

Acceleration of canine movement by laser assisted flapless corticotomy [An innovative approach in clinical orthodontics]

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ABSTRACT

Background: Corticotomy-assisted orthodontic treatment is done to induce a state of increased tissue turnover and transient osteopenia, which is followed by a faster rate of orthodontic tooth movement. It considered as an adjunct treatment option for orthodontic treatment of adults. The aim of this Study was to elucidate the effectiveness of a new surgical approach for acceleration of maxillary canine retraction in human with laser assisted flapless corticotomy and evaluate its effect on vitality of pulp and gingival sulcus depth.

Materials and methods: the sample comprised of 15 Iraqi patients (9 females and 6 males; mean age 21.7), who were required extraction for their maxillary first premolars followed by retraction of the canines as part of their orthodontic treatment plan. The study was designed as a split-mouth study. Decortications were done in the second stage of orthodontic treatment using Er:YAG laser to perform series of holes mesially and distally to the canine at the side with more space between the canine and second premolar without reflecting a surgical flap. The net canine movements and molar anchorage loss were calculated after six weeks. Vitality test, radiographical assessment and gingival sulcus depth were investigated.

Results and Conclusions: The canines on the laser corticotomy side showed statistically higher mean value of retraction than their controls during six weeks period. Pulp vitality response and post surgery gingival sulcus depth showed no significant difference between the pre-laser and post-laser surgery. Based on the result of our study, flapless laser assisted corticotomy can be considered for acceleration of orthodontic tooth movement in humans.

Key words: Er:Yag laser, corticotomy, acceleration of tooth movement. (J Bagh Coll Dentistry 2014; 26(3):133-137).

الخلاصة

يؤدي نزع قشرة العظم الجراحي لدعم المعالجة التقويمية للأسنان الى حاله من زيادة معدل الانتاج النسيجي و نقصان العظم المؤقت. الذي يتبعه ازدياد سريع في معدل الحركة التقويمية للأسنان. وتعتبر خيار مساعد للعلاج التقويمي للبالغين.

الهدف من الدراسة: لتقييم فعالية تدخل جراحي جديد من نوعه لتسريع حركة الناب العلوي في الانسان بواسطة تقشير العظم جراحيا بدون رفع سديله جراحيه وباستخدام الليزر وتقييم تأثيرها على حيوية لب السن و عمق اخنود اللثة المحيط بالسن.

المواد والطرق: تكونت عينة الدراسة من 15 مريض عراقي (9 اناث , 6 ذكور , معدل العمر 21.7) الذين كان القلع الجراحي للأسنان الضاحكه العلويه الاولى مع سحب لاحق لانياب الفك العلوي جزءا من الخطة التقويمية لعلاجهم. تمت عملية نزع قشرة العظم في المرحله الثانيه من العلاج التقويمي باستعمال الليزر لعمل سلسلة من الثقوب للجبهه الدانيه والقاصيه للنانب والضاحك الثاني العلويين في جهة الفك التي تكون فيها المسافه بين الناب والضاحك الثاني اكبر بينما ابقيت الجبهه الثانيه من الفك كعنصر ثابت للمقارنه. تم احتساب حصيلة حركة الناب و فقدان المقاومة للطواحن بعد ستة اسابيع وتم التحري عن حيوية لب الاسنان , التقييم بواسطة الاشعة السينيه واحتساب عمق اخنود اللثة المحيط بالسن في هذه الدراسة.

النتائج: احصائيا اظهرت الجبهه المقشره بالليزر قيم معدل عاليه للسحب مقارنتها الجبهه غير الجراحيه خلال فترة ستة اسابيع. كذلك لا يوجد فرق في فقدان مقاومة الطواحن ما بين الجانبين. لم يكن هناك فرق كبير بين عمق اخنود اللثة وقيم الاستجابه الحيويه لب السن قبل وبعد الجراحه الليزرية.

الاستنتاج: استنادا لنتائج دراستنا هذه تبين ان التقشير الجراحي للعظم بدون رفع سديله جراحيه وباستخدام الليزر يمكن اعتباره وسيلة لتسريع الحركة التقويمية للأسنان في الانسان.

INTRODUCTION

Orthodontic treatment is a lengthy procedure, making so many patients with malocclusions reluctant to this treatment. Almost every orthodontic patient cares about the possibility of reducing their treatment time. Thus it has become a primary goal that new approaches to accelerate orthodontic movement are required:-

1-Accelerated tooth movement has been tried by pharmacological & chemical agents like vitamin D3, corticosteroids and prostaglandins given locally & systemically ⁽¹⁾.

2- Accelerated tooth movement has been tried by physical agents concomitant with the orthodontic force to augment the mechanical force, e.g, local application of heat, electric current and static magnetic field ⁽²⁾.

3- Others used surgical approaches to accelerate tooth movement by means of surgical burs, vertical grooves and/or perforations in the cortical plate (Alveolar corticotomy) & selective alveolar decortications which are effective means to increase orthodontic tooth movement ⁽²⁾. Case reports have shown that comprehensive orthodontic treatment can be completed in 4-9 months with corticotomy whereas conventional orthodontic treatment takes 18-30 months. However, surgical procedures are considered invasive since the patient is subjected to flap reflection, bone drilling, and cutting by burs, suturing, in addition to the accompanying complications like contamination, pain, and swelling ⁽³⁻⁴⁾.

Recently lasers were introduced to do corticotomy without reflecting a surgical flap in experimental animals, one of these studies was a pilot study on beagles dogs done by Hao. The second was on rabbits by Seifi and coworkers.

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They used Er; yag laser to do the corticotomy. Both studies shows that laser facilitated flapless corticotomy is a useful procedure to speed up treatment time & it eliminates the necessity of invasive flap surgery⁽⁵⁻⁶⁾.

Er;YAG laser offers an attractive alternative drilling modality because it does not require physical contact with the bone in order to drill holes, cut bone with minimal thermal damage & precise control of bone cutting. This study will be conducted on human for the first time to test the efficiency of laser assisted flapless corticotomy to accelerate tooth movement and to verify the influence of this new approach on tooth vitality as well as on teeth surrounding structures.

MATERIALS AND METHODS

The sample included (15) patients, (5) males and (10) females, with an age ranged from 17-28 years with mean age 21.7 years. Males represented 33.33 %, while females represented 66.67% .The patients were informed about the nature of treatment and possible consequences and agreed to participate in the research. A split mouth design were done to ensure more accurate results, so the sample was set up to use each patient as his own control, this led to increase the power of small sample⁽⁷⁾.

The Inclusion Criteria:

1. Class I malocclusion cases that require bilateral extraction of maxillary and mandibular first premolar, due to sever crowding.
2. Class II malocclusion cases due to maxillary alveolodental protrusion with the general facial type toward a mesioognathic face requiring bilateral extraction of maxillary first premolar and bilateral maxillary canine retraction as part of their orthodontic treatment plan.
3. Clinically healthy patients with no history of drug intake and/or no history for any systemic illness, syndromes, craniofacial deformities.
4. No history of previous orthodontic treatment.
5. Vital teeth with normal periodontium and no root resorption. (seen by P.A for upper laterals, canines and second premolars for right & left sides, OpG, Cephalometric x-rays for proper diagnosis & examined by pulp tester).
6. Nearly equal upper and lower facial height excluding any maxillary excess.
7. Presence of upper and lower first and second molars.
8. No open bite, facial asymmetry, mandibular deviation or displacement.
9. No previous first premolar extraction.

All the patients who participated in this study were informed in simple language about the goal of the research and Informed consent was obtained from the patients and from the parents of those younger than 18 years before the study. All the patients were examined clinically and diagnostic case sheets were filled for every patient.

After completing the leveling and alignment stage the following steps were done:

- A- Pre surgical steps.
- B- Laser assisted corticotomy and retraction of canine.
- C- Monitoring visits.
- D- Six weeks after surgery.

A-Pre surgical steps: [The whole steps were done at same day of surgery].

1. Pulp vitality testing.
2. Gingival health and Pocket depth assessment.
3. Periapical radiograph.
4. Dental cast preparation

B- Laser- assisted corticotomy and retraction of canine:

Corticotomy was done at the side having more space between the canine and the second premolar. The laser device (**K.A.V.O** laser) was present at Al-Elwea Specialized Center in Baghdad and the participants were taken to this center to have the operation there. Each patient was instructed to use chlorhexidine mouth wash before any surgical intervention and before anesthetic administration. The use of an infiltration anesthetic was recommended for pain-sensitive patients. Less sensitive patients can be given a surface anesthetic by using small cotton pellet soaked with anesthetic solution on the determined site for surgery for ½ minute to avoid ulceration of oral mucosa. If no anesthetic is administered, the patient should be informed that he/she might experience a sensation of warmth in the mucous area that the sensation will disappear after treatment has ended.

Each patient needed a Periapical x-ray for the side of operation to determine the accurate position of the holes between the roots. In this situation a temporary arch wire was put (0.018 inch S.S) with two U-loops (indicator loops) one was between maxillary lateral incisor and maxillary canine and the other was between the maxillary canine and the 2nd premolar as shown in (figure 1).

A series of circular holes (4 holes) were made along the planned position. These holes were 2-3 mm apart and their spacing was determined

according to the depth of the buccal vestibule (as we did not reflect a surgical flap).

Each hole was approximately 1.5 mm in diameter. The depth of laser cutting was measured and controlled continuously during the operation by UNC 15 periodontal probe with stopper read about 3mm depth in addition to a few parts of a millimeter depth into the medullary bone to enhance bleeding.

The whole surgical procedure was done in two major steps with two different parameters:-

A- Soft tissue incision by KAVO laser device using special hand piece with fiberoptic delivery system.

B- Hard tissue cutting by Er:YAG laser using parameters for bone ablation and another type of hand piece in non contact mode with constant water spray irrigation .

The surgical site was covered by iodoform gauze and surgical pack was placed over it to prevent contamination of surgery site by saliva and food debris (figure 2 & 3).

C-Monitoring visits:

The patients came after one week of surgery to remove the surgical pack (figure 4).

D. Six weeks after surgery: in this visit all the patients had a periapical radiography for the maxillary canine at the site of operation to exclude any root resorption or Periapical pathology. Also vitality testing was done for the lateral incisor, canine and second premolar. Gingival sulcus depth was measured for the maxillary canine; finally an impression for the upper arch was taken for each patient.



Figure 1: U-loops in place



Figure 2: Soft tissue incision using Laser handpiece E 2055/2062 with fibre insert 50/10.



Figure 3: Hard tissue ablation in non contact mode mesial to the canine.



Figure 4: Surgical site after removal of surgical pack.

RESULTS

1- Canine movement

The net canine movement per six weeks for both surgical and nonsurgical sides was calculated and the results were expressed by descriptive statistics including (mean, SD, min. and max. values) and inferential statistics. The laser side (surgical side) showed a higher mean value as compared with the control side (non-surgical side) which was statistically highly significant according to t-test. It means that the surgical side demonstrated double net canine distalization than the non-surgical side, as shown in (Figure 5).

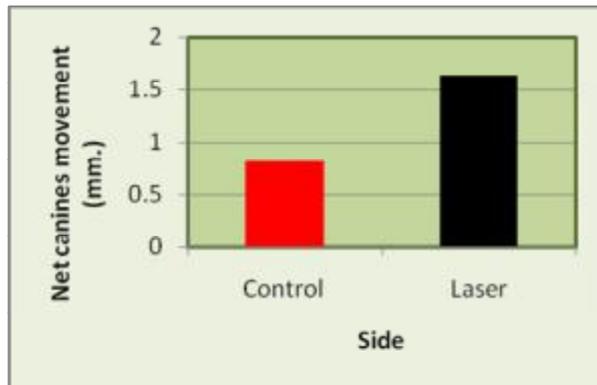


Figure 5: Net canine movement in both surgical (experimental) and non-surgical (control) sides.

Gingival sulcus depth

A comparison between the pre and post-surgery gingival sulcus depth values of laser surgical side, the values did not exceed 4 mm pre and post-surgery. According to t-test there is no significant change in the gingival sulcus depth. (Figure 6) shows a chart demonstrating this comparison.

Clinical complications and side effects:

There were no serious complications after laser surgery; one patient had post operative swelling for one to two days after the surgery. According to bleeding on probing index during the monitoring visits, there was no sign of gingival inflammation or any scar formation on the experimental side.

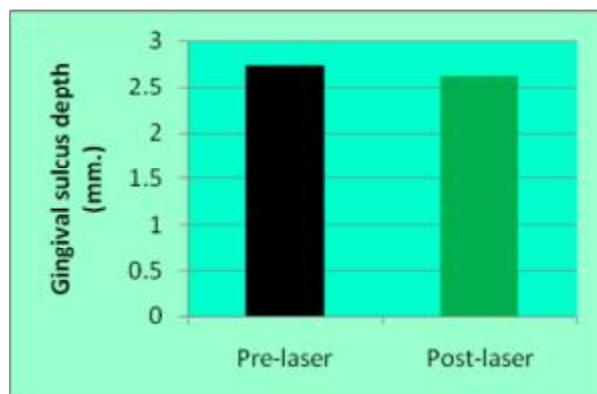


Figure 6: pre- and post- gingival sulcus depth in the laser side

DISCUSSION

Speed up of Canine Retraction:

The choice of doing selective corticotomy to the Canine during retraction in this study was due to the fact that canine retraction is a common treatment procedure in orthodontics. Osteotomy in this study was restricted to the cortical layer

[selected decortications] to minimize the injury of the vital structures.

It was observed that there is a direct correlation between severity of surgical insult and intensity of regional acceleratory phenomenon⁽⁸⁾. This finding suggests that reduction in the area of decortication will affect negatively the acceleration of orthodontic tooth movement. But we should also take in consideration that a very few patients accept the risk of very wide area of corticotomy despite the attractive results of corticotomy in speeding up orthodontic treatment. So our question here is: would selective decortication mesiobuccal & distobuccal to the canine that subject to retraction be effective in acceleration of orthodontic tooth movement?

The results of our study shows the answer to that question, as the net canine movement during retraction period of 6 weeks was in an average of 1.63 mm, and in The control side (Non-laser) in an average of 0.82 mm this means that the canine in the laser side moved twice the amount of that in the control side, I.e. it needs half the time required of that in the control side. So the canines in the laser side moved 67% comparing to their controls which were moved only 33% in the whole period of retraction.

Gingivitis and gingival sulcus depth

The successful prevention of gingival inflammation throughout the study period was attributed to the firm instructions about the proper oral hygiene maintenance given to the patients throughout the study, including the use of a special orthodontic brushes and mouth rinses.

Radiographic assessment

The majority of our examined teeth were radiographically normal and exhibited no pathological change in the PDL which means complete healing of laser-decortication side and good bone turnover which is related to proper and non-invasive surgical intervention.

Effect on Vitality of pulp

The use of non- traumatic surgical intervention in the laser surgical side, also we can add additional safety measure which was the use of optimal physiologic force that did not endanger pulp vitality.

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