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Case Report

Nonsurgical Treatment of an Adult with Asymmetrical Anterior Open-Bite, Gummy Smile, Skeletal Class II and Vertical Maxillary Excess

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Abstract

A 28-year-old male patient visited our clinic office with a chief complaint of incisor protrusion and open-bite. He was diagnosed with an asymmetrical anterior open-bite, asymmetrical occlusion, unilateral crossbite, gummy smile, skeletal Class II pattern, loss of six molars, periodontal defect and restorative complication on the mandibular left first molar. He refused the surgical-orthodontic treatment option, although he wanted to correct the malocclusion. After periodontal treatment and initial alignment with Edgewise appliances .022" □ .028" and the Tweed technique, differential intrusion of anterior and posterior teeth, left and right side in maxillary arch was necessary to maximize the skeletal treatment effects using two mini-implants as a temporary anchorage devices (TADs). These TADs were inserted at convenable areas on maxillary arch to allow reasonable biomechanics using archwires with accentuated curves of Spee. After a hopeful improvement of the malocclusion, extraction of the condemned mandibular left central incisor was done and the space was closed with a central loop to contract the mandibular arch, to shift dental midline and to mesialize the mandibular left dental sector achieving a compromised occlusion. These simple mechanics contributed to the effective intrusion of entire maxillary arch and differential intrusion of the anterior and posterior teeth, left and right side were achieved to treatment of the malocclusion with maximize skeletal treatment effects and a considerable improvement of the smile and profile, offering an alternative to orthognathic surgery for this patient. .

Keywords: *Vertical Maxillary Excess; Anterior Open Bite; Skeletal Class II, Arch Intrusion; Temporary Anchorage Device*

Introduction

In our daily orthodontic practice, we often receive adult patients with vertical maxillary excess (VME) and different forms of open-bite malocclusions. A complex anterior open-bite malocclusion is usually caused by a combination of habits and skeletal, dental, or functional influences.

The treatment of a skeletal open bite malocclusion with a VME especially in adult patients is always challenging for the orthodontist [1,2]. Orthognathic surgery is considered the first treatment option for an adult patient. However, when this surgical option is not possible, several alternative plans and various possibilities are proposed in the literature for nonsurgical options, such as external appliances [3-6]. Orthodontic treatment in adult patients with anterior open bite and VME requires strict vertical control. The mandibular opening is a recognized problem and can have detrimental effects on facial esthetics, dental esthetics, and effective mandibular growth. The control of posterior tooth eruption is the most manageable factor available to the orthodontist in the overall control, and it is an important component of treatment. Upper molar intrusion induces counterclockwise rotation of the mandible, thus improving the convex profile [7]. Several millimeters of posterior tooth eruption or depression are exaggerated at pogonion to cause the changes to the chin point, overbite,

anterior facial height, gnathion or pogonion and mandibular plane angle [8,9]. In contrast, more changes can occur in the occlusal plane angle and maxillary parameters in adults [10].

Traditional biomechanical techniques of controlling molar eruption in patients with VME, such as High-pull headgear [6,8], Vertical chin cups [6,11], Twin-block [12,13], Rapid molar intruder [14,15], removable and fixed appliances, etc. [16,17] cannot effectively control intrusion of the molars, especially in adult patients because of inadequate dental anchorage [18-23].

To provide adequate anchorage, dental mini-screws or mini-implants of various materials and designs have been developed as a temporary anchorage devices (TADs) and proposed for intrusion of upper molars [16,24-26]. The advantages of these TADs include ease of application, minimal patient compliance needed, and the ability to immediately load after initial wound healing. The surgical procedure for inserting or removing the TAD is simple, with minimal unfavorable complications [9,26-28]. Recent reports have showed the clinical efficiency of orthodontic TAD than conventional method of anchorage [7,8,16,26-33]. The vertical traction from orthodontic TADs reduces the maxillary posterior dentoalveolar height, thereby assisting to an orthodontic closure of anterior open bite. However, simultaneous eruption or extrusion of the mandibular molars should be controlled [34]. The cost-effectiveness need of anchorage reinforcement with buccal TADs and the number of TADs needed should be considered, when only moderate anchorage reinforcement is needed, TADs were less cost-effective. The TADs should be used in cases where anchorage loss cannot be accepted [35].

We describe in this article an adult patient with VME and an asymmetrical anterior open-bite, gummy smile, posterior crossbite and skeletal Class II pattern. This severe malocclusion was treated with simple and effective mechanics using just two maxillary TADs to achieve intrusion of the entire maxillary arch, a key to therapeutic success. Patient consent and release was obtained for this presentation.

Case Report

Diagnosis and etiology

A 28-year-old male visited our clinic office with a chief complaint of incisor protrusion and anterior open-bite. The patient was in good health and had no contraindications for dental treatment (Figure 1). He was hyperdivergent and had a convex profile with a retruded chin, and incompetent lips. There was a mild anterior gingival display and a moderate posterior gingival display when smiling. Maxillary central incisor exposure at rest was not excessive. There was a slight facial asymmetry with a small deviation of the chin on the right side in the frontal view of the face. He had no signs or symptoms of temporomandibular disorder despite the condylar asymmetry on the panoramic radiograph.

Intraorally, his lower dental midline was deviated by 3 mm on the right side due to the loss of the mandibular right first permanent molar while his upper dental midline was coincident with the facial midline. He had an asymmetrical anterolateral open bite reached from the maxillary right third molar to the maxillary left second premolar with a maximum vertical amplitude of 7 mm. On the right side, he has a posterior crossbite and he lost the maxillary first permanent molar and maxillary second molar, and the canine relationship was Angle Class II. On the left side he lost the three maxillary left molars, the canine relationship was Angle Class III, the mandibular left second and third molars were supraerupted due to the loss of antagonists. He had a mild anterior crowding and same spaces in both arches. The periodontal examination showed a gingival inflammation on the maxillary incisors at the buccal side. The mandibular central incisors were affected by periodontal disease with recessions and pockets (Figure 1).

The panoramic radiograph showed a condylar asymmetry, confirmed the different dental extractions already made and indicated a restorative complication on the mandibular left first molar (Figure 2). The lateral cephalometric analysis showed a skeletal Class II (ANB, 7°), retruded mandible (SNB, 72°) and hyperdivergent vertical pattern (FMA, 39°). The maxillary incisors had buccal inclinations (I to NA, 30°/9 mm), and an incisor-mandibular plane angle (IMPA) of 82°. The occlusal plane angle was excessive (OP, 22°) (Table 1). In addition,

the calculation of the index of difficulty gave a total difficulty score of 197 with a cranio-cacial difficulty of 161, putting this case in the severe difficulty category.

Figure 1: *Pretreatment facial and intraoral photographs.*

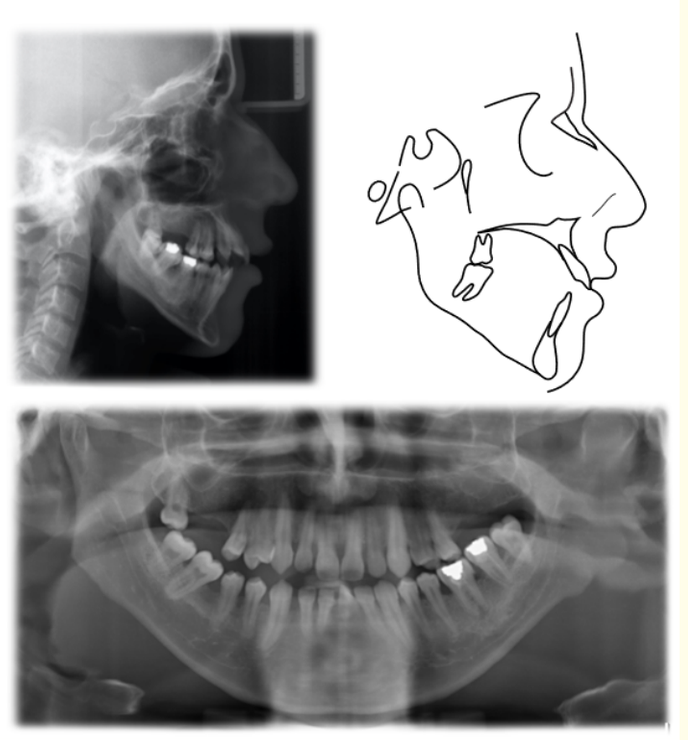

Figure 2: *Pretreatment records: lateral cephalogram, cephalometric tracing, and panoramic radiograph.*

	Norm	Initial	9 Months	2 Years
FMIA	67° ± 3	59	60	62
FMA	25° ± 3	39	37	34
IMPA	88° ± 3	82	83	84
SNA	82°	79	79	78
SNB	80°	72	74	74
ANB	2° ± 2	7	5	4
Ao-Bo	2 mm ± 2	2	-1	-2
OP to FH	10°	22	18	17
Z Angle	75° ± 5	82	80	78
Upper Lip	/	11	11	11
Total Chin	/	13	12	12
Post Facial Height	45 mm	47	47	47
Ant Facial Height	65 mm	68	68	68
Index Post-Ant	0,69	0,69	0,69	0,69
I to NA	4 mm	9 mm	3	3
Ito NA	24°	30°	18	20
Interincisal angle	131°	122°	131	133

Table 1: *Cephalometric measurements at pretreatment, 9 months, and posttreatment.*

Treatment objectives

The following treatment objectives for this patient were (1) to improve his facial profile and achieve a competent lip seal, (2) to correct the Angle Class II canine relationship on the right side and to achieve Class I canine and molar relationships, (3) to correct the Angle Class III canine relationship on the left side and to achieve a compromised occlusion with Class I canine relationship and Class III molar relationship on this side with normal overjet and overbite, (4) to shift the midline, (5) to expand the maxillary arch and contract the mandibular arch to obtain occlusal harmony in the transverse plane, (6) to close the anterior open bite, (7) to improve the gummy smile, (8) to reposition the maxillary incisor in the arch. The predicted treatment outcome was explained to the patient, and informed consent was obtained.

Treatment alternatives

Faced with this complex problem, we suggested a multidisciplinary protocol, starting with periodontal treatment to prepare the periodontium followed by orthodontics and finally prosthetics, with the fabrication of a permanent prosthesis. Two treatment options were considered for the patient:

1. Surgical orthodontic treatment, which could relieve vertical maxillary excess and anterolateral open bite efficiently with superior and posterior movement of the maxilla by LeFort I osteotomy after orthodontic preparation; In addition, favorable facial profile changes could be achieved by advancement and counterclockwise rotation of the mandible; and

2. Nonsurgical orthodontic treatment combined with TADs for maxillary molar and premolars intrusion. For this modality, four treatment choices were considered: (a) extraction of the mandibular left first permanent molar seen the restorative complications its presented and to correct the Class III canine and premolar relationships on the right side, and to shift the midline, and to

get a symmetrical mandibular arch. (b) extraction of the mandibular left central incisor seen the periodontal defect its presented to improve the periodontal state in this area, and to achieve a compromised occlusion on the left side with normal overjet and overbite, and to contract the mandibular arch to obtain occlusal harmony. Maxillary molar and premolars would be intruded using two TADs to close the open bite and to control the VME. This intrusion helps to correct posterior gummy smile and establish the occlusal plane. To maximize the counterclockwise rotation of the mandible, mandibular molars must be well leveled and controlled. (c) extraction of the mandibular left fist premolar to shift the midline, to correct dental disharmony and to get a symmetrical mandibular arch. (d) extraction of the mandibular left third molar and distalize all the mandibular left sector to shift the midline, to correct dental disharmony and to get a symmetrical mandibular arch. Because the patient refused surgical treatment, the second option was selected.

Treatment progress

Before orthodontic treatment, several sessions of periodontal treatment accompanied by recommendations concerning oral hygiene and medical treatment were performed. Re-evaluation of the periodontium showed an improvement in the periodontal condition, which allowed us to proceed with the orthodontic treatment. Both arches were banded or bonded using standard Edgewise appliances .022" × .028"and the Tweed technique.

After three months of alignment and leveling two TADs were placed on maxillary arch, the first one was inserted in the interdental septal bone next to the maxillary right third molar and the second was inserted behind the maxillary left second premolar (Figure 3) under infiltrative local anesthesia to allow adapted biomechanics (Figure 4). The TADs were 1.6 mm in diameter and 8 mm long. A hand key with a hexagonal long stem was used for insertion. The TADs were immediately loaded after initial wound healing, thereby an elastomic chain was stretched from each TAD to shaped hooks on the .017" × .025" stainless steel behind second premolars on both sides, and another elastic chain was connected from the right TAD to the hook of the molar band to generate a clockwise rotation of the maxilla (Figure 3). In a second time a buccal torque was added to the posterior teeth especially to the maxillary right third molar. To reduce the gummy smile, the maxillary incisors were also controlled by incorporating a curve of Spee in the upper archwire.

Figure 3: *Insertion of TDAs on maxillary arch, radiographic control and loading of the TDAs using an elastomeric chain on both sides.*

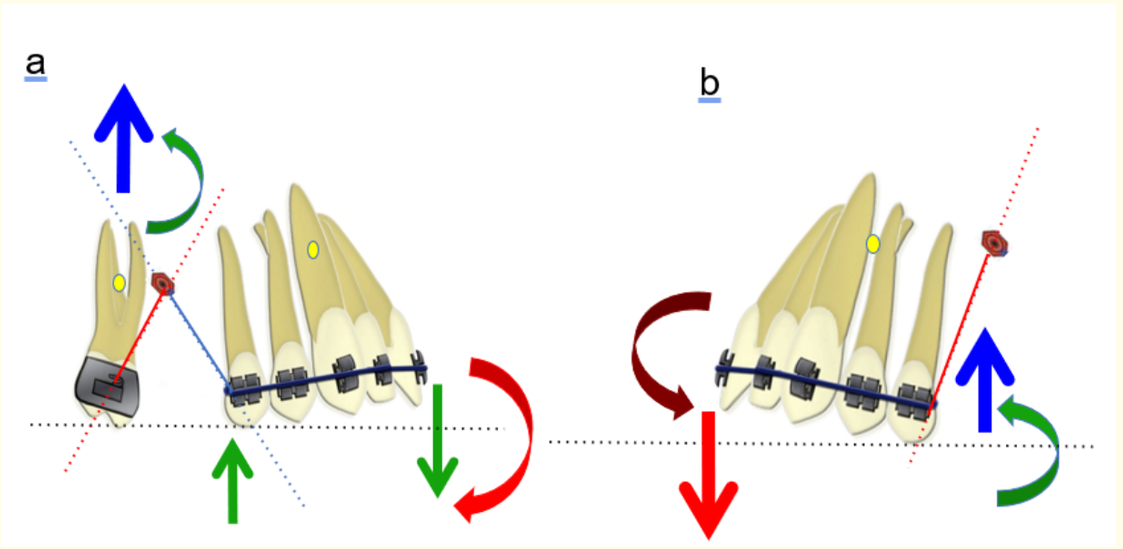

Figure 4: *Biomechanics of maxillary intrusion using temporary anchorage devices (TADs) on the right side (a) and left side (b). The placement of a stretched elastomeric chain from TADs to shaped hooks on the .017"⍰.025" stainless steel archwire at the second premolars on both sides produce intrusion and distalization of maxillary premolars, extrusion and distalization of maxillary incisors. The chain connected from the right TAD to the hook of the molar band generate intrusion, mesial tipping, buccal inclination of the maxillary right third molar. The result of these intrusive actions was a clockwise rotation of the maxilla and closure of the anterior open bite. To control maxillary incisors, an archwire incorporating a curve of Spee was added to the maxillary arch. In addition, the application of an intrusive force mesially to the center of resistance of the maxillary right third molar would result in mesial tipping, flattening of the occlusal plane and resulting in increased intrusion of the anterior teeth favorable for the correction of gummy smile.*

Before the placement of TADs we note a significant aggravation of the open bite consequent to initial leveling, but six appointments after loading of TADs there is a marked improvement in the malocclusion and the TADs showed a good stability (Figure 5 and 6). After this hopeful improvement we proceeded to the extraction of mandibular left central incisor seen the severe periodontal problem that it presented. This decision was made after explaining to the patient the advantages and disadvantages of each treatment option. This second alternative chosen by the author to treat the patient's problems had the least disadvantages. Then a central loop on the .019" × .025" stainless steel archwire was activated to contract the mandibular, to shift dental midline arch and to mesialize the mandibular left dental sector. In addition, this mechanic will improve the deep periodontal defect on the level of the lower incisors (Figure 7). A compromised occlusion with therapeutic class III on the left side was discussed and accepted by the patient (Figure 7 and 10). Total treatment time was 24 months.

Figure 5: *Facial and intraoral photographs after 9 months of treatment.*

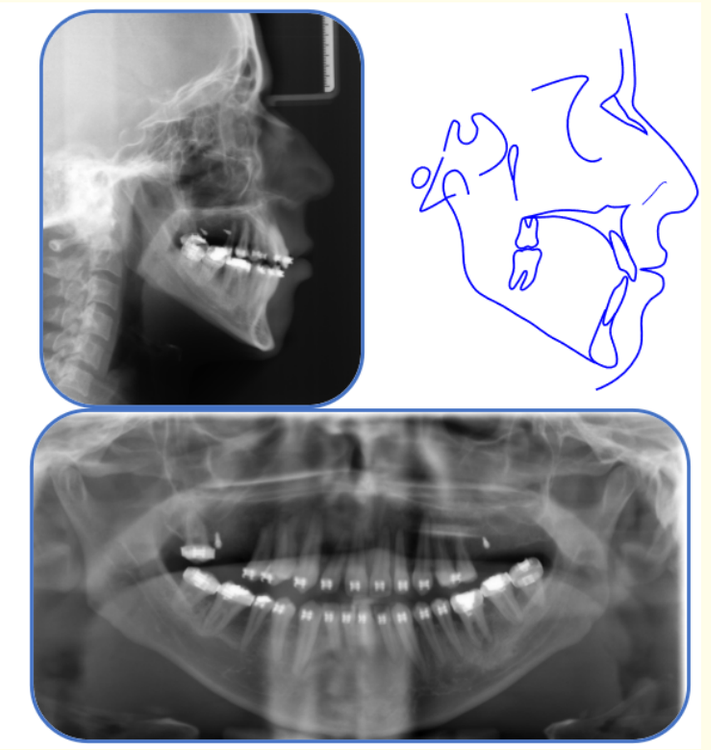

Figure 6: *Treatment records after 9 months of treatment: lateral cephalogram, cephalometric tracing, and panoramic radiograph.*

Figure 7: *Intraoral photographs during active treatment.*

Treatment results

Superimpositions of the cephalometric tracings demonstrated 3 mm of maxillary third molar intrusion, 7,5 mm of maxillary second premolar, 2,5 mm of maxillary incisor and an important component of the treatment results, subsequently the maxilla exhibited a clockwise rotation, with SNA decreasing 1° whereas the mandible exhibited a counterclockwise rotation (Figure 9) with SNB increasing 2° (Table 1). His profile was changed from a convex type with receding soft tissue menton to almost the straight type and a considerable improvement was noted in the nose-lip-chin relationship (Figure 10 and 11), due to FMA decreasing 5° and ANB decreasing 3° (Table 1). A more esthetic appearance of the chin contour was also apparent due to forward movement of Pog by 7 mm, along with autorotation of the mandible and 4mm reduction in lower anterior facial height. The lower molars showed minimal movements in the anteroposterior and vertical directions, and 1,5 mm of lower incisor extrusion (Figure 9). Because of the significant amount of tooth movement and intrusion, minor root resorption of the upper and lower teeth root apices could be seen in the posttreatment panoramic radiograph (Figure 5). The occlusion obtained was an acceptable compromise with Angle class I on the right side and therapeutic class III molar relationship on the left side thanks to the replacement of the condemned mandibular left central incisor and coronoplasty of the mandibular left canine and mandibular left first premolar (Figure 8). Maxillary prostheses will be installed in order to ensure proper occlusion and complete the esthetic result while at the same time providing reliable retention following the orthodontic treatment. As an unexpected result we have the persistence of a small lower deviation which we could not completely correct given the patient's time constraints.

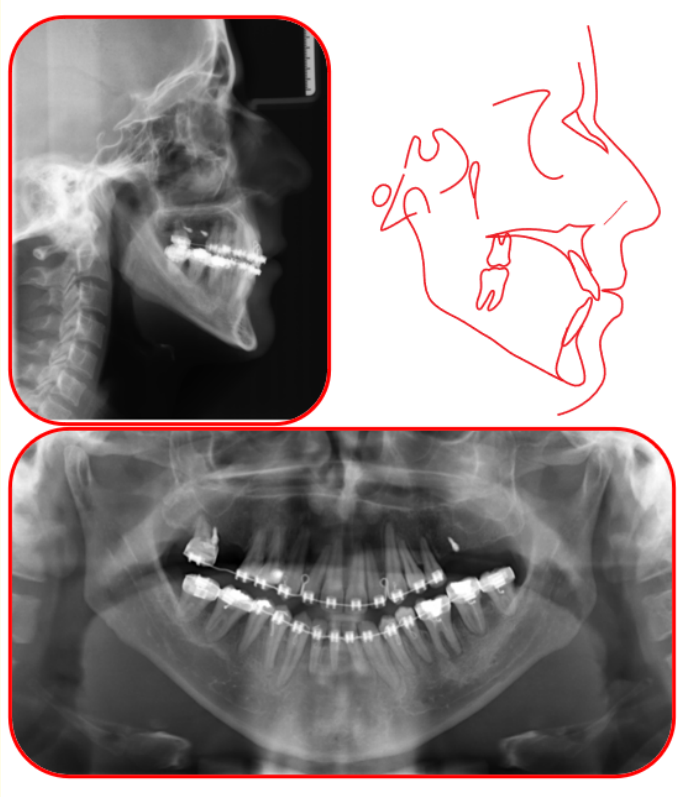

Figure 8: *Treatment records at the end of treatment: lateral cephalogram, cephalometric tracing, and panoramic radiograph.*

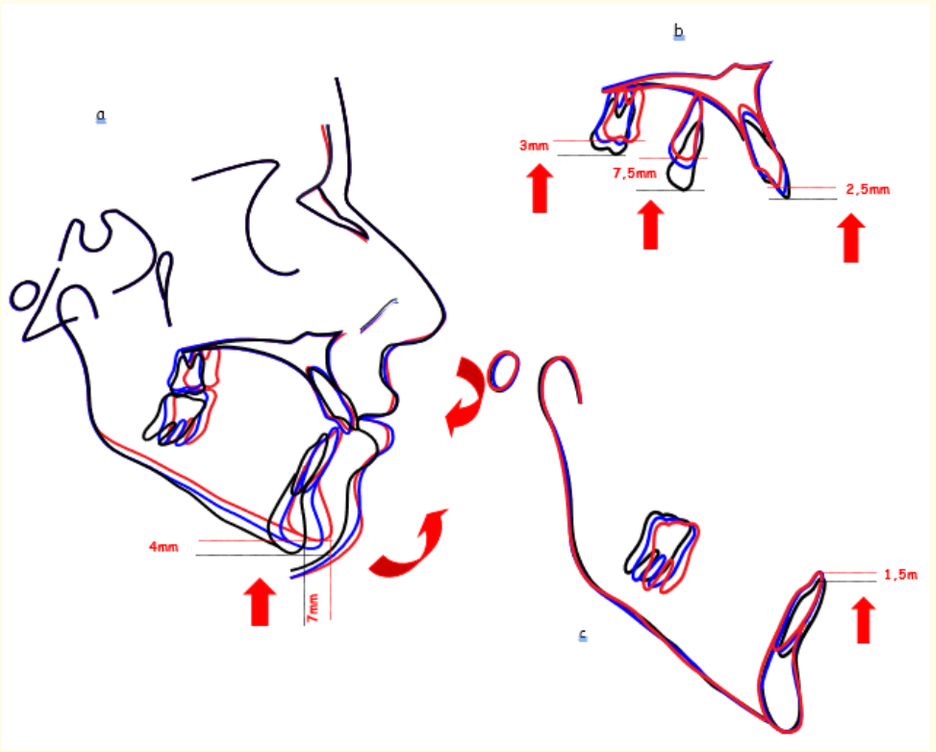

Figure 9: *Superimpositions of tracings before treatment (Black lines), 9 Months (blue lines), and the end of treatment (red lines): (a): overall, (b): maxilla, and (c): mandible.*

Figure 10: *Posttreatment facial and intraoral photographs.*

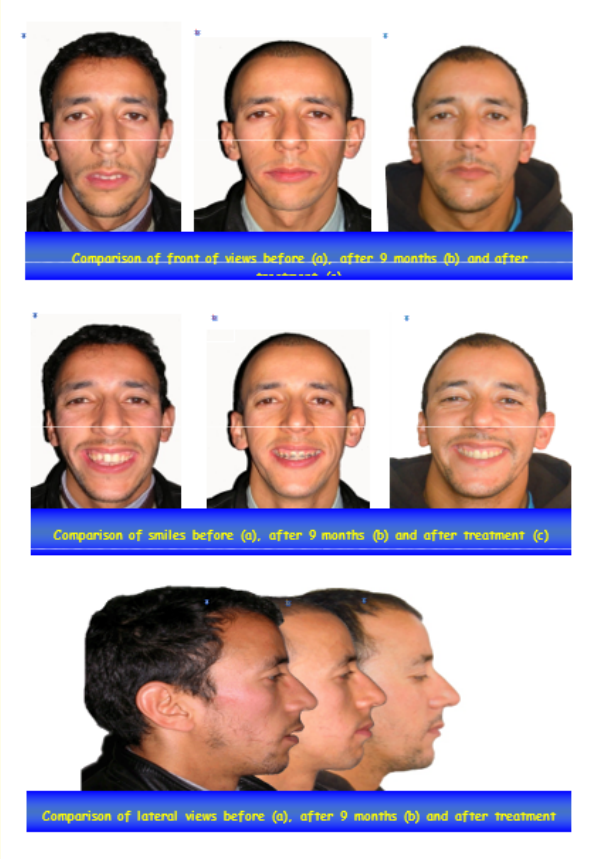

Figure 11: *Comparison of facial views (front of, smiles and lateral views): before (a), after 9 months (b) and after treatment (c).*

Discussion

To correct the malocclusion and improve the facial appearance for our patient, a surgical orthodontic procedure might have been the best treatment choice, although the patient refused this option, the decision was made to accomplish a nonsurgical orthodontic treatment using TADs. Control of the extrusion of posterior teeth is critical in adult patients with VME, especially, when combined with an asymmetrical anterior open-bite, skeletal Class II pattern and gummy smile. This case showed the feasibility of this treatment option if a good therapeutic scenario was established and suitable mechanicals has been well applied using TADs as anchorage.

To close this asymmetrical anterior open-bite, the maxillary teeth were directly intruded using a stretched elastomic chain from the right TAD to the second premolar hooks in each side of the maxillary arch and more intrusion was achieved on the maxillary right side using a second elastomeric module stretched from TAD to the maxillary right third molar band.

Several reports presented in the literature [3,7,16,25,36-41] have suggested that skeletal open bite can be corrected using TADs and showed successful results. Mechanically, molar intrusion causes counterclockwise rotation of the mandible; thus, anterior open bite tends to close automatically, this is agreed with several authors [30,39,42-44]. Paik [7,41-43] used a conventional transpalatal arch and TAD in the midpalatal area to treat adult patients with VME offering an alternative to orthognathic surgery for some patients, with an out-

come similar to that observed following LeFort I maxillary impaction, they called the procedure ″slow impaction″. Elastomeric chain was stretched directly from the TAD to the molars only. He kept the transpalatal arch away from the palate to allow intrusion of the molars while preventing palatal crown inclination. The same system described above was used to had more intrusion on the excessively erupted side by unilateral application of the elastomeric chain on the transpalatal arch hook on patients with vertical right-left asymmetries.

Application of an intrusive force more distally to the center of resistance of the first molars would result a steeper occlusal plane and increased intrusion of the posteriors teeth would be expected [7]. A huge amount of maxillary posterior teeth intrusion cause a clockwise rotation of the maxilla and occlusal plan which helping to quickly close of the anterior open bite, although it can aggravate the gummy smile. For this reason, in the present patient a little amount intrusion of anterior teeth should be considered. thus, we tried to apply an intrusive force mesial to the center of resistance of the maxillary right third molar as described by Paik [7]. It would result in mesial tipping, flattening of the occlusal plane and resulting in increased intrusion of the anterior teeth. Some factors should be considered for intrusion of the maxillary dentition like as upper incisor exposure, smile arc, and steepness of the occlusal plane [44].

To reduce the anterior gummy smile on our patient, simple and effective mechanics were applied, the incisors were intruded indirectly using an archwire incorporating a curve of Spee while intruding the maxillary posterior teeth using the same TADs. This mechanics was firstly suggested by Paik [7,42]. He used an archwire incorporating a curve of Spee, conventional transpalatal arch, and TAD in the midpalatal area to treat adult patients with VME ang gummy smile [41]. Elastomeric chain was stretched directly from the TAD to the molars only, whereas the anterior segment was effectively intruded by the archwire alone. He kept the rigid transpalatal arch away from the palate to allow intrusion of the molars while preventing palatal crown inclination. Previous case reports on patients with a gummy smile and Class II malocclusion used multiple TADs [45-47] or voluminous devices with multiple power arms [48] for intrusion of the entire maxillary dentition. Using multiple TADs can have a higher price, thus the cost-effectiveness and need of anchorage reinforcement with buccal TADs should be considered, when only moderate anchorage reinforcement is needed, TADs were less cost-effective [35].

In a patient with skeletal Class II hyperdivergence and a retruded mandible, both upper and lower arch intrusion are essential to obtaining significant skeletal change. If intrusion is performed in the maxillary arch only, compensatory extrusion of the lower molars often negates the ability of the mandible to autorotate [7]. This observation is clear in several reported cases [7,45,49,50] in which facial profiles were well improved as a result of molars intrusion simultaneously in both arches and consistent counterclockwise mandibular rotations. Some articles [48,51] reported cases with a gummy smile in which autorotation of the mandible did not occur as planned because simultaneous extrusion of the mandibular molar had occurred. In the mandible, the amount of intrusion of the anterior and posterior teeth can be determined by the amount of advancement of pogonion preferred [7,48].

In the present case report, the amounts of teeth intrusions were very interesting, maxillary third molar has been intruded by 3,5 mm, maxillary second premolar by 7 mm and maxillary incisor by 2,5 mm. Subsequently the mandible exhibited a counterclockwise rotation with a considerable improvement in profile and the nose-lip-chin relationship and reduction in lower anterior facial height. The lower molars showed minimal movements in the anteroposterior and vertical directions, and 1,5 mm of lower incisor extrusion to participate to open bite closure. This result was consistent with different studies that have worked on the treatment objectives visualized (VTO). It has been reported that the amount of molar intrusion demonstrated linear relationships with vertical and sagittal cephalometric parameters and every 1 mm intrusion of the molars results in about 3 mm of Overbite increase, 1.7 mm of Anterior facial height decrease, pogonion moved forward by 2.3 mm, and Mandibular plane angle decreased by 2°. The condyle was considered as the center of rotation of the mandible in establishing the treatment objective [5,52,53]. Nevertheless, the center of rotation during mandibular autorotation was reported [7-9,53] to show large individual variation. Therefore, prudent monitoring is necessary during actual treatment.

Summary and Conclusion

In this patient with VMA, asymmetrical anterior open bite, asymmetrical occlusion, unilateral crossbite, gummy smile, skeletal Class II pattern, loss of six molars, periodontal defect and restorative complication on the mandibular left first molar, intrusion of entire maxillary

arch and differential intrusion of the anterior and posterior teeth, left and right side were achieved to maximize the skeletal treatment effects. The combination of archwires with an accentuated curve of Spee, intrusion force applied using a simple and effective mechanics for the treatment with a minimal number of TADs contributed to an effective intrusion of the total maxillary arch, correction of asymmetrical anterior open bite, improvement of smile and profile.

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