Laser Apicoectomy with ER:YAG and Bone Xenograft Bio-Oss Collagen®. A Case Report

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Abstract: Main problem in apicoectomy procedures is the choice of access and flap, which determines the prognosis of the affected tooth. An additional complication is the presence of chronic periodontitis and increased tooth mobility. In such cases it is important to maintain the free marginal tissues and to do minimal trauma.

Aim: To show the possibilities of the Er:YAG laser for treatment of apical lesions in a tooth with chronic periodontitis.

Materials and Methods: Patient age 35 with moderate to severe chronic periodontitis, and a persistent cyst at tooth 22 was examined. After performing nonsurgical periodontal treatment apicoectomy was scheduled. A semilunar flap with vertical incisions was elevated 3mm from the gingival margin with a blade. All other procedures were performed with the help of Er:YAG laser in modes (release incision, bone remodeling, granulation tissue ablation, apex cutting). No retrograde filling was done. The cyst cavity was filled with Bio-Oss collagen® (Geistlich®, USA).

Results: In the post treatment period a flap dehiscence occurred due to: loose sutures, necrosis, infection. After a period of one year the X-ray showed complete bone filling of the defect with light lucidity at the sight of the dehiscence, which might be merited to the epithelial tissue proliferation towards the defect which resulted in forming bone with lesser density. After one year the tooth is preserved with mobility grade 1.

Discussion: The apicoectomy technique performed with Er:YAG is reliable and kept the soft tissues intact and also the tooth in spite of the severity of the chronic periodontitis. The technique can be recommended in similar cases.

Keywords: Er:YAG, Bio-Oss collagen®, Apicoectomy.

INTRODUCTION

Available evidence based literature supports the view that about 30% of apical lesions cannot undergo resolution and cannot be reversed with conservative methods of endodontic treatment. Here is the place of endodontic surgery and the procedure for apical osteotomy, which serves to remove the granuloma or cyst, stabilize the tooth and regenerate lost bone and thus remove from the body a focal fireplace and prevent further exacerbation of the lesion, which may lead to complications. A major problem in endodontic surgery is the choice of access flap and volume of cyst, which determines volume of tissue to be removed and survival prognosis of the tooth. The situation is further complicated in the presence of moderate to severe chronic periodontitis and increased mobility of the affected tooth-teeth which is considered a contraindication for treatment. Moreover, the standard technique for apical osteotomy is an even greater difficulty in periodontally affected teeth as the vibration of burs may further undermine the affected tooth and make treatment unsuccessful.

Depending on the location of the cyst and the size and length of root/s, the operator can select flap reflection extending from the marginal edge and or a flap which maintains free marginal gingiva intact. Using the second option limits surgical field size, is less traumatic and protects the affected tooth from recession, increase mobility. However the flap tears more often. Another major problem is due to retrograde filling issues: difficult access, special instruments, placement of retrograde filling, drying of cavity walls and root because of excessive bleeding and provision of stable hermetic sealing of the root end which is necessary and vital to provide stable periodontal-endodontic continuum which results in successful procedure and treatment. Other possible problems with endodontic surgery are: external root resorption, displacement or absorption of the root filling, incomplete removal of the cystic sac, leading to relapse. With the introduction of sealers and gutta-percha post in everyday endodontic therapy the problem of retrograde sealing is partly solved. Very controversial is also use of bone grafts after apicoectomy and some authors do not support at all. Lasers, the most modern in medicine and dentistry today [8, 18, 19], further improve endodontic surgery, since the energy of laser radiation leads to: disinfection of field, arrest of no bleeding, melting of the gutta-percha point and sealing of dentinal tubules, which allows sealing of the root end which is treatment's ultimate aim.

MATERIALS AND METHODS

A male patient 35 years old came into the clinic complaining of loose teeth, bleeding gums, bad breath

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and dry mouth. Objective clinical examination and paraclinical studies showed presence of moderate to severe, chronic periodontitis, and cyst on tooth 22 which had mobility grade 2 according to the Miller index of mobility. Tooth had Probing Pocket Depth –PPD 5mm and after full mouth scaling and root planning bleeding is arrested and PPD is 3mm. X-rays-Ortopanthomographs are done with Kodak Dental Imaging Software® (Kodak®, USA) which gives us digital picture (Figure **1**). Density of bone is evaluated with Isodensity dots a feature of the same software. After treatment of the chronic periodontitis we proceeded to remove the cyst of the affected tooth which had Root Canal Treatment with single cone gutapercha point and sealer from another provider. Apicoectomy procedure is performed with Er:YAG (Light Touch®, Sineron®, Israel) (Figure **2**). This technique, bone grafting and laser approach was

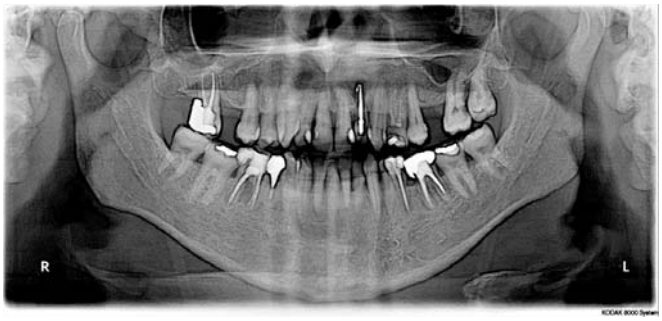

Figure 1: Preoperative condition of patient and tooth 22.

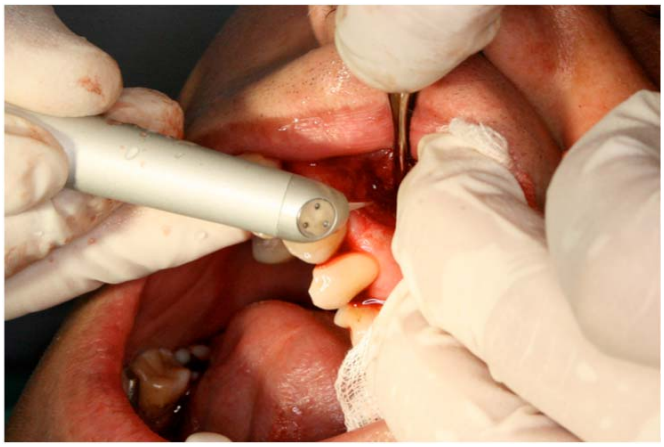

Figure 2: Flap reflection with incision tip and Er:YAG laser.

chosen as most suitable for periodontally affected teeth and requiring least armamentarium for performance compared to traditional techniques (Table **1**). We administered infraorbital anaesthesia and continued with reflection of semilunar flap 3 mm from the gingival margin in the apical region of tooth 22 with a scalpel N 15. Then dissection/reflection of the flap continued with tip for incision of soft tissues (contact mode; 200mJ/35Hz; 0.4x17mm tip; water level 5-6) with

Table 1: Standard Set of Instruments for Apicoectomy

Presurgical assessment
Mirror and curved explorer
Straight and curved periodontal probes
Soft tissue incision, elevation & reflection
Sharp scalpels – numbers 15, 15c, 11, and 12
Micro scalpels
Broad-based periosteal elevator
Broad-based periosteal retractor
Tissue forceps
Surgical aspirator
Irrigating syringes and needles
Periradicular curettage
Straight and angled bone curettes
Small endodontic spoon curette
Periodontal curettes
Fine, curved mosquito forceps
Small, curved surgical scissors
Bone removal and root-end resection
Surgical length round and tapered fissure burs
Straight and angled bone curettes
Rear-venting high speed handpiece
Contra-angled slow speed handpiece
Root-end preparation/placement of root-end filling/finish of resected root end
Ultrasonic or sonic unit with appropriate root-end preparation tips
Root-end filling material
Haemostatic agent (avoid bone wax)
Miniature material carriers and condensers
Small ball burnisher
Paper points or fine aspirator tip
Small, fine explorer
Suturing and soft tissue closure
Surgical scissors
Haemostat or fine needle holders
Various suture types and sizes (3-0 to 6-0)
Sterile gauze for soft tissue compression
Miscellaneous (or readily available)
Adequate aspiration equipment
Additional light source – magnification
Root canal filling materials
Anaesthetic syringes and anaesthetic

Er:YAG (Light Touch®, Sineron®, Israel) (Figure **2**). Cyst had resorbed vestibular cortical bone and the cavity is widened more for better access, with

additional bone removal around the edges of the cavity (non-contact mode; 300mJ/25Hz; 1.3x19mm tip; water level 8). Then the procedure continued with ablation of granulation and connective tissue from inner surface of flap and around cavity defect (non-contact mode; 400mJ/20Hz; 0,8x14mm tip; water level 4). This is to reduce bacterial load and prevent relapse of cyst and consequent inflammation. Then with tweezers cyst is removed. The cavity formed is treated with a flat cylindrical tip for ablation of granulation tissue and bone (Figure **3**). Then bone edges are shaped and smoothed with the same tip (non-contact mode;

Figure 3: Granulation tissue ablation, curettage and bone recontouring.

150mJ/50Hz; 1,3x19mm tip; water level 8). After treatment of the cystic cavity apical root end is resected 3 mm from the end (non-contact mode; 400mJ/20Hz; 0,8x14mm tip; water level 8) [5,16], finally, the defect is filled with Bio-Oss collagen® (Geistlich®, USA), and grafting material is placed above the cortical bone to overfill and thus augment alveolar ridge (Figure **4**). The

Figure 4: Application of Bio-Oss Collagen® (Geistlich®, USA).

endodontic surgery ended with suturing of the flap with absorbable interrupted 3.0 Vicryl® sutures 3 mm from each other. The patient is then instructed how to conduct oral hygiene habits in order not to disturb the flap site and is included in supportive maintenance program with chlorhexidine solution rinses 0.2% for a period of four weeks.

RESULTS

7 days after the procedure sutures were removed, but one of them had fallen earlier (Figure **5**). Defect was exposed and it showed the bone xenograft.

Figure 5: Postoperative dehiscence of flap and condition of gingival tissues.

Hygiene habits of the patient were not altered, nor were antibiotics prescribed. After a period of two weeks creeping epithelium attachment began from the flap to the borders of the defect (incision) and in the end of the first month defect was completely covered. After one year X-ray observations showed complete resolution and fill of the bone defect with less density and radiopacity in one zone (Figure **6**). Initially, density in

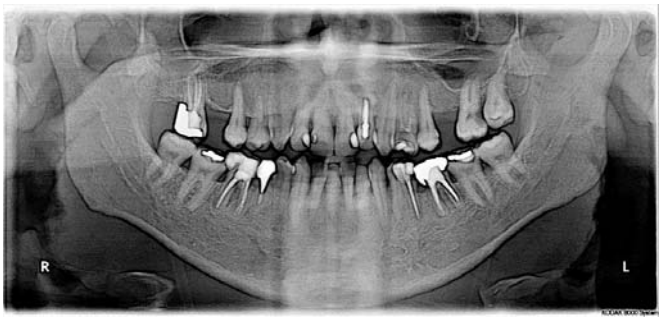

Figure 6: Postoperative condition of patient 1 year after apicoectomy with Er:YAG laser.

the area of cystic cavity is 24-64 isodensity units. After a period of one year density is 119 to 164 units evaluated with Isodensity dots a feature of Kodak Dental Imaging Software® (Kodak®, USA), which is nearly twice the initial value, which is a significant difference from the initial condition (Table **2**).

Table 2: Bone Density Before and After Treatment

Time	Density in Isodensity units Kodak Dental Imaging Software®
Before treatment	24-64 units
After treatment with ER:YAG laser and bone xenograft	119-164 units

Density in the least radiopaque portion of bone around the root is 94 units in only one point which shows improvement. After a period of one year the tooth is still in the patient's mouth with a first degree of mobility according to Miller index of mobility and PPD 3 mm, with no recurrent pain, bleeding and stabilised. Soft tissues have healed without any scar (Figure **7**).

Figure 7: Postoperative condition of gingival tissues one month after treatment.

DISCUSSION

The technique applied by us for apical osteotomy with Er:YAG laser did not cause an increase in recession which is an advantage of the semilunar flap. The tooth is maintained in the patient's mouth and has reduced mobility compared to its initial state. Particularly important in this method is the lack of trauma (vibration) on the tooth, allowing periodontal affected teeth to be maintained even despite their poor prognosis due to bone resorption marginally and apically [4]. Other authors, however [12], believe that the use of cutters is the best way to perform endodontic surgery. Bone ablation led to filling of the defect, which is supported and achieved by other authors using Er:YAG lasers [1, 2, 16] or can be a result of the bone grafting material. A disadvantage and discomfort of the case was the tear of the flap. Possible reasons for this may include: shrinkage due to flap tissue necrosis because of laser tissue ablation, dehiscence due to thinning of tissues, inflammation or too much tension on the edges of the flap because of overfilling with grafting material. Although the graft was exposed due to the flap dehiscence, which also may be a result of the thermal effect caused by lasers on tissues [16], the defect is covered with epithelium and bone fill is achieved which did not affect the length of recovery period and final result. This shows the excellent quality of Bio-Oss collagen® as a grafting material after apicoectomy which can be used with or without guided tissue regeneration [20]. Placing a collagen membrane may have resulted in full regeneration of bone and no radiopaque zone. Of course some authors point that the use of grafts has advantages when used for endodontic surgery [20] however there is the opinion that it is not necessary to use bone grafting and standard technique with no augmentation achieves the same results. The presence of a less radiopaque spot over the apical end may be due to proliferation of epithelial tissue into the defect and bone formation at a lower density than a remnant of cystic cavity being present. Another explanation is formation of bone scar, which is a normal or possible result after endodontic surgery and this not considered to be a failure. We can also hypothesize what would happen without the bone graft? Tissue healing would occur but without the bone graft that would take longer and possibly result and in a depressed scar on gingival tissues.

Some authors have shown that the use of lasers compared to cutters leads to delayed bone re-growth, but after 90 days, no significant differences can be detected between lasers and burs [14], while others believe that laser use will results in greater secretion of Platelet Derived Growth Factor-PDGF, which stimulates bone repair [10]. Using lasers leads to greater accuracy and reduces the volume of the tools needed for apicoectomies [17]. Another difference from conventional techniques in our methodology is that we did not use retrograde filling. Compaction and increased density of the cystic cavity indicated that enough disinfection and sealing of the root tip has been achieved, which ensures continuity of the periodontal tissues and resolution of the lesion [19]. We did this based on the articles of [9], which used retrograde

filling in their methodology or not [11], but both establish less micro leakage with lasers compared to ultrasonic preparation of the apex tip. Er:YAG lasers are better in terms of sealing the root surface and fewer cracks, defects, and burning effects are seen when compared to Nd:YAG and CO_2 lasers [4, 5, 7, 11, 12, 15]. In addition, treatment of root surface with Er:YAG laser delivers better adhesion between dentin and sealer [3]. Increase of laser energy gives us less micro leakage, better seal of dentinal tubules but increases the thermal effects in tissues hence possible undesired outcomes may occur [13].

Soft tissues recovered without scar and within the normal healing period. Another advantage of laser processing of soft tissues is that it may be more painless compared conventional scalpel surgery and therefore have less need for anaesthesia or sedation, which is desired when work is done on granulation and inflammatory formations which are almost always present in apical lesions and are usually difficult to anesthetise [21]. Some authors believe that laser endodontic surgery is not inferior to the standard technique, but it takes more time [18]. The methodology for using an Er:YAG laser instead of ultrasonic instruments and retrograde root filling has been piloted by a plurality of authors [3, 4, 6, 7, 9, 11, 12, 13, 14, 15, 20], who show that this technique is advantageous over other types of lasers and diamond burs cutters and some of their results are monitored for a period of 3 years and show stability and preservation of treated teeth [7].

CONCLUSION

Based on previous studies and our case report we believe endodontic surgery performed with Er:YAG laser, bone grafting material Bio-Oss Collagen® is suitable for maintaining stable results for a period of 1 year or more even without retrograde filling.

REFERENCES

[1] Akyol U, Güngörmüş M. Er:YAG laser ablation of bone in experimental diabetics. Photomed Laser Surg. 2010; 28(4): 477-82. http: //dx.doi.org/10.1089/pho.2008.2479

[2] Akyol UK, Güngörmüs M, Gündogdu C, *et al.* Histologic evaluation of the effects of Er:YAG laser on bone ablation. J Contemp Dent Pract. 2009; 10(5): 065-72.

[3] Arisu HD, Sadik B, Bala O, *et al.* Computer-assisted evaluation of microleakage after apical resection with laser and conventional techniques. Lasers Med Sci. 2008; 23(4): 415-20. http://dx.doi.org/10.1007/s10103-007-0497-z

[4] de Moura AA, Moura-Netto C, Barletta FB, Vieira-Júnior ND, Eduardo Cde P. Morphological assessment of dentine and cementum following apicectomy with Zekrya burs and Er:YAG laser associated with direct and indirect Nd:YAG laser irradiation. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2010; 109(4): 77-82. http://dx.doi.org/10.1016/j.tripleo.2009.12.032

[5] de Oliveira Ortolan AS, Torres CP, Gomes-Silva JM, *et al.* Effect of erbium-doped yttrium aluminium garnet laser parameters on ablation capacity and morphology of primary dentin. Photomed Laser Surg. 2009; 27(6): 885-90. http://dx.doi.org/10.1089/pho.2008.2358

[6] Francischone CE, Padovan LA, Padovan LE, *et al.* Apicectomy with the Er:YAG laser or bur, followed by retrograde root filling with zinc oxide/eugenol or sealer 26. Photomed Laser Surg. 2005 ; 23(4): 395-8. http://dx.doi.org/10.1089/pho.2005.23.395

[7] Gouw-Soares S, Tanji E, Haypek P, *et al.* The use of Er:YAG, Nd:YAG and Ga-Al-As lasers in periapical surgery: a 3-year clinical study. J Clin Laser Med Surg. 2001; 19(4): 193-8. http://dx.doi.org/10.1089/104454701316918961

[8] Ishikawa I, Aoki A, Takasaki AA. Clinical application of erbium: YAG in periodontology. J Int Acad Peridontol 2008; 10(1): 22-30.

[9] Karlovic Z, Pezelj-Ribaric S, Miletic I, *et al.* Erbium: YAG laser versus ultrasonic in preparation of root-end cavities. J Endod. 2005; 31(11): 821-3. http://dx.doi.org/10.1097/01.don.0000158234.33581.e9

[10] Kesler G, Shvero DK, Tov YS, *et al.* Platelet derived growth factor secretion and bone healing after Er:YAG laser bone irradiation. J Oral Implantol. 2011; Spec No: 195-204. http://dx.doi.org/10.1563/AAID-JOI-D-09-00120.1

[11] Leonardi DP, Sivieri-Araujo G, Zielak JC, *et al.* Apical sealing quality of in vitro apicectomy procedures after using both Er:YAG and Nd:YAG. Photomed Laser Surg. 2010; 28 Suppl 2: 63-7. http://dx.doi.org/10.1089/pho.2009.2612

[12] Lustosa-Pereira AC, Pozza DH, Cunha A, *et al.* Analysis of the morphology and composition of tooth apices apicectomized using three different ablation techniques. Med Oral Patol Oral Cir Bucal. 2011; 16(2): e225-30. http://dx.doi.org/10.4317/medoral.16.e225

[13] Marques AM, Gerbi ME, dos Santos JN, *et al.* Influence of the parameters of the Er:YAG laser on the apical sealing of apicectomized teeth. Lasers Med Sci. 2011; 26(4): 433-8. http://dx.doi.org/10.1007/s10103-010-0792-y

[14] Martins GL, Puricelli E, Baraldi CE, *et al.* Bone healing after bur and Er:YAG laser ostectomies.J Oral Maxillofac Surg. 2011 Apr; 69(4): 1214-20. http://dx.doi.org/10.1016/j.joms.2010.02.029

[15] Pozza DH, Fregapani PW, Xavier CB, *et al.* CO(2), Er:YAG, and Nd.YAG lasers in endodontic surgery. J Appl Oral Sci. 2009; 17(6): 596-9. http://dx.doi.org/10.1590/S1678-77572009000600011

[16] Stübinger S, Ghanaati S, Saldamli B, *et al.* Er:YAG laser osteotomy: preliminary clinical and histological results of a new technique for contact-free bone surgery. Eur Surg Res. 2009; 42(3): 150-6. http://dx.doi.org/10.1159/000197216

[17] Stübinger S, Kober C, Zeilhofer HF, *et al.* Er:YAG laser osteotomy based on refined computer-assisted presurgical planning: first clinical experience in oral surgery. Photomed Laser Surg. 2007; 25(1): 3-7. http://dx.doi.org/10.1089/pho.2006.2005

[18] Stübinger S, Seitz O, Landes C, *et al.* The Er:YAG laser in dentoalveolar surgery. Schweiz Monatsschr Zahnmed. 2007; 117(11): 1139-43.

[19] Sunitha VR, Emmadi P, Namasivayam A, *et al.* The periodontal-endodontic continium a review. J Conserv Dent 2008; 11(2): 54-62. http://dx.doi.org/10.4103/0972-0707.44046

[20] Taschiery S,Del Fabbro M, Testori T, *et al.* Efficacy of xenogenic bone grafting with guided tissue regeneration. in the management of bone defects after surgical endodontics. J Oral Maxillofac Surg 2007; 65(6): 1121-7. http://dx.doi.org/10.1016/j.joms.2006.10.022

[21] Zeredo JL, Sasaki KM, Yozgatian JH, *et al.* Comparison of jaw-opening reflexes evoked by Er:YAG laser versus scalpel incisions in rats. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2005; 100(1): 31-5. http://dx.doi.org/10.1016/j.tripleo.2004.11.012

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