Results of Endodontic Treatment for Molar Teeth with the Combination of Diode Laser in Root Canal Preparation

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ABSTRACT----
Root canal treatment techniques have recently had many modern support means, in which, laser technology becomes exceptional because of its benefits. However, its true effectiveness in disinfection phase remains controversial.
Objectives
To assess the efficiency of endodontic treatment for first molar teeth and second molar teeth with the support of Diode Laser machine in root canal preparation.
Methods
Controled clinical trial with 40 patients which are randomly divided into two study groups.
Results
Treated with the conventional method: 01 week after treatment: 85% good; 15% moderate; 0% poor. 3-9 months after treatment: 60% good; 40% moderate; 0% poor. The results of treatment using Diode laser machine in preparing root canal after 01 week: 95% good; 5% moderate; 0% poor. Monitoring after 3-9 months: 85% good; 15% moderate; 0% poor. There is no significant difference in treatment results after 3-9 months between the two groups.
Conclusions
The endodontically treated study subjects with the support of Diode Laser in root canal preparation demonstrate good results at high percentage of 95% after 01 week and 85% after 3-9 months of treatment compared with the treatment results of subjects using non Diode Laser method, 85% after one week and 60% after 3-9 months.

Keywords---- Endodontic, Diode Laser

1. BACKGROUND

Pulpitis is a very common dental disease, which affects significantly patients health due to acute dental pain, reduced chewing capacity, even threatening the lives of patients [1, 2]. Causes of the pulpitis are mainly due to the poor awareness of dental hygiene, leading to dental diseases such as dental caries, and pulpitis which is the closest complication of tooth decay. In Vietnam, the prevalence of dental caries is very high; the number of decayed teeth is increased by age, an average of 2.84 decayed teeth in the age of 18 and 8.93 decayed teeth at the age of over 45. In each age group, there are over 75% people with decayed teeth, in which the proportion of untreatment accounts for 80% [3].

Today, the root canal treatment techniques have had many modern support means such as the type of dentsply, protaper, magnifier - microscope (microsurgery), root canal fillings, disinfectants used in preparing the root canal. Many authors and clinicians have recognized the important effects that contribute to the success of the treatment is the root canal disinfection phase. In fact, while preparing the canal, root canal irrigation has contributed to remove and clean most of all residues, as well as bacteria. But the auxiliary root canal system, the tiny side root canals are also havens for many bacteria which are difficult to be removed. To overcome this problem, clinicians used disinfectants which have been so far used such as CMC (Camphorated parachlorophenol) or creosote, etc; because of the volatile nature, they can be used for washing into the auxiliary root canals and the side root canal to kill bacteria. However the disadvantages of CMC as well as creosote are that the patients must come and have drug tapes replaced at least once a week, hence it requires more time, at least two appointments for treatment of one tooth [4].

Today, the Laser technology has become one of the most important inventions of human in the 21st Century. The benefits of laser beams used in medicine compared with traditional techniques have been shown in the world medical literature such as: antisepticness, limited bleeding during surgery and after surgery... with the advance of science today, laser machines are designed in compact and easily portable forms, with the x-ray emission tips with sizes suitable for the pulp chamber and various x-ray emission intensities from small to large powers have brought efficiency and reliability in the treatment. Laser energy impacts on soft tissues will effectively remove the problem of bleeding during root canal preparation, creating a clean, sterile environment in the root canal to strengthen the success of the treatment process [5]. This means that the root canal disinfected by the laser energy will achieve higher efficiency and reduce the number of re-

examinations of patients down to only 2 treatments compared with conventional methods, 3 to 4 times higher in the root canal treatment of a large molar tooth, thereby improving the post-treatment comfort of the patient [6]. Because of these advantages, we conducted the research topic: "Assessing the root canal treatment effectiveness of first and second molar with the support of Diode Laser machine in root canal preparation".

2. METHODS

Subjects

Selecting the convenient sample of 40 patients who are diagnosed as irreversible pulpitis, pulp necrosis, pulp re-treatment. The study was conducted from January 2014 - November 2014 at the Department of Odonto-Stomatology, Binh Duong Medical College.

Selection criteria: The patients agree with the invesgation. Patients with first and second mandibular tooth designated for the root canal treatment, no surgery and good chewing capacity after being treated endodontically and conducted the prosthesis. Irreversible pulpitis teeth, pulp necrosis. Teeth with failed endodontic treatment. Patients who are not suffering from mental diseases.

Exclusion criteria: unqualified under the selected criteria.

Means of research

Laser Picasso Lite machine with the capacity of 2.0w [7]. Kit of tips 10mm-300µm. Endodontic examination and treatment kits. X-ray machine.

Methods

Controled clinical trial with 40 patients which are randomly divided into two study groups:

Group I: 20 patients with 20 teeth prepared by the conventional methods with root canal disinfected by CMC.

Group II: 20 patients with 20 teeth prepared root canal and disinfected by laser energy with the intensity of 0.5-1w, irregular beams.

Description of research methods

Group I:

- Step 1: Open the pulp chamber, empty the pulp chamber ceiling. Take the marrow with the dentsply of appropriate size. Irrigate NaOCl to clean the pulp chamber.
- Step 2: Conduct the radiography to determine the operational length, and check the lesions around the tip of the root.
- Step 3: Prepare, shape the root canal with the manual protaper, irrigate NaOCl to clean the pulp chamber.
- Step 4: After shaping and cleaning the root canal with NaOCl solution, dry the root canal and place the cotton absorbed with the CMC solution in the pulp chamber. Re-examine after 3-7 days, check and clean the root canal.
- Step 5: Fill the root canal with gutta percha manufactured for Protaper kit of Dentsply. Select the stick together with the final completed files. This stick must reach the working length, fit with the root canal in 1/3 apically. Conduct the radiography for checking.
- Step 6: Perform clinical examination and radiography after 1 week, 3 months, and 9 months.

Group II:

- Step 1: Open the pulp chamber, empty the pulp chamber ceiling with the dentsply of appropriate size. Irrigate NaOCl to clean the pulp chamber.
- Step 2: Conduct the radiography to determine the operational length, and check the lesions around the tip of the root.
- Step 3: Prepare and shape the root canal with the manual protaper, irrigate NaOCl to clean the pulp chamber.
- Step 4: After shaping and cleaning the root canal with NaOCl solution, use the tip 10mm-300µm into more than ½ of the root canal length and radiate beams with the intensity increased from 0,5-1watt, type of irregular beams. Radiate 03 times, 30-45 seconds per each, every 10 seconds reverse the tip outward for 1mm.
- Step 5: Dry the root canal and fill up with gutta percha manufactured for Protaper kit of Dentsply. Select the stick together with the final completed files. This stick must reach the working length, fit with the root canal in 1/3 apically. Conduct the radiography for checking.
- Step 6: Perform clinical examination and radiography after 1 week, 3 months, and 9 months.

Methods of assessing results

Evaluation of post-treatment results

Table 1. Assessment criteria with X-ray after treatment

Assessment criteria for the root canal	Good	Moderate	Poor
Shape	Equally tapered in cone-like shape	Tapered, not in cone-like shape	Wrong line, gone outside the root canal
Quantity	Full	Full	Omitted root canal
Preparation length	Full length	Insufficient < 1mm	Insufficient>1mm, out of apex
Filling length	Full length	Insufficient < 1mm	Insufficient>1mm, out of apex

Evaluation of results after one-week treatment

The treatment results were evaluated clinically for filled teeth after 01 week, at the time of permanent filling. Evaluation criteria according to 03 levels, based on the signs in the following table:

Table 2. Evaluation criteria based on 03 levels

Sign	Good	Moderate	Poor
Pain	No pain	Mild pain when chewing	Spontaneous pain
Gum branch	No swelling	No swelling	Red, oedema, pain when pressing
Percussing teeth	No pain	Mild pain	Severe pain

Evaluation of treatment after 3 to 9 months

Table 3. Clinical assessment criteria

Sign	Good	Moderate	Poor
Pain	No pain	Maild pain when chewing	Spontaneous pain
Gum branch	No swelling	No pain when pressing, no swelling	Red, oedema, pain when pressing
Percussing teeth	No pain	Mild pain	Severe pain

X-ray assessment

Table 4. X-ray assessment criteria

Assessment	X-ray images
Good	Reduced damages or completely recovered
Moderate	Not advanced injury, reduced, but not fully recovered
Poor	More severe lesions, new lesions appear or teeth to be extracted

Data processing

Collected research data are processed in accordance with medical statistic methods, using program SPSS 21.0 and program EPI - INFO 7.0.

Ethical considerations

Patients are explained about the purposes of the research so that they know full information about the root canal disease and its complications, benefits of the endodontic therapy. Patients agreed to participate in the study and may leave the study at any time. Results of the research will be published and proposed the treatment plans for the root canal treatment.

Error and control ways

Choose the adequate sample size and maintain consistency between the two groups in terms of the number of teeth, methods and means for preparing and shaping the root canal.

3. RESULTS

By studying 40 patients with 40 first and second mandibular molar teeth which are performed the endodontic treatment by the conventional method and method with the laser diode.

Table 1. Patient distribution by gender

Gender / Group	Male		Female		Total	
	No.	%	No.	%	No.	%
Group I (n=20)	9	45.0	11	55.0	20	50.0
Group II (n=20)	7	35 .0	13	65.0	20	50.0
Total	16	40.0	24	60.0	40	100.0

The proportion of female patients is higher than that of male patients in each study group; the difference was statistically significant (p_1<0.01). However, the gender difference between the groups was not statistically significant (p_2>0.05) (Table 1).

Table 2. Distribution of dental pathology by the study group

Group / Diagnosis	Group I		Group II		Total	
	No.	%	No.	%	No.	%
Irreversible pulpitis	13	32.5	11	27.5	24	60.0
Pulp necrosis	6	15.0	7	17.5	13	32.5
Pulp re-treatment	1	2.5	2	5.0	3	7.5
Total	20	50.0	20	50.0	40	100.0

The above table shows the irreversible pulpitis is the most common pathology, accounting for 60%; pulp necrosis makes up 32.5% and pulp re-treatment accounts for 7.5%. The difference between the two groups of pathologies with other lesions was statistically significant (p_1<0.001) (Table 2).

Table 3. Clinical symptoms after one-week treatment

Group / Complications	Group I		Group II		Total		p
	No.	%	No.	%	No.	%	
Pained	1	2.5	0	0.0	1	2.5	> 0.05
Swollen gum branch	0	0.0	0	0.0	0	0.0	
Extruded tooth	0	0.0	0	0.0	0	0.0	> 0.05

Table 3: Pain after one week in group I occurred with one tooth (2.5%) while in group II, it did not appear. After one week of treatment, no patient had swollen at the gum branch and extruded tooth in both groups. The difference in clinical manifestations after one week of treatment between two groups was not statistically significant with p>0.05.

Table 4. General results after one week of treatment

Group / Results	Group I		Group II		Total		p
	No.	%	No.	%	No.	%	
Good	17	42.5	19	47.5	36	90.0	> 0.05
Moderate	3	7.5	1	2.5	4	10.0	
Poor	0	0.0	0	0.0	0	0.0	
Total	20	50.0	20	50.0	40	100.0	

Good result after 01 week of treatment of the two groups was 90% in which the group I had 17 teeth (42.5%), group II had 19 teeth (47.5%). Moderate result after one week of treatment of the two groups was 10% in which the group I had 3 teeth (7.5%), group II had one tooth (2.5%). The difference in poor result after 01 week of treatment between the two groups was not statistically significant with p>0.05 (Table 4).

Table 5. Overall results after 01 week of treatment by pathological group

Results / Pathology	Good		Moderate		Poor		Total	
	No.	%	No.	%	No.	%	No.	%
Irreversible pulpitis	27	67.5	3	7.5	0	0.0	30	75.0
Pulp necrosis	7	17.5	1	2.5	0	0.0	8	20.0
Re-treatment	2	5.0	0	0.0	0	0.0	2	5.0
Total	36	90.0	4	10	0	0.0	40	100.0

The difference in the distribution of the results of treatment by pathological groups was statistically significant with p<0.05 (Table 5).

Table 6. General results after 3-9 months of treatment

Group / Results	Group I		Group II		Total	
	No.	%	No.	%	No.	%
Good	12	30.0	17	42.5	29	72.5
Moderate	8	20.0	3	7.5	11	27.5
Poor	0	0.0	0	0.0	0	0.0
Total	20	50.0	20	50.0	40	100.0

Table 6: Good result after 3-9 months of treatment of the two groups was 72.5% in which the group I had 12 teeth (30%), group II had 17 teeth (29%). Moderate result after 3-9 months of treatment of the two groups was 27.5% in which the group I had 8 teeth (20%), group II had 3 teeth (7.5%). There was no case with poor result (failure). The difference between the two groups was not statistically significant with $p>0.05$.

Table 7. General results after 3-9 months of treatment by the pathological group

Results / Pathology	Good		Moderate		Poor		Total	
	No.	%	No.	%	No.	%	No.	%
Irreversible pulpitis	23	57.5	6	15	0	0	29	72.5
Pulp necrosis	4	10.0	4	10	0	0	8	20.0
Pulp re-treatment	2	5.0	1	2.5	0	0	3	7.5
Total	29	72.5	11	27.5	0	0	40	100.0

The difference in the distribution of the results of treatment by pathological groups was statistically significant with $p<0.001$ (Table 7).

4. DISCUSSION

Of the studied 40 patients: the number of female patients: 24 (60%) is more than male patients: 16 (40%). Compared with a number in the studies of other authors in Vietnam, our research data also have the similar gender rates. In the study by Tran Thi Lan Anh: women 60%, men 40% [8]. Nguyen Dang Duong studied on 40 teeth: male 45%, female 55% [9]. According to Nguyen Manh Ha: female 57%, male 43% [1]; Do Thi Hong Nga: female 68.5%, male 31.5% [9]. Although our study showed that the prevalence of the root canal treatment in female was greater than that in male. However, to determine this ratio objectively, it is necessary to study on a larger sample.

In our study, the rate of teeth with irreversible pulpitis was 24 teeth (60%); pulp necrosis was 13 teeth (32.5%), pulp retreatment was 3 teeth (7.5%). The proportion of irreversible pulpitis is similar as in the study by Tran Thi Lan Anh [8] (57.15%), Nguyen Dang Duong [10] (57.5%) and Do Thi Hong Nga [9]. In our study, patients came mainly for the reason of dental pain (intermittent or continuous pain). So with other forms of pulpitis or periapical periodontitis that had no expression of pain, the patients often cared about it and came for examination and treatment only when there were complications, or new acute stage happened.

Post-treatment results

Treatment results after one week

After filling the root canal for one week, there was 01 patient with mild pain when chewing (2.5%), and no case of extruded tooth and swollen gum branch was detected. There was no statistical difference in general clinical outcomes between the research two groups. One week after the treatment, we found the conditions of treated teeth distributed by the pathology before and after the treatment are as follows: Irreversible pulpitis mostly had good results, with 27 teeth (67.5%), no poor results, moderate results with 3 teeth (7.5%). Pulp necrosis had 8 teeth in which 7 teeth had good results (17.5%), 01 tooth with moderate result (2.1%). The re-treated group had 2 teeth which both had good results (5%) and no moderate or poor results. Teeth treated with good results were mainly distributed in tooth group of irreversible pulpitis; good results were mainly in groups of pulp necrosis. The difference in the distribution of the treatment results by the pathological group was statistically significant with $p<0.05$.

Treatment results after 3-9 months

After 3-9 months, we re-examined 40 patients with treated 40 teeth; good result after 3-9 months of treatment of the two groups was 72.5% in which the group I had 12 teeth (30%), group II had 17 teeth (42.5%). Moderate result after 3-9 months of treatment of the two groups was 27.5% in which the group I had 8 teeth (20%), group II had 3 teeth (7.5%). There was no poor results (failure). The difference between the two groups was not statistically significant with $p>0.05$. After 3-9 months of treatment, the group of irreversible pulpitis mostly had good results, 29 teeth (72.5%) with good results, 6 teeth (15%) with moderate results, no teeth with poor results. Pulp necrosis had 8 re-examined teeth in which no cases had poor results, 4 teeth had good results (10%), 4 teeth (10%) had moderate results. The re-treated group had 2 teeth (5%) with good results, one tooth (2.5%) with moderate result. Treated teeth with good results were mainly

distributed in groups of irreversible pulpitis. The difference in the distribution of the treatment results by pathological group was statistically significant with $p<0.001$.

5. CONCLUSIONS

Through studying clinically, X-ray and assessing the root canal treatment outcomes of first and second mandibular molar teeth with the conventional root canal preparation and method using a Diode laser machine on the 40 teeth of 40 patients, we had a number of conclusions as follows:

Results of treatment with conventional methods: After 01 week of treatment: 85% good results; 15% moderate results; 0% poor result. Monitoring 3-9 months after the treatment: 60% good results; 40% moderate results; 0% poor result.

Results of treatment using a Diode laser: After 01 week: 95% good; 55% moderate; 0% poor. Supervising after 3-9 months: 85% good; 15% moderate; 0% poor. Treatment results after 3-9 months, there was no difference between the two groups.

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