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Photodynamic therapy for endodontic treatment of primary teeth: Original research article

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Abstract---Background: Tooth decay and traumatic dental injuries are the main causes of pulp inflammation in primary teeth. The present study was conducted on photodynamic therapy for endodontic treatment of primary teeth. Materials & Methods: 40 primary anterior teeth with pulp necrosis were divided into 2 groups: Group I,

conventional root canal therapy and group II, conventional root canal therapy combined with antimicrobial PDT. Each group with 20 patients. Microbiological samples of the intra-canal content were taken using paper cones. Results: Group I & II had 19 boys and 9 girls and 8 boys and 12 girls respectively. Colony-forming units (CFU/mL) before and after treatment in group I at sample 1, 2, 3, 4, 5, 6, 7, 8, 9& 10 were 94000 and 0, 87040 and 2433, 14530 and 0,154231 and 4500, 123145 and 3200, 28453 and 550, 110232 and 1250,112456 and 3100, 43294 and 0 and 142945 and 1955 respectively. CFU before and after treatment in group II at sample 1,2,3,4,5,6,7,8,9 &10 were 194000 and 248,187040 and 2450,24530 and 0, 254231 and 4200,23140 and 300,38453 and 430,120232 and 1280, 212438 and 3600,143294 and 0 and 242940 and 1924 respectively. Conclusion: Conventional treatment combined with antimicrobial PDT found to be equally effective as Conventional treatment alone in primary teeth.

Keywords---photodynamic therapy, endodontic treatment, primary teeth.

Introduction

Tooth decay and traumatic dental injuries are the main causes of pulp inflammation in primary teeth. Once irreversible pulp inflammation or pulp necrosis is established, radical endodontic treatment is required. There are two treatment options for pulp necrosis of primary teeth, namely, extraction and endodontic treatment; the latter aims to completely remove necrotic cells in the root canal for the tooth to remain asymptomatic and functional in the oral cavity until normal exfoliation.[1] Chronic periapical periodontitis is the major cause of the premature loss of primary teeth and it is widely accepted that this condition is related to endodontic infection. The use of handheld files and irrigating solutions with disinfectant properties is currently the most common form of endodontic treatment.[2] However, the existence of residual bacteria in many cases can lead to further infection of the root canal, which requires re-treatment or even extraction.

Pulp therapy in primary teeth is a complex matter due to difficulties in using dental instruments, the complexity of the apical delta, the biological cycle of primary teeth, physiological resorption and rhizolysis as well as a lack of cooperation on the part of the child and the need for long appointment.[3]Antimicrobial photodynamic therapy (aPDT), which has been employed as an adjuvant to endodontic treatment. aPDT is based on the interaction of three factors, namely, a light source at a specific wavelength; a photo-activated dye or photosensitizing agent, such as methylene blue or toluidine blue; and oxygen.[4] When the laser irradiates the photosensitizing agent, energy transfer takes place between the light, the photosensitizing agent, and the substrate, giving rise to singlet oxygen and free radicals. These substances alter the metabolism of the bacterial cell wall by affecting lipids, proteins, and nucleic acids, thereby leading to the death of these bacterial cells via apoptosis.[5] The

present study was conducted to photodynamic therapy for endodontic treatment of primary teeth.

Materials and Methods

The present study comprised of 40 primary anterior teeth with pulp necrosis of both genders. Parental consent was obtained. Data such as name, age, gender etc. was recorded. Patients were divided into 2 groups as follows: Group I, patients undergoing conventional root canal therapy and group II, patients undergoing conventional root canal therapy combined with antimicrobial PDT. Each group comprising of 20 patients. For PDT, methylene blue, at a concentration of 0.005 %, was used as the photosensitizing agent, which was applied to the interior of the canal with a sterile paper cone for 3 min, followed by the administration of laser light for 40 seconds, delivered in direct contact at the entrance to the root canal. Microbiological samples of the intra-canal content were taken (one before and one immediately after treatment in both groups) using paper cones. Presence of fistulas and mobility was recorded 1 and 3 months after treatment. Data thus obtained were subjected to statistical analysis. P value < 0.05 was considered significant.

Results

Table I
Distribution of patients

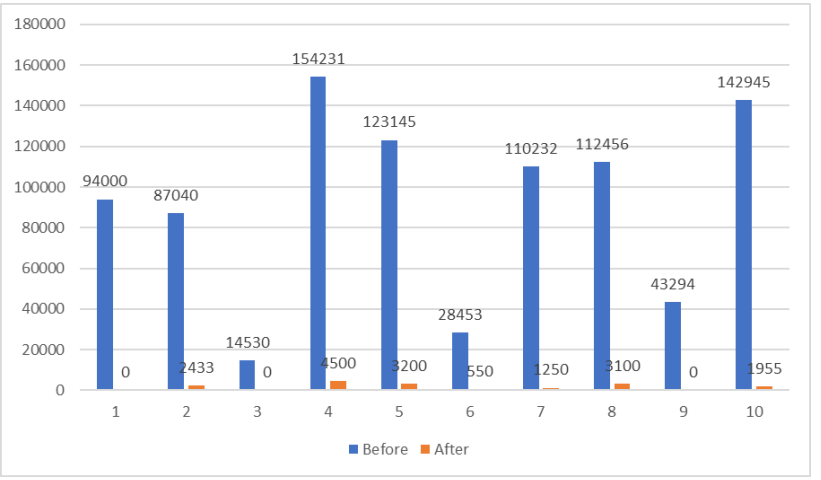
Groups	Group I	Group II
Method	conventional root canal therapy	conventional root canal therapy+ PDT
M:F	11:9	8:12

Table I shows that group I had 19 boys and 9 girls and group II had 8 boys and 12 girls.

Table II
Colony-forming units (CFU/mL) before and after treatment in group I

GI sample	Before	After	P value
1	94000	0	0.01
2	87040	2433	
3	14530	0	
4	154231	4500	
5	123145	3200	
6	28453	550	
7	110232	1250	
8	112456	3100	
9	43294	0	
10	142945	1955	

Table II, graph I shows that colony-forming units (CFU/mL) before and after treatment in group I at sample 1 was 94000 and 0, at sample 2 was 87040 and 2433, at sample 3 was 14530 and 0, at sample 4 was 154231 and 4500, at sample 5 was 123145 and 3200, at sample 6 was 28453 and 550, at sample 7 was 110232 and 1250, at sample 8 was 112456 and 3100, at sample 9 was 43294 and 0 and at sample 10 was 142945 and 1955 respectively. The difference was significant (P< 0.05).

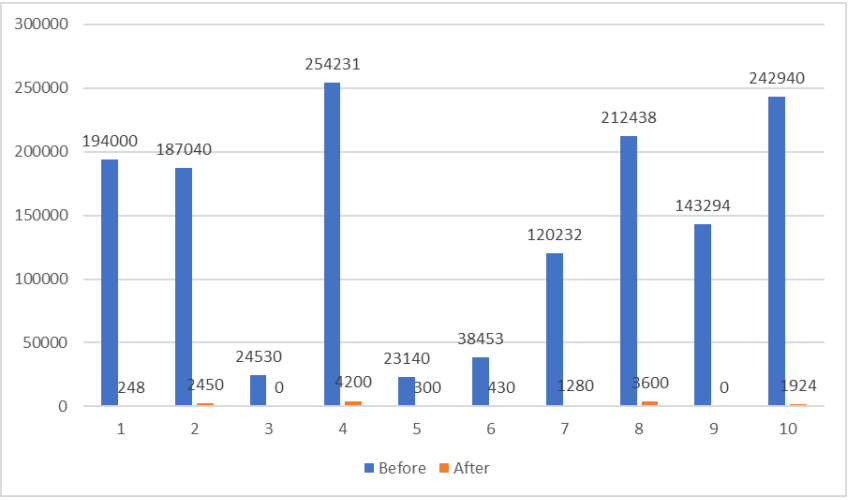


Graph I. Colony-forming units (CFU/mL) before and after treatment in group I

Table III
Colony-forming units (CFU/mL) before and after treatment in group II

GI sample	Before	After	P value
1	194000	248	0.01
2	187040	2450	
3	24530	0	
4	254231	4200	
5	23140	300	
6	38453	430	
7	120232	1280	
8	212438	3600	
9	143294	0	
10	242940	1924	

Table III, graph II shows that colony-forming units (CFU/mL) before and after treatment in group II at sample 1 was 194000 and 248, at sample 2 was 187040 and 2450, at sample 3 was 24530 and 0, at sample 4 was 254231 and 4200, at sample 5 was 23140 and 300, at sample 6 was 38453 and 430, at sample 7 was 120232 and 1280, at sample 8 was 212438 and 3600, at sample 9 was 143294 and 0 and at sample 10 was 242940 and 1924 respectively. The difference was significant (P< 0.05).



Graph II. Colony-forming units (CFU/mL) before and after treatment in group II

Discussion

The success of endodontic treatment depends on the effective decontamination of the root canal systems because microbial agents promote the development and maintenance of pathological processes that damage the pulp and periapical region. Handheld files and disinfecting irrigating solutions constitute the most widely used methods for endodontic treatment of primary teeth.[6] PDT may be a viable option for achieving a reduction in pathogenic microorganisms during endodontic treatment, as this method is painless, easy to administer, does not lead to microbial resistance and has no systemic effects. PDT has been widely tested for the endodontic treatment of permanent teeth, demonstrating positive results in comparison to conventional treatment.[7] However, few studies have evaluated the use of this type of therapy in primary teeth.[8,9] The present study was conducted to photodynamic therapy for endodontic treatment of primary teeth.

We found that group I had 19 boys and 9 girls and group II had 8 boys and 12 girls. Okamoto et al[10] evaluated the reduction in bacterial load following conventional endodontic treatment with and without antimicrobial photodynamic therapy (a-PDT) in primary teeth. Thirty primary anterior teeth with a diagnosis of pulp necrosis were selected. Patients were randomly allocated to two groups as follows: Group I, patients undergoing conventional root canal therapy (n = 15) and Group II, patients undergoing conventional root canal therapy combined with antimicrobial PDT (n = 15). Clinical follow-up involved the investigation of fistulas and mobility and was performed 1- and 3 months after treatment. The reduction in bacterial load was 93 % in group I and 99 % in group II, with no statistically significant difference.

We observed that colony-forming units (CFU/mL) before and after treatment in group I at sample 1 was 94000 and 0, at sample 2 was 87040 and 2433, at sample 3 was 14530 and 0, at sample 4 was 154231 and 4500, at sample 5 was 123145 and 3200, at sample 6 was 28453 and 550, at sample 7 was 110232 and

1250, at sample 8 was 112456 and 3100, at sample 9 was 43294 and 0 and at sample 10 was 142945 and 1955 respectively. Mota et al[11] determined effectiveness of photodynamic therapy during the endodontic treatment of primary teeth. Thirty primary anterior teeth in children aged 3 to 6 years old were divided into 2 groups: a control group, which will receive conventional treatment, and an experimental group, which was subjected to photodynamic therapy.

Microbiological evaluations were performed before and after endodontic treatment. Moreover, clinical and radiographic evaluations were performed on the day of treatment as well as 1, 3 and 6 months after treatment. As successful endodontic treatment is directly related to intra-canal bacterial disinfection and considering the difficult task of endodontic treatment in primary teeth, often due to difficulties in controlling young children, the internal anatomy of root canals and root resorption, the alternative of using PDT is a painless, easy-to-administer method that does not lead to microbial resistance and can assist in the achievement of successful endodontic treatment in primary teeth by eliminating the pain children can experience due to re-treatment as well as premature tooth loss.

We found that colony-forming units (CFU/mL) before and after treatment in group II at sample 1 was 194000 and 248, at sample 2 was 187040 and 2450, at sample 3 was 24530 and 0, at sample 4 was 254231 and 4200, at sample 5 was 23140 and 300, at sample 6 was 38453 and 430, at sample 7 was 120232 and 1280, at sample 8 was 212438 and 3600, at sample 9 was 143294 and 0 and at sample 10 was 242940 and 1924 respectively. Fernandes et al[12] evaluate the antimicrobial photodynamic therapy (aPDT) in infected deciduous teeth by quantifying the viable bacteria in root canal treatment. Radicular canal cultures were collected (n= 10). Four intra-canal samples were collected at four different times in each of the sampled teeth, as follows: Time 1 (T1), baseline: After opening the pulp-chamber; Time 2 (T2): After application of aPDT; Time 3 (T3): After mechanical, chemical manipulation; Time 4 (T4): After a second application of aPDT. The aPDT was performed with a 4J/cm energy low-intensity diode, together with 0.005% methylene blue as a photosensitizer. The clinical specimens were taken to the laboratory for a bacteria count (colony forming units) and the results were statistically analyzed. Statistical differences were seen between the numbers of bacteria at times T1-T2, T1-T3 and T1-T4 on the cultivated plates. However, no significant statistical differences were observed between the number of bacteria in samples T2-T3, T2-T4 and T3-T4.

Conclusion

Authors found that conventional treatment combined with antimicrobial PDT found to be equally effective as conventional treatment alone in primary teeth.

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