Revista Odontológica Mexicana

Facultad de Odontología

Vol. 20, No. 2 ● April-June 2016

pp 80-90

ORIGINAL RESEARCH

Corticotomy: historical perspective

Corticotomía: perspectiva histórica

Patricia Olguín Vargas,* Beatriz Raquel Yáñez Ocampo§

ABSTRACT

Introduction: An exposition is presented of different techniques and philosophies provided through time for corticotomy procedures from its origin or first listing in 1892 to the present or last modification in 2012. **Method:** Bibliographic search was undertaken on the subject of corticotomy in order to document modifications experienced by their surgical technique and offer evidence which might allow to make decisions based on scientific evidence. **Results:** Presentation of a series of tables where all techniques are recorded, including authors and years of description or proposal. **Conclusions:** Mechanism behind corticotomy procedures can be summarized as the induction of bone metabolism through decortication executed around teeth that are going to be moved to increase bone replacement, this improves and accelerates orthodontic tooth movement.

RESUMEN

Introducción: Se expone la evolución de las diferentes técnicas y filosofías que a través del tiempo ha presentado la corticotomía, desde su origen o primer registro en 1892 hasta el momento presente o última modificación del 2012. **Método:** Se realiza una búsqueda bibliográfica sobre el tema de corticotomía con la finalidad de documentar las modificaciones que ha tenido esta técnica quirúrgica y ofrecer la evidencia que permita la toma de decisiones basadas en una evidencia científica. **Resultados:** Se presenta una serie de cuadros en los cuales se registra cada una de las técnicas, su o sus autores y el año en el que fue descrita o propuesta. **Conclusiones:** El mecanismo detrás de la corticotomía puede resumirse como la inducción del metabolismo óseo mediante la decorticación que se realiza alrededor de los dientes que van a moverse para aumentar el recambio óseo, esto mejora y acelera el movimiento dentario ortodóncico.

Key words: Corticotomy, accelerated osteogenic orthodontics (AOO), periodontally accelerated osteogenic orthodontics (PAOO).
Palabras clave: Corticotomía, ortodoncia osteogénica acelerada (AOO), ortodoncia osteogénica periodontalmente acelerada (PAOO).

INTRODUCTION

The present article purports the aim of providing the reader with a historical perspective of corticotomy procedures, as well as exposing the evolution of different techniques and philosophies presented through time for this procedure, from its first recording in 1892 until its latest modification in 2012.

Corticotomy consists in a surgical maneuver where a cut or perforation is undertaken in the cortical portion of the bone. It can be achieved with cutting hand instruments such a high or low speed rotary instruments as well as with electrical hand-pieces, under constant and abundant irrigation. This procedure enables osteoblast and osteoclast activation thus facilitating tooth movement with favorable bone response.[1]

The target of this procedure is to pass cortical bone and touch medullar bone in order to stimulate bone replacement, thus providing easier orthodontic treatment. Corticotomy is characterized by a three to four times decrease of time in orthodontics treatments, additionally decreasing root resorption and achieving greater stability when compared to conventional orthodontic treatment.[2]

Among advantages achieved with this surgical procedure we can count the following: decrease of treatment time,[3] lesser orthodontic limits, providing thus more extensive movements without periodontically compromising the patient,[3] greater stability after treatment due to the socket's de-mineralization/re-mineralization process in initial circumstances and presence of neo-formed bone once orthodontic movement is completed,[4] decrease of extraction possibility and risk of root resorption,[2] decrease of periodontal ligament hyalinization in alveolar walls

* School of Dentistry Graduate.
§ Professor at the Implantology and Periodontics Department, Graduate and Research School, National School of Dentistry.

National Autonomous University of Mexico (UNAM).

Received: August 2015. *Accepted: November 2015.*

This article can be read in its full version in the following page: http://**www.medigraphic.com/facultadodontologiaunam**

caused by forceful and extensive movements.[4] It additionally allows correction of depression-shaped vestibular anatomical defects which often accompany narrow alveolar crests.[5]

Disadvantages of this procedure are the following: the fact that just like any surgical procedure, it might elicit pain and inflammation, it is not suitable for all patients, patient selection will depend on their systemic and oral circumstances to determine whether they are candidates for this procedure or not. In order to be able to achieve this procedure, there is a series of indicators such as having a 10 mm bone remnant in apical-crown direction,[5] a 7 mm minimum in vestibular-lingual direction, at least 3 mm thickness of alveolar bone, as well as sufficient amount of medullar bone between cortical bone in order to avoid fractures.[5] Corticotomy is used to undertake intrusion and extrusion movements or open bite closure,[4] as well as to potentiate correction of severe to moderate malocclusions and to achieve more extensive movements in a very short time when compared to conventional orthodontic treatments.[6]

Contraindications for a corticotomy procedure are the following: absence of medullar bone to provide suitable vascularization,[5] active periodontal disease,[4] thin bone crest,[5] inadequately endodontically treated teeth or teeth with periapical reactions previous to surgery,[1] ankylosis or systemic disease such as uncontrolled diabetes, blood dyscrasias or coagulopahties,[4] as well as patients ingesting drugs which change bone metabolism such as bi-phosphonates or non steroid anti inflammatory (NSAIDs) drugs, since these drugs inhibit prostaglandins and thus inhibit osteoclastic activity.[2]

DIFFERENT CORTICOTOMY SURGICAL TECHNIQUES

L.C. Bryan in 1892 was the first to report use of corticotomy as an adjuvant for malocclusion correction procedures. He reported cases of American Dental Society at a later date, in 1893, Cunningham presented the possibility of immediate correction for irregularly placed teeth.[7,8]

Bone block technique (Köle 1959)

In 1959 Heinrich Köle introduced the description of a corticotomy technique associated to orthodontic treatment to accelerate dental movement under the theory of bone block movements.[5] He proposed that tooth movement could be achieved in shorter time if interdental and osteotomies cuts were performed, since cortical bone represented greater resistance to tooth movement, and thus, if cortical bone continuity was altered, tooth movements could be achieved in shorter time.[5]

This surgical technique consisted on raising a muco-periosteal flap (from a vestibular and lingual/palatal direction), and conduct osteotomies in inter-radicular and supra-apical sites. Cuts should measure 10 mm and be located above all apexes; a perpendicular (horizontal) cut should be undertaken, achieving thus separation of small-sized bone blocks to provide acceleration of orthodontic movement *(Figure 1)*.[4] It is important to point out that most movements described by Köle were movements conducted with orthopedic forces applied through removable devices adapted by adjustable screws. Since this technique was highly invasive it garnered little acceptation.[2,4]

The advantage of this technique was that it provided faster tooth movement in shorter time (approximately 6 to 12 weeks). This procedure was recommended for separation of single or grouped teeth, it was used to achieve distally-oriented movements after an extraction *(Figure 2)*.[4]

Fast orthodontics (Chung 1975 and 1978)

A new technique called *Fast Orthodontics* was proposed by Chung between 1975 and 1978. This technique combined cuts with orthopedic forces

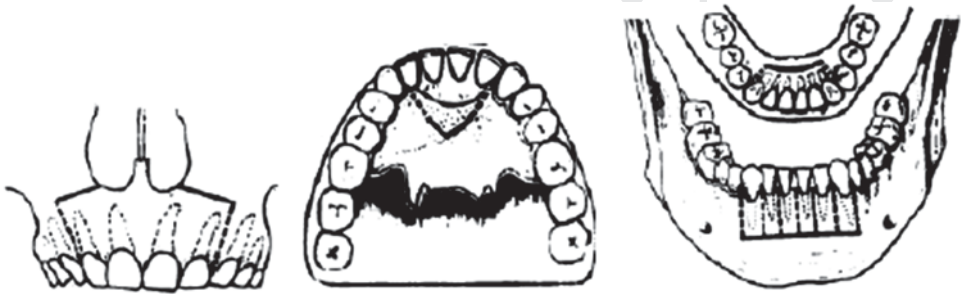


Figure 1.

Bone block[8] Köle osteotomies.

Figure 2.

Separation of small bone blocks per dental unit.[8]

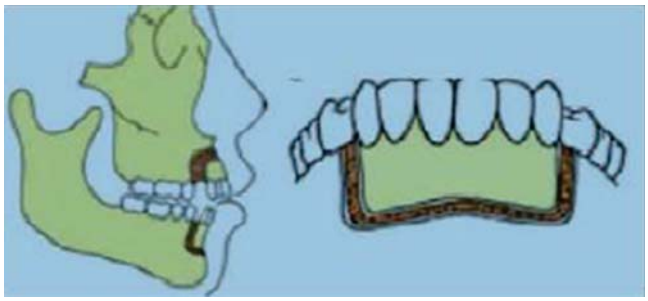


Figure 3. Chung's perisegmental osteotomy.[4]

exerted with intra-osseous anchoring devices which normally were mini-plates or implants. The surgical cut had a «C» shape and biologically attempted to generate compression-osteogenesis in the osteotomized segment *(Figures 3 and 4)*.[4] Correction of anterior protrusion with or without open bite was among suggested indications.[6]

Disadvantages of this technique were its invasive nature,[4] and the fact that osteotomies were performed at different surgical times with lapses of 2 to 3 weeks separating them.[6]

Limitations for this technique were the sort of removable devices used at the time which were insufficient to provide required forces after corticotomies procedures; said forces were the key factor to achieve treatment success.[5]

The aforementioned techniques were considered very aggressive and invasive, therefore, several authors began their modification, exchanging osteotomies for corticotomies; since osteotomy consists on performing surgical incisions through cortical bone transgressing medullar bone and corticotomy is the surgical technique in which only cortical bone is cut, perforated or mechanically altered until reaching medullar bone, which remains intact.[2]

Selective alveolar technique

In 1978, Generson modified Köle's technique by replacing supra-apical osteotomy for supra-apical corticotomy;[2] he described a method of open bite treatment using selective alveolar corticotomy in conjunction with orthodontic treatment *(Figures 5 and 6)*.[4]

Figure 6 shows vertical cuts only performed in vestibular cortical bone; joined with horizontal corticotomy (supra-apical); penetration in the thinnest cortical bone can be observed.

Up to this moment it was considered that accelerated dental movement could be due to an individualized displacement of the bone segment.[3]

Accelerated osteogenic orthodontics, AOO (Wilcko 2001)

In 2001, Wilcko reported two cases of corticotomy treated patients assessed through computerized tomography. In that study he proposed that speed of dental movement is due to local and transitory de-mineralization and re-mineralization in the alveolar bone which was compatible with regional acelerated phenomenon (RAP). This phenomenon was first described by the orthopedist H Frost in 1983, he showed that the design of the corticotomy was not responsible for accelerated dental movement, since this movement was caused by the degree of metabolic alteration. Wilcko's AOO technique required palatal and vestibular approach with de-corticalization, using rotary systems and orthodontic appliances. Although

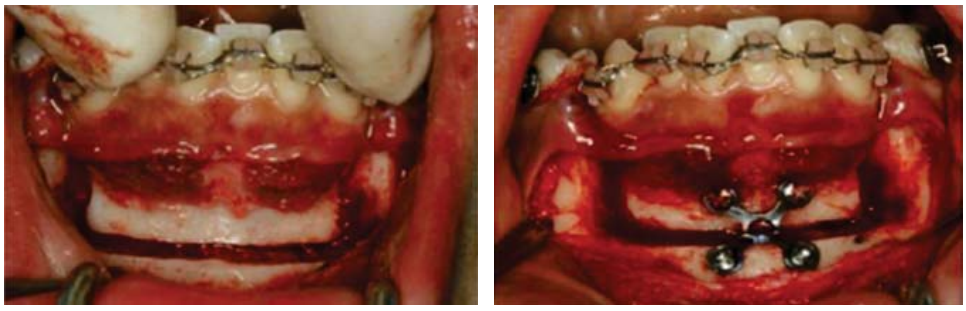


Figure 4.

Chung's osteotomy design with intra-osseous anchorage devices.[9]

Figure 5.

Selective alveolar corticotomy.[7]

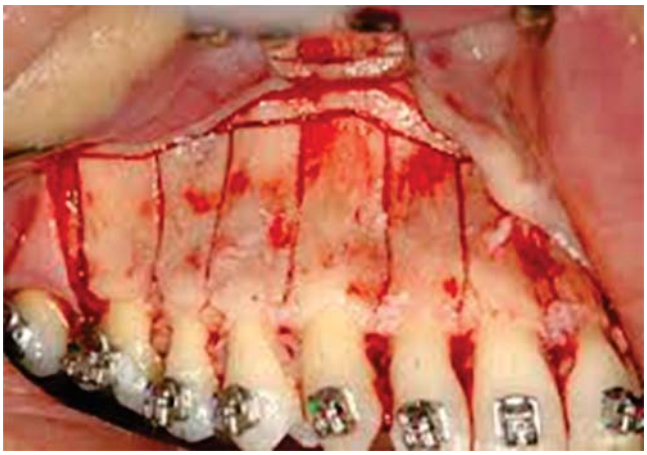


Figure 6. Selective alveolar corticotomy.[10]

yielding suitable results, this technique is considered invasive.[2]

The most important advantages of the AOO technique are the decrease of dental movement limits as well as avoidance of extractions.

The Wilcko brothers modified their AOO technique by incorporating bone graft to the aforementioned «osseous activity» in order to increase alveolar bone. This technique was renamed «periodontally accelerated osteogenic orthodontics» (PAOO), the comprehensive procedure was recorded as Wilckodontics *(Figure 7)*.[4]

Periodontically accelerated osteogenic orthodontics (PAOO), (Wilcko 2001)

This technique, proposed in 2001 by the orthodontist and periodontist Wilcko brothers is executed in three surgical phases.[4]

First phase: selective alveolar decortization was conducted, and a total thickness (muco-periosteal) flap was raised.[2] Vertical corticotomies were executed in inter-radicular spaces, (vestibular/lingual/palatal) with a number 1 round burr, preserving a distance of 2-3 mm to the osseous crest and exceeding by 2 mm the dental apex.[2] According to each case, vertical corticotomies were linked to semi-circular corticotomies in the upper or lower portion of the apex *(Figure 8)*.[4] After this, 0.5 mm deep perforations were undertaken on the root of the tooth with a round burr. These perforations were limited to vestibular and lingual cortical bone and had the aim of providing maximum bleeding *(Figure 9)*.[4] This technique recommends to locate perforations in the thickest areas of cortical bone, following dental root morphology.[4]

Second phase: consists on following alveolar increase procedures by placing bone graft material. Decalcified matrixes stimulate osteoblastic activity *(Figure 10)*, thus, after procedure, alveolar volume increase is achieved. Flaps are sutured with 4-0 silk or 5-0 Gortex; sutures are removed 2 or 3 weeks later, depending on post-surgical assessment.[4]

Third phase: It consists on application of orthodontics forces every two weeks. It is

Figure 7.

Corticotomy technique (PAOO).[11]

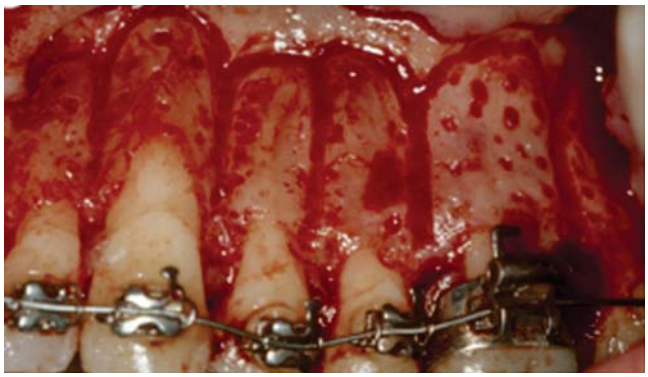


Figure 8. Link of inter-radicular vertical corticotomies with semi-circular cortcotomies at the apical third.[3]

recommended to place appliances one week before corticotomy, although they can be placed 2 to 3 weeks after surgery so as to facilitate surgical procedure *(Figure 11)*. Orthodontic activations can be conducted every two weeks. Movement rate achieved with this technique is 1-2 mm per week, in comparison with the single monthly millimeter achieved with a conventional orthodontic treatment.[4]

Advantages of this technique are the following: excellent visibility to execute procedure, possibility of achieving corticotomies with electrical scalpel or burr,[2,4] treatment time decrease,[4] faster dental movements lacking associated root resorption or pulp lesion in teeth subjected to dental movement,[13] accelerated canine retraction after premolar extraction.[13,14] Execution of alveolar increase and remodeling (covering with bone graft) improves gingival esthetics.[4] Disadvantages of this technique are prolonged surgical time as well as tissue inflammation proportional to treatment, ecchymosis and pain.[2]

Modified corticotomy technique

Germec published an article in 2006 where he presented his modified corticotomy technique. This technique significantly reduced surgical procedure time; it is a mono-cortical technique eliciting no negative effect in periodontal tissues, preserving as well pulp vitality of treated teeth. One week before undertaking surgery, it is recommended to stabilize upper and lower arches with 0.016" x 0.022" stainless steel arches.[15]

The main indication to use this technique is in patients with difficult lingual or palatal surgical access. Its greatest advantage lies in elimination of palatal or lingual flaps, as well as cuts in the cortical bone at the site; this results in surgical time decrease and thus greater comfort and lesser stress for the patient.[15]

Infiltrative local anesthesia is used in this surgical technique; a mucoperiosteal flap is raised from a vestibular direction, under dental apexes. Vertical cuts must be achieved with a low speed, 0.5 mm diameter stainless steel round burr, from the gingival margin up to 2 or 3 mm underneath dental apexes, with a 1.5 to 2 mm depth on the cortical bone *(Figure 12)*.[15]

Monocortical technique for dental dislocation and periodontal ligament distraction proposed by Vercelloti and Podesta (MTDLD)

In 2007, Vercelloti and Podesta proposed a vestibular approach corticotomy procedure executed with electrical hand-piece. This technique was called monocortical technique for dental dislocation and periodontal ligament distraction (MTDLD).

It was initially developed through dental pressure which caused periodontal compression, where there was rapid root (dislocation) and bone cortical unit movement without eliciting periodontal ligament compression or bone resorption (MTD), after this follows a rapid distraction of the periodontal ligament (LD) to culminate in an osteogenic healing process.

This technique arose due to a desire to maximize dental movement speed, preventing thus periodontal tissue damage. Since cuts are executed with an

electrical scalpel, which due to mitochondrial activation and cell reproductive capacity offers the advantage of causing minimum morbidity, rapid tissue regeneration and minimal damage are elicited.[4] Stages for this technique are similar to those described by the Wilcko brothers, but with the difference of being conducted in a mono-cortical manner, and with an alveolar crest modification where «Y» shaped cuts are performed in order to preserve the alveolar crest.

Figure 9. Perforations on the root of the tooth.[3]

During surgery, 0.5 mm -deep longitudinal interproximal cuts are performed in the vestibular cortical bone, one horizontal incision of same depth is equally performed at 1-2 mm above apexes, said incision is completed in a «Y» shape *(Figure 13)*.[4]

Alveolar increases are undertaken in selected cases where vestibular cortical bone thickness increase is required; this increase is achieved with autologous bone harvesting in the shape of chips from alveolar bone apical zone or through a 0.21-1 mm sliver of Bio-Oss®, in which case the graft is lined with BioGide® resorbable collagen membrane. With respect to orthodontic forces application it is preferred to immediately place appliances once corticotomies have been completed, so as to facilitate surgical procedures.

It is recommended to initiate force application from one to seven days after surgery completion, keeping activation rhythm every two weeks. It is advisable to examine the patient every week so as to avoid appearance of interferences which could block dental movement.[4]

This technique is recommended for over-erupted teeth and to faster achieve retained canine exposition. Advantages of this technique are that it is minimally invasive and less traumatic, and the fact of performing «Y» shaped incisions preserves the alveolar crest.[4]

Figure 10.

Bone graft placement.[10]

Figure 11.

Placement of appliances is recommended one week before corticotomy.[12]

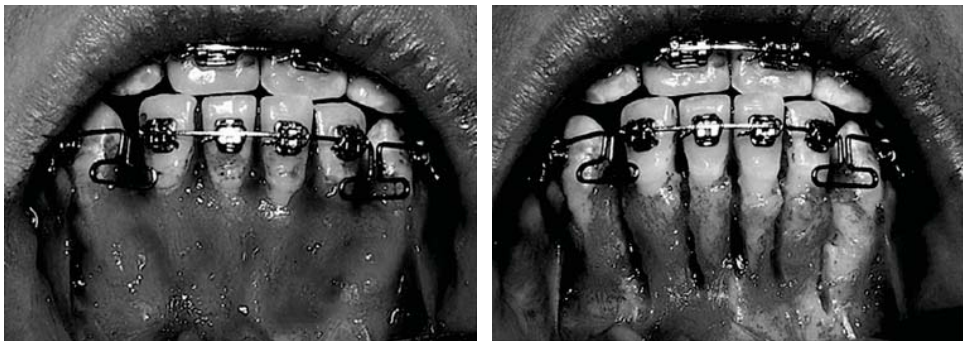


Figure 12.

Germec modified corticotomy.[15]

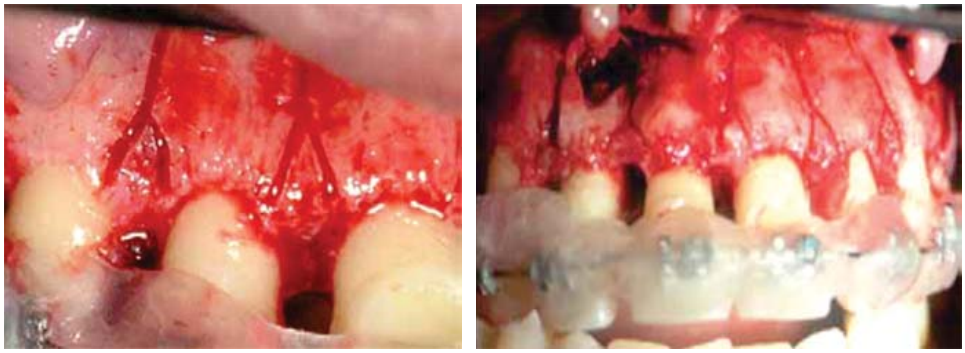


Figure 13.

Illustration of «Y» shaped cuts to preserve alveolar crest.[16]

Figure 14. Vertical micro-incisions in vestibular inter-radicular spaces from the papilla base.[2]

Piezocision technique[1] (Dibart 2009)

In 2009 Dibart published a trans-mucosal corticotomy technique called piezocision. It is considered less invasive than the others while providing the same results. It decreases orthodontic treatment time in patients with reduced or intact periodontium, and achieves better results with less aggressive procedures.

In this surgical technique, vertical mini-incisions are performed with a number 15 scalpel micro-blade in vestibular inter-radicular spaces located from the base of the papilla, after this, trans-mucosal corticotomies are performed through previously executed incisions, at a 2 to 3 mm depth. It is not necessary to suture unless there was previous tunnel-building for bone implant placement. Orthodontic forces are applied every 14 days *(Figure 14)*.

The advantage of this technique is that it is minimally traumatic, therefore post-surgical presence of pain, inflammation and ecchymosis is infrequent, since no full-thickness flap was previously raised[1,2] and surgical time was short. This technique decreases damage to osteocytes and allows bone cell survival.[1] One of the most important advantages of this technique is that the use of electrical scalpel, due to its micro-vibration, allows selective cutting of mineralized structures without damaging soft tissues. This is due to ultrasonic vibrations of 29 kHz frequency and 60/200 Hz range. Micro-metric vibration guarantees precise cutting *(Figure 15)*.[1] This technique suffers the disadvantage of allowing poor visibility, unavoidably requiring electrical scalpel use, and difficulties inherent to control bone graft.[2]

Technique for intrusion of molars with maxillary splint (Oliveira 2010)

In 2010, Oliveira published an article where he described a combination of alveolar corticotomy

with a modified maxillary splint with nickel-titanium spring. The aim of this technique was to intrude over-erupted molars *(Figure 16)*.[7]

Oliveira reported that in one patient, 4 mm intrusion was achieved in 2.5 months, and in another patient, 3 to 4 mm intrusion was accomplished in 4 months.[7] This technique is used in adult or young patients with healthy or reduced periodontium; it facilitates bi-maxillary protrusion correction, closure of skeletal open bite, intrusion of molar with removable appliances and treatment of patients with cleft lip and palate.

In the surgical technique, a full-thickness flap is raised from a vestibular, palatal or lingual approach, on the area where dental movement is to be conducted. After this, vertical corticotomies are performed with a round 701 burr in inter-radicular spaces 2 mm away from the alveolar crest and surpassing by 2 or 3 mm dental apexes, care must be exerted to barely touch medullar bone. At this height, horizontal corticotomies are performed to link vertical corticotomies *(Figure 17)*.

Figure 15. Trans-mucosal corticotomies through incisions previously achieved with electrical scalpel.[2]

Once the aforementioned is completed, the flap is repositioned and sutured, placed on a modified acrylic splint, and leaving uncovered the occlusal aspect of the molar to be intruded. Seven days later orthodontic forces are applied, and after this, forces are applied every 14 days until desired intrusion is achieved *(Figure 18)*.[7]

Advantages of this technique are the following: it facilitates difficult orthodontic movements, allows for significant transversal and anterior-posterior dental expansion, corrects moderate to severe skeletal malocclusions, and provides clinical results twice or three times faster when compared to conventional orthodontic treatment.[7]

Minimally invasive procedure conducted with endoscopy-assisted tunnel[6] (2012)

This technique was published in 2012. It can be considered the most conservative technique when compared with others; it decreases trauma to periodontal tissues during trans-surgical periods

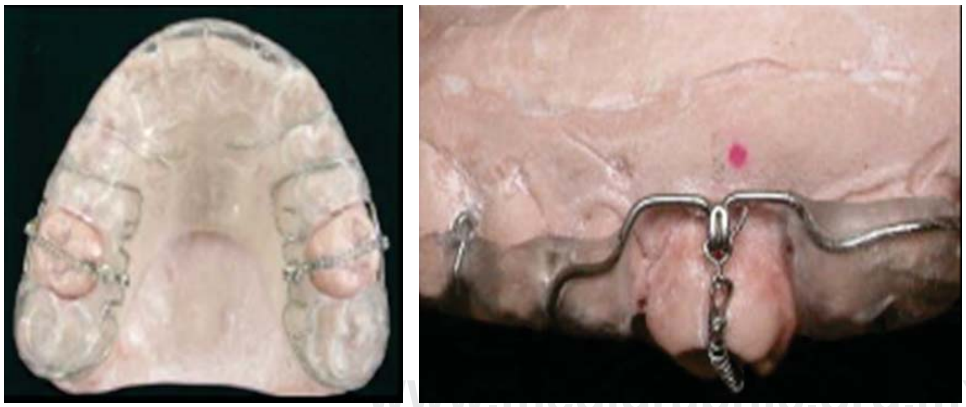


Figure 16.

Maxillary modified splint with Nickel-Titanium spring.[7]

Figure 17.

Corticotomy executed in the molar to be intruded, to later place a nickel-titanium spring.[7]

and post-operative discomfort, as well as surgical time since it can be accomplished in about 26 minutes.

This technique was first described in 2010. Computed tomography (Cone-Beam) will be needed in order to consider a patient as a possible candidate. Criteria to take into account are the following: Teeth to be moved and anchorage teeth, periodontal circumstances, root position and morphology as well as width of cortical bone.

Advantages of this technique are: decrease of surgical time, periodontium preservation, since it is not required to raise a muco-periosteal flap, patient's easy acceptance of the technique, maximum decrease of post-surgery inflammation since the technique is performed only in the upper or lower anterior section.[6]

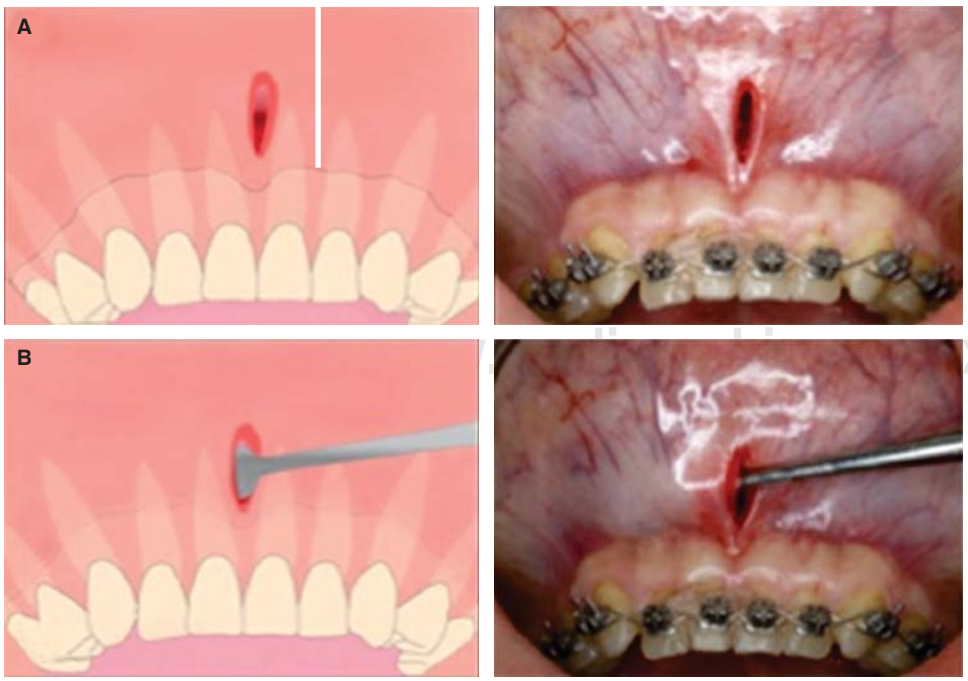
In order to execute this technique, a 5-10 mm full-thickness vertical incision is performed from a vestibular approach at the upper midline to treat the anterior segment, or behind the upper canine in cases when the posterior segment is to be treated. A sub-periosteal dissection is performed on the roots of the teeth with a sharp periosteal elevator *(Figure 19A)*, a full thickness vertical incision is performed from a vestibular approach on the midline *(Figure 19B)*. A «tunnel» sub-periosteal dissection is performed.

After this, an electrical micro-saw is introduced into the created tunnel and vertical corticotomies are executed from a vestibular approach following the length of the root, without touching the alveolar crest *(Figures 19C and D)*.[6]

With the help of an endoscope through 1.9 mm optic fiber it is possible to control cuts on cortical

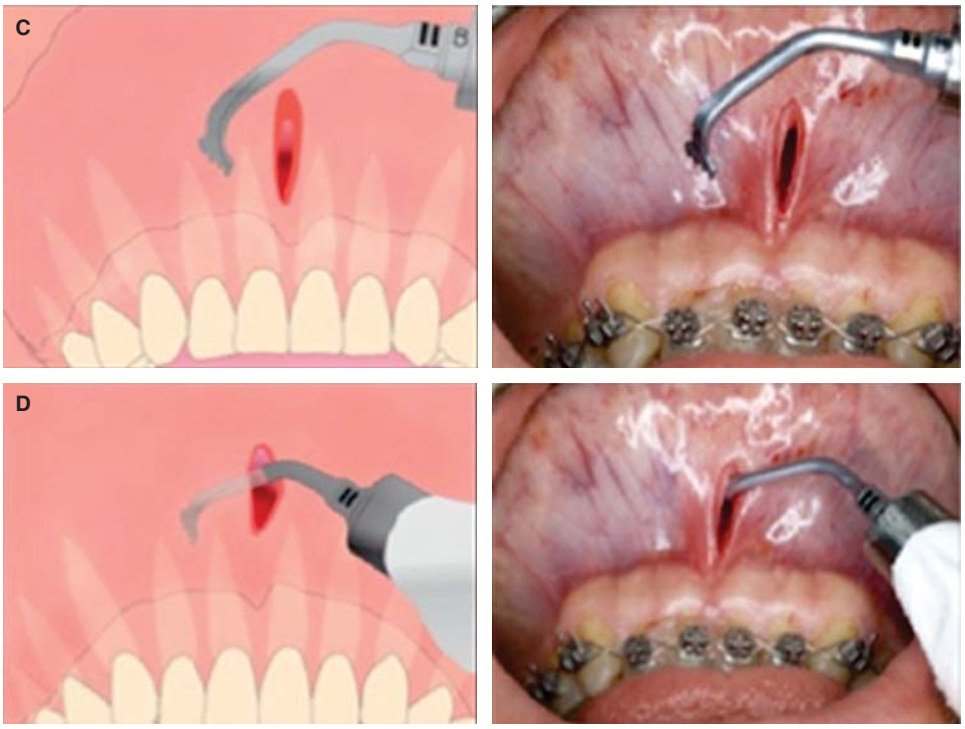
Figure 18.

Inter-consultation with orthodontics specialist from beginning of treatment until achieving molar intrusion.[7]



Figures 19A and B.

Vestibular approach with 5 to 10 mm full thickness incision.[6]



Figures 19C and D.

Surgical procedure with electrical micro-saw.[6]

bone, when the saw reaches cancellous matter, bleeding can be observed by means of the endoscope *(Figure 20)*.[6]

If resistance is met by the micro-saw, it means that it was placed on root surfaces, therefore, direction of cuts must be changed. Computerized tomography is used to assess corticotomy depth. Lastly, incisions are uninterruptedly sutured with 5-0 polyglactine *(Figure 21)*.[6]

This technique is presented as the most conservative. Small incisions are performed with the piezoelectrico in the cortical bone. Number of incisions will depend on amount and placement of teeth in the quadrant to be treated. Light afforded by the endoscope and wider image are important advantages as well as achieving better control in root position.

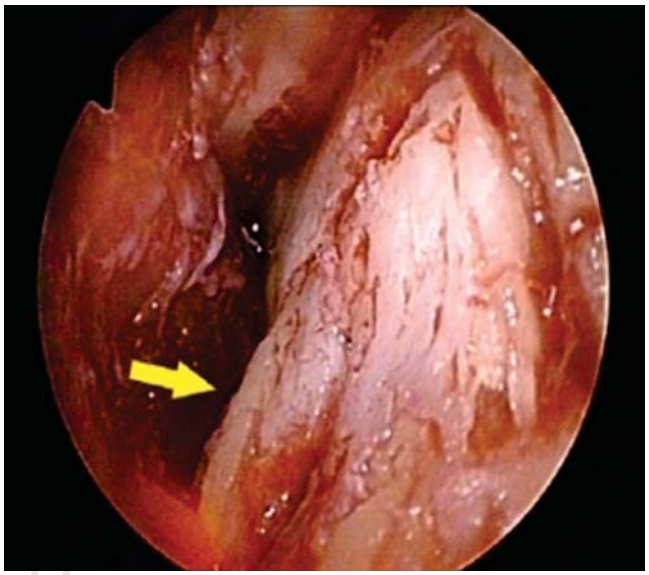


Figure 20. Close-up with endoscope to assess bleeding.[6]

DISCUSSION

When compared to conventional orthodontic treatments, it can be said that corticotomy is a technique through which dental movements can be achieved or facilitated; orthodontic treatment time can decrease and stability at treatment completion can be increased.

History shows us how techniques have been evolving, evidence compels us to discard initial thoughts which considered that accelerated dental movement or results were consequence of the displacement of bone blocks. Presently, clinical and histological findings indicate that corticotomy design is not responsible for dental movement, it rather potentiates dental movement as a result of the bone de-mineralization/re-mineralization physiological process; RAP is a local and transitory response to remodeling and is followed by post-surgical healing

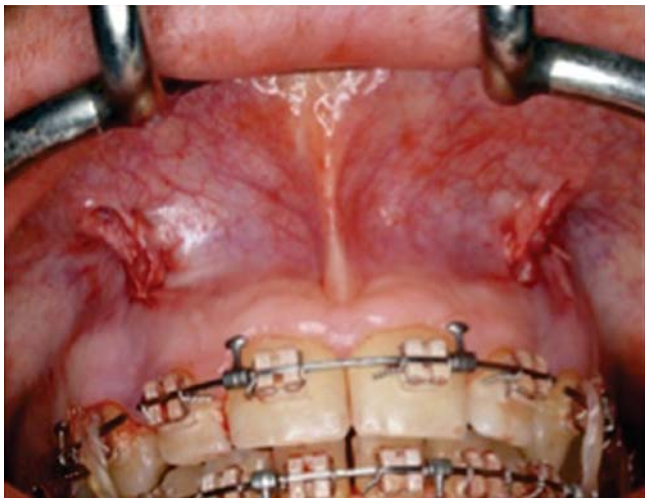


Figure 21. Incision suture.[6]

of cortical bone when facing a physical stimulus. As a consequence, latest techniques have proven to be conservative and biocompatible with periodontal tissues, along with orthodontics forces of lesser intensity.

CONCLUSIONS

Mechanisms found behind corticotomy procedures can be summarized as bone metabolism induction through decortications, performed around the teeth which are going to be moved to increase bone replacement, this will improve and accelerate orthodontic dental movement.

It might be said that corticotomy mechanisms and effects have been documented in recently conducted histological studies, nevertheless, further studies conducted in human beings are required in order to confirm findings.

Clinically, evidence is mainly based on case reports, therefore more research on proposed surgical protocols is needed so as to determine which are the most efficient. It is also necessary to determine relationship with minimum trauma amount necessary to originate clinically significant RAP.

REFERENCES

1. Wilcko MT, Wilcko WM, Bissada NF. An evidence-based analysis of periodontally accelerated orthodontic and osteogenic techniques: a synthesis of scientific perspectives. *SeminOrthod*. 2008; 14: 305-316.
2. Robles-Andrade MS, Guerrero-Sierra C, Hernández-Hernández C. Ortodoncia acelerada periodontalmente: fundamentos biológicos y técnicas quirúrgicas. *Rev Mex Periodontol*. 2011; 2 (1): 12-16.
3. Wilcko MT, Wilcko WM, Pulver JJ, Bissada NF, Bouquot JE. Accelerated osteogenic orthodontics technique: a 1-stage surgically facilitated rapid orthodontic technique with alveolar augmentation. *J Oral Maxillofac Surg*. 2009; 67 (10): 2149-2159.
4. Stöber E, Genestra-Villalonga P, Molina-Coral A, Puigdollers-Pérez A. La corticotomía alveolar selectiva como coadyuvante al tratamiento de ortodoncia. *Rev Esp Ortod*. 2010; 40 (4): 215-230.
5. Dehesa-Ibarra B, Herrero-Climent M, Lázaro-Calvo P. La expansión quirúrgica de la cresta alveolar mediante corticotomía. *Gaceta Dental*. 2011; 22 (227): 130-149.
6. Hernández-Alfaro F, Guijarro-Martínez R. Endoscopically assisted tunnel approach for minimally invasive corticotomies: a preliminary report. *J Periodontol*. 2012; 83 (5): 574-580.
7. Oliveira D, Oliveira BF, Soares RV. Alveolar corticotomies in orthodontics: Indications and effects on tooth movement. *Dental Press J Orthod*. 2010; 15 (4): 144-157.
8. Köle H. Surgical operations of the alveolar ridge to correct occlusal abnormalities. *Oral Surg Oral Med Oral Pathol*. 1959; 12 (5): 515-529.
9. [Consultado julio de 2013] Disponible en: http://www.ortodontiacontemporanea.com/2012/04/entrevista-com-professor-dr-seong-hun_19.html.
10. [Consultado septiembre de 2013] Disponible en: http://www.google.com.mx/search?q=corticotomia&tbm=isch&tbo=u&source=univ&sa=X&ei=l5zCUeS8CoebygGb34GwDA&sqi=2&ved=0CDgQsAQ&biw=1366&bih=643
11. Ferguson DJ, Wilcko WM, Wilcko MT. Selective alveolar decortication for rapid surgical-orthodontic resolution of skeletal malocclusion treatment. In: Bell WE, Guerrero C, editors. Distraction osteogenesis of facial skeleton. Hamilton, BC: Decker; 2006. pp. 199-203.
12. Holmberg-Peters F, Holmberg-Peters F, Holmberg-Peters H, Sandoval P. Aplicaciones periodontales a ortodoncia. *Int J Odontostomat*. 2010; 4 (1): 71-80.
13. Hassan AH, Al-Fraidi AA, Al-Saeed SH. Corticotomy-assisted orthodontic treatment: review. *Open Dent J*. 2010; 4: 159-164.
14. Germeç D, Giray B, Kocadereli I, Enacar A. Lower incisor retraction with a modified corticotomy. *Angle Orthod*. 2006; 76 (5): 882-890.
15. Reyes-Obeso A, Enríquez-Habib F, Marín-González MG. Corticotomía: microcirugía ortodóntica en paciente con periodonto reducido: caso clínico. *Rev Odont Mex*. 2012; 16 (4): 272-278.
16. Oliveira DD, de Oliveira BF, de Araújo-Brito HH, de Souza MM, Medeiros PJ. Selective alveolar corticotomy to intrude overerupted molars. *Am J Orthod Dentofacial Orthop*. 2008; 133 (6): 902-908.

Mailing address:
Beatriz Raquel Yáñez Ocampo
E-mail: raquely0@yahoo.com.mx