

Cephalometric evaluation of anterior open bite treatment using reverse curve arches and anterior elastics in adolescents

Baha Atout^a, Ahu Acar^b, Nazan Kucukkeles^c

Abstract

Introduction: Anterior open bite is a challenging malocclusion that Orthodontists deal with in their day to day practice. Many treatment options exist for its correction and the aim of this study was to evaluate the clinical effects of reverse curved NiTi arches on anterior open bite treatment in adolescents and to investigate whether true intrusion of molars could be achieved in this special age group.

Material and Methods: The study sample consisted of 15 patients (age ranged from 12.2 to 14 years). All presented a high angle skeletal pattern and an anterior open bite. After initial leveling, upper accentuated curve and lower reverse-curve 0.016 × 0.022 inch arch wires were placed, with anterior elastics applied in the canine regions. Cephalometric assessment was carried out on lateral head films taken at the beginning of treatment and on average 3 months after open bite closure was obtained.

Results: The upper and lower incisors, the upper and lower first premolars and the upper and lower first molars were uprighted and extruded. The overbite was increased significantly due to the extrusion of the upper and lower incisors, while the overjet was reduced due to uprightening of both upper and lower incisors.

Conclusions: This technique was effective in the treatment of open bite in young adolescents although no true intrusion was achieved in the molar region. Further studies are suggested to investigate the long term stability of our results.

Keywords: Reverse curve wires, Extrusion; Box elastics

Introduction

The open bite is blamed to develop by a morphogenetic abnormality resulting in a disturbance of skeletal development, an expression of muscle growth and muscle function and mal-placement or displacement of anterior teeth.¹ Open bite can be divided into skeletal and dental types.² The dental open bite presents with under eruption of anterior teeth caused by a mechanical obstruction to the normal incisor eruption.

^a Corresponding author: DDS, PhD. 001204 963 3365 208-1157 St Anne's Road. Winnipeg, Canada, E-mail: dratout@yahoo.com.

^b DDS, PhD. Professor, Department of Orthodontics, Marmara University, Faculty of Dentistry, Istanbul-Turkey.

^c DDS, PhD. Professor, Department of Orthodontics, Marmara University, Faculty of Dentistry, Istanbul-Turkey.

Once the cause is removed, most dental open bites tend to self correct.

Skeletal open bite patients usually display particular clinical and radiological features including short posterior face height, long lower anterior face height, large mandibular plane angle, gonial angles and downward tipping of the posterior maxilla. Patients usually have increased dentoalveolar heights and they might also have maxillary constriction, posterior cross-bites, a retruded mandible and an anterior open bite in combination with a tongue thrust habit.³

Among multiple etiologic factors, the most frequently discussed factor is the over-eruption of the upper molars. Clinicians have emphasized the necessity of reducing the vertical dimension of the upper posterior segments or at least trying to prevent their extrusion during orthodontic treatment.⁴

As intrusion of posterior teeth is difficult to achieve with conventional mechanics,

orthognathic surgery is often the only treatment option indicated in adult patients with severe open bite and un-esthetic facial proportions. Implants have also proved to be a valuable Orthodontic mean to achieve intrusion in the posterior buccal segments. For the treatment of borderline cases and for those reluctant to undergo surgery, search for cost effective, less invasive and practical alternative treatment modalities continues. One of the methods available for the treatment of open bite is the multi-loop edgewise arch wire technique developed by Kim.⁵ This technique involves the use of multi-loop gable bend arch wires with vertical elastics in the canine region. The goals of this technique include correction of the inclination of the occlusal plane, alignment of the maxillary incisors relative to the lip line and up righting of the of the posterior teeth. Using this technique, Goto et al⁶ and Sato et al⁷ reported successful treatment outcomes. Enacar et al⁸ modified Kim's⁵ technique by using 0.016 × 0.022 inch upper accentuated-curve and lower reverse-curve nickel titanium arch wires instead of multi-loop gable bend arch wires with inter-maxillary elastics applied in the canine regions. They suggested that these wires were simpler, more hygienic, reduced chair time and are less irritating to the soft tissues when compared with multi-loop arch wires. Enacar et al⁸ reported of similar results to those obtained by the multi-loop edgewise arch wire system. Hence the aim of the present study was to evaluate the changes in dentofacial structures of open bite patients treated with upper accentuated-curve and lower reverse-curve NiTi arch wires with inter-maxillary elastics in young adolescents and to investigate whether molar intrusion could be achieved with these mechanics.

Material and Methods

Young and health patients (up to age 14) with permanent dentition, Class I and mild class II

sagittal relationship, with anterior open bite of at least 1mm, mild crowding were included in this study. Patients with gummy smile of more than 2 mm of gum show during smiling were excluded from this study.

Sample comprised of 15 patients (8 females and 7 males) with age range of 12.2 to 14 years with an average of 13 years in females and 12.6 to 13.8 years with an average of 13.2 years for males. The mean average age of the sample was 13.1.

The sample had a high angle skeletal pattern (SN-GoMe > 37°), hyper-divergent facial profile, downward and backward rotation of the mandible, narrow palates with over erupted molars, having two distinct occlusal planes that were only in contact in the molar or premolar area and an anterior open bite that ranging between 1-5 mm with average being 2.33 mm.

These patients were counseled prior to start of fixed strap up since it was a patient dependent treatment modality. On the contrary with non-compliance, the bite could further open due to the intrusive effect of the wire on the anterior teeth. After complete strap up, treatment was initiated with 0.0175 inch coaxial arch wires. The leveling phase was continued with 0.016 inch round stainless steel arch wires. After leveling was completed, 0.016 × 0.022 inch upper accentuated-curve and lower reverse-curve nickel titanium arch wires (G & H Company, Greenwood, USA) were placed. With the addition of vertical elastics (Ormco Z pack elastics, Glendora, California) in the canine regions, the intrusive forces that act on the anterior region were cancelled while those acting on the posterior teeth were allowed. The intrusive force of the wires on the anterior teeth was counteracted with two ³/₁₆ inch, 6 oz elastics placed between upper and lower canines on both sides. The patients were instructed to renew their elastics once a day.

Once the open bite in the canine region was eliminated, the elastics were applied in box

form for 3 months till incisal overlap was fully achieved. After removal of the NiTi arch wires, 0.017 × 0.022 inch stainless steel arch wires were inserted and kept in place for a period of 3 months, during which box elastics were continued. Average treatment time with fixed appliances was 12 months. After debonding, positioners were inserted for 6 months, followed by Hawley retainers which were worn for at least 6 months.

Cephalometric evaluation of the treatment changes was conducted on lateral cephalograms from patients, taken at the beginning and on average 2 months after an overbite of 1 to 2 mm was obtained. Siemens Orthopas Cephalostat was used. Kodak X-Omat K100 with a film size of 18-24 cm were used developed using "Okamoto Medical X-Ray film automatic processor". Tracing of the pretreatment and post-treatment cephalograms were done on 8-10" acetate paper using 0.5 mm tracing pen. To minimize the error of tracing, pairs of cephalograms were traced together at the same sitting. A Cartesian coordinate system was used to measure the positional changes of the cephalometric landmarks between the two tracings. A horizontal reference line (TH) was constructed reducing 7 degrees from the SN plane and was used as X-axis. The Y-axis (TV) was constructed by drawing a vertical line passing through the Sella point perpendicular to the X-axis, these constructed lines were mentioned by Burstone and his colleagues⁹ and used in several studies for orthodontic and orthognathic purposes.^{9,10} The Y and X axis were transferred from the first film to the second film by superimposition along the S-N line. Fifteen cephalometric landmarks were chosen as reference points. Based on these reference points 5 horizontal and 10 vertical planes were constructed. Twenty two cephalometric measurements were used in the study (14 linear measurements and 8

angular measurements). Overbite and overjet were also measured from the cephalometric radiographs.

Results

Many dental and skeletal changes were observed (Tables 1 and 2 with means before and after treatment with standard deviations). Dental changes observed in this study were upper incisors extruded and uprighted, upper

Table I. Skeletal Changes

	before		after		difference		wilcox on P-Value	Sig.
	x	sd	x	sd	x	sd		
SNA	81.78	3.49	81.78	3.31	.00	1.50	1.000	
SNB	78.78	2.95	79.00	3.28	-.22	1.20	.594	
ANB	3.00	3.28	2.78	2.91	.22	1.20	.594	
Go°	130.33	6.93	130.67	7.65	-.33	3.35	.773	
SN-Po	79.67	3.24	79.00	3.81	.67	1.87	.316	
N-ME	120.67	5.20	122.22	5.65	-1.56	1.67	.023	*
ANS-Me	69.44	5.05	71.22	5.72	-1.78	1.48	.007	**

*p<.05, **p<.01

Table II. Dental Changes

	Before		after		difference		wilcox on P-Value	Sig.
	X	Sd	x	sd	X	sd		
U1-TH	76.44	18.08	81.33	16.81	4.89	3.48	.003	**
U1-THmm	73.33	4.33	75.33	4.30	2.00	1.41	.003	**
U4-TH	88.89	6.43	96.00	7.70	7.11	7.44	.021	*
U4-THmm	70.33	5.07	71.67	4.47	1.33	1.23	.011	*
U6-TH	99.11	12.82	111.56	7.54	12.44	8.82	.003	**
U6-THmm	68.56	3.32	68.89	3.06	0.33	1.32	.471	
L1-MP	91.33	5.48	86.78	3.49	4.56	3.21	.003	**
L1-MPmm	40.00	3.20	43.00	3.71	3.00	1.41	.000	***
L4-MP	81.11	8.39	69.89	6.27	11.22	9.32	.007	**
L4-MPmm	36.78	2.73	38.33	3.39	1.56	1.24	.005	**

L6-MP	76.89	5.71	66.56	7.54	10.33	6.91	.002	**
L6-MPmm	68.56	3.32	68.89	3.06	0.33	1.32	.471	
SN-FOP	22.44	5.15	18.33	6.42	4.11	3.98	.015	*
PP-FOP	11.44	4.48	7.33	6.29	4.11	3.92	.014	*
Overbite	-2.33	1.32	1.56	.53	-3.89	1.69	.000	***
Overjet	2.44	0.73	1.56	0.89	.56	0.78	.009	**

*p< .05, **p< .01, ***p< .001

first premolars extruded and uprighted, upper first molars uprighted and extruded, lower incisors extruded and uprighted, lower first premolars extruded and uprighted, lower first molars uprighted significantly and extruded, functional occlusal plane rotated counter clockwise, overbite increased significantly while overjet decreased significantly.

The skeletal changes observed were; N-Me, ANS-Me increased significantly, SNA° didn't change, SNB° increased insignificantly, ANB° reduced insignificantly and gonial angle increased insignificantly

Discussion

The results of this study indicated that bite closure had been achieved to a great extent by up righting and extrusion of the upper and lower incisors. Elastics, which were applied to prevent incisor intrusion as a result of NiTi arch wires, caused extrusion and up righting of the incisors. The 2.00 mm extrusion (P<0.01) measured in the upper incisors was in part due to the change in the relative distance of the incisor tip to the true horizontal plane "TH" that took place as the central incisors were being uprighted (5.38°). In a previous study, Kucukkeles et al¹¹ found that extrusion in the upper incisors was 3.07 mm and the up righting degree was 6.41° and both results achieved were significant too. Chang et al⁴ evaluated the treatment changes of anterior open bite malocclusion treated by multi-loop edgewise arch wire technique. It

was found that the upper incisors extruded significantly by 1.92 mm (P < 0.001).

It was further found that lower incisors were both extruded and uprighted. These extruded 3 mm (P<0.001) while in the previous study, (which was conducted on adults) lower incisors extruded 3.35 mm.¹¹ Lower incisors were also uprighted 3.38° (P<0.01) greater than that found in the previous study 1.26°. Proffit¹² pointed out that it is better to err for lower incisor extrusion than uppers in the perspective of stability and esthetics for the management of anterior open bite and as it is also noticed in all previous studies that more lower incisor extrusion was achieved.

If we compare the effects on upper premolars, it was found that in the present study upper first premolars extruded 1.33 mm (P<0.01) contrary to the reduced extrusion of 0.7mm found previously.¹¹ Similarly, the lower first premolars extruded 1.56 mm (P<0.01) lesser than that of 2.59 mm found previously.¹¹ Although the configuration of the arch wires in the molar region forced the molars to be both intruded and uprighted, no true molar intrusion occurred, instead they uprighted and extruded. Extrusion of molars is an undesirable treatment effect in this group of patients. The amount of lower molar extrusion in this study was minimal (0.33 mm) and this may have been related to the selection of mesio-buccal cusp tip of the first molar as a landmark for linear measurements. Mesio-buccal cusps of both upper and lower first molars are expected to be extruded as a result of the up righting movement.

Lower first molars were uprighted significantly in this study by 10.33°. In the present study upper molars extruded insignificantly (0.33 mm) but uprighted significantly (12.44°, P<0.01). Conclusively, only up righting effect occurred in the upper molars. Extrusion of lower premolars and up righting of lower molars led to rotation of the functional occlusal plane in a counterclockwise direction, thus decreasing its steepness. The increase in N-Me and ANS-

Me could be attributed to 0.33 mm extrusion of lower first molars and 0.33 mm in the upper molars which might have caused slight clockwise rotation of the mandible. However, this change was not reflected in mandibular plane angle which stayed stable throughout treatment. Extrusion of lower incisors, increase in overbite, and up righting of upper incisors were in accordance with the findings of Goto et al,⁶ Enacar et al,⁸ Kucukkeles et al¹¹ and Chang et al.⁴ Furthermore, up righting of teeth in the buccal segments and the alteration of the occlusal plane to SN angle were in agreement with the reports of Enacar et al. On the other hand, Goto et al reported an increase in SNB angle and a decrease in ANB and mandibular plane angles, while in the present study no significant difference was noted regarding these parameters. The effects of this treatment method were similar to those of the multi-loop edgewise arch wire system in a way that inclination of the occlusal plane was corrected, open bite was corrected by extrusion and up righting of both upper and lower incisors and inclinations of the posterior teeth were corrected. Working with upper accentuated-curve and lower reverse-curve NiTi arch wires was less time consuming compared with multi-loop arch wires. The patients did not have any difficulty in maintaining their oral hygiene and there was no complaint about oral soft tissue irritations. In this study no molar intrusion was achieved but the molars were held in place. Further studies are suggested to investigate the long term stability of our results.

Conclusions

The conclusions of this study are as follows:

1. The treatment changes mainly occurred in the dentoalveolar region.

2. The upper accentuated and lower reverse curve arch wire therapy was shown to be an effective and efficient method to treat open bite malocclusion. As a result of treatment, the overbite increased an average of 3.89 mm in young adolescents.

3. The treatment changes were an alteration of the functional occlusal plane in a counter clock wise direction accompanied by the up righting of posterior teeth.

4. Both upper and lower incisors were uprighted and extruded.

5. No molar intrusion was achieved and both upper and lower molars extruded and uprighted slightly. These were in accordance with the previous findings conducted on adults.

References

1. Galletto L. Adult anterior open bite. *Am J Orthod* 1990; 6: 522-26.
2. Cangialosi T. Skeletal morphologic features of anterior open bite. *Am J Orthod* 1984; 85: 28-36.
3. Jeryl D. Early treatment of skeletal open bite malocclusions. *Am J Orthod* 2002; 121: 563-5.
4. Chang Y. Cephalometric evaluation of the anterior open bite treatment. *Am J Orthod* 1999; 115: 29-38.
5. Kim Y. Anterior open bite and its treatment with multi-loop edgewise arch wire. *Angle Orthod* 1987;57: 290-321.
6. Goto S, Boyd R L, Nielsen I L, Iizuka T. Case report: nonsurgical treatment of an adult with severe anterior open bite. *Angle Orthod* 1994; 64: 311-8.
7. Sato S. Case report: developmental characterization of skeletal Class III malocclusion. *Angle Orthod* 1994; 64: 105-11.
8. Enacar A, Ugur T, Toroglu S. A method for correction of open bite. *J Clin Orthod* 1996; 30: 43-8.
9. Burstone C J, James R B, Legan H, Murphy G A, Norton L A. Cephalometrics for orthognathic surgery. *J Oral Surg* 1978; 36: 269.
10. Tallas M, Tallas L, Baker R. Soft tissue profile changes resulting from retraction of maxillary central incisors. *Am J Orthod* 1987; 91:385-94.
11. Kucukkeles N, Acar A, Demirkaya A, Evrenol B, Enacar A. Cephalometric evaluation of open bite treatment with NiTi arch wires and anterior elastics. *Am J Orthod* 1999; 116:555-62.
12. Proffit W, Fields H. *Contemporary Orthodontics*. Mosby Year Book, second edition 1993.