Periodontally Accelerated Orthodontics

ER, Cr:YSGG Laser-Induced Regional Acceleratory Phenomenon

INTRODUCTION

Malocclusion presents aesthetic and functional problems for the patient and its treatment is a major area of basic research. Corticotomy-facilitated orthodontic therapy has been demonstrated to greatly reduce treatment times for malocclusion when compared with traditional orthodontics. It has also been shown to achieve more ideal results in cases where traditional orthodontics would not be able to realign teeth to a sufficient extent. This procedure is very sensitive to the bone healing process, and the use of surgical lasers to perform the corticotony surgery is advantageous in effecting an ideal outcome.

The purpose of this paper is to present rationale and a case report of a patient treated for malocclusion with corticotomy-facilitated orthodontics using surgical lasers, specifically the Waterlase MD (BIOLASE Technology).

Orthodontic Tooth Movement and Treatment Time

Orthodontic tooth movement is thought to be a cell-mediated process, which occurs largely within the periodontal ligament (PDL). Orthodontic force, whether retractive or expansive, causes pressure on the side of the PDL in the direction of the tooth movement and tension on the opposite side of the PDL. Osteoclast cells catabolize bone on the pressure side, and osteoblast cells deposit bone onto the tension side, causing a net movement inward or outward of the teeth. A period lasting 4 to 5 weeks immediately after application of orthodontic force of PDL hyalinization effectively brings tooth movement to a standstill. Histological studies of corticotony-facilitated orthodontics have shown that hyalinization was eliminated faster with corticotomy than with traditional orthodontics.1

Excessive orthodontic force can cause root resorption, necrosis of the PDL, and damage to the alveolus. In order to keep these sequelae in check, relatively light (150 g) orthodontic forces are applied, especially in adult patients where the surrounding anatomy is less elastic than in children or young adolescents. While minimized, even with "ideal forces," root resorption is still possible.

Consequently, in many cases, orthodontic therapy takes 2 to 3 years in order to achieve a satisfactory result. Efforts to shorten this time are stymied by the resistance afforded by the PDL. Many patients are reluctant to undergo treatment for this length of time because of the discomfort of brackets and self-consciousness associated with how the appliance will affect their appearance. Accordingly, reduction of orthodontic treatment time is a high priority for both adult and adolescent patients. Relapse is also a risk, especially when patients do not comply with proper use of retainers. To the author's knowledge, the risk of long-term relapse after corticotomy-facilitated orthodontic treatment has not been evaluated.

Corticotomy-assisted orthodontics provides an advantageous middle ground between conventional orthodontics and orthognathic surgery, and has been shown to greatly accelerate treatment time with no additional risk of root resorption, according to the literature, and may in fact even decrease the risk. The basic principle is that horizontal and vertical corticotomy cuts around the roots of the teeth can accelerate tooth movement considerably by lowering the resistance of the hard cortical bone to expansive or retractive tooth movement. The entire cortex has been shown to remodel to a desired form.

Additionally, in cases of severe malocclusion or bimaxillary protrusion where orthodontics may not accomplish all treatment goals and yet patients prefer to avoid orthognathic surgery, corticotomy-facilitated orthodontics is a compromise between the 2 procedures.

Corticotomy in Orthodontics

Several authors have reported the advantages of corticotomy surgery in shortening treatment duration for orthodontic therapy. Köle2 originally described corticotomy-facilitated orthodontics in 1959, as tooth movement by bony "block." Köle2 claimed that corticotomy surgery allowed the tooth roots to be moved independently of each other within their alveolar processes because the thick cortical bone was the primary obstruction to tooth movement. His procedure called for much higher than normal orthodontic force in order to achieve good results in a shorter time than orthodontic treatment without surgery, but the outcome was dramatic. Despite the use of greater force, instances of root resorption with Köle's procedure were no higher than normal.

Recent research by Wilcko et al3 refuted the hypothesis of movement by bony block, citing a regional accelerated phenomenon (RAP) and a temporary osteoporotic condition in the surgical area. This claim is buttressed by the effectiveness of the procedure when corticotomies are not extended into the deeper medullary bone, and the bone in between the vertical and horizontal bone cuts is perforated to induce bleeding. Evidence from the field of orthopedics also supports the claim that RAP causes rapid tooth movement after corticotomy surgery. The phenomenon of RAP in the mandible has been studied in rats, confirming that RAP can occur in places other than long bone, where RAP is typically studied.4 Furthermore, Wilcko et al's procedure calls for the normal orthodontic force of one N as opposed to greater than normal orthodontic force.

Other studies have shown that corticotomy-facilitated orthodontics is an effective

continued on page 96

Lawrence D. Singer, DMD

LASERS

DENTISTRYTODAY.COM • MAY 2013
Periodontally Accelerated...

continued from page 94

Figure 1a. Preoperative frontal view in repose.
Figure 1b. Preoperative frontal view retracted.
Figure 1c. Preoperative left side view in repose.
Figure 1d. Preoperative left side view retracted.
Figure 1e. Preoperative right side view in repose.
Figure 1f. Preoperative right side view retracted.
Figure 1g. Preoperative lower occlusal.
Figure 1h. Preoperative upper occlusal.
Figure 1i. Preoperative side view.
Figure 1j. Preoperative frontal view.

LASERS

Corticotomy-assisted orthodontics has been demonstrated to significantly decrease treatment time for malocclusion.

Treatment for bimaxillary protrusion, whose treatment options are either conventional orthodontics or anterior segmental osteotomy. While orthodontics without corticotomy surgery is effective in many cases of bimaxillary protrusion, treatment is not always effective and has a long duration. Anterior segmental osteotomy, while guaranteed to get immediate results, can result in complications associated with the surgery. Typically, corticotomy facilitated orthodontics is performed for bimaxillary protrusion with the aid of an anchorage device such as a mini-screw.

Lasers in Oral Surgery

The use of surgical lasers affords more accurate procedures, with extensive research to support that bone healing after laser surgery is comparable to or better than with traditional instruments. Lasers in the midinfrared wavelength such as the erbium doped yttrium, aluminum, garnet (Er:YAG) and erbium, chromium-doped yttrium, scandium, gallium, garnet (Er,Cr:YSGG) have been shown to give good results in dental applications, and to have a bactericidal effect which has no statistically significant difference from irrigation with 2.5% NaOCl solution. Other findings imply that healing times are shorter for surgeries performed with midinfrared lasers as compared with bone burs. Given that one of the primary advantages of corticotomy-facilitated orthodontics is the elimination of the lag period at the beginning of orthodontic treatment, the use of lasers to aid in faster healing is especially advantageous and is in keeping with the purpose of the procedure.

Furthermore, studies have demonstrated better patient acceptance of laser surgery as opposed to surgery with traditional instruments. Physical contact between the instrument head and the tissue is a source of discomfort in procedures using bone burs and piezoelectric devices, whereas lasers are noncontact.

CASE REPORT

Diagnosis and Treatment Planning

A 39-year-old male presented with
Class III malocclusion. Anatomical features at the time of surgery were narrow maxillary arch, generalized moderate anterior crowding, mild generalized cervical gingival inflammation, Class III canine relationship, and teeth Nos. 7 and 27 were in crossbite. The upper 2 first molars had been previously extracted, and the treatment plan called for distalization of the second premolars in preparation for implant placement to replace the missing teeth. The patient was informed of treatment options, including the possibility of no treatment. When told of the possibility of using corticotomy to shorten orthodontic treatment time, the patient readily accepted.

**Clinical Protocol**

Surgery was performed on the maxilla with local anesthesia using Articaine hydrochloride 4% with epinephrine 1:100,000 injection (Septodont). Full thickness mucoperiosteal flaps were reflected on the buccal and palatal side of the maxilla. The Er:YSGG laser, Biolase MD (BIOLASE Technology), was used at 45 W 315 pulses per second with 33% water and 66% air setting. Corticotomy cuts were made vertically between the tooth roots, and were connected by horizontal cuts superapically. Perforations (“bleeders”) were also made to help induce the RAP: Particulate bone graft material, Puros (Zimmer Dental) was spread in a thin layer across the surgical area prior to closure.

Figures 1a to 1j show the patient’s preoperative presentation. Description of bone defects performed before surgical closure. Figures 2a and 2b show the full-thickness flap with laser corticotomy performed before surgical closure. The patient was seen one week postoperatively (Figure 3) and then approximately every 2 weeks thereafter for monitoring. Figures 4a to 4c show significant movement after only 30 days of treatment. The wire was changed to 0.018 x 0.025 N heat activated nitinol at 94 days. Figures 5a and 5b show the results at 90 days. Figures 6a to 6d show the final results after bracket removal at 6 months. After bracket removal, the patient was given removable hawley appliances for an extended period of treatment after only 3 months of orthodontic treatment, corticotomy-assisted orthodontics because of the shortening treatment.

**Outcome**

Orthodontic treatment was completed in 5 months. Total treatment time including implant therapy was just more than 10 months.

No significant problems were observed during or after treatment. There was no root resorption, no probing depths greater than 3 mm, and no detected gingival recession. Patient photos demonstrate pre- and post-operative treatment results. Note that the patient did not smile preoperatively because he was not happy with his malaligned teeth. It is the author’s experience that certain adult patients are particularly attracted to accelerated orthodontics because of the shortened treatment time.

**CONCLUSION**

Corticotomy-assisted orthodontics has been demonstrated to significantly decrease treatment time for malocclusion. Given patients’ typical aversion to the aesthetic effects of having brackets for an extended period of time, this treatment is a valuable tool for the dental practitioner. Furthermore, since the therapy is reliant on the inner workings of the bone healing process, the use of lasers in the surgical part of the procedure is an advantage that has not yet been reported in other articles on this subject. While the case shown here incurred no side effects or complications, further research is needed to evaluate the effects of corticotomy-facilitated orthodontics in the long term.+

**References**


Dr. Singer has a private practice in the Washington, DC, and Alexandria, VA, areas. He is also an assistant clinical professor in the department of surgery at George Washington University. He can be reached at (202) 912-9200.

Disclosure: Dr. Singer reports no disclosures.