procedure. Overall three patients were seen with intraoral swelling at the end of 6 months follow-up and the main complications encountered were radicular radiolucency and internal resorption on radiographic follow-up at 6 and 12 months intervals. The poor success rate can be attributed to the fact that radiographic criteria were also used to assess the success, which was not done in the earlier studies. There are limited and conflicting reports in the literature to substantiate the clinical and radiographic success rate of LSTR.

From the above study, it was concluded that "Pulpotec" can be used as a proven, safe and effective alternative to conventional ZOE pulpectomy in teeth with pulpal exposure secondary to caries with or without partial necrosis, which eliminates the need to instrument into the canals and simplifies the procedure.

We recommend further long-term clinical and radiographic evaluations for LSTR before it can be recommended as NIET.

CONCLUSIONS

1. Our study concluded that pulpotomy and pulpotec could be a good alternative for conventional ZOE pulpectomy
2. Long-term clinical and radiographic evaluations should be undertaken to further strengthen the efficacy of LSTR as NIET.

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