

# Early Treatment of Centric Occlusion-Maximum Intercuspation Discrepancy in Skeletal Class III Growing Patient: A Case Report

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## Abstract

An early treatment of anterior crossbite in young patient to eliminate any possible mandibular deviation is crucial. A presence of discrepancy between centric occlusion (CO) and maximum intercuspation (MI) from dental interference, such as anterior crossbite, can cause the mandible to deviate from its centric position. Treatment planning based on the deviated jaw position may lead to an incorrect approach which can later cause temporomandibular problem. A delayed treatment of CO-MI discrepancy can also cause asymmetrical mandibular growth later in life. This case report shows a case of a successful treatment of Class III malocclusion beginning with the detection of CO-MI discrepancy. An 11-year old girl in mixed dentition stage, presented with a protruding chin, seeking orthodontic treatment. Antero-posterior CO-MI discrepancy of 2 mm was detected during clinical examination. Due to an acceptable facial profile in CO, a camouflage treatment was proposed. Non-extraction conventional orthodontic treatment with bidimentinal bracket system was used. After 30 months of active treatment, a normal occlusion with Class I canine and molar relationship was achieved with a favorable facial profile. Upper incisor proclination and lower incisor retroclination were executed to create a normal overjet, while the upper and lower posterior teeth were extruded to promote a clockwise rotation of the mandible. This case report highlights the importance of clinical examination. A thorough evaluation of the patient's function to detect discrepancy between CO and MI is vital in developing an appropriate treatment plan.

**Keywords:** Anterior crossbite, Class III malocclusion, CO-MI discrepancy, Early treatment

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## Introduction

Anterior crossbite is one of the urgent conditions needing early orthodontic treatment in children as it can possibly lead to multiple unwanted sequelae; periodontal problem,<sup>1</sup> proclination of lower incisors,<sup>2</sup> decreased jaw muscle activity,<sup>3</sup> discrepancy of gingival margin,<sup>2</sup> and a forward shift of the mandible promoting unphysiological position to be more class III.<sup>4</sup>

A study reported prevalence of anterior crossbite in Southern Thai children to be 18.98%.<sup>5</sup> The treatment of a Class III malocclusion can vary greatly depending on the diagnosis of the malocclusion and treatment timing; the use of facemask in a growing patient with moderate to severe skeletal discrepancy, dentoalveolar compensation or camouflage treatment, and orthognathic surgery.<sup>6</sup> Distinguishing pseudo-Class III from true skeletal Class III is one of the keys to a successful treatment. In true skeletal Class III, the skeletal components consist of underdeveloped maxilla, overdeveloped mandible, or both. The dentoalveolar components are presented with protruded maxillary incisors and retruded mandibular incisors. At the same time, in pseudo-Class III malocclusion, the patient has decreased midface length and a mandible of a forward position but with normal length.<sup>7</sup> The occlusion is Angle Class I<sup>7</sup> or Class III<sup>8</sup> at habitual occlusion and become more Angle Class II<sup>7</sup> or Class I<sup>8</sup> in centric relation (CR). The upper incisors are retroclined with normal lower incisors.<sup>7</sup> To make the posterior teeth occlude, a forward displacement of the mandible to disengage the incisors is present when premature contact exists.<sup>9</sup> The profile of a pseudo-Class III patient would appear fairly normal at CR and slightly concave at maximum intercuspsation (MI).<sup>8</sup> Early treatment of Class III malocclusion has been supported as to promote a more favorable environment for normal growth and prevent progressive bony or soft tissue change e.g. asymmetrical growth or severe skeletal disharmony.<sup>10</sup>

A discrepancy between centric occlusion (CO) and MI can be initially caused by the neuromusculature position of the mandible to achieve MI regardless

of the condylar position<sup>11, 12</sup> in response to dental interference. The mandible can be deflected either anteroposteriorly or laterally if occlusal interference prevents intercuspsation in CR.<sup>13</sup> Mandibular shift caused by dental interference is one of the reason of the development of facial asymmetries.<sup>14</sup> Diagnosis and treatment given at a deflected mandibular position may lead to an improper treatment plan. The condylar position must be evaluated prior to treatment planning to correctly analyze occlusal and jaw.<sup>15</sup>

This case report describes a patient with a mild skeletal Class III malocclusion with anterior crossbite and antero-posterior CO-MI discrepancy treated with orthodontic camouflage treatment. An acceptable facial profile at CO suggested that a backward rotation of the mandible could improve the facial esthetics. The necessity of detecting CO-MI discrepancy in an accurate treatment planning is discussed.

## Case report

An 11-year-old girl, motivated by her father, seek orthodontic treatment at Orthodontic Clinic of Prince of Songkla University with a chief complaint of a protruding chin with no family history of mandibular prognathism. History of an early loss of maxillary right primary canine was given by her parents. The patient had no known underlying disease or allergy and was not taking any medication. Her menstruation began less than a year ago and her secondary sexual characteristics were beginning to develop. The growth status from cervical vertebral maturation was cervical stage 3 (CS3), indicating a maximum craniofacial growth velocity was to be expected.<sup>16</sup>

Extraoral examination at frontal view revealed a mesofacial type with no obvious asymmetry or chin deviation. Apart from having a normal smile line and a competent lip, lip redundancy was presented due to mandibular overclosure at MI, causing a more protruded position of the lower lip (Figure 1). At lateral

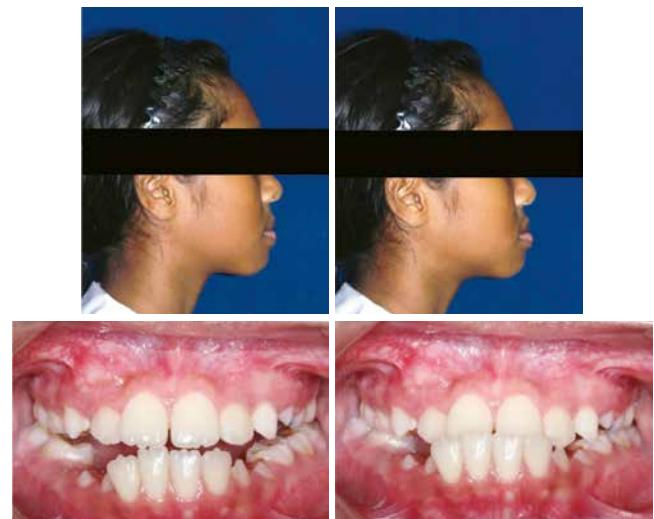


**Figure 1** Pretreatment extraoral and intraoral photographs

view, the patient exhibited a concave facial profile at MI, however, the profile was straight at CO (Figure 2).

Intraoral examination revealed an anterior crossbite with an overjet of 2- mm and overbite of 3 mm According to Angle's classification, canines were unclassified and molars were Angle Class III relationship (2 mm on the right side and 4 mm on the left side). Both upper and lower dental midline deviated from facial midline to the right by 1 mm Moyer's analysis demonstrated moderate crowding of the upper arch and mild crowding of the lower arch (Figure 1 and 3). There was no dental interference or functional shift detected. Bimanual manipulation to locate the CR position of the condyle was carried out.<sup>17</sup> The first contact was found between the maxillary and mandibular right central incisors at CO. Moreover, a -2mm antero-posterior discrepancy between the CO and MI position was observed upon clinical examination (Figure 2).

Panoramic radiograph showed dental development at a late mixed dentition stage with four developing



**Figure 2** Pretreatment facial lateral view and intraoral photographs at CO (left) and MI (right)

third molars. Maxillary sinus, nasal septum, mandibular condyle, and bone density and trabeculation were within normal limit with no other visible pathology. Lateral cephalometric analysis indicated a skeletal Class III hyperdivergent pattern with retrognathic maxilla and orthognathic mandible, proclined and

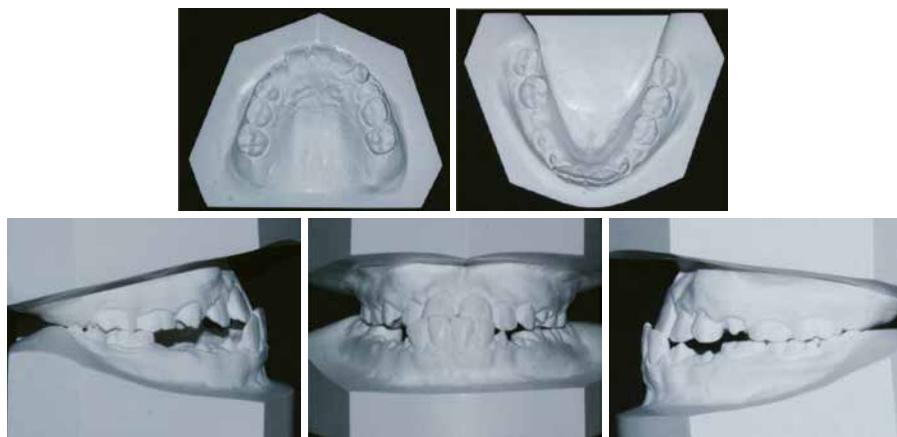


Figure 3 Pretreatment dental casts

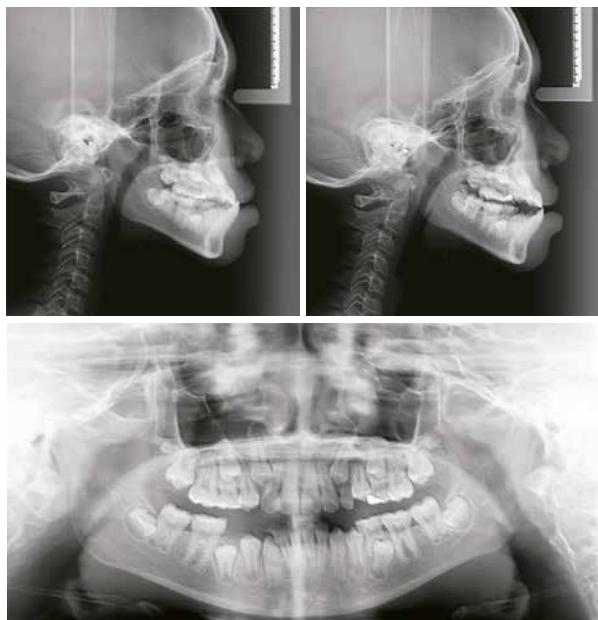


Figure 4 Pretreatment lateral cephalometric at MI (upper left), lateral cephalometric at CO (upper right), and panoramic (lower) radiograph

protruded upper incisors, normally inclined and positioned lower incisors, normal interincisal angle, normally positioned upper lip, protruded lower lips, and acute nasolabial angle (Figure 4). The analysis at CO was also inspected. An improvement in the mandibular position and soft tissue were observed despite the unchanged skeletal and dental diagnosis. The pretreatment cephalometric analysis in MI was used to represent the patient's current condition at the time, which is shown in Table 1.

According to the collected information, the patient was diagnosed as pseudo-Class III malocclusion

with retrognathic maxilla and orthognathic mandible. A conventional non-extraction orthodontic treatment with bidimensional appliance was then proposed with the treatment objectives of creating a normal occlusion and an acceptable facial appearance. CO-MI discrepancy that could potentially cause trauma to the lower incisors and disturb the temporomandibular joint (TMJ) function was to be reduced. The treatment plan included upper incisors proclination and upper arch expansion to gain space for upper right permanent maxillary canine eruption, labial root torque to improve the upper incisors' inclination, and posterior teeth extrusion by the use of Class III elastics to promote mandibular clockwise rotation. In the lower arch, all of the space problems were solved utilizing the Leeway space. Bi-dimensional preadjusted edgewise appliances with slot 0.018-inch on incisors and slot 0.022-inch on canines, premolars, and molars were bonded on all the teeth. Leveling phase was achieved by sequential application of 0.012-inch, 0.014-inch, and 0.016-inch nickel-titanium (NiTi) wires on both upper and lower arches. After leveling phase, 0.016-inch stainless steel (SS) with stop advance was used to protract the maxillary incisors, while 0.016-inch x 0.022-inch titanium molybdenum alloy (TMA) wire intrusion arch bend was used to intrude the mandibular incisors. When the space was adequate for the upper right canine eruption, double wire technique was used with 0.012-inch NiTi to piggy back the upper right canine. Finishing was done with 0.016-inch x 0.016-inch SS

**Table 1** Pretreatment and posttreatment cephalometric analysis

Area		Measurement	Norm Mean±SD	Pre- treatment	Post- treatment	Difference
Skeletal	Maxilla to Cranial base	SNA (degree)	84±4	77	78	+1
		SN-PP (degree)	9±3	6	9	+3
	Mandible to Cranial base	SNB (degree)	81±4	78	77	-1
		SN-MP (degree)	29±6	38	41	+3
		SN-Pg (degree)	82±3	78	77	-1
		NS-Gn (degree)	68±3	69	71	+2
	Maxillo- Mandibular	ANB (degree)	3±2	-1	1	+2
		Wits (mm)	-3±2	-5	-5	0
		MP-PP (degree)	21±5	32	32	0
		FMA (degree)	23±5	32	31	-1
Dental	Maxillary dentition	UI-NA (degree)	22±6	30	34	+4
		UI-NA (mm)	5±2	8	11	+3
		UI-SN (degree)	108±6	106	112	+6
	Mandibular dentition	LI-NB (degree)	30±6	30	31.5	+1.5
		LI-NB (mm)	7±2	9	8	-1
		LI-MP (degree)	99±5	94	93	-1
	Maxillo- Mandibular	UI-LI (degree)	125±8	122	114	-8
Soft tissue	Soft tissue	E line-UL (mm)	-1±2	-0.5	0.5	+1
		E line-LL (mm)	2±2	5.5	4	-1.5
		NLA (degree)	91±8	84	75	-9
		H-angle (degree)	14±4	14	17	+3

\*PP=palatal plane, MP= mandibular plane, FMA= Frankfort mandibular plane angle, UI= upper incisor, LI= lower incisor, UL= upper lip, LL= lower lip, NLA= Naso-labial angle, H= Holdaway

wire, with torque, artistic bend, and c-chain to close the remaining space. The treatment was completed within 30 months, the appliances were removed, and full-time-wear wraparound retainers for both arches were prescribed.

Figure 5 showed posttreatment extraoral and intraoral photographs. A satisfactory facial appearance with normal upper and lower lip position was obtained. Normal occlusion were achieved since upper and lower teeth crowding was corrected and dental midline was centered. Normal overjet, overbite, and Class I canine and molar relationship were also achieved (Figure 5 and 6). Posttreatment radiographs are shown in figure

7 and posttreatment cephalometric analysis are shown in Table 1.

Pretreatment and posttreatment cephalometric tracings were superimposed to analyzed the change after treatment (Figure 8). Cranial base superimposition demonstrated a forward and downward movement of the maxilla, forward and downward movement of the mandible, and a slightly clockwise rotation of the mandible. Maxillary superimposition showed that the upper incisors were proclined, protruded and extruded, while the upper molars were extruded and slightly mesialized. Mandibular superimposition showed that the lower



Figure 5 Posttreatment extraoral and intraoral photographs



Figure 6 Posttreatment dental casts

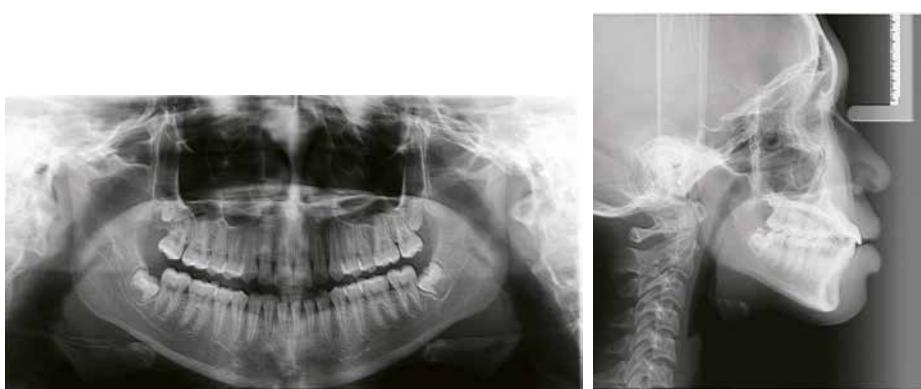
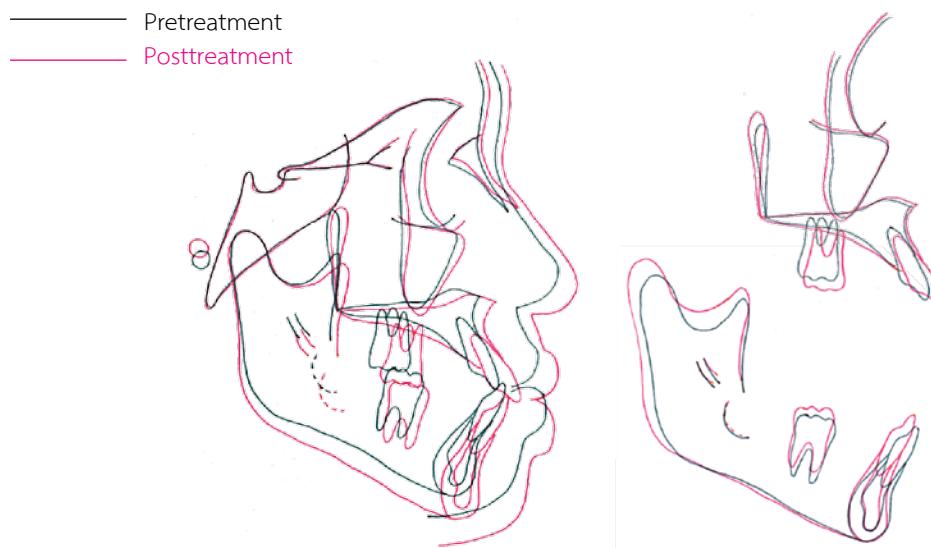


Figure 7 Posttreatment panoramic (left)  
and lateral cephalometric (right) radiograph



**Figure 8** Cephalometric superimposition of pretreatment and posttreatment tracings

incisors were retroclined and extruded and the lower molars were extruded and slightly distalized. Upward and backward growth of the mandibular condyle and ramus were also observed. At the same time, soft tissue profile was less concave having the lower anterior facial height increased. The upper and lower lips were more protruded and nasolabial angle was decreased.

## Discussion

It is well-known that CR is an ideal jaw position employed by orthodontist, defined as a musculoskeletally stable position when the condyle is most forward and upward, centering with the articular disc.<sup>18</sup> Although CR is repeatable, it is anatomically defined. Locating CR clinically might be inaccurate as we cannot see if the TMJ is actually in the position termed. The Glossary of Prosthodontic Terms defined CO as “the occlusion of opposing teeth when the mandible is in centric relation; this may or may not coincide with the maximal intercuspal position”.<sup>19</sup> According to the definition, an occlusion in CO is believed to be when the mandible is in CR. CO is easier to locate clinically since it is a dental determined position. Studies reported that the condylar position is highly related to the dental contacts and intercuspatation

because the condyles and the teeth are connected with each other through muscles and ligaments.<sup>15, 20</sup> Nevertheless, CR and CO usually do not necessarily coincide in natural dentition.<sup>15, 20-22</sup> Costea et al. found that only 2.5% of patients came seeking orthodontic treatment had CO-CR coincidence in the horizontal and vertical plane and 12.5% in the transversal plane.<sup>22</sup> Furthermore, Crawford reported a strong correlation between the occlusal-dictated condylar position and symptoms of temporomandibular disorders (TMD), suggesting a condylar displacement of more than 1 mm horizontally or vertically or 0.5 mm transversely may have an unwanted effect on the patient.<sup>23</sup> Other literatures indicated a clinically significant discrepancy of 2 mm in the vertical and horizontal plane and 0.5 mm of the transversal plane.<sup>20, 24</sup> It is suggested that the condylar position must be evaluated prior to treatment planning for the analysis of occlusal and jaw relationship to provide a proper treatment plan.<sup>15</sup>

In this case report, the patient denied having family history of mandibular prognathism, so an early loss of maxillary right primary canine might have contributed to the development of anterior crossbite, causing the dentition in the first quadrant to collapse into the space. Loss of upper incisors

together with the perioral pressure could have led to maxillary arch constriction. With anterior crossbite, the mandible needed to protrude to be able to occlude at a more stable and comfortable position<sup>9</sup>, deviated anteroposteriorly to avoid interference, expressing as overclosure of the mandible at a more protruded position<sup>8</sup>, leading to a more concave facial profile. Protrusion of the chin was exacerbated by overclosure of the mandible that could have been caused by the adaptation to the anterior crossbite. Despite the patient's main complaint of a protruding chin, she had only mild skeletal discrepancy. The patient was diagnosed as pseudo-Class III malocclusion. Although the upper incisors expressed some degrees of dental compensation, a premature contact was detected during bimanual manipulation into CO, a straight facial profile, and Angle Class I relationship at CO<sup>8</sup>. These characteristics are qualities of pseudo-Class III malocclusion. Regarding the treatment mechanics, the patient was still growing which made it possible to include the treatment plan of upper incisors proclination and upper arch expansion, and labial root torque and posterior teeth extrusion to promote mandibular rotation. Posttreatment cephalometric analysis also revealed a clockwise mandibular rotation according to SN-MP angle, however, the FMA exhibited otherwise because of an upward and backward remodeling of Porion. Removing the CO-MI discrepancy was one of the treatment goal for long-term stability. The facial profile was acceptable at CO and planned tooth movement was within the Envelope of Discrepancy.<sup>6</sup> Even though the upper arch was presented with moderate crowding, the supporting alveolar bone was adequate for upper incisor proclination to solve the crowding. Eslami et al. reported that Holdaway H angle and Wits appraisal can be used to indicate treatment plan for borderline Class III cases, recommending that cases with Holdaway H angle of more than 10.3° and Wits appraisal of greater than -5.8 mm could be corrected successfully by orthodontic camouflage.<sup>25</sup> In this case, the Holdaway H angle was 14° and the Wits appraisal was -5 mm,

which suggest a camouflage treatment. Therefore, a camouflage treatment was a suitable choice of treatment for this patient. It is important to correct the anterior crossbite early rather than later as the patient was at her peak growth. The mandible would have grown even further from its currently protruding position, contributing to an even more concave facial profile.<sup>10</sup>

## Conclusion

Careful evaluation of the condylar position to detect a CO-MI discrepancy during clinical examination is essential in the analysis of occlusal and jaw relationship and should not be overlooked in order to provide a proper treatment plan prior to orthodontic treatment. This case report confirms the necessity and usefulness of early correction of anterior crossbite with anterio-posterior CO-MI discrepancy.

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