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Case Report: Compensatory Orthodontic Treatment of a Patient with Skeletal Class II Malocclusion Using the 3D Maxillary Bimetric Distalizing Arch

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Abstract: *The selection of the treatment protocol for a patient with class II malocclusion will depend on many factors, the age and degree of skeletal discrepancy being relevant.* ***Case Report****: A 10-year and 10-month of age female patient is taken by her parents to the orthodontic department at the Autonomous University of Baja California (UABC), Mexico, requesting orthodontic treatment. Taking into account the results of the different analysis performed, a class II division I skeletal pattern was found due to a maxillary protrusion and a mandibular retrusion, presenting a deep bite and mixed dentition. Since the patient is growing up, a dentoalveolar compensation is chosen, using a 3D Maxillary Bimetric Distalizing Arch (3D-MBDA). Obtaining as a result the correction of molar and canine relationships to class I and better facial harmony were achieved.*
Conclusion: *3D-MBDA can be effectively used as an aid in compensatory orthodontic treatment of CII malocclusion.*

Key Word*: Orthodontics; Class II malocclusion; 3-D Maxillary Bimetric Distalizing Arch; Dentoalveolar compensation; Molar distalization.*

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I. Introduction

Class II division I malocclusion "is one in which the lower first molars occlude distally in their normal relationship with the upper first molars in extension of more than one half of the width of a cusp on each side, presenting protruded incisors"[(1)]. Throughout history, various procedures have been described for the correction of this type of malocclusion, which are selected depending on their etiology, either due to excessive maxillary growth, mandibular growth deficiency, a combination of both or simply a dentoalveolar alteration. Among these procedures we can mention myofunctional devices and mandibular propulsor, for example, twin-block, Andersen device, Herbst, etc. In addition, there are maxillary distalizers, some require the cooperation of the patient, such as the headgear and the maxillary bimetric distalizing arch, on the other hand, the following devices do not require patient activation, such as the Hilgers pendulum appliance, the Jones Jig device, Distal Jet and the Temporary Anchoring Devices (TADs). It should be mentioned that there is also the option of extractions to obtain a dentoalveolar camouflage, as well as resorting to an orthognathic surgical approach in case the previous procedures are not viable[(2,3)].

William L. Wilson and Robert C. Wilson[(4–7)] introduced the Modular Orthodontic System in the late 70s and early 80s, which proposed, for the correction of class II malocclusions, the use of a device called 3D Maxillary Bimetric Distalizing Arch (3D-MBDA) in combination with a lingual arch. The objective of the lingual arch is to reduce side effects and serve as an anchor for the use of class II intermaxillary elastics. The Lip Bumper can also be used to maintain stability in the mandibular arch; this device has some extra advantages such as the uprighting of the lower molars and the elimination of the mandibular anterior crowding, if it's present in the patient[(3)]. The 3D-BMDA arch consists of a round anterior section with a thickness of 0.022" and a posterior one of 0.040", the hooks for the elastics are welded at the anterior end in the section of 0.040" at the level of the cusp of the canine and presents an adjustable omega loop at the level of the first molar and the second premolar, which will remain closed when starting treatment. Activation is performed by placing an open stainless steel coil of 0.010" X 0.045" and 5 mm in length between the closed omega loop and the mesial portion of the accessory tube of the first molar, only 2 mm being compressed. As the molars rapidly distalize, space will be created between the loop and the accessory tube, which will require opening the omega loop to keep the coil activated. To avoid any effect on the anterior area and that the coil force is directed only towards the molars, two 5/16" 3 oz (85 gr.) elastics are used for 24 hours, the first 10 days after the adjustment, afterwards only one elastic is used until the day of the adjustment, in cases of extractions, it is suggested 1/4" elastic of 3 oz. (85 gr.). The purpose is to deliver an initial strength of 170 gr., to later reduce it to 85 gr. on each side of the arch.

Certain effects produced after the use of 3D-MBDA have been reported in the literature, which we can divide into:

- *Dentoalveolar effects.* In the maxilla, it causes proclination and extrusion of the incisors, inclination and molar distalization. At the mandibular level, the first molars are extruded, inclined and mesialized, as well as incisor proclination, protrusion and intrusion[8,9].
- *Skeletal effects.* It causes a slight mandibular projection and maxillary retrusion attributed to the modification of the position of the teeth. In certain situations, a clockwise mandibular rotation occurs[10].
- *Effects on soft tissues.* It is mentioned that various changes may arise, among which we find the decrease in the nasolabial angle in conjunction with the anterior movement of the upper lip[11], the protrusion only of the lower lip[10,12] or the retrusion of both lips due to a greater projection of the surrounding soft tissues during growth[13]. These studies refer to the role played by the position of the incisors in the final projection of both lips.

The purpose of this article is to describe a clinical case treated with the 3D-MBDA and fixed appliances in the orthodontic clinic of the Autonomous University of Baja California (UABC), Mexico, and to report the changes that occurred in said patient.

II. Case Report

A 10-year and 10-month of age female patient attends the orthodontic department of the Autonomous University of Baja California (UABC) led by her parents, who refer as the main complaint "I see a deformity in her bite". In the anamnesis, the parents deny any type of systemic condition or being under any medical treatment that may affect the results of orthodontic treatment.

The extraoral analysis shows an oval face shape, the lower facial third diminished with respect to the middle and upper, presents a convex profile, obtuse nasolabial angle (103°), closed mentolabial sulcus (80°), lower lip is 2 mm in front of the Ricketts E-plane, when smiling, a partial exposure of the teeth of approximately 50% of the clinical crown is appreciated, as well as the dental and facial midline not coinciding with each other (Fig. 1).

Fig. 1 *Pretreatment extraoral photographs*

On intraoral inspection we observed that the patient has a thin periodontal biotype with no apparent pathological data, she has mixed dentition with the presence of upper and lower second primary molars (5.5,6.5, 7.5 and 8.5), first lower primary molars (7.4 and 8.4), superior temporal canines (5.3 and 6.3); class II right and left molar relationships, overbite of 10.5 mm and overjet of 10 mm; rotations in some teeth (1.6, 1.2, 1.1, 2.1, 2.2, 2.6, 3.1, 3.2, 4.1, 4.2), absence of space for the lower permanent canines (3.3 and 4.3), retroclined and extruded lower incisors generating a very accentuated curve of Spee, as well as upper square and lower oval arch shapes (Fig. 2).

Fig. 2 *Pretreatment intraoral photographs*

Among the imaging studies requested from the patient, there was a panoramic radiograph and a lateral cephalogram (Fig. 3) in which the cephalometric tracing was performed. The results are annexed in Table I.

	Means	Initial
SNA	82°	**85º**
SNB	80°	**76º**
ANB	2°	**9º**
Áng 1s / SN	104°	**104º**
1i / Go-Gn	90°	**87º**
Mandibular Length (Go-Me)	71 mm	**72mm**
Anterior Cranial Base (S-N)	71 mm	**70mm**
Mandibular Length / BCA	1:1	**LM>LBCA**
Go-Gn / SN	32°	**30º**
Witts	0 mm	**7mm**

Table I. *Pretreatment Cephalometric Measurements*

Fig. 3 *Pretreatment lateral cephalogram and panoramic radiograph*

Diagnosis:

Female patient of 10-years and 10-months of age, Latin race, in peak of growth (stage of cervical vertebral maturation of Baccetti CS4) (Fig. 4), presents a brachyfacial biotype according to the results of the Ricketts VERT index, convex profile, skeletal pattern class II division I (maxillary overgrowth and sagittal mandibular projection deficiency), late mixed dentition, class II molar relationships both right and left, indeterminate canine relationships (clinical absence of permanent lower canines), retroclined lower incisors, upper incisors positioned at their bony bases, reduced lower arch length, dental midlines deviated to the right from the facial midline, pronounced curve of Spee, increased overjet (10 mm) and severe deep bite.

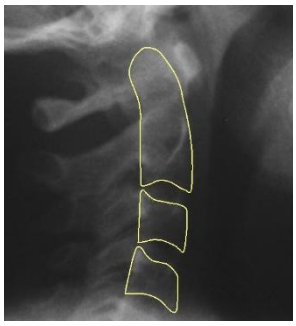

***Fig. 4** Cervical stage 4 (CS4)*

Treatment:

Due to the growth potential and the main complaint, it was decided to carry out a dentoalveolar compensation process for the correction of the class II division I malocclusion, which, in this case, is of skeletal origin. The treatment was divided into two phases:

First phase.

It consisted of molar distalization until class II was modified to class I; the process is summarized below.

It was started by placing 2 X 4 appliances (Roth slot 0.018" X 0.025") in the maxillary incisors (2-2) and bands on the molars (Fig. 5), proceeding to leveling and aligning the anterior sector with a sequence of arches nickel titanium (0.014" and 0.016"), later a 0.016" SS archwire was placed, helix loop were added mesial of the first molars with the intention of place a tieback from the tube hook to the loop and thus avoid incisor proclination. In addition, the upper arch was prepared for the subsequent placement of a 3D-MBDA.

Fig. 5 2X4 Appliance

Afterwards, a Lip Bumper was placed, which will help to counteract the mesialization forces that the elastics will exert, that is, it will function as an anchor. This device will favor the proclination of the lower incisors which are retroclined, this will be achieved thanks to the lip bumper's buccal shield, which neutralizes the pressure force of the lip (3 to 39 g/cm^2)[14] on the lower incisors, allowing the pressure produced by the tongue not to be counteracted (Fig. 6).

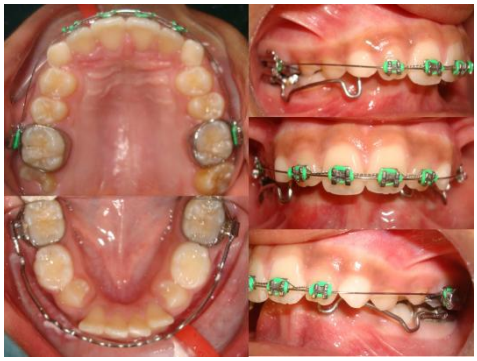

Fig. 6 Lip Bumper placement

Once the lower anchoring mechanism had been adapted and the maxillary anterior sector leveled and aligned, the 3D-MBDA was placed following the indications for its adaptation to the patient. In this session, the

activation was not carried out, it was decided to wait until the next appointment; the activation protocol using intermaxillary elastics differs from the original, initially 5/16" elastics of 4.5 oz. (delivering 130 gr.) were used for a duration of 2 months and then 1/4" elastics of 4.5 oz. (150 gr.) and 6 oz. (170 gr.) until the expected molar relationship was achieved (Fig. 7).

Fig. 7 *Activation of 3D Maxillary Bimetric Distalizing Arch*

Due to the overbite problem, it was decided to place an anterior bite plane to enhance the effect of the Lip Bumper and in turn promote an extrusion of the lower molars, thus flattening the curve of Spee. The mandibular projection stimulus was continued by using class II intermaxillary elastics (Fig. 8).

Fig. 8 Anterior bite plane placement

With the eruption of the rest of the permanent teeth, it was decided to remove the Lip Bumper and place the lower fixed appliances except for the left canine, which required space for its correct eruption. A sequence of 0.014", 0.016" NiTi and 0.016" SS archwires was placed, as well as an open coil between the lateral and premolar of the left side to generate space for the eruption of the lower left canine. At the same time that the use of class II intermaxillary elastics continued, the leveling of the lower arch continued. Upon obtaining a class I molar relationship, the 3D-MBDA was removed (Fig. 9).

Fig. 9 *Class I molar relationship obtained*

Second phase.

During this stage, the placement of both the upper and lower fixed appliances was completed and the different stages of the straight-wire technique described below were carried out.

It began by leveling and aligning, in the upper arch a sequence of 0.016 X 0.016", 0.016 X 0.022" NiTi archwires was followed and in the lower arch a sequence of 0.016", 0.016" X 0.022" NiTi archwires (Fig. 10). Subsequently, the working stage was carried out with upper and lower 0.016" X 0.022" SS archwires, which were coordinated with each other and upper tieback were placed to retract the anterior segment (Fig. 11). Once the spaces were closed, the manufacture of removable Hawley-type retainers was carried out (Fig. 12 and 13). She is referred for prophylaxis, extraction of third molars and restoration of decayed teeth. Given this, the patient refuses to extract the third molars.

Fig. 10 Alignment and leveling

***Fig. 11** Closure of spaces with upper tieback*

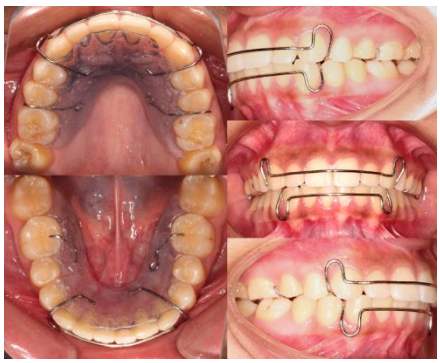

***Fig. 12** Removable Hawley retainers*

***Fig. 13** Postreatment intraoral photographs*

III. Results

The results that were obtained were satisfactory, both functional and aesthetic. Good coordination of the arches, correction of the molar and canine relationship from class II to class I, a reduction of the overbite from 10.5 mm to 2 mm and the overjet from 10 mm to 2.5 mm, as well as a flattening of the curve of Spee (Fig. 13). The skeletal pattern underwent some changes, the cephalometric values are observed in table II, an improvement in the mandibular projection is appreciated, helping to improve its relationship in the sagittal direction with the maxilla, which did not show any modification, there is also a rotation in clockwise direction of the mandibular plane (Fig. 14). A good crown-root relationship was maintained (Fig. 14). Facially, there was a reduction of the nasolabial angle (93°), the mentolabial sulcus improved (95°) and the lower lip presented a retrusion, being 1 mm in front of the Ricketts E-plane. A harmonious smile arc is presented with the presence of buccal corridors, at the same time as a good correlation between the dental midline and the facial midline (Fig. 15).

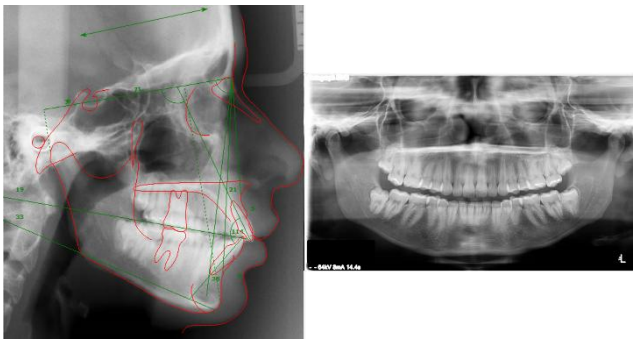

Fig. 14 *Postreatment lateral cephalogram and panoramic radiograph*

	Means	Final
SNA	82°	**85°**
SNB	80°	**78°**
ANB	2°	**7°**
Áng 1s / SN	104°	**106°**
1i / Go-Gn	90°	**102°**
Mandibular Length (Go-Me)	71 mm	**72mm**
Anterior Cranial Base (S-N)	71 mm	**71mm**
Mandibular Length / BCA	1:1	**LM>LBCA**
Go-Gn / SN	32°	**33°**
Witts	0 mm	**2mm**

Table II. *Postreatment Cephalometric Measurements*

Fig. 15 *Postreatment extraoral photographs*

In the superimposition (Fig. 16) various modifications are perceived at the dentoalveolar level, the upper incisor shows a retrusion and slight proclination, the lower incisor shows a marked protrusion and proclination, the upper first molar shows distalization and extrusion, while the lower first molar suffered a mesial movement and also manifested extrusion. Regarding the soft structures, the lips also showed modification when retracting after treatment.

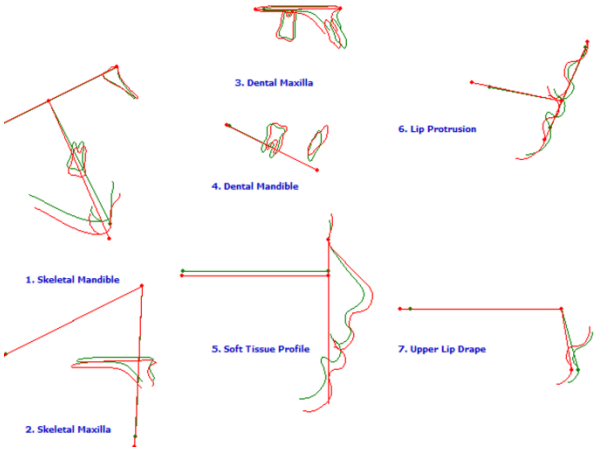

Fig. 16 *Cephalometric superimposition. Green, pretreatment; red, postreatment*

IV. Discussion

The use of the 3D Maxillary Bimetric Distalizing Arch has been a reference in several studies in which the effects produced on the patient's structures are evaluated[8,11], as well as comparing it with other devices used for the correction of class II malocclusion[10,12], obtaining positive results.

Rana and Becher[8], refer among the effects produced by the use of elastics in the 3D-MBDA, the loss of anchorage in the mandibular arch is found, generating protrusion and intrusion of the incisors, the protrusion being the most evident change presented by the patient, but not completely attributed to the use of this device, the absence of space for the eruption of the permanent canines played an important role in the protrusion and proclination of the incisors.

The loss of anchorage in the lower arch suggests that the correction of the class II malocclusion in the patient was not carried out only by the distalization of the upper molars but also by the mesialization of the lower molars as reported by Muse et al.[9]

Altug-Atac et al. [10,12], mention in their articles that there is a backward displacement of point A in the maxilla sagittally, as a result of the palatal movement of the roots of the incisors at the time of distalization. It also refers to the forward movement of point B on the mandible due to protrusion of the incisors. The patient did not show a change in point A, but point B does present a sagittal projection, being visible in the cephalometric tracings, partially agreeing with what was described by the authors.

At the time of selecting the candidate patient for 3D-MBDA use, a brachyfacial or mesofacial pattern is preferably suggested, if it is used in dolichofacial it is recommended to have good vertical control due to the extrusion of the posterior sector producing a greater rotation in clockwise direction[2,11].

In the study carried out by Oliveira[13], he mentions a retrusion of the lips after treatment, taking as a reference the Ricketts E-plane for comparison; on the contrary Üçem et al.[11], using the same reference plane, obtained a protruding upper lip as a result. In the present case, there was a reduction in the anterior labial projection despite presenting a reduction in the nasolabial angle, which could be justified, as mentioned by Oliveira, to a greater growth of both the nose and the chin, these being the points of reference used to determine the anteroposterior position of the lips.

To help control unwanted effects, especially incisor proclination and mesialization of molars in the mandibular arch, today it is proposed to use the 3D-MBDA in conjunction with TAD's[2], thus also eliminating the patient cooperation increasing the success rate.

V. Conclusion

Correction of class II malocclusion in patients with late mixed dentition can be effectively treated with the 3D Maxillary Bimetric Distalizing Arch, which will not only correct the malocclusion by distalizing the upper molars but also by mesializing the lower molars. Other relevant dental movements are proclination and protrusion of the lower incisors in cases of limited arch length, proclination and retrusion of the upper incisors, extrusion of the lower molars, even if the appropriate anchorage is available, and extrusion of the upper molars due to the distalization movement, at the skeletal level the most significant movement is the anterior projection of the point B in the mandible.

There are several devices similar to 3D-MBDA that help us avoid surgical treatment in patients with skeletal discrepancies through dentoalveolar compensation. It is important to bear in mind that for the success of any treatment a proper diagnosis and timely intervention is required.

The facial biotype becomes relevant when using the 3D-MBDA due to the possible clockwise rotation, and care must be taken in dolichofacial patients.

The use of TADs is recommended if the aforementioned effects on the lower arch are not desired when using the 3D-MBDA. It is suggested to carry out a thorough evaluation to know the effects that this combination produces.

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