Indonesian Journal of Denstistry 2009; 16(3): 199 - 209
http://www.fkg.ui.edu

ISSN 1693-9697

Treatment of Class II Division 1 Malocclusion Using Cervical Headgear (Case Report)

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ABSTRACT

Class II division 1 malocclusions have many variation and treatment options. Choosing the right treatment begins with a correct diagnosis. The aim of this article is to describe treatment of Class II division 1 malocclusion in a growing patient using combined cervical headgear and non-extraction fixed orthodontic therapy. Class I molar and canine relationship was achieved with normal overbite and overjet. There is improvement in jaw relationship and facial profile. This correction was achieved by downward displacement and inhibition of the forward growth of maxilla with favorable growth of mandible, upper molar distalization and retraction of upper incisors from cervical headgear use. There was neither downward rotation of the mandible nor maxillary first molar extrusion. Treatment time, favorable mandibular growth pattern and patient compliance proved to be determining factors in the success of this treatment.

Keywords: Class II division 1 malocclusion, cervical headgear, growth.

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INTRODUCTION

Class II division 1 malocclusion is frequently encountered in orthodontic clinic. Previous studies reported the prevalence reaching 20% in different populations and ethnicities.[1] Typical characteristics are convex facial profile, sometimes accompanied with lip incompetence or lower lip trap, class II molar and canine relationship, excess overjet with proclined upper incisors, narrow maxillary arch, and open bite or deep bite.[1,2]

Ideal treatment alternative for class II division 1 malocclusion in a growing patient is growth modification using jaw orthopedic appliances to hold maxillary growth and maximizing mandibular growth in accordance with the genetic potential. This can be done either with orthopedic extra oral traction or intra oral functional appliances. Extra oral traction is more effective in holding maxillary growth whereas functional appliances is more effective in maximizing mandibular growth potential.[1-3]

This case report describes treatment of class II division 1 malocclusion in a 9 years 4 months old female with cervical headgear and fixed orthodontic appliance.

CASE REPORT

A female Indonesian patient presented at 9 years and 4 months of age. She complained that her upper front teeth is too forward. Extra oral examination (Fig.1) demonstrated a typical class II division 1 face, which are convex profile with lip incompetence and an acute nasolabial angle. Facial symmetry and facial proportions were good, upper left dental midline coincided with facial midline.

Fig. 1. Pre-treatment extra-oral photographs

Intra oral examination also showed class II division 1 characteristics which are molar and canine class II cusp to cusp relationship, severely proclined upper incisiors with excessive overjet and palatal bite. There was also a mesiodens located palatal to the upper right incisor causing central diastem on the upper arch, moderate crowding on the upper arch and mild crowding on the lower arch (Fig.2). Lower midline coincided with facial midline and upper left incisor.

There were no signs or symptoms of TMD. Tongue thrusting was found during speaking and swallowing.

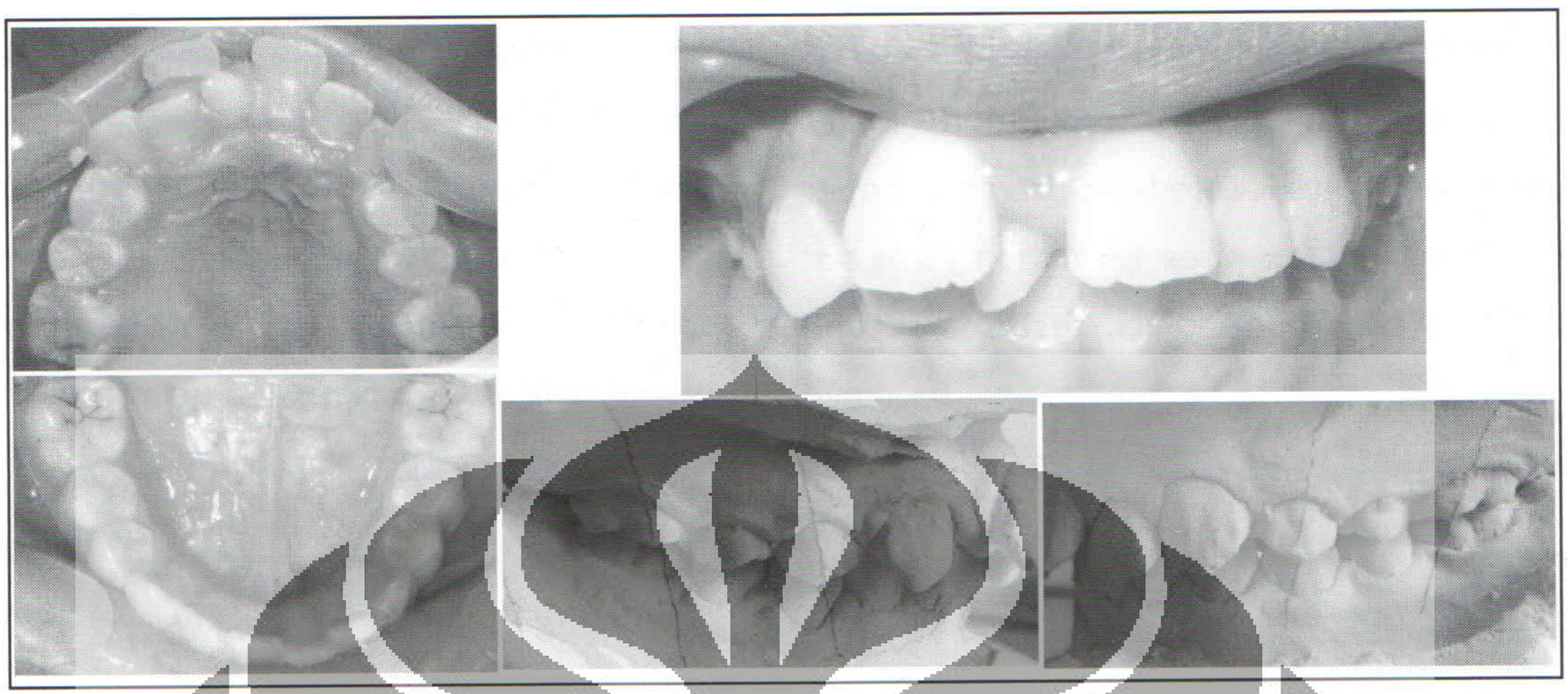

Fig. 2. Pre-treatment intra-oral photographs.

Cephalometric analysis confirmed the class II division 1 diagnosis. There was a retrognathic relationship with a protruded maxilla and normal mandible, convex skeletal profile and protrusive upper incisors. Upper and lower lips are located anterior to the E-line (Fig. 3, Table 1).

Fig. 3. Pre-treatment cephalometric radiograph and tracing.

Table 1. Pre-treatment cephalometric analysis.

Measurement	Mean ± SD	Pre-treatment
SNA	82° ± 2°	88°
SNB	80° ± 2°	80°
ANB	2° ± 2°	8°
Facial angle	87° ± 3°	87°
Angle of Convexity	0°	14°
Y-axis	60° ± 5°	66°
Go Angle	123°	129°
SN-MP	32°	34°
T -1	130°	112°
1-SN	104°	127°
1-NA	4 mm	8 mm
1-Apg	4 mm	13 mm
T-Apg	2 mm	2 mm
T-MP	90°	95°
T-NB	4 mm	8 mm
P-NB	4 mm	1 mm
Bbr atas – E line	1 mm	5 mm
Bbr bwh – E line	0 mm	3 mm
Pjg Mand.(Co-Gn)	103 ± 5 mm	107mm
S-Go : N-Me	62 – 65%	64.6%
A – N ⊥ FHP	0 mm	4 mm
Pg – N ⊥ FHP	-4 – 0mm	-4 mm

Panoramic radiograph showed all third molars are present but have not erupted, upper second molars are located two thirds of upper first molar's crown, apex formation have not completed on all premolars, first and second molars and there is a mesiodens between upper central incisors (Fig.4).

Fig. 4. Pre-treatment panoramic radiograph

Carpal radiograph showed presence of sesamoid bone which indicates that patient's growth has reached SMI 4 (Fig.5) and compared to patient's chronological age, the patient is an advanced maturer.

Fig. 5. Carpal radiograph.

Bolton analysis showed 2 mm excess tooth material on the upper arch. Kesling analysis with 8 mm retraction of upper arch and lower arch maintained to achieve 2 mm overjet showed that 4 mm of space is needed on the left and right upper arch segment.

Treatment Objectives :

1. Improve jaw relationship and reduce facial convexity with jaw growth modification
2. Establish class I molar and canine relationship and ideal overjet and overbite with distalization of upper posterior and retraction of upper anterior teeth
3. Correction of central diastem with extraction of the mesiodens.

Treatment Plan :

1. Cervical headgear to modify jaw growth and to distalize upper molars until class I molar relationship is achieved and pre-adjusted edgewise appliance (0.022 x 0.028 inch slot) with MBT prescription on lower arch to level & align the lower teeth.
2. Pre-adjusted edgewise appliance (0.022 x 0.028 inch slot) with MBT prescription on upper arch for leveling and aligning continued with canine and premolar distalization to achieve class I relationship. Headgear still used as maximum anchorage.
3. Retraction of upper incisors.
4. Finishing, interdigitation and arch coordination.
5. Retention using Hawley retainer.

Treatment Progress

Mesiodens was extracted before orthodontic treatment. Treatment began on February 2008. On this initial appointment, cervical headgear was placed with 500gram/side force and brackets were placed on lower arch with 0.014 NiTi" initial wire. The patient was instructed to wear the headgear for a minimum 14 hours/day and was given a diary to keep track of her headgear use (Fig.6).

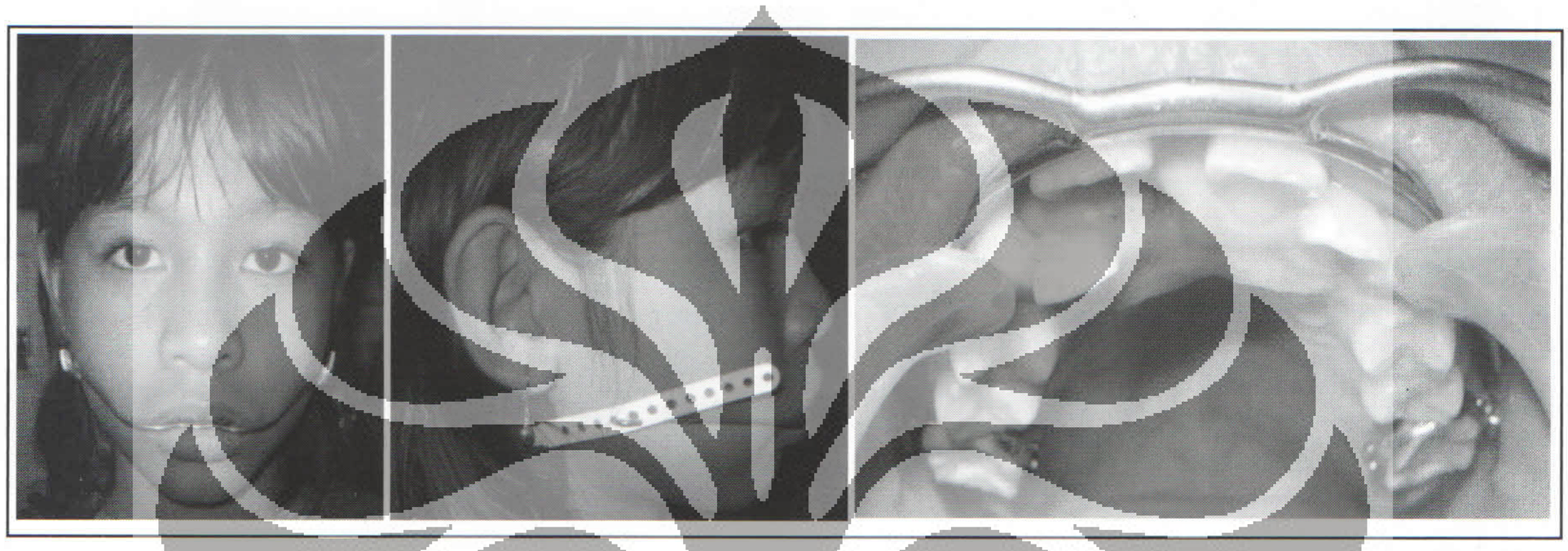

Fig. 6. Cervical headgear placement on initial appointment

The patient was highly motivated to comply with headgear therapy with 17 hours/day average headgear use. After two months, class I molar relationship was achieved. Upper brackets were placed except on the lateral incisors with 0.014" NiTi initial wire.

One month later, 0.016x0.016" SS archwire was placed on upper arch and midline correction and distalization of canines were begun. Patient was instructed to use class II elastics (3/16", 3.5oz).

Three weeks later, the upper lateral brackets were bonded and releveling & aligning was done using overlay technique with 0.014"NiTi archwire on 0.016x0.022" SS main archwire. Patient was instructed to use *Cervical headgear* on nights only and to continue to wear the class II elastics to correct the overjet.

Seven months after headgear use, cephalometric and panoramic photographs were taken to evaluate treatment progress and root paralleling. Afterwards, finishing and artistic positioning were done to parallel the roots and achieve good interdigitation.

Achieved Results

Seventeen months after intial appointment, positive facial changes were achieved, there was an increase on the nasolabial angle and the lips were competent on relax position. Intraorally, class I molar and canine relationship were achieved with 2 mm overbite and 3 mm overjet (Figs.7 & 8). Patient was scheduled for debonding.

Fig. 7. Post-treatment extra-oral photographs.

Fig. 8. Post-treatment intra-oral photographs.

Cephalometric photograph taken 7 months after intial appointment (Fig.9 and Table 2) showed positive changes on SNA angle, inclination and position of upper incisors and also skeletal profile. Vertical dimensions were maintained.

Fig. 9. Cephalometric radiographs taken 7 months into treatment (020908).

Table 2. Cephalometric summary.

Measurement	Mean ± SD	Pre-treatment	7 months after treatment
SNA	82° ± 2°	88°	85°
SNB	80° ± 2°	80°	80°
ANB	2° ± 2°	8°	5°
Facial angle	87° ± 3°	87°	87°
Angle of Convexity	0°	14°	10°
Y-axis	60° ± 5°	66°	66°
Go Angle	123°	129°	129°
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T-MP	90°	95°	95°
T-NB	4 mm	8 mm	8 mm
P-NB	4 mm	1 mm	1 mm
Bbr atas – E line	1 mm	5 mm	3 mm
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S-Go : N-Me	62 – 65%	64.6%	66%
A – N ⊥ FHP	0 mm	4 mm	4 mm
Pg – N ⊥ FHP	-4 – 0mm	-4 mm	-1 mm

Cephalometric superimpositions of 7 months after treatment and pre-treatment were done to evaluate treatment progress. Superimposition on cranial base (SN) showed that maxillary growth was redirected more downward whilst the anterior position of maxilla was maintained (Fig.10A). B point moved forward and downward 2 mm and the A and ANS point was maintained. The soft tissue profile also showed positive changes on the relative positions of the forehead, tip of the nose, lips and chin, where the lower lip moved forward 7 mm and the chin became more prominent thus reducing convexity of the profile. Superimposition on the maxilla showed upper molars moved distally 2 mm with distal crown tipping movement and extruded 2 mm and upper incisors retracted (Figs.10B). Superimposition on the mandible showed no obvious tooth movement however there was 1 mm backward and upward growth of the ramus thus bringing the mandible forward and downward. The combination of these skeletal and dental changes contributed to the correction of class II division 1 malocclusion and improving patient's facial profile.

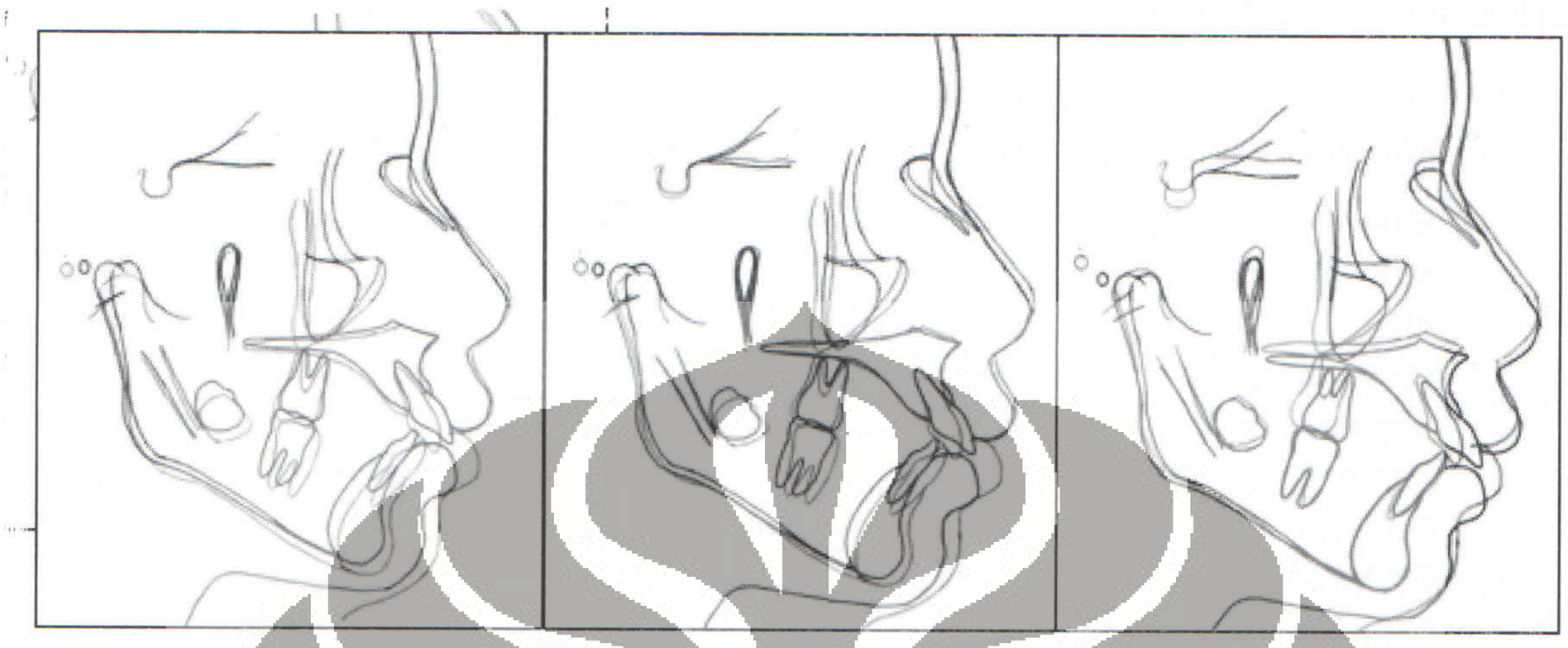

Fig. 10. Cephalometric tracing superimpositions; **A.** On cranial base(SN), **B.** On maxilla, **C.** On Mandible Pre-treatment (220108); Seven months into treatment (020908)

DISCUSSION

Malocclusion developed through interaction of inherent genetic hereditary potential and circum oral environment such as bad habits. It is important to identify the etiologic factor in diagnosis of malocclusion. From clinical observation, patient had an anterior tongue thrust during speaking and swallowing. Anterior tongue thrusting is common habit but not all tongue thruster exhibits dentoalveolar manifestations. It depends on the frequency, duration and force magnitude of the tongue thrusting habit.[3] Common clinical manifestations such as open bite anterior, narrow maxillary arch, increased vertical dimension, and sometimes multiple spacing were not found on this patient. This means that tongue thrusting habit is not a significant etiologic factor in this case.

Protrusion of upper incisors, excessive overjet and lip incompetence can be perdisposing factors to lower lip trap, which in turn can worsen the existing class II division 1 malocclusion, but this does not always happen.[2,3] Clinical symptoms of lower lip trap include lower lip indentation with retroclined lower incisors. Both of these symptoms were not found on this case, instead the lower incisors were proclined at the beginning of treatment. Thus lower lip trap is also not an etiologic factor.

Information gained from talking with the patient's mom revealed that the patient's dad also has the same facial characteristics and the patient's brother also seek orthodontic treatment with the same class II division 1 malocclusion diagnosis. Thus it seems that the significant etiologic factor in this case is inherent genetic hereditary factor.

Ideal treatment alternative for a class II division 1 malocclusion in a growing patient is jaw growth modification so that the skeletal discrepancy can also be corrected with more growth on one jaw relative to the other.[1,3] *Cervical headgear* was chosen because the retrognathic jaw relationship was caused by a protruded maxilla with a normal mandible and the vertical dimension was within normal boundaries. Cervical headgear is relatively more convenient for the patient and this will improve patient's cooperativeness in using it.

The skeletal orthopedic effect of *cervical headgear* can be seen from a reduction of the SNA angle, changes in palatal plane inclination, and distal movement of the pterygomaxillary (PTM) suture. The reduction of the SNA angle can be explained as a result of several factors: either as a result of maxillary restraint, resorption at A point due to retraction of upper anterior teeth, or lengthening of the cranial base as a result of normal growth. Nanda suggested that changes in palatal plane inclination, ANS point and PTM position are more reliable as maxillary skeletal changes parameters. The palatal plane inclination changes very little during growth. Previous research showed that cervical headgear use caused the palatal plane to rotate clockwise to a more horizontal position thus bringing the ANS point postero-inferiorly. There was also remodelling of the PTM suture and the PTM moved distally because of cervical headgear use. These changes were not seen on the untreated control group. To achieve these skeletal orthopedic effects, headgear needs to be used consistently for 14-18hours/day for a minimum of 6 months. The recommended force is 350-500gram/side.[4-9] Cephalometric superimposition on cranial base (Fig.10A) showed downward displacement and inhibition of the forward growth of maxilla accompanied with favorable downward and forward growth of mandible thereby reducing the ANB angle to 5° and improving the jaw relationship. However, the position of ANS and PTM stayed the same. This means, correction of class II malocclusion on this patient was achieved more from molar distalization and retraction of upper incisors and favorable growth of the mandible than skeletal maxillary restraint.

Cervical headgear also has dental effects which are upper molar distalization, increasing inter-molar and inter-canine distance and also reducing anterior overjet with expansion of the inner bow. In this case, upper molar distalization is needed to achieve class I molar relationship and to gain space for upper anterior retraction. The upper second molars have not erupted but their position is already two thirds of upper first molar's crowns, thus distalization of upper first molars can still be done with minimal risk of second molar impaction or delayed eruption. Molar distalization can cause distal tipping of the crown and extrusion which can cause an increase of the vertical dimension on anterior

lower third of the face.[4-6] Molar extrusion can be minimized by bending the outer bow upward an average of 10º-20°.[10] However, this was not done. The inner bow was positioned 3 mm from the labial surfaces of upper incisor. Cephalometric superimposition on the maxilla showed that upper molars moved distally 2 mm with distal crown tipping movement and were also extruded 2 mm (Fig.10B). Even though there was 2 mm of molar extrusion, the vertical dimension stayed the same. This is probably due to favorable vertical growth of the ramus so that it can compensate the molar extrusion.

There were positive extra-oral changes, in accordance with research done by Kirjavainen, et al.[8] The convexity of the patient's profile lessen, there was an increase on the nasolabial angle, and the lips were competent on relaxed position (Fig.7).

The best treatment timing for orthopedic treatment of class II skeletal malocclusion using cervical headgear is during SMI 4-7 skeletal maturation stage.[11] Carpal radiograph showed that this patient was on SMI 4 at the beginning of treatment. The patient is 9 years and 4 months old and very cooperative in using the cervical headgear with an average use of 14 hours/day. This is in accordance with previous researches which showed that pre-adolescent patients (7-11 years old) are more cooperative in using the headgear than adolescent patients and that female patients are also more cooperative than male patients.[7,12]

CONCLUSION

The treatment plan chosen for this patient was modification of jaw growth by restricting maxillary growth and distalization of upper molars to achieve class I molar relationship and gaining space for upper incisor retraction using cervical headgear. Cervical headgear was chosen because the patient was in skeletal maturation stage SMI 4 when treatment begun with a protruded maxilla and a normal mandible and the upper second molars have not yet erupted.

Correction of the class II division 1 malocclusion in this patient was achieved by the combination of the skeletal and dental effect of cervical headgear, with the dental effect being more pronounced than the skeletal effect. The direction and quantity of mandibular growth, appropriate treatment time, and patient's cooperativeness played a major role in the success of this treatment.

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