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Mandibular bi-directional distraction osteogenesis: A technique to manage both transverse and sagittal mandibular diameters via a lingual tooth-borne acrylic plate and double-hinge bone anchorage

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ABSTRACT

Purpose: Mandibular hypoplasia can develop transversely, sagittally, or in both diameters simultaneously. Current techniques achieve either sagittal or transverse expansion with different surgeries. Here, we present a novel method to obtain transverse and sagittal mandibular distraction in one stage.
Materials and methods: The technique consists of a double osteotomy: a dento-alveolar osteotomy comprising four or six anterior teeth and a vertical symphysiotomy underneath. The mandibular basal bone is immediately expanded transversely and fixed to the lower symphysis via a miniplate carrying only one screw on each side that functions as a hinge during active distraction. The plate is connected to the anterior dento-alveolar block with a metal wire ligature. A teeth-anchored lingual distraction system can expand transversely at the alveolar bone level and then sagittally with the anterior dento-alveolar segment wired to the lower plate.
Results: Satisfying and stable results were achieved, confirmed by measurements on serial plaster casts.
Conclusion: To the best of our knowledge, this is the first proposal for ortho-surgical correction of both transversal and sagittal mandibular hypoplasia via a bi-directional distraction procedure. A combination of bone-hardware anchorage and dental-anchored distraction systems is suggested.

Transmucosal hardware emergence and need for a second surgery to remove bone-borne appliances are avoided.

1. Introduction

Mandibular hypoplasia is often a bi-dimensional defect requiring skeletal correction in both the transverse and sagittal directions. Clinical features of this situation include severe dental crowding, severe transverse/sagittal skeletal deficiency, unilateral or bilateral crossbite, tipped teeth, or inadequate space for anterior teeth. Defects in the length and width of the dental arches are usually managed orthodontically with dental extractions. Mandibular and maxillary deficiencies and crowding in the anterior aspect of the jaws are commonly observed in orthodontic patients. Herberger et al. and Housley et al. showed how orthodontic treatment can achieve a high rate of recurrence after lengthening and widening the dental arches with or without dental extractions (Herberger, 1981; Housley et al., 2003). Alexander et al. presented an approach for enlarging the mandible with vertical osteotomy of the symphysis and laterally rotating the hemi-mandibular segments with or without a bone graft (Alexander et al., 1993).

Distraction osteogenesis (DO) is an accepted technique in the maxillo-facial surgical practice. Distraction can correct defects in the two spatial planes in both the maxilla and mandible, combining osteogenesis and histogenesis with increased bone and mucosal tissue formation. Mandibular distraction osteogenesis can expand the mandible in two directions: transverse and sagittal.

Transverse mandibular expansion is mandibular distraction of the midline (MMD), described by various names including mandibular symphyseal distraction osteogenesis, trans-

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mandibular symphyseal distraction (osteogenesis), and mandibular midline osteo-distraction (Carlino et al., 2016; Duran et al., 2006; Guerrero et al., 2000; Gunbay et al., 2009; King and Wallace, 2004). The most common indications for MMD include severe anterior mandibular crowding, severe mandibular transverse deficiency, unilateral or bilateral crossbite, anterior teeth crowding with inadequate space, and inclined teeth (Duran et al., 2006; King and Wallace, 2004).

Commonly used distraction devices can be divided in two systems: namely, bone-borne and tooth-borne distraction systems, each having specific advantages and disadvantages. Bone-borne appliances can achieve efficient enlargement of the basal bone with increased dental stability, i.e. lower relapse rates of dental crowding after orthodontic alignment. Disadvantages include encumbrance in the frontal area due to the hardware transmucosal emergence and the need for a second surgical step for appliance removal (Carlino et al., 2016; Guerrero et al., 2000). Dental-borne appliances, on the other hand, have several advantages, including the absence of trans-mucosal hardware emergence and no need to remove the hardware in a second surgery. Disadvantages include larger dental than bony expansion with more risks for dental relapse (Carlino et al., 2016; Duran et al., 2006; Guerrero et al., 2000; Gunbay et al., 2009).

The mandibular transverse distraction procedure is effective but not commonly used, which may be due to the encumbrance of most distraction devices, which often negatively impact aesthetics and quality of life. Considering that the procedure requires a treatment time ranging from 4 to 6 months, with active distraction and consolidation time, most patients avoid the procedure.

Mandibular sagittal osteo-distraction can be performed either in the retro-molar site or in the anterior dento-alveolar region. The latter is known as dento-alveolar distraction osteogenesis and is used for simultaneous bi-directional expansion. The technique was originally described by A. Triaca in 2001 and is now commonly used in maxillofacial surgical practice to expand the mandible in the front area sagittally (Bengi et al., 2007; Carlino, 2013; El-Bialy et al., 2013; Matsushita et al., 2011; Metzler et al., 2012; Triaca et al., 2001; Zemann et al., 2012). This procedure consists of a dento-alveolar osteotomy comprising four or six anterior teeth; after a 1-week latency period, the dento-alveolar block is moved forward via a distraction procedure performed with lingually teeth-anchored orthodontic screws. The procedure is effective, easy to accomplish both surgically and orthodontically, and the devices have minimal encumbrance and are generally well tolerated by patients.

When mandibular hypoplasia is present in both transverse and sagittal planes in the same patient, the two procedures are performed separately in different surgical steps. In this report, we present an original surgical-orthodontic procedure designed by the first author (F.C.) to perform both transverse and sagittal mandibular osteo-distraction simultaneously. The procedure combines the advantages of both bone-borne and dental-borne distraction systems, creating a dental-borne rigid double-direction distraction system.

Aims of this work were to evaluate the feasibility, effectiveness and safeness of the new technique analysing expansion amount, alveolar peak preservation, stability at 1 year and TMJ function.

2. Materials and methods

Eight adult patients affected by dento-alveolar mandibular transverse and sagittal collapse were selected; in most cases, a transverse maxillary hypoplasia was also present, as well as an association with another skeletal malocclusion (i.e. skeletal class II, skeletal class III, anterior open bite, skeletal mandibular asymmetry). Systemic or psychological disorders and neoplastic pathologies or previous treatments with bisphosphonate drugs were excluded. We also excluded patients who underwent other surgical procedures excluding surgically assisted rapid palatal expansion (SARPE), bilateral sagittal split osteotomy, genioplasty, and Le Fort I osteotomy. All patients were informed about the study protocol and surgical risks, and written consent was signed by all patients explaining the alternatives, advantages, and disadvantages of surgery. The study was conducted in accordance with the ethical principles provided by the Declaration of Helsinki and the principles of good clinical practice under the IRB protocol number 38/06. Patients were analysed preoperatively (T0), at the end of active distraction before tooth alignment (T1), after orthodontic tooth alignment (T2), and 1 year postoperatively (T3). X-ray orthopantomography, lateral-frontal X-ray cephalograms, and dental model measurements were performed at T0, T1, T2, and T3.

Measurements on model casts for transverse dental expansion were performed between buccal mesial cusps of the first molars, buccal cusps of the first premolars, and canines. Sagittal measurements were taken perpendicularly from a line connecting the mesio-buccal cusps of the first molars to the inter-dental papilla between the central mandibular incisors. Alveolar bone peaks preservation was detected on x-ray panoramic pre and post-operative at different times (T0, T1, T2, and T3). Also, TMJ function was investigated concerning TMJ pain, click on motion and mouth opening limitation. Possible condylar resorption was detected on x-ray image.

2.1. Surgical technique

Orthodontic appliances were applied before surgery, avoiding orthodontic alignment. Surgery was performed under local anaesthesia with deep intravenous sedation or under general anaesthesia via naso-tracheal intubation. All surgeries were performed by the same surgeon (F.C.). When maxillary transverse expansion was required, a mucosal incision was performed in the upper maxilla at 14–24 days followed by the traditional technique for SARPE.

In the lower jaw, an incision was made in the buccal mucosa from teeth 33 to 43, leaving enough soft tissue for the suture. Periosteal elevation was performed to the inferior border of the mandible. A dento-alveolar osteotomy was performed in the anterior mandible; two vertical osteotomies were traced between the lateral incisors and canines or between the canines and bicuspids. These were connected underneath the tooth apices by a horizontal osteotomy. Thus, the dento-alveolar block comprising the anterior four or six teeth was mobilised. This is the classic dento-alveolar osteotomy for anterior sagittal distraction (Triaca et al., 2001). A vertical symphysiotomy was then performed from the previous horizontal osteotomy cut midline to the inferior border of the mandible. Thus, the basal bone was divided in two halves, enabling subsequent transverse mandibular distraction (Fig. 1).

Osteotomies were performed using thin rotating burs, avoiding periosteal elevation at the fixed mucosa level. In the alveolar inter-dental septum, osteotomies were performed using a thin chisel to preserve bone fragment nourishment and minimize the risk of gingival clefts on neighbouring teeth. After completing the osteotomies, the two mandibular halves were manually spread at the basal bone level, acting on the symphysiotomy cut, resulting in an immediate enlargement of the bone to the planned extent. Therefore, the mandibular teeth were inclined lingually. After this manoeuvre, the two hemi-mandibles were fixed with a single mini plate with two screws, one on each side (Fig. 3a). The osteosynthesis mini-plate was connected via a metal wire to a single screw applied in the dento-alveolar block (Fig. 2); this loose wire fixation

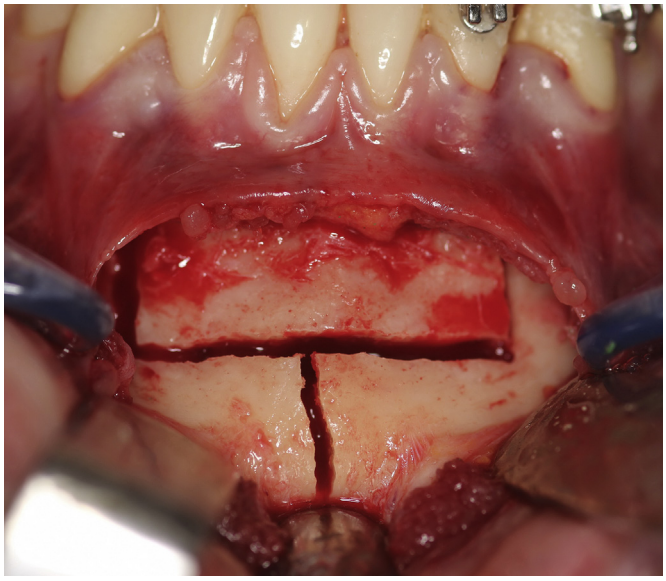

Fig. 1. Osteotomy lines traced, before bone mobilization.

allows for sagittal movement of the dento-alveolar block. This represents the bone-anchorage system.

A lingual acrylic plate with a transverse-acting orthodontic screw was fixed with wire ligatures to the teeth; this represents the active distraction device (Fig. 4a). After being pushed transversely by the screw action, the two mandibular halves rotate laterally at the dental plane level, spreading apart, with the two osteosynthesis screws on the inferior mandibular border functioning as hinges (Fig. 3b). Active transverse distraction was performed one week after surgery and the screw was activated once daily in a one-quarter turn, which provided 0.35 mm distraction. No over-correction was performed. Only mild dental overexpansion was performed to allow proper orthodontic crowding resolution.

The transverse distraction continued until the diameter of the arch was sufficient for proper occlusal correction; the mandibular teeth, previously lingually inclined, became correctly uprighted

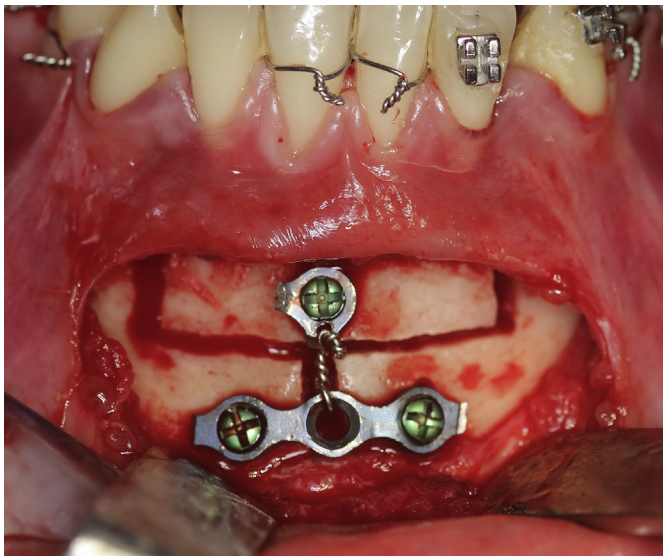

Fig. 2. Osteotomies completely performed, the osteosynthesis plate is fixed with two screws. The mandibular basal bone has been spreaded.

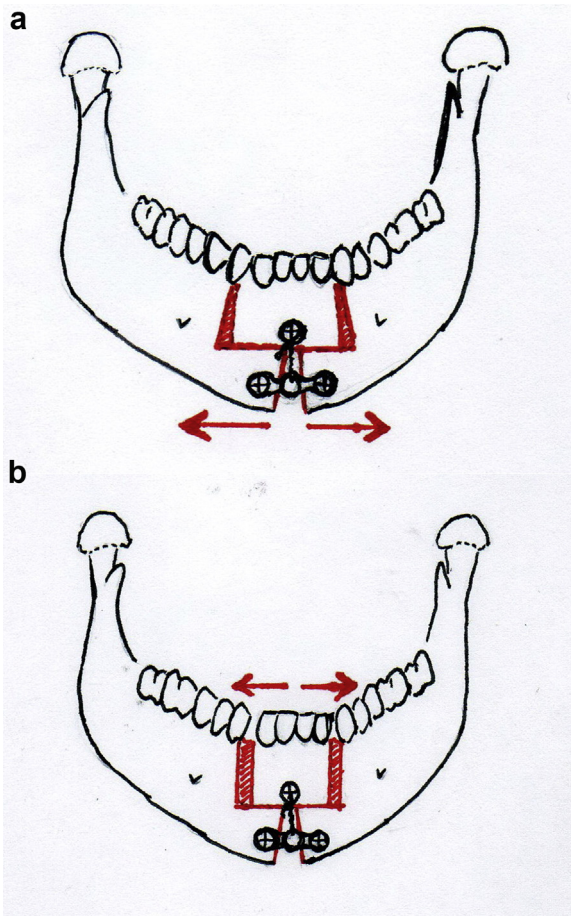

Fig. 3. Surgical technique: osteotomy is finished, the mandibular base has been widened (3a). After completed activation of transversal distraction screw, mandible is expanded also at the alveolar ridge level (3b).

(Fig. 4a and b). At this time, the system was prepared for sagittal distraction. A new lingual acrylic appliance was applied, carrying two lateral, sagittally acting screws. These were activated daily; thus, the dento-alveolar block could be transported to the desired position (Fig. 5b).

When sagittal expansion was completed, the orthodontic dental alignment could continue, aligning the arches and closing the spaces opened during the distraction procedures (Fig. 5c). The majority of these patients were candidates for further orthognathic correction of dento-skeletal malocclusions; the treatment could be performed in the usual manner. Figs. 6–11 present all treatment phases of two patients, respectively: initially (Figs. 6 a,b and 9 a–e); after the distractions procedures (Figs. 7 a,b and 10 a–c); and at the end of treatment after final correction via bimaxillary osteotomy (Figs. 8 a,b and 11 a–e). The distraction procedure resulted in rapid space opening at the osteotomy site. If orthodontics was started rapidly, teeth also moved very quickly, shortening the treatment time.

3. Results

All patients suffered from a severe dento-skeletal discrepancy; thus, bi-directional mandibular distraction was the first surgical procedure to correct mandibular bi-dimensional hypoplasia and related dental crowding. Patients were candidates for subsequent correction of malocclusion via major orthognathic procedures (bimaxillary surgery). If the space between dental roots was not sufficient for osteotomy, the orthodontist could create the space by

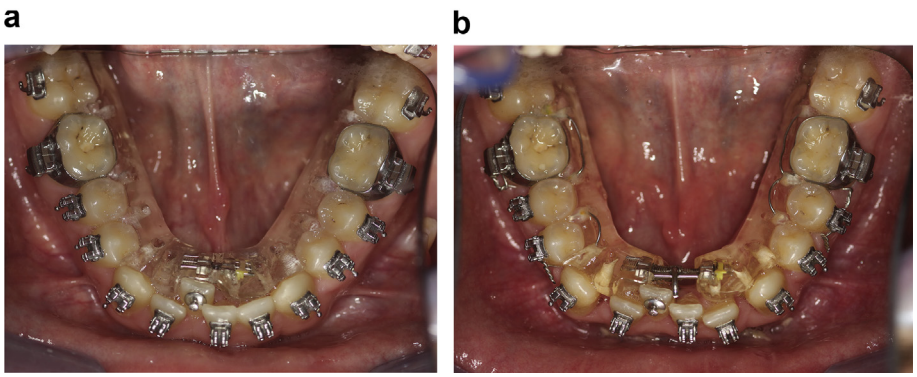

Fig. 4. Step 1: Transversal distraction. Before distractor activation (4a). At the end of the activation (4b).

spreading the two roots apart. After the distraction procedures were completed, orthodontic treatment could align the dental arches, and finally major orthognathic surgical procedures corrected the skeletal malocclusion.

The whole treatment required 18–24 months. No major complications (i.e. infections, non-union of the osteotomy-distraction gap, failure of the procedure due to poor functioning of the distraction procedure) occurred during or after surgeries; the transverse and sagittal diameter changes obtained with the distraction procedures remained stable. After treatment, no increase in the inter-condylar diameter was detected on X-ray P-A projection, and no patients reported any impairment of mandibular function, temporo-mandibular pain, clicking or any other symptoms at clinical examination. Table 1 presents results in the transverse diameter. In all cases, an increase in interdental distances was observed, with stable values at the three measurement points (canines, first premolars buccal cusps, first molars mesio-buccal cusps). Most of the expansion was achieved at T1, followed by a minor reduction at T2 and T3. This result is not suggestive of a relapse, but rather a normal trend caused by overexpansion required to correct teeth crowding. During orthodontic space closure, this overcorrection was normalised, diminishing the interdental diameters.

However, in patients 1 and 4, the increase in inter-molar distance was greater than the inter-canine and inter-premolar distances. This may have been because transverse distraction was performed with a four-band jackscrew, while in all other patients an acrylic device was used. The band-anchored device is more rigid and transmits the screw activation force more equally to both anterior and posterior teeth, unlike the acrylic distraction device, which acts more effectively on the anterior part of the dentition. Patient 3 showed less expansion at the molar level than in anterior teeth. In this patient, the lower arch was particularly narrow anteriorly; thus, it was previously planned to have a greater

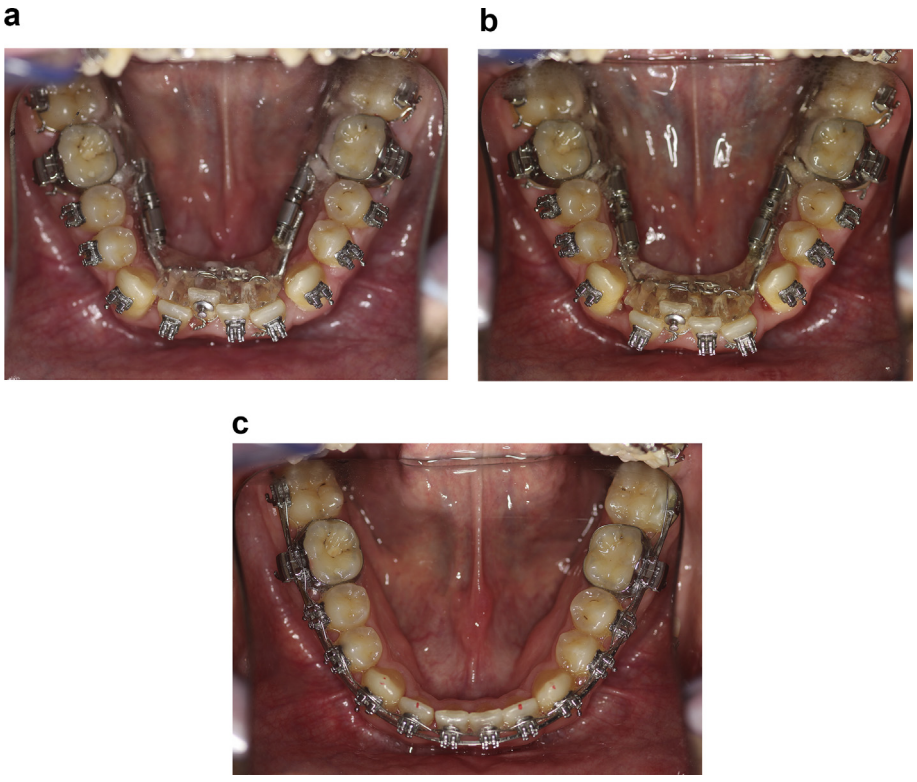

Fig. 5. Step 2: Sagittal distraction. Before screws activation (5a). At the end of activation (5b). After orthodontic alignment (5c).

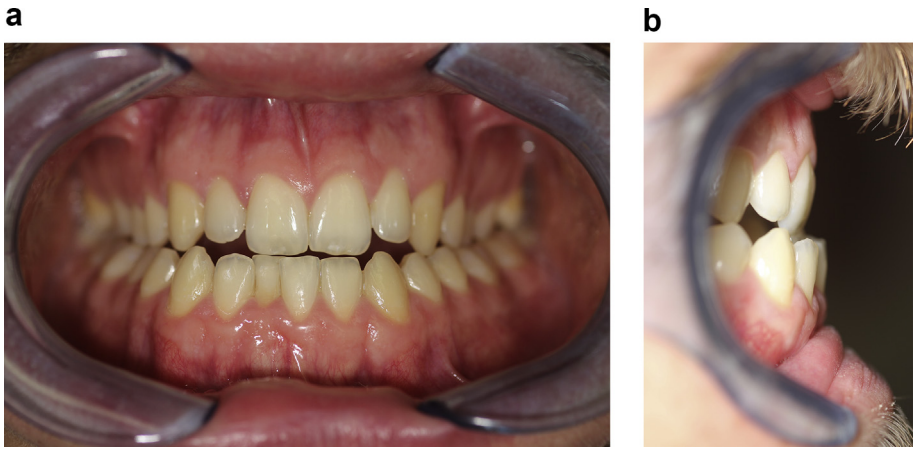

Fig. 6. Case 1. Occlusion and over-jet before treatment (6a-b).

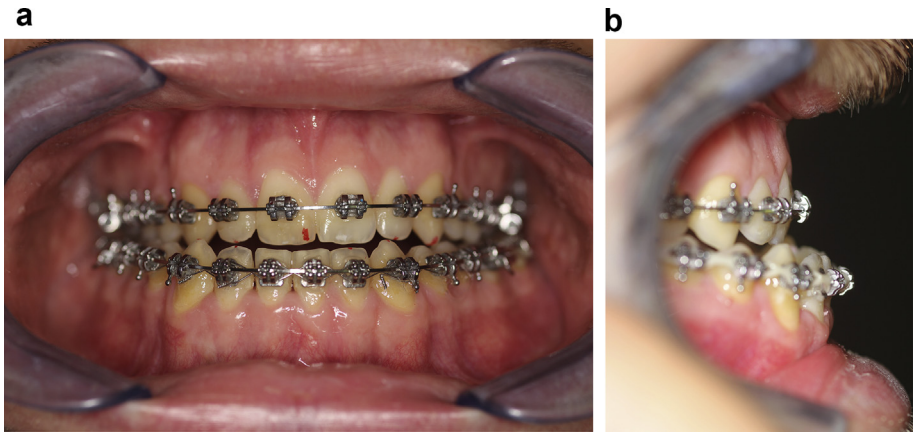

Fig. 7. After bi-directional distraction and orthodontic alignement (7a-b).

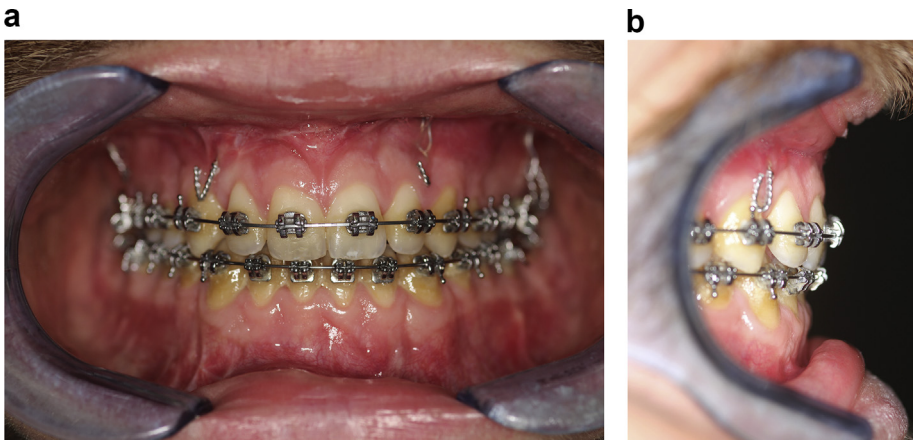

Fig. 8. After bimaxillary osteotomy for correction of skeletal malocclusion (8a-b).

expansion in the canine area than between molars. To achieve this, the dental plaster cast was sectioned and re-mounted with a specific degree of expansion anteriorly, while posteriorly it was left unchanged. The acrylic transverse distraction device was built on this modified model, and when it was mounted on the osteotomised mandible, it assumed the planned shape of the model. Moreover, discrepancies in single dental movements may be due to subsequent orthodontic alignment. Mean transversal expansion was 2,9 mm at cuspids and first bicuspids with 1,6 and 0,9 respectively for standard deviation. Sagittal expansion values are shown in Table 2. Measurements were obtained on dental models from a transverse line connecting the two first molars mesio-buccal cusps with the inter-dental papilla between the two central lower incisors. In addition, these measurements present a peak at the end

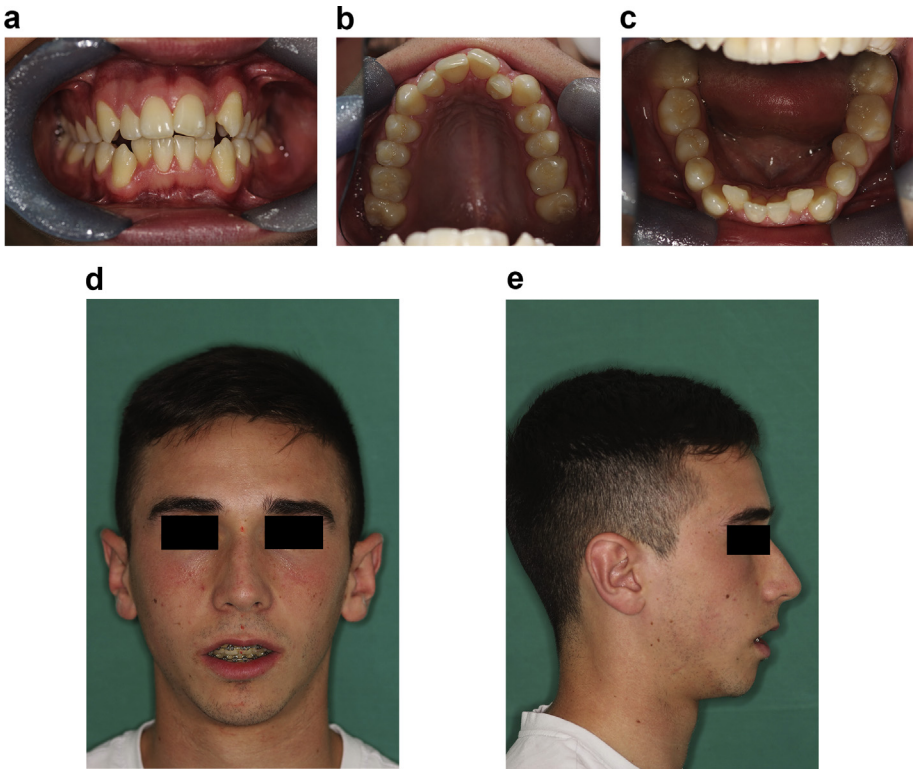

Fig. 9. Case 2. Occlusion, upper and lower arches before treatment (9a-c); patient's front and profile view before treatment (9d-e).

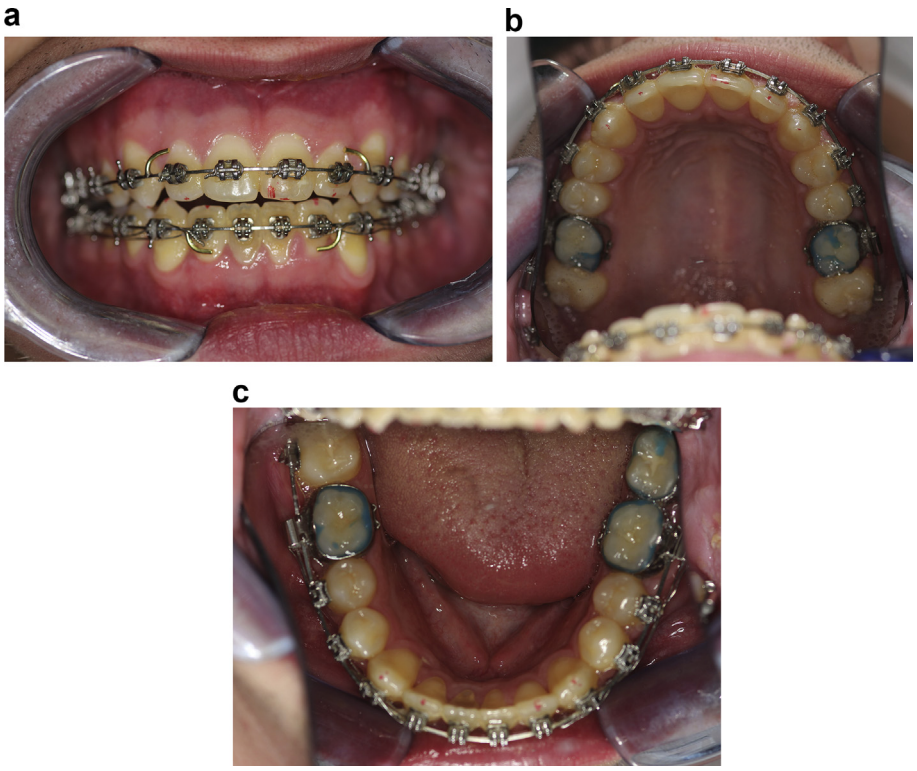

Fig. 10. Occlusion and dental arches after maxillary surgically assisted rapid expansion (SARPE) and mandibular bi-directional distraction and following orthodontic alignement (10a-c).

of active distraction (T1), essentially because of the overcorrection intentionally pursued with distraction, suitable for correction of teeth crowding; the values then decreased during orthodontic spaces closure and stabilised 1 year after teeth alignment (T3). Mean sagittal advancement was 3,1 mm with 0,6 for standard deviation and no relapse detected at T3.

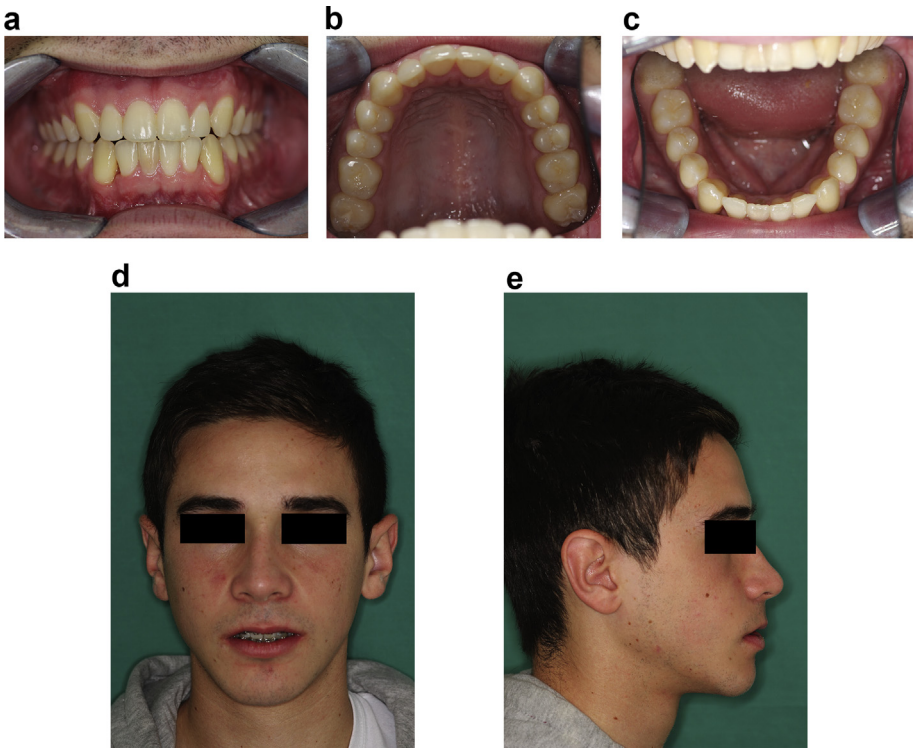

Fig. 11. Occlusion, dental arches and patient's face at the end of treatment, after bimaxillary osteotomy for skeletal correction of malocclusion (11a-e).

4. Discussion

Our novel procedure combines two common mandibular distraction procedures; namely, anterior dento-alveolar distraction and the transverse mandibular distraction with lower mandibular border bone anchorage (Carlino, 2013; Carlino et al., 2016; Duran et al., 2006; El-Bialy et al., 2013; Guerrero et al., 2000; Gunbay et al., 2009; King and Wallace, 2004; Matsushita et al., 2011; Metzler et al., 2012; Triaca et al., 2001; Zemann et al., 2012). The former is commonly used to expand the anterior mandibular alveolar process sagittally (Triaca et al., 2001). The latter is a novel technique introduced to expand the mandible via a minimally cumbersome tooth-borne device, maintaining strict control of the two laterally moving mandibular halves (Carlino et al., 2016). The bi-directional distraction technique presented here combines the two single distraction procedures with a resulting original osteotomy line.

The first is the dento-alveolar osteotomy, as described for front-block distraction, comprising either four or six anterior mandibular teeth. The second is the symphysiotomy, consisting of a simple vertical osteotomy going from the previous horizontal osteotomy midline to the inferior mandibular border. The mandibular base is laterally spread and fixed with a two-screw plate, as performed for the simple midline expansion technique (Carlino et al., 2016), from which the only difference is that the osteosynthesis plate is connected to the dento-alveolar segment via a metal wire ligature. This system allows for a transverse distraction using the two osteosynthesis screws as hinges followed by a sagittal distraction of the dento-alveolar block, allowed for by the wire ligature. Therefore, a double distraction procedure is performed after a single surgical step.

As previously described, the procedure implies immediate expansion of the mandibular base after symphysiotomy, with fixation of the two mandibular halves at their inferior border with a single miniplate, carrying only one screw on each side. Therefore, the mandibular teeth are lingually inclined. After a 1-week latency, the lingual transverse screw, anchored with a metal wire ligature to the lower teeth, is activated at the rate of one-quarter turn each day. The two mandibular halves are spread using the two osteosynthesis screws as hinges. The teeth are then uprighted and the alveolar process expansion can proceed.

This system combines advantages of both bone-borne and tooth-borne appliances, commonly used alone for mandibular transverse distraction. At the lower mandibular border, immediate bone widening is performed. The intrinsic regenerative properties of this bone area allow for rapid recovery. The two bone segments have remarkable stability despite the masticatory forces during distraction due to the combination of the miniplate at the lower mandibular border with the intrinsic rigidity of the lingually positioned metal screw anchored to the teeth. Due to the skeletal stability of the distraction system, full control of distraction vectors is possible (El-Bialy et al., 2013; Gunbay et al., 2009; Zhao et al., 2014).

Sagittal distraction begins after transverse expansion. The wire ligature present between the basal bone osteosynthesis plate and the dento-alveolar bone block allows for sagittal movement. A lingual acrylic device with two sagittal screws is applied; daily activation of the screws allows for sagittal distraction, which is typically done for simple, traditional dento-alveolar distraction (Carlino, 2013; Triaca et al., 2001). Briefly, our method is an advancement of the previously reported mandibular symphyseal distraction technique (Carlino et al., 2016), in which the amount of bone obtained with the distraction is located at one site (mandibular midline). Using this technique, the bone distraction is divided into three osteotomy sites (two inter-dental and the symphysis); thus, a more regular shape of the mandible and better joining between the dental arch and mandibular base can both be obtained (Carlino, 2013; Carlino et al., 2016).

Table 1
Dental Measurements for transversal expansion of Selected Patients before surgery (TO), at the end of active distraction before teeth alignment (Tl), after orthodontic teeth alignment (T2), 1 year after surgery (T3).

Patient	Cuspids	1° Bicuspids	1° Molars
PATIENT 1	T0: 24,5	T0: 30,5	T0: 43,5
	Tl: 27,5	Tl: 35	Tl: 49
	T2: 26,5	T2: 34,5	T2: 48,5
	T3: 26	T3: 33	T3: 50
PATIENT 2	T0: 21,5	T0: 31,5	T0: 44
	Tl: 27	Tl: 34,5	Tl: 45,5
	T2: 27	T2: 35,5	T2: 46,5
	T3: 25,5	T3: 35	T3: 46,5
PATIENT 3	T0: 26,5	T0: 36	T0: 48
	Tl: 32	Tl: 39,5	Tl: 51
	T3: 32	T2: 39	T2: 50
	T4: 30,5	T3: 39	T3: 49
PATIENT 4	T0: 26,5	T0: 32	T0: 37,5
	Tl: 28	Tl: 35	Tl: 44
	T2: 27,5	T2: 34	T2: 43
	T3: 27	T3: 33	T3: 42,5
PATIENT 5	T0: 22	T0: 27	T0: 39
	Tl: 29	Tl: 32	Tl: 43
	T2: 28,5	T2: 32	T2: 42
	T3: 28	T3: 31	T3: 42
PATIENT 6	T0: 26,5	T0: 35	T0: 45
	Tl: 30,5	Tl: 38	Tl: 48,5
	T2: 30	T2: 38	T2: 48
	T3: 29,5	T3: 37,5	T3: 47,5
PATIENT 7	T0: 28	T0: 30,5	T0: 41,5
	T2: 31	Tl: 35	Tl: 45,5
	T3: 30	T2: 35	T2: 45
	T4: 30	T3: 34,5	T3: 44,5
PATIENT 8	T0: 25,5	T0: 33,5	T0: 46,5
	Tl: 28,5	Tl: 38,8	Tl: 50
	T2: 28,5	T2: 38,5	T2: 50
	T3: 27,5	T3: 37,5	T3: 49
	Cuspids	T°Biscuspids	I°Molars
PATIENT 1 Expansion	1,5	2,5	6,5
PATIENT 2 Expansion	4	3,5	2,5
PATIENT 3 Expansion	4	3	1
PATIENT 4 Expansion	0,5	1	5
PATIENT 5 Expansion	6	4	3
PATIENT 6 Expansion	3	2,5	2,5
PATIENT 7 Expansion	2	4	3
PATIENT 8 Expansion	2	2,5	2,5
Average Expansion	2,9	2,9	3,3
Standard Deviations	1,6	0,9	1,6
Standard error	0,6	0,4	0,6

Table 2
Dental Measurements for sagittal expansion of Selected Patients before surgery (TO), at the end of active distraction before teeth alignment (Tl), after orthodontic teeth alignment (T2), 1 year after surgery (T3).

Patient	I° Molars - Papilla 1-1
PATIENT 1	T0: 23
	Tl: 28
	T2: 27
	T3: 26
PATIENT 2	T0: 20
	Tl: 27
	T2: 24,5
	T3: 24
PATIENT 3	T0: 22
	Tl: 28
	T3: 26
	T4: 26
PATIENT 4	T0: 24
	Tl: 28
	T2: 26,5
	T3: 26
PATIENT 5	T0: 20
	Tl: 25
	T2: 23,5
	T3: 23
PATIENT 6	T0: 23
	Tl: 27
	T2: 26
	T3: 26
PATIENT 7	T0: 25
	T2: 30
	T3: 28,5
	T4: 28
PATIENT 8	T0: 20
	Tl: 24,5
	T2: 23,5
	T3: 23
	I° Molars - Papilla 1-1
PATIENT 1 Expansion	3
PATIENT 2 Expansion	4
PATIENT 3 Expansion	4
PATIENT 4 Expansion	2
PATIENT 5 Expansion	3
PATIENT 6 Expansion	3
PATIENT 7 Expansion	3
PATIENT 8 Expansion	3
Average Expansion	3,1
Standard Deviation	0,6
Standard Error	0,2

As previously stated, this distraction system has many of the advantages of both tooth- and bone-borne distraction devices, without the respective disadvantages. As with bone-borne appliances, basal bone expansion has good stability because it is performed surgically and stabilized with the osteosynthesis plate. However, it does not have the drawbacks of classic bone-borne devices; i.e. there is no transmucosal emerging hardware that requires additional surgeries for removal, and it avoids the unpleasant encumbrance in the buccal anterior mandible. As with tooth-borne appliances, it has minimal encumbrance lingually and presents no issues with aesthetics or quality of life during the active distraction and retention time, and it can be activated daily by the patient or caregivers.

The amount of transverse mandibular expansion is independent of the amount of sagittal expansion; they are achieved on demand, depending on the needs of the respective correction. Moreover, when maxillary surgical expansion is performed, strict coordination between upper and lower dental arches is accomplished (Cortese et al., 2013, 2014, 2016; Nada et al., 2013; Seeberger et al., 2015). TMJ dysfunction symptoms do not arise because the transverse expansion modality uses the condyles as hinges, and therefore the inter-condylar distance does not increase. The transverse distraction device hardware is responsible for the expansion pattern. If an acrylic plate is used, V-shaped expansion usually occurs because of the low rigidity of the device. On the other hand, when a four-band jackscrew is used, bodily movement of the two mandibular halves is achieved due to the greater stiffness of the appliance. After active distraction, a retention phase of at least 3 months is recommended. There is no need for a second surgery for hardware removal because no transmucosal parts are present.

No relapse was detected because of bone fixation by plate and screws at basal bone level and because of new mucosa and bone formation after distraction at the alveolar bone level.

Over correction was achieved for safe and suitable orthodontic space closure and teeth alignment; thus, mild transversal diameter decrease is not to be considered as relapse.

5. Conclusion

Skeletal dimensions of the mandible have always been a limit to the orthodontic alignement of lower dental arch; orthodontists are forced therefore to perform selected extractions to gain space.

Ortho-surgical skeletal expansion of the mandible in both transversal and sagittal directions is a unique opportunity to orthodontically level the whole mandibular arch without extractions and in a short time.

We present an original technique to perform the bi-directional mandibular distraction. The surgical procedure is accomplished in a single step.

The distraction devices present minimal encumbrance and consequently have a minimal impact on quality of life, working life, and aesthetics. The system is loose enough to allow the desired distraction in two directions and firm enough to stabilize the osteotomized bone during distraction. This minimally invasive technique and the use of minimally cumbersome distraction devices make the procedure applicable to all orthognathic patients with a proper indication.

Even if the procedure is new and data result from low numbers of patients, we can consider the technique safe and effective.

Mandibular expansion of both basal and alveolar bone was always achieved with proper dental arches alignment, without onset for relapse or TMJ disfunction.

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Conflicts of interest

None.

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