

Clinical and Radiographic Evaluation of Nd: YAG Laser On The Healing of Flaring-Up Chronic Periapical Lesion “ Phoenix Abscess”

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Abstract:

The aim of this study was to evaluate the effect of Nd:YAG laser on healing of chronic periapical lesion with repeated flare-up. Forty six infected teeth in thirty six patients were treated using Nd:YAG laser and then obturated in the second visit. All cases reported clinical success with no complain of pain or further flare-up following root canal obturation. During radiographic examination, the periapical radiolucency decreased in size by time. The lesion healed completely after 6 months in healthy patient, while in diabetic patients, it took longer time, nearly 9 months for complete disappearance of periapical radiolucency.

Introduction:

It is currently accepted that the biomechanical instrumentation throughout the entire root canal system is a fundamental importance for successful endodontic treatment of teeth with chronic radiographic periapical lesions⁽¹⁾.

Unfortunately, during the initiation of endodontic treatment, the root canal instrumentation could force some of infected materials containing bacteria from the canal into the apical tissues⁽²⁾. This bacteria can grow in different ways releasing a microbial and host tissue antigens into periapex⁽³⁾. This could activated a greater number of obligate anaerobic strains, that altered the dynamic equilibrium of chronic periapical lesion allowing acute exacerbation of periapical lesions and flaring-up the condition resulting in what is called phoenix abscess⁽⁴⁾.

Studies showed that when a prophylactic antibiotic was used immediately with initiation of endodontic approach for patients having asymptomatic teeth with pulpal necrosis and associated periapical radiolucent lesions, flaring-ups develop about 13% of the time⁽⁵⁻⁷⁾. They reported that some of flare-up cases were serious and hospitalized with severe cellulitis and septicemia's and required massive antibiotic therapy to save their lives⁽⁷⁾. However, excessive administration of antibiotic reported 15.1% incidence of deleterious gastro-intestinal side effect such as nausea, vomiting, cramps diarrhea, hypersensitivity and allergic reaction could also develop^(5,8).

Furthermore, the excessive use of prophylactic antibiotics might lead to the development or resistant strains of microbes⁽⁴⁾. The mechanism of healing or repair of periapical lesion depends on several factors including type of lesion, the predominant cell type, healing potentiality of patient, the degree to which the original antigen has been eliminated and the adequacy of root canal obturation⁽⁹⁾.

Cleaning and shaping the root canals within a single treatment session is considered to be a very important procedure. Successful results were reported after single endodontic treatment for necrotic pulps associated with chronic periapical lesions opened with sinus tract⁽¹⁾. However this objective is difficult to fulfill particularly in patient with low tissue resistance such as diabetic patients. Diabetic patients may have problem during endodontic treatment where they are susceptible to infections because of their compromised microvasculature that is responsible for flaring-up chronic lesions together with the fact that the lesion heal in a slow rate because of both impaired vasculature and altered metabolism^(4,10). The surgical approach is the best line of treatment in such cases for promoting successful prognosis without flaring-up the condition⁽⁴⁾. Unfortunately, the indication for surgery are considered poor as with lower molars or with debilitated and elder patients, so the non-surgical approach must still pursued⁽¹¹⁾. Therefore, if such cases can be treated conventionally and completed in short time, this will be considered a good way of management for both patient and dentist.

Among the potential uses for laser in endodontic therapy is the ability to aid in cleaning and sealing the root canal prior to obturation⁽¹²⁾. Nd:YAG laser has been proven to be effective in cleaning of root canal and removing the smear layer leaving the dentinal tubules in a varying degree from partially or completely occluded, with an absence of minerals or organic debris⁽¹³⁾.

Another interesting phenomenon of laser exposure in surgery was the ability to sterilize the contaminated root apex, potential reduction in permeability of dentin of root surface, reduction of postoperative pain, edema and hemorrhage⁽¹⁴⁾.

Dederich et al.,⁽¹⁵⁾ showed that the relatively high CO₂ laser energies had consistent bactericidal activity obtaining sterile root canals. The energy required to eliminate 99.5% of microbial root canal flora was less than 200 J/Cm.

The aim of this study is to evaluate the effect of Nd:YAG laser on prognosis of chronic periapical lesion with frequent flare-up, clinically as well as radiographically.

Materials And Methods:

Thirty-six patients from both sexes were selected for this study. The patients could have repeated attacks of flare-ups of periapical lesions. All patient data were collected and kept for further investigation including age, sex, past and present medical and dental histories. The patient age ranged between 15-57 years. Some of those patients had systemic debilitating disease, such as diabetes mellitus. Preoperative radiographs were taken to determine the location and size of periapical radiolucent area for further comparison with post-operative follow-up radiograph.

The x-ray films were exposed under standard condition as described by Goaz and White⁽¹⁶⁾ to permit accurate comparison of preoperative or immediate postoperative radiograph with the follow-up radiographs according to the following parameters: 60 KVP., 10 M.Am. and kodac ultra-speed periapical films. Projection was done using paralleling technique and the film were automatically processed.

Careful clinical examination was performed for all patients including, testing tooth mobility, tooth vitality and pocket probing if present. Condition of surrounding tissues was also recorded to aid in comparing the condition before and after treatment. Cases with sinus or fistula were excluded from this study.

In patients with facial cellulitis the tooth was given time for drainage while the rubber dam was in place, then biomechanical preparation was completed with copious amount of saline as irrigant. Root canals were prepared with master apical file # 40 then root canals were flared with gates glidden burs. Root canals were irrigated with saline then exposed to Nd:YAG laser beam (American dental laser INC, Birmingham, MI. USA.) 1.06 wave length at 15 pps and 1.5 minutes. The fiber optic was inserted 3mm short to the apex to minimize the thermal trauma to the periapical tissues. Finally, root canals were irrigated with saline and dried with sterile paper points. Dry cotton pellet was inserted in the pulp chamber and the coronal access was sealed with temporary filling.

In the second visit (after two days) each root canal was obturated under complete aseptic condition with laterally condensed gutta-percha and sealapex root canal sealer (Kerr-Sybron, MI. USA.). The coronal cavities were sealed either with composite or amalgam. Immediate post-operative radiograph was taken and kept for further comparison with follow-up radiographs. The patients were asked to return after one to two weeks for clinical evaluation.

Each treated tooth was evaluated according to : no complain or even discomfort, condition of surrounding soft tissues, tenderness to palpation, presence of swelling or sinus, pocket depth, degree of tooth mobility and tenderness to percussion or even with occlusion.

Radiographic evaluation was done by asking the patient to attend every three months where periapical radiographs were taken, interpreted and compared with immediate post-operative radiograph.

Results:

A total of thirty-six patients with forty-six teeth were treated and followed. Twenty-one patient had varying degrees of swelling in acute stage. Seven patients had diabetes mellitus, five of them were completely controlled and other two were irregularly taking their medicine. Two patients suffered from rheumatic fever. Among the treated teeth, the involved anterior teeth (24 teeth)

were nearly equal to the involved posterior teeth (22 teeth). Most of the affected teeth particularly who came in acute condition, showed some degree of tooth mobility.

During clinical follow-up, all cases reported complete relief after Nd:YAG laser application with no complain of pain even after complete root canal instrumentation. There was no signs and symptoms or even discomfort. If there was tenderness to palpation preoperatively, it disappeared two days after laser application. There was also no tenderness to percussion or with occlusion. In cases demonstrated tooth mobility before treatment, they appeared with markedly decreased mobility after 15 days, if there was no excessive cervical bone loss. Furthermore, the tooth became firm with no evidence of mobility one month post laser treatment. Only one case returned after two days with severe pain that persisted for ten days and so the patient decided to extract the involved tooth.

During radiographic examination, the periapical radiolucencies decreased in size by time and complete resolution was recorded after 5 to 9 months according to each condition. The lesion healed completely after 6 months in healthy patients (fig, 1-7), while the diabetic patients took longer time, nearly 9 months for complete disappearance of periapical radiolucencies (Fig. 8-10).

Figures (1-10) representing different pre-operative, immediate post-operative and follow-up radiographs of some treated cases.

Fig (1): A series of radiograph for 37 years old female patient who complained of frequent attacks of swelling in relation to her upper anterior teeth. (A) preoperative radiograph showed very poor root canal filling even with paper pin in 1 (B,C) Re-treatment was done, root canal filling of 21 12 (D) follow-up radiograph ,6 months, showed complete healing of periapical lesion.

Fig (2): Radiographs for 24 years old female patient, follow-up (5 months) showed complete healing, even in the presence of excess sealer.

Fig (3): A series of radiograph for 21 years old male patient attended with (A) poorly filled root canal of 1 associated with periapical lesion. (B) Immediate Post-operative radiograph showed excess sealer extruded inside lesion. (C) Follow-up (6 months) showed complete healing.

Fig (4) : A series of radiograph for 23 years old male patient. (A) preoperative radiograph showed very huge periapical lesion related to apices of 12 (B) Immediate Post-operative radiograph showed root canal filling of 12 (C) 2 months follow-up radiograph , showed marked healing of large periapical lesion in related to 12, where root canal treatment was done for both 34 .

Fig (5): A series of radiograph for 36 years old female patient complained of frequent attacks of swelling in upper right side. (A) pre-operative radiograph showed improper root canal treatment [6] and periapical lesions related to apices of [65]. (B) Tooth length determination radiograph. (C) Immediate post-operative radiograph. (D) 6 months follow-up radiograph showed complete healing of lesion.

Fig (6): Radiographs for 35 years old female patients suffered from repeated flare-up of periapical lesion associated with apex of her [5] as shown in pre-operative radiograph (A). (B) tooth length determination radiograph. (C) Immediate post-operative radiograph. (D) 5 months follow-up radiograph showing complete resolution of radiolucency.

Fig (7): A case of 15 years old female patient attended complaining of a swelling in the lower right side. (A) Pre-operative radiograph showed mesial caries approaching the pulp of her [5] with slight periapical rarification. Emergency treatment was done, the patient escaped her appointment and disappeared for one year then she came back with another episode of swelling. (B) Tooth length determination on the second time where periapical lesion appeared to be increased in size. (C): 6 months follow-up radiograph showed complete healing of the lesion.

Fig (8): A series of radiographs for 40 years old diabetic female patient complained of frequent attacks of exacerbations in relation to lower anterior teeth. (A) Pre-operative radiograph showing periapical lesion in relation to apices of [12]. (B) Immediate post-operative radiograph. (C) 9 months follow-up radiograph showed almost complete healing of lesion after Nd:YAG laser exposure.

Fig (9): Radiographs of 35 years old diabetic female patient (A) preoperative radiograph for [6] showing periapical lesion involving both roots and extending alongside the distal surface of distal root. (B) Immediate post-operative radiograph. (C) 9 months after laser, follow-up radiograph showing complete healing of lesion.

Fig (10): A case of 36 years old diabetic male patient. (A) Preoperative radiograph of [7]. (B) Tooth length determination radiograph. (C) Immediate post-operative radiograph. (D) 8 months follow-up radiograph showing complete disappearance of radiolucency.

Discussion:

In the present study, sixty-two teeth in forty-nine patients were treated. During their routine check up periods, some cases failed to return, so they were excluded from the study. The results were recorded according to the number of patients returned at follow-up periods.

A total of forty-six infected teeth were treated and follow-up in thirty-six patients. 30% of the cases (13 teeth) has debilitating diseases particularly diabetes. It was reported that a low percentage of the chronic lesion became acute after the first endodontic appointment and defined as phoenix or rebirth abscess⁽¹¹⁾. Even with prophylactic dose of antibiotic⁽¹⁷⁾. It is usually attributed to either the presence of high virulence microorganism or to poor host resistance⁽¹¹⁾. As regard the uncontrolled diabetic patients, alternation in blood glucose level or arteriosclerosis may affect and retard the healing process⁽¹¹⁾. They have abnormalities in red blood cells and vascular disease which reduce oxygen delivery to the wound area and hamper its healing process⁽⁴⁾.

Furthermore, it was reported that the reduction of local blood supply in diabetic patients was responsible to the increase in periodontal disease and alveolar bone loss⁽¹⁸⁾. Kohsaka et al.⁽¹⁰⁾. Also revealed histometrically that the periapical lesion were significantly larger in rate with high blood glucose level than those in control rats.

All root canals treated in the present study revealed a good success clinically with no further flare-ups. Radiographically, almost all of the cases showed complete or marked healing of lesions. All patients had no complain of pain post-operatively after Nd:YAG laser application except one case only. Tuffin and Carruth⁽¹⁴⁾, showed that the post-operative pain was completely relieved after Co₂ laser application. The failed case had severe pain persisted for ten days and the patient decided to extract the tooth. This failure may be attributed to severe periodontal affection.

As regard the flare-up, microbes are the primary etiologic factor responsible for repeated flare-up⁽⁴⁾. It was found that the number of obligate and facultative anaerobic strain is great in teeth with large periapical lesions having the greatest incidence of flare-up⁽¹⁹⁾. Naidorf⁽²⁾, also pointed that the microbes presented in the infected root canal associated with large periapical lesion, was sealed in an anaerobic environment. Once the endodontic treatment initiated, it may alter the dynamic equilibrium of the lesion by forcing the microorganism or their products into periapical tissues⁽⁴⁾. Seltzer and Naidorf⁽²⁰⁾, also suggested that the biomechanical root canal instrumentation may injure the periapical tissue resulting in excessive exudate. This exudate was not absorbed enough by lymphatics creating pressure on nerve ending and causing pain. On the other hand, it can exaggerate the flare-up of the condition. In the present study, there was no pain or swelling post Nd:YAG application. Furthermore, it has been claimed that wound healing improved with marked decrease in edema following the use of laser⁽²¹⁾. Similar result was obtained after conventional endodontic treatment, as in lesion associated with sinus tract that permitted continuous drainage for edema and prevented flaring-up⁽¹⁾.

Otherwise, the flare-up was considered as an inflammatory response to stimulate the antigen- antibody reaction attempting to neutralize the condition. Furthermore, histamine was released increasing capillary permeability that cause edema and flare-up the lesion ⁽²⁾. Morse et al ⁽¹⁷⁾, used different types of antibiotic to prevent flaring-up the lesion during endodontic therapy. They showed that prophylactic administration of high dose of penicillin V or erythromycin resulted in low incidence of flare-up (2.2%), however, it was not absolutely prevented.

In the present study, there was no evidence of flare-up in any of the cases treated with Nd:YAG laser. All patients had no sign or symptoms all over the follow-up periods. The Nd:YAG laser exposure seems to eliminate all microbes present in the root canal and prevent the flare-up of the lesion. Miserendino ⁽²¹⁾, reported that Co₂ laser was capable of sealing small blood vessels and lymphatic vessels which may cause reduction of post-operative pain and flare-up. Our results were confirmed by other studies which concluded that Nd:YAG laser can be used to reduce bacteria on contaminated dentin surface ⁽²²⁾. In other study, Co₂ laser was found to be able to kill all bacterial species present and sterilize the root canal ⁽¹⁵⁾. Miserendino ⁽²¹⁾, used Co₂ laser during surgical apicoectomy, the patient did not require pain medication. After ten days the swelling of the secondary apical abscess had subsided and the wound partially healed with minimal inflammation surrounding the suture material. He concluded that the laser application in endodontic surgery improved homeostasis and can sterilize the infected root surface and enhance the risk of contamination of the surgical site. Another study suggested that Nd:YAG can be used to reduce bacteria on contaminated dentin surface ⁽²¹⁾.

In contradiction, Friedman and Rotstein ⁽²³⁾, demonstrated various degrees of periapical inflammation in all specimens with area of external root resorption after Co₂ laser irradiation in apical surgery. The laser also produced crater on root surface which was lined with charred layer persisted for 6 months and seemed to interfere with healing.

The effect of the laser on the target tissue is dependent on several factors, primarily the wave length of the laser, absorption characteristics of the exposed tissue, amount of power used, length of exposure, sharpness of focus and distance to the object ⁽²⁴⁾. In the present study, Nd:YAG was used with a suitable dose according to the manufacture instructions to minimize the harmful effect on periapical tissue. Nd:YAG laser beam was also inserted 3mm short of the apex to avoid the excessive thermal trauma to periapical tissue. Bathcall et al ⁽²⁵⁾, studied the histological effect of Nd:YAG laser on periradicular tissue in dogs. They revealed greater occurrence of necrosis and subsequent osteolytic and osteoclastic activities in the periradicular area than those treated conventionally. They attributed this damage to the excessive heat energy transferred or dispersed to the tissue by conduction, or by direct transmission of Nd:YAG laser beam through dentin and cementum causing thermal damage to the surrounding tissue.

Radiographic evaluation of the treated cases showed that the radiolucent areas in all cases decreased in size by time with complete resolution within 5-6 months in normal patients. While, in diabetic patients, the radiolucent areas disappeared within

9 months post-operatively. The varying degrees of healing is related to the health condition of the patients. The lesion healed slowly in diabetes due to impaired vasculature and poor metabolism^(4,10).

Finally it can be concluded that the repair process of periapical lesions depends mainly on the complete elimination of root canal infection as well as the host body resistance⁽²⁶⁾. The use of Nd:YAG laser, seems to reduce the infection and microbes of the root canal preventing the flare-up of the lesion and enhance the healing of periapical lesions.

Conclusions:

From this study we can concluded that Nd:YAG laser prevent the tendency of flare-up of the chronic periapical lesions, particularly in cases with lower body resistance such as in diabetic patients. Furthermore, it enhance the healing process of chronic periapical lesion in healthy patients within 6 months and 9 months in diabetic patients following Nd:YAG laser applications.

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