



Clinical and Radiographic Evaluation of Mineral Trioxide Aggregate, Laser and Antioxidant Mix as Pulpotomy Agents in Primary Molars

Shaymaa A. El Shesheny ^{1*}, Osama S. El Shall ², Magda A. El Malt ³

Codex : 16/21.10

azhardentj@azhar.edu.eg

http://adjg.journals.ekb.eg

DOI: 10.21608/adjg.2021.20156.1205

Pediatric Dentistry & Orthodontics
(Pediatric Dentistry, Orthodontics)

ABSTRACT

Purpose: The purpose of this study was to access post-operative clinical as well as radiographic success of Mineral Trioxide Aggregate (MTA), Diode Laser and Antioxidant mix as pulpotomy agents for human primary molars. **Materials and Methods:** A total of 60 primary molars that had deep carious lesion and need pulpotomy treatment from 38 healthy and cooperative patients, aged 5-8 years old were chosen for this study. After removal of the coronal tissue and depending on the type of radicular pulp medicament, the teeth were divided randomly and equally into three groups; Group I (MTA), Group II(Diode Laser) and Group III (Antioxidant mix). Treatments in all groups were completed with Glass Ionomer restoration then stainless steel crowns. **Results:** The cumulative clinical and radiographic success rates after 6 months follow up were 100%, 90% and 85% for the MTA, Diode Laser and Antioxidant mix pulpotomy groups respectively. **Conclusion:** MTA, Lasers and Antioxidant mix used for primary teeth pulpotomy had a more advanced success rate on follow-up. Statistically, no significance difference was found between the three study groups in the overall clinical and radiographic success rate.

INTRODUCTION

In pediatric dentistry, one of the most important goals is to maintain the primary dentition till eruption of permanent one ⁽¹⁾. Pulpotomy technique is performed when accidental or carious exposure of dental pulp happens in painless tooth with a deep carious lesion and without peri-radicular pathology, this is achieved by cutting of the pulpal tissues

KEYWORDS

Primary Molars Pulpotomy,
Diode Laser, Mineral Trioxide
Aggregate (MTA), Antioxidant
mix.

- Paper extracted from Doctor Thesis titled “Clinical and Radiographic Evaluation of Mineral Trioxide Aggregate, Laser and Antioxidant Mix as Pulpotomy Agents in Primary Molars”

1. Assistant lecturer of Pedodontics and Oral Health, Faculty of Dental Medicine for Girls Al-Azhar University, Cairo, Egypt.
2. Professor of Oral Medicine, Periodontology, Oral Diagnosis and Radiology Faculty of Dental Medicine for Girls Al-Azhar University, Cairo, Egypt.
3. Assistant Professor of Pedodontics and Oral Health, Faculty of Dental Medicine for Girls, Al-Azhar University, Cairo, Egypt.

* Corresponding author email: ashaymaa46@gmail.com

in the pulp chamber and then covering the radicular pulp stump by a medicated dressing to keep radicular pulp tissue vital⁽²⁾. Classically, formocresol (FC) have been expressed as the gold standard pulpotomy medicament for primary molars, but concerns against the use of FC in humans due to its deleterious effects, possible carcinogenic action, mutagenicity and cytotoxicity have been raised⁽³⁾.

New innovations and researches in dentistry endorsed biocompatible alternatives like Mineral trioxide aggregate (MTA), laser treatment and most recently Antioxidant mix. MTA offer the advantages of being biocompatible and induce apposition of reactionary dentine as it stimulates activity of odontoblasts, and reparative dentine formation^(4,5).

On the other hand, Diode lasers offered many advantages like hemostasis, sterilization and enhancement of pulpal wound healing⁽⁶⁾. They are procedure specific, easy to operate, portable and cost effective⁽⁷⁾. Antioxidant mix was recommended as a promising substitute to traditional pulpotomy medicament for pulpotomy which has major advantages of being biocompatible and other unique features which overcome the disadvantages of other pulpotomy medicaments⁽⁹⁾.

MATERIALS AND METHODS

Patient selection:

A total of 60 primary molars with deep carious lesions from 38 healthy and cooperative patients, aged 5-8 years old and need pulpotomy treatment were selected for this study. The children were diagnosed, selected, treated and followed up in the clinics of Pedodontics Department, Faculty of Dental Medicine for Girls, Al-Azhar University. The children were 18 males and 20 females.

Ethical consideration:

Written informed consent was gained. Research Ethics Committee approval was taken from Faculty of Dental Medicine for Girls, Al-Azhar University.

Randomization:

Regulated by the type of radicular pulp medicament, the primary molars were divided randomly and equally into three groups as follow: Group I (MTA), Group II (Diode Laser) and Group III (Antioxidant mix).

Inclusion Criteria⁽¹⁰⁾:

Clinically the primary molar must be symptomless with a deep carious lesion. There must be no swelling, tenderness on percussion, sinus trace opening, pathological mobility or spontaneous pain. Molars must be restorable after finishing the procedure.

Radiograph criteria constituted absence of internal resorption, absence of inter-radicular bone destruction, absence of periapical bone destruction and no loss of the lamina dura /widening of periodontal ligament space.

Exclusion Criteria⁽¹⁰⁾:

Including excessive bleeding during pulp amputation, non-vital/necrotic teeth, any sort of medical history contraindicating the pulp treatment, teeth approximate exfoliation, patient gradient not intending to be part of the study.

Diagnosis of cases:

Before treatment, a thorough medical and dental history was earned then a clinical checking and radiographic examination with a standardized paralleling technique employing size 2 films D speed (Kodak Insight, Eastman Kodak, Rochester, NY, USA), an XCP posterior film holder and an X-ray machine (70KVP, 8mA).

Treatment protocol:

Molars were anesthetized by local anesthesia (Septocaine® and epinephrine 1:100,000 Septodont, USA). The rubber dam was used for isolation. Caries removal and deroofting of the pulp chamber was achieved then pulpal tissue amputation with

sharp excavator and irrigation was done from the pulp chamber. Subsequent irrigation, initial hemorrhage was controlled in 3-5 minutes by wet cotton pellets with slight pressure. According to radicular pulp medicament type, the treatment was preceded as following:

- **In Group I:** MTA in powder and liquid form was mixed according to producer instructions to get ball-like consistency which was placed in the cavity then the cavity was filled with Glass-Ionomer restoration (EQUIA fort® system (Fil & coat) GC corporation, Tokyo, Japan. ALSIP,IL 60803).
- **In Group II:** After initial hemostasis was gained, the 20 molars were managed by exhibiting root canal orifices to Diode Laser(810 nm) applied in continuous mode for 1-2 seconds using 300 microns optical fiber tip in contact mode with 1.5 watt power. Radicular stumps were topped with a layer of ZOE paste (Prevest Dent Pro, India) then restored with Glass-Ionomer restoration.
- **In Group III:** Antioxidant mix which was available in capsule form was broken to get thick paste-like consistency mix which was applied on the prepared cavity. Antioxidant was topped with a layer of ZOE paste then restored with Glass-Ionomer restoration.

Treatment in the three groups was completed with stainless steel crown and immediate post-operative radiograph was done.

Follow up and outcome evaluation:

Clinical and radiographic monitoring of the treated molars at 3, 6 months was done. The clinical evaluation and periapical radiographs were done in every follow up visit using same parameters as pre-

operative radiograph; data were documented in the patient evaluation and follow up form.

Outcome assessment criteria

a- Clinical evaluation criteria:

Teeth showing the following characters were considered as successful: free of pain symptoms on percussion as well as during mastication, pathological mobility absence, no swelling of pulpal origin and no sinus tract.

b- Radiographic evaluation criteria:

Teeth showing the following criteria were accepted as successful: no internal root destruction, no external root destruction, no periapical or furcation radiolucency and no widening of periodontal ligament space.

RESULTS

Regarding the clinical evaluation, all clinical signs of failure were absent in group I (MTA). In group II (Diode laser), 2 cases (10%) had pain. In group III (anti-oxidant mix), 3 cases (15%) had pain, while 2 cases (10.5%) developed swelling and sinus tract. Chi square test revealed no statistically significant difference between groups in the overall clinical success after 6 months ($p=0.21$), (Table 1)

Regarding the radiographic evaluation, all radiographic signs of failure were absent in group I (MTA). In group II (Diode laser), 2 cases (10%) showed widening of the periodontal membrane space. In group III (antioxidant mix), 3 cases (15%) had widening of the periodontal membrane space, while 2 cases (10%) developed internal or external resorption and furcal or apical radiolucency. Chi square test revealed no statistically significant difference between groups in the overall radiographic success after 6 months ($p=0.21$), (Table 2, Fig.1, 2)

Table (1) Clinical evaluation after 6 months and significance of difference between both groups (chi square test)

Clinical evaluation (after 6 months)	Group I (MTA)		Group II (Diode laser)		Group III (anti-oxidant mix)		X ²	P
	N (20)	%	N (20)	%	N (20)	%		
1- Pain	0	0	2	10	3	15	3.1	0.21 ^{ns}
2- Pathologic tooth mobility	0	0	0	0	0	0	0	1 ^{ns}
3- Swelling	0	0	0	0	2	10	4.1	0.12 ^{ns}
4- Sinus tract	0	0	0	0	2	10	4.1	0.12 ^{ns}
Clinical success	20	100	18	90	17	85	3.1	0.21 ^{ns}

Significance level $p < 0.05$, ns= non-significant

Table (2) Radiographic evaluation after 6 months and significance of difference between groups (chi square test)

Radiographic evaluation (after 6 months)	Group I (MTA)		Group II (Diode laser)		Group III (anti-oxidant mix)		X ²	P
	N (20)	%	N (20)	%	N (20)	%		
1-External or internal resorption	0	0	0	0	2	10	4.1	0.12 ^{ns}
2-Widening of periodontal membrane space	0	0	2	10	3	15	3.1	0.21 ^{ns}
3-Apical or furcal Radiolucency	0	0	0	0	2	10	4.1	0.12 ^{ns}
Radiographic success	20	100	18	90	17	85	3.1	0.21 ^{ns}

Significance level $p < 0.05$, ns= non-significant

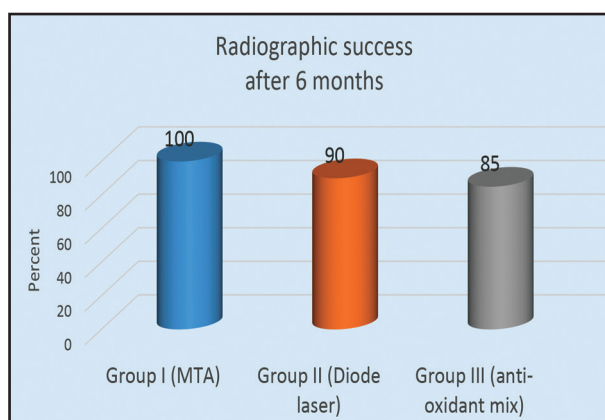


Figure (1) Column chart showing percentage of Clinical and Radiographic success at immediate and 3,6 months follow up in MTA group (Group I), Diode Laser group (Group II) and Antioxidant group (Group III).

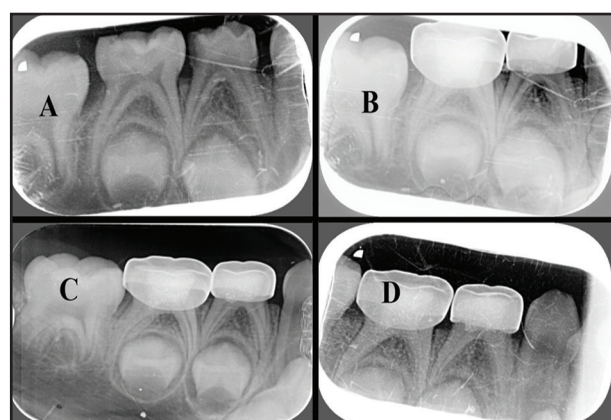


Figure (2) Radiographic photos of successful pulpotomized lower first and second primary molars using Diode laser (group II): (A) preoperative, (B) immediate post-operative, (C) 3months, (D) 6months follow up.

DISCUSSION

This research was implemented to determine the effectiveness of pulpotomized primary molars using MTA, Diode Laser irradiation and antioxidant mix in an attempt to reach for the best successful pulpotomy technique to replace FC pulpotomy. It was a double blinded study, as both participants and statistician were blinded. RCT is the gold standard for a clinical trial and the highest level of evidence⁽¹¹⁾.

In MTA group regarding the clinical evaluation, immediately after treatment and at 3 and 6 months, all clinical signs of failure were absent in all treated teeth (100%). Regarding the radiographic evaluation, all radiographic signs of failure were absent immediately after treatment, at 3 and 6 months. The result of present study was coincide with previous studies which conclude that the total success rates for MTA pulpotomy in primary molars ranged from 94 to 100%⁽¹²⁾ based upon meta-analysis⁽¹³⁾, systematic reviews⁽¹¹⁾ and evidence base assessments⁽¹⁴⁾. On the other hand a previous study which compared four pulpotomy agents in primary teeth using Formocresol, Ferric Sulphate, Calcium hydroxide and MTA stated that a success rate was of 76.9% for Formocresol, 73.3% for Ferric Sulphate, 46.1% for Calcium hydroxide, and 66.6% for MTA. However, the difference between the groups had no statistical significance⁽¹⁵⁾. This was in contrast to the present study that stated 100% MTA success rate.

Group II (Diode laser group) regarding the clinical evaluation, immediately after treatment and at 3 months, all clinical signs of failure were absent in all treated teeth (100%). At 6 months, 2 cases (10 %) revealed pain. Regarding the radiographic evaluation, all radiographic signs of failure were absent immediately after treatment, at 3 months. At 6 months, 2 cases (10 %) had showed widened periodontal ligament. The overall radiographic success was 100% at 3 months, 90 % at 6 months.

A previous study was showed that the clinical success rate of diode laser (810nm) pulpotomy after 6 months was 100% and the radiographic success

rate was 95.5%⁽¹⁶⁾. Another study which used 3W diode laser until hemostasis reached, stated reduced radiographic success in comparison with formocresol⁽¹⁷⁾. It was found that clinical success rate of Nd:YAG laser pulpotomy at 2W 20 Hz, 100 mJ was attained in 66 out of the 68 teeth (97 %), and 94.1 % were successful in radiographic follow up⁽¹⁸⁾. Therefore based on these interpretations, the present study was carried out using Diode Laser at 1.5W. Clinical and radiographic failure were present in 2 cases after 6 months. The success rate of Laser pulpotomy in the present study could be correlated with the results of the previous studies.

In contrast to the present study It was stated that pulpotomies using Er:YAG laser showed overall success rate of (78%) slightly lower than formocresol (85%) after 2 years follow up⁽¹⁹⁾. Other study stated that about 67% radiographic success rate with Diode laser which carried out using 632nm wavelength in a continuous mode, with an energy of 4.0 J/cm² for about 30 seconds with fiber tip of 2 mm not contacting root stumps⁽²⁰⁾.

Group III (anti-oxidant mix group) regarding the clinical evaluation, immediately after treatment all clinical signs of failure were absent in all treated teeth (100%). At 3 months, 2 cases (10%) showed pain, swelling and sinus tract. At 6 months, a 3rd case had pain, giving a total of 3 cases with pain (15 %).

Regarding the radiographic evaluation, all radiographic signs of failure were absent immediately after treatment. At 3 months, 2 cases (10 %) showed internal and external resorption, widened periodontal membrane space and apical or furcal radiolucency. At 6 months, a third case showed widening of the periodontal membrane space giving a total of 3 cases (15%) showing widened periodontal ligament. The overall radiographic success was 100% immediately, 90% after 3months and 85% after 6 months.

Three teeth in this group recorded with evidence of clinical and radiographic failure, the reasons may be due to several clinical significant factors are

known to inhibit wound healing including hypoxia, infection, and the presence of necrotic debris.

These results are in disagreement with other previous study which concluded that the high success rate of pulpotomy clinically and radiographically with antioxidant mix (95%) is impressive, especially considering the long-term follow-up period. All molars treated with antioxidant mix presented a successful outcome. One failure reasons may owe to that dislodged restoration or mishandling of the medicament while performing the procedure⁽²¹⁾.

CONCLUSION

The following could be concluded:

- MTA, Lasers and Antioxidant mix is uprising pulpotomy technique in primary molars.

ACKNOWLEDGMENT

Special appreciation and deepest gratitude to all members of Pediatric Dentistry department, Al-Azhar University-Girls branch for their considerable cooperation and support.

REFERENCES

1. Sancaklı HS. Carious Destruction of the Remaining Teeth: Diagnostic and Treatment. *Oral Rehab J.* 2019;1:97-120.
2. Fuks AB, Kupietzky A, Guelmann M. Pulp therapy for the primary dentition. *Pediatric Dent J.* 2019;1: 329-51.
3. Chandrashekhar S, Shashi Dhār J. Formocresol, still a controversial material for pulpotomy: A critical literature review. *J Rest Dent.* 2014; 2:114.
4. Kadir AS, Rahman M, Sajib NH, Al Rabbi A, Nipun JN. Mineral Trioxide Aggregate: A Wondrous Savior. *Int J Sci Surv.* 2019;8:2.
5. Noorollahian H. Comparison of mineral trioxide aggregate and formocresol as pulp medicaments for pulpotomies in primary molars. *Br Dent J.* 2008;11:204-20.
6. Bhatnagar A, Agarwal R, Khan F. Diode Laser application in Pediatric Dentistry. *Ann Dent Spec.* 2016;1:4-68.
7. Yazdanfar I, Gutknecht N, Franzen R. Effects of diode laser on direct pulp capping treatment: a pilot study. *Lasers Med Sci* 2015; 30:1237-43.
8. Reddy MA, Niharika P, Reddy H, Reddy NV, Manoj Kumar MG, Pranitha V. Antioxidant mix: A novel pulpotomy medicament: A scanning electron microscopy evaluation. *Contemp Clin Dent.* 2014;5:428-33.
9. Fuks AB, Nuni E. Pulp therapy for the young permanent dentition. *Pediatric Dent J.* 2019;1:482-96.
10. Patricia B. Burns, Rod J. Rohrich, Kevin C. Chung. The Levels of Evidence and their role in Evidence-Based Medicine. *Plast Reconstr Surg.* 2011; 128: 305–10.
11. Anthonappa R, King N, Martens L. Is there sufficient evidence to support the long-term efficacy of mineral trioxide aggregate (MTA) for endodontic therapy in primary teeth? *Int J Endod.* 2013;46:198-204.
12. Peng L, Ye L, Tan H, Zhou X. Evaluation of the formocresol versus mineral trioxide aggregate primary molar pulpotomy: a meta-analysis. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology.* 2006;102:40-4.
13. Simancas-Pallares M-A, Díaz-Caballero A-J, Luna-Ricardo L-M. Mineral trioxide aggregate in primary teeth pulpotomy. A systematic literature review. *Med Oral Patol Oral Cir Bucal.* 2010;15:942-6.
14. Shirvani A, Asgary S. Mineral trioxide aggregate versus formocresol pulpotomy: a systematic review and meta-analysis of randomized clinical trials. *Clinical oral investigations.* 2014;18:401023-3.
15. Sonmez D, Sari S, Çetinbaş T. A comparison of four pulpotomy techniques in primary molars: a long-term follow-up. *J Endod.* 2008;34:950-5.
16. Sheila C, Cirigiri SK. Clinical and Radiographic Evaluation of Diode Laser (810 NM) pulpotomy and formocresol pulpotomy *Ann Essen Dent.* 2017; 1: 9.
17. Golpayegani MV, Ansari G, Tadayon N, Shams S, Mir M. Low-level laser therapy for pulpotomy treatment of primary molars. *J Dent Tehran.* 2009;13:168-74.
18. Liu J-f. Effects of Nd: YAG laser pulpotomy on human primary molars. *J Endod.* 2006;32:404-7.
19. Huth K, Paschos E, Hajek-Al-Khatat N, Hollweck R, Crispin A, Hickel R, et al. Effectiveness of 4 pulpotomy techniques randomized controlled trial. *J Dent Res.* 2005;84:1144-8.
20. Kimura Y, Wilder, Smith P, Matsumoto K. Lasers in endodontics: a review. *Int J Endod.* 2000;33:173-85.
21. Kathal S, Gupta S, Bhayya DP, Rao A, Roy AP, Sabhlok A. A comparative evaluation of clinical and radiographic success rate of pulpotomy in primary molars using antioxidant mix and mineral trioxide aggregate: An in vivo 1-year follow-up study. *J Indian Soc Pedod Prev Dent.* 2017;35:327.