

Treatment of A Class II Malocclusion Case having Low Mandibular Angle & Deep Bite with Inter-arch Elastics and Reverse Curve Archwire

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Abstract

Inter-arch elastics and reverse curve arch wire can be used successfully in the treatment of deep bite malocclusions and are two of the most common methods available for treating class II malocclusions. Careful diagnosis and treatment planning is primordial for choosing the right treatment modality which can vary from patient to patient. The subject treated in this study was a 14 years old female patient with a Class II division 2 Angle's malocclusion having a skeletal deep bite of around 6 mm and an overjet of 1.5mm, deep curve of spee, coinciding upper and lower arch midlines with that of the facial midline. After analysis made, the case was treated without any extraction due to the fact that she was a low mandibular angle patient with minimal amount of crowding in both the arches and also a Combination Factor of 171.50 (greater than 155.90) which represents the balance of both the vertical and horizontal dimensions. The Anterior Posterior Dysplasia Indicator value fell within the normal range indicating a Class I horizontal maxillo-mandibular relationship. The duration of the treatment was around 20 months. After achieving the goals of the treatment, cephalogram was taken and the pre and post treatment variables compared. The correction of the deep overbite condition was achieved successfully along with the correction of the molar relationship into a Class I malocclusion. U1-SN has increased by 50.0 and L1-NA increased by 4.50 together with a decrease in the inter-incisal angle by 8.50 contributing to a decrease in bite depth. The assessment of the cephalometric findings showed that the lower anterior facial height change was minimal but not insignificant partly due to the continued growth of the mandible which can be confirmed through the values of FMA which shows an increase in 20.0, Facial Height Index dropping from 0.89 to 0.88 and the TPFH:TAFH values decreasing by 0.8%. But this change was not enough to have a positive impact on the facial appearance of the subject. Change in the molar relationship was aided by the use of inter-arch elastics and the deep bite correction facilitated by the slight rotation of the occlusal plane caused by extrusion of lower first molar along with the flaring of the lower incisors induced through the use of the reverse curve arch wire. So it was confirmed that the combined use of inter arch elastics & reverse curve arch wire help to correct the class II division 2 malocclusion along with some improvement for increasing the lower anterior facial height.

Key words: Angle's Class II Div 2, Inter-arch elastics, Reverse curve arch-wire, Skeletal Deep Bite.

Introduction

Deep overbite is a common vertical orthodontic anomaly. Although the correction of deep overbite is routinely achieved by orthodontic treatment, the need for careful diagnosis and a logically sequenced plan of treatment is critical for optimal results. According to the associated etiological factors, deep bite can be divided into two groups, developmental and acquired deep overbite. One important factor in the development of deep bite is the pattern of growth of the mandible and the variations in the rate of growth in both maxillary sutures and mandibular condyles can further influence the development of the vertical malocclusion¹.

The directions of growth of the lower jaw and those subjects with an upward and forward growth²⁻⁴ of the mandibular condyle often have a reduced anterior facial height and if a malocclusion stands in, a deep bite is the usual finding. Differences in anterior facial height and posterior facial height development⁵ can also lead to a rotational growth or positional changes of the mandible that greatly influence the position of the chin. Acquired deep bite on the other hand has a multifactorial background including those conditions wherein a lateral tongue thrust is present, early loss of deciduous teeth and wearing of occlusal surfaces on the posterior teeth as seen in bruxism patients. The treatment of deep bite is one of the priorities because of the potential negative effects deep bite can have on the teeth and supporting periodontal tissues. Nonsurgical approaches are focused on either transition from a horizontal to a vertical growth pattern by forcing the mandible into a clockwise rotation, labial tipping of anterior teeth, extrusion of posterior teeth or intrusion of anterior teeth. The decision must be based on the patient's age, etiology of the anomaly, skeletal and dental morphology, surrounding muscular and periodontal tissues, existence of the deep bite in the rest position, length of lips, occlusal plane, ideal incisor position and the lower facial height⁶.

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History & clinical examination

A female patient named Xin Ting Hong aged 14 years 5 months was received in the second affiliated hospital of Dalian Medical University, CHINA. She complained about the mal alignment of anterior teeth and minimal display of anterior teeth on smiling. She got some restorations in some of her teeth but gave no previous history of any deleterious habit, trauma and orthodontic treatment.

The patient was healthy without any medical complicated history and medication. Intra orally she got normal hard & soft palates, tongue, mucosa and gingiva. Her upper arch was square shaped and lower arch was ovoid. All teeth were present except the third molars. Dental midline coinciding 14,24,25,26. Rotation found on 14,24,45 disto-buccally. 21 & 22 were lingually inclined. Her molar relationship was class I at left side & class II at right side. Bilaterally canine relationship was class II. Overjet was 1.5 mm & overbite 6 mm or more than 40% overlaps. Curve of spee was 4 mm bilaterally

On extra oral examination we found TMJ without any tenderness or clicking sound. She didn't have any difficulty in opening of mouth. Lips were competent and mento-labial fold was slightly prominent. Mandibular angle was measured by placing a mouth mirror along the lower border of mandible reveals her as a patient having low mandibular angle which was confirmed later with lateral cephalogram.



Pretreatment study model photographs

Case analysis

Using the craniofacial total difficulty to identify the areas of major disharmony and evaluating the difficulty of correction of the current malocclusion

Craniofacial analysis

Normal range	Case	Difficulty	Factor
FMA (22-28) ^o	17	5	25
ANB (1-5) ^o	1	15	-
Z angle (70-80) ^o	79	2	-
Occ plane (8-12) ^o	6	3	6
SNB (78-82) ^o	80	5	-
FHI (0.65-0.75) ^o	.94	3	57
C.F difficulty total			88

Anterior arch analysis

Value	Difficulty factor	Difficulty
Tooth arch disc	2.0	1.5
Head film disc	3.2	1.0
Soft tissue mod	1.0	0.5
Total	6.2	6.7

Mid arch analysis

Tooth arch disc	2.5		
Curve of spee	4.5		
Total	7.0	1.0	7.0
Occlusal disharmony	6.0	2.0	12.0

Posterior arch analysis

Tooth arch disc	7.2		
Expected increase(-)	4		
Total	3.2	0.5	1.6

Total space analysis 16.4

Total difficulty in space analysis 27.3

Combined craniofacial difficulty = 88.0

Combined space analysis difficulty = 27.3

Total difficulty = 115.3 (moderate)

Bolton's Analysis of the discrepancy

Calculated through the Bolton calculator⁷⁻⁸

Anterior relationship 76.14

General relationship 87.78

Sum of upper six anterior teeth=44 mm

Sum of upper twelve teeth=90mm

Sum of lower six anterior teeth=33.5mm

Sum of lower twelve teeth=79mm

Excess detected on upper twelve teeth=4.13mm

Excess on upper six anteriors=2.86mm

Norm=77.2

Norm=91.3



Pre treatment facial photographs



Pretreatment intraoral photographs

Spee

Leveling the curve of spee requires additional space to accommodate all the teeth. In this patient the spee depth was 4 mm on the right and on the left as well. So the space needed to level the spee would come to (4+4) mm /2 +0.5mm = 4.5mm bilaterally.

Arch perimeter analysis

Arch	Arch length	Tooth material	Discrepancy
Upper arch	70.0mm	72.5mm	-2.5mm
Lower arch	59.0mm	61.5mm	-1.5mm

❖ Interpretation: An excess of 0-2.5mm discrepancy can be corrected by proximal stripping carried out to reduce the minimal tooth material excess.

Kim's analysis

(1) **Overbite depth indicator⁹ (ODI)**

MP-AB 85.5°
 FH-PP 4.0°
 ODI (74.5°±6.0° normal range) 89.5° (>< OK, <OPENED, > CLOSED)
 MP-AB = Mandibular plane to AB plane
 FH-PP = Frankfort horizontal plane to palatal plane

(2) **Anteroposterior dysplasia indicator¹⁰ (APDI)**

FH-PP 86°
 AB-PP -8°
 FH-PP 4°
 APDI (81.4°±3.7°-normal range) = 82° (class I maxillo-mandibular relationship)

(3) **Combination factor¹¹**

ODI+APDI=89.5°+82.0°=171.5°

Cephalometric analysis

Cephalometric tracing was carried out for this patient using these above basic landmarks and different analyses were done including those from Tweed, Downs, Steiner's, Sassouni, Wits and Jarabak.

The landmarks are as follows:

Hard tissue landmarks:

Nasion (N)-The intersection of the internasal suture with the nasofrontal suture.

Sella turcica (S)-The midpoint of the sella turcica (by inspection).

Porion (Po)-The midpoint on the upper edge of the external auditory meatus.

Condylion(Co)-The most superior point on the head of the condyle.

Articulare (Ar)- The junction between posterior border of ramus and inferior border of basilar part of occipital bone

Gonion (Go)-The point which on the jaw angle is most inferiorly, posteriorly and outward.

Orbitale (Or)-The lowest point on the lower margin of the bony orbit.

Posterior nasal spine (PNS)- The tip of the posterior spine of the palatine bone of the hard palate.

Anterior nasal spine (ANS)-The tip of the anterior nasal spine seen on the x-ray film from norma lateralis.

Subspinale(A)-The deepest midline point on the pre-maxilla between the ANS and prosthion.

Supramentale(B)-The most posterior point in the concavity between the infradentale and pogonion.

Menton(Me)-The lowermost point on the symphyisial shadow.

Gnathion(Gn)-The most inferior point in the contour of the chin.

Pogonion(Pog)-Most anterior point in the contour of the chin.

Soft tissue landmarks

Glabella(G)-Most prominent point in the mid-sagittal plane of forehead.

Nasion soft tissue(Ns)-Point of deepest concavity of the contour of the root of nose.

Pronasale(Pn)-Most prominent point of the nose.

Subnasale(Sn)-Point at which the nasal septum merges with the upper cutaneous lip.

Soft tissue pogonion(Pg')-Most anterior point on the soft tissue chin.

Menton soft tissue(Ms)-Intersection of a vertical coordinate from menton and inferior soft tissue contour of chin.

Variables	Case	Normal range
SNA	81.0	82.8±4.0
SNB	80.0	80.1±3.9
ANB	1.0	2.7±2.0
U1-SN	110.0	105.7±6.3
U1-NA	29.0	22.8±5.7
U1-NA (mm)	3.0	5.1±2.4
L1-NB	15.0 (l)	30.3±5.8
L1-NB (mm)	-1.5 (l)	6.7±2.1
U1-L1	135.0 (t)	125.4±7.9
FMA	17.0 (l)	31.3±5.0
FMIA	69.0 (t)	54.9±6.1
IMPA	94.0	93.9±6.2
Z angle	79 (t)	72.0-75.0
AOBO (mm)	1.0 (t)	0-(-1)
PFH (mm)	49.0	
AFH (mm)	52.0	
FHI	0.94 (t)	0.65-0.75
Facial plane	86.0	85.0±5.0
Y axis	59.0	59.0±6.0
Chin prominence	6.0 (t)	2.0±2.0
UPFH (mm)	50.0	
LPFH (mm)	33.0	
TPFH (mm)	83.0	
UAFH (mm)	57.5	
LAFH (mm)	52.0	
TAFH (mm)	109.5	
LAFH:TAFH	47.0% (l)	55.0%
TPFH:TAFH	75.80% (t)	65.0%

Treatment planning

Since the patient is 14 years old, the peak time of her growth spurt was way passed by already which was around from 9 ½ years to 12 ½ years. The goal of the treatment should be aimed at decreasing the deep bite along with extruding the lower molars to allow for the rotation of the mandible in a clockwise direction and hence increasing the lower anterior facial height at the same time. First it was decided that a fixed appliance with a removable anterior bite plane could be used for extrusion of molars to decrease the bite depth. Patients' negative approach on wearing the removable bite plane made us to reconsider the treatment option and opted for just a fixed appliance. Molar relationship correction would be achieved through the usage of Class II inter-arch elastics and also in an effect to benefit from the side effects of this mechanics to allow for lower first molar extrusion for occlusal plane rotation. A reverse curve of spee in the lower arch not only will level the arch but also will to some extent intrude the lower incisors hence decreasing the bite. Anchorage control in this case is minimal as no extraction was performed.

Treatment progress

Treatment started on: 3rd August 2010, Age of the patient: 14 yrs 5 months.

Treatment completed on: 13th March 2012, Age of the patient: 16 yrs 1 month

Duration of treatment: 20 months.

(i) 3/8/2010- Impression taken and placement of separators done.

(ii) 31/8/2010- Placement of pre-adjusted edgewise bracket^{12, 13} (MBT)¹⁴ on the upper teeth only. Bands placed on all the 4 first molars. 0.014" round NiTi wire placed on the upper bracket. Due to the deep bite and the decreased overjet, bracket placement on the lower arch was deferred to a later stage.

(iii) 28/9/2010- 0.016x0.022 NiTi rectangular arch wire fitted for the upper arch.

(iv) 19/10/2010- a 0.016x0.022 stainless steel wire along with an accentuated curve of spee is placed in the upper arch for the upper anteriors to flare forward to allow for the placement of brackets in the lower arch.

(v) 23/11/2010- Lower brackets bonded. A bite block using GIC material was placed on the lower first molars to prevent premature contact of the upper teeth with the lower brackets. Also this would help in the leveling of the lower arch much faster. A 0.012" NiTi wire was fitted on the lower arch.

(vi) 12/01/2011- Repositioning of the upper central incisors bracket more incisally and placement of a 0.016x0.022" NiTi wire. In the lower arch, the wire is changed to a 0.014" NiTi round wire. Trimming down the height of the bite block on the lower molars till the point where any premature contact of the lower brackets with the upper teeth noticed.

(vii) 23/3/2011- upper wire was changed to 0.016x0.022 stainless steel, lower wire was changed to 0.016" NiTi wire.

(viii) 28/4/2011- Lower right first premolar bracket and lower left second premolar bracket debonded. Both brackets are re-bonded and the same 0.016" NiTi wire is placed. An accentuated curve of Spee was again given for the upper arch wire.

(ix) 11/8/2011- Upper arch wire removed and checked, molar offset given. Lower arch wire changed to 0.016x0.022 NiTi along with a reverse curve of spee in it. For the rotated lower right second premolar, a power chain was used from half of the bracket of the lower first premolar to engage fully in the second premolar bracket to aid in derotation.

(x) 14/9/2011- Lower arch wire changed to 0.016x0.022 stainless steel. Molar offset given and a reverse curve of spee incorporated into the archwire. Upper arch wire was removed and checked. Due to the derotation of the upper first premolars, space has been appearing mesial and distal to them. A power chain is used from upper left first molar to the canine on the same side. Another power chain is used from upper right molar to the first premolar.

(xi) 25/10/2011- Stripping of upper anteriors done. Crimpable hooks placed distally to upper lateral incisors for placement of Class II elastics (3/8 inch) from lower first molars to the hooks.

(xii) 1/12/2011- Stripping is continued on the upper anteriors and the usage of Class II elastics is also continued for retraction of the upper anteriors and also using the side-effects of the elastics for lower molar extrusion to allow for the rotation of the occlusal plane.

(xiii) 1/12/2011 till 16/2/2012 finishing the case- proper torque adjustments for the upper and lower anteriors, good interdigitation of the buccal segments, any midline corrections done. On the 13/03/2012, patient was summoned for impression taking for fabrication of Hawley's retainers¹⁵ on both upper and lower arch. On the 20/3/2012, the retainer was delivered to the patient which consisted of a short labial bow from canine to canine and C-clasps on second molars. In addition to that, the upper retainer had a passive lingual bite plate which when the patient bites, the lower teeth come into contact with the plate and disoccludes the posterior teeth by around 1mm. This will help in the maintenance of the deep bite correction. The patient was instructed to wear the retainers full-time for a period of 6 months in the beginning, after which the retainer was worn at night only for another 6 months and lastly on and off wearing for the last 6 months.

Results

After the completion of the treatment for around 20 months, the deep bite reduced to 3mm from 6mm, overjet increased from 1.5 to 2.5 mm. A solid Class I occlusion with the ideal overjet and overbite was obtained. Most of the treatment objectives were met. The FMA increased from 17⁰ to 19⁰, Z-Angle decreased from 5⁰ to an ideal 74⁰.

Not much change was observed though in the facial appearance which was confirmed by the post treatment analysis out of which the Facial Height Index and the Y-Axis remained unchanged. The final panoramic radiograph shows a flat curve of spee, good root alignment and upright first molars. Although the maxillary and mandibular third molar crowns appear to erupt into good position, they should be monitored. The lateral cephalometric radiograph shows a balanced profile with competent lips, an improved axial inclination of both the upper and lower central incisors, which added to the correction of the deep bite condition, a good Class I occlusion. Superimposition of the pre and post treatment tracings on the anterior cranial base shows the maxilla moved downward and forward with occlusal movement of the maxillary molars and labial tipping of the incisors. Mandibular superimposition reveals mandibular growth in a same downward and forward direction, a little mesial movement of the molars and slight labial inclination of the incisors.

Variables	Pre treatment	Post treatment	Change
SNA	81.0	82.0	1.0
SNB	80.0	82.0	2.0
ANB	1.0	0.0	-1
U1-SN	110.0	115.0	5.0
U1-NA	29.0	33.5	4.5
U1-NA (mm)	3.0	4.0	1.0
L1-NB	15.0	23.0	8.0
L1-NB (mm)	-1.5	1.0	2.5
U1-L1	135.0	126.5	-8.5
FMA	17.0	19.0	2.0
FMIA	69.0	63.0	-6
IMPA	94.0	98.0	4.0
Z angle	69.0	74.0	-5
AOBO (mm)	1.0	1.0	0.0
PFH	49.0	50.0	1.0
AFH	52.0	53.0	1.0
FHI	0.94	0.94	0.0
Facial plane	86.0	88.0	2.0
Chin prominence	6.0	6.0	0.0
Y axis	59.0	59.0	0.0
UPFH (mm)	50.0	50.0	0.0
LPPH (mm)	33.0	34.0	1.0
TPFH (mm)	83.0	84.0	1.0
UAFH (mm)	57.5	59.0	1.5
LAFH (mm)	52.0	53.5	1.5
TAFH (mm)	109.5	112.5	3.0
LAFH:TAFH	47%	47.5%	0.5%
TPFH:TAFH	75.80	75.0	0.8%

Orthodontic influence upon the anterior facial height¹⁶ was calculated using these landmarks:

Nasion, Anterior nasal spine, Posterior nasal spine, Gnathion, Palatal plane, Occlusal plane and Anterior skeletal plane.

N-Gn—Total facial height

P-Gn--- Lower facial height

P-O--- Maxillary components of lower facial height

O-Gn-- Mandibular components of lower facial height

Anterior facial height

	N-GN	N-P	P-O	O-GN	P-GN
Pre Rx (mm)	105.5	58.0	18.5	29.0	47.5
Post Rx (mm)	108.5	59.0	20.5	29.0	49.5

Percentage values of anterior facial height

	Lower as a percentage of N-Gn	Max. as a percentage of N-Gn	Mand. As a percentage of N-Gn	Mand. As a percentage of P-Gn
Pre Rx-%	45.02	17.53	27.49	61.05
Post Rx-%	45.62 (Ⓢ)	18.89 (Ⓢ)	26.72 (Ⓢ)	58.58 (Ⓢ)

Discussion

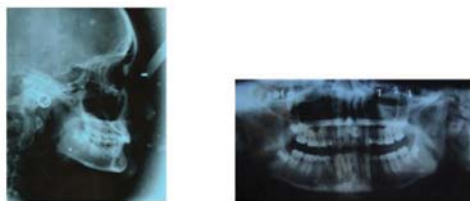
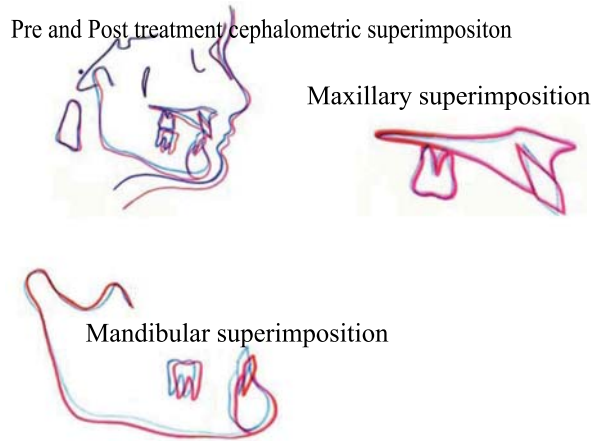
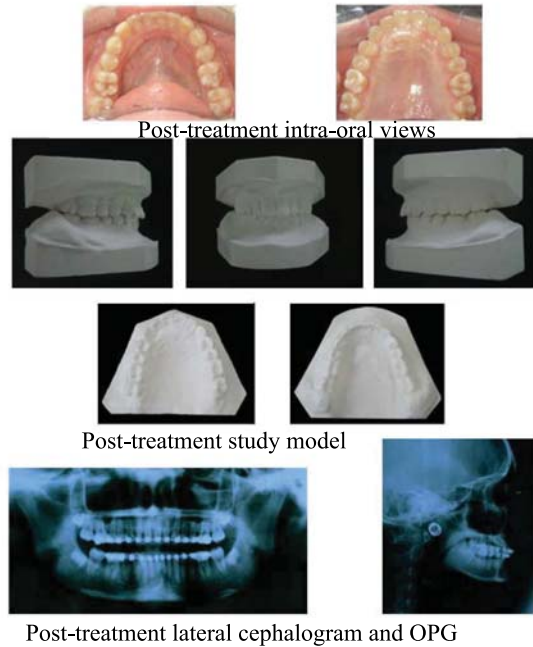
After a thorough analysis of the cephalogram, it was concluded that the patient had a Class II division 2 dental malocclusion with a skeletal deep bite. The patients' main concern was about the alignment of the upper teeth and also a lack of display of the upper teeth upon smiling. It was noticed that the patient had a low mandibular angle with a slightly prominent mento-labial sulcus. Facial height index was 0.94 as compared to the mean 0.65-0.75 and the Y-axis was 59.0⁰ which may be a result of the posterior cranial base slope (where the glenoid fossa is located), or the height of the mandibular ramus. It is also possible when the anterior facial height decreases, due to the vertical deficiency of the nasomaxillary process and the mandibular symphysis, or by the mandibular anatomic shape (euryprosopic facial type), that may show a closed gonial angle which in this case was 112⁰ as compared to the mean of 127.3⁰±4.76⁰.

Jarabak ratio of the proportion of lower anterior facial height to total anterior facial height was 47% and the total posterior facial height to total anterior facial height was 75.8%. Proportionality of the upper and lower facial height by Wylie¹⁷ reported that lower facial height represented 56.8% of the total facial height whereas Mayne¹⁸ had a figure of 43.95% of the upper to the total facial height. The overbite depth indicator is the arithmetic sum of the angle of the A-B plane to the mandibular plane and the angle of the palatal plane to the Frankfort horizontal plane and this determines the vertical maxillo-mandibular relationship. In this case, the MP-AB angle was 85.5⁰, higher compared to the mean of 75.8⁰, indicating an open angle because of decreased anterior facial height and hence relating to a deep bite tendency. Confirmation of this condition was made through the FH-PP angle which was 40 showing a palate that tipped downward and forward. The ODI value was 89.5⁰, well beyond the range of 74.5⁰ ± 6.0⁰. Antero-posterior maxilla-mandibular relationship was evaluated using the Antero-Posterior Dysplasia Index which combines the FH-FP, AB-FP and the FH-PP angles. The FH-FP angle determines if the skeletal class II is due to mandible with a normal range of 87.0⁰ ± 3.0⁰, with the case having a value of 86.0⁰. On the other hand the AB-FP angle, evaluating the convexity of the face, was -80 indicating a Class II tendency. Further analyses did not confirm this tendency with an ANB of 1⁰ and AOBO linear measurement of 1mm. The value for the APDI was 82⁰, lying within the range of 81.4⁰ ± 3.7⁰, shows a normal Class I maxillo-mandibular relationship. Combination Factor represents the balance of both dimensions (vertical-horizontal) with a norm of 155.9⁰ and in this patient the value was well above it indicating that a non-extraction procedure will maintain a better relation. Since the FMA angle did not changed quite significantly in this patient, we should try to ascertain the site of correction when the overbite was corrected orthodontically, that is, in the incisor or molar region. The percentage value for the maxillary component increased from 17.53% to 18.89% which possibly, clinically suggests a very slight elongation of the maxillary incisors due to the use of Class II elastics and a restriction of the elongation by implementing an accentuated curve of Spee in the arch wire. On the other hand, the mandibular component of the total facial height and that in relation to lower facial height showed a decrease in the values indicating that the mandibular incisors were intruded with the help of the reverse curve of Spee incorporated in the arch wire in the overbite correction which is in agreement with the findings of Stoner, Lindquist and Haynes¹⁹. Moreover, an increase in proclination of the upper and lower incisors within normal limits contributed to the decrease in bite depth.

The overbite correction did not cause a significant elongation of the lower face in relation to the total facial height. The morpho-genetic pattern of the muscles of mastication of the patient may have been the determining factor in the relationship between the maxilla and the mandible. Also a stronger musculature may have inhibited the posterior dentoalveolar development²⁰ in the maxilla together with an inhibition of the elevation of the buccal teeth. The tweed triangle values showed a slight improvement in the FMIA angle and FMA angle which may be due some late growth of the mandible forward and downward as seen in some deep bite patients. Finally the Hawley's retainer delivered to the patient with an anterior bite plane incorporated in the upper one to maintain the corrected bite depth. Instructions on how to wear and remove it and the timings of when to wear it during the 3 periods of 6 months each were given to the patient. The prognosis of the treatment is quite good in the way that the patient's growth spurt is negligible since the patient is already around 16 yrs of age. In addition, the third molars are about to erupt with sufficient space distal to the second molars which might further help in the maintenance of the bite depth by physiological means.

Conclusion

From this case, we can conclude that deep bite correction in a patient with low mandibular angle can be achieved successfully using Class II elastics and reverse curve arch wire. It should be noted however that the treatment outcome regarding the facial height did not change to a desired value as it was a surgically destined case treated with only a fixed appliance. Also, the treatment timing in such a case is very important as a maximum benefit from the growth spurt could be advantageous not only in adjusting the bite depth but also in improving any facial height discrepancies and for better stability.



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