รายงานผู้ป่วย
Case Report

Effectiveness of an Activator in Early Treatment of a Class II Retrognathic Mandible : A Case Report

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Abstract

This case report showed a 13 years old Thai boy with a chief complaint of having proclined teeth and spacing around his upper incisors. The main problem was a large overjet due to upper incisor proclination in combination with anterio-posterior skeletal discrepancies by a retruded position of the mandible. The treatment plan included two phases; the first phase was growth modification of the mandible with pre-pubertal growth spurt potential, and the second phase was conventional orthodontic treatment to correct the residual dental problem. The initial treatment was an arch expansion with an upper lateral expansion plate to coordinate the upper and lower arch for four months and to guide the mandible growth with an activator appliance by wearing it at least 12 hours/day for seven months. Progression was evaluated at the end of the first phase. The second phase period was a fixed appliance for twenty months. After treatment, the results showed a satisfactory lateral profile and alignment of teeth where the upper incisor position was corrected and a normal position of the mandible was presented. These outcomes suggest that growth modification works for severe Class II skeletal discrepancies, especially in young patients with future growing potential, as it decreases the severity and enhances normal skeletal growth pattern that decrease the chance of orthognathic surgery.

Keywords: Activator, Class II treatment, Functional appliance, Growth modification, Two-phase treatment

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Introduction

Skeletal Class II problems mean there are discrepancies between the maxilla and mandible that result in a convex profile with Class II malocclusion. Orthodontists often discriminate between the abnormal position of the maxilla or mandible in adults or young growing patients that lead to a specific treatment plan.[1]

In adults, the options for skeletal Class II treatment are orthodontic treatment (camouflage treatment) and orthodontic treatment combined with orthognathic surgery.[2] In young growing patients, the patients require two phases of treatment. In the first phase, it is necessary to evaluate the skeletal maturation stage by assessing the hand and wrist[3] or cervical vertebra radiograph.[4] An evaluation indicated the growth potential of abnormal growth of the maxilla or mandible, so the chosen approach was growth modification to enhance, inhibit or redirect the bone to normal growth and decrease the severity of discrepancies of the maxilla and mandible. The second phase includes orthodontic treatment to correct the remaining problems.[5] The success of the treatment depends upon these following factors: 1) whether the treatment attacked to the abnormal jaw, 2) the proper treatment time, 3) the patient's compliance and motivation, and 4) the individuals response. Furthermore, the appliances for growth modification were diverse including the head gear, activator, twin blocks, the fixed functional appliance, and a miniplate.

An activator was first suggested by Viggo Andresen in 1908 and has been widely used until now. The activator indicated for Class II retrognathic mandible issues in young growing patients and is effective for growth modification of the retrognathic mandible. Some studies believe that an activator promotes an orthopaedic effect for condylar growth[6] and inhibits maxillary growth.[7] On the other hand, there was a study that showed only dentoalveolar effects.[8,9] Therefore its usage is controversial and lead to a systematic review. The outcome of Class II correction by an activator was from the combination of dentoalveolar and skeletal position changes. The dentoalveolar effect decreased the inclination of upper incisors and gave more proclination of lower incisors. The skeletal effects inhibited anteroposterior maxillary growth, increased the mandibular length, and assisted backward rotation of the mandible with increased lower facial height.[10] The suitable treatment time for mandibular growth modification should be before the peak of pubertal growth spurts.[11]

The aim of this case report was to present the growth modification using an activator on young Thai growing patient with Class II severe antero-posterior discrepancies by retrognathic mandible treatment.

Case report

A thirteen-year-old Thai boy met an orthodontist with protruding and spacing of the upper anterior teeth as his chief complaint. He had a history of extraction, fillings and scaling for dental treatment with no other medical history. The growth status evaluation from his hand and wrist radiograph revealed the appearance of an abductor sesamoid bone showing the beginning of a pubertal growth spurt (Figure 4).

Figure 1 Pre-treatment extraoral examination

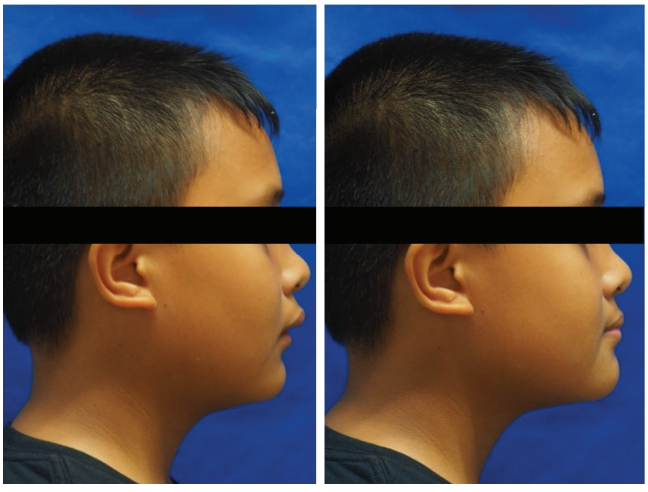

Figure 2 Normal (a) and protruded (b) chin position

Figure 3 Pre-treatment intraoral examination

Figure 4 Hand and wrist radiograph

An extra-oral examination showed a mesofacial and asymmetrical face with 2 millimeters of chin deviation to the right, normal lower anterior facial height, no occlusal plane canting, incompetent lips, and a low smile line (Figure 1). The facial profile showed a convex facial profile with a protruded upper lip. His profile was better in the protruded chin position, which indicated mandibular growth modification (Figure 2). Functional analysis showed no signs or symptoms of temporomandibular joint disorders, no CO-MI shift, correct nasal breathing, and a lower lip biting habit.

The patient's intraoral examination showed fair oral hygiene with mild gingivitis with normal frenum attachment (Figure 3). The maxillary arch was V-shaped with an asymmetrical arch form showing impinging gingiva at a retro-incisive area, he had a median diastema and some unerupted teeth (numbers 15, 17, 25, and 27). The mandibular arch was V-shaped with an asymmetrical arch form showing lower anterior teeth crowding, with 43 partially erupted and four unerupted teeth (numbers 33, 37, 45, and 47). Malocclusion described an antero-posterior problem as having a large overjet of 11 millimeters with proclination of the upper incisors, and a vertical problem presented a 7 millimeters deep overbite and 4 millimeters deep curve of the Spee. There was a Class II canine relationship of 4 millimeters and a Class II molar relationship of 2 millimeters on both sides (Figure 3). Bolton's analysis showed that the lower anterior teeth were larger than the upper anterior teeth by 1.5 millimeters with consonant upper and lower sizes of overall teeth.

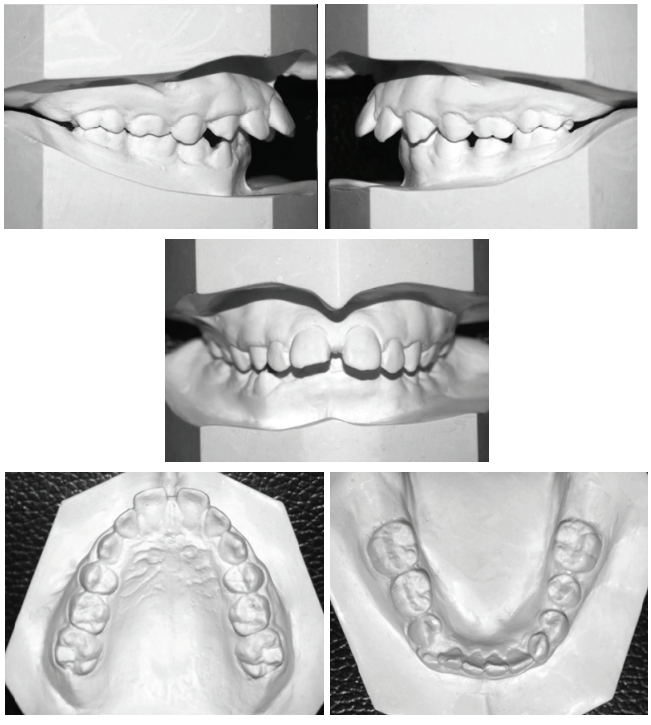

Figure 5 Pre-treatment dental casts

Figure 6 Pre-treatment-lateral cephalogram

Table 1 Pre-treatment with Korkhaus' analysis

Type	Upper		Lower	
	Thai norm[12]	Pre-treatment	Thai norm[12]	Pre-treatment
Arch height (mm.)	19.1 ± 2.4	23	17.3 ± 2.3	12
Anterior arch width (mm.)	36.4 ± 1.9	35	36.2 ± 2.1	34
Posterior arch width (mm.)	46.8 ± 2.2	48	45.7 ± 2.2	49

The intraoral examination was consonant with the dental casts (Figure 5). Korkhaus analysis showed an increase in the upper anterior arch height and a decrease in the lower anterior arch height, and also presenting a large overjet, anterior and posterior arch width of upper and lower arch were resemble (Table 1). The lateral cephalometric analysis with Thai norms presented[13-15] as (Figure 6, Table 2): A Skeletal Class II normodivergent pattern with an orthognathic maxilla and retrognathic mandible, proclined and protruded upper incisors, retroclined and retruded lower incisors, normal interincisal angles, a protruded upper lip but a normally positioned lower lip, and a normal nasolabial angle. A panoramic radiograph (Figure 7) showed asymmetrical condyles (the right was larger than the left), maxillary sinus pneumatization adjacent to the posterior tooth roots, four unerupted teeth (numbers 15, 25, 33, and 45), and three crown formations (on teeth numbered 28, 38, 48). The etiology of malocclusion showed tooth-sized and arch-sized discrepancies, and lower lip biting.

Figure 7 Pre-treatment panoramic radiograph

Table 2 Pre-treatment cephalometric analysis

Area		Measurement	Norm Mean±SD	Pre-treatment	Interpretation
Reference line		FH-SN (degree)	6±3	8	Normal SN plane
Skeletal	Maxilla to Cranial base	SNA (degree) SN-PP (degree)	84±4 9±3	82 7	Orthognathic maxilla Normal inclination of maxilla
	Mandible to Cranial base	SNB (degree) SN-MP (degree) SN-Pg (degree) NS-Gn (degree)	81±4 29±6 82±3 68±3	76 26 79 65	Retrognathic mandible Normodivergent pattern Orthognathic mandible Normodivergent pattern
	Maxillo-Mandibular	ANB (degree) Wits (mm) MP-PP (degree) FMA (degree)	3±2 -3±2 21±5 23±5	6 2 18 18	Skeletal Class II Skeletal Class II Normodivergent pattern Normodivergent pattern
Dental	Maxillary dentition	$\underline{1}$ to NA (degree) $\underline{1}$ to NA (mm) $\underline{1}$ to SN (degree)	22±6 5±2 108±6	38 9 124	Proclined upper incisor Protruded upper incisor Proclined upper incisor
	Mandibular dentition	$\overline{1}$ to NB (degree) $\overline{1}$ to NB (mm) $\overline{1}$ to MP (degree)	30±6 7±2 99±5	18 4 91	Retroclined lower incisor Retruded lower incisor Retroclined lower incisor
	Maxillo-Mandibular	$\underline{1}$ to $\overline{1}$ (degree)	125±8	119	Normal interincisal angle
Soft tissue	Soft tissue	E line U. lip (mm) E line L. lip (mm) Nasolabial angle (degree) H-angle (degree)	-1±2 2±2 91±8 14±4	3 -1 88 23	Protruded upper lip Retruded positioned lower lip Normal nasolabial angle Protruded upper lip

There were two options for the treatment plan; 1) Growth modification and 2) Camouflage with upper teeth extraction. The treatment plan had to be considered according to the patient's complaint, which included protruded upper incisors, a skeletal Class II problem requiring retrognathic mandible treatment, a large overjet, and retroclined and crowding of the lower incisors. The patient's profile was convex and required advancement of the mandibular position. Therefore, two-phase of treatment was chosen as follow: 1) growth modification with an activator appliance and 2) comprehensive orthodontic treatment, because of the growth status as the peak of a pubertal growth spurt that would occur one year after this stage. The upper arch was narrowed and the overjet decreased when manipulated in a hand held articulation position. The maxillary arch expansion was performed with a bilateral expansion plate and followed by an activator appliance to enhance mandibular growth. In addition, the objective of the treatment included both the skeletal and dental beneficial effects.

Figure 8 Progression extraoral examination

Figure 9 Progression intraoral examination after expansion and activator

The upper bilateral expansion plate was activated and turned one time each week and followed up every month. During expansion of the upper arch, the palatal acrylic and labial bow were adjusted to retract and close spacing at upper anterior teeth. After four months of expansion, the buccal overjet was increased and the activator was inserted. After ten months of the activator placement, the patient's lateral profile improved with a more downward and forward position of the chin when compared with the initial position (Figure 8), and the intra-oral examination showed that the large overjet and deep overbite had improved (overjet; from 11 to 3 millimeters, and overbite; from 7 to 3 millimeters). The molar and canine Classification was changed from a Class II to a Class III relationship. In addition, the upper arch form was corrected from a v-shape to a paraboloid-shape and to conform with the lower arch, the upper incisor spacing was closed (Figure 9). The overall superimposition of progression showed downward and forward growth of the mandible, which was consonant with the mandibular superimposition being backward of condylar growth. In addition, the maxillary superimposition showed mesialization of the upper molar, which had slightly extruded and shown retroclination of the upper incisors. Mandibular superimposition showed extrusion and mesialization of the lower molar and proclination of the lower incisors (Figure 11).

Figure 10 Progression lateral cephalogram

Progression lateral cephalometric analysis (Table 3) showed an improved skeletal relationship as Class I, dental analysis as normal of upper and lower incisors inclination, soft tissue analysis as normal for the position of the upper and lower lips, and a nasolabial angle at the end of the first phase of treatment (Figure 10).

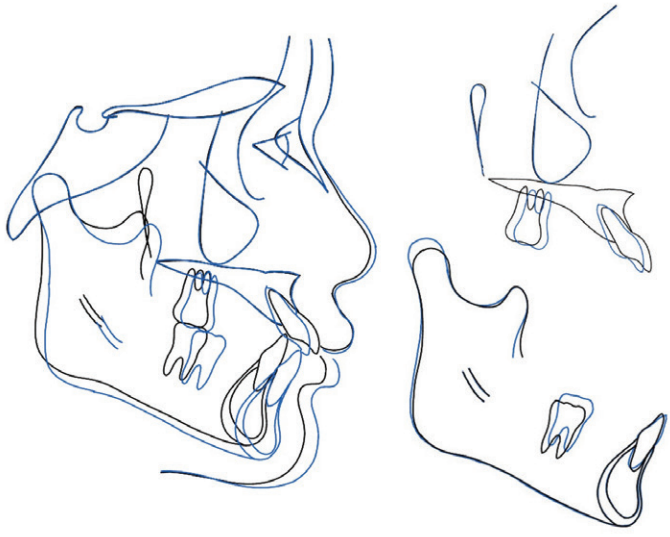

Figure 11 Progression lateral cephalogram superimposition (Black line - Initial, Blue line - Progress)

Table 3 Comparison of pre- and progress-treatment cephalometric analysis

Area		Measurement	Norm Mean±SD	Pre treatment	Progress treatment	Difference
Reference line		FH-SN (degree)	6±3	8	8	0
Skeletal	Maxilla to Cranial base	SNA (degree)	84±4	84	84	0
		SN-PP (degree)	9±3	7	7	0
	Mandible to Cranial base	SNB (degree)	81±4	78	82	+4
		SN-MP (degree)	29±6	26	26	0
		SN-Pg (degree)	82±3	79	83	+4
		NS-Gn (degree)	68±3	65	65	0
	Maxillo-Mandibular	ANB (degree)	3±2	6	2	-4
		Wits (mm)	-3±2	2	-2	-4
		MP-PP (degree)	21±5	18	18	0
		FMA (degree)	23±5	18	18	0
Dental	Maxillary dentition	$\underline{1}$ to NA (degree)	22±6	38	26	-12
		$\underline{1}$ to NA (mm)	5±2	9	5	-4
		$\underline{1}$ to SN (degree)	108±6	124	112	-12
	Mandibular dentition	$\overline{1}$ to NB (degree)	30±6	18	25	+7
		$\overline{1}$ to NB (mm)	7±2	4	6	+2
		$\overline{1}$ to MP (degree)	99±5	91	96	+5
	Maxillo-Mandibular	$\underline{1}$ to $\overline{1}$ (degree)	125±8	119	120	+1
Soft tissue	Soft tissue	E line U lip (mm)	-1±2	3	0	-3
		E line L lip (mm)	2±2	-1	0	+1
		Naso-labial angle (degree)	91±8	88	91	+3
		H-angle (degree)	14±4	23	17	-6

Figure 12 Progression panoramic radiograph

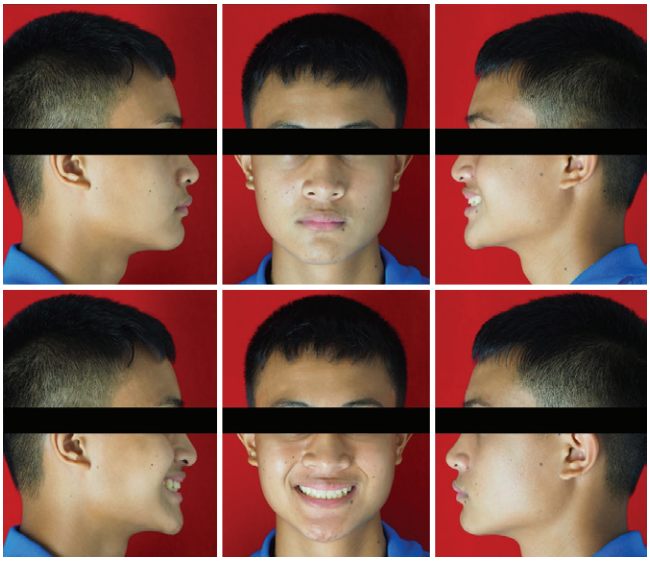

Figure 13 Post-treatment extraoral examination

Figure 14 Post-treatment intraoral examination

After finishing the first phase of treatment, the facial profile, incisors and lip position were accepted. The remaining problems were upper anterior teeth spacing, upper second premolar rotation, lower anterior teeth crowding, and a Class III molar relationship that could be solved by conventional orthodontic treatment without extractions.

The second phase of the treatment plan included closing all upper spaces, aligning the teeth of the upper and lower arches, and upper molar mesialization for correcting the Class III molar relationship. Bi-dimensional preadjusted edgewise appliances (slot 0.018" at incisors and slot 0.022" at all remains) were bonded for leveling and aligning; starting with 0.012" followed by 0.016" nickel-titanium wires on both arches. In the movement phase, stainless steel arch wires were used (0.016", 0.016" x 0.016" and 0.016" x 0.022"). Upper anterior and posterior teeth were grouped together, and Class II elastic and upper incisor retraction by a c-chain was applied. The finishing phase was performed until the following were achieved: a Class I canine and molar relationship was achieved, there was a normal overjet and overbite, and good occlusal intercuspation. The second phase of the treatment was completed after 20 months with an upper and lower wraparound retainers for the retention phase.

After the final treatment, the outcome showed dramatic changes in the lateral profile (Figure 13) providing the patients with satisfaction and confidence. From the dental cast analysis, the upper anterior spacing was corrected with good alignment and normal inclination, and transverse discrepancies was corrected (Figure 15) Panoramic radiographs showed root parallelism with no significant root and alveolar bone resorption or other pathologic findings (Figure 16).

Figure 15 Post-treatment dental casts

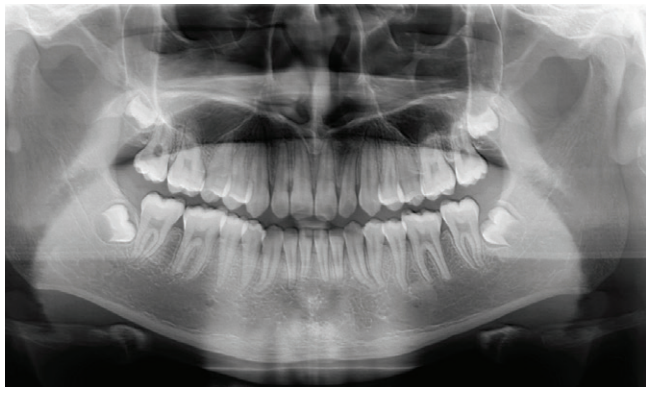

Figure 16 Post-treatment panoramic radiograph

Figure 17 Post-treatment lateral cephalogram

The cephalometric analysis and superimposition (Figure 17, 18; Table 4) showed dramatic changes in the antero-posterior position of the mandible by forward growth, and the upper incisors were retroclined.

Figure 18 Lateral cephalometric superimposition
(Black line - Initial, Red line - Progress)

Table 4 Comparison of pre- and post-treatment cephalometric analysis

Area		Measurement	Norm Mean±SD	Pre treatment	Post treatment	Difference
Reference line		FH-SN (degree)	6±3	8	8	0
Skeletal	Maxilla to Cranial base	SNA (degree) SN-PP (degree)	84±4 9±3	84 7	84 7	0 0
	Mandible to Cranial base	SNB (degree) SN-MP (degree) SN-Pg (degree) NS-Gn (degree)	81±4 29±6 82±3 68±3	78 26 79 65	82 26 83 65	+4 0 +4 0
	Maxillo-Mandibular	ANB (degree) Wits (mm) MP-PP (degree) FMA (degree)	3±2 -3±2 21±5 23±5	6 2 18 18	2 -2 18 18	-4 -4 0 0
Dental	Maxillary dentition	$\underline{1}$ to NA (degree) $\underline{1}$ to NA (mm) $\underline{1}$ to SN (degree)	22±6 5±2 108±6	38 9 124	24 5 110	-14 -4 -14
	Mandibular dentition	$\overline{1}$ to NB (degree) $\overline{1}$ to NB (mm) $\overline{1}$ to MP (degree)	30±6 7±2 99±5	18 4 91	26 5 97	+8 +1 +6
	Maxillo-Mandibular	$\underline{1}$ to $\overline{1}$ (degree)	125±8	119	120	+1
Soft tissue	Soft tissue	E line U lip (mm) E line L lip (mm) Naso-labial angle (degree) H-angle (degree)	-1±2 2±2 91±8 14±4	3 -1 88 23	0 0 91 17	-3 +1 +3 -6

Table 5 Comparison of pre- and post-treatment dental cast analysis

		Pre-treatment	Post-treatment
Overjet		11 mm	2 mm
Overbite		7 mm	2 mm
Canine relationship	Right	Class II 4 mm	Class I
	Left	Class II 4 mm	Class I
Molar relationship	Right	Class II 2 mm	Class I
	Left	Class II 2 mm	Class I
Upper	Midline	Center	Center
	Arch form	V-shaped	Paraboloid-shaped
	Intercanine width	33 mm	37 mm
	Intermolar width	52 mm	55 mm
Lower	Midline	Deviate to the right 3 mm	Center
	Arch form	Paraboloid-shaped	Paraboloid-shaped
	Intercanine width	N/A	28 mm
	Intermolar width	45 mm	47 mm

Discussion

The patient's chief compliant was proclination of the upper incisors. An extraoral examination showed a mesofacial pattern and chin deviation to the right of 2 mm in the frontal view and having a convex profile and retruded chin in the lateral view, including incompetent lips at the rest position. The lateral profile improved from a convex to straight profile in the forward chin position. An intraoral examination showed upper teeth spacing (median diastema) and lower teeth crowding. The diagnosis included a skeletal Class II normal bite with a retrognathic mandible, dental Class II division 1 malocclusion with a deepbite, proclined and protruded upper incisors, and retroclined and retruded lower incisors. The challenge of this case was the large overjet and skeletal discrepancies in an antero-posterior dimension.

Lateral cephalometric analysis indicated an orthognathic maxilla and retrognathic mandible. The patient's profile improved from a convex to a straight profile in an advanced mandibular position. There are two options for Class II treatment in growing patients as follows: 1) Growth modification by head gear or a functional appliance[16] or 2) Dentoalveolar treatment with three alternatives being upper arch distalization, upper anterior teeth retraction or a combination of upper arch distalization[17] and lower arch mesialization.[18]

The growth modification treatment plan was chosen for this patient with the maturity indicator from a hand and wrist radiograph having ossification of the adductor sesamoid one year before peaking from a pubertal growth spurt. A functional appliance was used to enhance the mandibular growth. The indication of a functional appliance was well aligned dental arches, especially a fixed functional appliance, a posterior positioned mandible, non-severe skeletal discrepancy, lingual tipping of the mandibular incisors, and proper patient selection.[19-21]

In this case, the patient needed treatment at the pre-functional appliance phase by upper arch expansion to correct a narrow upper arch (v-shaped arch form) and by preparing a transverse dimension in the forward position of the mandible. Furthermore, the objectives of the treatment included both skeletal and dental beneficial effects.

Lateral cephalometric radiographs superimposition between initial and post treatment showed downward and forward direction of mandibular growth with upward and backward growth of condyles, and retroclination of the upper incisors that improved the patient's profile and increased the lower facial height. In addition, the deep bite was corrected from posterior teeth extrusion.

The prognosis of the treatment was good according to these following factors:[22] 1) The overjet and overbite improvement after treatment; 2) Arch coordination enhanced the stability of the treatment and decreased relapse; 3) A normal interincisal angle decreased relapse of overbite; 4) Good functional occlusion with a group function occlusal scheme as buccal cusp touching at the working side with no interference at the non-working side; and 5) Good patient compliance with internal motivation for wearing the orthodontic appliance and retainer.

Wraparound retainers were chosen for the retention phase. The wearing time and frequency of using the retainer would gradually decrease until the occlusion is stable and the growth status is complete. The retention phase needed monitoring every 1, 3, and 6 months until no relapse presented, and then an annual follow-up is suggested.

Conclusion

Finally, the treatment outcome presented successful growth modification by a lateral expansion plate and an activator in severe Class II skeletal discrepancies with large overjet and overbite in a Thai boy patient. The mandible dramatically enhanced growth in the forward and downward position. The outcome of the treatment was satisfied: the upper incisors proclination was corrected, there was normal overjet and overbite, there was interdigitation and

a Class I canine and molar occlusion, the lateral profile was changed from a convex profile to be a straight profile, and the retruded chin was improved.

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