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THE IN VITRO ROLE OF DIODE LASER IN ERADICATION OF ENTEROCOCCUS FAECALIS INFECTION IN DENTAL PULP

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ABSTRACT

Background: Root canal treatment has been the main form of treatment for endodontic infections, and it comprises, chiefly, of physical instrumentation coupled with chemical irrigation. The primary objective of endodontic therapy is to eradicate bacteria in the root canal and associated regions. **Objective:** To investigate the antibacterial effect of a diode laser on Enterococcus faecalis in deep root canal dentin. **Materials and Method:** Two hundred extracted single rooted teeth were selected for this study. The root canals were prepared and shaped with sterile reamers (#15-35) and diode laser needle was introduced into the canal and microbiological samples were collected from each tooth using sterile paper points before and after the treatment with diode laser and inoculated into(brain heart infusion agar and blood agar)for the isolation and identification of Enterococcus faecalis. **Results:** Twenty one (10.5%) isolates of Enterococcus faecalis were isolated from 200 single rooted canals, after treatment with diode laser 20 (95.2%) isolates were eradicated, whereas only 1 (4.8%) isolate was resistant to treatment with diode laser. **Conclusion:** Diode laser method was very effective in the elimination of Enterococcus faecalis from infected single rooted canals.

KEYWORDS: Diode laser, Enterococcus faecalis, dental pulp, brain heart infusion agar, blood agar.

INTRODUCTION

Bacterial infection plays an important role in the development of necrosis in the dental pulp and the formation of periapical lesions; therefore, the main goal of endodontic treatment is the elimination of bacterial infection and associated inflammation in the pulpal tissue and also the mechanical removal of damaged tissue found inside the root canal that acts as a growth medium for microbes.[1]

Achieving predictable long-term success of root canal treatment requires effective debridement and disinfection of the root canal system.[2]

E. faecalis has been the micro-organism most commonly found[3], due to the specific characteristics such as: ability to colonize the dentin and tubules, which makes its removal by chemical and mechanical means difficult[4,5], and may even resist the medication[6] and irrigating solutions.[7]

E. faecalis has proved to be a potentially important microorganism to the colonization or overgrowth in endodontic infections, being the dominant microorganism in post treatment apical periodontitis, and has often been isolated from the root canal in pure culture.[8]

In some cases, E. faecalis has been found as the only organism (pure culture) present in root filled teeth with periradicular lesions.[9]

The 810nm diode laser (Fox, A.R.C., Germany) is specifically a soft tissue laser. This wavelength is ideally suited for soft tissue procedures since it is highly absorbed in hemoglobin and melanin, both of which are prevalent in soft tissues.[10]

For decades, laser therapy has been employed for soft tissue surgery, caries removal and cavity preparations. Lasers have also proven to have a variety of clinical applications in dentistry and low level laser therapy (LLLT) has been employed in the treatment of dentine hypersensitivity and periodontal ligament pain.[11,12] There has also been increasing evidence to prove that LLLT may be effective in the destruction of cariogenic and other oral microorganisms without causing excessive stress to the oral environment.[13,14]

The use of laser for decontaminating periodontal pockets has been shown to be effective[15,16] and has encouraged research for determining or clarifying its effectiveness in the treatment of peri-implantitis.[17,18]

Diode lasers are used primarily for soft tissue procedures involving cutting, coagulating, ablating or vaporizing soft tissues and they achieve this with less trauma, improved post-operative healing and faster recovery times than conventional methods.[19]

The aim of this study is to investigate the antibacterial effect of a diode laser on isolated E. faecalis from deep root canal dentin.

MATERIALS AND METHODS

Two hundred extracted teeth with single rooted canal were collected randomly from different private dental clinics in Duhok city, Kurdistan province, Iraq. The study was carried out in the Department of Microbiology, School of Medicine, Faculty of Medical sciences, University of Duhok. The period of this study was from November 2010 to March 2011.

A reamers of suitable sizes (#15-30) were used to enlarge the canal and remove the pulp tissues. Instrumentation was followed by irrigation with normal saline. The initial microbiological samples were obtained by inserting sterile paper point into the prepared canal.

The laser needle was introduced into the canal, which should be reaching the apex and one to two impulses were emitted and then the second sample was taken by inserting sterile paper point into the canal. Following the manufacturer recommendation, the current applied was 3watts for 30seconds.

The sterile paper points were cultured into brain heart infusion broth. After incubation at 37ºC for 24 hours, each sample was sub-cultured on brain heart infusion agar, and blood agar,
After incubation at 37ºC for 24 hours, colony morphology were noted and diagnosed by catalase test and gram stain. The suspected colonies were sub-cultured onto bile esculin agar and incubated at 37ºC for 24 hours, diagnosis and antibiotic susceptibility tests were done by BD Phoenix100 for further confirmation.

Phoenix ID

The Phoenix system offers a combination ID and AST panel (PMIC/ID-70), with the identification substrates on one side and antimicrobial agents on the other side of the panel. The isolates were sub-cultured onto Bile Esculin Agar (BEA**).**

The Phoenix ID broth was inoculated with several bacterial colonies from a pure culture adjusted to 0.5 McFarland standard using a Phoenix Nephelometer (BD Diagnostics). After the transfer of 25 µl of the ID broth suspension to the Phoenix AST broth, the remaining suspension was poured into the ID side of the panel.

Once the inoculated panel was labeled, it was logged and loaded into the instrument and incubated at 35°C. Purity plates were prepared for all isolates.

Phoenix AST

Preparation of the Phoenix AST broth requires adding a drop of Phoenix AST indicator (resazurin based dye acting as the terminal electron acceptor) before inoculation of 25 µl of the broth from the standardized ID suspension. After addition of the ID broth suspension, the tube was mixed by inverting several times. The broth was then poured into the AST side of the panel. Once the inoculated panel was labeled, it was logged and loaded into the Phoenix apparatus and incubated at 35°C.

RESULTS

Out of a total of 200 samples, 21 (10.5%) isolates of E. faecalis were isolated and 179(89.5%) showed negative cultures.

Table: 1 Number & percentage of E. faecalis response before & after treatment with diode laser.

No. of samples	positive isolates of E. faecalis	negative isolates of E. faecalis	Before treatment with diode laser	After treatment with diodelaser	
				Eradicated	Non eradicated
200	21 (10.5%)	179(89.5%)	21 (100%)	20 (95.2%)	1 (4.8%)

Diode laser eradicated 20 (95.2%) isolates of E. faecalis, while 1 (4.8%) was resistant (Table 1).

DISCUSSION

For the first time diode laser is used in Iraq and Middle East using wave length 810 nm for the elimination of E. faecalis in root canal (infected pulp).

E. faecalis was chosen as a test organism because it is a facultative organism that is non-fastidious, easy-to-grow, and rapidly colonizes tubules.[20] It has been used extensively in endodontic research because it has been found to be present in 63% of teeth with post-treatment disease.[21]

In the present study, only 10.5% cases of Enterococcus faecalis were isolated and 89.5% were negative for Enterococcus faecalis. This is similar to a study from Turkey.[22]

Other studies showed that Enterococcus faecalis from patients with endodontic infections varies from 7.3% (6) to 75%[23]

A recent study from Duhok city, Kurdistan, Iraq showed that the prevalence of E. faecalis in root canal (infected pulp) was 40/500 (8%) positive cases.[24]

These differences in findings between previous studies in comparison to our study in regard to E. faecalis prevalence are probably mainly due to different

identification techniques, geographic differences, or sample size, and they may also be due to differences in dietary intake in these different populations.[25]

Our study showed that diode laser 810nm eliminated Enterococcus faecalis in 95.2% isolates. Our study proved that diode laser 810 nm was effective in eradicating E. faecalis from the root canal system without mechanical cleaning treatments.

Other in vitro studies performed on roots of extracted human teeth described that an average of a bacterial reduction 90.31% to 99.91% was able to be achieved by laser.[26,27]

A study by Gonçalves illustrated that the diode laser showed the highest antibacterial effect against E. faecalis, when using 3W, of the diode laser, bacterial eradication was completely (144/144).[28]

In our study the results obtained were so similar to the Gonçalves study in which diode laser showed higher antibacterial effect in eradication of E. faecalis.

CONCLUSIONS

The diode laser showed high effectiveness in eradicating E. faecalis from single rooted canals. We recommend Diode laser to be used as a replacement to classical method used in the dental clinics for treating single rooted canals for the complete eradication of E. faecalis.

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