รายงานผู้ป่วย
Case Report

PSU Intruder Technique to Intrude an Over-erupted Single Tooth: A Case Report

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Abstract

Most orthodontists are often challenged with single tooth over-eruption. The solution should focus only on specifically intruding the tooth and ensure it does not unexpectedly move the adjacent teeth. Various techniques of tooth intrusion are used mainly with an asymmetrical V-bend or temporary anchorage devices. These techniques clearly affect the adjacent teeth or result in soft tissue invasion.

This case report introduces an alternative single-tooth intrusion technique applied to the upper second molar. This technique is the so-called “PSU intruder technique that used a 0.016" × 0.022" beta titanium wire bent into a single helical loop with palatal positioned brackets. The patient in this case report had missing bilateral upper lateral incisors and the lower left first molar. Unfortunately, there was an interference at the palatal cusp of the upper left second molar during the finishing stage since this patient was treated during the growth stage. However, correct alignment of the upper left second molar was achieved with an acceptable occlusion, while the PSU intruder technique did not affect the adjacent teeth.

Keywords: Congenital missing, Fixed orthodontic appliances, Intrusion, Over-eruption

Received: 15-Dec-2022 **Revised:** 25-Mar-2023 **Accepted:** 20-June-2023

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Introduction

The upper second molars are almost the last permanent teeth to erupt. The most common erupting path of an upper second molar when observing tooth inclination relative to the occlusal plane is the distobuccal direction because the upper first molar root is distopalatally inclined and the tuberosity space is limited.[1] The occlusal plane may shift due to occlusal interference, and the mandible tends to rotate clockwise, which results in a skeletal open bite.[2] There are many options to intrude the upper second molar, such as an asymmetrical V-bend, which is designed to be one-third bent close to an anterior tooth. The orthodontic force can be transferred to the molar tooth. Conventional orthodontic mechanics, on the other hand, will most likely have an unfavorable effect on the adjacent teeth.[3] Recent articles have presented temporary anchorage device techniques for orthodontic intrusion such as the buccal mini-screw to intrude the upper posterior teeth. Although skeletal anchorage may choose a corrected specific tooth, it invades the tissue during insertion and removal procedures with an extra cost.[4-6]

The objective of this article was to present a simple wire-bending technique that can be modified to correct upper second molar tooth supra-eruption. The PSU intruder technique, which was invented by Dr. Bancha Samruajbenjakun in the Orthodontic Section of Prince of Songkla University in Thailand, is made from 0.016" × 0.022" beta-titanium wire (TMA). In addition, this case report presents a multidisciplinary treatment plan for a patient who had missing upper lateral incisors and the lower left first molar.

Case report

The patient was a 12-year-old Thai male. The dentist recommended orthodontic treatment to manage the missing upper lateral incisors. The patient reported no medical problems or allergies to drugs. The extraoral examination determined a symmetrical dolichofacial face. The proportions of the face were normal. Lip position was competent and well aligned with the upper lip line while smiling. The facial profile was straight with a normal nasolabial angle (Figure 1).

An intra-oral examination revealed good oral hygiene and upper anterior teeth spacing.

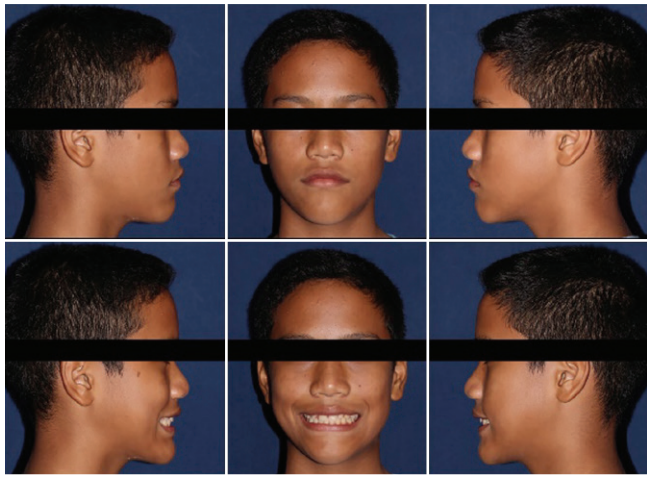

Figure 1 Pre-treatment extraoral examination

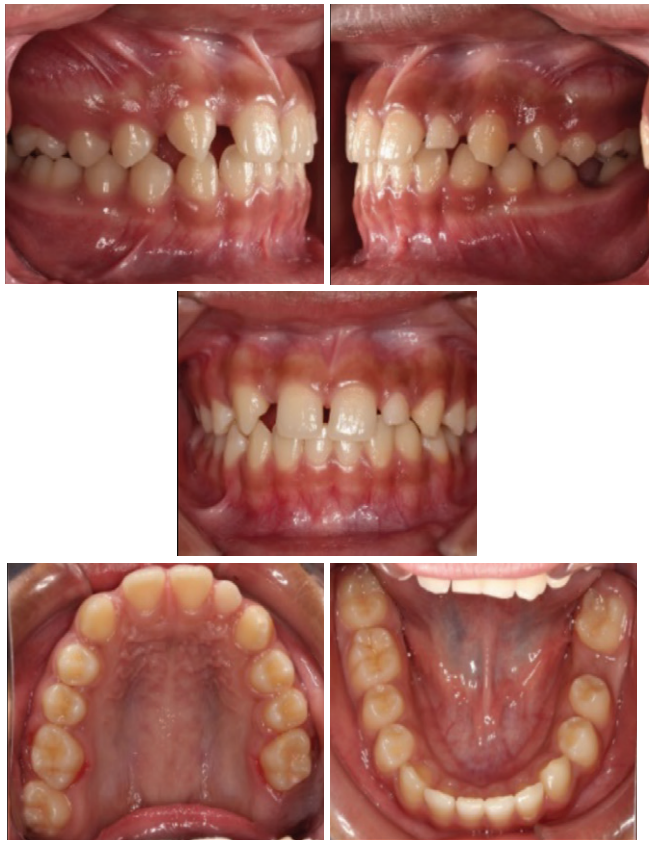

Figure 2 Pre-treatment intraoral examination

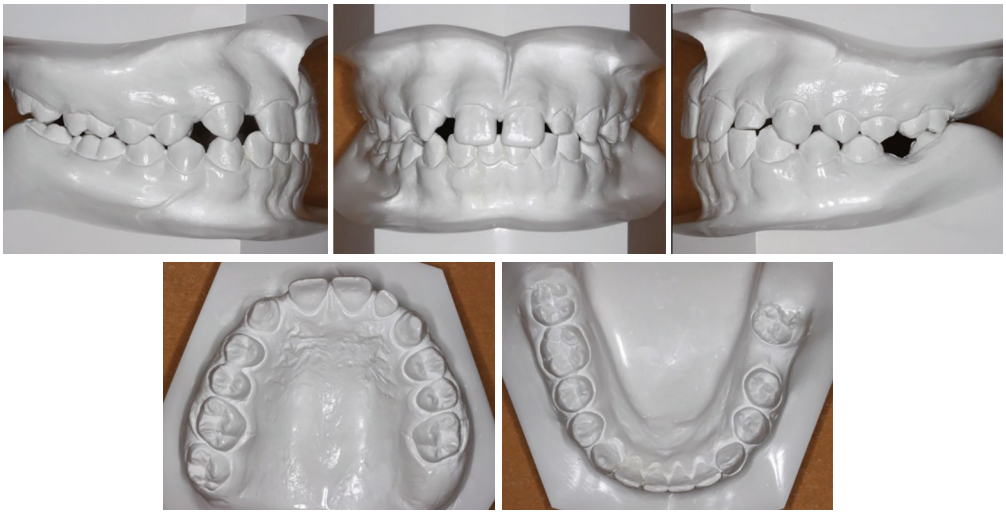

Figure 3 Pre-treatment dental casts

Table 1 Pre-treatment tooth size measurements and space analysis

Tooth number	18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28
Size (mm)	-	10.5	11	7.5	8	9	-	9.5	9.5	-	9	8	7.5	11	-	-
Size (mm)	-	10.5	11.5	8	8	7.5	7	5.5	5.5	6.5	7.5	8	8	-	10.5	-
Tooth number	48	47	46	45	44	43	42	41	31	32	33	34	35	36	37	38

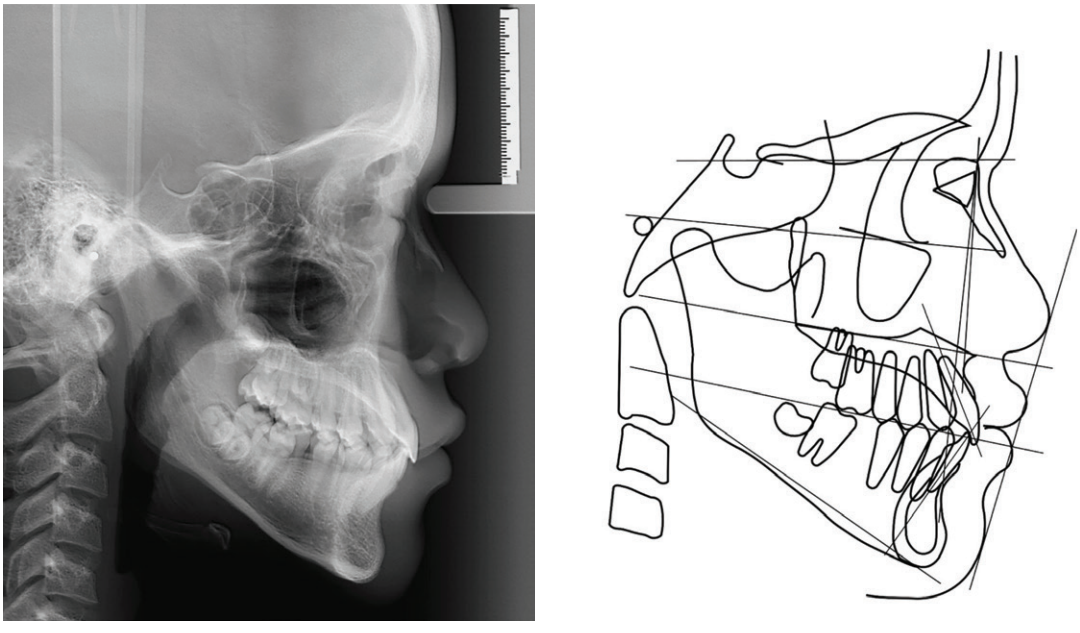

Figure 4 Pre-treatment cephalometric radiograph and tracing

The upper left and right lateral incisors and the lower left first molar teeth were clinically absent. The lower left first molar had been extracted. The upper left deciduous lateral incisor was maintained and without any symptoms. Dens evaginatus and mesial angulation were present in the lower left second molar. Canine classification was Class II on the right side and Class I on the left side. A Class I molar relationship was present

on the right side but the left side was unclassified. The occlusion presented a normal overjet but increased overbite by 4 mm (Figures 2 and 3). The temporomandibular joint, speech, and swallowing functions were normal. The patient had symmetrical and parabolic upper and lower arches with a proper Bolton tooth size analysis (Table 1).

The cephalometric radiograph revealed a skeletal Class I normodivergent pattern with orthognathic maxilla and mandible. The upper and lower incisors were normally inclined and positioned with a normal interincisal angle. The patient had normally positioned upper and lower lips and a normal nasolabial angle (Figures 4 and Table 2).

Table 2 Pre-treatment cephalometric analysis

Area		Measurement	Norm Mean±SD	Pre-treatment	Interpretation
Reference line		FH-SN (degree)[7]	6±3	6	Normal SN plane
Skeletal	Maxilla to cranial base	SNA (degree)[8]	84±4	86	Orthognathic maxilla
		A-Nperp (mm)[9]	5±4	2	Orthognathic maxilla
		SN-PP (degree)[9]	9±3	10	Normodivergent
	Mandible to cranial base	SNB (degree)[8]	81±4	83	Orthognathic mandible
		Pg-Nperp (mm)[9]	0±6	1.5	Orthognathic mandible
		SN-Pg (degree)[8]	82±3	85	Orthognathic mandible
		SN-MP (degree)[8]	29±6	34	Normodivergent
		NS-Gn (degree)[8]	68±3	65	Normodivergent
	Maxillo-mandibular	ANB (degree)[8]	3±2	3	Class I
		Wits (mm)[7]	-3±2	-1	Class I
		FMA (degree)[9]	23±5	27	Normodivergent
		MP-PP (degree)[8]	21±5	25	Normodivergent
Dental	Maxillary dentition	$\underline{1}$ to NA (degree)[8]	22±6	25	Normally inclined upper incisors
		$\underline{1}$ to NA (mm)[8]	5±2	5	Normally positioned upper incisors
		$\underline{1}$ to SN (degree)[8]	108±6	111	Normally inclined upper incisors
	Mandibular dentition	$\overline{1}$ to NB (degree)[8]	30±6	29	Normally inclined lower incisors
		$\overline{1}$ to NB (mm)[8]	7±2	6.5	Normally positioned lower incisors
		$\overline{1}$ to MP (degree)[7]	99±5	90	Retroclined lower incisors
	Maxillo-mandibular	$\underline{1}$ to $\overline{1}$ (degree)[8]	125±8	125	Normal interincisal angle
Soft tissue	Soft tissue	E line U. lip (mm)[9]	-1±2	1	Normally positioned upper lip
		E line L. lip (mm)[9]	2±2	2	Normally positioned lower lip
		NLA (degree)[7]	91±8	83	Normal nasolabial angle
		H-angle (degree)[8]	14±4	16	Normally positioned upper lip

From the panoramic radiograph, the upper left and right lateral incisors were missing. Only the upper left deciduous lateral incisor crown and the upper and lower third molar crown formations were present on both sides (Figure 5).

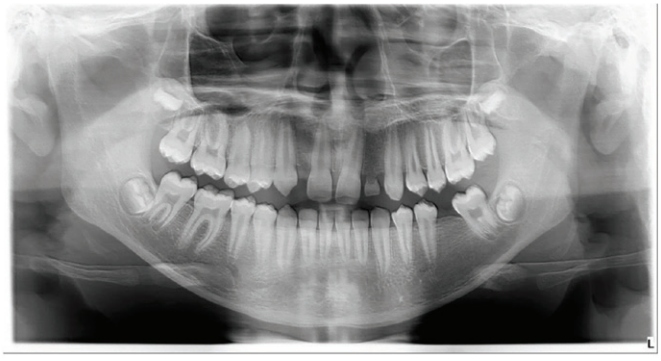

Figure 5 Pre-treatment panoramic radiograph

Conventional orthodontic treatment was appropriate for this patient since he had a normal facial profile and no skeletal problems. Due to a poor long-term prognosis, the upper left deciduous lateral incisor was planned for extraction. In addition, the dental occlusion was almost a Class I molar and canine relationship. As a result, opening the upper left and right spaces for the dental substitute was more practical than closing the space by protraction of the teeth. Furthermore, at maximum intercuspal occlusion, the posterior teeth would have been more difficult to move and would have required longer treatment times. In addition, the lower left third molar crown developed at an early stage, which predicted forward movement in the lower left second molar area. Therefore, mesial tipping of the lower left second molar had to be uprighted to prepare the way for forward movement into contact with the lower left second premolar tooth before lower left third molar eruption.

The teeth of the patient were bonded directly with the bidimensional Roth bracket prescription, which has a 0.018" × 0.022" slot at the incisors and a 0.022" × 0.028" slot attached at the canine and posterior teeth. The upper and lower teeth were aligned by 0.012", 0.014", and 0.016" nickel-titanium (NiTi) wires, 0.016" × 0.016" stainless steel (SS), and 0.016" × 0.022" SS wires, respectively. Space at the edentulous area was generated by a NiTi open coil spring until sufficient. However, the lower left first molar space used a customized 0.016" × 0.022" beta-titanium wire of the mushroom-loop design for the purpose of uprighting and mesializing the lower left second molar (Figure 6).

Unfortunately, the upper left second molar was erupting, and the palatal cusp supra-erupted. A 0.016" × 0.022" TMA wire was bent into a single helix and cantilever design, which is called the PSU intruder technique, to intrude the palatal cusp with 20 grams of force. The PSU intruder wire was placed in the bracket slot at the palatal surface of the upper left first and second premolars. A 0.016" × 0.022" SS wire was placed at the buccal surface of all teeth as anchorage preparation (Figure 7). The palatal cusp of the upper left second molar was intruded 1.5 mm within two months.

After 24 months, a facial assessment demonstrated an increased lower facial height and

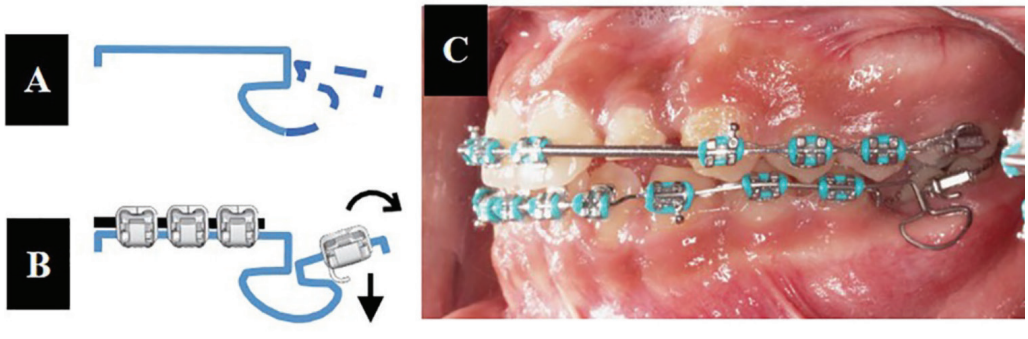

Figure 6 A. The preactivated mushroom loop.
B. The intrusive force and tip-back moment from the mushroom loop that created at the lower left first molar.
C. The actual figure, which was inserted at the lower left second molar.

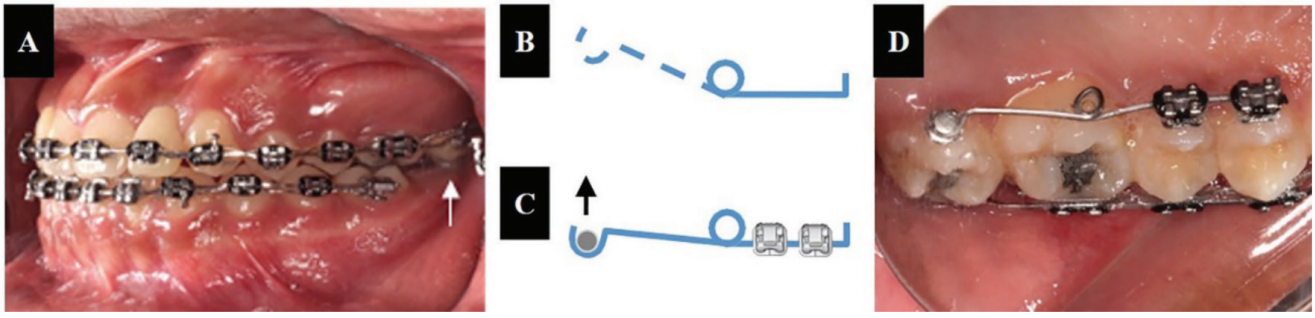

Figure 7 A. The upper left second molar supra-erupted tooth.
B. The preactivated PSU intruder technique.
C. The intrusive force of the PSU intruder design caused intrusion of the upper left second molar.
D. The actual wire was bent and inserted at the upper left second molar.

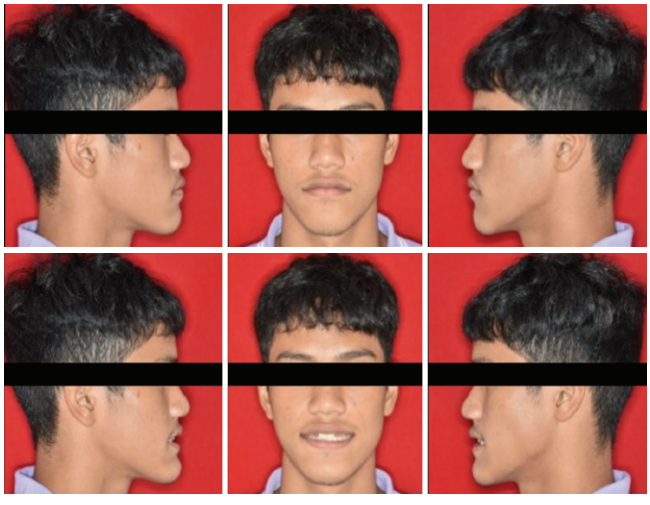

Figure 8 Post-treatment extraoral examination

Straight facial profile. Moreover, the smile line was in a lower position compared to the initial treatment condition. The upper and lower dental midlines coincided with the facial midline (Figure 8).

The upper left and right lateral incisor spaces were increased by 7 mm on each side. The lower left second molar had shifted to the mesial position and was in close contact with the lower left second premolar. All teeth were well aligned and harmonized with the upper and lower arch forms. The obtained canine and molar relationship was a Class I relationship with normal overjet and overbite and upper and lower midlines that coincided with the facial midline (Figures 9, 10 and Table 3).

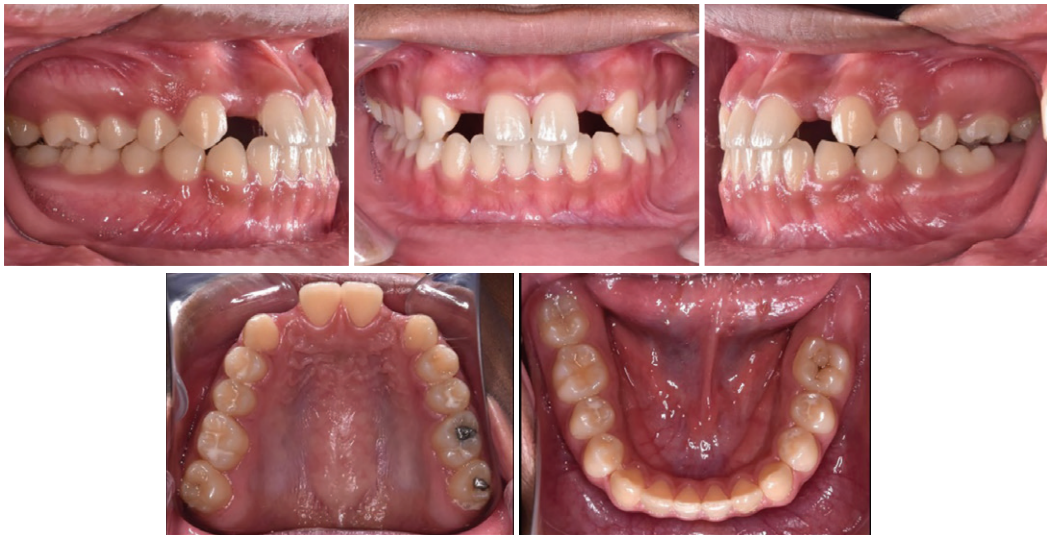

Figure 9 Post-treatment intraoral examination

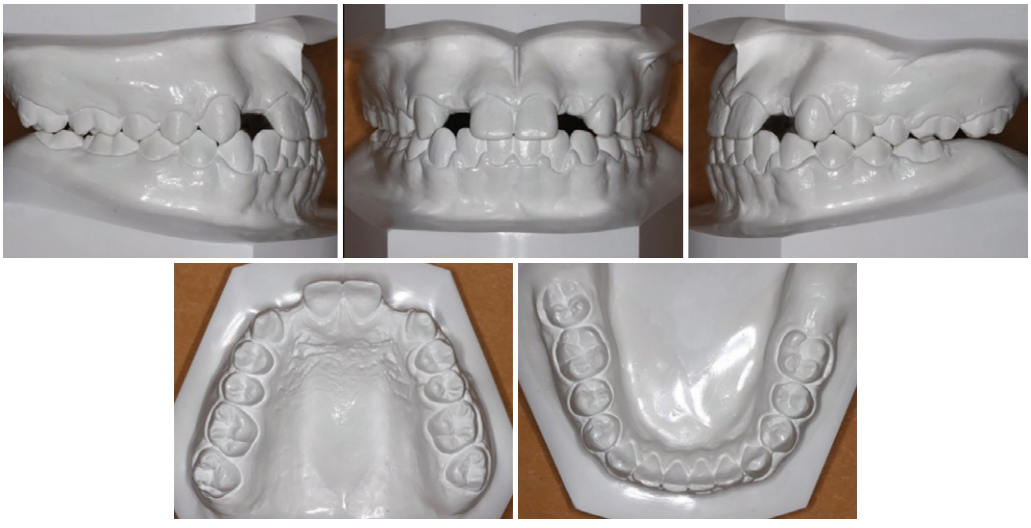

Figure 10 Post-treatment dental cast

Table 3 The comparison of pre-treatment and post-treatment dental cast analysis

Parameters		Pre-treatment	Post-treatment
Overjet		2 mm	2 mm
Overbite		4 mm	2 mm
Canine relationships	Right	Cl. II 3 mm	Cl. I
	Left	Cl. II 1 mm	Cl. I
Molar relationships	Right	Cl. I	Cl. I
	Left	Unclassified	Cl. I
Upper	Midline	Shift to the right 1 mm	Center
	Arch form	Paraboloid	Paraboloid
	Intercanine width	37 mm	40 mm
	Intermolar width	57 mm	58 mm
Lower	Midline	Center	Center
	Arch form	Paraboloid	Paraboloid
	Intercanine width	30 mm	30 mm
	Intermolar width	55 mm (37-46)	54 mm

The post-treatment lateral cephalometric radiograph revealed (1) skeletal Class I hyperdivergent pattern with orthognathic maxilla and mandible (Class III tendency), (2) proclined but normally positioned upper incisors, (3) retroclined but normally positioned lower incisors, (4) normal interincisal angle, (5) straight soft tissue profile, (6) normally positioned upper and lower lips, and (7) normal nasolabial angle (Figure 11 and Table 4).

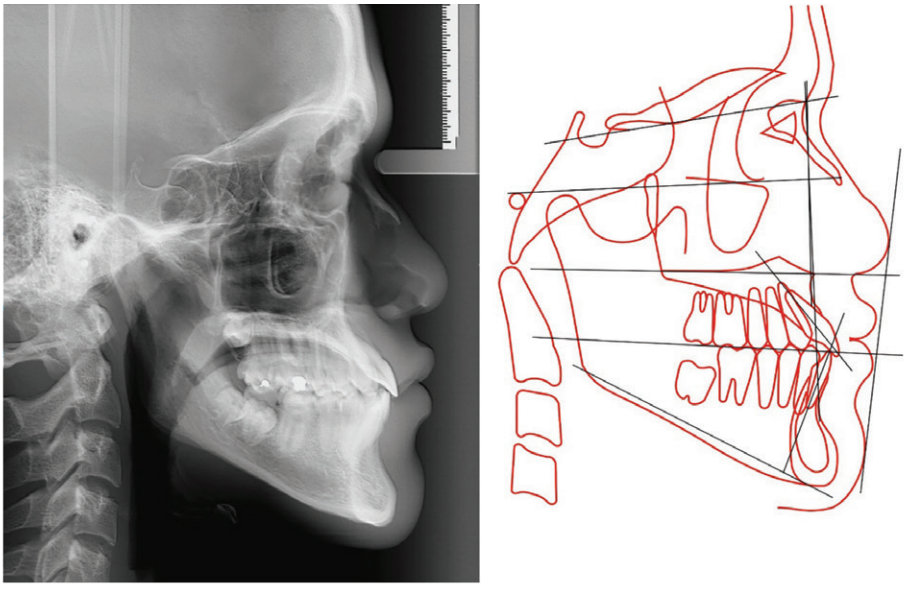

Figure 11 Post-treatment cephalometric radiograph and tracing

Table 4 Comparison of the pre-treatment and post-treatment lateral cephalometric analyses

Area		Measurement	Norm Mean±SD	Pre-treatment 27-07-60	Post-treatment 14-07-63	Difference
Reference line		FH-SN (degree)[7]	6±3	6	6	0
Skeletal	Maxilla to cranial base	SNA (degree)[8]	84±4	86	86	0
		A-Nperp (mm)[9]	5±4	2	2	0
		SN-PP (degree)[9]	9±3	10	10	0
	Mandible to cranial base	SNB (degree)[8]	81±4	83	87	+4
		Pg-Nperp (mm)[9]	0±6	1.5	5	+3.5
		SN-Pg (degree)[8]	82±3	85	87.5	+2.5
		SN-MP (degree)[8]	29±6	34	36.5	+2.5
		NS-Gn (degree)[8]	68±3	65	65	0
	Maxillo mandibular	ANB (degree)[8]	3±2	3	-1	-4
		Wits (mm)[7]	-3±2	-1	-4	-3
		FMA (degree)[9]	23±5	27	28	+1
		MP-PP (degree)[8]	21±5	25	29	+4
Dental	Maxillary dentition	$\underline{1}$ to NA (degree)[8]	22±6	25	33	+8
		$\underline{1}$ to NA (mm)[8]	5±2	5	7	+2
		$\underline{1}$ to SN (degree)[8]	108±6	111	119	+8
	Mandibular dentition	$\overline{1}$ to NB (degree)[8]	30±6	29	24	-5
		$\overline{1}$ to NB (mm)[8]	7±2	6.5	5	-1.5
		$\overline{1}$ to MP (degree)[7]	99±5	90	85	-5
	Maxillo-mandibular	$\underline{1}$ to $\overline{1}$ (degree)[8]	125±8	125	120	-5
Soft tissue	Soft tissue	E line U. lip (mm)[9]	-1±2	1	-1	-2
		E line L. lip (mm)[9]	2±2	2	0	-2
		NLA angle (degree)[7]	91±8	83	88	+5
		H-angle (degree)[8]	14±4	16	13	-3

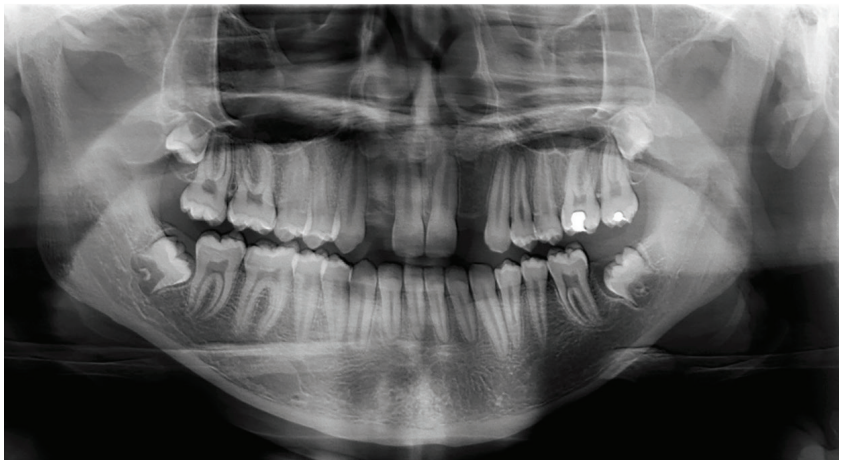

Figure 12 Post-treatment panoramic radiograph

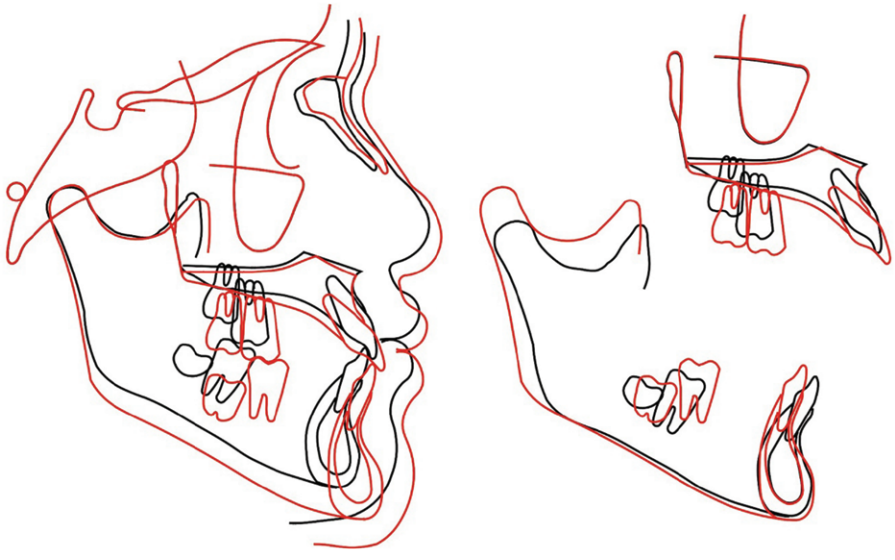

Figure 13 Superimpositions of the pre-treatment (black line) and post-treatments (red line) of the lateral cephalometric tracings

The panoramic radiograph revealed nearly parallel roots and mild external root resorption. The area of the lower left third molar had sufficient space for eruption to replace the lower left second molar (Figure 12).

A cranial base superimposition revealed that the maxilla grew downward and the mandible grew forward and downward. The lower anterior facial height had increased and clockwise rotation of the mandible had occurred, but the upper and lower lips were maintained. The maxillary superimposition represented the upper incisor, which was proclined and extruded approximately 2 mm. Furthermore, an examination of the mandibular superimposition showed that the lower incisor had retroclined and retracted (2 mm) and extruded (2 mm), while the lower molar was uprighted, mesialized (2 mm), and extruded (2 mm), and also the lower third molar tooth bud was mesialized (2 mm) (Figure 13).

Treatment entered the retention phase after all brackets were removed. While waiting for prosthetic treatment, the retention appliance was a wraparound retainer with upper left and right lateral incisor dental substitutes. The palatal acrylic appliance was fitted to the tooth surfaces to control the position of the teeth. The lower arch was retained with a wraparound retainer as well (Figure 14).

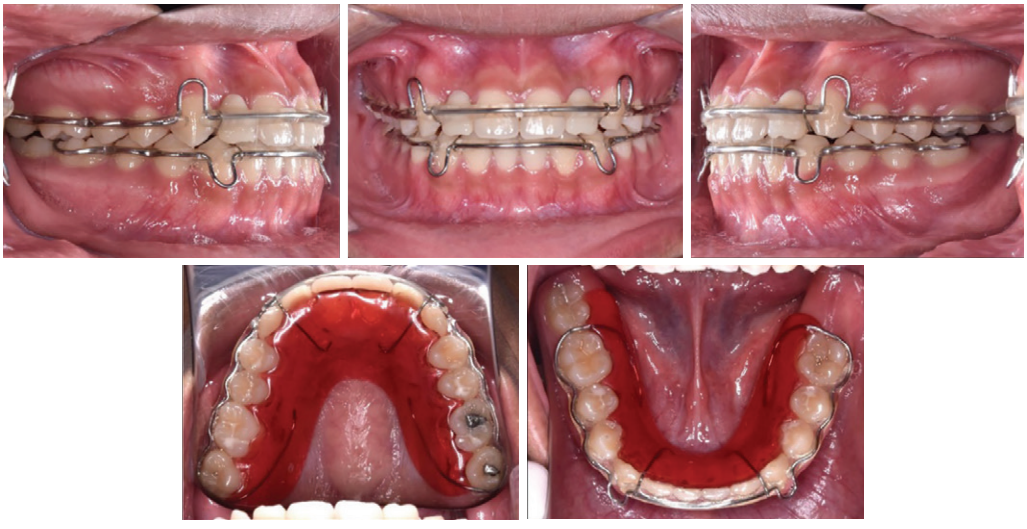

Figure 14 Post-treatment with retention appliances

Discussion

Orthodontists are frequently challenged with over-eruption of an upper second molar when treating with fixed orthodontic appliances. Since adolescents comprise the vast majority of patients who receive orthodontic treatment, occlusal interference from over-extruded cusps is common. The PSU intruder technique, which was invented by Dr. Bancha Samruajbenjakun, uses a rectangular 0.016" × 0.022" TMA wire. TMA provides the lightest continuous force with the least deformation compared with stainless steel or Blue Elgiloy wire.[10] The PSU intruder technique has several benefits. 1) The wire is easy to bend because it only has one small helix that can produce a highly flexible wire. 2) The intruding force can be applied to a single tooth, which avoids a reciprocal force at the adjacent teeth when action is applied at the palatal or lingual side. The buccal side of the corrected tooth as well as the anchorage tooth can be maintained by the stiffer arch wire. 3) The intruder spring can overlay the stiff main archwire when designed to correct the buccal side. 4) The intruder can be designed for one or both sides of an over-extruded occlusal cusp. 5) It works perfectly well in the finishing stage. 6) There is less oral irritation. The only disadvantage is it cannot be applied to more than one tooth. In the post-treatment phase, there were no marginal ridge discrepancies between the upper left first and second molars, which represented an excellent result for the PSU intruder technique.

The mushroom-loop shape was initially developed by Dr. Uribe and Dr. Nanda[11] who characterized the elastic range and its practicability based on vestibular depth. Hence, the modified mushroom loop was capable of producing a distal moment and mesialized force at the lower left second molar. The unintended vertical obstruction of some teeth was quickly fixed by a straightforward wire bending procedure.

The dens evaginatus at the lower left second molar can be prophylactically treated by different methods, which include: (1) selective grinding to eliminate interference with the opposing cusp; (2) covering the tubercle area with a flowable, cured resin composite; and (3) filling the removed tubercle if the pulp changed direction.[12,13] This case was categorized as type I mature apex and normal pulp tissue, and no signs and symptoms were observed. It was possible to apply compressive force to the opposing tooth because of the minor under-occlusion of the upper left first molar, which kept the patient informed throughout the retention period.

One of the greatest concerns during orthodontic movement in this case was the aesthetic result since a congenitally missing upper lateral tooth is the second most common in tooth agenesis.[14] To open or close a space, factors that include the site and bone properties, the patient's facial development, and gingival and tooth characteristics (i.e. gingival biotype and level, tooth size, shape, and color) need to be considered. Closing the upper lateral incisor space tends to cause excessive reduction of upper canine tooth mass and insufficient papillary growth.[15-17] On the other hand, opening the space allows for many optional prosthetic treatments. In this case, the patient preferred a single titanium implant. This treatment showed a good prognosis because after treatment the occlusion had maximum intercuspation with a proper interincisal angle of the anterior teeth, which decreased the probability of tooth relapse.[18] A wraparound retainer with artificial teeth was essential to maintain the spaces for further prosthetic substitution. Furthermore, the fitted palatal acrylic appliance had to be extended to the upper left second molar to prevent re-extrusion. A long follow-up time was necessary to observe the eruption pattern because the lower third molar was still developing.

Conclusion

The patient needed teeth to fill the upper anterior space. The skeletal Class I relationship and normodivergent pattern with the orthognathic maxilla and mandible were investigated in all of the available data. Normal molar Class I relationship and overjet were observed but the patient had an increased overbite. In addition, the most remarkable points were the increased upper anterior tooth spacing due to the left and right congenitally missing lateral incisors along with the lower left first molar extraction. The lower left second molar tip was visible in the lower space. Opening the space for forward restoration was applied because of the shorter treatment time and fewer complex mechanics. Even though the esthetic zone was quite concerning because of the activated appliance, dental substitutes were positioned during the insertion of the orthodontic wires. As a result, the patient could smile at anyone without concern. The outcome of the upper incisor spaces was the presentation of a suitable space for future dental implants, and the lower left second molar was protracted close to the lower left second premolar. The patient still had mandibular growth during the treatment processes, which definitely increased the vertical proportion and forward mandibular growth direction. After treatment, the lateral cephalometric radiograph indicated a straight profile and skeletal Class I relationship, which pleased both the patient and his parents. In addition, this case report shared the novel idea of intruding a local tooth, which in this case was the upper left second molar. The palatal cusp was intruded more by adjusting the TMA wire combined with the palatal bracket of the adjacent teeth. This is a novel technique that required only a minor modification of existing orthodontic knowledge. This technique is suitable for correcting a single supra-eruption tooth without invasive bone punching. The multiple issues associated with congenitally missing teeth and the interference of an erupting tooth during orthodontic treatment were the most significant concerns in this case. The successful outcome resulted from good communication among the multidisciplinary team members that included the orthodontist, endodontist, prosthodontist, and oral and maxillofacial surgeons to consider the suitability of the treatment plan as well as the future plan .

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