In-Vivo Evaluation of Efficacy of Ultrasonic Irrigation with 3% Naocl & Nd:Yag Laser for Disinfection against Streptococcus and Staphylococcus in Root Canal

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Root canal infection has multibacterial etiology. Micro-organisms and their end products are considered the main cause of pulpal and periapical disease. The success of the endodontic treatment is directly influenced by elimination of microorganisms from infected root canals. In our routine endodontic procedures many a times just chemomechanical therapy is not sufficient to debride the root canals. Therefore, newer modalities or devices must be tried and tested in –vivo for complete disinfection of the root canal.

Since, *Streptococcous and Staphylococcous* are prevalant in root canal, therefore the purpose of this study is-

To determine the efficacy of Ultrasonic irrigation with 3% sodium hypochlorite and Nd:YAG Laser for root canal disinfection against *Streptococcous and Staphylococcous* micro-organism.

Root canal treatment in single rooted teeth were included in this study, in which pre-operative sample and post operative sample were taken after using the modalities in each group with the sterile paper point. The collected samples were placed in Brain Heart Infusion transports media and then sent for microbiological culture, which was observed after 48 hrs.

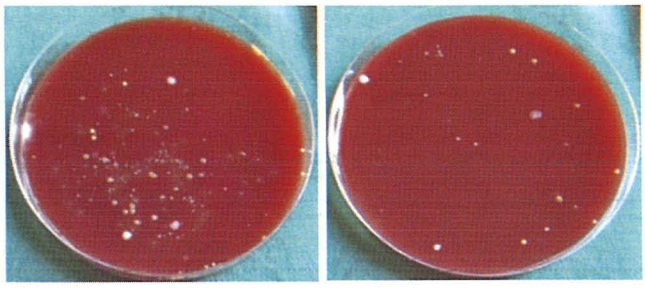
Nd:YAG Laser was more efficient than ultrasonic irrigation with 3% NaOCl against *Streptococcous and Staphylococcous* micro-organism.

Key Words: Disinfection, Nd: YAG Laser, Ultrasonic irrigation.

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Fig No: 1 Showing agar plates with growth of Streptococcous and Staphylococcous

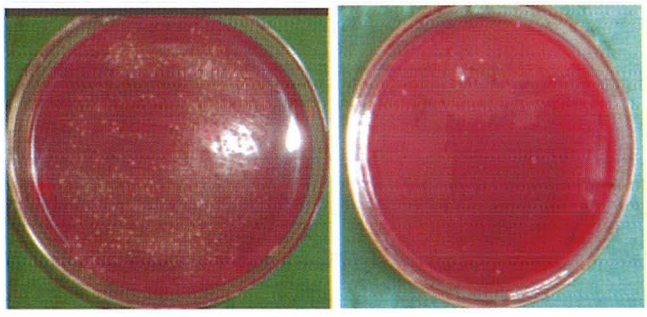
ULTRASONIC IRRIGATION WITH 3% NaOCl



(A) Pre-Operative CFU After 48 Hrs *(B) Post-Operative CFU After 48 Hrs*

Fig No: 2 Showing agar plates with growth of Streptococcous and Staphylococcous.

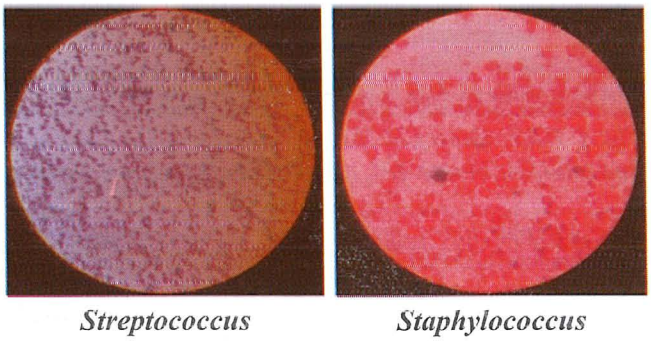
Nd: YAG LASER



(A) Pre-Operative CFU After 48 Hrs *(B) Post-Operative CFU After 48 Hrs*

Fig No: 3 Showing Streptococcous and Staphylococcous under 100X magnification

MICROSCOPICALLY



Streptococcus *Staphylococcus*

W D Miller in I890 described microorganisms that could be seen in and recovered from the infected root canal [1]. He was perhaps the first to associate disease and inflammation in the jaws with the infected dental pulp canal space. One of the crucial points in endodontic therapy is to disinfect root canal before root filling because of the role of bacteria and their by-products in both the initiation and perpetuation of pulpal and periapical disease. The majority of bacteria found in the root canal microflora may be simply removed by the mechanical action of endodontic instruments. Nevertheless, because of the anatomical complexities of many root canals, organic residues and bacteria located in the dentinal tubules cannot be sufficiently cleaned, even after meticulous mechanical procedures. Therefore, various substances have been used during and immediately after root canal preparation to remove debris and necrotic pulp tissue and to eliminate microorganisms from the root canal.[2]

AIM

To evaluate and compare ultrasonic irrigation with 3% NaOCl & Nd:YAG Laser for disinfection against *Streptococcus* and *Staphylococcus* in root canal.

OBJECTIVES

1) To evaluate the efficacy of Ultrasonic Irrigation with 3% NaOCl for disinfection of root canal against *Streptococcus & Staphylococcus.*
2) To evaluate the efficacy of *Nd: YAG LASER* for disinfection of root canal against *Streptococcus & Staphylococcus.*
3) To compare the efficacy of *Ultrasonic Irrigation & Nd: YAG Laser* for root canal disinfection against *Streptococcus & Staphylococcus.*

METHOD

Patients who enroll at OPD of Dr. D. Y. Patil Dental College requiring root canal treatment in single rooted teeth of maxillary incisors, canine & mandibular incisors, canines & premolars were included in the study. A detailed case history & preoperative radiographs of the patient were taken. In radiographic and clinical examination, all teeth having apical pathosis were selected. Informed written consent from the patient was obtained.

INCLUSION CRITERIA

1) Single rooted teeth requiring root canal treatment.
2) Patient in the age group of 20-45years.

EXCLUSION CRITERIA

1) Vital teeth.
2) Any systemic disorder or antibiotic therapy with in previous 2 months.
3) Teeth with abnormal anatomy & calcified canals.
4) Teeth with periodontal pocket more than 2mm deep.

Patients were divided into **2 Groups:**

a) ***GROUP I*** :- Ultrasonic irrigation with 3% NaOCl (n = 5)

b) ***GROUP II*** :- Nd : YAG LASER (n = 5)

1) Local anaesthesia with 2% lignocaine if required was administered at the site of disease. Single tooth isolation using rubber dam was done. Antisepsis of the operating field was performed with 10% povidon-iodine solution.
2) A high – speed handpiece and sterile round bur #2 was used to remove the carious tooth structure, restoration etc and access to the root canal was achieved. #10k file was used to penetrate the apical foramen & to check the patency or any curvatures in root canal. Working length was established using apex locator. This was confirmed with an IOPA radiograph.
3) Minimal instrumentation and irrigation was carried out with saline till no further debris or other particulate matter was visible. Apical gauging was done.
4) The first sample was collected by introducing a sterile paper point with a diameter comparable to the full length of the canal and retained in position for 60sec for microbial sampling.

5) If the root canal was dry, a small amount of sterile saline solution was introduced into the canal to ensure viable sample acquisition.

6) The paper point was immediately placed in the test tube containing Brain Heart Infusion transport medium and was sent to the laboratory, for microbiology processing. 20uml of the sample was collected into the micropipette and placed over sheep blood agar plates, streaking of the sample was done. The CFU were counted for *Streptococcous and Staphylococcous* after 48 hrs (Fig 1A & 2A).

7) Each group was treated as follows :

a) ***For GROUP I*** :- Ultrasonic irrigation with 3% NaOCl

Ultrasonically operated #15k file was used for 3 mins at a distance of 2 mm short of working length. This was followed by #20k for 60sec in a filing action and then 30 sec in circumferential action. Total of 50ml irrigant solution was used.

b) ***For GROUP II*** :- Nd : YAG LASER

Nd:YAG Laser (Fotona) of 1064 wavelength with Standard settings of 15Hz at 100mJ = 1.5W at pulsed mode repeated 4 cycles for 5sec each. A 200U optical fibre 2mm short of working length was introduced into root canal without activating laser. Then laser was activated and fibre guided in apical to coronal direction with circular movements and in contact with wet root canal walls.

Subsequently, a sterile paper point was placed in the root canal to procure the post operative sample, which was processed as above and counted for *Streptococcous and Staphylococcous* CFU which was further confirmed by catalase test. (Fig 1B,2B and 3)

8) The root canals was medicated and temporary dressing given with zinc oxide eugenol cement till completion of the endodontic treatment.

9) The pre and post operative data was analysed statistically using "paired t" test for reduction in CFU using the two different modalities for disinfection of root canal (Table No 1 & 2).

DISCUSSION

Infections of the root canal system typically have a polymicrobial flora with approximately equal proportions of gram negative and gram positive bacteria. 14.2% of *Streptococcus* & 8.6% *Staphylococcus* is observed in untreated root canals.[3] Consequently the complete removal of the pathogenic bacteria and their toxic by-products is of crucial importance for the successful outcome of therapy. The discrepancy of the penetration depth of micro-organisms and bactericidal irrigating solutions often holds responsible for treatment resistant cases

RESULTS AND ANALYSIS

Table No 1: Comparative Analysis of ultrasonic irrigation with 3% NaOCl for disinfection of root canal (GROUP I)

No. of Samples	STREPTOCOCCUS		STAPHYLOCOCCUS	
	Pre -operative CFU	Post -operative CFU	Pre -operative CFU	Post -operative CFU
Sample - 1	54	5	32	4
Sample - 2	24	10	5	4
Sample – 3	65	11	21	6
Sample – 4	48	6	28	10
Samples- 5	51	4	19	3
Mean	56	7.2	21	5.4

and long-term failures which can be observed in conventional endodontics. Literature documents the use of various other adjuvant treatment modalities for disinfection of root canal such as ultrasonics, ozone, lasers etc.

Sodium hypochlorite has been a gold standard as a root canal irrigant for disinfection of root canal. Studies have shown that when activated ultrasonically it potentiates & enhances the antibacterial efficacy of NaOCl.[4]

Mechanism of action of ultrasonic irrigation :

1) When a file is placed in the root canal it causes acoustic streaming effect by mechanical energy, thus dislodging the debris from canal and by the warming effect it potentites the activity of NaOCl.
2) Ultrasonic synergistic system has a significantly superior ability to clean the root canal space when compared to conventional hand filing- irrigating technique. NaOCl has tissue-dissolving capacity as well as antibacterial properties.[4-5]

Lasers were introduced to dentistry & had applications in Endodontics. Particularly using a neodymium (Nd:YAG) laser, Altamura et al found that smear layer & debris removal was effective at a lower power level of 2W, 100mJ energy, and 20 Hz pulse rate.[6] Most lasers are heat-producing devices converting electromagnetic energy into thermal. These lasers find uses in oral surgery for cutting or coagulating soft tissues or in the welding of dental prostheses. More recently, new types of lasers have offered non-thermal modes of tissue interaction, called photoablation, photodisruption and photochemical effects. The effect of laser radiation on tissue depends on various properties of the material, e.g. specific absorption, chemical structure and dentistry. On the other hand, the properties of the laser radiation, e.g. wavelength, energy density and pulse duration, must be taken into consideration. The basis of the photochemical effect is the absorption of laser without any thermal to a change in the chemical and physical properties of atoms and molecules.

Mechanism of action of Nd: YAG LASER

1) When fiber is placed in the canal, there is a physicochemical change on the molecular level which acts on bacterial cell wall and leads to cell wall degeneration.
2) Canals irradiated with Nd: YAG Lasers may have reduced permeability due to melting action of the beam on the dentin.[7]
3) Smear layer & debris removal is effective at low power.[8-9]

In *1997, KLINKE et al*, were able to prove bactericidal effect of Nd:YAG laser at a depth of 1,000 um. In comparison, a rinsing solution, such as NaOCl, only achieves effective bacterial reduction up to a depth of 100 um.[10]

Table No 2: Comparative Analysis of Nd:YAG Laser for disinfection of root canal (GROUP II)

No. of Samples	STREPTOCOCCUS		STAPHYLOCOCCUS	
	Pre-operative CFU	Post-operative CFU	Pre-operative CFU	Post-operative CFU
Sample - 1	82	5	40	2
Sample - 2	50	4	20	3
Sample – 3	43	2	14	1
Sample – 4	49	3	23	2
Samples- 5	56	4	19	1
Mean	**56**	**3.8**	23.5	**1.8**

However, one of the limitations of this in vivo study was a relatively small sample size.

CONCLUSION

The following are the observations of this in vivo study -

1) Both ultrasonic irrigation with 3% NaOCl and Nd: YAG Laser are effective against Staphylococcus & Streptococcus.
2) Nd : YAG Laser is more efficient than Ultrasonic irrigation with 3% NaOCl against Staphylococcus and Streptococcus.

Conflict of Interest Statement

"I declare that I do not have any commercial or associative interest that represents a conflict of interest in connection with the work submitted".

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