

Case Report: High pull headgear orthopedic effects on vertical maxillary excess and mandibular autorotation; report of three cases



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ABSTRACT

A notable proportion of class II population suffer from excessive vertical maxillary growth which leads to subsequent backward rotation of mandible. Excessive tooth show at rest and on smile are the associated presentation of this group. We report treatment results of this subdivision of class II patients, treated by high pull headgears attached to maxillary acrylic splints with posterior bite-blocks. In all cases, maxillary vertical & sagittal growth had been controlled and simultaneous vertical mandibular growth contributed to improvement of facial profile, incisor show, lip and mentalis muscle function. Considering every aspect of an individual's growth pattern is an inevitable step in treatment planning in orthopedic patients, as it may play a direct role in the treatment plan and mechanotherapy. Comprehensive diagnosis and a customized treatment plan is the key to clinical success.

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Introduction

Class II malocclusion patients comprise a significant proportion of the Iranian population, and the prevalence, which is estimated to be more than 20%, is about the same all over the world and is significant. (1)

It is believed that a broad spectrum of class II situations exist that would not benefit from a single therapeutic approach, therefore treatment should address the individuals' specific skeletal characteristics. (2)

Although deficient mandibular growth is seen in the larger proportion of this group, excessive maxillary growth is also evident. A subgroup of the latter mentioned population, described as "vertical maxillary excess or long face Syndrome" have common skeletal features. Maxillary growth in this group, although limited in anteroposterior direction is excessive in the vertical dimension and this vertical excess contributes to backward-downward rotation of mandible and posterior re-direction of condylar growth. As a result chin prominence decreases, worsening facial esthetics.(3)

Considering advantages of Early treatment including, better social and interpersonal relationship and functional improvement, dento-facial deformities have been addressed from childhood since the last century. The significance is such that even early surgical treatment has been advocated.(4)

Since aberrant growth is the primary cause of these deformities, controlling undesired growth and redirecting it to a favorable pattern would be the ideal decision and is the first option to be considered rather than later orthodontic camouflage or orthognathic approaches. Maxillary vertical growth is the last to complete. Being the last growth vector to cease, vertical maxillary excess is the challenging deformity orthodontists face.(5)

If addressed at the proper time, in appropriate candidates, vertical maxillary excess and high angle patients may be able to escape later orthognathic surgery, which is mentioned as the ideal treatment of gummy smile cases or cam-

ouflage treatments such as intrusion with skeletal anchorage application which is among costly and time-consuming complex procedures.(6)

There is evidence in the literature highlighting the effects of extraoral maxillary traction on limiting maxillary growth and enhancing the patient's profile.(7-9)

Here we report 3 cases of vertical maxillary excess accompanying skeletal class II and a rotated mandible.

Case 1

History and diagnosis

An 11-year-old boy attended the orthodontic department of X University of Medical Sciences with chief complaint of lingually erupted lower incisors. After completing medical examination, we evaluated the dental history of the patient. He was in mixed dentition and demonstrated good oral hygiene. upon clinical evaluation, excessive tooth show at rest, gingival display on smile and long face was noted. He had a convex profile with retruded chin and incompetent lips, and an increased mentalis tonicity. The overjet and overbite of the patient were 6 & 4 mm respectively (figure 1). Interpreting cephalometric data (table 1, cephalometric summary) showed excessive vertical maxillary growth and subsequent downward rotation of mandible.

The problem list of the patient was designed as follows:

- I. Severe crowding in the lower arch,
- II. Vertical maxillary excess, downward backward rotation of mandible, resulting in skeletal class II



Figure1- pretreatment extraoral photographs of case 1

Table 1- summary of cephalometric measurements of case 1

Measurement	T1(before treatment)	T2(progress)
SNA	84.6	83.4
SNB	75.2	75.1
FMA	28.3	27
P-A facial height ratio	61.1	64.6
U1 to FH	108	99.8
IMPA	102.4	93.4

Case 2

History and diagnosis

A 10-year-old boy with the chief complaint of protruded maxillary incisors visited our department. He had a history of minor anemia.

He was in mixed dentition and his oral hygiene was poor. We observed Several caries and marginal gingivitis.

Oral function: He had incompetent, short, and protruded lips and hyperactive mentalis muscles. A convex profile, excessive tooth show at rest, and gingival display on smile was also noted. (figure 2, table 2)

The problem list we concluded:

I. Vertical maxillary excess resulting in increased tooth show and downward rotation of mandible and profile convexity

II. Moderate crowding in upper and lower dental arches, proclined upper and lower incisors

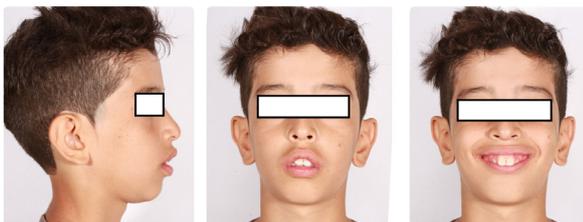


Figure2- pretreatment extraoral photographs of case 2

Table 2- summary of cephalometric measurements of case 2

Measurement	T1(before treatment)	T2(progress)
SNA	78.5	78.2
SNB	71.8	72
FMA	31.5	30.3
P-A facial height ratio	59.3	63.6
U1 to FH	112	113.2
IMPA	95.7	99.6

Case 3

History and diagnosis

A 10-year old boy attended the clinic with a chief complaint of: “protruding upper jaw”

he was in good health and in mixed dentition.

Oral function:

He had protruded incompetent lips. Mentalis tonicity was greatly increased on lip closure. His upper and lower incisors were proclined, overbite and overjet were minimum, and he had a weak chin. (figure 3, table 3)

The problem list we concluded is as follows:

I. Vertical maxillary excess and subsequent downward rotation of mandible ending in class II skeletal relationship

II. Moderate spacing in upper & lower arches, previous extraction of all first molar teeth

III. Lip incompetency and protruded lips

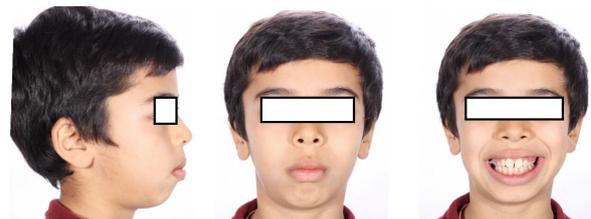


Figure3- pretreatment extraoral photographs of case 3

Table 3- summary of cephalometric measurements of case 3

Measurement	T1(before treatment)	T2(progress)
SNA	78.2	79.3
SNB	70	73
FMA	38.4	38.6
P-A facial height ratio	56	57.3
U1 to FH	106	115
IMPA	107.2	105

Treatment objective

The treatment objective of all mentioned cases was to restrain further maxillary growth allowing unrestricted mandible to grow and auto-rotate.

Treatment alternatives

1. Growth modification by a class II functional appliance with a thick acrylic bite block which would enhance mandibular growth and have a

headgear effect on maxilla. The bite block will counteract the side effect of posterior extrusion and prevent further mandibular rotation to some degree. One of the side effects of this treatment is proclination of lower incisors and retroclination of upper incisors.

2. Growth modification by a high-pull headgear which restricts further maxillary vertical and anteroposterior growth, at the very same time, mandible grows, auto-rotates and catches a more normal and esthetic sagittal position.

3. Deffering treatment until skeletal maturity is achieved and intruding maxillary dentition with TADs

4. Leveling and aligning the upper and lower dental arches and postponing further treatment to the time of maturation and then surgically impacting maxilla.

The skeletal morphology and clinical characteristics of the patients were reviewed: the vertical dimensions including vertical maxillary height, anterior to posterior facial height and lower anterior facial height had increased; Mandibular body and ramus lengths were all but normal. Regarding the skeletal discrepancy of the patient and bearing the fact that esthetic improvement would enhance interpersonal relationships of the patients, the second treatment option was considered the treatment of choice.

Treatment in detail

To apply extra-oral force to the whole maxilla a removable maxillary splint was prescribed.

Appliance: we designed a removable upper splint with a modified labial bow and Adams clasps on molars for retention. Headgear tubes were inserted in the acrylic plate in the molar region. We designed the acrylic base to cover occlusal surfaces of posterior teeth (5mm thickness) to take advantage of the bite-blocking effect in uncooperative times.

At delivery, we regulated the outer bow length, so the force line would pass through the center of resistance of maxilla. The force was measured to be 400 gm on each side and the patient was instructed to wear the splint and

headgear full time, except during meals, physical activity, and oral hygiene procedures.

Discussion

Case 1

Soft tissue clinical assessment

Facial profile and chin contour had greatly improved, both upper and lower lip had increased in length, there was normal tooth and gingival show.

The upper lip did not move forward while the lower lip had moved forward a significant distance. The occlusion had changed to a class I molar relationship and there was normal overbite and overjet.

Cephalometric assessment: Based on the superimposition of cephalograms, taken at an interval of 15 months we observed the following:

Skeletal: Mandible experienced a vertical growth more than maxilla, specifically, ramus height increased a significant amount, A-point had not been moved anteroposteriorly but B-point had moved forward a significant distance. Maxillary movement was minimal in anterior direction but mandible had advanced and also increased in length. Mandible auto rotated about a degree.

Dental: both upper & lower incisors were retroclined, upper and lower molars were extruded but the vertical movement of the upper molar was smaller. Distal movement of upper first molar had corrected the dental relationship. (figure 4,5 and table 1)



Figure4- posttreatment extraoral photographs of case 1

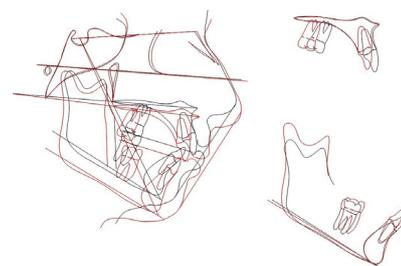


Figure5- superimpositions of initial and final tracings of case1

Case 2

Soft tissue clinical assessment:

On examination, we recognized the improvement in vertical relationship of tooth –lip and the lips were competent. The upper lip had moved backwards, while soft tissue B-point and pogonion were advanced. The occlusion had improved to a class I on both sides.

Cephalometric assessment: In this case the cephalograms superimposed were taken at an interval of 36 months.

Skeletal: Mandibular vertical growth and downward movement was more than maxilla. Ramal and condylar height had increased significantly. A-point and B-point had not moved sagittally. Mandibular length had increased and Mandibular plane angle was reduced about 1 degree.

Dental: upper incisors were retroclined while lower ones did not change in inclination. Upper molars were not extruded, while lower molars were extruded. The improvement in molar relationship was greatly due to mesial movement of lower molar. (figure 6,7 and table 2)



Figure6- posttreatment extraoral photographs of case 2

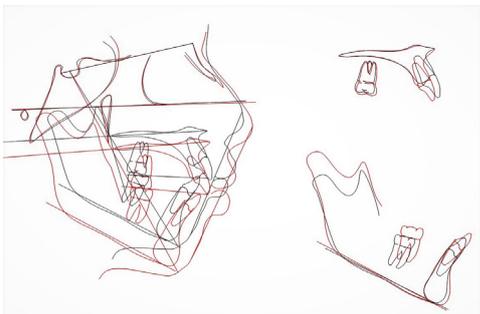


Figure7- superimpositions of initial and final tracings of case2

Case 3:

Soft tissue clinical assessment:

The clinical appearance of the patient had improved. The mentolabial sulcus increased.

Chin contour had improved. Incisor show was near to normal and the lips were not protruded and were competent. A class I molar relationship was evident on both sides.

Cephalometric assessment: We evaluated superimpositions of two cephalograms at an interval of 30 months.

Skeletal: Maxilla and mandible had moved down equally. Ramus height had increased. Maxillary forward movement was restricted, Therefore, A-point had not changed in Antero-posterior direction. B-point had moved anteriorly and while mandible had increased in length, Mandibular plane angle had not changed.

Dental: Upper incisors were retroclined while lower incisors did not change. Upper and lower molars had erupted. Both molars had moved mesially but the lower molar movement was greater which contributed to the occlusal correction. (figure 8,9 and table 3)



Figure8- posttreatment extraoral photographs of case 3

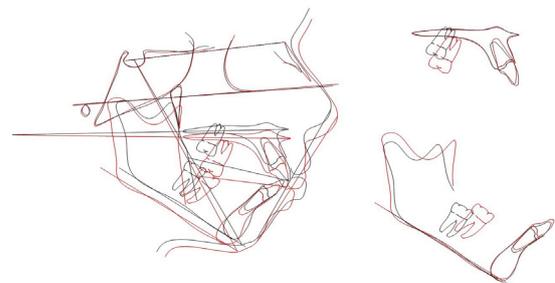


Figure9- superimpositions of initial and final tracings of case3

It is widely accepted that the great population known as “class II” can be subdivided to smaller clusters with similar morpho-skeletal features and growth patterns which will require specific treatment approaches.(2) Thus the well-known approach of ‘targeted therapy’ will shine through after carefully examining dento-skeletal features of orthopaedic patients. One significant division of class II patients are those with near to normal mandibular dimensions and increased

vertical growth of maxilla.

Targeting vertical maxillary excess and associated features often included surgical maxillary impaction to decrease the vertical dimension and induce autorotation of mandible to address the often-accompanying retrogenia.(4)

The burden of surgery, cost and complications, technical errors, and adverse esthetic impacts on soft tissue as thinning and shortening of upper lip and alar base widening has always concerned clinicians and patients and led to alternative treatment modalities.(10)

Recently, temporary anchorage devices have been implicated in managing vertical dysplasia and open bite cases; however, issues such as minor surgery, complex biomechanical designs, unexpected dental movements, and the considerable cost should be highlighted.(11)

An important aspect of successful reduction of vertical excess is controlling eruption of mandibular molars as well which can be achieved by controlling through posterior bite blocks, or by simultaneous intrusion of lower molars by means of TADs.(10)

Although some clinicians may disregard traditional approaches of controlling vertical dimension, these measures as high-pull headgear with or without a maxillary splint should not be overlooked. Excellent clinical results have been obtained with the use of orthopedic vertical force to maxilla. This extra-oral traction addresses craniofacial growth at early ages when surgery is less appealing but the time that evidence has shown psycho-social and functional benefit to the patient.(12)

This non-invasive approach has considerable advantages including, biomechanical simplicity, ease of fabrication and clinical management, and less cost.

The results of this study indicated that a vertical pull headgear through a maxillary splint can successfully combat excessive vertical maxillary growth. It should be emphasized that the line of force application is a critical factor in obtaining the desired result. From a biomechanical standpoint, the force vector should pass

through the nasomaxillary center of resistance (figure 10).

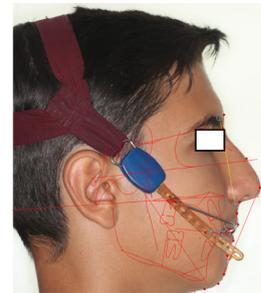


Figure 10- linked photograph and lateral cephalogram to obtain biomechanical advantage

It is only through this line that the whole complex would be restricted from downward forward displacement. Force vectors passing higher or lower would rotate the maxillary complex counterclockwise or clockwise, respectively, which is detrimental to mechanical advantage and facial esthetics. To be more specific, downward rotation of posterior maxilla interferes with vertical control and mandibular counterclockwise rotation and in the absence of bite blocks, could cause clockwise mandibular rotation. Upward rotation of posterior maxilla steepens the occlusal plane which is unaesthetic and could result in a normal face height with an increased anterior maxillary show.

Controlling dentoalveolar eruption of mandibular dentition is also another critical factor in obtaining maximal biomechanical advantage. This is mainly accomplished through bite blocks as was in this study.(13)

Analyzing the biomechanical force system helps to achieve predictable results and save time.

To be more precise, in our clinical experience, we may face cases which appear to be class II patients with common features of convex profile, increased overjet, poor chin contour, etc., which may lead to the incorrect conclusion of a deficient mandible at first, neglecting the impact of a significant dimension of growth: the vertical dimension. This subgroup will mostly benefit from controlling or inhibiting further vertical and to a lesser degree sagittal growth

of maxilla, while the ramus and condyle grow vertically and the facial profile improves in this manner. Noticing obvious clinical characteristics of this group, including increased tooth show and increased lip separation, in a class II appearing patient should redirect the vigilant clinician from prescribing the conventional functional appliances to the most appropriate treatment plan for that specific group.

Conclusion

Deformity oriented approach is the single important key to successful outcomes. Identifying the specific deviation of normal growth should not be overlooked. Not all class II patients with chin deficient appearances could be treated with identical appliances. In a smaller subdivision of class II patients, primarily modulating maxillary growth rather than mandibular growth is necessary to obtain excellent outcomes.

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None

Authors' contributions

Sepideh Soheilifar: Conceptualization, Methodology, Writing - Review & Editing
Maryam Salehzadeh: Writing - Original Draft, Data Curation, Supervision

Conflict of interest

There are no conflicts of interest.

Ethics declarations

Patients have agreed on their data being published.

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Availability of data and material

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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