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The success rate of pulpectomy in infected pulp of primary molar teeth using manual and rotary instruments using two different filling materials: An In vivo study

[1]Dr Shikha Choubey, MDS, Pediatric Dentistry, Associate Professor, Dept. of Pediatric Dentistry, MA Rangoonwala Dental College, Pune.

[2]Dr Anand Shigli, MDS, Pediatric Dentistry, Professor and Head, Dept. of Pediatric Dentistry, Ajeenkya DY Patil Dental College, Pune.

Corresponding Author: Dr Shikha Choubey, MDS- Pediatric Dentistry, Associate Professor, Dept. of Pediatric Dentistry, MA Rangoonwala Dental College, Pune.

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Introduction

The primary tooth pulpectomy is an acceptable treatment for saving infected primary teeth. Clinical studies have reported success rates of 65-100% following this treatment[1].The prime objective of endodontic therapy is the retention of the pulpally or periapically involved tooth in a healthy state[1].

Pulpectomy in the primary teeth was first described in 1930 by **Sweet** as a four or five step technique using formocreosol[2]. In recent times, pulpectomy procedure is described as one stage technique and two stage techniques and extraction of the offending tooth is recommended if the symptoms do not resolve in the second visit[3]. It was not until the mid 90's when research started regarding the use of rotary files in primary teeth pulpectomy. **Barr et al** first described this technique for primary teeth using the Profile system[4]. Rotary instrumentation facilitates the maintenance of the original canal shape and the position in space of the apical foramen[5]. The use of zinc oxide and eugenol (ZOE) to fill root canals of primary teeth was described by **Sweet** in **1930**[2]. Since the 1930s many other authors have advocated the use of ZOE to fill the canals of primary teeth needing root canal therapy

It is speculated that the resorption rate of ZOE and the root differs, resulting in small areas of ZOE paste possibly being retained [6]. Many authors[7,8,9] agree that resorption of the filling material is considered one of the requirements of an ideal root-canal medicament for pulpectomies of primary teeth. If the material is expressed beyond the apex, it should be resorbable and non-toxic to the periapical tissues and the permanent tooth germ[9,10].

Dominguez et al in **1989**[11]were the first to combine pure iodoform with calcium hydroxide as a pulpectomy agent,

with excellent clinical, radiographic and histological results were obtained.

The use of calcium hydroxide- Iodoform paste (Vitapex^{R}) is especially recommended in patients whose return for follow-up is doubtful. In 2010, **Nakornchai etal**[12]found clinical success with pulpectomy of primary tooth obturated with Vitapex over a 12 month study period.

Aims and Objectives

The aim of this study was to compare the in-vivo success rate of pulpectomy in infected pulp of primary molar teeth using manual and rotary instruments using two different filling materials i.e. to evaluate the success of pulpectomy after:

- Hand instrumentation followed by ZOE obturation
- Hand instrumentation followed by Metapex^{R} obturation
- Rotary instrumentation followed by ZOE obturation
- Rotary instrumentation followed by Metapex^{R} obturation

Materials and Method

120 teeth either primary first or second maxillary or mandibular molars from 74 patients with ages between 4.5 to7.5 years, with carious exposure were selected. Teeth with periapical pathologies and interradicular radiolucencies, external or internal resorption, mobility or fracture, grossly mutilated and unrestorable teeth were not included in this study. Pulpectomy was the treatment advocated in these cases based on the criteria of **Coll** and **Sadrian**[6]**.**

The teeth were randomly divided into two groups the first group (Group I) being stainless steel manual K-file (Mani^{R} Dental Products) group. The second group (Group II) being ProTaper^{R} Ni-Ti rotary files with Anthogyr^{R} reduction gear hand piece. Each group was subdivided into two subgroups, the first (Subgroup 1) is Zinc oxide Eugenol obturating material and the second (Sub-group 2) is the Metapex^{R} obturating material.

In the first appointment, after local anesthesia and isolation of the teeth with rubber dam, a straight-line access to the pulp chamber is achieved, and extirpation of pulpal debris from the root canals using no.10 K-file (Mani^{R} Dental Products) followed by copious irrigation with 2.5% sodium hypochlorite was done. A diagnostic radiograph was taken to ascertain the exact length of the root canal.

Procedure for Group I

After the determination of the working length, the canals are prepared by quarter turn and pull motion till no.35 using stainless steel K-files. Each instrument was followed by copious irrigation with 2.5% NaOCl alternating with normal saline. Following this, the canals were dried and obturated. The subgroup 1 was obturated with thin mix of zinc oxide and eugenol paste with powder liquid ratio of1.23gm powder with 0.5ml liquid using a no.30 reamer in anticlockwise direction. The subgroup 2 was obturated after drying using a Metapex^{R} syringe (Meta Dental Manufacturing Inc. Korea) where the tip is inserted into the canal up to the apex and the plunger is pushed gently while slowly the tip is withdrawn. The procedure is repeated for all the canals. After obturation a post-obturation radiograph is taken and the teeth were restored with type IX glass ionomer cement (GC Fuji).

Procedure for Group II

The pulp chamber has to be filled with irrigating solution (NaOCl 2.5%) during the whole shaping procedure. After a glide path has been established with K-files, ProTaper^{R} S1 is the first instrument used. During insertion, a brushing motion against the canal wall in the direction of repositioning the canal orifice is used. This motion is repeated a few times before removing the file from the canal. After successful insertion of S1, S2 is used in one

or two strokes to working length in the same manner. The coronal two thirds of the root canal now should be shaped ideally. Apical preparation is done with the finishing file F2 that can be worked to working length. According to the manufacturer's recommendations, each ProTaper^{R} instrument was used in not more than 10 deciduous teeth canals. The procedure was repeated for all the canals. The obturation of the two subgroups was performed as mentioned above.

On a second appointment the pulpectomized tooth was restored with a stainless steel crown.

The patients were evaluated up to 6 months (recall set at 3months and 6 months post-operatively) clinically for presence or absence of swelling, pain, and sinus/fistula and radiographically for internal resorption, periapical changes, and furcation radiolucencies. The statistical analyses were done by "**Two way Analysis of Variance**" (Two-way ANOVA).

Result

Out of 120 teeth selected, 38 were maxillary primary molars and 82 were mandibular primary molars. 6 teeth out of the 38 maxillary teeth were right first primary molars, and 18 were right second primary molars, 4 were maxillary left first primary molars, and 10 were maxillary left second primary molars. In the 82 mandibular teeth 17 were left first primary molars, 28 were left second primary molars, 13 were mandibular right first primary molars and 24 were right second primary molars.

In the hand instrument group (Group I), the subgroup obturated with zinc oxide (Subgroup one) pain was present in 25 teeth before treatment. In the subgroup 2 (calcium hydroxide obturation), 24 teeth exhibited pain prior to treatment. In Group II, in subgroup one, 9 teeth had pain and 3 teeth in subgroup `two showed positive results for pain.

Comparing the hand instrumentation group against the rotary instrumentation group it was seen that the decrease is pain is much more in the hand instrumentation group which was highly significant ($p<0.000$) but this may be clinically insignificant since the pain ultimately subsided in all the patients.

Comparing the presence of sinus in all the groups, 3 teeth in subgroup2 of group I and 1 tooth of subgroup1 of group II had presence of sinus that was completely resolved immediately after treatment. Comparing amongst all 4 components, the Metapex^{R} obturation in the hand instrumentation group was seen to cause significant decrease in sinus and fistulae ($p=0.042$).

Out of the 120 teeth selected for the study, there was no evidence of internal resorption before treatment in any tooth. And even after treatment there was no evidence of internal resorption in any of the subgroups of the two groups at the 3 month or the 6 month recall.

2 patients in subgroup 1 of group I had evidence of periapical changes before treatment which reduced to 1 after treatment and increased to 3 in 3 months and increased to 4 on the six month review.In the subgroup 2 of group I only 1 tooth showed periapical changes which resolved at the 6 month recall.

In the case of furcation involvement, 5 teeth of subgroup 1 in group I showed pretreatment evidence of furcation involvement which increased to 7 after treatment and reduced to 3 patients after three months and to 1 at the six months recall.

In group II, the subgroup 1 had 3 teeth showing presence of furcation involvement before the treatment which was the same till the three month recall and reduced to 1 at the 6 months recall. In subgroup 2 of group II, 4 teeth had pre treatment evidence of furcation involvement which remained the same till the 3 month recall and totally resolved at the 6 months recall.

No tooth with extraoral swelling was selected for the study. After pulpectomy treatment swelling did not occur in any of the cases and no swelling was observed at the 3 month or the 6 month recall.

Discussion

The biomechanical endodontic treatment of permanent teeth is a well-established procedure, but this cannot be done in the deciduous dentition because of the complexity and the irregularity of the root canals and the inability to determine an apex as in the permanent teeth[13]. Pulpectomy helps in preserving a pulpally involved primary tooth by eliminating bacteria and their products and ensures hermetic seal of the root canals so that the primary teeth can complete its function until normal exfoliation can occur[14].

A total of 120 teeth either primary first or second maxillary or mandibular molars from 74 patients with ages between 4.5 to7.5 years, with carious exposure were selected. Teeth with periapical pathologies and interradicular radiolucencies, external or internal resorption, mobility or fracture, grossly mutilated and unrestorable teeth were not included in this study.

The pain subsided in all the cases (120 cases) immediately after treatment thus there is no difference amongst the various groups, so therefore both methods and both obturating materials were found to be equally efficient in relieving pain. **Thomas et al in 1994**[15] found complete pain relief after pulpectomy within first week of treatment. According to a study by **Nadkarni et al in 2000**[16] two out of twenty eight patients showed spontaneous pain after calcium hydroxide obturation. In the same study three out of thirty one patients following ZOE obturation exhibited pain at the first month post operatively. **Mortazavi** and **Mesbahi 2004**[17] in a 16 month study found 100% relief in pain post-operatively following both ZOE and Vitapex obturation. In another study, **Ramar** and **Mungara 2010**[14]found post-operative pain in 1 out of 34 ZOE obturated cases which had to be followed by extraction.

Comparing the presence of sinus in all the groups, out of 120 cases, 3 (10%) cases in subgroup2 (Metapex^{R}) of group I (Hand Instrumentation) and 1 case (3.3%) of subgroup1 (ZOE) of group II (Rotary instrumentation) had presence of sinus that was completely resolved immediately after treatment. **Mortazavi** and **Mesbahi**[17]found that sinus was healed within one month of pulpectomy with both ZOE and Vitapex obturation.

2 patients (6.7%) in subgroup 1(ZOE) of group I (hand instrumentation) had evidence of periapical changes before treatment which reduced to 1 (3.3%) after treatment and increased to 3 (10%) in 3 months and increased to 4 (13.3%) on the six month review. In the subgroup 2 (Metapex^{R}) of group I only 1 patient (3.3%) showed periapical changes which resolved at the 6 month recall (0%). In the study of **Kuo et al**[18], an increase in radiolucency was found in the furcal area in one case at the 6-month and in another case at the 12-month recalls which they considered as radiographic failure. **Nadkarni et al**[16] also found similar results where furcation radiolucencies reduced from 25 to 7 within 3 months following ZOE obturation and from 24 reduced to 3 following Calcium hydroxide obturation.

In the case of furcation involvement, 5 patients (16.7%) of ZOE obturation in the hand instrumentation group showed pretreatment evidence of furcation involvement which increased to 7 (23.3%) after treatment and reduced to 3 patients (10%) after three months and to 1 (3.3%) at the six months recall. 8 patients i.e. 26.7% had radiographic evidence of furcation involvement before treatment in the calcium hydroxide subgroup of the hand instrumentation group that which remained the same after treatment and at the 3 month recall but reduced to 2 (6.7%) at the end of 6 months. In group II(Rotary instrumentation), the subgroup

1 (ZOE) had 3 patients (10%) showing presence of furcation involvement before the treatment which was the same till the three month recall and reduced to 1 at the 6 months recall. In subgroup 2(Metapex^{R}) of group II(Rotary instrumentation), 4 patients (13.3%) had pre-treatment evidence of furcation involvement which remained the same till the 3 month recall and totally resolved at the 6 months recall. **Coll** and **Sadrian**[6] defined pulpectomy success if bifurcation radiolucency resolved within 6-12 months postoperatively. In a study by **Trairatvorakul** and **Chunlasikaiwan**[19]in **2008** there was 48% healing of furcation radiolucencies with ZOE and 78% healing with Vitapex at the 6 month recall.

Comparing the hand instrumentation group against the rotary instrumentation group it was seen that the decrease is pain is much more in the hand instrumentation group which was highly significant ($p<0.000$) but this may be clinically insignificant since the decrease in pain in each group was 100%.

Comparing amongst all 4 components, the Metapex^{R} obturation in the hand instrumentation group was seen to cause significant decrease in sinus and fistulae ($p=0.042$). This is similar to the findings of **Trairatvorakul** and **Chunlasikaiwan**[19] in 2008 who found statistically significant difference between ZOE and Vitapex in reducing furcation radiolucencies over 6 month review.

Bahrololoomi Z., Tabrizizadeh M. and **Salmani L**[20] conducted a study in **2007** to compare the cleaning capacity between rotary and manual instruments and found that there was no significant difference among the cervical, middle and apical thirds after manual and rotary instrumentation. Several studies have evaluated the success rate of pulpectomy for necrotic primary molars and anterior teeth.

Study by **Primosch RE, Ahmadi A, Setzer B,** and **Guelman M**. in **2005**, determined a failure rate of 24% for pulpectomies using ZOE paste in vital primary teeth[21].

Nakornchai S., Banditsing P. and **Visertratana N**.[12] in a twelve month follow-up study reported a clinical success rate of 100% at the end of 6 months and 96% at the end of 12 months using Vitapex^{R} which is similar in composition with Metapex^{R} that was used in our study. In the same study the radiographic success rate of Vitapex^{R} was 80% at the end of 6 months and 56% at the end of 12 months.

Other alternative materials such as Endoflas F.S. show a pulpectomy radiologic failure rate of about 3.3% by **Moskovitz et a**l in **2010**. They also found no relationship between root canal therapy in primary teeth and enamel defects or ectopic eruptions of following permanent teeth[22].

ZOE is not bactericidal, unless mixed with drugs such as formocresol[23]. ZOE alone or with a fixative gave a success rate ranging from 65-86% in deciduous teeth[24, 25].

Garcia-Godoy[9] **1987** and **Dominguez**[11] **1989** reported that when combining Iodoform with Calcium hydroxide, it gave a success rate of 100%, but the main disadvantage was the intra-radicular resorption of the material.

When comparing the efficacy in oval root canals **El Ayouti et al** found no instrumentation technique was able to circumferentially prepare the oval outline of root canals[26]. However, nickel titanium rotary files were not found to be effective in cleaning flattened root canals[27].

Moskovitz, Samara and **Holan (2005)** related the success rate of root canal treatment in primary molars with the type of post-obturation restoration. They reported that the success was higher in teeth that were restored with silver amalgam and stainless steel crown. However, they did not find any statistically significant relationship between extent of filling and success rate[28]. Principle advantage of Calcium hydroxide-iodoform paste was that it resorbed

from the periapical tissue within one week to two months [29].

Some researchers claim that manual technique is more efficient in cleaning flattened root canals than rotary technique[30]. But in case of curved root canals, more centered and tapered preparation was observed with NiTi rotary preparation than with conventional K-type files[31]. In case of oval root canals, both instrumentation techniques were equal[26] NiTi instruments exhibit an increased incidence of breakage for several reasons, including cyclic fatigue, instrument design and technique of instrumentation, lack of operator experience, degree of curvature of canal, torque generated and vertical load causing increase in torque[32]

In-vitro study by **Tchaou et al** reported that Vitapex^R is generally non-inhibitory to a large number of bacteria[33]. Similar results were reported for Metapex^R by **Reddy** and **Ramakrishna** in **2007**[34]. Also **Oncag, Gogulu** and **Uzel** found calcium hydroxide to be less effective in eradication of *E.faecalis* from root canals[35].

ZOE is neurotoxic under some circumstances and cytotoxic in cell culture systems[36] **Thomas et al** consider Iodoform paste to be the best obturating material for necrotized primary teeth[15].

Pulpectomies are contraindicated in patients with severe systemic disease, such as congenital heart disease, such as congenital heart disease. Prevention of malocclusion in these patients is difficult when a pulpally necrotic deciduous second molar is encountered before the eruption of the permanent first molar. Treatment of these patients by endodontic therapy rather than by surgery would be beneficial.[37]

Conclusion

Failure of root canal treatment may be evident from development of new radiolucencies or enlargement of existing defects.

- Both ZOE and Metapex^R gave encouraging results.
- All groups showed complete relief in pain immediately after treatment.

Comparing the hand instrumentation group against the rotary instrumentation group it was seen that the decrease is pain is much more in the hand instrumentation group which was highly significant ($p<0.000$) but this may be clinically insignificant since the decrease in pain in each group was 100%.

Comparing amongst all 4 components, the Metapex^R obturation in the hand instrumentation group was seen to cause significant decrease in sinus and fistulae ($p=0.042$).

The manufacturer's instructions were followed and there were no instrument breakage. Ledges or over-instrumentation were not encountered, and neither instrument separation nor lateral perforation occurred.

The obturation using Metapex^R was better in the hand instrumentation group as compared with the Rotary instrumentation group, since the diameter at the tip of the largest rotary file used (0.8mm) was smaller than the tip of the Metapex^R syringe (1.1mm).

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Legends Tables

Table 1: Total statistical data after 2 Way ANOVA Test

		Decrease in Pain	Decrease in Sinus/ Fistula	Decrease in Internal Resorption	Decrease in Periapical Changes	Decrease in Furcation Radiolucency
Hand Instrument (Group I)	Zinc Oxide Eugenol (Subgroup1)	.83	.00	.00	.07	.13
	Calcium Hydroxide (Subgroup2)	.80	.10	.00	.03	.20
Rotary Instrument (Group II)	Zinc Oxide Eugenol (Subgroup1)	.30	.053	.00	.00	.07
	Calcium Hydroxide (Subgroup2)	.10	.00	.00	.00	.13
2 way ANOVA	Difference in groups	$p < 0.000$	$p = 0.307$	$p = 0.075$	$p = 0.708$	$p = 0.321$
	Difference in Sub Groups	$p = 0.107$	$p = 0.307$	$p = 0.075$	$p = 0.262$	$p = 0.321$
	Interaction of Group and Sub Group	$p = 0.249$	$p = 0.042$	$p = 0.075$	$p = 0.262$	$p = 1.000$