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# Front Block Distraction in Orthodontic Treatment – case report

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Mestre em Medicina Dentária

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**ABSTRACT –**

The contribution of segmental osteotomies in ortho-surgical treatment has been given new ways of treatment by combining them with bone distraction techniques. The Köle osteotomy was used to correct anterior crowding in patients with Class I malocclusion involving mandibular incisors and canines. With minimal orthodontic preparation, bilateral diastemas were created in 15 days, which allowed alignment of the incisor-canine section without stripping or extractions. In this clinical case instead of the treatment plane involving extraction of premolars and an orthognathic surgery, a more conservative and rapid option was selected. The orthodontic preparation lasted 3 months, the surgery was performed, the distraction lasted 15 days and the orthodontic treatment finishing 4 months. The mandibular crowding and the overjet were corrected in 8 months.

**Keywords:** front block distraction; mandibular advancement; crowding

**RESUMO**

A contribuição das osteotomias segmentares no tratamento ortodôntico-cirúrgico são novas formas de tratamento ao combinarem-se com técnicas de distração óssea. A osteotomia de Köle foi usada para corrigir o apinhamento anterior em pacientes com má oclusão de Classe I envolvendo incisivos e caninos inferiores. Com o mínimo preparo ortodôntico, os diastemas bilaterais foram obtidos em 15 dias, o que permitiu o alinhamento dos incisivos e caninos sem desgastes interproximais ou extrações. Neste caso clínico, em vez do tratamento ser efetuado com exodontia de pré-molares e cirurgia ortognática, optou-se por uma opção mais conservadora e rápida. O preparo ortodôntico durou 3 meses, a cirurgia foi realizada, a distração durou 15 dias e o tratamento ortodôntico finalizando em 4 meses. O apinhamento mandibular e o *overjet* foram corrigidos em 8 meses.

**Palavras-chave:** distração do bloco frontal; avanço mandibular; apinhamento

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# I - INTRODUCTION

Patients with inferior incisal crowding, expansion treatment plans are subject to a significant risk of periodontal injury with fenestrations or even root dehiscence (Triaca *et al.*, 2001). In addition, permanent instability of the incisors and canines may persist after treatment and require prolonged bonded retention, which does not always prevent recurrence (Triaca *et al.*, 2001).

Excessive interproximal reductions are detrimental aesthetically, and also may affect the long-term prognosis of the teeth if the stripping is imperfect.

Therapy involving premolar extractions can lead to mismatches between the mandibular symphysis and the anterior teeth, and may compromise the aesthetics of the facial profile and lip support in the medium to long term (Triaca *et al.*, 2001). This is particularly true in cases where pre-surgical decompensation is required in Class III malocclusions due to symphyseal bone insufficiency.

Due to periodontal risks and the lack of newly-formed bone, the one-stage segmental osteotomies of the incisor-canine block to treat crowding was abandoned. To avoid these difficulties, these osteotomies have been combined with bone distraction procedure and can thus achieve the increase in space necessary to correct tooth alignment.

## 1. History

Bone distraction was introduced by Codivilla's femoral lengthening in 1905 (Codivilla, 1905) (Codivilla, 2008), but was popularized in the 1950s by Ilizarov, who demonstrated the effect of tension on bone regeneration and soft tissue. He described a biological process of new bone formation based on the natural ability to generate new bone tissue after gradual separation of the bone margins of an osteotomy. The edges are gradually separated by tensile forces using a distractor.

The distractor generates tensile forces within the callus, resulting in a neo-formed bone, parallel to the distraction vector. This bone undergoes different phases of maturation and remodeling (hematoma, granulation tissue, callus, and bone osteogenesis) until it becomes undifferentiated from the adjacent bone. Tractional forces on the surrounding soft tissue also allow for new formation of the soft tissue.

Distraction consists of four essential stages: a surgical phase, a latency phase, an active distraction phase, and finally a consolidation phase.

The surgical phase consists of placing the distractor and performing the osteotomy. The distractor can be placed prior to the surgical phase if it is a tooth-supported distractor or during the surgical phase if it is a bone-supported distractor. The choice of osteotomy and the positioning of the distractor are decisive in defining the displacement vector. Preservation of the bone vascularization during surgery is fundamental (minimal de-periostealization) (Kewitt and Van Sickels, 1999).

The latency phase lasts approximately one week and is necessary for soft tissue healing. Capillary neoformation optimizes osteogenesis, the proteinaceous bone callus is formed and will serve as the starting point for the distraction process. If this period is too long, longer than 10/15 days, there is a risk of premature consolidation of the bone surfaces. In children, the latency period can be reduced by two to three days.

In the active distraction phase, the bone gradually is lengthened at an activation rate of 1 mm/d, ideally twice a day. The device can be activated by the practitioner or by the patient under regular radiological supervision.

The consolidation phase with mineralization is based on a minimum of three months of support. It begins at the ends and then extends towards the center of the bone callus. Radiographic confirmation of calcification of the callus is a decisive factor in the removal of the appliance, but radiography can be replaced by ultrasound.

During this stage, it is common to observe a migration of a tooth not held by an orthodontic appliance towards the space created by the distraction (moving tooth). This migration through non-mineralized bone does not seem to increase the risk of complications (apical migration of the junctional epithelium attachment, necrosis, sensitivity disorders), some authors even recommend initiating dental movements early, around 14 days after the end of activation to promote the creation of alveolar bone in the distraction site. (Savoldelli *et al.*, 2010)

The same principles of bone distraction were used by Wassmund in 1926 to advance the maxilla; the following year, Rosenthal and Sonntag applied them for the lengthening of a micro-mandible. In 1992, McCarthy (McCarthy *et al.,* 1992) described a modern device for mandibular distraction of congenital malformations.

The first medial symphyseal distraction was performed in 1997 by Guerrero (Guerrero *et al.*, 1997). He performed an anterior mandibular widening using a vertical inter-incisor osteotomy followed by a transverse distraction, allowing an increase in the transverse direction and the inter-canine distance, and resolves the crowding without extractions (Bouletreau and Paulus, 2012) (De Gijt *et al.*, 2012) (Vereecke *et al.*, 2001).

Tooth-supported distractors, placed lingually, seem to be preferred by some authors because of their modest cost, simplicity of use, lower complication rate, and their more marked action on the alveolar bone than on the basal bone (Alkan *et al.*, 2007) (Savoldelli *et al.*, 2010).

Some authors report histological changes in the temporomandibular joint (Harper *et al.*, 1997) or condylar rotation (Gunbay *et al.,* 2009) (Samchukov *et al.*, 1998), although others consider them inconsequential (Bouletreau and Paulus, 2012) (Braun *et al.*, 2002) (Gokalp, 2008) (Kewitt and Van Sickels, 1999) (Landes *et al.*, 2008) (Malkoc *et al.*, 2006) (Sukurica *et al.*, 2010). Moreover, these transverse distraction techniques require an osteotomy line between the incisal apices, which are often very close to each other with fragile alveolar bone, and the periodontal consequences can be dramatic (Gunbay *et al.,* 2009) (von Bremen *et al.*, 2008). Thus, induced condylar rotations do not seem to have harmful consequences for temporomandibular joins and periodontal abnormalities are far from systematic, but these transverse distraction techniques, if they correct crowding, cannot at the same time lengthen the mandible and correct an overjet.

## 2. Front Block Distraction

Distraction of the lower incisor-canine alveolar segment was described by Albino Triaca in 2001 (Triaca *et al.*, 2001) and repeated in 2011 by Matsushita (Matsushita *et al*., 2011). Its aim was to avoid extractions in patients with mandibular anterior crowding, in whom the mandibular transverse direction did not require correction.

The initial indications were multiple:

- Skeletal Class II with crowding for which we wished to reduce the overjet to be corrected by mandibular advancement.

- Skeletal Class III to decompensate lower incisor lingual proclination before orthognathic surgery.
- Skeletal and molar Class I, but canine Class II create space for a premolar and thus normalize the overjet.
- Dental and skeletal Class I with overjet, in which treatment by extraction would have had harmful aesthetic consequences, for example, when the chin is well-placed.

Current indications have become more generalized to dental crowding, lingual proclination, and vertical anomalies with marked curve of Spee.

The front-block is a segmental alveolar anterior mandibular osteotomy of the classic Köle type (Bell, 1978) (Kole, 1959) but which avoids its disadvantages (creation of a void, periodontal risk) because it is associated with a distraction. It allows correction of the axis and position of the mandibular incisor-canine bone block in the anteroposterior direction. The repositioning is progressive and uses the principles of distraction by osteogenesis. No bone or soft tissue grafting is required. The lingual tissues are intact and allow bone and periodontal vascularization. The risks to damage the inferior alveolar nerves are almost null.

Historically, the distraction anterior block was exclusively based on dental anchorage appliances adapted to the individual case (Merli *et al.*, 2007). The molars were used as anchors and the anterior teeth were used to transmit the distraction forces to the alveolar bone segment. These exclusively tooth-anchored procedures considerably increased the risk of flaring the lower incisors in a bone that was often thin, with the risk of fenestration and gingival recession. In addition, the lack of control of the bone fragment led to its buccal tipping and sometimes even to the recession of its base. This disadvantage motivated the use of a complementary bone-anchored distractor.

The rigid system is manufactured by the usual laboratory. The intraoral distractors can be likened to a lip bumper equipped with two expansive right and left hyrax, ligated forward to the lower incisor's brackets. Bands with lip bumper sleeves are placed on 36 and 46 or 37 and 47. A thick lip bumper wire is associated with two 7 mm lateral breaker jacks on each side, equipped with stops and will be inserted into the molar band's sheaths. This rigid wire allows incisors-canine guidance during the expansion, it is either ligated under the brackets of the incisors and canines, directly bonded to the teeth with resin, or finally inserted directly into the grooves of the brackets. The jacks are located at the level of the premolars and their activation allows the anterior translation of the block. A space is thus progressively created between lower 3 and 4 to increase the arch perimeter. The device allows a combination of translation and rotation to obtain an optimal position and axis of the lower incisors (Obwegeser *et al*., 2012) (Triaca *et al*., 2001) (Fig. 1).

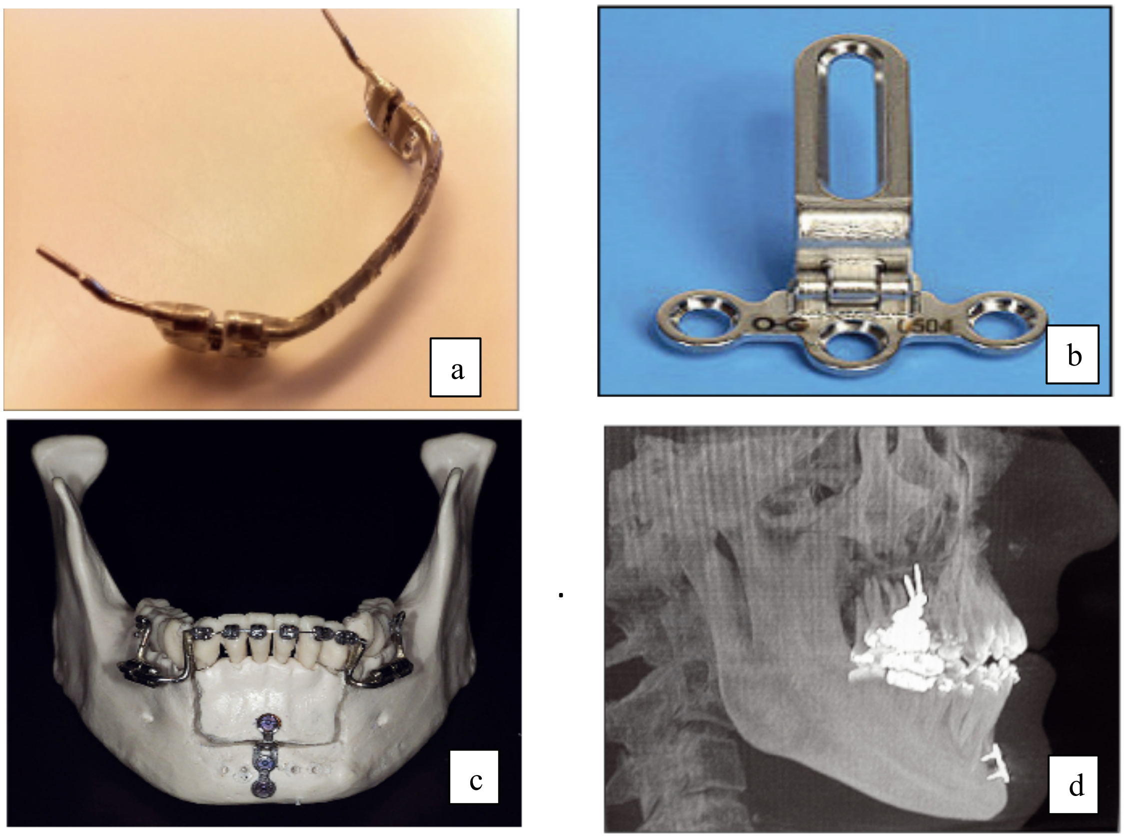


Figure 1: a) Intra-oral dental anchorage appliances. b) Bone distractor MDO-FB, Orthognatics®, Zurich. c) Hinge plate and buccal distractor's front view. d) Hinge plate lateral view before distraction.

This lack of direct guidance of the alveolar fragment has been corrected by the use of two types of appliances that control the lower part of the bony fragment.

These mixed appliances consist of either a double plate connected by a hinge or a special distractor (model MDO-H or MDO-FB, Orthognathics® , Zurich) (Triaca *et al.*, 2001) and a lip bumper equipped with two expansive hyrax ligated to the lower incisors brackets.

The first device (MDO-H, Orthognatics® , Zurich) is a simple double hinged plate (Zemann *et al.*, 2012b) (Zemann *et al.*, 2012a) (Fig 1c) that is fixed at the base of the fragment. It allows clockwise rotation (buccal tipping) of the fragment upon activation of the two intraoral tooth-supported distractors. It prevents lingual tipping of the base of the fragment.

The second distraction system (MDO-FB, Orthognathics®, Zurich) is based on a double plate with an upper slide that allows the position and inclination of the upper screw and thus the distraction vector to be varied (Fig. 1b). The lower part is fixed on the fixed point (Fig. 2).

Figure 2: Front view: osteotomy with bone distractor and intra-oral distractors.

Activation of the bicortical screw, which goes through the alveolar fragment below the apices, allows advancement of the basal part of the anterior alveolar block of the mandible. The incisors-canine block can also be effectively translated in the anteroposterior direction (Figs. 3 a b).

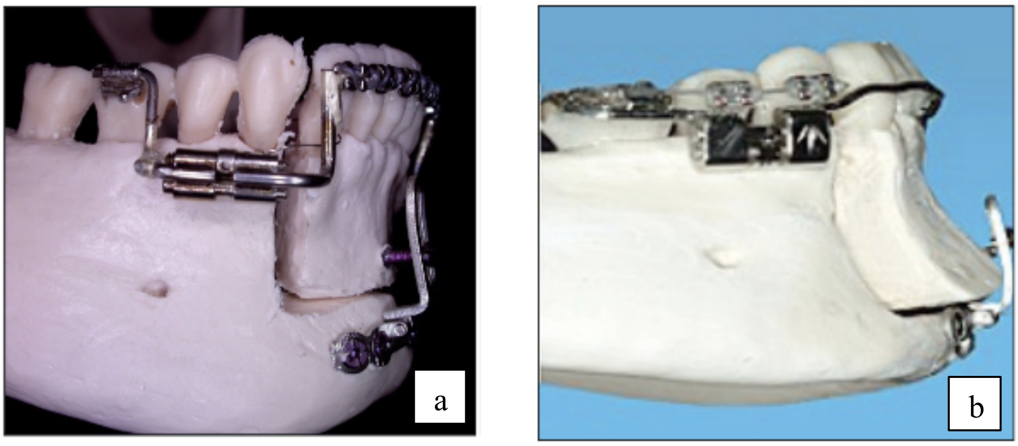


Figure 3: a) Front block lateral view before distraction. b) Lateral view at the end of distraction

Some authors have attempted to replace the two intraoral distractors with a single bone distractor (Metzler *et al*., 2012, Obwegeser *et al*., 2012) to avoid the application of force through the anterior teeth. This procedure requires two screws placed in the alveolar fragment, one of which is placed between the apices of lower central incisors, which must be displaced by the orthodontist beforehand.

## 3. Orthodontic preparation

The orthodontist may need to perform a root divergence adjacent to the osteotomy, either between canine and premolar, or more rarely between lateral incisor and canine. The placement of molar bands with vestibular lip bumper sleeves and an impression with a plaster model will allow the prosthetist to make the intraoral distraction appliance. Particular attention must be paid to the vector of the two integrated hyrax, which must be parallel to the occlusal plane (Triaca *et al.*, 2001).

The planning of the new position of the anterior alveolar segment and its angulation is performed on profile simulations by the orthodontist in collaboration with the surgeon. The size of the anterior fragment is determined, isolated and then transferred to its new position. The orthodontist then will determine the final position of the incisal edges and its relationship to point B and the chin point.

## 4. Surgical protocol

The procedure (Triaca *et al.*, 2001) is performed under general or local anesthesia with antibiotic prophylaxis.

The procedure begins with a medial inferior vestibular approach staggered in the lip in an inverted "V" shape, followed by subperiosteal exposure of the symphysis and the two chin foramina. The osteotomy is performed vertically between the roots of the canines and first premolars or, more rarely, between the lateral incisors and canines. In the horizontal direction, the osteotomy is located at least 5 mm below the apices. The osteotomy can be performed with a fine conical bur (bone cutter or Zekrya type) or with a piezotome (which avoids any injury to the lingual periosteum and the mucosa). The osteotomy line must be wide enough to avoid any risk of interference during the anterior translation movement. The Triaca distractor (MDO H or FB) is osteosynthesized before mobilizing the alveolar fragment. A simulation of future distraction during surgery ensures that there will be no interference during distraction and enables verification of the distraction vector. Suturing is done in two muscular and mucosal planes (Fig. 4).

Figure 4: Osteotomy and distractor type MDO-FB.

The procedure is performed as an outpatient or ambulatory procedure, depending on the type of anesthesia (local or general brief) chosen. Simple analgesics are enough to provide postoperative comfort to the patient with appropriate dietary advice.

## 5. Distraction

After seven days of latency and healing, activation of the left and right intraoral distractors is started at a rate of 0.5 mm per day. If a bone distractor of the MDO-FB type (Orthognathics®, Zurich) has been placed, it is released only opposite the activation screw under local anesthesia. Then the upper screw is activated daily by the surgeon, who then places a small fat iodoformed wick that is changed daily without further anesthesia or under contact anesthesia (xylocaine 10%) (Triaca *et al.*, 2001).

Anterior distraction is performed here with three vectors, two intraoral with dental support and one basal with bone support. The MDO-FB distractor allows for differential translation of the upper and lower anterior blocks (allows for posterior-anterior translation as well as clockwise or counterclockwise rotation of the fragment). The average activation phase duration is 15 days and allows for up to 6 mm advancement and thus correction of up to 12 mm crowding. The retention phase lasts after six weeks with maintenance of the final position, then the orthodontic alignment is continued by distributing the teeth in the distraction space. The hinge plate, or bone distractor, is removed six months later or during subsequent orthognathic surgery.

## II - CLINICAL CASE

A 30-year-old man with a Class I molar, and a Class II canine, with ANB at 4º and a normo-divergent face, had significant anterior mandibular crowding and lingual proclination of the maxillary incisors. He also had four third molars and an odontoma to extract (Figs. 5-11).

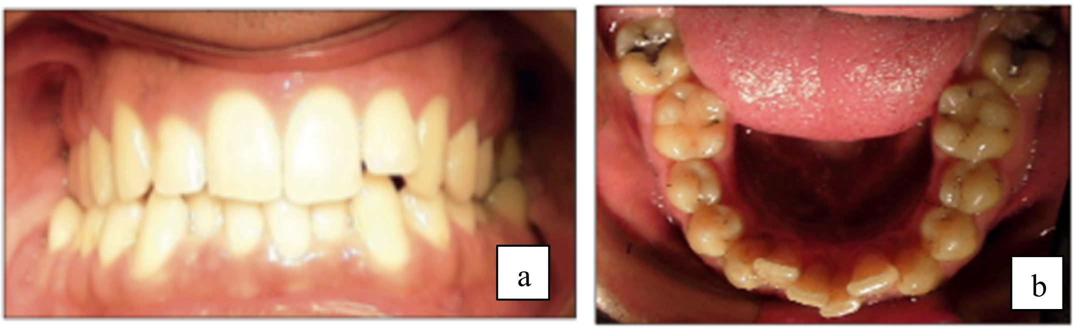


Figure 5: a) Frontal intra-oral photo. b) Occlusal inferior photo.

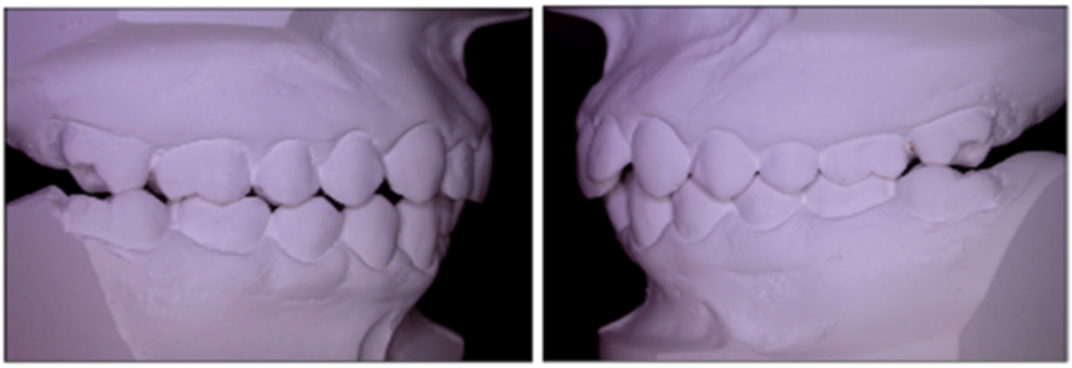

Figure 6: Left and right of articulating cast models

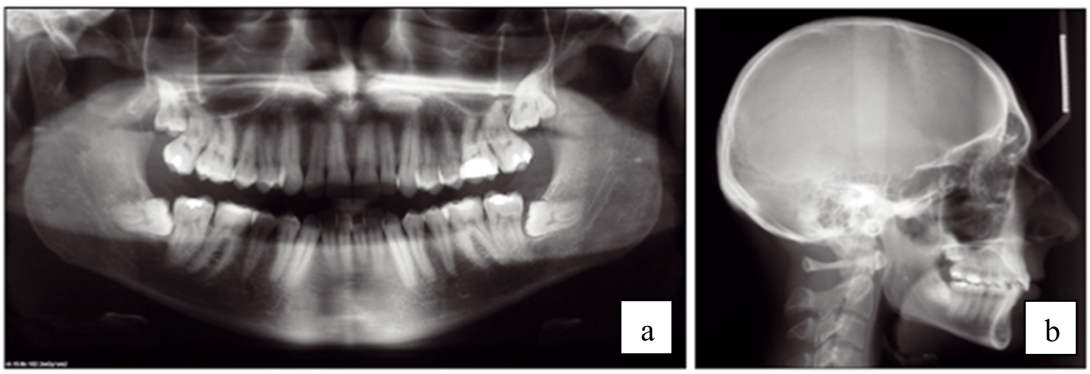


Figure 7: a) Orthopantomography. b) Profile cephalometric Xray

The patient wanted rapid treatment, without extractions of premolars, with the simplest possible surgical procedure and a short orthodontic treatment duration. He also wanted to limit physical changes as much as possible.
As there were unfavorable root divergence between canines and premolars, orthodontic preparation was required to create sufficient space for osteotomies. Pre-operative occlusal view with intraoral distractors in place and after fifths days of activation (Fig. 8).

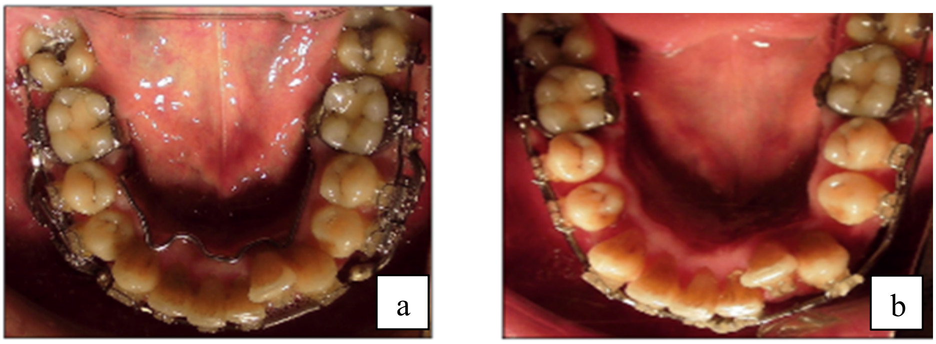


Figure 8: a) Intra-oral photo before treatment. b) Intra-oral photo after fifth day of distraction

The diastemas were created during the treatment with the distractor activation. At the end of the distraction there was enough space to align the anterior teeth (Fig 9 a e b).

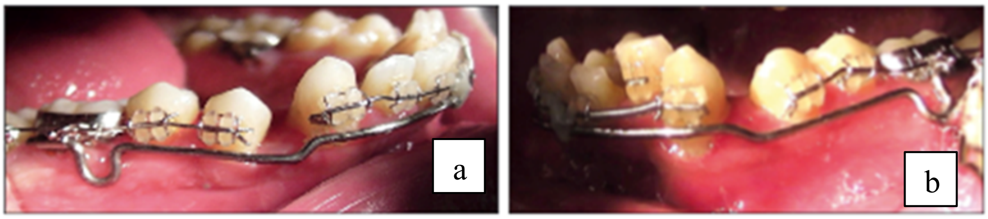


Figure 9: a) Right intra-oral photo at the end of the activation phase b) Left intra-oral photo at the end of the activation phase

Figure 10: Profile cephalometric Xray with the distractor in place.

The treatment lasted a total of eight months, and the Classe I canine were obtained as the anterior crowding solved (Fig. 11).

Figure 11: a) Intra-oral frontal view. b) Intra-oral contention.

**III - DISCUSSION**

The surgical procedure is simple and very well tolerated, provided that the principles and precautions outlined above are followed. It is based on a well-codified osteotomy (Bell, 1978) to which a distraction procedure has been simply added. Thorough ortho-surgical planning and correct positioning of the distraction vectors are essential and require excellent orthodontist/surgeon/technician collaboration.

The preservation of soft tissues, especially lingual, is essential and is in accordance with the biological basis and principles of distraction, which require maximum preservation of the periosteal and endosteal vascularization (Kojimoto *et al*., 1988).

It allows rapid correction of major crowding, since the spaces will be created at the level of the vertical osteotomies, i.e., as close as possible to the crowding to be corrected. It avoids complex bone or connective tissue grafting procedures and creates larger spaces than traditional one-step procedures.

Corrections of overjet of less than 6 mm, Class III decompensation and reopening of spaces for implant placement are also greatly facilitated (Carlino, 2013). The matching of basal bone and alveolar bone can be achieved more easily.

This avoids bone fenestration, which would be impossible with dental movements alone without extractions.

In the case of a pronounced labio-mental sulcus, a clear improvement can be observed by advancing the bony B-point and, more generally, an aesthetic improvement (Carlino, 2013) (Joss *et al.*, 2012a, Joss *et al.*, 2012b) (Merli *et al.*, 2007).

The potential risks are damage to the inferior alveolar nerve, which has never been described. Damage to the roots must be avoided by a preoperative orthodontic divergence and a precise alignment of the osteotomy.

Alveolar effects are evaluated differently according to the authors and can affect 20% of patients with isolated dental support techniques (Zemann *et al*., 2012b, Zemann *et al*., 2012a). The use of a distractor such as MDO-FB is likely to limit this side effect (Joss *et al.*, 2013b, Joss *et al*., 2013a).

Thus, the long-term stability of this technique seems to be demonstrated, with incisor recession attributed to the final orthodontic alignment, rather than to alveolar recurrence (Joss *et al.*, 2013b, Joss *et al.*, 2013a).

Contraindications include periodontal disease, bone disease or treatments that limit osteoformation. For some, a thin mandibular symphysis is also defensible (Zemann *et al.*, 2012b).

Finally, the distraction period, when it combines the activation of both intraoral distractors with a basal bone-supported distractor, can be a strain for the patient who has to see his surgeon every day for almost two weeks. This major inconvenience can be avoided by using a basal hinge plate to the fragment, shaped to create an immediate, intraoperative advancement of the fragment base. Thus, the lingual angulation of the bone fragment will then be progressively corrected during distraction with intraoral distractors, achieving true distraction of only the alveolar bone and soft tissue between canines and premolars (Fig. 12). Alternatively, activation of the intraoral distractors can be performed more easily by the orthodontist, the surgeon or even the patient himself.

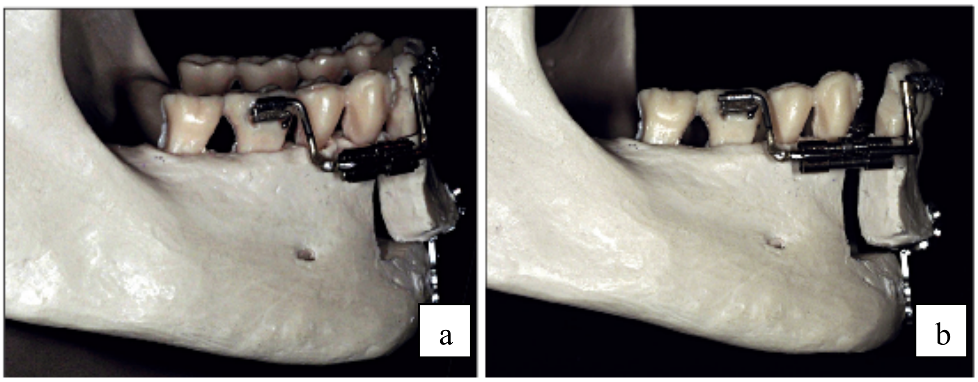


Figure 12: Two-step procedure: a) Basal advancement of the bone fragment. b) Progressive distraction by intraoral distractors

## IV - CONCLUSION

The front block distraction technique remains little known and little used. However, it is very useful if orthodontists and surgeons work together closely.

Thus, when the chin is well-placed, especially in cases of skeletal Class I with a Class I molar but a Class II canine, an overjet and crowding, this technique allows to correct the anterior occlusion, crowding and overjet without extraction.

The orthodontist can thus propose a treatment of a few months in total, with a well-tolerated procedure, performed on an outpatient basis, possibly concomitant with the third molar extractions.

In this way, a long treatment with four premolar extractions can be avoided, which would require decompensation of the arches and often a bimaxillary osteotomy.

The front block is also useful in the management of other dysmorphia:

- Skeletal Class II with crowding to reduce the overjet to be corrected by mandibular advancement.

- Skeletal Class III to decompensate a lower incisor lingual proclination before orthognathic surgery.

- Skeletal Class II compensated by anterior orthodontic treatment with too much flaring of the lower incisors to quickly correct the incisal axis, without risk and without extraction.

Unfortunately, the fact that the health insurance system does not cover bone distractors (hinge or slide plates) may limit the use of this procedure.

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## VI - ANEXES

**1.** Permission for use the clinical case.

JEAN-PAUL FORESTIER
DOCTEUR EN CHIRURGIE DENTAIRE
MAÎTRE DE CONFERENCES DES UNIVERSITES
PRATICIEN HOSPITALIER
SPECIALISTE QUALIFIE EN ORTHOPEDIE DENTO-FACIALE
droit au dépassement permanent vis à vis des assurés sociaux

146, RUE DE COURCELLES, 75017 PARIS.FRANCE
Tél: 33 01 42 27 51 00
email: drforestierjp.odf@free.fr

75 4 15901 0 / N° RPPS: 10000097666

Paris, le 28/06/2020

Prénom et Nom du patient :

[redacted]

je soussigné Dr JP Forestier, Maire de conférences des Universités, certifie avoir traité conjointement avec le dr Esnault le patient présenté dans la thèse que le dr Olivier ESNAULT doit présenter à l'Université Fernando Pesoa et donner mon accord pour l'utilisation de ce cas clinique et de toutes ses photos intra buccales et radios. »

Dr. Jean-Paul FORESTIER

**2.** "Consentement éclairé"

# DÉCLARATION DE CONSENTEMENT ÉCLAIRÉ

***En tenant compte de la 'Déclaration de Helsinki' de l'Association Médicale Mondiale (Helsinki 1964; Tokyo 1975; Venise 1983; Hong Kong 1989; Somerset West 1996 et Édimbourg 2000)***

***Désignation de l'étude (en portugais):***

Distração Front-Block: apresentação da técnica ilustrada por um caso clínico

**Moi, soussigné(e), (nom complet du patient ou volontaire sain)** ——————

[redacted]

Je déclare avoir compris l'explication fournie au sujet de la participation à la recherche à réaliser et sur l'étude où je serai inclus. On m'a donné l'opportunité de poser les questions que j'ai jugées nécessaires et j'ai obtenu des réponses satisfaisantes.

J'ai pris connaissance du fait que, en conformité avec les recommandations de la Déclaration de Helsinki, les informations ou explications données étaient au sujet des objectifs et méthodes, et, si survient une situation de pratique clinique, les bénéfices prévus, les risques potentiels et l'éventuel inconfort. En outre, on m'a indiqué que j'ai le droit à tout moment de refuser ma participation à l'étude, sans que ce refus puisse avoir comme effet un quelconque préjudice personnel.

Par conséquent, j'accepte que la méthode ou le traitement proposés par le chercheur me soient appliqués le cas échéant.

J'accepte l'utilisation de toutes les photos nécessaires à l'étude.

Date: 21 / [illegible] / 2021

***Signature du patient ou du volontaire sain:***

Le chercheur responsable:

***Nom:*** [illegible]

**Signature:**

Commission d'Ethique de l'Université Fernando Pessoa