AJDS LAZHAR Al-Azhar Journal of Dental Science
Vol. 23- No. 2- 131:137- April 2020
Record 1110-2624 | the ISSN Portal
portal.issn.org

COMPARATIVE EVALUATION BETWEEN GLUTARALDEHYDE AND COLLAGEN AS CAPPING MATERIALS IN PULPOTOMIZED PRIMARY MOLARS

Mohamed Taha Elfezary•*, Samy Yousef El Bayomy**, Ibrahim Farouk Brakat***

ABSTRACT

Objective: The objective of this study was to compare the clinical and radiographic effects of two medicaments (Glutaraldehyde GA and Collagen) on the pulp tissue of the primary teeth.

Subjects and Methods: The present study was composed of 60 primary molars from 30 patients. These teeth were classified into two equal groups. The patients age ranged from 5 to 7 years old. The radicular pulp of the primary teeth were capped with GA in (group A) and collagen in (group B) after pulpotomy procedures. The teeth were assessed clinically and radiographically at different intervals (Three months, six months, and 12 months).

Result: The present study revealed that the clinical and radiographic success rate of GA was 80% while the success rate of collagen was 20%.

Conclusion: The GA was more useful as pulp medicament materials than collagen after pulpotomy in primary teeth.

KEY WORDS: Primary teeth, pulpotomy, GA, collagen.

INTRODUCTION

Human beings have two successive sets of teeth primary and permanent; therefore, they are better known as diphyodont. Primary teeth previously were also known as deciduous or milk teeth, which account for a total of 20 teeth (10 in each arch). These teeth begin to develop at six weeks of intrauterine life, the first primary tooth erupts in the oral cavity at the age of 6 months, and this eruption sequence completes till the age of 2 years. These teeth are functional at the age of 5 years until 12 years after which the permanent teeth start to erupt in the oral cavity [(1)].

Primary teeth are considered to be equally important as the permanent teeth. Primary teeth help in the chewing of food, speech, and aesthetics and also act as a template for permanent teeth to assume a proper position in the dental arch [(2)]. The early or premature loss is defined by the loss of primary tooth before the time of its natural exfoliation, it is believed that premature loss of primary teeth is related to space reduction and hence will result in malocclusion of successive teeth; the most common reason of premature loss of primary teeth is most commonly associated with dental caries [(3)].

• B. D.S 2008 Faculty of Dental Medicine Al-Azhar University
* Assistant lecturer, Department of Pedodontics and Oral Health (Assuit Branch)
** Professor of Pedodontics and Oral Health, Faculty of Dental Medicine, Boys, Cairo Al-Azhar University
*** Assistant Professor of Pedodontics and Oral Health, Faculty of Dental Medicine, Boys, Cairo Al-Azhar University

Although the prevalence of dental caries in young children has decreased considerably in recent years, caries continues to affect many children in the general population. Other causes may include trauma, ectopic eruption, congenital disorders, the loss of primary teeth also predisposes crowding, rotation, and impaction in the permanent teeth [3]. Access to oral health care is minimal, especially in rural children. It is also believed that the primary teeth need no treatment as new teeth will erupt automatically and may be attributed to the fact that the parents lack of education and attitude towards dental treatment in primary teeth [4].

Pulpotomy is the surgical removal of the entire coronal inflamed pulp leaving the vital radicular pulp intact within the canals; maintain arch integrity by allowing preservation of teeth that would otherwise be destined for extraction.

The main objective of pulp therapy in the primary dentition is to retain every primary tooth as a fully functional component in the dental arch to allow for proper mastication, phonation, swallowing, preservation of the space required for the eruption of permanent teeth and prevention of detrimental psychological effects due to tooth loss [5]. Some materials do better than others when placed on exposed pulps due to their ability to prevent bacterial contamination of the pulp [6]. S-Gravenmade proposed glutaraldehyde for pulp fixation in 1975. In recent years, glutaraldehyde has been proposed as an alternative to formocresol based on its superior fixative properties, self-limiting penetration, low antigenicity, low toxicity, and elimination of cresol, rapid surface fixation [5,7,8].

Collagen membrane has a proven rate of success in the field of dentistry as guided tissue regeneration, hemostatic, and wound dressing agent. It has inherent properties like low immune response and toxicity, ability to promote cellular growth and attachment [9-14].

SUBJECTS AND METHODS

Study design:

A prospective clinical study

Study setting and population:

This study was carried out in children with 60 vital decayed primary molars that indicated for vital pulp therapy.

The children were selected from the pedodontics outpatient's clinic, Faculty of Dental Medicine, Boys, Cairo, Al- Azhar University.

Eligibility criteria:

Inclusion criteria:

- An age range of 5-7 years.
- Carious/mechanical pulp exposure.
- No clinical or radiographic sign of pulp pathoses.
- A possibility of proper restoration of the tooth after the procedure.
- At least two-thirds of the root length is still present.

Exclusion criteria:

- History of spontaneous and unprovoked pain.
- Mobility.
- Sensitive to percussion.
- Any sign of Presence of fistulae, external or internal root resorption, carious furcation involvement, and periapical lesion.
- Dystrophic calcification of the pulp.

Sample size calculation:

Based on previous studies [15], a sample of 60 vital decayed primary molars that indicated for vital pulp therapy were selected.

Intervention:

Molars to be treated were locally anaesthetized using mepecaine-L (a local anesthetic solution containing 20mg Mepivacaine hydrochloride with 0.06mg Levonordefrin hydrochloride). Patients were allowed to wait for 10-15 min before performing the pulpotomy procedure. Rubber dam was

used to isolate the designated molar. Cavity outline was established with a sterile #330 high-speed pear-shaped carbide bur with air/water spray. Caries was removed with a slow speed sterile round carbide bur. Access to a pulp chamber was detected with a probe, or if the roof of the pulp chamber was sufficiently thin to see the pulpal tissue. When the pulpal exposure was confirmed, the roof of the pulp chamber was removed with a sterile, non-end cutting slow-speed bur. Removal of the coronal pulp tissue was achieved with a sterile low-speed carbide round bur and/or sharp, large, spoon excavator. Hemostasis was attained by placing small cotton pellet moistened in sterile saline with slight pressure; then it was removed [16].

The patients were classified randomly into two equal groups:

Group A: (Control group) 30 primary molars were receiving glutaraldehyde after pulpotomy.

Group B: 30 primary molars were receiving collagen membrane after pulpotomy.

Ethical consideration:

The study was approved by the Pedodontics scientific Committee and department council, Faculty of Dental Medicine, Boys, Cairo, AL-Azhar University. A signed informed consent will be obtained from the parents of each child prior to entry into the study.

Data management and analysis:

Statistical Package of Social science version 21 was used for data management and data analysis. Data were explored for normality using Kolmogorov-Smirnov and Shapiro-Wilk tests; data showed parametric (normal) distribution. For parametric data, independent t-test was used to compare the two groups in related samples. The significance level was set at $P \leq 0.05$.

RESULTS

Clinical evaluation results

Group A: (Glutaraldehyde)

Clinical evaluation of primary molars treated with GA at different intervals. All cases had no pain after three and six months, while, after 12 months follow up, four cases were associated with mild pain on percussion, sinus tract related to treated tooth and two teeth had acute pain, swelling and grade II mobility recorded as treatment failure cases. For this reason, a pulpectomy treatment was performed for them.

Radiographic evaluation results

Group A: (Glutaraldehyde)

Radiographic evaluation of primary molars treated with GA at different intervals. All cases had no radiographic changes after three months postoperatively, while after six months postoperatively six teeth showed widening of periodontal membrane spacing. After 12 months follow up six cases were associated with periapical radiolucency, periodontal space widening and internal external root resorption that recorded as treatment failure cases. For this reason, a pulpectomy treatment was performed for them as fig 1.

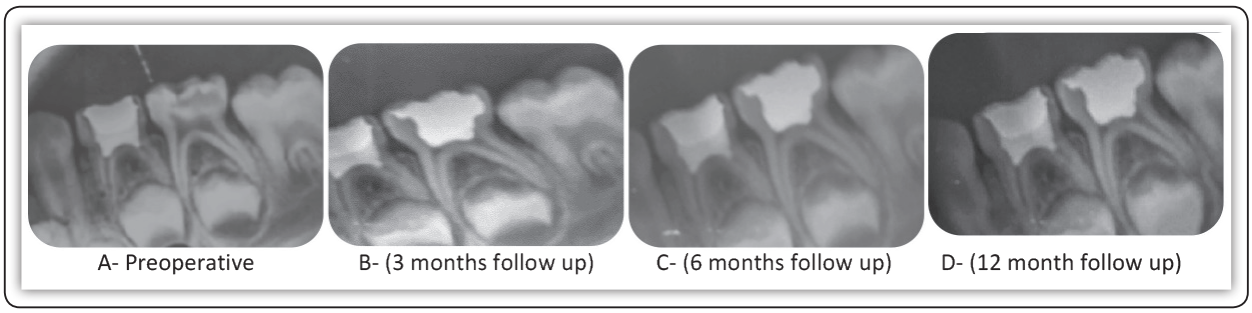

FIG (1) Radiographic feature of GA pulpotomy of second mandibular primary molar.

Group B: (Collagen)

Clinical evaluation results

Clinical evaluation of primary molars treated with collagen at different intervals. 24 case had acute pain, tender on percussion, swelling and grade II mobility after three months postoperatively while, after 12 months follow up six cases were associated with mild pain on percussion. 24 case that had acute pain recorded as treatment failure cases. For this reason, a pulpectomy treatment was performed for them.

Radiographic evaluation results

Radiographic evaluation of primary molars treated with collagen at different intervals. Only six cases had no radiographic changes after three months, six months and 12 months postoperatively. After three months postoperatively 24 teeth showed widening of periodontal membrane spacing and periapical radiolucency that recorded as treatment failure cases. For this reason, a pulpectomy treatment was performed for them as fig 2.

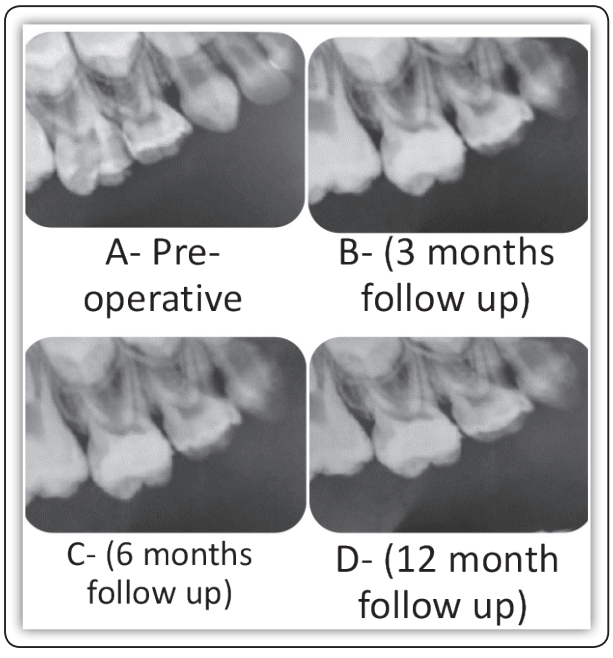

FIG (2) Radiographic feature of collagen pulpotomy of second maxillary primary molar.

Comparison between two groups: On comparing the success rate of the groups, A, B. using independent T test it was found that there is no significant statistical difference between group A and B where p value=0.001 (Table 1).

TABLE (1): Comparison between all groups regarding the success rate.

Character	GA (A)	Collagen (B)
Sub. No.	30	30
Success cases	24	6
Percentage success	80%	20%
Failed cases	6	24
Percentage failure	20%	80%
S.D.	0.407	0.407
Sig.	0.001	

Correlation is significant at the 0.05 level

DISCUSSION

In the present study, the Glutaraldehyde group (A) the success rate was 100% in 3 and 6 months follow up period and 80% in 12 months follow up period while failure rate in GA group was 20%.

This agreed with previous studies that glutaraldehyde is a satisfactory pulp medicament in human primary teeth [17-21].

Prakash et al. reported 100% clinical and radiographic success following glutaraldehyde pulpotomy in 6 months evaluation [17].

Havale *et al*. reported clinical and radiographic success of GA at three-month and one-year recall where the clinical success rates of GA were 100% and radiographic success rates gradually decreased to 83.3% in one year [18].

Shumayrikh et al. reported a 96.5% and 75.8% clinical and radiographic success rate, respectively, in 12 months follow-up period [19].

Lloyd et al., suggested that the reaction of the pulp tissue to GA is related to the concentration and the time of application, since they observed that the depth of tissue fixation increased with the concentration and application time. The authors also observed aggressive internal resorption in teeth treated with low concentrations of GA and for lesser application times [20].

Kopel et al., indicated vital tissue was found under a layer that was treated with 2% glutaraldehyde 1 year later. Also, Fuks et a1.,[20] showed no difference in glutaraldehyde pulpotomy in monkey's teeth between coronal inflamed pulp and healthy pulp [21].

Conversely, long-term follow-up studies have not shown similar success rates. Fuks et al., reported a 90.4% success rate after 12 months, which dropped down to 82% [17]. Similarly, Tsai TP et al. obtained a 98% clinical success rate but when combined with radiographic evaluation, the average success rate was 78.7% [21].

The success rate of GA group may be due to its little superficial inflammation of the pulp, antibacterial action, rapid and superior surface fixation properties, and less penetration to pulpal tissue, low antigenicity, low toxicity, and elimination of cresol [22].

While failure rate of GA group may be due to low concentration, minimal time of application, inaccurate detection of pulp inflammation degree, follow up time, microleakage, and subject variations [23,24,25].

The development of newer materials that are biocompatible and have good results in the vital pulp therapy procedure like pulpotomy is being tried.

In the collagen group (B), the success rate was 20% in 3, 6, and 12 months follow up period while the failure rate was 80%.

This agreed with previous studies where Kakarla et al., found moderate to severe inflammation is seen in the pulp architecture of samples treated with collagen [26,27].

Assed et al. reported that the results of the pulp tissue capped with collagen had a high failure rate because the pulp tissue did not remain vital after protection leading to pulp fibrosis accompanied by cellular death, which was a frequent finding with this material in this study [27].

Conversely, other previous studies showed the success of collagen as pulp capping,where Marsan *et al*., found that collagen, bioresorbable membrane was used as a pulp capping material and after 6 weeks, the pulp tissue preserved its vitality with a better blood supply in the pulp and an increased number of blood vessels; however, none of the tested samples showed reparatory bridge formation. Thus, the authors stated that collagen bioresorbable membranes showed preservation of the morphology of all histological structures [26,28,29].

Postlewaithe *et al*. demonstrated that placed collagen could initiate wound healing by activating inflammatory cells and promoting increased vascularization of the healing tissue [26].

Rutherford *et al*., tested the pulpal reaction to human osteogenic protein where collagen matrix was used as a carrier, and results showed that human osteogenic protein had good characteristics as pulp capping material. Still, the collagen matrix itself did not initiate mineralization nor create the dentinal bridge [29].

It had been demonstrated that a stimulative chemical factor is necessary for the development of protective reaction of traumatized dental pulp, where mere contact with biocompatible nonstimulative matter is not enough [29].

Both Bimstein and Shoshan and Fuks *et al*. used an enriched collagen solution which contained some vitamins, amino acids, and other nutritive factors, which are more significant initiators of positive pulp reaction than the collagen itself [26].

Several pathogens are capable of producing collagenase, an enzyme that can lead to premature membrane degradation as Porphyromonas

gingivalis and Bacteroides melaninogenicus. So, collagen combined with therapeutic concentrations of antibacterial and antibiotic agents, such as chlorhexidine, minocycline and doxycycline, partially inhibits the enzymatic membrane degradation[30].

The studies had shown that premature membrane resorption could lead to incomplete healing, so it is advised that the membranes should have a degradation period between 3 to 9 months to achieve hard tissue formation [31].

The success rate of the collagen group may be due to its hemostatic properties and the ability to aggregate platelets, so it can enhance wound healing, bioactivity, and biocompatibility [28].

While the failure rate of collagen group may be due to improper marginal sealing, collagen degradation after a short time leaving space that allows entrance of microorganisms, absence of growth factors combined with collagen, microleakage, and inaccurate detection of pulp inflammation degree[30,31].

CONCLUSIONS

- GA proved better clinical and radiographic results as a pulp medicament than collagen, but this with an insignificant difference.
- Collagen use as pulp capping medicament without combination with growth factors recorded unpromising results.

REFERENCES

1. Hulland S, Lucas J, Wake M. Eruption of the primary dentition in human infants: A prospective descriptive study. Pediatr Dent 2000; 22:415–21.
2. Mouadian W, Wehr E, Crall J. Disparities in children's oral health and access to dental care. JAMA 2000; 284:2625–31.
3. Bansal M, Gupta M, Gupta P, Arora V, Thakar S. Reasons for extraction in primary teeth among 5-12 years school children in Haryana, India- A cross-sectional study. J Clin Exp Dent 2017; 9: 545–9.
4. Chhabra N, Chhabra A. Parental knowledge, attitudes and cultural beliefs regarding oral health and dental care of preschool children in an Indian population: a quantitative study. Eur Arch Paediatr Dent 2012; 13:76–82.
5. Vijayaalakshmi L. Comparison of ferric sulfate and glutaraldhyde as a pulpotomy agent. Int J Eng Sci Res 2017; 5:73-80.
6. Han L, Okiji T. Uptake of calcium and silicon released from calcium silicate-based endodontic materials into root canal dentine. Int Endod J 2011; 44:1081-7.
7. Maria S, Gama P. Acomparative study between formacresol and glutaraldhyde in pulpotomy. Rev Dent Odont 2005; 2:27-32.
8. Havale R, Anegundi R, Indushekar K, Sudha P. Clinical and radiographic evaluation of pulpotomies in primary molar with formacresol, glutaraldhyde and ferric sulphate. Oral Health Dent Manag 2013; 12:24-31.
9. Kakarla P, Avula S, Mellela G, Bandi S, Anche S. Dental pulp response to collagen and pulpotec cement as pulpotomy agents in primary dentition: A histological study. J Conserv Dent 2013; 16: 434–8.
10. Da Silva LA, Leonardo MR, Nelson-Filho P, Medeiros AS, Rossi MA. Pulp response of anionic lyophilized collagen matrix with or without hydroxyapatite after pulpotomy in dog's teeth. Mater Res 2006; 9:175–80.
11. Marsan T, Prpic-Mehicic G, Karlovic I, Sostaric B, Anic I, Karlovi Z. Pulpal response to direct pulp capping with collagen bio-resorbable membrane.Acta Stomat Croat 2003; 37:59–62.
12. Bimstein E, Shoshan S. Enhanced healing of tooth-pulp wounds in the dog by enriched collagen solution as a capping agent. Arch Oral Biol 1981; 26:97–101.
13. Fuks A, Michaeli Y, Saks B, Shoshan S. Enriched collagen solution as a pulp dressing in pulpotomized teeth in monkeys. Pediatr Dent1984; 6:243–7.
14. Gamal S, Ahmed S, Baroudi K. Clinical and radiographic evaluation of allium sativum oil as a new medicament for vital Pulp treatment of primary Teeth. J Int Oral Health 2014; 6: 32–6.
15. Goyal P, Pandit K, Gugnani N, Gupta M, Goel R, Gambhir R. Clinical and radiographic comparison of various medicaments used for pulpotomy in primary molars: A randomized clinical trial. Eur J Dent 2016; 10: 315–20.
16. Gamal S, Ahmed S, Baroudi K. Clinical and radiographic evaluation of allium sativum oil as a new medicament for vital Pulp treatment of primary Teeth. J Int Oral Health 2014; 6: 32–6.

17. Kumar V, Chandna P, Joshi J, Thomas A and Singh N. A Comparative Evaluation of Hydroxyapatite Crystals and Glutaraldehyde as Agents for Pulpotomy in Deciduous Molars. Int J Clin Pediatr Dent.2009;2: 13–22.
18. Parisay I, Ghoddusi J, and Forghanib M. A Review on Vital Pulp Therapy in Primary Teeth. Iran Endod J. 2015; 10(1): 6–15.
19. Shumayrikh NM, Adenubi JO. Clinical evaluation of glutaraldehyde with calcium hydroxide and glutaraldehyde with zinc oxide eugenol in pulpotomy of primary molars. Endod Dent Traumatol. 1999 Dec; 15(6):259–264.
20. Fuks AB, Bimstein E, Michaeli Y. Glutaraidehyde as a pulp dressing after pulpotomy in primary teeth of baboon monkeys. Pediatr Dent.1986;8:32-6.
21. Tsai P, Huey Li," and Tseng Li.Glutaraldehyde preparations and pulpotomy in primary molars. Oral surc Oral med Oral pathol.1993;76:346-50.
22. Vijayaalakshmi L. Comparison of ferric sulphate and glutaraldehyde as pulpotomy agent. Inter J of Eng& Sci Res. 2017; 5:76.
23. Maria S, Gama P. Comparative study between formocresol and glutaraldehyde in pulpotomy- Literature review. Revista Dental Odontalgia 2005; 2: 27-32.
24. Holan G, Anna B and Fuks. Long-term Evaluation of Pulpotomy in Primary Molars Using MineralTrioxide Aggregate or Formocresol. Pediatr Dent. 2005; 27:2.
25. Holan G. Fuks AB. Keltz N. Success rate of pulpotomized primary molars restored with stainless steelcrown vs amalgam. Pediatr Dent 2002; 24:212-16.
26. Kakarla P, Sai J, Manojkumar G, Bandi S, and Anche S. Dental pulp response to collagen and pulpotec cement as pulpotomy agents in primary dentition: A histological study. J Conserv Dent. 2013 Sep-Oct; 16(5): 434–38.
27. Assed L, Roberto M, Nelson P, Sárzyla A, Antonio M, Pulp response of anionic lyophilized collagen matrix with or without hydroxyapatite after pulpotomy in dog's teeth. Mat. Res.2006; 9:2.
28. Marsan T, Prpic-Mehicic G, Karlovic I, Sostaric B, Anic I, Karlovi Z. Pulpal response to direct pulp capping with collagen bio-resorbable membrane.Acta Stomat Croat 2003; 37:59–62.
29. Rutherford RB, Wahle J, Tucker M, Rueger D, Charette M. Induction of reparative dentine formation in monkeys by recombinant human osteogenic protein 1. Arch Oral Biol. 1993; 38:571–6.
30. Bubalo M, Lazic Z, Tatić Z, Magic M. The use of collagen membranes in guided tissue regeneration. Bubalo M.2017; 74(8): 767–72.
31. Oh T, Meraw SJ, Lee E, Giannobile WV, Wang H. Comparative analysis of collagen membranes for the treatment of implant dehiscence defects. Clin Oral Implants Res.2003; 14(1): 80–90.