# Alveolar corticotomies by lasercision

## A new procedure to accelerate orthodontic treatments

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**_An increasing number of adult patients** visit us because they want to regain a more harmonious, aesthetic, young smile. To have "nicely aligned teeth" is a wish that we hear constantly. Dento-maxillary disharmony is a condition that can occur in all of the adult population. This is because over time the teeth start to overlap and/or this overlap increases for various reasons (resorption of the bone base, decreasing periodontium support, parafunction etc.). However, many patients shy away from the idea of having orthodontic treatment.

Today, we have many aesthetic methods of orthodontics at our disposal which are practically invisible (lingual orthodontics and aligners make orthodontic treatment popular with many adults). Still orthodontic treatment, even if it is done aesthetically, needs convincing (duration of treatment, impact on the daily life, frequent appointments, articulation difficulties, wounds, pain etc.). This is why we are frequently confronted with patients who prefer rehabilitation of their smile by means of prosthodontics.

Luckily there is a technique that reduces the time needed for orthodontic treatment and facilitates its course: Alveolar corticotomies. This is a surgical technique where we make vertical incisions into the vestibular osseous cortical , maxillary and mandibular proxy, so that the orthodontic tooth movement is accelerated. Due to the growing demand of adult patients to improve their smile and the survival of their teeth, aesthetic orthodontic treatment and alveolar corticotomy are

**Figs. 1a–f**_Initial situation.

carried out more and more often, especially since there are now protocols, which are much less invasive.

## _History

The first corticotomies were described at the end of the 19th century. In 1959, Köle suggested a protocol linking vestibular and lingual segmentary corticotomies and subapical horizontal osteotomy after elevation of a complete periosteal flap.[1] Köle developed the bony blocks theory in order to explain the faster tooth movement. At that time orthodontists thought that it was necessary to obtain an almost complete dissociation of the bony block to accelerate the tooth movement.

This extremely invasive technique was not very popular with orthodontists. During the following years, simplified protocols without subapical osteotomy were invented[2, 3, 4, 20, 21], which, however, still heavily relied on the bony blocks theory. Frost, an orthopedist from the US, showed that after a surgical intervention in long bones there was an accelerated bone turnover (bone remodelling) and a transient osteopenia directly at the site of intervention.[5, 6] He introduced the so-called regional activation phenomenon (RAP) concept to explain this physiological scarring process. The concept and the correlation between post-surgical RAP and tooth mobility would later be validated by various studies. Yaffe A. et al. suggested that the RAP is responsible for the increased tooth mobility after periodontium surgery.[7] Verna showed that there is a correlation between bone remodelling and tooth movement.[8]

## _Biological concept of corticotomies

Based on the various studies and the RAP concept, the Wilcko brothers (an orthodontist and a periodontist from the US) introduced the biological concept in 2001 in order to explain the increased speed of dental displacement after corticotomies.[9] However, their protocol is still conventional and invasive: a complete vestibular and lingual mucosa periosteal flap followed by bone drill corticotomies (sometimes including a soft tissue and/or bone graft).

Later, other studies showed that the RAP effect is also present at some distance from the corticotomy zones[14-17] and this led to less invasive protocols without flaps.[10, 11] In 2007, Vercellotti introduced using a piezosurgical microsaw.[12] However, his method still required elevating a vestibular flap.

In the course of the evolution of knowledge and understanding of the underlying biological phenomenon (RAP concept), the methods became more and more simple without any compromise to the results. In 2009, Dibart, Sebaoun and Surmenian used piezosurgery in forming minimally invasive segmentary corticotomies.[13] This new method works without palatine corticotomies and mucosa periosteal flap. The corticotomies are carried out with a piezotome directly through the attached gingiva after a vertical scalpel incision. This can be combined with soft and/or hard tissue grafts.

Fig. 2a

Fig. 2b

Fig. 2c

Fig. 2d

**Figs. 2a–d**_Situation immediately after the maxillary and mandible surgery.

*Indications and counter-indications of corticotomies*

Corticotomies help reduce the duration of orthodontic treatment significantly and facilitate its course. They can be used for most malocclusions, particularly those of class I malocclusion with DMD. Corticotomies are mostly used for aligning teeth (temporary RAP of about four to six months), but they are also useful for facilitating complex displacements in adults (distalisation of molars, mass

Fig. 3a

Fig. 3b

Fig. 3c

Fig. 3d

**Figs. 3a–d**_Healing status 15 days after the surgery.

**Figs. 4a–f**_End of orthodontic treatment; the duration was nine months. Now the preconditions for a prosthesis are looking better.

distalisations, ingressions etc.) so they can simplify the treatment plan and reduce necessary orthodontic extractions. Corticotomies are also indicated with dental decompensation during orthosurgical treatment. Furthermore, corticotomies can be used with all orthodontic methods (vestibular, lingual, aligners).

The patients that can be treated with this intervention must not present active periodontal disease, periacipal lesions, local or general bone pathologies or be currently undergoing an immunosuppressive, bisphosphonate or cortisone treatment (modification of the cell turnover). There must be no risk of infectious endocarditis or previous radiation therapy in the cervico-facial area. Smokers have a higher risk of post-surgical infection. Prior to surgery there must be a periodontal and dental examination carried out. Any carious lesions, periapical abscesses or active periodontal disease must be treated before an orthodontic therapy can be initiated. Shortly before the surgery, a dental cleaning and, if necessary, root planning, must be carried out. Also, a three-dimensional examination (cone beam) of the jaw and/or mandible is necessary to determine the root axis, the cortical thickness and chin foramens in the mandible.

## _Laser-assisted corticotomy: "lasercision" corticotomy procedure

The erbium laser has successfully been used for many years in high-precision bone and muco-gingi-

**Figs. 5a–f**_Initial situation.

val surgery (sinus lift, crown lengthening, endodontic surgery, periodontal surgery etc.). There are two erbium laser types: Er:YAG (lasing medium erbium-doped yttrium aluminium garnet, wavelength λ = 2,940 nm) and Er,Cr:YSGG (erbium, chromium: yttrium-scandium-gallium garnet, λ = 2,780 nm). It is important to highlight that erbium lasers are the only kind of lasers used in odontology that enable a surgical treatment of hard tissue.

In 2012, Seifi et al. showed that corticotomies without flaps which were carried out with an erbium laser (Er,Cr:YSGG, Waterlase, Biolase, United States) on rabbits accelerated dental displacement.[18] The ablative effect of the erbium laser on the osseous cortical leads to a RAP reaction without any post-surgical consequences or side-effects. We suggest a minimally invasive alveolar corticotomy method without muco-gingival flap using an erbium laser: the Lasercision corticotomy procedure.

*Functional principle of the erbium laser*

The wavelengths of erbium lasers (2,940 and 2,780 nm) are strongly absorbed by water and hydroxylapatite. The pulse energy leads to immediate localised vaporisation of the water molecules (5 µm depth). A brutal elevation of the intratissue pressure will trigger a micro-explosion (also called explosive vaporisation) and the dissociation of cells from the target tissue. This is the photo-ablative effect. There is also a direct action on the hydroxylapatite (photo mechanical effect), but this is less severe. Because of the strong absorption of water, there is no carbonisation of the target tissue. Furthermore there is no distal thermal effect and therefore no tissue necrosis risk. The ablation concerns only a small area (5 µm depth), resulting in an extremely fine incision.

*Clinical procedure using an erbium laser*

The intervention is carried out some days after orthodontic brackets have been installed or on the same day if transparent aligners are used. We use the LightWalker® Er:YAG laser ( λ = 2,940 nm) from Fotona (Ljubljana, Slovenia). We used 2 W on the attached gingiva (energy = 200 mJ, pulse frequency = 10 Hz, MSP mode and water and air sprays) and then 3 W (energy = 200 mJ, pulse frequency = 15 Hz, QSP mode and water and air sprays). This is sufficient for attaining a rapid gingival and bone ablation without the risk of thermal injuries.

Beforehand, we use local anaesthesia. With chiseled, sapphire tip, we make an extremely fine incision into the gingiva and the bone. The intervention occurs vestibularly only. We penetrate the attached gingiva directly with the tip up to the cortical bone. The tip must always be at an angle of 45 to 60 degree to the

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Fig. 6a

Fig. 6b

Fig. 6c

**Figs. 6a–c**_Situation immediately after the maxillary surgery. We carried out the mandible intervention 15 days afterwards as requested by the patient.

surface. The tip works in pre contact mode. The gingiva and osseous cortical should not be touched. We recommend starting the incision at the level of the muco-gingival junction and continuing up to the papilla without harming it. Several passages are necessary. We recommend "sweeping" the surface by starting at the initial spot each time so that the tip does not tear the gingiva. We then perform an ablation of the alveolar bone between every tooth that needs displacement, just as with the attached gingiva (sweeping from apical to coronal so that the cortical is not touched by the tip).

The depth of intracortical penetration is about 2 to 3 mm depending on the depth of the cortical, measured with the cone beam. The osseous cortical must never be pierced. The depth of penetration is measured with a graduated periodontal probe. It is important to stay within the attached gingiva and to reduce the incision cut into the strongly vascularised mucosa. However, it is possible to penetrate the mucosa with the tip in order to reach the osseous under the cortical so that a more extensive apical corticotomy can be realised. We do this systematically. It is possible to also carry out a gingival and/or osseous graft in the areas where the cortical is of low depth by lifting the gingiva between the individual incisions, as described by Sebaoun et al.[19]

At the end of the intervention, haemostasis is carried out using sterile pads. There is no suture because gingiva heals very quickly. Antibiotics are also not necessary (the laser has a bactericide effect). Most of the time, the patient feels no pain after surgery, only a prickling sensation (analgetic effect of lasers). There is no oedema (anti-inflammatory effect of lasers). The patient can return to their workplace on the same day. The follow-up appointment is one week after the intervention. The orthodontic archwires must be changed every 15 days (instead of 4 to 6 weeks). Aligners must be changed every week (instead of 2 to 3 weeks).

*Advantages of the erbium laser in corticotomies*

Using a laser has many advantages as compared to conventional treatments:

- As the laser is used in pre contact mode, the patient feels no unpleasant sensation during the intervention (no vibration etc.);
- No post-surgery pain or oedema (analgetic and anti-inflammatory effect of the laser due to biomodulation);

**Figs. 7a–f**_Situation immediately after the mandible surgery and healing status 15 days after the maxillary surgery.

Fig. 7a

Fig. 7b

Fig. 7c

Fig. 7d

Fig. 7e

Fig. 7f

Fig. 8a

Fig. 8b

Fig. 8c

**Figs. 8a–c**_Healing status 15 days after the mandible surgery.

– No heat (air and water spray), so no risk of tissue necrosis;
– Gingiva heals very quickly and without scars (biomodulation effect on the healing and scarring process of the gingiva);
– Thanks to using a fine tip, a more extensive corticotomy can be carried out under the mucosa without harming it;
– Quick treatment with a power of about 3 W;
– Possible link to the biostimulation effect of all lasers (LLLT) – several studies show an effect on the acceleration of dental displacement.

## _Clinical cases

*Case 1*

Mr G was transferred to us by a colleague and we were asked to perform orthodontic treatment before a global maxillary and mandible rehabilitation with ceramic veneers and crowns was to be carried out. The patient is not happy with his smile and wants an optimal, long-lasting solution. He has a class II, two with a slight DMD, a strong supraclusion and a maxillary constriction resulting in a pronounced linguoversion of his teeth and significant wear. The initial situation renders a successful prosthetic rehabilitation unlikely. The patient wishes a quick and aesthetic orthodontic treatment. We choose transparent aligners and laser-assisted corticotomies (Figs. 1a–f, 2a–d, 3a–d, 4a–f).

*Case 2*

Ms P presents with a class II, two malocclusion and a 5 mm DMD. The patient feels that misalignement has increased over time. She feels self-conscious because of her smile and does not want the situation to worsen. She wants a quick and aesthetic solution. We choose transparent aligners combined with laser-assisted corticotomies (Figs. 5a–f, 6a–c, 7a–f, 8a–c).

## _Conclusion

Laser-assisted alveolar corticotomies or the Lasercision Corticotomy Procedure is a minimally invasive technology which is reliable, very well tolerated by the patients and has all the inherent advantages of laser treatments. This method has plenty of potential for the years to come as more and more dental clinics decide to buy laser equipment. Furthermore, the procedure still has simplification potential.

Due to the development of aesthetic methods and minimally invasive corticotomies, today adult orthodontics forms an inherent part of the treatment plan of general physicians. Orthodontics can make prosthetic rehabilitation easier (obtaining a better occlusal stability, molar ingressions with antagonist teeth lacking, new space in case of versions, axe straightening for minimally invasive prosthodontics restorations etc.) and improves long-term results of periodonteum treatments (better hygiene, occlusal stability etc.). Last but not least, obtaining a harmonious and stable occlusion will positively impact TMJ and general locomotor system pathologies.

Even though the overall duration of treatment will be prolonged, the functional and aesthetic results will more than justify this for our patients._

*Editorial note: A list of references is available from the publisher.*

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