Case Report

Lip incompetence resolved by active vertical control in nonsurgical treatment of a protrusion case with vertical maxillary excess

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ABSTRACT

In this case report, we present the treatment of a 28-year-old patient with lip incompetence and vertical maxillary excess (VME), using a combination of a midpalatal miniscrew-anchored cantilever clip appliance and submerged buccal shelf miniscrews. The patient exhibited a convex profile, long face, gummy smile, and protrusion, with a Class II skeletal relationship and mentalis strain. The patient declined conventional orthognathic surgery, leading to an orthodontic camouflage treatment plan involving extraction of four first premolars, maximum retraction, and active vertical control with skeletal anchorage devices. Treatment included the use of infrazygomatic crest miniscrews, anterior subapical miniscrews, and a cantilever clip appliance for molar intrusion, resulting in significant improvement in facial profile, reduction of gummy smile, resolution of lip incompetence, and alleviation of mentalis strain. This case demonstrates the effectiveness of a nonsurgical orthodontic intervention in managing a complex case of VME and lip incompetence. (*Angle Orthod*. 2025;00:000–000.)

KEY WORDS: Vertical maxillary excess; Lip incompetence; Protrusion; Active vertical control; Skeletal anchorage; Mentalis strain

INTRODUCTION

Vertical maxillary excess (VME), also known as long face syndrome, is characterized by an elongated face with an increased vertical proportion of the lower anterior facial height and lip incompetence.[1–3] The ideal treatment modality is orthognathic surgery, which includes maxillary impaction and mandibular repositioning. However, some patients may reject surgical intervention and request camouflage treatment for other concerns, such as protrusion, as in the present case.

To address protrusion, maximum retraction using temporary skeletal anchorage devices (TSADs) could be attempted.[4–7] If mentalis muscle strain persists after space closure with maximum retraction, active vertical control to reduce the lower anterior facial height and alleviate the mentalis strain could be considered.

In addition to the combined intrusion and retraction force system provided by an infrazygomatic crest (IZC), buccal shelf (BS), and anterior subapical miniscrews, a cantilever clip appliance could be introduced to enhance maxillary molar intrusion. The BS miniscrew could be submerged with a wire extension to enhance the range of activation for lower molar intrusion.

Diagnosis and Etiology

A 28-year-old patient presented with protrusion, a gummy smile, and lip incompetence. Upon examination, the patient exhibited a convex profile and a long face. Her nasolabial angle was approximately 90°, and the labiomental fold appeared shallow, with noticeable mentalis strain. Her smiling photograph showed excessive gingival display of about 6 mm. The proclination of her maxillary incisors was normal. Her chin deviated slightly to the right, and she had a long face with VME.

Intraorally, the overjet measured 2 mm, and the overbite 1 mm. Both arch forms were tapering ovoid. Arch length discrepancies were 2 mm in the maxilla and 3 mm in the mandible. The maxillary dental

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Figure 1. Pretreatment facial and intraoral photographs.

midline was shifted to the left by 1 mm, while the mandibular dental midline was shifted to the right by 0.5 mm. Bilateral canine relationships were Class I, with the molar relationship being Class I on the right side and Class III on the left side (Figures 1 and 2).

The panoramic radiograph revealed multiple composite resin restorations. The third molars were missing except for the maxillary left third molar. The maxillary left first molar was missing, with the space almost closed due to mesial tipping of the maxillary left second molar. The periodontal condition was fair (Figure 3). Cephalometric measurements indicated a skeletal Class II relationship (ANB: 5°). The maxillary incisor inclination was within the normal range (U1-SN: 111°). The lower incisors were proclined (L1-MP: 98°). Vertically, she had a high mandibular plane angle (SN-MP: 38.5°) and an increased lower anterior facial height to upper anterior facial height ratio (UAFH : LAFH = 39.7%:60.3%). Both the upper and lower lips were protrusive to the E-line (UL-E line: 6.5 mm, LL-E-line: 10 mm; Table 1).

This patient was skeletally Class II with a high mandibular plane angle and VME. Her dentition was well compensated, maintaining a primarily Class I relationship, with a missing maxillary left first molar. The etiology was primarily genetic.

Treatment Objectives

Treatment objectives for this patient included reducing the facial profile, correcting the gummy smile, and alleviating muscle strain to improve lip competence and facial esthetics as well as creating an ideal overjet, overbite, and Class I dental relationships.

Treatment Alternatives

To reduce the protrusion, the incisors were required to be positioned significantly backward, either through

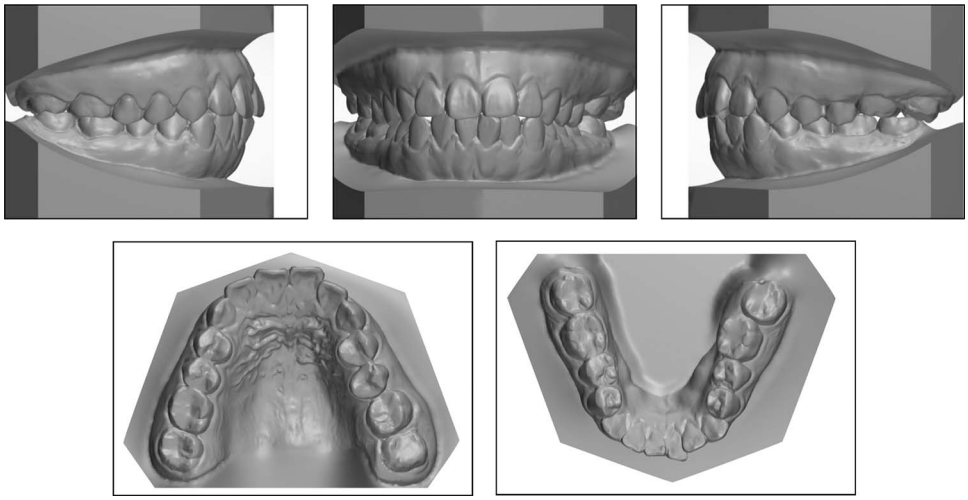

Figure 2. Pretreatment study models.

orthognathic surgery or orthodontics with maximal anchorage.[8–10] To correct the gummy smile and alleviate muscle strain, Le Fort I maxillary impaction might be indicated.[2,11,12] The mandible would be repositioned by autorotation or bilateral sagittal split osteotomy. The patient declined the surgical approach and requested camouflage treatment with orthodontics only.

To correct the gummy smile without surgery, the maxillary anterior teeth could be intruded.[13–15] Periodontal surgery for esthetic crown lengthening might be needed later to restore appropriate crown length. The limitations of camouflage treatment were thoroughly discussed. Four first premolars would be extracted and maximum intrusion and retraction would be supported by IZC, BS, and anterior subapical miniscrews to reduce the profile,

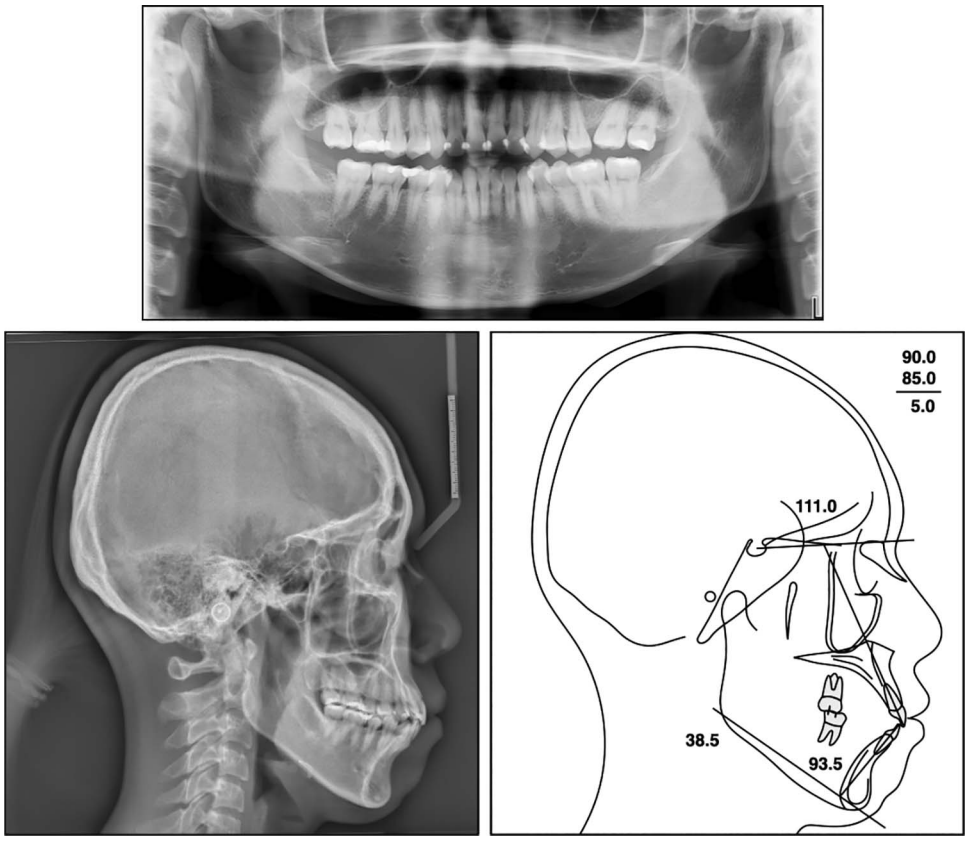

Figure 3. Pretreatment panoramic radiograph, lateral cephalogram, and cephalometric tracing.

Table 1. Cephalometric Measurements[a]

	Taiwanese Norms	Pretreatment	Posttreatment
SNA (°)	81.5 ± 3.5	90.0	90.0
SNB (°)	77.7 ± 3.2	85.0	86.0
ANB (°)	4.0 ± 1.8	5.0	4.0
SN-MP (°)	33.0 ± 1.8	38.5	35.0
U1- NA (mm)	3.9 ± 2.1	5.5	0.0
U1-SN (°)	108.2 ± 5.4	111.0	109.0
L1- NB (mm)	6.6 ± 2.8	11.5	4.5
L1-MP (°)	96.8 ± 6.4	93.5	85.5
UADH (mm)	29.0 ± 2.0	35.5	34.0
UPDH (mm)	20.0 ± 2.0	27.5	26.5
LADH (mm)	45.0 ± 3.0	48.0	42.0
LPDH (mm)	35.0 ± 3.0	36.5	35.0
E-LINE/UL (mm)	−1.1 ± 2.2	6.5	1.0
E-LINE LL (mm)	0.5 ± 2.5	10.0	1.5

[a] UADH indicates upper anterior dental height; UPDH, upper posterior dental height; LADH, lower anterior dental height; and LPDH, lower posterior dental height.

correct the gummy smile, and relieve mentalis strain, but it could not be guaranteed that camouflage treatment would satisfy the patient.

Treatment Progress

Appliances with a modified Alexander prescription with 0.018-in slots were used for the anterior teeth (canine-to-canine) and 0.022-in for the posterior teeth. After extracting the premolars, brackets were bonded in both arches with 0.016-in nickel-titanium (NiTi) wire for initial leveling. Bilateral IZC miniscrews (Biokey classic type, 2.0 × 10 mm, Bomei Co Ltd, Taoyuan, Taiwan) were installed in the second month for maximum retraction. After progressing to 0.016 × 0.022-in NiTi archwire in the third month, a midpalatal miniscrew (Biokey classic type, 2.0 × 10 mm, Bomei Co Ltd, Taoyuan, Taiwan) and lower anterior subapical miniscrew (Biokey flat type, 2.0 × 10 mm, Bomei Co Ltd, Taoyuan, Taiwan) were inserted for bite opening in the fourth month. Space closure began 1 month after switching to 0.016 × 0.022-in stainless steel archwire in the fifth month (maxillary arch) and seventh month (mandibular arch; Figure 4).

The maxillary incisors became excessively upright during space closure, likely because the intrusion and retraction force from the palatal miniscrew passed below the center of resistance (CR) of the maxillary incisors. An anterior subapical miniscrew (Biokey flat type, 2.0 × 10 mm, Bomei Co Ltd, Taoyuan, Taiwan) was inserted labially between the maxillary central incisors to counteract the torque loss. The elastomeric chains from the palatal miniscrew to the lingual buttons on the maxillary central incisors were discontinued.

Most of the spaces were closed by the 11th month, but the facial profile had not improved significantly, and mentalis strain was noted (Figure 5). With minimal remaining extraction space, active vertical control was attempted to rotate the mandible counterclockwise and relieve the muscle strain. A second midpalatal miniscrew (Biokey classic type, 2.0 × 10 mm, Bomei Co Ltd, Taoyuan, Taiwan) was installed 7 mm behind the first miniscrew. An impression was taken, and two used miniscrews were inserted into the impression as analogs before pouring the cast. A bondable transpalatal arch with 3 mm clearance and a midpalatal, screw-supported cantilever clip appliance was fabricated on the cast model. In the 12th month, the device was installed to deliver intrusive force by activating the cantilever arms hooked onto the helices of the transpalatal arch (Figure 6).

The bonded transpalatal arch impinged on the palatal soft tissue 2 months after the setup of the midpalatal screw-supported cantilever clip appliance, indicating

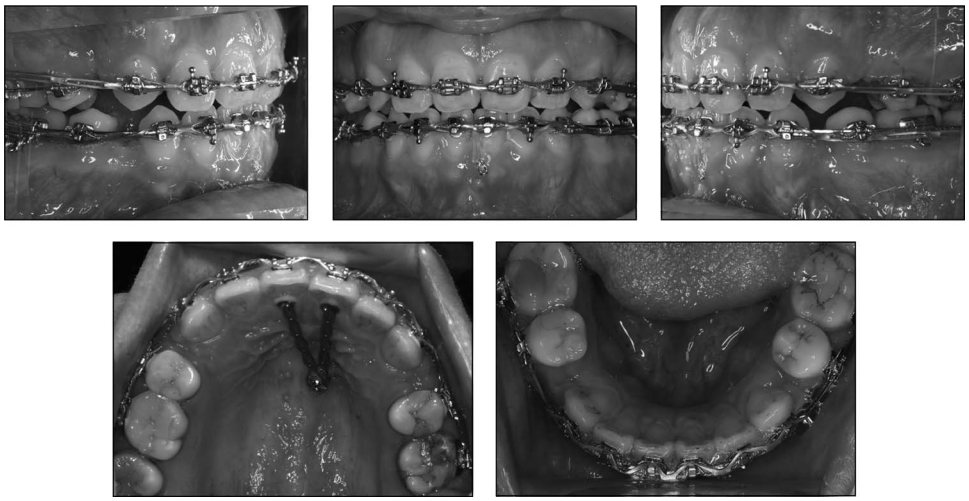

Figure 4. Space closure began in the seventh month, with bilateral infrazygomatic crest (IZC) miniscrews for maximum retraction, a midpalatal miniscrew, and a lower anterior subapical miniscrew for anterior intrusion.

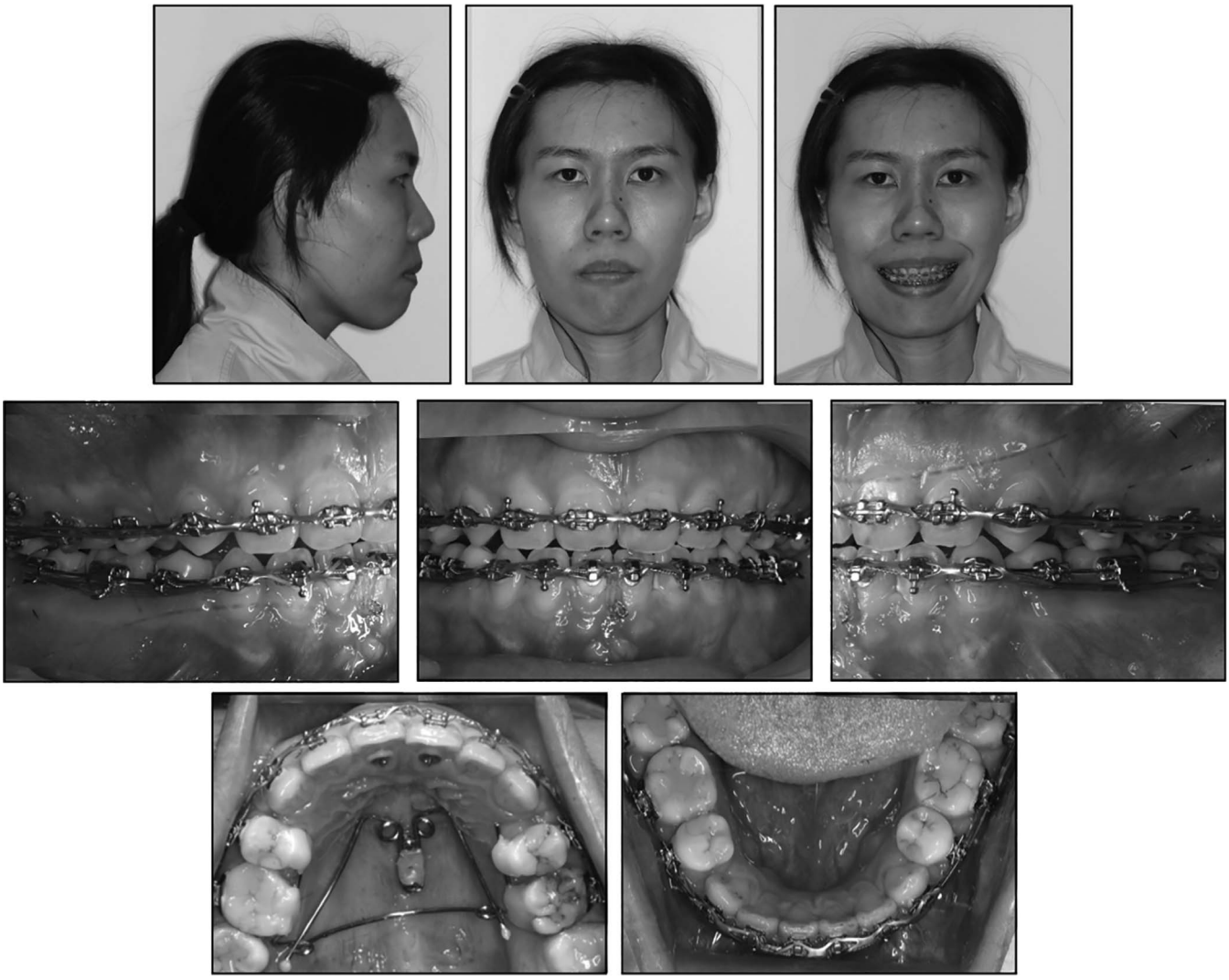

Figure 5. Progress records at the 11th month showed limited improvement of the facial profile, but evident mentalis muscle strain remained, while extraction spaces were almost closed.

successful maxillary molar intrusion. The occlusion became more Class III and an edge-to-edge incisor relationship developed, suggesting forward rotation of the mandible following the maxillary molar intrusion. In the 14th month, two submerged BS miniscrews (Biokey flat type, 2.0 × 10 mm, Bomei Co Ltd, Taoyuan, Taiwan) were inserted on the buccal shelves bilaterally with 0.028-in stainless steel wire extensions for total arch retraction of the mandibular dentition and intrusion of the mandibular molars (Figure 7).

Class I canine and molar relationships were achieved 6 months after the total arch distalization of the mandibular dentition with the submerged BS miniscrews (Figure 8). After 9 months of finishing and detailing, all appliances were removed. Vacuum-formed clear retainers were provided immediately after debonding. The patient was instructed to wear them full-time for the initial 6 months, followed by nighttime use.

Treatment Results

Total active orthodontic treatment time was 29 months. The protrusion was significantly reduced (Figures 9 through 11). The gummy smile was corrected, lip incompetence was resolved, and mentalis muscle strain was alleviated. The occlusion was finalized with Class I relationships at the canines and molars, along with optimal overjet and overbite. While the VME could not be fully addressed without orthognathic surgery, total arch intrusion treatment optimized the facial profile and mitigated the mentalis muscle strain.

Cephalometric superimpositions showed successful active vertical control; the lower anterior facial height was reduced by 2.4 mm and the mandibular plane angle by 3.5° (SN-MP: from 38.5° to 35.0°; Figure 12). The maxillary dentition showed total arch intrusion, with 2.1 mm of intrusion of the maxillary first molar and

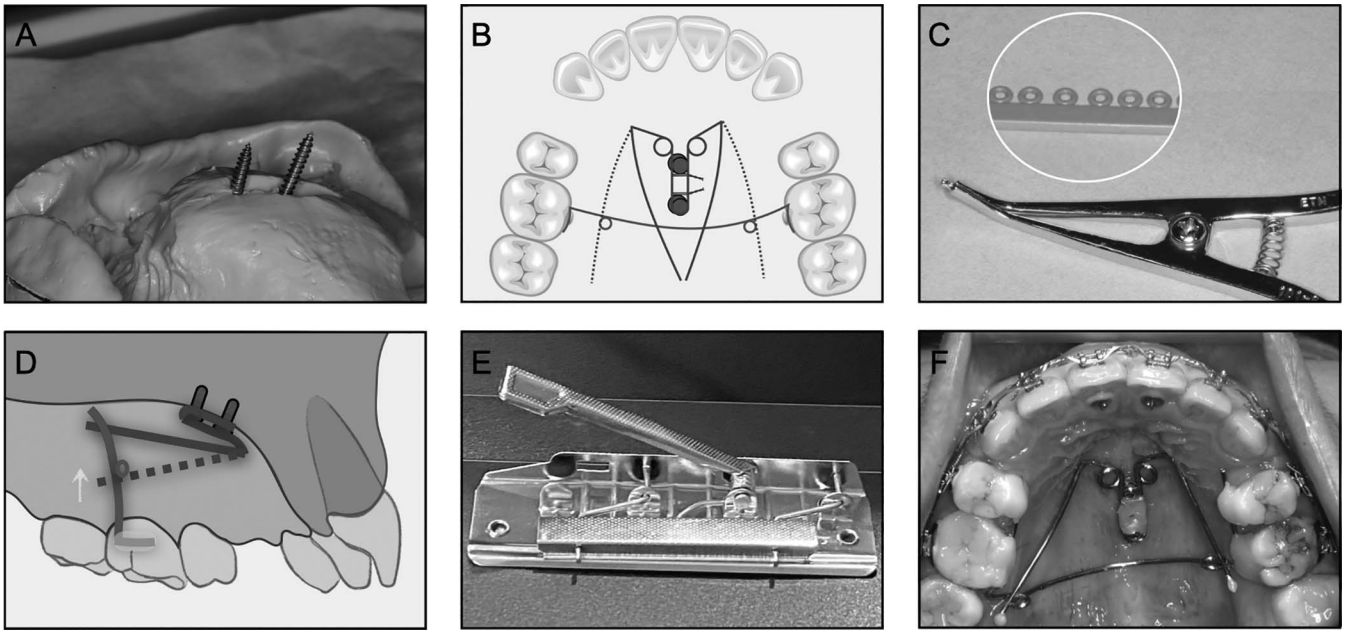

Figure 6. (A) An impression was taken after installation of the second midpalatal miniscrew. Two used miniscrews were inserted into the impression as analogs before pouring the cast. (B) A transpalatal arch and cantilever clip appliance were fabricated, represented by solid lines, and activated as indicated by the dotted line. (C) A separator applicator was used to hold the cantilever appliance helices by clipping them onto the midpalatal miniscrews. (D) The cantilever arm was hooked beneath the helix of the transpalatal arch to deliver intrusive force to the maxillary molar. (E) The cantilever clip operates like a file folder lever clip. (F) Ligature wires were tied to secure two legs of the central loop together. Flowable composite resin was then applied to mitigate irritation.

4.1 mm of intrusion of the maxillary central incisors. For profile reduction, the maxillary incisors were retracted by 6.0 mm and the mandibular incisors by 7.6 mm. The mandibular incisors were intruded 4.2 mm, and the mandibular molars were intruded 0.8 mm. The successful total arch intrusion of the maxillary dentition was a prerequisite for effective active vertical control. Additionally, preventing compensatory supereruption of the mandibular molars was crucial. Upper anterior dental height (UADH) was reduced from 35.5 mm to 34.0 mm, while upper posterior dental height (UPDH) was reduced from 27.5 mm to 26.0 mm. Lower anterior dental height (LADH) was reduced from 48.0 mm to 42.0 mm, while lower posterior dental height (LPDH)

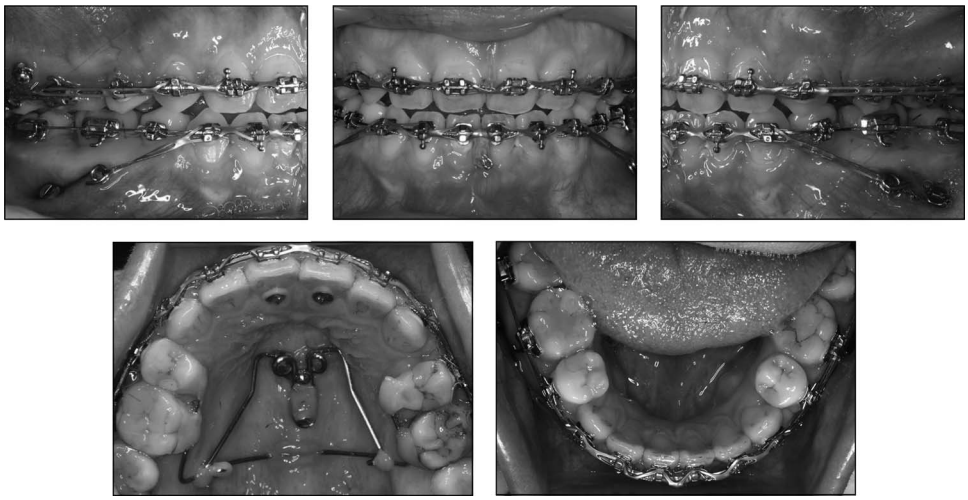

Figure 7. Two months after the setup of the cantilever clip appliance, the transpalatal arch impinged on the soft tissue, indicating successful maxillary molar intrusion. Canine and molar relationships became more Class III, and the bite became edge-to-edge, indicating forward rotation of the mandible following successful total arch intrusion of the maxillary dentition. Bilateral buccal shelf miniscrews were installed with a submerged wire extension to direct the retraction force through the center of resistance (CR) of the whole mandibular arch.

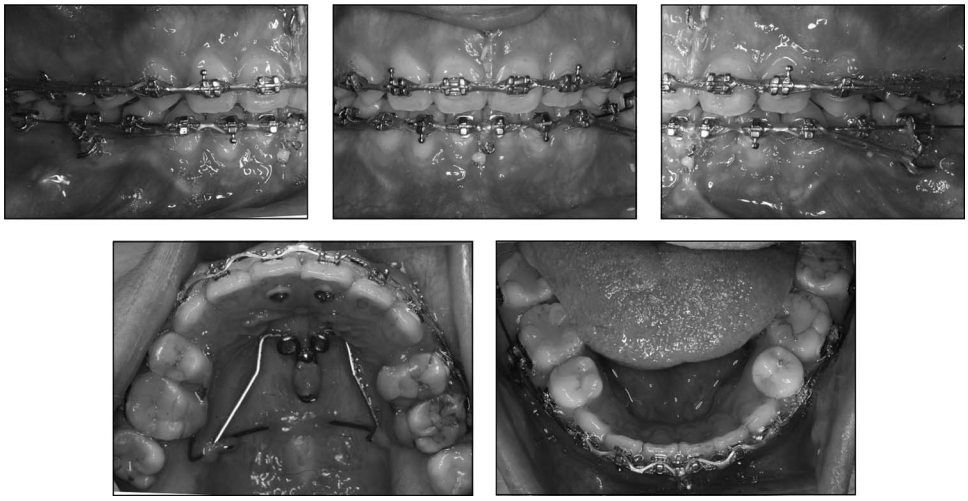

Figure 8. Six months after buccal shelf (BS) miniscrew installation, dental relationships returned to Class I with optimal overjet and overbite.

Figure 9. Posttreatment facial and intraoral photographs.

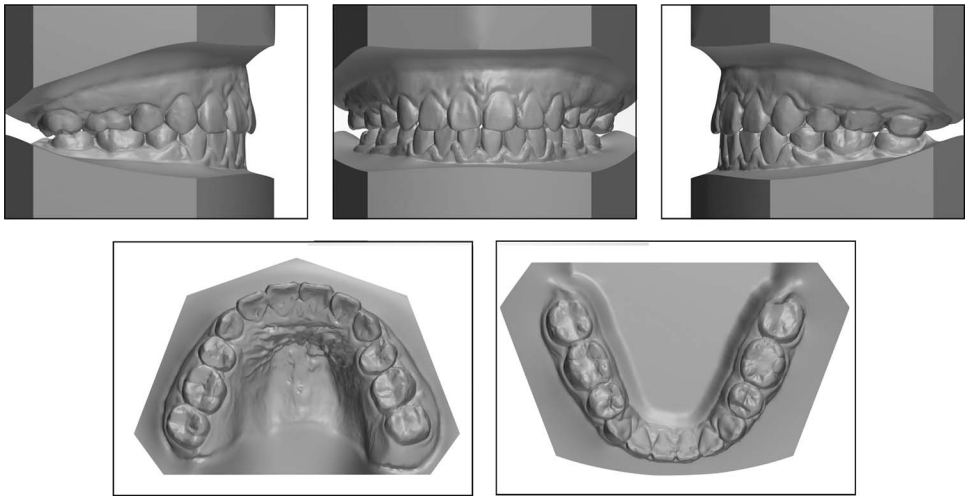

Figure 10. Posttreatment study models.

was reduced from 36.5 mm to 35.0 mm. Proper torque control of the maxillary incisors (U1-SN: from 111.0° to 109.0°) plus adequate intrusion and retraction of the mandibular incisors ensured clearance between the maxillary and mandibular incisors, ultimately allowing the mandible to rotate forward. At the 2 year postretention checkup, the occlusion appeared satisfactory. Enhancement of the profile through maximum retraction and active vertical control with TSADs appeared relatively stable without mentalis strain (Figure 13).

DISCUSSION

Protrusion is a common malocclusion in Asians, and premolar extraction often improves the facial

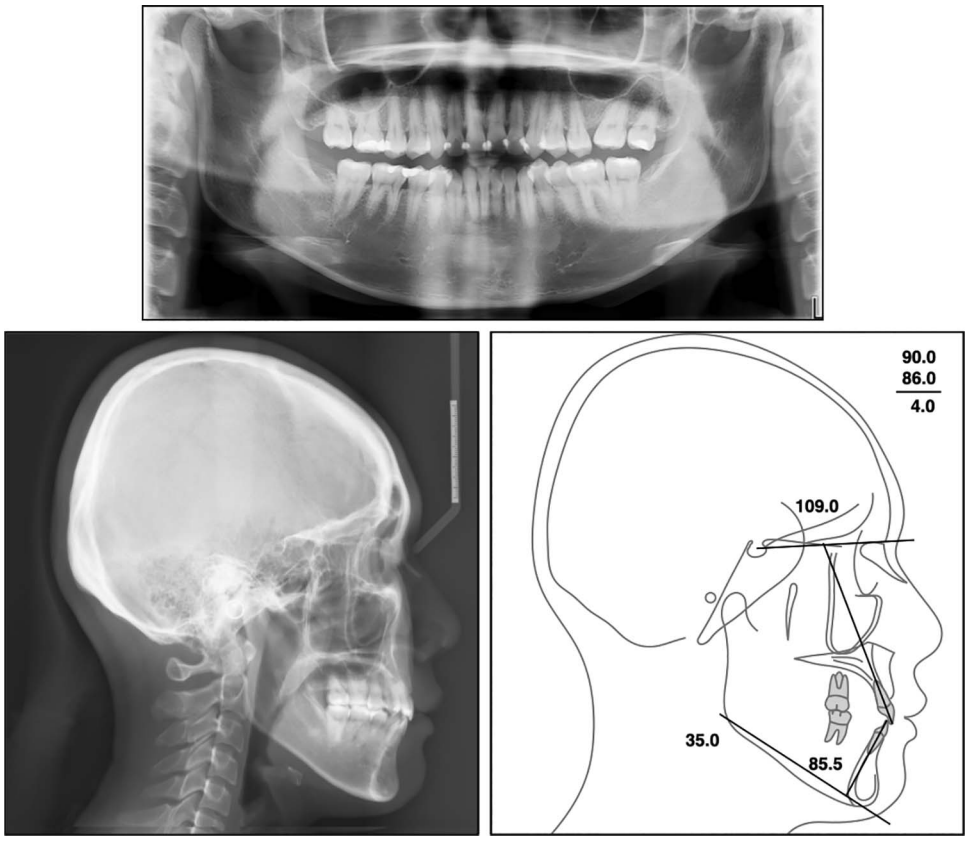

Figure 11. Posttreatment panoramic radiograph, lateral cephalogram, and cephalometric tracing.

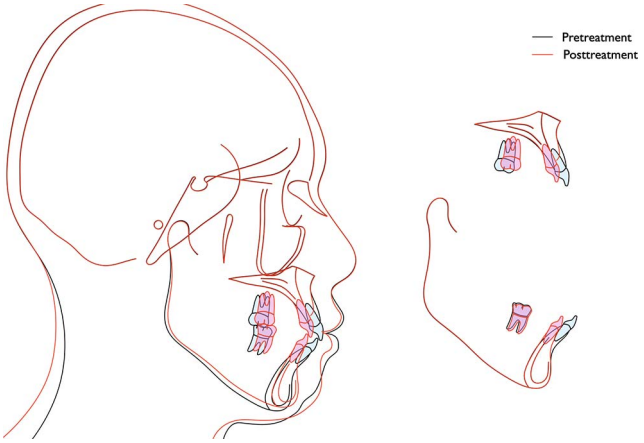

Figure 12. Cephalometric superimpositions of pretreatment and posttreatment cephalograms show maximum retraction of the mandibular incisors, total arch intrusion of the maxillary dentition, and forward rotation of the mandible.

profile. Orthognathic surgery is considered when protrusion is more closely related to skeletal components than being of dental origin. TSADs offer an alternative to orthognathic surgery.

A gummy smile is a multifactorial problem related to supereruption or protrusion of the maxillary anterior teeth, VME, gingival hypertrophy or altered passive eruption, and inadequate length or hypermobility of the upper lip.[14,16] Previously, Le Fort I maxillary impaction was the gold standard for adults with severe gummy smiles for complete correction. With TSADs, it is possible to successfully treat adult gummy smiles without orthognathic surgery, although periodontal surgery may be needed for crown lengthening afterward.

Lip incompetence is a clinical manifestation of protrusion or VME, resulting from insufficient soft tissue drape to cover the underlying hard tissues.[17,18] As VME typically falls outside the scope of orthodontic treatment without orthognathic surgery, the most practical solution for lip incompetence is extraction for protrusion. It usually resolves after anterior retraction; however, if retraction is insufficient for severe protrusion, some lip incompetence may persist. Efforts can be made to reduce the lower anterior facial height to alleviate mentalis strain and achieve lip competence.

VME is characterized by an elongated face with an increased vertical proportion of the lower anterior facial height and lip incompetence.[19] The typical treatment modality is orthognathic surgery, which includes Le Fort I maxillary impaction and mandibular repositioning. Using TSADs, total arch intrusion of the maxillary dentition can rotate the mandible forward, improve chin projection, reduce lower anterior facial height, and relieve mentalis strain.

To achieve total arch intrusion of the maxillary dentition, a dual-screw technique[20–22] and combined intrusion and retraction force system[7,23] were suggested to provide directional force for total arch intrusion. In addition to the labial force systems discussed, Paik et al.[24,25] used a midpalatal screw and transpalatal arch to intrude maxillary molars and maxillary anterior teeth with archwires. Pei et al.[26] used buccal and palatal miniscrews in the maxillary posterior areas, anterior miniscrews in the maxillary anterior areas, and BS miniscrews, to achieve active vertical control and reduce lower anterior facial height with clear aligners. Wilmes et al.[27] successfully intruded elongated maxillary molars with the mousetrap appliance. Various designs work well with the help of skeletal anchorage for vertical reduction.

Treatment began with a combined intrusion and retraction force system in the maxillary arch for maximum retraction and gummy smile correction, using IZC miniscrews and anterior subapical miniscrews on both arches. After most extraction spaces were closed, the facial height still seemed excessive, with significant mentalis strain. Inspired by the design of the mousetrap appliance, a bondable transpalatal arch with helices was fabricated. A midpalatal miniscrew-anchored cantilever clip appliance was installed to deliver intrusive force by activating the cantilever arms hooked onto the helices of the transpalatal arch. The cantilever clip appliance offered a mechanical advantage, with its longer lever arm providing superior activation and a more consistent load deflection rate.

The appliance was fabricated with 0.036-in stainless steel wire, designed to clip onto the two midpalatal miniscrews at the neck level between the head and platform, isolating it from the palatal tissue surface. A helix was bent at the end of the central body of the appliance to provide a slot for the separator applicator to install the appliance intraorally. Stainless steel ligature wires were tied to secure the two legs of the central body together to avoid dislodgment. Flowable composite resin covered the ligature wires to mitigate irritation. The cantilever arms were bent to adapt to the palatal fornix and hooked beneath the helices of the transpalatal arch.

The cantilever clips were activated like file folder lever clips. The advantages of the midpalatal miniscrew-anchored cantilever clip appliance include the best bone quality for miniscrew installation, long lever arms for molar intrusion, and a transpalatal arch to maintain arch width. The only disadvantage is the additional time required for lab work and installation appointments.

While a gummy smile can be successfully treated with maxillary anterior intrusion using an anterior miniscrew and periodontal surgery after orthodontic tooth movement, this approach may flatten the smile arc. Simultaneous molar intrusion not only

Figure 13. Two-year postretention facial and intraoral photographs.

facilitates total arch intrusion but also helps preserve the smile arc.

In this case, 2 months after the application of the cantilever clip appliance, the transpalatal arch impinged into the palatal soft tissue, indicating effective molar intrusion. Another sign of total arch intrusion following maxillary molar intrusion was the forward positioning of the mandible to become more Class III and the development of an edge-to-edge incisor relationship. To correct the Class III dental relationship, BS miniscrews were installed. To intrude the mandibular molars simultaneously, the BS miniscrews were inserted subapically with 0.028-in stainless steel wire extensions to direct the force through the CR of the mandibular dentition. Six months later, Class I canine and molar relationships were achieved.

The successful total arch intrusion of the maxillary dentition was a prerequisite for effective active vertical control. Additionally, preventing compensatory supererupption of the mandibular molars was crucial. Proper torque control of the maxillary incisors and adequate intrusion and retraction of the mandibular incisors ensured clearance between the maxillary and mandibular incisors, ultimately allowing the mandible to rotate forward.

Lip incompetence was caused by insufficient soft tissue coverage over the underlying hard tissues. Reducing the total volume of hard tissues, either in the sagittal or vertical direction, may help alleviate muscle strain and improve lip competence. Despite the limited total arch intrusion achieved in the present patient, the treatment effects from this modest intrusion were significant. Admittedly, the use of miniscrews needed to be gradually incorporated as treatment progressed because the treatment plan was not comprehensively planned before the start of treatment. However, this is the reality, and it is why the authors chose to share these insights with our colleagues so treatment efficiency can be improved in the future.

CONCLUSIONS

- Treating protrusion, VME, and lip incompetence with IZC and anterior subapical miniscrews plus a midpalatal miniscrew-anchored cantilever clip appliance and submerged BS miniscrews demonstrated significant improvement in facial esthetics.
- This nonsurgical approach provided effective vertical control, reducing lower anterior facial height and alleviating mentalis strain, while achieving optimal dental relationships.
- Although orthognathic surgery remains the gold standard for severe cases, this case illustrates that well-planned orthodontic camouflage treatment with skeletal anchorage devices can offer substantial benefits for patients seeking alternatives to surgical intervention.

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