

Improvements of facial profile and smile aesthetic using temporary anchorage devices and botulinum toxin: a case report

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The severe gummy smile and a skeletal class II profile pose challenges in treatment. This case report outlines an effective alternative for addressing these problems in a patient with skeletal class II division 2, class II molar relationship, retroclination of upper incisors, and lip protrusion. Treatment objectives included normalizing the overjet and overbite, improving the gummy smile, and establishing a satisfactory occlusion. A three-dimensional simulation was performed to consult with the patient, assess possible results, and predict treatment biomechanics. The treatment involved the use of two zygomatic and one inter-radicular temporary anchorage devices, along with botulinum toxin. After the 2-year follow-up, a satisfactory dental occlusion, aesthetic improvement, and adequate function were achieved. This approach offers a viable alternative to orthognathic surgery for adults with skeletal class II malocclusion and a severe gummy smile due to hypermobile lip.

Abbreviations: IZC, infrazygomatic crest; 3D, three-dimensional

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INTRODUCTION

Malocclusion, which is the primary aesthetic concern, motivates patients to require orthodontic treatment [1]. Skeletal class II malocclusion presents a particular challenge and frequently requires the intervention of surgical orthodontics, par-

ticularly when coupled with a gummy smile resulting from a hypermobile lip. The etiology of skeletal class II malocclusion involves the protrusion of the maxilla, retrusion of the mandible, or a combination of both. In cases where orthognathic surgery is not financially feasible for patients, non-surgical orthodontic treatment becomes a viable alternative [2].

Prior to treatment, it is essential to establish treatment goals, predict potential improvements for the patient, and design appropriate biomechanics. Utilizing three-dimensional (3D) simulation allows us to assess these factors and consult with the patient before initiating treatment [3,4]. The advent of skeletal anchorage systems has expanded the range of orthodontic possibilities and is well-received by patients [5,6]. Additionally, botulinum toxin emerges as a promising option post-orthodontic treatment, particularly for addressing gummy smiles with an

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etiology involving hypermobile lips [7,8].

This report describes a multi-approaching technique for repairing severe skeletal class II division 2 and gummy smile using 3D simulation, temporary anchorage devices, and botulinum toxin.

CASE REPORT

A 30-year-old woman presented with several concerns, including a deep bite, retruded maxillary incisors, protruded mandibular incisors, and an excessive overjet. Extraorally, she exhibited a convex profile with a normal nasolabial angle. A gummy smile of 5 mm on both sides, attributed to a hypermobile lip (with an interlabial gap exceeding 8 mm from rest position during smiling [9]), and incompetent lips were also noted. The patient experienced temporomandibular joint pain on both sides (Fig. 1).

Intraorally, discrepancies in the anterior and posterior occlusal planes were observed, along with a class II molar and canine relationship on both sides, deep overbite, and retroclined upper

incisors. Mild crowding and a deep curve of Spee were present in the lower arch. Additionally, the patient had small upper lateral incisors contributing to a Bolton tooth size discrepancy of 3-3 (80.7%). While the lower midline coincided with the facial midline, the upper midline deviated 1 mm to the left. The patient exhibited a thin-scalloped gingival biotype (Fig. 1).

Lateral cephalometric analysis revealed a skeletal class II jaw relationship with a normal maxilla and retruded mandible (sella nasion point A, 82.4°; sella nasion point B, 75°; A point, nasion, B point, 7.4°), along with a normal lower facial height (Frankfort mandibular plane angle, 25°). The maxillary incisors were retroclined, and the mandibular incisors were proclined (upper central incisor sella nasion, 89.8°; lower central incisor mandibular plane, 89.5°). Both the upper and lower lips were positioned in front of the E-line. The panoramic radiograph indicated the presence of all teeth (Table 1, Supplementary Fig. 1).

After 1 month of wisdom teeth extraction in the upper and lower arches (totally four teeth), the patient underwent orthodontic treatment. An individualized 3D simulation [10] was used for decision-making (Supplementary Fig. 2). The use of



Fig. 1. Pre-treatment images. (A) Extraoral images and (B) Intraoral images.

Table 1. Comparison of cephalometric measurements

	Measurement	Normal	Pre-treatment	Post-treatment
Skeletal	SNA (°)	78 to 82	82.4	82.4
	SNB (°)	76 to 82	79.0	78.2
	ANB (°)	0 to 4	3.4	4.1
	A to N perp FH (mm)	-1.9 to 2.7	2.8	3.1
	B to N perp FH (mm)	-5.5 to -1.5	-0.6	-1.7
	FMA (°)	25	24.4	23.7
	Y-Axis (°)	59 (53 to 63)	60.4	60.2
Dental	U1-SN (°)	104	121.7	114.8
	U1-NA (mm/°)	4/22	8/39	4.5/32.4
	U1-MaxP (°)	110 to 116	127.9	122.0
	U1-L1 (°)	131	102.6	112.5
	L1-NB (mm/°)	4/25	8.7/34.8	6.4/31
	L1-MP: IMPA (°)	90	100.8	98.2
Soft tissue	UL-E line (mm)	-4 to -1	-1.3	-2.0
	LL-E line (mm)	-2 to 0	0.7	0.4

SNA, sella nasion point A; SNB, sella nasion point B; ANB, A point, nasion, B point; A to N perp FH, distance between point A to nasion perpendicular Frankfort plane (FH); B to N perp FH, distance between point B to nasion perpendicular FH; FMA, Frankfort mandibular plane angle; U1, upper central incisor; SN, sella nasion; NA, nasion point A; MaxP, maxillary plane; L1, lower central incisor; NB, nasion point B; MP, mandibular plane; IMPA, incisor mandibular plane angle; UL, upper lip; E-line, A line connects the nose tip to the chin; LL, lower lip.

braces that are bonded from 7-7 upper and lower arches with a 0.012 nickel titanium wire. After 5 months, the patient returned to continue the alignment and leveling phase. This involved transitioning to a larger wire and the installation of infrazygomatic crest (IZC) mini screws on both sides of the upper arch. At the 7th month of treatment, inter-radicular mini screws are installed between teeth 11 and 21. We conducted distalization of the upper arch using two IZC screws, anterior intrusion with a mini screw, and lower anterior intrusion facilitated by a 0.016 × 0.022 reverse nickel titanium wire. Interproximal reduction of 2 mm from teeth 33 to 43 was performed in the finishing stage, and fillings for teeth 12 and 22 were recommended post-treatment to address Bolton discrepancies (Fig. 2). After 1 month of orthodontic treatment, botulinum toxin is used to address the concern of a gummy smile. Specifically, two doses of botulinum toxin were prescribed.

All treatment objectives were successfully accomplished, resulting in a well-aligned dentition and enhanced facial aesthetics. The upper incisors were retracted, and torque was applied, while the lower incisors were slightly proclined. The overbite and overjet are now within normal ranges, achieving a class I occlusion

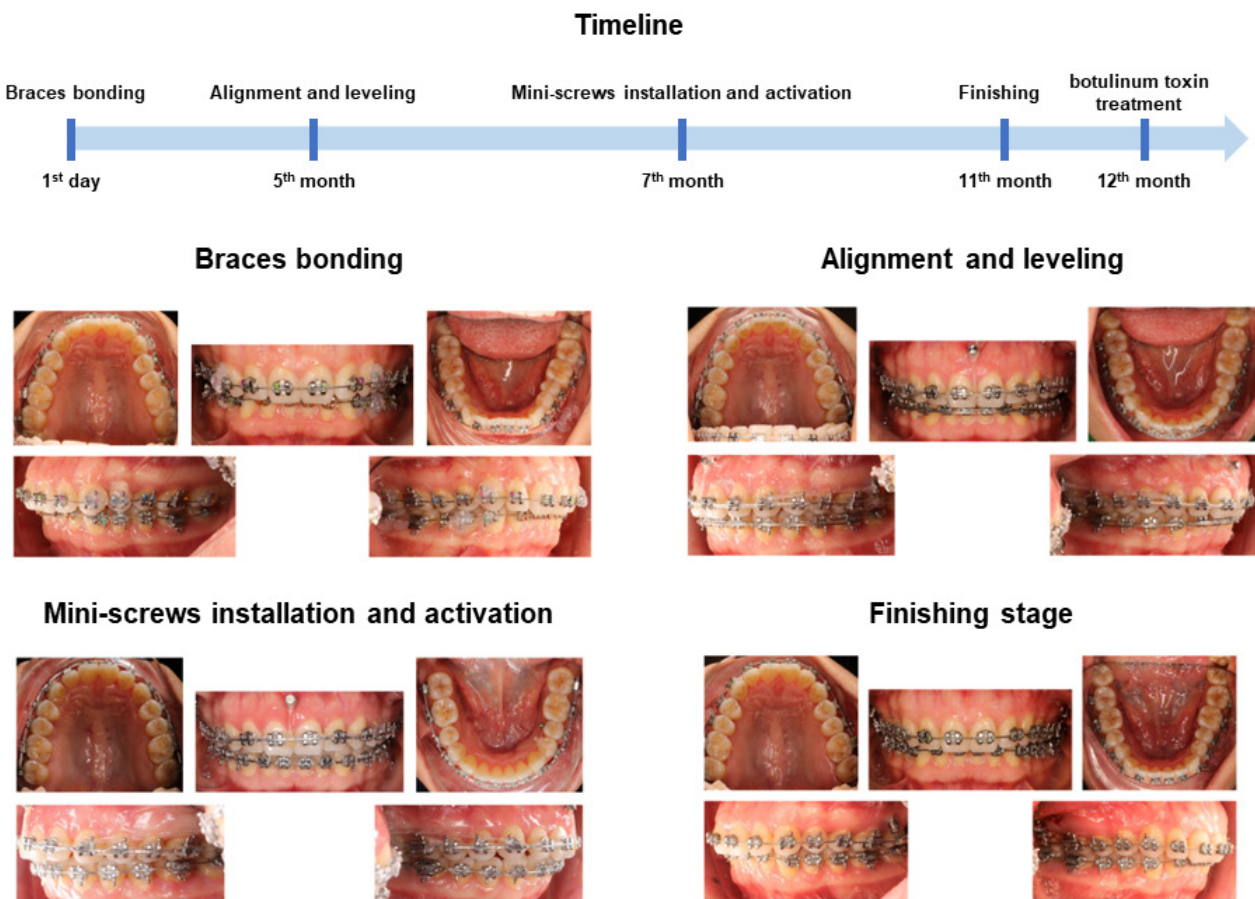


Fig. 2. Fixed orthodontic treatment progress.

and visibly reduced gummy smile after treatment. We attained a class I canine and molar relationship, with 3-3 Bolton discrepancies of 77.9%, along with a normal overbite. Midline correction was achieved through the distalization of the upper arch and torque intrusion of the upper incisors (Supplementary Fig. 3).

The maxillary and mandibular intra-arch width was slightly expanded through the uprighting of molars. The comprehensive treatment resulted in the retraction of both upper and lower lips, achieving a passive lip seal and a straight profile post-treatment. Despite a minor amount of root resorption attributed to torque and intrusion of upper incisors, good root parallelism was attained.

Cephalometric superimposition revealed the leveling of the lower curve of Spee through the intrusion of upper and lower

incisors and the proclination of lower incisors. Significant improvements were observed in incisor inclination and soft tissue profile, particularly in the E-line and nasolabial angle. Cephalometric analysis confirmed a 5.2° increase in the inclination of the maxillary incisors. Subsequently, the incisors mandibular plane angle was adjusted to 105° post-treatment to achieve a dental class I relationship in the compromise treatment approach (Supplementary Fig. 1).

The integration of orthodontic treatment and botulinum toxin effectively addressed the gummy smile (Fig. 3).

After a 2-year follow-up, the occlusion remained stable, and there was no recurrent temporomandibular joint issue (Fig. 4, Supplementary Fig. 3). However, the gummy smile relapsed, as expected, given the temporary effect of botulinum toxin, which

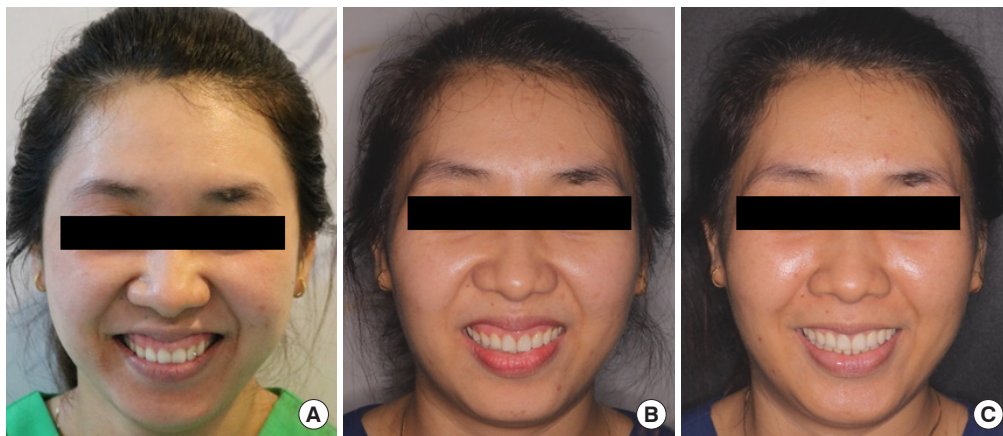


Fig. 3. Improvements of patient's smile. (A) Pre-treatment. (B) Post-orthodontic treatment. (C) Post-botulinum toxin treatment. The gummy smile was significantly corrected after botulinum toxin treatment.



Fig. 4. Two-year post-treatment intraoral images. The occlusion remained stable, and there was no recurrent temporomandibular joint issue.



Fig. 5. Two-year post-treatment extraoral images. The gummy smile relapsed, as expected.

typically lasts for 4–6 months. While the option to repeat the treatment every 4–6 months was available, the patient expressed satisfaction with the initial results, and the decision was made not to repeat the procedure (Fig. 5).

DISCUSSION

The patient complained about the gummy smile, maxillary protrusion, temporomandibular joint problem, and difficulty in closing lips. After active treatment and retention, these orthodontic problems were satisfactorily relieved through the intrusion of the upper incisors and the elimination of the class II dental malocclusion. The upper lip became more relaxed and was placed more backward, which allowed the patient to close her lips effortlessly [11].

For camouflage of severe class II skeletal malocclusion combined gummy smile, 3D simulation for treatment planning is useful for assessing expected outcomes and treatment biomechanics, and consulting with patients [12]. Mini screws are the key to a successful result, zygomatic mini screws for distaliza-

tion and anchorage, inter-radicular mini screw between 11 and 21 for upper anterior intrusion. With mini screws, we can manage the gummy smile, and control the occlusal plane and distalization for solving class II dental malocclusion at the same time. In the finishing stage, 2 mm interproximal reduction on lower anterior was done and after orthodontic treatment 12 and 22 filling was applied to achieve stable occlusion and solve Bolton discrepancies. The gummy smile was partially improved by upper anterior intrusion with mini screws so botulinum toxin, which is good indication for patients with hypermobile lips, was indicated.

Regarding economic benefits for dental treatments, several factors should be considered. For surgeries such as jaw realignment coupled with orthodontic procedures, the cost in Vietnam typically ranges from USD 4,000–5,000 for the surgical intervention, with an additional USD 1,000–1,500 for orthodontic treatment preceding and following the surgery. However, supplementary procedures like botulinum toxin injections or lip surgeries might be necessary, particularly in cases involving hypermobile lips, incurring extra expenses. Alternatively, opt-

ing solely for orthodontic treatment proves more reasonable, with costs averaging USD 1,500–2,000. This option may present a cost-effective solution for patients, with the additional expense of botulinum toxin treatment typically ranging from USD 200–300. Ultimately, economic factors play a crucial role in treatment decisions, balancing effectiveness with financial feasibility for patients.

Significant challenges in achieving a class I dental relationship, normal overbite, and overjet were characterized by severe class II skeletal and dental relationships, compounded by deep overbite, retroclined upper incisors, and proclined lower incisors. Throughout treatment, emphasis was placed on torquing and retracting the upper incisors while maintaining the position of the lower incisors or making slight proclinations. This approach aimed to enhance both profile aesthetics and dental occlusion, ensuring long-term stability. Implementing biomechanics in such cases was complex, yet the utilization of temporary anchorage devices facilitated the process. Challenges arise during treatment, such as the upper teeth becoming displaced from the lower due to the force exerted by inter-radicular mini screws for upper distalization, which was resolved through the application of cross elastics from lower buttons to corresponding brackets. Despite these difficulties, post-treatment evaluation revealed acceptable levels of root resorption in the upper anterior region, attributed to the intrusion force applied during treatment. These observations underscored the intricate nature of orthodontic interventions, where strategic planning and adaptive techniques are essential for achieving optimal outcomes while mitigating potential side effects.

The study had some limitations, one of which was a 2-year follow-up period that may have limited the assessment of long-term effects. Despite this, the stability of treatment results, signs of relapse and root resorption, and root health can be effectively evaluated at that follow-up point [12]. Anh and Ninh [12] reported successful management of severe class II division 1 malocclusions, deep overbites, and gummy smiles using lingual appliances and mini-screws. Two patients showed positive changes in facial profile and cephalometric analyses, and these outcomes were stable after a 2-year follow-up. Horiuchi et al. [13] used a wire with J-hook headgear for the treatment of severe class II division 1 malocclusions. After a 2-year follow-up, the treatment results were stable, with corrected overjet, good occlusion, and improved facial aesthetic. Paredes-Gallardo et al. [14] employed mini-screws for maxillary arch distalization and the correction of a gummy smile with a brachyfacial pattern. A satisfactory smile and good occlusion were achieved, and these results were maintained after 2 years. Therefore, it possibly assesses treatment stability after 2 years to some extent.

Another limitation was related to the botulinum toxin injection. It temporarily improved smile aesthetics rather than having a synergistic effect on skeletal profile correction. Although its effect was not permanent, the etiology of a gummy smile is a hypermobile lip, this procedure is still the most appropriate. According to a systematic review, botulinum toxin injection is the most common aesthetic procedure, and regardless of facial areas or specific assessment scales, it leads to high patient satisfaction [15]. Therefore, despite its temporary effect, botulinum toxin injection plays as the most appropriate procedure to improve smile aesthetic in this case.

As alternatives to surgical orthodontics, non-surgical approaches utilizing skeletal anchorage systems have significantly expanded the scope of camouflage treatment for moderate to severe skeletal dysplasia. Simultaneous intrusion and distalization of anterior teeth are now possible with mini-screws without losing anchorage and vertical control. In this case, multidisciplinary treatment was indicated for stable occlusion which is key in the long term for orthodontic treatment and achieve smile aesthetic.

NOTES

Conflict of interest

No potential conflict of interest relevant to this article was reported.

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Patient consent

The patients provided written informed consent to publish their medical information, treatment process, and photographs.

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Supplementary material

Supplemental data can be found at: <https://doi.org/10.7181/acfs.2024.00052>.

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