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**Cover Page Footnote**

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# Assessment of Efficacy of Photoactivated Disinfection Versus Calcium Hydroxide Disinfection in Regeneration of Immature Infected Teeth - A comparative in vivo study.

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## Abstract

**Aim:** To study the effectiveness of photo activated disinfection (PAD) Disinfection Versus Calcium Hydroxide Disinfection in Regeneration of Immature Infected Teeth.

**Material and Methods:** 30 patients with immature, single rooted teeth appearing with or without signs and/or symptoms of periapical pathology were involved in the study. Cases were classified into three groups according to the disinfection protocol, ten patients each group (n=10). **Group I:** Calcium hydroxide (Ca (OH)) was injected in the canal after drying the canal with sterile paper points. **Group II:** Photosensitizers (Azulenocyanine) was inserted in the canals and agitated in the canal, then activated with diode laser 940 nm used in cycles 4 x 2mm/sec for disinfection of canal. **Group III:** Photosensitizers (Azulenocyanine) was inserted in the canals and agitated in the canal, then activated with diode laser 940 nm used in cycles 4 x 2mm/sec for disinfection of canal then calcium hydroxide (Ca (OH)) is injected in the canal after drying the canal with sterile paper points. **Results:** Overall results of our study, there was a significant difference ( $p>0.05$ ) between the three groups, where group III “calcium hydroxide and diode laser” showed higher significant values than the other two groups. **Conclusion:** PAD can be used as an adjunctive procedure in disinfection of immature necrotic teeth.

**Keywords:** Regeneration, photoactivated disinfection, calcium hydroxide, immature teeth

## 1. Introduction

Regenerative endodontics are techniques designed to replace impaired tissues such as dentin-pulp complex by using stem cells, scaffolds and growth factors<sup>1</sup>. In regeneration, we depend more on irrigants and intra canal medicaments for achieving proper disinfection<sup>2</sup>. Photo-activated disinfection (PAD) is a new approach for elimination of intra-canal micro-organisms<sup>3</sup>. PAD depends on the contact of a antimicrobial agent and a light source. It uses a safe pigment named photosensitizer (PS) and low-intensity light. In existence of oxygen, the PS adhere to the bacterial membrane. Irradiation with a precise wavelength produces singlet oxygen, causing rupture of the microbial cell wall<sup>4</sup>.

## 2. Materials and methods.

### 2.1 selection of patients.

30 cases with immature, single rooted teeth with or without signs and/or symptoms of periapical pathology were involved in the study from the clinic of Faculty of Dentistry, Ainshams University.

### 2.2 cases classification

Patients were classified into three groups rendering to the disinfection protocol, ten patients each group (n=10).

**Group I:** 10 patients were treated as follows:

Calcium hydroxide (Ca (OH)) was injected in the canal after drying the canal with sterile paper points.

**Group II:** 10 patients were treated as follows:

Photosensitizers (Azulenocyanine) was inserted in the canals and disturbed in the canal for 60 seconds using #50 K endodontic file, then activated with diode laser 940 nm used in cycles 4 x 2mm/sec for disinfection of canal.

**Group III:** 10 patients were treated as follows:

Photosensitizers (Azulenocyanine) was inserted in the canals and disturbed in the canal using #50 K endodontic file, then activated with diode laser 940 nm used in cycles 4 x 2mm/sec for disinfection of canal then calcium hydroxide (CH) is injected in the canal after drying the canal with sterile paper points.

### 2.2 Methods of assessment

Patients were recalled every 3 months for one year. Follow up involved the evaluation of pain and standardized radiographic assessment which included the following:

- I. An increase in root length.
- II. An increase in root thickness.
- III. A decrease in apical diameter.

### 2.3 statistical analysis

Two-way ANOVA followed by post hoc Tukey test was used to compare between more than two groups in non-related samples.

## 3. Results

### 3.1 Increase in root length

During the first three months, (Group III) has shown significantly higher values than each of (Group I) and (Group II) where ( $p=0.014$ ).

### 3.2 Increase in dentine thickness

During the first three months, there wasn't significant difference between the three groups where ( $p=0.050$ ). From 3-6 months, there was not statistically significant difference between the three groups where

( $p=0.365$ ). From 6-9 months, there was not statistically significant difference between the three groups where ( $p=0.136$ ).

From 9-12 months, there was not statistically significant difference between the three groups where ( $p=0.265$ ).

### 3.3 Decrease in apical diameter (showed in table 3)

During the first three months, (Group II) showed higher significant numbers than each of (Group I) and (Group III) where ( $p=0.045$ ) and ( $p=0.003$ ).

## 4. Discussion

In this study, the disinfection effectiveness of calcium hydroxide and photo activated disinfection was tested. Calcium hydroxide is an excellent medicament in regeneration cases due to its disinfectant properties<sup>6</sup>, the improbability of tooth staining, the discharge of growth factors from dentin, and its availability in clinical practice<sup>7</sup>.

A study by Ruparel et al<sup>8</sup> estimated the outcomes of Triple antibiotic paste, double antibiotic paste, and Ca(OH) on human Stem cells of apical papilla (SCAPs). It revealed that drugs used at high concentration in regenerative procedures have a damaging impact on the continued existence of SCAPs, except for Ca (OH). Calcium hydroxide also enhanced the production of growth factors from dentine<sup>9</sup>.

A new strategy termed photo activated disinfection (PAD) was introduced. PAD is a therapy that uses illumination to trigger a photosensitizing agent (PS) in the existence of oxygen. The contact of the PS to light results in the development of oxygen free radicals, causing photo damage.<sup>10</sup> It is not common that bacteria would build resistance

to the cytotoxic action of singlet oxygen or free radicals.<sup>4</sup>

In our study, the effect of photo-activated disinfection versus calcium hydroxide disinfection on the regeneration of immature infected teeth was assessed. Cases are divided equally into three groups according to the disinfection protocol. In the first group, Disinfection was done using Calcium hydroxide (CH). In the second group, disinfection was done using PAD. In the third group, disinfection was done by PAD followed by calcium hydroxide.

Our clinical observations agree with **Abdel Rahim et al.**<sup>11</sup> who reported the success of revascularization process in an upper central incisor where photoactivated disinfection was used. Clinical findings revealed absence of signs and symptoms. Radiographic examination of increase in root length and apical closure, with thickening of the root canal walls, after 12- months. This is consistent with previously published articles<sup>12,13,14,15,16</sup>.

The results of our study are also in conflict with **Lin et al. (2014)**<sup>17</sup> who reported a failed revascularization case, in which the tooth was free of symptoms for 16 months and then established pain and localized swelling. The failure of revascularization in this case was attributed to insufficient cleaning without complete removal of bacteria in dentinal tubules.

Overall results of our study, there was a significant difference between the three groups, where “calcium hydroxide and diode laser” showed higher significant values than the other two groups, and this agrees with **balakrishna et al.**<sup>18</sup>, **shlafer et al.**<sup>19</sup> and **mohan et al.**<sup>20</sup> who concluded that PAD is a helpful method to destroy remaining bacteria in root canal.

## 6. conclusion

Considering this study, it can be concluded that:

1. calcium hydroxide and photo-activated disinfection are both successful disinfection protocols.
2. photo-activated disinfection can be used as an adjunctive method for disinfection in regenerative procedure.
3. Regenerative approach was a good way for treatment of juvenile teeth with necrotic pulp, which was evident by continued root growth and resolution of periapical radiolucency.

## 7. Representative case:



**Figure (1):** Radiograph showing a representative case of group I (calcium hydroxide) through follow up.

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