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Permeability of Radicular Dentine after Using Different Irrigant Activation Techniques Including Photo Induce Photoacoustic Streaming Technique

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Abstract: Background: preparation of root canals is an important step in root canal treatment. Mechanical instrumentation of root canals cause an irregular layer of debris, known as the smear layer. As a result, several studies reported that preferring the removal of the smear layer. **Objective**: To study the influence of the energy (100 mJ) of Erbium, Chromium: Yttrium Scandium Gallium Garnet (Er,Cr:YSGG) laser at short pulse duration (60 µs) on smear layer removal of apical third after using Photon induced photoacoustic streaming technique. **Materials and methods:** Eighteen straight single-rooted mandibular premolars were used. The roots length were uniform to 14mm from the anatomic apex and instrumented using Protaper Gold Rotary NiTi file system to size 40 taper 0.06. Er,Cr:YSGG pulsed laser (waterlase iplus Biolase, CA, USA) 2780 nm was used at short pulse duration (60 µs, 5 Hz ,air and water off) delivered by MD/iplus Glass Tips (MZ6) 600 µm in diameter, length=6 mm, calibration factor= 1.00. Ultrasonic activator ENDO1 (Guilin Woodpecker Medical Instrument Co., Ltd.china) was used with Ultrasonic activator tip ED98 (25#, 2% taper, 18.5mm) (Guilin Woodpecker Medical Instrument Co., Ltd.china). The samples were arbitrarily divided into three groups (n=6) and used as follows: (A) conventional irrigation with 5 ml of 17 % EDTA, (B) passive ultrasonic irrigation with 5 ml of 17 % EDTA, (C) Er,Cr:YSGG induced photoacoustic streaming with 5 ml of 17 % EDTA. After final irrigation with normal saline and drying, the roots were painted with nail varnish externally, and 2% methylene blue dye injected into canal until the canal filled with dye. The tooth was splitted at the fourth millimeters from root apex with a diamond disc representing the apical third. Picture was taken by Professional Digital SLR camera (Nikon D7100, Nikon Corporation, Thailand) with 40X magnification. The dye penetration was measured by using analytical software (measure picture CAD-KAS Kessler Germany). ANOVA test was used to analyse repeated measure mean between tested concentration (5.25% NaOCL, 17% EDTA) and control. Data was expressed as mean±SD. LSD (Least Significant Difference) test was used to calculate the significant differences between tested mean. **Results**: The mean values of the percentage of dye penetration area in two experimental groups was higher than the control group, as the follow (20.79±1.15control, 34.5453±0.45 ultrasonic group, 85.9804±2.69 Er,Cr.YSGG+17%EDTA at 0.5 W). The Percentage of dye penetration in Er,Cr:YSGG laser induced photoacoustic streaming with 17% EDTA was significantly high (P value 0.001), followed by ultrasonic activated group, while control group result in less Percentage of dye penetration than both study groups. **Conclusion:** In this study, we concluded that Er,Cr:YSGG pulsed laser (0.5 W,5 Hz , air and water off) at short pulse duration (60 µs) with 17% EDTA using PIPS technique for activation of irrigant in endodontic treatment give better result than ultrasonic activation in smear layer removal.

Keywords: smear layer, 17%EDTA, endodontic, PIPS, ultrasonic irrigation.

1. Introduction

One of the main requirements to reach successful root canal treatment is cleaning and shaping of root canals. In addition to chemomechanical preparation of the root canal, hermetic three dimensional filling of the root canal is also considered a key factor in successful endodontic therapy (Zand et al., 2019). Many causes contribute to unsuccessful endodontic treatment consist of presence of bacteria in the root canals and dentinal tubules, in addition to irregular and apical canal (Aksel and Serper, 2017)**.** Thus, chemical cleansing is required by irrigant alongside mechanical preparation. Numerous progressions have been existing in endodontics field like hand- and engine-determined instruments and altered irrigating solution (Mittal et al., 2018). Study by Plotino et al (Plotino et al., 2019) used endodontic files with different sizes and tapers concluded that all basic root canal preparation techniques were accompanying with less smear layer and debris on the canal walls in coronal and the middle thirds, without variances between them. While in the apical third debris and smear layer were always present, an apical size of 25 compared to a size 20 and resulted in significantly cleaner canals walls. Irrigation is a critical part of successful endodontic treatment as it performs numerous important chemical, mechanical and (micro) biological functions. Irrigation is similarly the only method to reach areas of the root canal wall that are not touched and cleaned via mechanical instrumentation. The effect of irrigation on the smear layer attracted by most of the research on endodontic irrigation (Dioguardi et al., 2018). Ideal chemical irrigant should have bactericidal factor and act as a tissue solvent and lubricant in addition to physical flush for debris exclusion (Kamble et al., 2017).

A mixture of two or more irrigant is vital for safe and effective irrigation because no single solution has totally desired effects (Topbas and Adiguzel, 2017). Sodium hypochlorite (NaOCl) irrigation is critical for the success of endodontic treatment and several agitation techniques developed to improve the efficacy of this irrigation (Peeters et al., 2018). Ethylene Diamine Tetra-acetic Acid (EDTA) was irrigant of choice for smear layer removal, assisted in the removal of the inorganic constituents of the smear layer, acting as an aide to irrigation (da Silva Beraldo et al., 2017)). EDTA decalcifies dentine to a distance of 20–30 μm in 5 min(Doumani et al., 2017). Using irrigation solutions especially 17% EDTA + 5.25% NaOCl have been effective in smear layer removal, although the mechanical pressure of saline was somewhat able to remove smear layer (Mirseifinejad et al., 2017). An ultrasonic unit for endodontic use for debridement of root canals, which designed by Martin et al (Martin et al., 1980) became available commercially. Root canal irrigants agitation or activation by the use of lasers is a new conception in endodontic. The mechanism of interaction between dental hard tissue (enamel, dentine) and Erbium lasers family is explosive thermo-mechanical ablation or water-mediated ablation, the procedure that occurs with wavelengths between 2.7 and 3 μm and leads to expulsion of mineral particles with conservation of their mineral structure (Brugnera Jr et al., 2003). Paloma et al performed a study in comparisons of smear layer and debris removal with EDTA and Erbium, Chromium:Yttrium Scandium Gallium Garnet (Er,Cr:YSGG) laser. They concluded that Er,Cr:YSGG laser displayed a better cleanliness in the middle third, with statistically significance differences compared to 17% EDTA (Montero-Miralles et al., 2018) . The laser effect in smear layer removal can be more efficient way than other conventional agitation (Grinkevičiūtė et al., 2019). In 2020, Ayca Yilmaz et al have considered the efficiency of many final irrigation methods on penetration of sealer by using a confocal laser scanning microscopy. They found that higher penetration rates in all the experimental groups than the control group with maximum penetration depth of 652 μm (Yilmaz et al., 2020). The current study was investigated the influence of the energy of Erbium, Chromium: Yttrium Scandium Gallium Garnet (Er,Cr:YSGG) laser at short pulse duration on smear layer removal of apical third using single-rooted human mandibular premolars with (17%EDTA).

2. Material and method:

Eighteen single-rooted and canal completely formed, mandibular premolar straight teeth were extracted for orthodontic or periodontics purposes. The teeth were examined clinically and

radiographically to ensure that there is no root fracture, open apex, and/or root resorption. Then, they were stored in a plastic container containing 0.1% thymol solution until the performing of the experiment.

The roots length was standardized to 14 mm from the anatomic apex. The exact apical foramen location and canals patency were recognized by using a stainless steel K-file #10 (dentsply, Maillefer, Ballaigues, Switzerland) and the correct working length was standard by deducting 1mm from the length previously determined.

The canals were instrumented mechanically by Rotary Protaper Gold NiTi endodontic files (SX, S1, S2, F1, F2, F3, and F4) (Fanta, China) to size F4 (size 40, 0.06 taper). The canal was irrigated by 2.0 ml of 5.25% NaOCl (Chloraxid Extra, PPH Cerkamed, Stalwa Wola , Poland) at each instrument change.

Ultrasonic activator ENDO1 (Guilin Woodpecker Medical Instrument Co., Ltd.china) was used with Ultrasonic activator tip ED98 (25#, 2% taper, 18.5 mm) (Guilin Woodpecker Medical Instrument Co., Ltd.china). Er,Cr:YSGG pulsed laser (waterlase iplus Biolase, CA, USA) 2780 nm was used at short pulse duration (60 µs) delivered by MD/iplus Glass Tips (MZ6) 600 µm in diameter , length=6 mm, calibration factor= 1.00.setting was Power=0.5 W for EDTA group, pulse duration: 60 µs, repetition rate: 5 Hz. water and air was off. We did pilot study on different laser powers (0.25 W, 0.5 W, 0.75 W, 1 W, 1.25 W) and conclude that the best power for activation of 17% EDTA irrigant using PIPS is 0.5 W.

The specimens were arbitrarily divided into three groups:

G1:- control group (n=6)

The samples were irrigated with 5 ml of 17% EDTA (Disodium edetate, PPH Cerkamed, Stalwa Wola, Poland) for 1 min by Side-vented irrigation needle which was positioned shorter than 2 mm of the working length of the root canal. Then we deliverd 5 ml of distilled water by same type of syringe and with paper point F4 (Diadent, Korea) the canal was dried.

G2:-ultrasonic activation (n=6)

The samples were irrigated with 5 ml of 17% EDTA for 1 min. The ultrasonic system was used according to the instructions of manufacturer. After injection of the solution into root canal the Ultrasonic, activator tip ED98 was fitted passively inside canal, 2 mm lesser than the working length, then the tip was move up and down motion in a small range. after 20 seconds , we stop to clean the root canal .A root canal was irrigated for 3 times and each time takes 20 seconds. Then we delivered the final rinse (5 ml of distilled water) and with paper point F4 the canal was dried.

G3:- 17% EDTA+ pulsed Er,Cr:YSGG laser 2780 nm (n=6).

The samples were irrigated with 5 ml EDTA 17% and agitated with Er,Cr:YSGG pulsed laser 2780 nm for 1-minute .The delivery was by MD/iplus Glass Tips (MZ6). The fiber tip was inserted just into canal orifice. Then we delivered the final rinse (5 ml of distilled water) and with paper point F4 the canal was dried. Each fiber tip was used for only one canal, after that discarded.

3. Permeability test experiment

The test was prepared to assess the dye penetration area in apical third of root canal. The wax was used to seal Root apex. Two layers of nail paint were covered the surface of roots and left to dry. Then 2% methylene blue dye (India) was introduced into the canal by hypodermal syringe with needle gauge 23, by placing the needle 2 mm inside the canal until the canal filled with dye. Then k-file # 20 (dentsply, Maillefer, Ballaigues, Switzerland) was inserted and withdrawn one time to confirm that the dye was reached to the apical root third (Esteves-Oliveira et al., 2010)

(Zmener et al., 2008). After that, the dye was left inside the canal for 20 min. at (27-29 °c). When time passed, they was washed comprehensively below running tap water to clean external root surface and with absorbent paper cone, the root canal was dried constantly until the cone appears white.

Root sectioning for permeability test

The tooth was split transversally at the fourth millimeters from root apex with the aid of diamond disc (China) just below the guiding line representing the apical third. Pictures were taken by Professional Digital SLR camera (Nikon D7100, Nikon Corporation, Thailand) for each sample with 40X magnification.

Radicular dentin permeability measurements and evaluation

The images were opened with measure pictures V 1.0 software (CAD-KAS Kassler Computer software GbR, Germany) (Figure1), for computing of radicular dentin Permeability. The dye penetration area and the total root section area were calculated then subtract the root canal whole area from both earlier mentioned areas to acquire the actual area of dye penetration and root section figure (2).

First, calibration done by numerical scale to change pixel unit into millimetre figure (1).

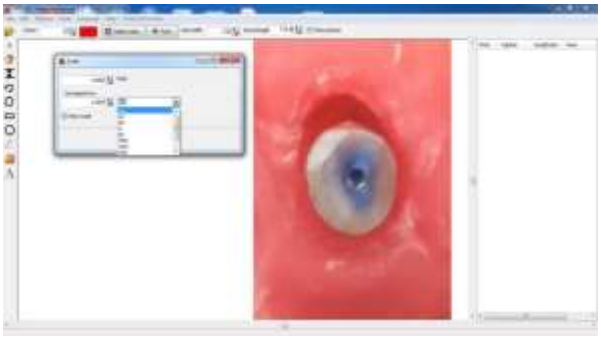

Figure (1): Calibration to change pixel unit into millimeter by using numerical scale.

Measurement of dye penetration area in square millimeter unit was done as seen in figure (2).

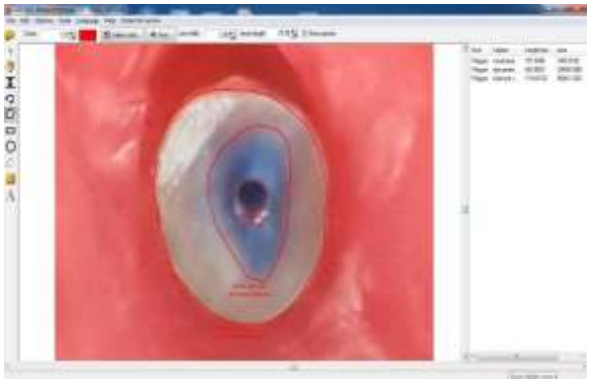

Figure (2): measurement of dye penetration area in square millimeter unit.

The dye penetration area shown in figure (3**)** as follow:

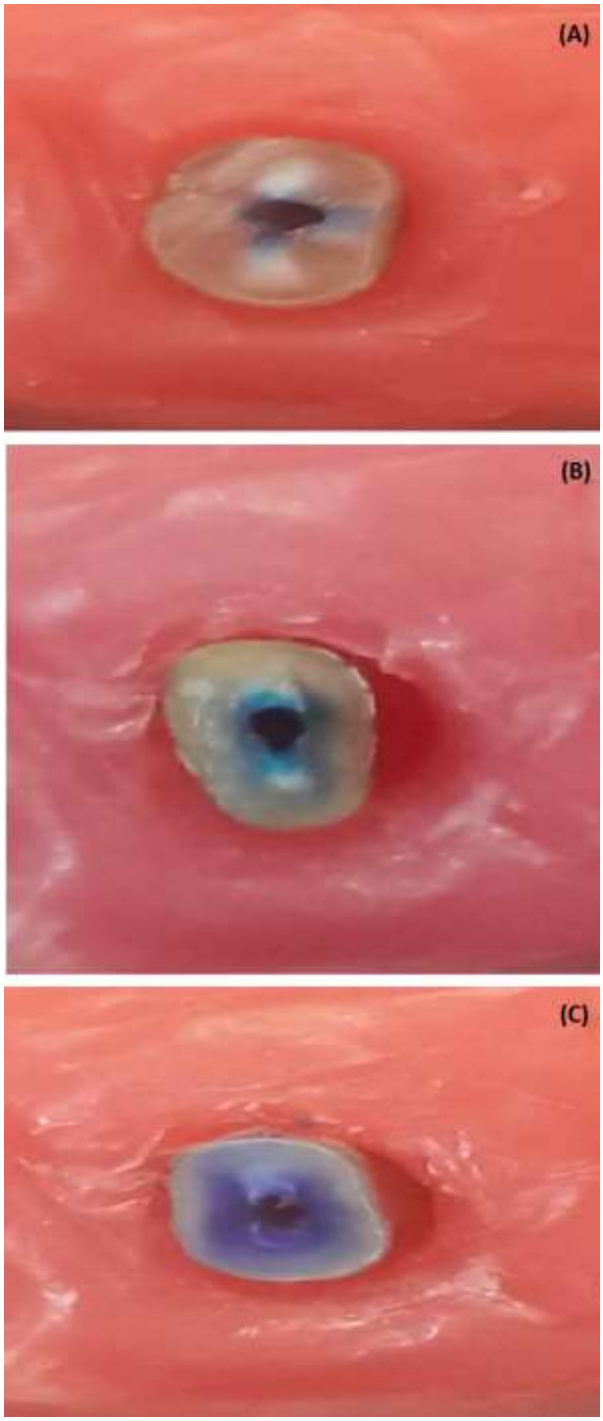

Figure (3): Image after transversal cuts and dye solution penetration for control group (A), 17%EDTA+ultrasonic group (B), 17%EDTA+pulsed Er,Cr.YSGG group (C).

Statistical analysis: The statistical analysis done by SPSS (v 20). ANOVA test was used to

analyse dye penetration area between study and control groups. Data were expressed as mean±SD. LSD test was done to analyse the significant differences between tested mean, the letters (A, B, and C) represented the levels of significant, highly significant start from the letter (A) and decreasing with the last one. Similar letters mean there are no significant differences between tested mean. Values of $p>0.05$ were reflected statically non-significant while $p\leq0.05$ and <0.01, 0.001 were reflected significantly different, highly significantly different correspondingly. Estimate of correlation coefficient between difference parameters in this study.

4. Results:

Permeability test: Dye Penetration in Root Section = (Net Dye Penetration Area / Net Total Root Third Area) × 100**.** The Data of permeability of root canal dentin stated as percentage of dye penetrating area at apical third of root canal.

After descriptive and statistical test for the dye penetrating percentage, the highest mean percentage were presented in activate Erbium laser group with 17%EDTA followed by ultrasonic group respectively and the lowest mean percentage were appeared in control group with highly significant difference among groups.

In figure (4) the mean values of the dye penetration area percentage among all three groups were shown that the percentage of dye penetration area will be increase in ultrasonic group and became the highest in 17%EDTA+ Er,Cr:YSGG .

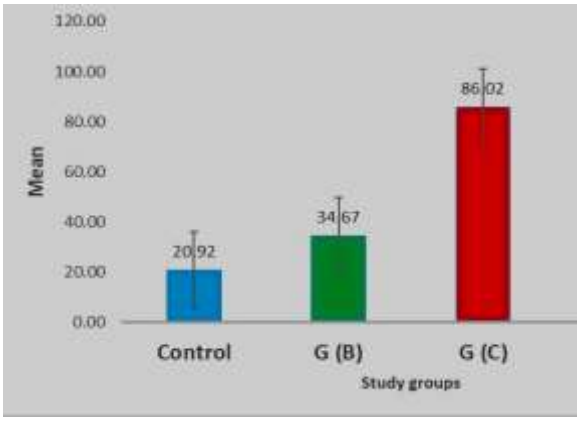

Figure (4): Bar chart showing mean percentage of dye penetration area.

The summary of descriptive and statistical test for the dye penetrating area percentage between control and experimental groups are shown in Table (1).

Table (1): Descriptive and statistical test of Permeability among groups

STUDY GROUPS	A CONTROL	B 17%EDTA+ ULTRASONIC	C 17%EDTA+ ER,CR:YSGG	P VALUE CONTROL VS TESTED GROUPS(B AND C)	P VALUE BETWEEN TESTED GROUPS
MEAN±SD	20.79 ± 1.15	B 34.5453 ± 0.45	A 85.9804 ± 2.69	0.001	0.001

5. Discussion:

It is important that the irrigants brought into direct contact with the entire canal wall surfaces for effective action particularly in the apical portions of root canals because of the typically challenging complexity of the root canal morphology (Karade et al., 2017).

Using rotary instruments and chemical irrigation in existing instrumentation techniques stay fail of successful removal of the smear layer. This result seen in the control group (group1) in which the conventional method used.

The Er,Cr:YSGG laser in the study was used with 600 µm diameter Glass Tips (MZ6) by means of subablative parameters (power 0.5 W) at short pulse duration (60 µs) shown best effect than conventional and ultrasonic methods for the smear layer removal. The reason could be due to the photomechanical effect, which occur after light energy is pulsed in liquid (Blanken et al., 2009, De Groot et al., 2009).

Er,Cr:YSGG wavelength absorption in water, mutual with the peak power resulting after the short pulse duration used (60 µs), was caused in a

photomechanical phenomenon. We conclude that the resulted phenomenon was the reason for the smear layer elimination in (group 3). A reflective"shockwave-like" influence obtained after tips immersed in root canal filled with liquid. As a result, of the diminutive volume, the effect can remove residual tissue and the smear layer and decline bacterial contents with the tubules and accessory canals (Schoop et al., 2007) (Schoop et al., 2009) (Gordon et al., 2007).

In this study the smear layer was removed by means of photomechanical flowing of the liquids where laser activation in coronal access of the root and not by thermal vaporization. This light energy phenomenon describe as photon induced photoacoustic streaming (PIPS). The irradiation influence of the Er,Cr:YSGG laser at subablative power settings enhanced by the existence of EDTA as seen in (group 3). This leads to significantly better percentage of dye penetration area than all group because when the specimens cleaned with EDTA, the delivering and transforming of the laser energy to thermal energy directly into the dentin matrix that existing a low mineral constitute because of the effect of EDTA (Hülsmann et al., 2003)**.**

In conventional treatment procedures, the irrigation syringe becomes more active when the tip positioned closer to the working length. While in laser method, the laser tip not positioned with the canal, but restricted to the coronal access beyond the orifice to allow simple access of the photomechanical effects to happen inside the root canal. This can help in cleaning of numerous canals shapes.

6. Conclusion:

In this study, its concluded that using Er.Cr:YSGG pulse laser (0.5 W,5 Hz , air and water off) at short pulse duration (60 μs), and 17% EDTA using PIPS technique for activation of irrigant in endodontic treatment give better result than ultrasonic activation.

References:

AKSEL, H. & SERPER, A. 2017. Concentration and time-dependent effect of initial sodium hypochlorite on the ability of QMix and ethylenediaminetetraacetic acid to remove smear layer. *Journal of conservative dentistry: JCD,* 20**,** 185.

BLANKEN, J., DE MOOR, R. J. G., MEIRE, M. & VERDAASDONK, R. 2009. Laser induced explosive vapor and cavitation resulting in effective irrigation of the root canal. Part 1: a visualization study. *Lasers in Surgery and Medicine: The Official Journal of the American Society for Laser Medicine and Surgery,* 41**,** 514-519.

BRUGNERA JR, A., ZANIN, F., BARBIN, E. L., SPANO, J. C., SANTANA, R. & PÉCORA, J. D. 2003. Effects of Er: YAG and Nd: YAG laser irradiation on radicular dentine permeability using different irrigating solutions. *Lasers in Surgery and Medicine: The Official Journal of the American Society for Laser Medicine and Surgery,* 33**,** 256-259.

DA SILVA BERALDO, Â. J., SILVA, R. V., DA GAMA ANTUNES, A. N., SILVEIRA, F. F. & NUNES, E. 2017. Scanning electron microscopic evaluation of smear layer removal using isolated or interweaving EDTA with sodium hypochlorite. *Iranian endodontic journal,* 12**,** 55.

DE GROOT, S., VERHAAGEN, B., VERSLUIS, M., WU, M. K., WESSELINK, P. & VAN DER SLUIS, L. 2009. Laser-activated irrigation within root canals: cleaning efficacy and flow visualization. *International endodontic journal,* 42**,** 1077-1083.

DIOGUARDI, M., DI GIOIA, G., ILLUZZI, G., LANEVE, E., COCCO, A. & TROIANO, G. 2018. Endodontic irrigants: Different methods to improve efficacy and related problems. *European journal of dentistry,* 12**,** 459-466.

DOUMANI, M., HABIB, A., DOUMANI, A. & KINAN, M. 2017. A review: the applications of EDTA in endodontics (Part I). *IOSR Journal of Dental and Medical Sciences,* 16**,** 83-85.

ESTEVES-OLIVEIRA, M., DE GUGLIELMI, C. A., RAMALHO, K. M., ARANA-CHAVEZ, V. E. & DE EDUARDO, C. P. 2010. Comparison of dentin root canal permeability and morphology after irradiation with Nd: YAG, Er: YAG, and diode lasers. *Lasers in medical science,* 25**,** 755-760.

GORDON, W., ATABAKHSH, V. A., MEZA, F., DOMS, A., NISSAN, R., RIZOIU, I. & STEVENS, R. H. 2007. The antimicrobial efficacy of the erbium, chromium: yttrium-

scandium-gallium-garnet laser with radial emitting tips on root canal dentin walls infected with Enterococcus faecalis. *The Journal of the American Dental Association,* 138**,** 992-1002.

GRINKEVIČIŪTĖ, P., POVILAITYTĖ, G. & SIUDIKIENĖ, J. 2019. The Effect of laser irradiation in smear layer removal–a review of the literature. *European International Journal of Science and Technology (EIJST). South Shieds: Centre for Enhancing Knowledge (CEK), UK, 2019, vol. 8, no. 3*.

HÜLSMANN, M., HECKENDORFF, M. & LENNON, A. 2003. Chelating agents in root canal treatment: mode of action and indications for their use. *International endodontic journal,* 36**,** 810-830.

KAMBLE, A. B., ABRAHAM, S., KAKDE, D. D., SHASHIDHAR, C. & MEHTA, D. L. 2017. Scanning electron microscopic evaluation of efficacy of 17% ethylenediaminetetraacetic acid and chitosan for smear layer removal with ultrasonics: an in vitro study. *Contemporary clinical dentistry,* 8**,** 621.

MARTIN, H., CUNNINGHAM, W. T., NORRIS, J. P. & COTTON, W. R. 1980. Ultrasonic versus hand filing of dentin: a quantitative study. *Oral Surgery, Oral Medicine, Oral Pathology,* 49**,** 79-81.

MIRSEIFINEJAD, R., TABRIZIZADE, M., DAVARI, A. & MEHRAVAR, F. 2017. Efficacy of different root canal irrigants on smear layer removal after post space preparation: a scanning electron microscopy evaluation. *Iranian endodontic journal,* 12**,** 185.

MITTAL, A., DADU, S., YENDREMBAM, B., ABRAHAM, A., SINGH, N. S. & GARG, P. 2018. Comparison of new irrigating solutions on smear layer removal and calcium ions chelation from the root canal: An in vitro study. *Endodontology,* 30**,** 55.

MONTERO-MIRALLES, P., TORRES-LAGARES, D., SEGURA-EGEA, J.-J., SERRERA-FIGALLO, M.-Á., GUTIERREZ-PEREZ, J.-L. & CASTILLO-DALI, G. 2018. Comparative study of debris and smear layer removal with EDTA and Er, Cr: YSGG laser. *Journal of clinical and experimental dentistry,* 10**,** e598.

PEETERS, H. H., SUARDITA, K., MOODUTO, L. & GUTKNECHT, N. 2018. Extrusion of irrigant in open apex teeth with periapical lesions following laser-activated irrigation and passive ultrasonic irrigation. *Iranian endodontic journal,* 13**,** 169.

PLOTINO, G., ÖZYÜREK, T., GRANDE, N. M. & GÜNDOĞAR, M. 2019. Influence of size and taper of basic root canal preparation on root canal cleanliness: a scanning electron microscopy study. *International endodontic journal,* 52**,** 343-351.

SCHOOP, U., BARYLYAK, A., GOHARKHAY, K., BEER, F., WERNISCH, J., GEORGOPOULOS, A., SPERR, W. & MORITZ, A. 2009. The impact of an erbium, chromium: yttrium-scandium-gallium-garnet laser with radial-firing tips on endodontic treatment. *Lasers in medical science,* 24**,** 59-65.

SCHOOP, U., GOHARKHAY, K., KLIMSCHA, J., ZAGLER, M., WERNISCH, J., GEORGOPOULOS, A., SPERR, W. & MORITZ, A. 2007. The use of the erbium, chromium: yttrium-scandium-gallium-garnet laser in endodontic treatment: the results of an in vitro study. *The Journal of the American Dental Association,* 138**,** 949-955.

TOPBAS, C. & ADIGUZEL, O. 2017. Endodontic irrigation solutions: A review. *International Dental Research,* 7**,** 54-61.

YILMAZ, A., YALCIN, T. Y. & HELVACIOGLU-YIGIT, D. 2020. Effectiveness of Various Final Irrigation Techniques on Sealer Penetration in Curved Roots: A Confocal Laser Scanning Microscopy Study. *BioMed research international,* 2020.

ZAND, V., MILANI, A. S., YAVARI, H. R. & REZA MAJIDI, A. 2019. The Effects of Different Agitation Techniques of Canal Irrigant on Tubular Penetration of a Bioceramic Sealer. *Iranian Endodontic Journal,* 14**,** 289-295.

ZMENER, O., PAMEIJER, C. H., SERRANO, S. A., VIDUEIRA, M. & MACCHI, R. L. 2008. Significance of moist root canal dentin with the use of methacrylate-based endodontic sealers: an in vitro coronal dye leakage study. *Journal of endodontics,* 34**,** 76-79.

نفاذية العاج بعد استخدام تقنيات تنشيط مختلفة بما في ذلك تقنية PIPS

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المقدمة: إعداد قنوات الجذر هو خطوة هامة في علاج حشوات الجذر. تسبب الأجهزة الميكانيكية عند معالجة قنوات الجذر طبقة غير منتظمة من الحطام ، تعرف باسم طبقة اللطاخة. ونتيجة لذلك، ذكرت العديد من الدراسات أن يفضل إزالة طبقة اللطاخة. **الهدف:** لدراسة تأثير طاقة (Er.Cr:YSGG) ليزر في مدة نبض قصيرة على إزالة الطبقة اللطاخة من الثلث القمي بعد استخدام تقنية التدفق الصوتي الضوئي الناجمة عن الفوتونPIPS . **المواد والطريقة:** ثمانية عشر سن احادي الجذر من الضواحك السفلية.تم توحيد طول الجذور إلى 14 ملم من القمة التشريحية . حضرت قنوات جذور الاسنان ميكانيكيا إلى حجم 40/0.06. استخدم الليزر النبضي Er.Cr:YSGG (waterlase iplus Biolase، كاليفورنيا، الولايات المتحدة الأمريكية) 2780 نانومتر في مدة نبض قصيرة (60 ميكروثانية) مع MD / iplus (MZ6) 600 ميكرومتر في القطر، طول = 6 ملم، عامل المعايرة = 1.00. وايضا استخدم المنشط بالموجات فوق الصوتية ENDO1 (Guilin Woodpecker الطبية المحدودة، الصين) مع ED98 (25#،2٪ ، 18.5ملم). العينات قسمت إلى ثلاث مجموعات (n= 6) وتستخدم على النحو التالي: (أ) الري التقليدي مع 5 مل من 17 ٪ EDTA، (B) الري بالموجات فوق الصوتية السلبية مع 5 مل من 17 ٪ EDTA، Er.Cr:YSGG(C) مع تقنية التدفق الصوتي الضوئي المستحث مع 5 مل من 17 ٪ EDTA. بعد الري النهائي والتجفيف، تصبغ الجذور مع طلاء الأظافر خارجيا، و 2٪ صبغة الميثيلين الزرقاء تحقن في القناة. يقسم السن عرضيا عند المليمتر الرابع من قمة الجذر باستخدام قرص ألماس ليمثل الثلث القمي. ثم تاخذ الصور بكاميرا SLR الرقمية المهنية (نيكون D7100 ، نيكون كوربوريشن ، تايلاند) مع التكبير X40. يقاس اختراق الصبغة باستخدام البرمجيات التحليلية (قياس صورة CAD-KAS كيسلر ألمانيا). اختبار ANOVA يستخدم لتحليل النسبة المئوية لنفاذية عاج السن بين المجموعات المدروسة. اختبارLSD يستخدم لحساب الاختلافات الهامة بين المتوسط. **النتائج:** كان متوسط قيم النسبة المئوية لمنطقة اختراق الصبغة في مجموعتين تجريبيتين أعلى معنويا من مجموعة التحكم، حيث تراوح بين (1.15±20.79 مجموعة التحكم، 0.45±34.54 مجموعة الموجات فوق الصوتية، 2.69±85.98 مجموعة 17+Er,Cr.YSGG٪EDTA عند 0.5 واط). النسبة المئوية لاختراق الصبغة في مجموعة Er,Cr.YSGG الليزر المستحث بالموجات الصوتية الضوئية مع EDTA بنسبة 17٪ كان مرتفعا بشكل عالي المعنوية (قيمة P 0.001) ، تليها المجموعة المنشطة بالموجات فوق الصوتية ، في حين أن مجموعة التحكم تسجل معنويا نسبة أقل في اختراق الصبغة من مجموعتي الدراسة.

الاستنتاج: في هذه الدراسة نستنتج ان استخدام Er.Cr:YSGG الليزر النبضي (0.5 واط ،5 هرتز، والهواء والماء مغلق) في مدة النبض القصير (60 ميكروثانية)، و 17٪ EDTA باستخدام تقنية PIPS لتنشيط محلول الري في علاج حشوات الجذور و تعطي نتيجة أفضل من التنشيط بالموجات فوق الصوتية في إزالة طبقة اللطاخة.