Iraqi J. Laser, Issue 1, Vol.19. pp.1-11 (2020)

IRAQI JOURNAL OF LASER

A Comparison between Er,Cr:YSGG 2780 nm Laser and Carbide Fissure Bur in Root-End resection

Doaa A. Almiran [(1)] and Salah A. Alkurtas [(2)]

(1) Institute of Laser for Postgraduate Studies, University of Baghdad, Baghdad, Iraq
(2) Alkarkh General Hospital, Oral and Maxillofacial Department. Baghdad, Iraq

(Received 12 July 2017, accepted 28 August 2018)

Abstract: Aim: The Aim of the *study* is to compare between Er,Cr:YSGG 2780 nm laser and carbide fissure bur in root-end resection regarding the morphological variations, temperature changes and the duration of resection process. **Settings and Design:** 5 W, 25 Hz, 50% water, 80% air,25.47 J/cm^2 . **Material and method:** twenty-one extracted single rooted teeth endodontically were treated, twenty teeth were obturated and divided into two groups according to method of resection. Group 1 root-end resected using cross cut carbide bur while group 2 root-end resected using laser with MGG6 sapphire tip of 600 µm diameter. Temperature on external root surface and duration of resection were recorded. The remaining tooth served as control. Samples were prepared for SEM and examined to evaluate dentinal cracks, cemental damage, roughness, filling material-root canal wall interface. **Statistical Analysis:** whenever required**,** x^2 test/Fisher exact and Kruskal–Wallis test were used. **Results**: laser result in intradentin cracks in 70% of samples while bur cause intradentin crack in 30% of samples. There was no significant difference between group 1 and 2 regarding the percentage of complete and incomplete cracks. Resection with bur resulted in cemental damage in 70% of samples while resection with laser didn't result in cemental damage in any of the samples .Evaluation of surface roughness revealed statistically significant difference ($P \leq 0.05$). The difference in duration of resection was statistically significant while in recorded temperature was not significant. **Conclusion:** Er,Cr:YSGG laser showed higher percentage of intradentinal cracks, no cemental damage, larger gap area ,rougher surface and longer time for resection than bur .There is no elevation of temperature on external root surface.

KEYWORDS: root-end ,Er:Cr:YSGG laser, gap, crack, roughness, cemental damage.

Introduction

Root-end resection indicated removing pathologic processes and the anatomic variations, to manage blocked or perforated root canal, to gain access to deeply place soft tissue around the apex and to reduce fenestrated root apices. Root end resection of 3 mm is essential since 98% of apical canal anomalies and 93% of lateral canals system ramifications occur in the apical 3 mm (J., S.J., et al., 2005). Komoori et al. evaluated two types of laser in root resection, Ho:YAG laser irradiation produced some signs of thermal damage and relatively large voids between the gutta-percha and the canal walls while Er:YAG 2940 nm laser produced smooth resected surfaces without signs of thermal damages (Komori, T., et al., 1997). This contradicts with several studies (Duarte, M.A., et al., 2007, Camargo V. B, et al., (2010) and Paghdiwala, A.F., (1993)), as Paghdiwala et al encountered voids between the gutta-percha and the canal walls with rough surface after root end resection with Er:YAG (Paghdiwala, A.F., 1993). A similar study was conducted by Takahide but voids could not be detected despite cutting speed of this laser which was slightly slower than that of conventional method (Komori, T., et al., 1997).

Duarte et al. used two burs ,one of them for cutting and the other for finishing and this resulted in a smoother surface than Er:YAG laser (Duarte, M.A., et al., 2007). This agrees with Camargo Villela Berbert F. L. et al. who found that smoother apical surface was produced by the bur than that of laser and ultrasonic. Bur performed root end resection faster with better surface finishing; however, it was also the method that most interfered with the adaptation of the remaining filling material; the three methods evaluated did not cause damage to the root-end surface, but they harmed the apical adaptation (Camargo V. B, et al., 2010). Ayrancı et al. found that there was no difference in smoothness of surface treated with Er:YAG laser and tungsten carbide bur, but better than that of diamond coated tip, also those tips produce more cracks than Er:YAG laser and the latter showed greater number of cracks than those resected with bur (Ayranci, F., *et al.,* 2015). Babar, P. and H. Adhikari compared between bur and Er,Cr:YSGG laser for root-end resection as laser resulted in less smeared out or overlapping Gutta Percha, less gap between Gutta Percha and dentin which may indicate having a second thought about the need for retrograde filling in laser resected root in specific cases, less damage to cemental surface, less surface cracks and microcracks and showed smooth dentinal surface , absence of debris and smear layer, patent dentinal tubules and exposed intertubular collagen while samples resected with bur revealed irregular, rugged root surface covered with debris, smear layer ,clogged dentinal tubules and larger Gutta Percha wall interface (Babar, P. and H. Adhikari, 2016). This study contradicts with Sullivan et study at which gap formation was frequently observed and similar to that of bur but laser resulted in rougher resected surface than bur (Sullivan, J., et al., 2009).

Materials and methods:

Sample preparation

Twenty-one extracted human teeth with single root and single canal were selected for this study ,after approval of the university of Baghdad on research proposal (number 17 in 12 July 2017). The exclusion criteria included immature apices, calcification of the canal , root caries, apical resorption , developmental anomalies or cracks. Hand scaler used to clean the external surface of root from soft tissue remnants and hard deposits to avoid cemental damage, then samples were kept hydrated in thymole at 4˚C in 0.1% until the time of use in this study. Standard coronal access cavities were prepared, the working length was determined 0.5 mm shorter than the apical foramen. Manual Protaper files was used to prepare root canal till F4 file. The irrigation protocol included : one ml of 5.25% NaOCl before canal instrumentation and 2 ml of it between each file and the other, 1 ml of 17% Ethylendiaminetetraacetic acid(EDTA) was used for one minute at the end of the instrumentation, followed by 3 ml of 5.25% NaOCl washed with 5 ml of normal saline. Root canal dried with protaper paper point F4. Gutta Percha F4 (Dia – ProT^{plus}™), AH Plus sealer (Dentsply ,Maillefer, USA) along with accessory Gutta Percha were used in the obscuration of canal with cold lateral condensation technique. Tetric-N ceram composite was used to seal the coronal access .Each tooth was stored in separated test tube filled with normal saline at 37^{0}C in a water bath.

Twenty teeth were randomly divided into two groups according to the method of root end resection, each group is of 10 teeth : group 1: Root end resection with carbide bur under 14 ml/min water flow, group 2: Root end resection with Er:Cr:YSGG 2780 nm laser (the parameter used according to manufacturer instructions).The same rate of water flow ml/min in both groups was set with the aid of Beker and clock watch to establish standardization .All the teeth were stabilized in water bath with their crowns immersed in water and the temperature on the external root surface was 37 °C before beginning the resection process. The temperature was recorded every second during root-end resection with the aid of the thermocouple probe which was held to the external tooth surface at 5mm from apex connected to computer software program (AMPROBE TMD®-56, Everett, WA, USA) and at the same time the duration of resection process was recorded. The data were analyzed with x^2 test/Fisher's exact and Kruskal–Wallis test wherever needed. The level of significance was set at P value ≤ 0.05.

Root end resection

The resection was performed from buccal to palatal aspect of root at 0° to the long axis of the tooth . Each single carbide bur and MGG6 tip was used for 10 teeth. The rate of water flow during resection with bur was set through intravenous administration set up. The resection in group 1 was performed with slow speed surgical handpiece NSK 40,000 rpm and carbide cross cut tapered bur 52 mm (ELA ,Germany), the direction of cutting was with the direction of the rotation of bur ,starting from the apical end and cutting coronally,3 mm of the root end is shaved away while the root-end resection in the group 2 was carried out with laser by using MGG6 sapphire tip of 6 mm length and 600 µm in diameter (calibration factor is 1.00).The tip –hard tissue distance is 1.5 mm .The root amputation set up was used in this study according to the manufacturer instruction (P_{ave}=5 watt, PRR=25 Hz, water level is 50% ,air spray is 80%) and the fluence was 25.47 J/cm^2 .At the end of each resection, the Gutta Percha was cold burnished .The root-end resection in laser group was performed with single cut at 3 mm from root apex .The sample used as a control was root end resected with diamond wafering blade (Smart Cut™ ,Ted Pella,USA), in previous pilot study it was ensured that this blade would not cause cracks.

Scanning electron microscope evaluation (SEM)

Teeth were sectioned with the diamond wafering blade under continuous and copious flow of normal saline .The sectioning was accomplished at 4 mm from resected surface .Samples were prepared for SEM according to Marchesan et al. protocol (Marchesan, M.A., et al., 2008). All specimens examined at 50X magnification by single observer to detect cemental damage and to evaluate the cracks on the resected-end surface (intradentinal, incomplete and complete cracks) according to Beiling et al., (Beling, K.L., et al., 1997) where intradentinal crack is that confined to the dentine, incomplete crack is originating from the root canal and radiating into the dentine or originating from the root surface radiating into the dentine while complete crack is the one that extend from the root canal to the outer root surface (Figure 1). At 150X ,the gap between the filling material and the canal walls was measured in µm^2 with the aid of Image J software program. On the buccal side of the resected surface and at 0.5 mm from the border of root canal, the area was observed at 400X(to evaluate surface roughness). Two calibrated examiners in a double-blinded fashion used scoring system as described by Duarte et al. (Duarte, M.A., et al., 2007) (Figure 2) at which 0 for smooth surface ,1 for surface with slight roughness ,2 for surface with moderate roughness and 3 was set for surface with severe roughness . For the purpose of standardization all specimens were observed at 10 kV.

Results: (Dentinal cracks)

There was no significant difference between group 1 and 2 regarding percentage of complete and incomplete cracks .Group 1 showed presence of intradentinal crack in 3(30%) samples while the rest 7(70%)of samples were without intradentin cracks. Group 2 showed intradentin cracks in 7(70%) sample while the rest 3(3)%of samples were without intradentin cracks . The difference between the two groups was statistically significant at which P value is 0.04.(table 1)

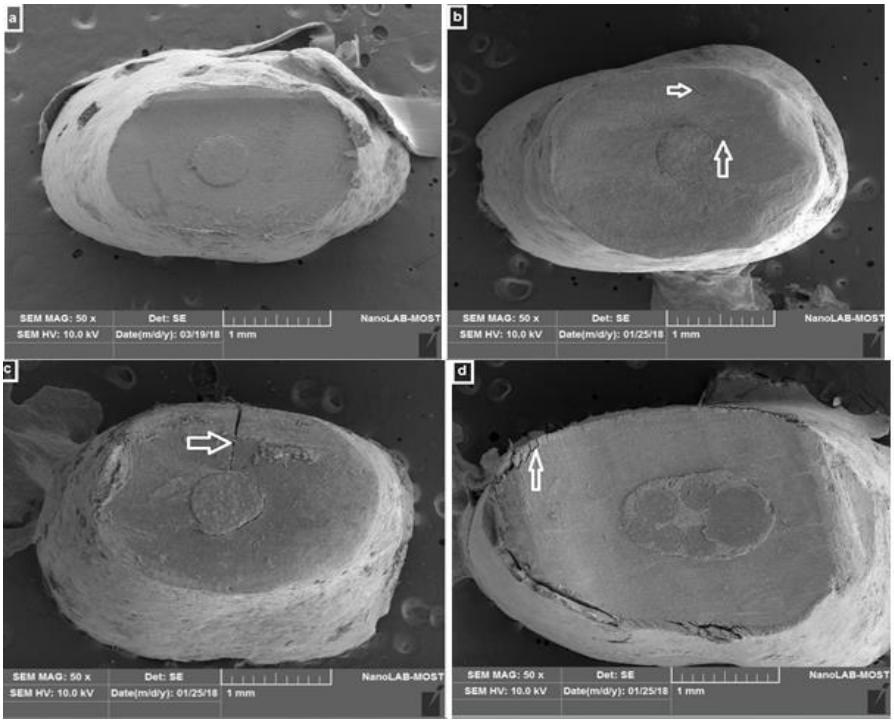

Fig. (1): SEM evaluation of samples at 50x magnification (a) control sample ,(b) intradentin and incomplete crack(white arrow),(c) complete crack (white arrow),(d) cemental damage (white arrow).

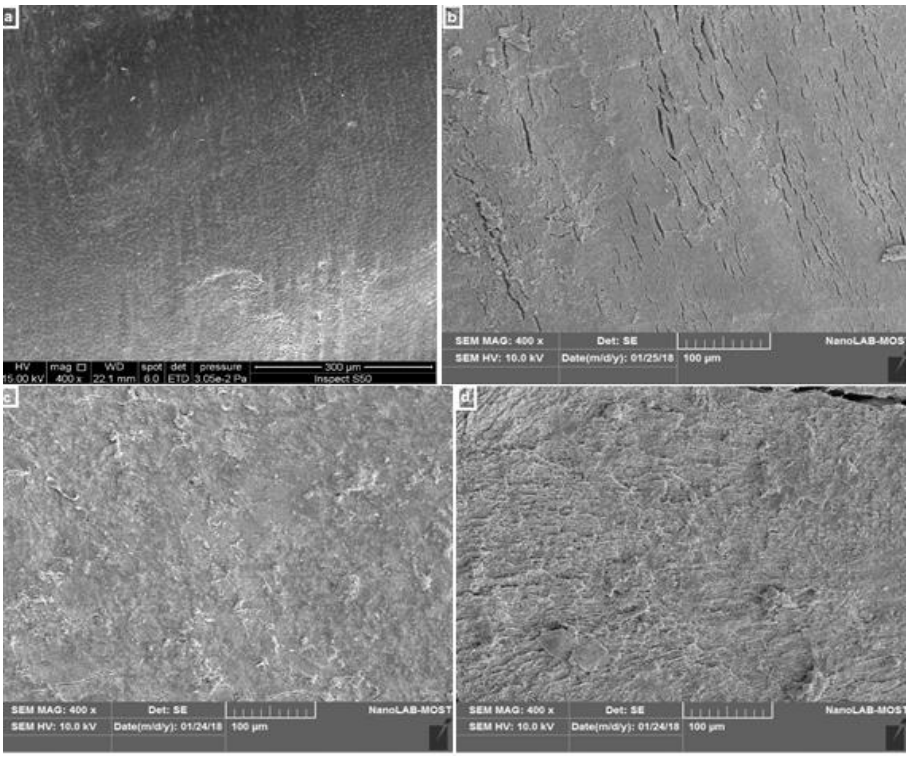

Fig. (2): SEM of resected samples at 400x magnification shows surface roughness scoring system (a) score 0 (b) score 1 (c) score 2 (d) score 3

Cemental damage

Group 1 showed presence of cemental damage in 7(70%) samples. Group 2 didn't show cemental damage in any of the samples. The difference between group 1 and 2 was highly statistically significant at which P value is 0.01.(Table 2)

Filling material–root canal wall interface (gap measurement)

The gap between filling material and the dentinal wall was measured with the aid of Image J software program .The area measurement was set in $\mu m^{2.}$ The statistical analysis was performed using x^2 test/Fisher's exact test. The level of significance was set at P value ≤ 0.05. Resection with laser resulted in larger gap between filling material and the dentinal wall. The difference between group 1 and 2 was statistically significant at which P value is 0.05.(table 3)

Roughness

The analysis of the interexaminer agreement of the scores obtained for the surface roughness by the Kruskal–Wallis test determined significant differences between both groups ($P \leq 0.05$). Burs group produced significantly smoother surface than the laser groups ($P < 0.05$). The analysis of scores obtained for the cut quality by the Kruskal–Wallis test revealed no significant differences inside the groups (E1 and E2) ($P > 0.05$). The comparison between the groups for the surface roughness was performed using the Kruskall–Wallis and Dunn tests. The significance level was established at 5%. Statistical significant differences ($p < 0.05$) occurred in the comparisons between the Bur and laser groups.(Tables 4 and 5)

Temperature

There wasn't elevation in temperature above 37°C in both groups. The recorded temperature was lower than 37 °C during resection in both bur and laser groups. The lowest temperature reached during root-end resection at the external root surface was considered for each sample in both groups. There was no statistically significant difference between the two groups (table 6).

Duration of resection process

The time consumed in root-end resection in both groups was recorded. Laser took a longer time to perform root-end resection than bur. The difference was statistically significant at which p value is 0.03 (Table 7).

Table 1: Dentinal cracks.

Groups	**Complete cracks**		**Incomplete cracks**		**Intradentin cracks**	
	With (Yes%)	**Without (No%)**	**With (Yes%)**	**Without (No%)**	**With (Yes%)**	**Without (No%)**
Bur Samples (10)	**1 (10%)**	**9 (90%)**	**6 (60%)**	**4 (40%)**	**3 (30%)**	**7 (70%)**
Laser Samples (10)	**3 (30%)**	**7 (70%)**	**8 (80%)**	**2 (20%)**	**7 (70%)**	**3 (30%)**
***P*- Value (x^2 test/Fisher's exact test)**	**0.07(NS)**	**0.07(NS)**	**0.07(NS)**	**0.07(NS)**	**0.04**	**0.04**

Table 2: Statistical analysis of cemental damage [n(%)]

Techniques	**Cemental damage**	
	With (Yes%)	**Without (No%)**
Bur Samples (10)	**7 (70%)**	**3 (30%)**
Laser Samples (10)	**0 (0%)**	**10 (100%)**
***P*- Value (x^2 test/Fisher's exact test)**	**0.01**	**0.01**

Table 3: Statistical evaluation of filling material-root canal wall interface (gap measurements)

Techniques	**Gap measurement (μm^2)**
Bur Samples (10)	**7042.7 ± 2310**
Laser Samples (10)	**7164.3 ± 3412**
***P*- Value (x^2 test/Fisher's exact test)**	**0.05**

Table 4: Roughness scores by two observers

Specimen	**BUR (resection group)**		**LASER (resection group)**	
	Examiner 1	**Examiner 2**	**Examiner 1**	**Examiner 2**
1	2	2	2	2
2	2	2	1	2
3	2	2	1	2
4	1	1	2	2
5	1	1	2	1
6	2	1	3	2
7	1	1	2	2
8	0	0	2	2
9	0	0	2	2
10	0	1	3	2

Table 5: Statistical analysis of surface roughness.

Groups	Median	Minimum	Maximum
Bur	1[a]	0	2
Laser	2[b]	1	3
Kruskall–Wallis and Dunn tests	Different letters show significant statistical differences ($p<0.05$)		

Table 6: Statistical analysis of temperature measurements of resection groups

Group	Temperature (°C)
Bur Samples (10)	23.7 ± 1.5
Laser Samples (10)	24.5 ± 0.7
***P*- Value (x^2 test/Fisher's exact test)**	0.1(NS)

Table 7: Statistical analysis of duration of root end resection

Techniques	duration of cutting (min)
Bur Samples (10)	1.61 ± 0.3*
Laser Samples (10)	3.4 ± 0.9
***P*- Value (x^2 test/Fisher's exact test)**	0.03

Discussion

The Er,Cr:YSGG 2780 nm laser offers many advantages when used for root-end resection , the resection can be performed without carbonization or thermal damage if adequate parameter was used, Er,Cr:YSGG laser has antibacterial effect so that it can be used for sterilization of root apex and the surrounding tissue (Angiero, F., et al., 2011). The cross cut fissure burs are commonly recommended for use in apical root resection because of their rapid cutting characteristic. Shredding and pulling of the gutta-percha occur when high-speed handpiece is used in resection process (Nedderman, T.A., et al., 1988). Furthermore, this occurs when direction of cutting is in reverse direction in relation to the direction of rotation of the bur (D., W.G., M.A. J., 1999). Therefore the choice was to use cross cut tapered bur with slow speed handpiece and the direction of resection from buccal to palatal side that mean it was with the direction of rotation of bur. For the removal of dental hard tissue, the Er:YAG 2940 nm and Er,Cr:YSGG 2780 nm lasers wavelengths correlate closely with the maximum absorption of hydroxyapatite in which water

contained evaporates and ablation occur with only minimal thermal side effects (Schoop, U., et al., 2007). According to our study, higher percentage of samples at which root-end resected with Er,Cr:YSGG laser were associated with intradentinal cracks than those resected with carbide bur. This coincides with a study conducted by Ayranci et al.,while both groups showed no statistical difference in term of complete and incomplete cracks. In general, this contradicts with Babar et al, Those cracks may provide sanctuaries that favor bacterial growth and result in accumulation of their irritant and toxic metabolites (Min, M.M., et al., 1997) .Therefore, an attempt to decrease those cracks might be necessary through alterations of parameters. As long as cracks on the surface of the apex could occur during mechanical preparation (Adorno, C.G., 2009); therefore, only cracks of length longer than that of the control sample are considered as incomplete cracks related to the resection methods. The dentine of the root is covered with thin layer of mesenchymal tissue "cementum" that support the tooth along with alveolar bone and the periodontal ligament .The cementum is affected by environmental stimuli (Gupta, R., et al., 2013). Therefore, its preservation is essential for successful outcome. According to our study Er,Cr:YSGG laser didn't cause damage in the cementum ,this might be related to the higher water content in cementum than in dentin[19] which make less thermal damage applied on cementum as Er,Cr:YSGG 2780 nm laser highly absorbed by water (Oliveira, G.J., et al., 2012). This might explain why there were cracks in dentin while there was no crack or damage in cementum.

The Kruskal–Wallis test was used to evaluate the cut quality which showed no significant differences inside both groups which indicated that the resection process was standardized for all samples. The laser group resulted in rougher surface than bur group. This coincides with Sullivan et al. study who suggested that this might increase the root-end surface area after resection and theoretically this will expose more dentinal tubules than a smooth flat resected surface which make it more difficult to burnish the retrograde filling material smoothly against the margins (Parker, S., et al., 2007) surface´s irregularities and roughness may serve as irritant and lead to accumulation of debris, and stimulation of the resorption during the reparation (Kim, S., 2006), but this is not parallel with a study conducted by Hakki et al who considered that rough surface endorsed cell attachment as short pulse setting of Er,Cr:YSGG laser is suitable for cell attachment and migration, and also there was an increase in the number of cells that may differentiate to cells that is important for periodontal regeneration (Hakki, S.S., et al., 2010). The pulsed cutting mode of the laser prevents the uniform cutting of dentin which results in rough surface (Duarte, M.A., et al., 2007).

Root-end resection may create gaps at the Gutta Percha-tooth interface which may jeopardize previously sealed canals by obturating and exposing them to bacteria as well as supporting their growth (D., W.G., M.A. J., 1999). There are many controversies about the effect of laser radiation on interface between Gutta Percha and the wall of dentin .In our study, the mean area of gap between filling material and dentin wall in group 2 was larger than that of group 1.The difference was statistically significant. This contradict with Babar et al. which might be due to the minor difference in parameters used in those studies. Mahdee et al suggested that rapid increase of temperature generated by laser applied to the gutta-percha and root canal sealer cause shrinkage and thermal damage of the gutta percha which will jeopardize the apical seal area (Mahdee, A.F., et al., 2013). Those results may indicate the necessity of using retrograde filling to seal the canal after resection with laser with those specific parameters.

Thermal energy released as a result of using laser in endodontic treatment depends on the laser type, pulse energy, pulse repetition rate and pulse duration. Increase in temperature leads to the denaturation of enzymes, particularly alkaline phosphatase. Absorption of laser energy results in instant water evaporation which leads to increase volume and results in the cracking of the dentine structure. External root resorption is also one of its consequences. Because of the reduced vascularisation of the surrounding bone, this makes it more sensitive to thermal stress than periodontium (Mitić, A., et al., 2016). Elevation

of temperature of to more than 10°C on the external surface of root for 1 minute results in external root resorption and necrosis of periodontal ligament (Freitas, P.M. 2015). The recorded temperature in this study was below 37°C for all samples in both groups because of water cooling effect of laser, the extreme reduction in temperature in all sample could be related to the limitation of in vitro study as a result of absence of blood circulation role in maintaining the steady temperature inside operation site.

Root end resection with laser was slower than that with bur and this coincides with a study conducted by Berbert et al..The correlation between the speed of cutting and the incidence of crack is controversial (Del Fabbro, M., et al., 2010). However; in our study there was variation of time spent in cutting among the samples within the same group and this could be related to the variation of the cross section area of the apical third and also could be related to the thickness of dentin ,this coincides with Paghdiwala et al.. The time required for the root end resection could be reduced by increasing the power setting of the laser which results in greater amounts of ablated dentin taking in consideration maintaining the integrity of dental structures (Camargo V. B, et al., 2010).

There are two methods for sample´s preparation for SEM analysis either by dehydration and drying of samples(direct method) which may create artifacts in hard tissues or creation of replica to the hard tissue(indirect method) but this technique lacks the detailed information of the tooth structure (Aydemir, S., et al., 2013). A preliminary study was performed to evaluate the effect of direct method on the hard tissue and the results showed that using the direct method with dehydration protocol described by Marchesan et al. and examining the sample at 10 kV didn't create those artifacts.

Conclusion

Root-end resection with Er:Cr:YSGG 2780 nm laser according to the manufacturer instruction parameters results in : More intradentin crack than carbide bur with no statistical significant difference regarding incomplete and complete cracks. No cemental damage , Larger interface between the filling material and the dentinal wall than cross cut carbide bur, and Rough surface . The root-end resection by Er,Cr:YSGG laser took longer time than carbide bur but both showed reduction in temperature on external root surface below 37°C due to the cooling effect of Waterlase.

References

J., S.J., D.G. E., and G.J. L., *Root-end management: resection, cavity preparation, and material placement.* Endodontic Topics, 2005. **11**(1): p. 131-151.

Komori, T., et al., *Erbium:YAG and holmium:YAG laser root resection of extracted human teeth.* J Clin Laser Med Surg, 1997. **15**(1): p. 9-13.

Duarte, M.A., et al., *Evaluation of apical surface roughness after root resection: a scanning electron microscopic study*. Oral Surg Oral Med Oral Pathol Oral Radiol Endod, 2007. **104**(6): p. e74-6.

Camargo Villela Berbert, F.L., et al., *An in vitro evaluation of apicoectomies and retropreparations using different methods.* Oral Surg Oral Med Oral Pathol Oral Radiol Endod, 2010. **110**(4): p. e57-63.

Paghdiwala, A.F., *Root resection of endodontically treated teeth by erbium: YAG laser radiation.* J Endod, 1993. **19**(2): p. 91-4.

Komori, T., et al., *Clinical application of the erbium:YAG laser for apicoectomy.* J Endod, 1997. **23**(12): p. 748-50.

Ayranci, F., et al., *Assessment of root surfaces of apicected teeth: a scanning electron microscopy evaluation.* Niger J Clin Pract, 2015. **18**(2): p. 198-202.

Babar, P. and H. Adhikari, *Scanning electron microscope evaluation of morphological changes in dental hard tissue after root resection in apicoectomy by Er,Cr:YSGG laser and #702 TC Bur: Part I.* Journal of Dental Lasers, 2016. **10**(2): p. 58-66.

Sullivan, J., R. Pileggi, and C. Varella, *Evaluation of Root-End Resections Performed by Er, Cr: YSGG Laser with and without Placement of a Root-End Filling Material.* International Journal of Dentistry, 2009. **2009**: p. 798786.

Marchesan, M.A., et al., *Ultrastructural analysis of root canal dentine irradiated with 980-nm*

diode laser energy at different parameters. Photomed Laser Surg, 2008. **26**(3): p. 235-40.

Beling, K.L., et al., *Evaluation for cracks associated with ultrasonic root-end preparation of gutta-percha filled canals.* J Endod, 1997. **23**(5): p. 323-6.

Angiero, F., et al., *Apicoectomies with the erbium laser: a complementary technique for retrograde endodontic treatment.* Photomed Laser Surg, 2011. **29**(12): p. 845-9.

Nedderman, T.A., G.R. Hartwell, and F.R. Portell, *A comparison of root surfaces following apical root resection with various burs: Scanning electron microscopic evaluation.* Journal of Endodontics, 1988. **14**(9): p. 423-427.

D., W.G., M.A. J., and B.P. M., *A scanning electron microscopic evaluation of root surfaces and the gutta-percha interface following root-end resection in vitro.* International Endodontic Journal, 1999. **32**(6): p. 450-458.

Schoop, U., et al., *The use of the erbium, chromium:yttrium-scandium-gallium-garnet laser in endodontic treatment: the results of an in vitro study.* J Am Dent Assoc, 2007. **138**(7): p. 949-55.

Min, M.M., et al., *In vitro evaluation of effects of ultrasonic root-end preparation on resected root surfaces.* J Endod, 1997. **23**(10): p. 624-8.

Adorno, C.G., T. Yoshioka, and H. Suda, *The effect of root preparation technique and instrumentation length on the development of apical root cracks.* J Endod, 2009. **35**(3): p. 389-92.

Gupta, R., et al., *Evaluation of thickness of cementum of periodontally diseased teeth of non-diabetic and type 2 diabetic patients: A scanning electron microscopy study.* Journal of Indian Society of Periodontology, 2013. **17**(5): p. 592-596.

Parker, S., et al., *The Use of Laser Energy for Therapeutic Ablation of Intraoral Hard Tissues* J Laser Dent, 2007. **15(2)**: p. 78-86.

Oliveira, G.J., et al., *Effect of Er,Cr:YSGG and Er: laser irradiation on the adhesion of blood components on the root surface and on root morphology.* Braz Oral Res, 2012. **26**(3): p. 256-62.

Kim, S. and S. Kratchman, *Modern endodontic surgery concepts and practice: a review.* J Endod, 2006. **32**(7): p. 601-23.

Hakki, S.S., et al., *Comparison of Er,Cr:YSGG laser and hand instrumentation on the attachment of periodontal ligament fibroblasts to periodontally diseased root surfaces: an in vitro study.* J Periodontol, 2010. **81**(8): p. 1216-25.

Mahdee, A.F., A.H. Abbas, and S.A. Issmaeel, *Evaluation of the effect of ER: YAG laser on apical microleakage (in vitro study).* J Bagh Coll Dentistry, 2013. **25**(4): p. 66-71.

Mitić, A., et al., *Effects of Laser Treatment on Intracanal Dentine and Cementum at The Root Apex.* Acta Medica Medianae, 2016. **55**: p. 26-32.

Freitas, P.M. and A. SimÃµes, *Lasers in Dentistry: Guide for Clinical Practice*. 2015: Wiley.

Del Fabbro, M., et al., *Scanning electron microscopic analysis of the integrity of the root-end surface after root-end management using a piezoelectric device: a cadaveric study.* J Endod, 2010. **36**(10): p. 1693-7.

Aydemir, S., et al., *Evaluation of two different root-end cavity preparation techniques: A scanning electron microscope study.* Eur J Dent, 2013. **7**(2): p. 186-90.

مقارنة بين Er,Cr:YSG نانومتر ليزر وكربيد بر في استئصال نهاية الجذر

دعاء اياد طلعت [1] **صلاح عبد المهدي القرطاس** [2]

(1) معهد الليزر للدراسات العليا ، جامعة بغداد ، بغداد ، العراق
(2) مستشفى الكرخ العام ، بغداد ، العراق

الخلاصة: الهدف: الهدف من هذه الدراسة هو المقارنة بين الليزر Er,Cr:YSGG 2780نانومتر وبين مثقب كربيد في استئصال نهاية الجذر فيما يتعلق باختلافات التركيب الشكلي ، تغيرات درجة الحرارة ومدة عملية الاستئصال. الإعدادات والتصميم: 5 واط، 25 هرتز ، 50٪ ماء ، 80٪ هواء ، 25.47 جول/ سم^{2}. المواد والطريقة: واحد وعشرون أسنان مقلوعه ذات جذر واحد تم معالجتها لبياً ، تم حشو جذر 20 سن وقسم إلى مجموعتين وفقًا لطريقة البتر. تم استئصال طرف جذر المجموعة رقم الاولى باستخدام مثقب الكربيد ذا الشقوق المتقاطعه بينما تم استئصال طرف جذرالمجموعه الثانيه باستخدام الليزر و اداة طرف الياقوت MGG6 بقطر 600 ميكرومتر. تم تسجيل درجة الحرارة على سطح الجذر الخارجي ومدة عملية القطع. اما السن المتبقي فقد استخدم بمثابة سيطرة. تم تحضير العينات لـغرض الفحص بواسطة SEM وتم فحصها لتقييم الشقوق العاجيه ، الأضرار الأسمنتية ، الخشونة ، سدّ سطح جدار قناة الجذر. التحليل الإحصائي: كلما كان ذلك مطلوبًا ، تم استخدام اختبار x^2 / اختبار فيشر الدقيق و اختبار Kruskal – Wallis. النتائج: ينتج عن الليزر تشققات متداخلة في العاج في 70٪ من العينات بينما يتسبب المثقب بتشققات في 30٪ من العينات. لم يكن هناك فرق كبير بين المجموعتين 1 و 2 فيما يتعلق بنسبة الشقوق الكاملة وغير الكاملة. الاستئصال مع المثقب يؤدي إلى ضرر ملموس في 70٪ من العينات بينما لا يؤدي الاستئصال بالليزر إلى تلف في الأسمنت في أي من العينات. أظهر تقييم خشونة السطح اختلافات معنوية ذات دلالة إحصائية ($P \leq 0.05$). كان الفرق في مدة الاستئصال معنويا من الناحية الإحصائية ولكن الفرق درجة الحرارة المسجلة لم يكن معنويا. الاستنتاج: أظهر ليزر Er,Cr:YSGG نسبة أعلى من ناحية الشقوق المتداخلة ، لا يوجد ضرر في الطبقه الاسمنتيه ، نتج عنه مساحة فجوة أكبر ، سطح أكثر خشونة وأطول زمنًا للإستئصال من المثقب. لا يوجد أي ارتفاع في درجة الحرارة على سطح الجذر الخارجي.