

## CLINICAL AND RADIOGRAPHIC EVALUATION OF DIODE LASER(810NM) PULPOTOMY AND FORMOCRESOL PULPOTOMY-AN INVIVO STUDY.

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**ABSTRACT: Objective :** The purpose of this study was to investigate whether a diode laser pulpotomy could be an acceptable alternative to formocresol pulpotomy in primary molars. **Method:** A randomized, single-blind split mouth study was used with a sample of 10 patients with at least two primary molars indicated for pulpotomy were selected for the study. Twenty teeth were randomly divided into 2 groups- the formocresol group that where formocresol pulpotomy was carried out and the study group where a diode laser pulpotomy was carried out. All the teeth were followed up clinically and radiographically at 1, 3 and 6 months. **Results:** No failures were recorded in both the groups at 1 and 3 months follow-up; while 1 tooth in each of the groups showed a radiographic failure at 6-month follow-up. There was no significant difference between the 2 groups. Studies with larger sample size and longer follow-up periods are required to establish laser pulpotomy an acceptable method for primary molars.

**KEYWORDS:** Pulpotomy, Diode Laser, Formocresol.

### INTRODUCTION

Pulpotomy entails the removal of infected coronal pulp followed by placement of a suitable medicament to preserve the health of remaining radicular pulp. Formocresol pulpotomy has remained a treatment of choice in primary teeth and is widely accepted<sup>1</sup>. Studies have demonstrated the potential for local and systemic distribution of formocresol with associated potential toxic effects<sup>3</sup> like mutagenicity<sup>4,5</sup>, carcinogenicity<sup>5</sup>, immune sensitization<sup>6</sup> and a definite relationship between formocresol pulpotomies and enamel structure changes in permanent successors<sup>7,8</sup>. For a number of years there has been a debate about the appropriateness of formocresol as a vital pulpotomy material, regarding the safety of its principal component: formaldehyde. Therefore, there is great interest in the alternative materials to replace formocresol. This led to the search of biocompatible substitutes like glutaraldehyde<sup>9</sup>, ferric sulfate<sup>10</sup>, electrosurgery<sup>11</sup>, mineral trioxide aggregate<sup>12</sup> and laser irradiation<sup>13</sup>. A recent Cochrane review in 2004 found that there is lack of evidence regarding the most appropriate technique<sup>2</sup>.

The diode is an excellent soft tissue surgical laser. The chief advantage of the diode lasers is smaller size of instrument making the units portable and compact easily

moved with minimum setup time and are the lowest-priced lasers currently available<sup>15</sup>. Diode LASER suits the tissue resistant temperature values of pulp due to its high absorbance at 810nm wavelength which avoids excessive heating and charring of pulp. The available wavelengths of diode lasers for dental use are in the range from about 800 to 980nm, placing them at the beginning of the near-infrared visible non ionizing part of spectrum. These diode lasers exhibit a substantial difference in performance despite of a small difference in range of wavelengths. The 810nm and 980nm diode lasers demonstrate a large difference in coagulation affects, ablation affects, and tissue involvement affects.

In a study where diode laser irradiation for pulpotomy procedure was used, the investigator has used 980nm diode laser with MTA as sealing medicament in experimental group<sup>15</sup>. The properties of 810nm diode laser are closer to argon ion laser and were proved to be a better coagulator than the 980nm wavelength diode laser. In view of these properties of 810nm wavelength the present in vivo study to evaluate the clinical and radiographic comparison of diode laser (810 nm) pulpotomy with formocresol pulpotomy was initiated.

**Aim**

This invivo pilot study was done to establish a preliminary evaluation on the clinical and radiographic success rate of diode laser pulpotomy when compared to formocresol pulpotomy.

**METHODOLOGY**

This is a split mouth study. A sample of 10 patients each with at least two vital primary molar teeth that are indicated for pulpotomy were selected for the study (**Fig.1** and **Fig.2**) 20 teeth were divided in two groups i.e. formocresol group the control group and laser group the study group. In formocresol group, after caries removal, pulp chamber was opened with a sterile high speed hand piece followed by excavation of coronal pulp with sharp spoon excavator. Complete hemostasis in canal orifice was achieved by applying 1:5 dilution of formocresol wetted cotton pellet. In study group, excavation of coronal pulp and complete hemostasis in canal orifice was achieved by using diode laser (810nm).( **Fig.3.**) Zinc oxide eugenol paste was used to restore the pulp stumps in both study and control group. Stainless steel crowns were then placed on all the teeth. Clinical and radiographic follow ups were performed at 1, 3, 6 months.( **Fig.4**). The differences between the groups is assessed by Student's 't' test and 'p' values of ) 0.01 is considered as statistically significant.



**Fig.1. Materials used for the study.**



**Fig.2.Diode laser used for the study**



**Fig.3.Haemostasis achieved after laser irradiation.**

**RESULTS**

The present in vivo study was conducted for the evaluation of clinical and radiographic success of diode laser (810nm) pulpotomy compared to formocresol pulpotomy. All teeth in both categories were to be followed up clinically and radiographically at 1, 3 and 6 months. The outcome of success or failure was determined by the following clinical and radiographic criteria:

1. Teeth remained asymptomatic;
2. Absence of a sinus tract;
3. Absence of furcal radiolucencies, pathologic resorption and/or damage to succedaneous follicle;
4. No premature tooth loss.

If any one of the symptoms is present the treatment outcome is considered as failure.

The recorded values were statistically analyzed using SPSS 14 version. A p-value of <0.05 is set to be statistically significant. The recorded data was subjected to Chi-square test with Yates continuity correction.

The teeth in the laser group had a clinical success rate of 100% and a radiographic success rate 90% at 6months. The teeth in the formocresol group had a clinical success rate of 100% and radiographic success rate of 90% at 6 months. The success observed for each group was compared at each of the three follow-up periods. Statistical analysis of the data revealed no statistically significant differences between the two groups.( **Table 1.** and **Table.2**)

All the teeth in the laser group and formocresol group remained symptom free. None of the teeth showed the presence of any swelling or fistula and no premature tooth loss was recorded in both the groups. The clinical findings showed no statistical significance between the two groups. The radiographic failure was due to observation of pathologic root resorption in both formocresol group and laser group.

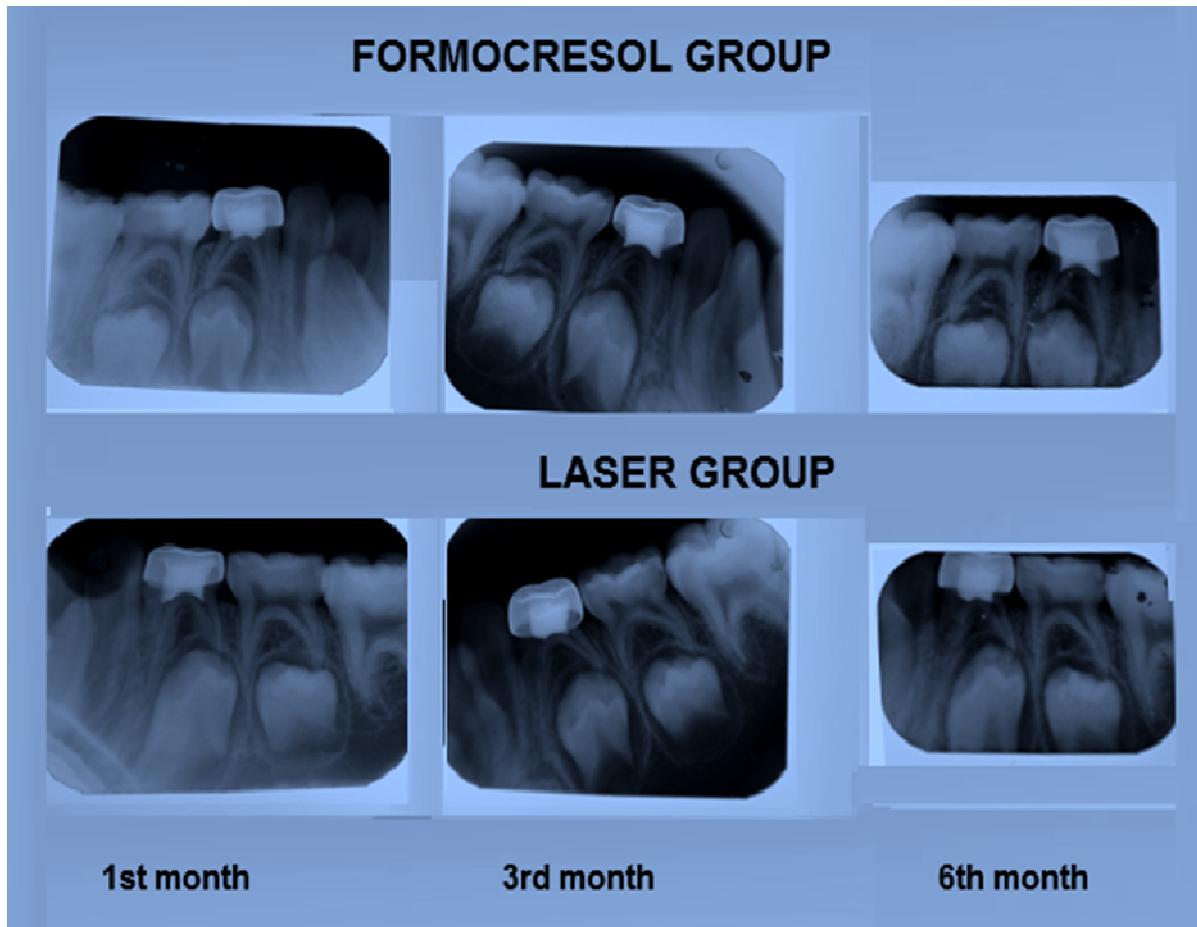


Fig  
2. Radiographic analysis of formocresol group and Laser Group at the end of 1st, 3rd and 6th months

Table.1. Comparison of the clinical success of the two methods

CLINICAL Success/failure	1 <sup>st</sup> month		3rd month		6th month	
	FG	LG	FG	LG	FG	LG
Sound	10	10	10	10	10	10
Failure	0	0	0	0	0	0
P-value	0.1		0.1		0.1	

p<0.01-significant; P>0.01-NS; FG:Formocresol group  
LG:Laser Group

Table.2. Comparison of the Radiographic success of the two methods

RADIOGRAPHIC Success/failure	1 <sup>st</sup> month		3rd month		6th month	
	FG	LG	FG	LG	FG	LG
Sound	10	10	10	10	10	10
Failure	0	0	0	0	1	1
P-value	0.18		0.18		0.19	

p<0.01-significant; P>0.01-NS; FG:Formocresol group  
LG:Laser Group

**DISCUSSION**

The research for a preservative, reparative and biological approach to paediatric pulp therapy over the devitalisation approach of formocresol pulpotomy led to the use of lasers. Lasers, because of their absorption effect on tissues cause cellular vaporization and ablation, which helps in proper hemostasis. Its properties like cellular

vaporization causes molecular bond breaking and photobiochemical disruption which leads to complete bacterial destruction. Laser irradiation accelerates wound healing of the pulp by the expression of the lectins and collagens. In experimental studies, diode laser irradiation showed mineralization of human dental pulp (HDP) cells with wavelength of 810 nm (± 20 nm). Irradiation at 1.0 W for 500 s continuously increased BMP production and activates cell signaling molecules such as

Smads (protein) and promotes mineralization of human dental pulp (HDP) cells.<sup>18</sup>

Laser has advantages when used as a pulpotomy agent such as control of haemorrhage, sterilization, preserving the vitality of the dental pulp and faster pulpal wound healing. Laser sterilization reinforces the overall sterilizing procedure, and laser coagulation produces a thin necrotic layer over the vital remaining pulp. This could be attributed to the minimal penetration of diode laser into the pulp tissue. The depth of penetration reported with the diode LASER was 100 - 300µm.<sup>18</sup>

Formation of a thin laser-induced necrotic layer stops the pulp from having direct contact with the covering materials and reduces the possible chemical or toxic effects of the materials used.

In an animal study done on canines using diode laser, the necrosis was limited to the point of application in all the samples and no carbonization was seen, probably due to the use of pulsed laser with limited lasing duration.<sup>24</sup>

Based on this evidence, the present study was done where diode laser (810nm) was clinically and radiographically evaluated as a pulpotomy agent.

Diode LASER suits the tissue resistant temperature values of pulp due to its high absorbance at 810nm wavelength which avoids excessive heating and charring of pulp.

Whereas other lasers which fall in high infrared wavelength such as Er:YAG laser, and Er,Cr:YSGG have shown carbonization and charring of pulp in experimental animals. As these lasers are hard tissue lasers they have a high affinity for hydroxyapatite so they tend to affect the adjacent hard tissues and therefore, are not much recommended for soft tissue procedures.

Furthermore diode LASER is a contact LASER, i.e. the LASER-emitting tip is applied in immediate contact with soft tissues. Hence only the site of application (micrometer range) is affected, leaving the remaining tissue unaffected. In diode laser, energy is released as photons, while in most other lasers such as CO<sub>2</sub> laser, ruby laser, Er Cr :YSG, Er: YAG, energy is released as heat which may damage the remaining radicular pulp tissue. This makes diode laser as a suitable laser for soft tissue incision and ablation, now as a pulpotomy agent<sup>14</sup>. The tip of the laser used in our study is only 300micrometers in diameter which is accessible for its use in contact mode in primary teeth. Whereas in other non-contact lasers such as CO<sub>2</sub> laser, Er,Cr YSGG, Er.YAG, Nd.YAG, the delivery system is either a hollow wave guide or fibre optics in free running pulse or non-pulse mode where the laser light is applied from a minimum of 4mm of distance from tissue thus the removal of coronal tissue is not precise. Also, in non-

contact lasers, there is unnecessary collateral damage to the adjacent tissues.

Jengfen Liu<sup>27</sup> found clinical success of pulpotomy procedure with Nd: YAG laser at 2 W. Shoji<sup>28</sup> concluded that bleeding from the pulp was prevented when CO<sub>2</sub> laser at ≥3 joules was applied. Saltzman<sup>15</sup> used diode laser with 3watts until the hemostasis was achieved and reported less radiographic success compared to formocresol pulpotomy. In an animal trial done using diode laser 810nm the authors have found better integrity of odontoblastic layer with 2W in a pulsed mode. Thus in our study the lasing energy of diode laser selected was 1.5 to 2W in a pulsed mode.<sup>17</sup>

The result of our study showed that the clinical success rate of diode laser (810nm) pulpotomy after 6 months was 100% and the radiographic success rate was 95.5%, which was statistically insignificant than that of formocresol pulpotomy group which showed a success rate of 90.9% clinically and 77.3% radiographically. However, there are very few human clinical trial studies using laser as pulpotomy tool for the purpose of outcome comparison.

## CONCLUSION

The present study revealed comparable success rates with both formocresol and diode laser pulpotomies. However additional studies with larger sample size and longer follow-up periods are needed to establish lasers as a preferred method for pulpotomies in primary molars.

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