Revista Mexicana de Ortodoncia

Vol. 5, No. 3 • July-September 2017
pp e178–e183

CASE REPORT

Alveolar transportation through bone anchorage and sliding mechanics**

Transportación alveolar mediante anclaje óseo y deslizamiento (TAAOD): técnica innovadora

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ABSTRACT

The reconstruction of hard and soft tissues in craniofacial anomalies is a great challenge in clinical practice. For a longtime, grafts have been the technique of choice in patients with cleft lip and palate; however, when the soft tissue that surrounds the cleft is insufficient to obtain adequate closure, failures have been reported. Alveolar transport has been applied for the closure of oronasal communication with adequate bone quality and quantity, allowing implant placement and final restoration. An innovative technique of alveolar transport with a curved trajectory is hereby presented respecting arch shape, unlike the techniques previously described, through a bone anchoring system and fixed orthodontic appliances with sliding mechanics resulting in a predictable and successful treatment.

RESUMEN

La reconstrucción de tejidos duros y blandos en anomalías craneofaciales es un gran reto en la práctica clínica. Por mucho tiempo los injertos han sido la técnica de elección en pacientes con fisura labio-alveolo palatina (FLAP), sin embargo, cuando el tejido blando que rodea a la fisura es insuficiente para obtener un cierre adecuado se han reportado fracasos. La transportación alveolar se ha aplicado para el cierre de la comunicación oronasal con adecuada calidad y cantidad ósea permitiendo la colocación de implante, movimientos dentales y restauración final. La transportación alveolar mediante anclaje óseo y deslizamiento (TAAOD) es una técnica innovadora de transportación alveolar con trayectoria curva respetando la forma del arco a diferencia de las técnicas antes desarrolladas, mediante un sistema de anclaje óseo y aparatología fija ortodóntica con el principio de deslizamiento. Dando como resultado un tratamiento predecible y exitoso.

Key words: Alveolar cleft, distraction osteogenesis, alveolar bone transport, bonegraft.
Palabras clave: Fisura alveolar, distracción osteogénica, transportación alveolar, injerto óseo.

INTRODUCTION

The correction of palatal alveolar clefts is a major challenge for the area of maxillofacial surgery and orthodontics. Placement of bone grafts in patients with this anomaly has been the most used technique to treat these disorders. However, when the surrounding soft tissues are insufficient to obtain a good closure, several problems have been described.[1]

Alveolar transport is the movement of a segment of bone surgically fractured and pulled in a gradual and controlled manner guiding it to the site of the fissure in a horizontal direction.

Among the factors that Ilizarov describes as being of great importance for the formation of new bone tissue when performing a bone transport are: preserve the most medullar and extra osseous blood supply, stable fixation, time of latency, respect the range of distraction of a 1 mm per day by means of small, frequent activations and a period of consolidation.[2]

Alveolar transportation is a technique that has gained acceptance in recent years. This procedure generates bony and soft tissue support, eliminates the morbidity of the donor site and has a high percentage

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See related content at doi: http://dx.doi.org/10.1016/j.rmo.2017.12.010

of success by the predictability of treatment, which makes it an ideal technique. One of its applications is for closure of oronasal communications, where bone formation is required with the precise quality and quantity needed to allow final rehabilitation.

Alveolar transport by means of bone anchorage and sliding (ATBAS) is an innovative technique of alveolar transport without the use of a distractor or screw, at low cost and with the advantages of distraction osteogenesis in a curved form respecting the trajectory of the dental arch by means of skeletal anchorage and fixed orthodontic appliances with the principle of sliding mechanics.

CASE REPORT

Female patient, 17 years of age, without pathological antecedents of importance and a diagnosis of sequel of unilateral left lip-alveolo-palatal cleft. Reason for consultation «I don't like my cleft, I want to close it» *(Figure 1)*.

Upon facial examination she presented a convex profile, depression of the nasal wing and lip on the left side. The intraoral findings of greater relevance were agenesis of the left and right upper lateral incisors, a 9 mm width and 16 mm in the vertical direction alveolo-palatal fissure and the transposition of the upper left canine and premolar.

Using ConeBeam a supernumerary tooth in the nasal floor was discovered in addition to the bone defect in the cleft area, extending up to the floor of the nose *(Figure 2)*.

A consultation was performed with the Maxillofacial Surgery and Dental Rehabilitation Service. It was decided to conduct an alveolar transport of the bone segment that included teeth #11, 14.21 without the use of an intraoral screw-type distractor, employing only a prototype with a skeletal anchorage system and self-ligating brackets.

Prior to the alveolar transport, self-ligating orthodontic appliances (3M Gemini SL) were placed to allow the segment to be transported to slowly slide through the 0.017" x 0.025" SS archwire.

Between teeth #13 and 14 root divergence was created for performing the osteotomy properly. A palatal arch was cemented to provide stability to both segments. A crimpable hook was placed between teeth #23 and 24 and Kobayashi ties were fixed to teeth #14, 21, 11 as anchorage for the accessory closed coil (Sentalloy 250 g). To avoid invagination of the spring into the mucosa an accessory labial arch anchored to the molar band tubes was placed, as a guide for the main closed coil (Sentalloy 250 g), anchored from plate to plate. With both springs a translation movement without rotation of the osteotomized segment to be transported is obtained *(Figure 3)*.

Three aesthetic stops were added to the archwire as space maintainers as well as ten rings made with

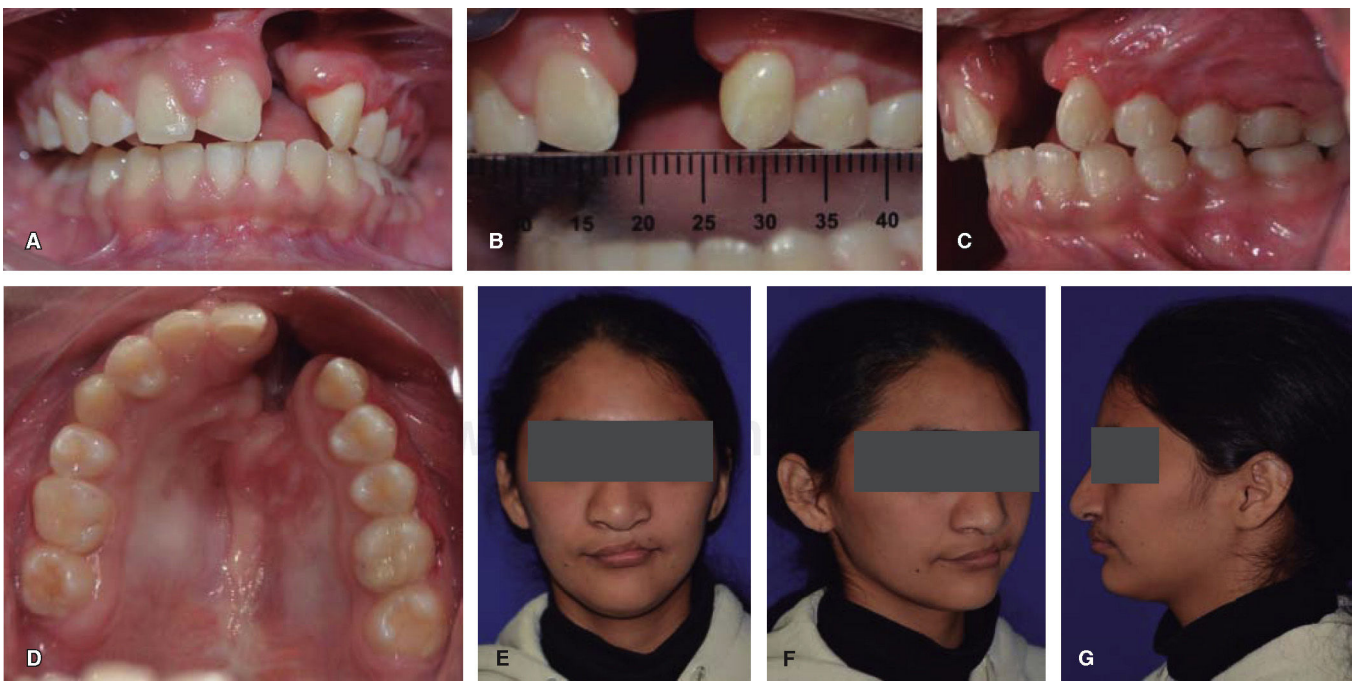

Figure 1. A. Front view. **B.** 9 mm fissure. **C, D.** Intraoral left photograph, occlusal. View **E, F, G.** Initial facial photographs.

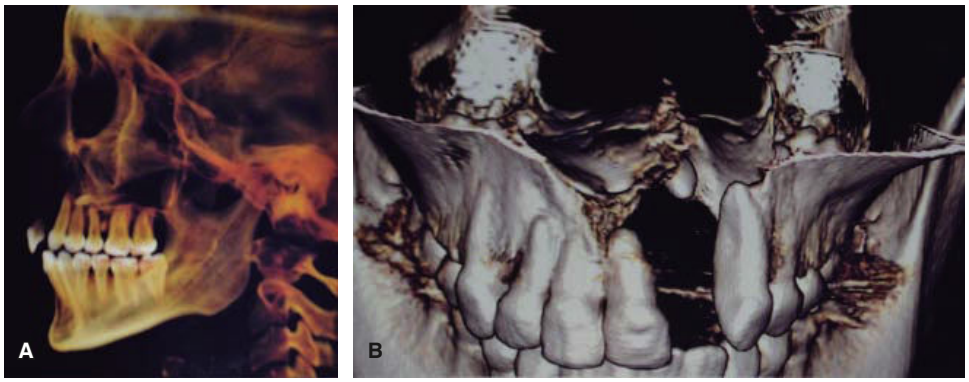

Figure 2.

Tomographic images. **A.** Sagittal view, the supernumerary is observed. **B.** Axial view where the width of the fissure may be observed.

Figure 3. Auxiliary labial arch as a guide for the closed coil anchored to the modified plates.

0.036" (0.9 mm) wire to control the displacement of the bone segment *(Figure 3)*.

Two stops were bonded mesial to the tube of teeth #16 and 26 to prevent the archwire from moving during the alveolar transport.

Under general anesthesia, a semi-Newman incision was made, the mucoperiosteal flap was performed and the bone tissue was exposed in order to perform the interradicular osteotomy between teeth #13 and 14 and the subapical osteotomy of teeth #14, 11 and 21, thus fracturing the bone segment through a thin chisel with rotating movements. The palatal mucosa was preserved to maintain the blood supply. Additionally, the supernumerary that was located on the floor of the nose was removed *(Figure 4)*.

In the transported segment and in the upper left segment two fixation plates of the 2.0 System were placed modified at its ends in the shape of a «C» as anchorage for the closed springs *(Figure 5)*.

After a latency period of three days, distraction was activated once a day by removing a ring, in addition to the activation of the two springs for the gradual traction of the segment *(Figure 6)*.

At the end of the distraction period the segment was blocked and the springs were deactivated, thus initiating the consolidation phase. A bone graft was placed in the residual fissure of the cleft.[3]

The ATBAS was made in a curved shape respecting the form of the dental arch, by means of the principle of sliding mechanics, unlike conventional procedures that use internal rigid distractors *(Figures 7 to 9)*.

RESULTS

The 9 mm alveolar defect was closed in 10 days at a rate of 0.9 mm per day using the ATBAS and a post-bone transport bone graft. Arch form was respected, gaining a positive 2 mm overjet without collapse in the area of the transport and correcting the midline deviation. Nasal and labial projection increased due to the obtained bone support. The oronasal communication was eliminated thus restoring function as well as facial and dental aesthetics.

A year after the ATBAS relapse has not been observed and the newly formed bone was used to perform orthodontic movements.

The patient is satisfied with the results and the strengthening of her self-esteem is evident.

DISCUSSION

The technique described above achieves severe alveolar bone defects closure in a predictable way. This promotes achieving a good dental arch form, coordinated with the bony bases of its antagonist thus obtaining a better nasal and lip projection. It also enables oronasal closure, improving muscular dynamics, restoring function and increasing dental aesthetics.

Thanks to ATBAS the use of an internal rigid distractor is not necessary and this device is more practical and cheaper.

The limitations are that activations every must be performed every 24 hours personally and the implications of knowing how to manage all devices used in the system.

There are many reports in the literature describing alveolar bone transport. Liouy et al. in 1999 achieved the closure of a maxillary alveolar cleft in a patient with ALPF (alveolar-lip-palatal fissure) through accelerated orthodontics and dental distraction.[4]

Figure 4. Surgical removal of the supernumerary.

In 2002, Warrior managed to close a left unilateral cleft and a full bilateral intraoral fissure by means of distraction devices with linear vectors.[5]

In the 2004 Bilbao et al., using a modus distractor conducted a successful alveolar transport after a posterior maxillectomy due to an epidermoid carcinoma. However the occlusion did not have a favorable resolution.[6]

Mitsugi et al. performed the closure of an alveolar cleft through an intraoral vertical distractor placed in a horizontal position conducting a linear distraction osteogenesis with an edge-to-edge final occlusion.[7]

Vega et al., in the 2010,[8] conducted a successful alveolar transport by means of an innovative device with a screw type Hyrax, with which the final occlusion remained compromised. Years later Hegab in 2012[9] and 2014[10] Bousdras et al. replicated the technique succesfully, however the occlusion was not operational at the end of treatment in all cases.

In Mexico in 2014, Flores et al. reported two successful cases of alveolar transport with a vertical

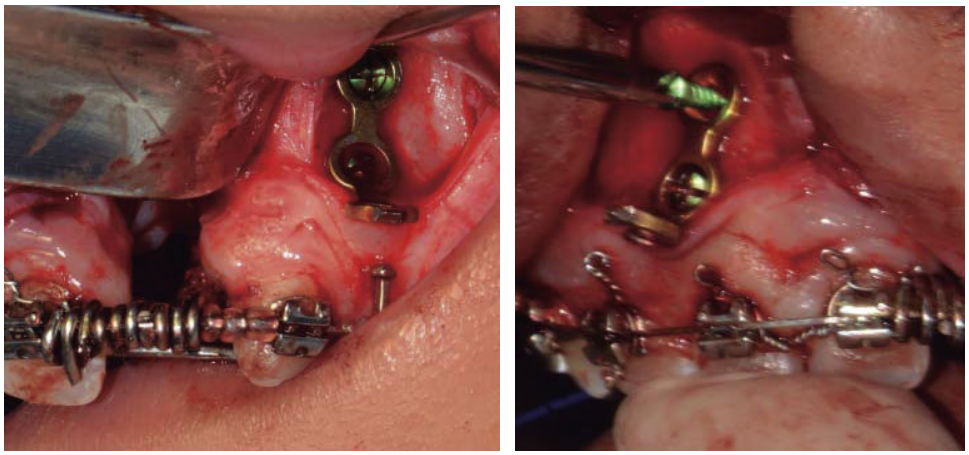

Figure 5.

Placement of modified plaques with the 2.0 System.

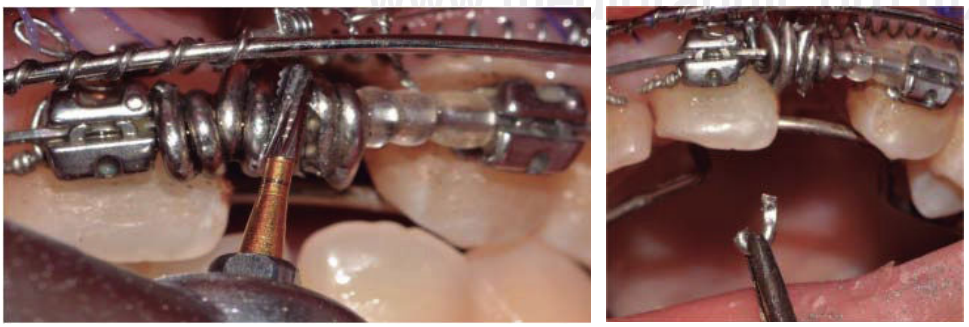

Figure 6.

The ring is cut for activation.

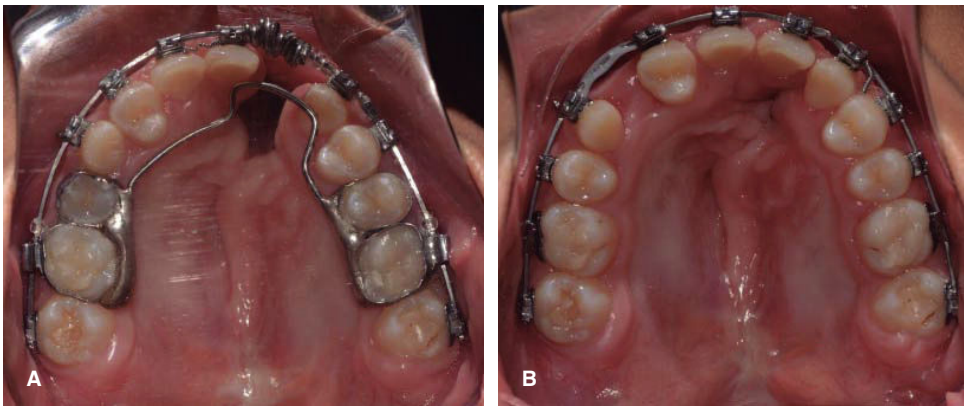

Figure 7.

A. Initial occlusal view. **B.** Final occlusal view.

Figure 8.

A y **B.** Submental comparative, note the improvement in the left side of the nose and lips.

Figure 9. A. Initial activation. **B.** Seventh activation. **C.** Tenth activation.

distractor in a horizontal position with the same objective as the other authors.[11]

After performing the literature review we determined the need to develop a minimally invasive technique at low cost, which will generate a distraction osteogenesis in a curved form in accordance with the shape of the dental arch, with the principle of sliding mechanics through controlled and better targeted forces, establishing an aesthetic and functional occlusion.

CONCLUSION

ATBAS is an innovative and versatile technique for the reduction of fissures and bone defects, through a low-cost system using skeletal anchorage and orthodontic fixed appliances with a predictable and successful outcome.

ATBAS is performed with a curve direction respecting the form of the dental arch the principles of sliding mechanics in contrast to conventional procedures that use an internal rigid distractor. Distraction osteogenesis in a curved shape ensures a proper occlusion.

REFERENCES

1. Vega O, Pérez D, Páramo V, Falcón J. A new device for alveolar bone transportation. *Craniomaxillofac Trauma Reconstr*. 2011; 4 (2): 91-106.

2. Van Sickels JE. Distraction osteogenesis: advancements in the last 10 years. *Oral Maxillofac Surg Clin North Am*. 2007; 19 (4): 565-574, vii.
3. Suzuki EY, Watanabe M, Buranastidporn B, Baba Y, Ohyama K, Ishii M. Simultaneous maxillary distraction osteogenesis using a twin-track distraction device combined with alveolar bone grafting in cleft patients: preliminary report of a technique. *Angle Orthod*. 2006; 76 (1): 164-172.
4. Liou EJ, Chen PK, Huang CS, Chen YR. Interdental distraction osteogenesis and rapid orthodontic tooth movement: a novel approach to approximate a wide alveolar cleft or bony defect. *Plast Reconstr Surg*. 2000; 105 (4): 1262-1272.
5. Guerrero CA. Intraoral bone transport in clefting. *Oral Maxillofac Surg Clin North Am*. 2002; 14 (4): 509-523.
6. Bilbao A, Cobo R, Hernández M, Rocha R, Albertos JM. Reconstrucción del maxilar superior mediante transporte del proceso alveolar: presentación de un caso. *Rev Esp Cirug Oral y Maxilofac*. 2006; 28 (1): 51-56.
7. Mitsugi M, Ito O, Alcalde RE. Maxillary bone transportation in alveolar cleft-transport distraction osteogenesis for treatment of alveolar cleft repair. *Br J Plast Surg*. 2005; 58 (5): 619-625.
8. Vega LG, Bilbao A. Alveolar distraction osteogenesis for dental implant preparation: an update. *Oral Maxillofac Surg Clin North Am*. 2010; 22 (3): 369-385, vi.
9. Hegab AF. Closure of the alveolar cleft by bone segment transport using an intraoral tooth-borne custom-made distraction device. *J Oral Maxillofac Surg*. 2012; 70 (5): e337-e348.
10. Bousdras VA, Liyanage C, Mars M, Ayliffe PR. Segmental maxillary distraction with a novel device for closure of a wide alveolar cleft. *Ann Maxillofac Surg*. 2014; 4 (1): 60-63.
11. Flores-García RA, Hernández-Carvallo JR, Muruaga-Lleverino A. Transporte óseo alveolar en labio y paladar hendido. *Rev Mex Cir Bucal Max*. 2016; 12 (2): 57-62.

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