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Original Study

Comparative evaluation of smear layer removal in root canals after using lasers using SEM analysis

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ABSTRACT

Introduction

Smear layer is comprised of organic and inorganic material and might also hold bacteria. Smear layer is generated on instrumentation of canal walls in endodontic treatment.

Aim

To identify the impact of Erbium laser irradiation on elimination of smear layer compared with routine irrigation methods.

Materials and methods

Forty-Five teeth were taken and divided into three groups . In 1 Group, cleaning with (EDTA) and (NaOCl) done. In 2 group Erbium laser at 1W power is used and 3 group erbium laser at 2 W is used for disinfection of canal walls. (SEM) images at all the three sections of root canals are being taken removal of smear layer.

Results

There was no significant improvement between groups 2 and 3 on smear layer removal but group 1 did not remove smear layer only.

Conclusion

Within the constraints of this study, it can be established that laser can be used as an effective technique to obtain clean canals**.**

***Keywords:** Endodontic irrigants; Debris removal; Laser; Scanning Electron Microscope; Smear Layer.*

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INTRODUCTION

The aim of the endodontic treatment is to remove all remnants from the root canal like microbes, pulpal remnants. A smear layer is formed upon instrumentation which gets deposited on the root canals. The smear layer contains organic and inorganic debris, pulpal remnants, microbes, toxic substances.[1,2] The smear layer acts as a barrier and blocks the entry of antimicrobial irrigants, root canal sealers and intra canal medicaments into the dentinal tubules which may interfere with disinfection of root canals during the course of treatment.[3,4] Various methods used to remove the smear layer includes chemical agents like EDTA, lasers and ultrasonics.[5,6]

Ethylenediaminetetraacetic acid (EDTA) at 17% concentration is used to remove the smear layer.[7] Irrigation with 17% EDTA and sodium hypochlorite (NaOCl) eradicates the smear layer completely.[8] Lasers are an effective tool for smear layer removal and root canal disinfection.[9,10] The Erbium is an infrared laser that has the ability to absorb water and to disinfect root canals in powers ranging from 1–3 W.[5,9,11]

The objective of the study was to find out the effect of erbium laser with power output at two levels on eradication of debris layer in all three sections of canal walls comparing with the conventional method.

MATERIALS AND METHODS:

Forty-five specimens were selected for this study. Specimens were disinfection with sodium hypochlorite for 2 h and stored in saline till procedure. Each tooth was cut off at the (CEJ) by a micromotor, and the final length of root was of 14–15 mm. A 15 size K-file was utilised to check for patency of the canal. The Endometrics is by Ingles radiographic method.

The canals were cleaned and shaped using ProTaper Universal system (Dentsply Maillefer, Ballaigues, Switzerland) till size F3(size 30,0.06 taper). Root canals irrigation was carried with 5.25% of sodium hypochlorite and 17% of chelating agent and finally with saline. The roots were divided into 3 groups on laser mode.(n=15 per group). Group 1 no treatment kept as standard. In Group 2, irrigant was water and 2.78 μm Erbium laser irradiation (with a 320 μm with firing tip and power output of 1 W and 20 Hz frequency and 15% ratio of water and air pressure.[12,13] The laser tip kept into canal 1mm less than WL and rotated from the apical to the coronal direction at 2 mm/sec. In Group 3, had same procedure as that of Group 2 and power output at 2W ;. Irradiation of laser at (25°C) for 30 seconds and done again two times with a 10 sec break for the two. Finally, the canals were cleaned with 5 mL of saline and dried with paper points #35.

Scanning Electron Microscope (SEM) analysis

Roots were sectioned using a carborundum disc under the water coolant. Forty-five SEM photos were taken of each specimen at 2000× magnification. The images were analyzed according to the scoring criteria for evaluations of smear layer and removal of debris.

Torabinejad *et al* (2003) as follows:[6]

1. No to minimum smear layer: None or negligible smear layer formation on the walls of the canals; all dentinal tubules were clear of debris.

2. Moderate smear layer: No smear layer is found on root canal, but the tubules had debris.

3. Thick smear layer: Smear layer surrounded canal walls and the dentinal tubules.

STATISTICAL ANALYSIS:

The statistics were given using the test of Kruskal–Wallis ANOVA and tests of Dunn. P value kept α=0.05.

RESULTS:

The results described no change between Groups 2 and 3 in all three sections. In Group 1, large amounts of smear layer were seen in the dentinal walls at apical level. Result of the scores showed very high in group 1 than in 2 and 3(p<0.0.5).

Table 1

Group (n= 15)	Middle area (SD)	Apical area (SD)
1	0.86(0.35)	1.46 (0.516)
2	0.50(0.51) *	1.06 (0.457) *
3	0.42(0.51) *	0.73 (0.457) *

Remaining smear layer on root canal walls. Values are shown as mean and SD.*shows a significant difference (p<0.0.5) compared to Group 1.

DISCUSSION

The smear layer should be removed from canal walls which is very difficult without altering surface of the root .Cleaning canals with Ethylene diamine tetra acetic acid and sodium hypochlorite removes smear layer effectively.[14,15] In this study, Group 1, 2 mL of 5 mL of NaOCl and 17% EDTA for 3 min removed smear layer at coronal and middle level. But adverse effects on root surface may occur because of the procedure. Uzunoglu et al. showed on application of EDTA the resistance to fracture or RCT treated lower incisors were not affected on removal of smear layer.[16] But usage of EDTA for >1 min has been found to erode dentinal walls. Hence further studies are required for EDTA effects on the root canal of anterior teeth.[17]

In our study, laser beams could reach apex because the tips were small than the file used. Shock wave formation by water activation and vapour bubbles formed by Erbium lasers effectively remove smear layer.[18]

The Erbium laser, uses power of 1W, removes debris from all the three sections. Formation of dentinal cracks and carbonization on the surface of walls from ER lasers (>4 W) and (1 W) without a coolant.[10] However at 3W there was no difference root surfaces. Even though no dentinal change was seen thermal damage was observed.[11] They were seen as burned surfaces, liquefaction of DT, and the sealing of dentinal tubule in such areas.[11] Group 3 (2W)ended up with same conclusion as of that at 1 W. But it may not be consistent as other studies.[10,11] Size of tip of the laser, and its irradiation, medium used and preparation of apical size were determined in several studies. Based on these studies a Er,Cr:YSGG laser can enter the full WL, at power >1.5 W but does not remove smear layer but also causes thermal damage on the root surface. However, it may be noted that the very high-power laser may cause debris formation on dentinal structure rather than removing the smear layer.

In this study, all groups proved good eradication layer of smear layer on the middle and upper rather than in the apical thirds which agrees with other studies.[19] In the apex of the root numerous lateral and accessory canals will be found that cannot be removed by lase irradiation. Even if laser is able to remove smear layer in apical third by irrigation and laser driven EDTA irrigation it raises safety factors during clinical procedures.[5] Laser and EDTA combination has been able to successively remove smear layer in few studies.[20] This study tells us laser alone is not useful for smear layer removal on apical third. And a combination of laser and chelating agent can be effective duo for removing debris from canal walls.[21]

CONCLUSION

From this research it can be established that lasers can assist in cleaning and removing smear layer along with other irrigants and cannot be used alone. Additional studies are essential to detect the influence of laser on the other properties of root dentin.

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