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Case report

Treatment of skeletal Class II with retrognathic mandible in growing patient using modified sagittal guidance twin-block appliance

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ABSTRACT

Background: *Class II discrepancies were primarily perceived as sagittal problems. Class II malocclusions usually cause aesthetic and functional problems, depending on the degree of anterior-posterior mismatch and interaction with adjacent soft tissues.* ***Purpose:*** *This case report aimed to evaluate the effect of modified sagittal guidance twin-block (SGTB) for Class II Skeletal and Dental Changes in a growing patient.* ***Case:*** *A 10-year-old patient presented with her parents and complained mainly of aesthetic problems. Diagnosis showed skeletal Class II pattern (ANB 6º) with retrognathic mandible, angle Class II molar relationship, convex facial profile, lower dental midline shift, crowding in the lower anterior teeth, and incompetent lips.* ***Case Management:*** *A growth modification treatment plan was considered for the patient, using modified SGTB. Both bonded and removable had the same design. In the SGTB, the bite block was angled at 70º, pushed toward the occlusal plane to maximize horizontal force toward the mandible. As a result, the mandible is guided forward and optimally positioned during occlusion.* ***Conclusion:*** *An ideal overjet and slight correction on lower anterior crowding teeth were achieved after full-time wear of a modified SGTB for 12 months. A modified SGTB appliance is effective in treating skeletal Class II with a retrognathic mandible.*

Keywords: *growing patient, malocclusion, modified SGTB appliance, retrognathic mandible, skeletal Class II*
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INTRODUCTION

Class II malocclusion is one of the orthodontic problems that requires early intervention. They usually cause aesthetic and functional problems of varying severity, depending on the degree of anterior-posterior mismatch and interaction with adjacent soft tissues. Class II malocclusions do not self-repair and may worsen with age in some cases.[1] Many different types of Class II malocclusions include changes in skeletal, dental, and soft tissue morphology.[2]

Class II discrepancies were recognized as predominantly sagittal problems, and they were classified into four groups based on various anterior-posterior criteria: position of maxillary skeleton, position of maxillary skeleton, position of mandibular skeleton, position of mandibular alveolar bone. Treatment planning should also consider the longitudinal and lateral dimensions of each patient.[1]

A diagnostic examination is necessary to accurately identify the etiology and affected anatomy and to develop an appropriate treatment plan to correct Class II malocclusions.[1] There are different treatment options, such as growth correction, camouflage processing, double jaw surgery, and combinations of the above.[1,3]

Functional assessment is performed during clinical examination, especially in growing patients. Excessive mentalis muscle function can lead to progressive deformation of the dentition.[2] Functional appliances have been used by orthodontists for more than 100 years. The primary purpose of functional devices is the treatment of Class II/1 malocclusions in adolescents. Capable of mitigating overjet and overbite and achieving Class I relationships, then finished with fixed appliances.[4]

In this case report, we used a modified sagittal guidance twin-block (SGTB) appliance for a 10-year-old

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girl with skeletal Class II malocclusion. This modified SGTB consisted of removable maxillary and mandible components. The maxillary component was made removable at first, which could be bonded later if the patient was not cooperative. It turned out that she was cooperative, so we did not bond the maxillary component. We used expansion screws in the mandible component to gain space for the crowding anterior teeth. Both maxillary and mandibular components used Adams clasps and labial bow as retention parts. The angulation of the interface between the upper and lower occlusal planes was 70º.

The purpose of the inclined planes on occlusal bite blocks is to correct Class II skeletal malocclusions with the mandibular protrusion function. The inclined plane guides the mandible downward and forward.[5] The upper and lower bite blocks work together at a 70º angle and are designed for long-term wear, allowing full utilization of all functional forces, including mastication forces.[5,6] The following case report demonstrates the effect of a modified SGTB appliance on skeletal and dental changes in patients of growing age.

CASE

A 10-year-old female patient with a convex facial profile sought orthodontic treatment in the Orthodontic Clinic at the Faculty of Dentistry, University of Sumatera Utara, with her parents. The patient was healthy and exhibited a protrusive mouth. The main complaint was proclined maxillary upper front teeth with crowding of the mandibular front teeth. From the frontal view, the patient showed a normal and symmetrical face; however, the centerline of the mandibular teeth was shifted to the right and had incompetent lips at rest (Figure 1). Lifting the upper lip evenly to expose the upper front teeth (full smile), the incisisal margin of the maxillary central incisors appears on the lip line in the rest position (frontal).

Pre-treatment intraoral examination and model analysis presented an angle Class II molar relationship bilaterally, where the molar relation indicated that the mesiobuccal groove of the mandibular first molar is located distally (posteriorly) when occlusion on occlusal with the mesiobuccal cusp of the maxillary first molar. The relationship of occlusion between the Class I canine on the right and the Class I canine on the left. The overjet of 11/41 was 6 mm and the 21/31 was 7 mm, while the overbite of 11/41 was 3 mm and the 21/31 was 6 mm. The mandible incisors were impinging on palatal tissue on closure and shifted the center line to the right by 1 mm. (Figure 1. and 2.)

Functional assessment found that the patient's oral hygiene was good and there was no gingivitis or periodontitis. She had normal labial frenulum, lingual frenulum, buccal frenulum, tongue, tonsils, and high palate, upper lip hypertonic, and no bad habit. The path of closure was normal and there was no displacement of the mandible. TMJ evaluation was normal.

Lateral cephalometric analysis showed a Class II skeletal pattern with retrognathic mandible (SNA 80º; SNB 74º; ANB 6º; Wits appraisal 7.5mm), high mandibular plane angle (MP-SN 45º), and vertical growth pattern (NSGn 72º).

Figure 1. Pre-treatment intraoral and extraoral photographs.

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The inclinations of both maxillary and mandible incisors were found normal (U1-SN 104º; L1-MP 89º). The upper and lower lips protruded beyond the E line (E-LS + 5mm; E-LI + 7.5mm). A panoramic radiograph showed that the mandible second premolars were about to erupt and the four third molars were developing. Regarding growth status, based on the Hassel and Farman analysis, the patient was in the second stage of the lower margin, where C2 is jagged or serrated, with a depression of the lower margin becoming more pronounced as it matures and indicated that only 65–85% of growth could be expected during the following year of treatment (Figure 3A).

Tweed analysis showed a vertical growth of mandible (FMA 39º) and lower incisors proclined (FMIA 52º; IMPA 89º). Based on these clinical and radiographic findings, the patient had a Class II jaw relationship with retrognathic mandible and a Class II Division 1 malocclusion angle, high mandibular plane angle, and vertical growth.

CASE MANAGEMENT

The treatment objectives for the patient included the correction of jaw relationship, the achievement of optimal overjet and overbite, the expansion to treat arch discrepancy, the alignment to treat crowding, the correction of lower midline, and the reduction of the convex profile. A growth modification treatment plan was considered for this patient using SGTB (Figure 4). The non-modified SGTB was the same as the SGTB appliance, while the modified SGTB used in this study was a fixed maxillary component with a removable mandible component to eliminate possible side effects (proclination and periodontal risks). Our upper SGTB design (Figure 4) can be either fixed or removable. Both bonded and removable had the same design. In SGTB, the occlusal angle was set to 70°, as the occlusal plane maximizes the horizontal force directed toward the mandible. As a result, the mandible is guided forward

Figure 2. Pre-treatment intraoral photographs.

Figure 3. Pre-treatment A. Lateral cephalometry. Red circle on lateral cephalometric radiograph showed cervical vertebral maturation stage II; B. panoramic radiograph.

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Figure 4. Sagittal guidance twin-block (SGTB).

Figure 5. Post-treatment intraoral and extraoral photograph.

Figure 6. Post-treatment study cast.

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and is optimally positioned during occlusion. The parents chose the removable type of modified SGTB and were willing to cooperate during the treatment. The appliance would be bonded if the patient did not cooperate during the treatment time.

Obvious improvements were seen after 12 months of treatment. The overjet was reduced (11/41 2.5 mm, 21/31 3 mm), the impinging overbite was also reduced (overbite 11/41 2.5 mm and 21/31 3.5 mm), lower anterior teeth were more aligned, Class I molar relationships were achieved on both sides, but the interdigitation was not occluded yet (Figure 5 and Figure 6).

Changes of molar relationship from Class II to Class I were achieved by changing the occlusal inclination plane by utilizing the occlusal pressure and 70º occlusal inclination on the mandible so that the mandible could be advanced anteriorly by the occlusal inclination plane. Cephalometric superimpose analysis post-treatment (Figure 7 and Table 1) showed reduction in skeletal antero-posterior position after functional treatment. ANB decreased by 2.5º from 6º to 3.5º and the Wits appraisal decreased from 7.5 mm to 0 mm. The mandible was positioned forward, which was shown by the SNB value from 74º to 76.5º. The upper and lower lip were improved but still in front of the aesthetic line (E-LS + 2 mm, E-LI + 6.5 mm). The mandibular plane angle increased by 1º from 45º to 46º. The nasolabial angle was corrected from 85º, becoming 90º.

The appliance was recommended to be used for 24 hours per day for the first 7–10 days after the insertion, allowing the patient to get used to it completely. The patient was also encouraged to have regular dental check-ups every two weeks. This also contributed to the mandibular changes. The treatment will be continued with fixed orthodontics to further correct the interdigitation.

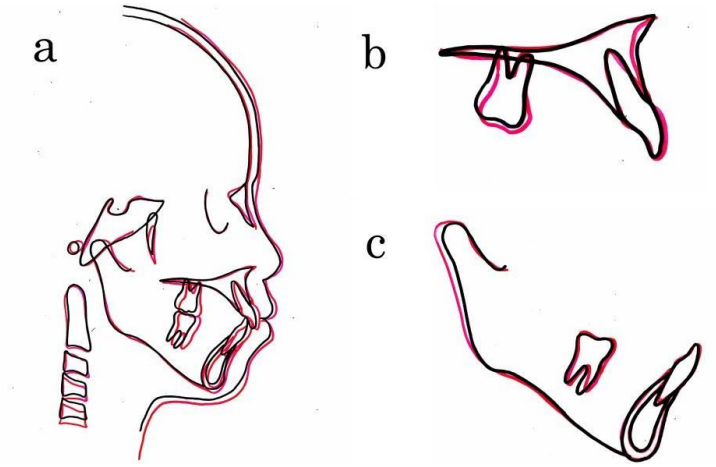

Figure 7. Superimposition of the patient's lateral cephalometric photos before (red) and after (black). (a) in the SN plane, (b) the palatal vault, and (c) the lingual portion of the mandibular symphysis.

Table 1. Skeletal, dental and soft tissue changes shown by cephalometric measurements

Measurement	Norm (mean±SD)	Pre-	Post-	Difference
Skeletal				
SNAº	82 ± 2	80º	80º	0
SNBº	80 ± 2	74º	76.5º	+ 2.5
ANBº	2 ± 2	6º	3.5º	- 2.5
NAPogº	0 (-8-10)	13º	10º	- 3
MP: SNº	33 ± 5	45º	46º	+ 1
NSGnº	65 ± 3	72º	72º	0
Pog: NB mm	2 ± 1	0 mm	2.5 mm	+ 1.5
SGo:NMe %	68 ± 4	(60/109)x100%=55.04%	(63/115)x100%=55.75%	+ 0.71
Dental				
1: ī º	131 (130–150)	121º	117º	- 4
1: SNº	102 ± 2	104º	103º	- 1
ī: MPº	90 ± 2	89º	93º	+ 4
1: APog mm	2,7 (- 1–5)	11 mm	11 mm	- 2
ī: NB mm	4 ± 2	8 mm	8 mm	0
Soft Tissue				
E-LS (mm)	+1 ± 1.9	+ 5 mm	+ 2 mm	- 1.5
E-LI (mm)	0 ± 3	+ 7.5 mm	+ 6.5 mm	- 1
Witts Appraisal AO-BO (mm)	0 ± 2	7.5 mm	0 mm	- 6
Tweed				
FMA	22º–28º	39º	39º	0
FMIA	68º	52º	48º	- 4
IMPA	87º	89º	93º	+ 4

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DISCUSSION

Class II skeletal malocclusions can result from the prognathic and normal mandible, the retrognathic mandible and normal maxilla, or a combination of both.[2] The retrognathic mandible was the most common characteristic of Class II.[7] In this case, the patient had a skeletal Class II malocclusion with retrognathic mandible, and we used the most common functional appliance, which was the twin-block (TB), to correct the jaw relationship. TB is one of the functional appliances that has a simple design, is efficient, and cheaper than the clear aligner.[8,9] For two decades, TB has been one of the most popular appliances for treating cases in the growing phase with satisfactory results. It allows regular functional activities, such as mastication, so it can be worn continuously, resulting in faster patient outcomes compared to other functional appliances. Despite the excellent therapeutic results of TB, their bulky nature may compromise their acceptance and adherence. In addition, there is an inherent limitation when the tilting of the mandibular incisors occurs, reducing the likelihood of complete skeletal alteration. The patient required correction of both dental and skeletal misalignment. Significant changes were observed within 2–3 months after using TB. It was likely caused by changes in muscle balance due to the continuous wear of the device. The TB appliance consists of two acrylic bite blocks that are inclined at an 70° angle to each other. The action mechanism of the TB is based on the functional displacement of the mandible to the proper position to correct the maxillary discrepancy. The two-piece design of the TB allows patients to use the device 24/7 to improve orofacial function by inducing both dental and skeletal changes. When using functional appliances, it is recommended to slightly overcorrect the buccal segments (molars and canines) to the superclass I position and allow for slight relapses. Southern clamps, acrylic labial arches, ball clamps, and acrylic copings were used to limit anteversion of the lower incisors after use of a TB.

TB is one of the functional appliances used to move the lower jaw forward so that it lines up better with the upper jaw. By stimulating the growth of the condylar cartilage and limiting the growth of the maxilla, the mandible can be lengthened. Moving the mandibular condyle away from the fossa glenoid, it relieves pressure on the actively growing condylar cartilage.[10] Changes in muscle tension in the condyles promotes endochondral growth. The block functions help to position the lower jaw forward. Over time, the lower jaw will remain in this position permanently. TB is based on the physiology of the occlusal inclined plane and the everyday masticatory forces. The purpose of the inclined plane is to change the growth pattern of the mandible in a more favorable direction.[11,12,13]

The SGTB appliance has recently been used in China as a modified TB. As an advanced appliance, the SGTB had the same indication as the traditional TB appliance but was redesigned: in the SGTB appliance, the maxillary component was connected to the maxillary posterior teeth to eliminate the possible side effects (proclination and periodontal risks). It can be used by patients who are less cooperative in using the TB appliance. The maxillary component, which is glued to the maxilla, has an occlusal surface that covers the buccal dentition on both sides and often has a palatal built-in screw extension.[14] The mandibular part is removable for retention via Adams clasps on the first premolar and first molar and a ball clasp between the mandibular incisors, with occlusal surfaces covering only the premolar area on both sides, posteriorly, combined with a stretchable lingual acrylic pad. The angle of the interface between the upper and lower occlusal surfaces is 70°.[15] The bite angle is set to 70° by the SGTB. We chose this angle for the maxillary-mandibular interface for several reasons. We tried to create a space between the small incisors so that the patient could close her lips naturally. A low occlusal lock angle causes the maxillary and mandibular interfaces to move further apart when the patient is in the resting position, and if the angle is large, the lock will affect the normal rotation of the mandible. The main mechanisms included the distalization of the posterior maxilla, lingual inclination of the upper incisors, and slight labial inclination of the lower incisors.

For the Clark Classic TB and other orthopedic instruments used in angle Class II for adolescents, the following functional maintenance is required: an anterior inclined plane. With our SGTB, the device is used at the end of mixed dentition and early stages of permanent dentition, when a patient's growth potential is between 60% and 80% according to vertebral evaluation.[16]

Growth frequency is often an important factor in the treatment plan selection and supports treatment success. Several therapies, such as functional appliances, rely on this growth as part of orthopedic treatment to stably correct skeletal inconsistencies.[2] Mandibular growth increases or decreases with changes in posture. Functional appliances reposition the mandible by altering the functional environment. Abnormalities in muscle function, changes in occlusion, interdigitation, and other factors can affect mandibular size and shape in class II adolescents.[10]

An assessment was made at each visit to assess the progress of antero-posterior and reduction in overjet and overbite. By the end of the active phase, the distal occlusion was corrected to a Class I relation, where the maxilla and mandible were in an ideal relationship of normal overjet and overbite. The duration of the active phase, in which the correction of distal occlusion of overjet and overbite was achieved, was approximately 12 months. Class II division treatment with the modified SGTB appliance had both skeletal and dental effects. Skeletal changes were evident as facial contours improved. The repositioning of the retrognathic mandible can be assessed by increasing the antero-posterior angle (SNB value) between the mandible and skull base. The increased vertical dimension at eruption of the mandibular molars increased the lower part of the facial anterior height.

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There are two treatment strategies in treating Class II malocclusion. The first is during pre-adolescent years (ages 8–11) and the second is during adolescent years (ages 12–15). Some authors have suggested that the orthopedic Class II correction in the pre-adolescent period is more effective because the tissues of the craniofacial complex may be more adaptive at a younger age and pre-adolescent patients may be more compliant than teenagers.[10] So, based on this hypothesis, we decided to start an early orthodontic treatment, while the patient was still in her pre-adolescent years to obtain more orthopedic than dentoalveolar corrections. We stimulated the mandibular growth by using a functional appliance.[16]

Growth modification is a successful approach for children with a retrognathic mandible problem. A successful treatment depends on the patient's cooperation. Although this modified functional appliance corrected the overjet and the Wits appraisal significantly, it could not correct the interdigitation, so we will continue with a fixed appliance treatment for detailing the occlusion.[17]

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