Case Report

A modified three-piece base arch for en masse retraction and intrusion in a Class II Division 1 subdivision case

ABSTRACT

This case report describes the orthodontic treatment of an 18-year-old male patient who presented with the prognathic maxilla, deep bite, low mandibular plane angle, and proclined incisors. Modified three-piece base arch was used for the intrusion and retraction of maxillary incisor. En masse retraction was achieved in 6 months. Reduced time for retraction was attributed to a single stage of retraction, unlike burrstone three-piece intrusion base arch where canines are individually retracted followed by retraction of incisors. A modified utility arch was used in lower arch followed by a continuous archwire technique. The case was finished using bite settling elastics on a continuous archwire. The step between canine and premolar was corrected in the finishing phase of treatment. The final treatment outcomes were satisfactory, and true intrusion was achieved with proper selection of biomechanics.

Keywords: Biomechanics, intrusion, segmental mechanics, three-piece base arch

INTRODUCTION

In majority of orthodontic cases, routine treatment protocol has been applied. In a few special cases rather than conventional protocol, we need to choose different treatment mechanics. The "segmental mechanics" is very efficient in case of anterior crowding with deep overbite cases and flared incisors.[1] This article describes a modified three-piece base arch for simultaneous deep bite correction and en masse retraction. In case of severe anterior crowding, increased overbite, and horizontal growth pattern, the treatment with full-arch alignment stage directly is difficult.[2] Since uprighting of incisors often lengthens the crown vertically and increases the amount of overbite,[3] the use of segmental mechanics can be taken to get satisfactory results.[1,4,5]

CASE REPORT

Case 1

The present case report showcases the treatment results and biomechanics involved for en masse retraction and intrusion of anterior teeth using a modified three-piece base arch.

Diagnosis and treatment plan

An 18-year-old male patient in the permanent dentition presented with the chief complaint of crowded, overlapping, and forwardly placed anterior teeth. On extraoral examination, he had a convex profile, incompetent lips, and posterior divergence [Figures 1-5]. He had a Class II Division 1 subdivision malocclusion. The mandibular midline had shifted 2 mm to the right the facial midline. The overjet was 4.5 mm, and the overbite was 40%. A Class I molar relation on the right side and a Class II molar relation on the left side diagnosed as a Class II Division 1 subdivision case. A Class II canine relation was present on the right side [Figures 6-10]. No signs of root resorption were observed [Figure 11]. Cephalometric analysis [Figure 12] indicated a prognathic maxilla and normal

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Figure 1: Pretreatment extraoral frontal view

Figure 2: Pretreatment extraoral frontal smile view

Figure 3: Pretreatment extraoral oblique view

Figure 4: Pretreatment extraoral oblique smile view

Figure 5: Pretreatment extraoral right lateral profile view

Figure 6: Pretreatment intraoral right lateral view

mandible with upper and lower incisor flaring. The patient had a horizontal growth pattern and a reduced lower anterior facial height [Table 1].

Following a comprehensive clinical and database analysis, we devised a treatment plan involving extraction of the upper first premolars, lower left first premolar, and lower right second premolar to achieve a symmetrical buccal occlusion,

Figure 7: Pretreatment intraoral frontal view

Figure 8: Pretreatment intraoral left lateral view

Figure 9: Pretreatment intraoral maxillary occlusal view

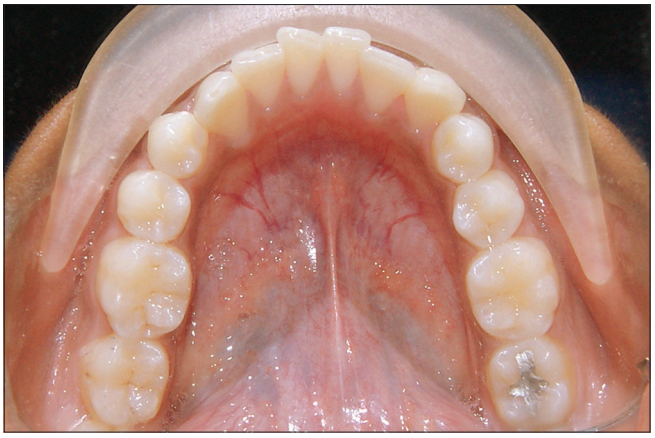

Figure 10: Pretreatment intraoral mandibular occlusal view

Figure 11: Pretreatment orthopantomogram

Figure 12: Pretreatment lateral cephalogram

coincident midline, appropriate overjet, and adequate retraction of the flared upper and lower incisors. Asymmetric extraction also helped achieve a Class I canine and molar relation on the subdivision side.

Treatment progression

Full-arch. 022" appliances were bonded, and leveling and alignment were carried out with continuous 0.016" heat-activated nickel titanium archwire [Figure 13]. Lace back and bendback were used. All the second molars were banded to increase the anchorage value of posteriors. This was followed by a 0.019" × 0.025" heat-activated nickel titanium wire [Figure 14]. Once the arches were aligned, a segmental approach was used to retract the anterior segment en masse. A different approach was used in upper as well as lower arch. A modified three-piece

base arch was used in the upper arch which consisted of the following:

Anterior segment

The rigid anterior segment consisted of a 0.021" × 0.025" stainless steel wire placed into the brackets of the incisors and canines bilaterally and stepped up gingivally distal to the canine brackets. The wire was then again bent to 90° slightly below the center of resistance. The angled posterior segment allows the intrusive and retraction force to pass through the center of resistance such that a complete bodily movement of the incisors could be achieved. The posterior extensions were adapted such that no soft tissue impingement was created [Figures 15-17].

Posterior segment

The posterior segments were consolidated bilaterally from first premolar to second molar using a passive stabilizing wire of 0.021" × 0.025" stainless steel wire [Figures 15-17].

The intrusion spring

The bilateral intrusion spring was made of 0.017" × 0.025" titanium molybdenum alloy (TMA) wire. The tip back bends were incorporated mesial to the auxiliary tube on the maxillary first molars, and the springs were inserted into the tube. The hooks which place an intrusion force on the anterior extension were engaged on the posterior extension of the anterior segment at a point distal to canine [Figures 15-17].

Distal force component (elastic chain)

An elastic chain is extended bilaterally from the molar hook to the posterior hook of the anterior segment. This small distal force directs the intrusive force, so its line of action of force passes through the center of resistance of the anterior segment. A tip-back moment is generated on the posterior segment. The anterior segment was retracted as a result of small tip back moment created. En masse retraction was competed in 6 months [Figures 15-17].

For the lower arch, a modified intrusion and retraction utility arch was used which consisted of incisors and canine made of 0.017 × 0.025" TMA wire. The utility arch was inserted in the auxiliary tube of the first molars bilaterally. Posterior segment consisted of segments from second premolar to second molar on the left side [Figure 15] and from first premolar to second

Figure 13: Continuous 0.016" heat-activated nickel titanium archwire

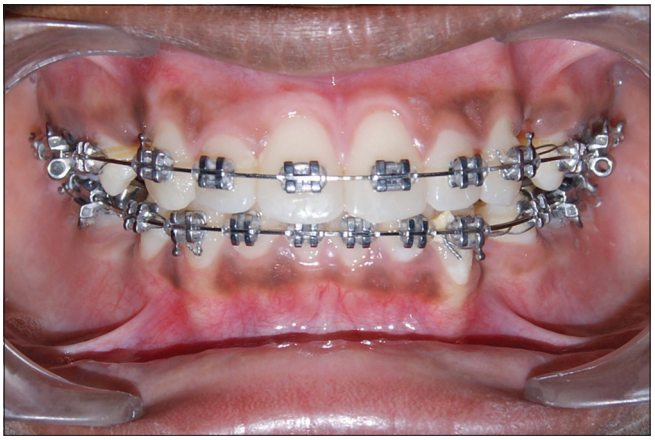

Figure 14: 0.019" × 0.025" heat-activated nickel titanium wire

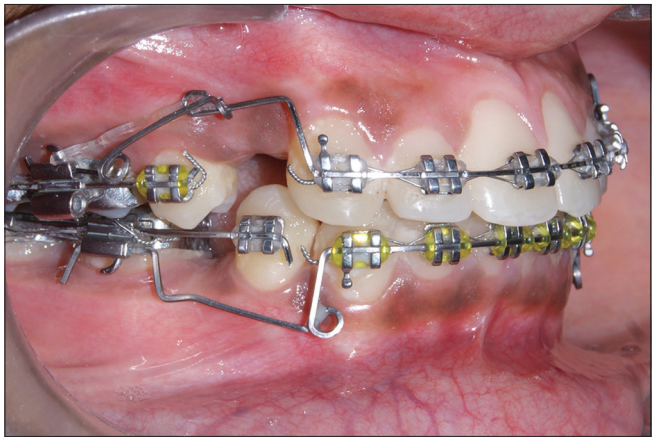

Figure 15: Modified three-piece base arch - right lateral view

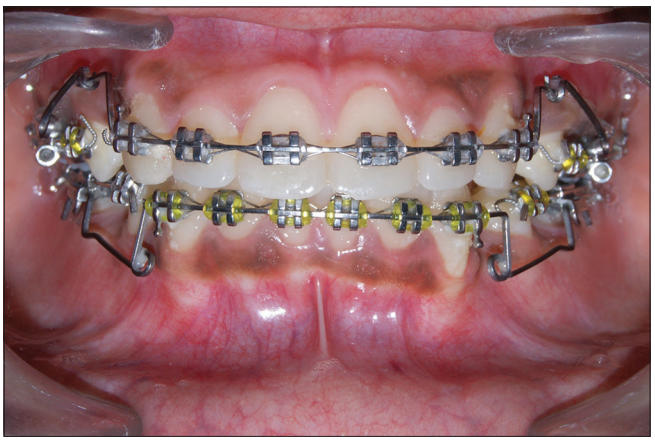

Figure 16: Modified three-piece base arch - frontal view

molar on the right side [Figure 17]. The curve of spee was corrected by the tip back moment from the utility arch. An e-chain was used from lower right first molar to first premolar to convert the subdivision side to Class I molar relation before retraction. After achieving a Class I molar on the subdivision side, a continuous archwire with friction mechanics was used to complete the case [Figures 18 and 19].

At the end of treatment, the patient had competent lips with reduced convexity of face [Figures 20-24]. Intraorally, a Class I molar relation bilaterally, Class I canine relation, 2 mm overjet, and 2 mm overbite with stable functional occlusion were achieved [Figures 25-29]. Posttreatment orthopantogram (OPG) and lateral cephalograms were taken at the end of orthodontic treatment [Figures 30 and 31].

DISCUSSION

Absolute intrusion, relative intrusion, and extrusion of posterior teeth are the three methods used for deep overbite correction. Relative intrusion is achieved by preventing the eruption of the lower incisor while ramal growth provides vertical space into which the posterior teeth erupt, whereas in the extrusion of the posterior of teeth mandible rotates down and back in the absence of growth.[6] As a general rule, extrusion is undesirable, while relative intrusion is acceptable during growing stage and absolute intrusion in nongrowing stage.[6] Bite opening with molar eruption is usually desired in low angle cases with deep overbite, whereas in high angle cases with a deep overbite, bite opening should be carried out with upper and lower anterior teeth intrusion.[7] Clinically intrusion is a difficult movement to achieve, and it requires three-dimensional controls. Intrusion mechanics basically depend on the initial inclination of the incisor. Clinically, pure bodily intrusion is difficult owing to the complexity of the movement. A slight change in the relationship of the line of action of the force with the center of resistance can change the type of movement,[8] if the forces pass anterior to the center of resistance the incisor protrude, which can be prevented with a light chain elastic.[7] Leveling by intrusion can be accomplished with continuous archwire

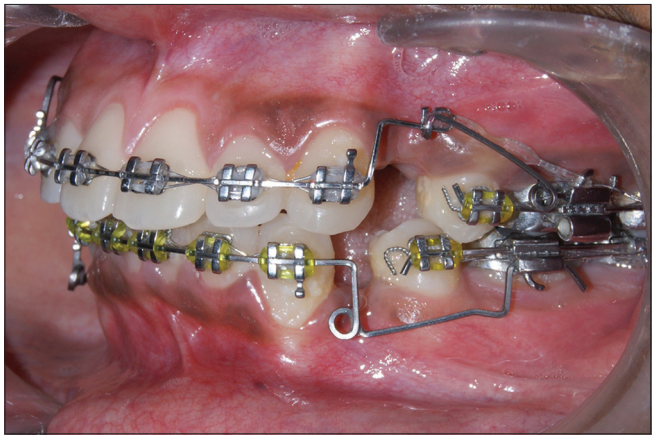

Figure 17: Modified three-piece base arch - left lateral view

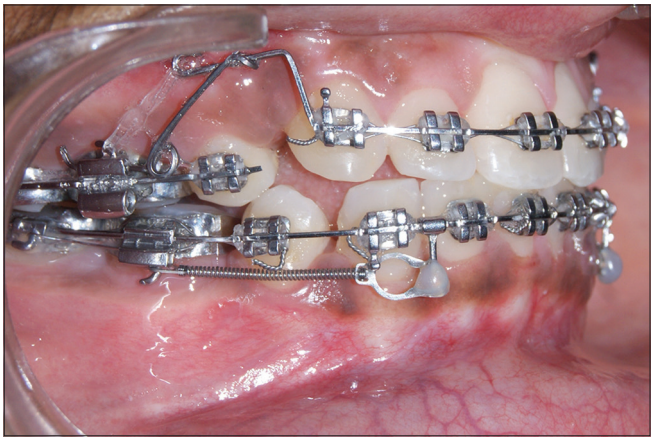

Figure 18: Continuous archwire in lower arch after achieving a Class I molar relation

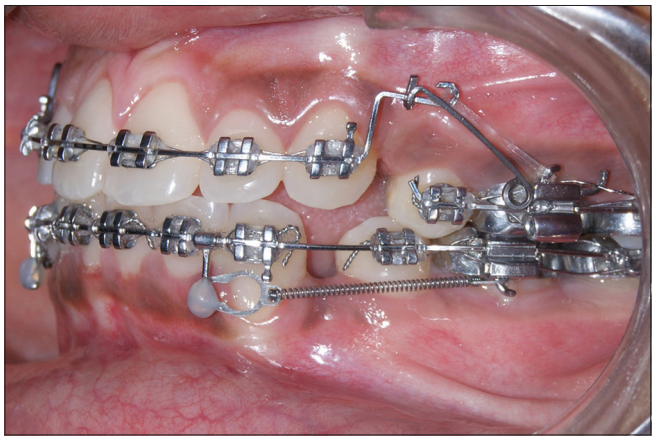

Figure 19: Continuous archwire - left lateral view

Figure 20: Posttreatment extraoral frontal view

Figure 21: Posttreatment extraoral frontal smile view

Figure 22: Posttreatment extraoral oblique view

Figure 23: Posttreatment extraoral oblique smile view

Figure 24: Posttreatment extraoral right lateral profile view

Figure 25: Posttreatment intraoral right lateral view

Figure 26: Posttreatment intraoral frontal view

that bypass the premolar and segmented archwire with auxiliary depressing arch.[6]

The key to successful retraction and intrusion is a light continuous force directed through the center of resistance of the anterior segment.[3] The low force also helps in minimizing root resorption. Approximately, 10 g of force per tooth is used for intrusion. The reactionary molar distal tipping and extrusion may occur due to intrusive force in anterior segment.[6,7,9] The molar extrusion rotates

Figure 27: Posttreatment intraoral left lateral view

Figure 28: Posttreatment intraoral maxillary occlusal view

Figure 29: Posttreatment intraoral mandibular occlusal view

Figure 30: Posttreatment orthopantomogram

Figure 31: Posttreatment lateral cephalogram

the mandible downward and backward which results in an increase of lower anterior facial height and worsening of the incisor lip relationship and soft tissue profile.[10] Ideal maxillary incisor display of 3 mm is recommended for good esthetics.[11] The occlusal forces normally can compensate for this bite opening because low-angle individuals have relatively strong chewing muscles.[12] Hence, in our case, modified three-piece base arch was selected for intrusion and retraction of upper anterior teeth. The most frequently used ones are two-step retraction where retraction of canine is followed by retraction of all four incisors and en masse retraction where retraction of all six anterior teeth is done simultaneously. The two-step retraction approach allows retraction of canine teeth independently, followed by retraction of incisors in the second step, and this helps to obtain a greater retraction of the anterior teeth by reducing the tendency of anchorage loss through incorporating more teeth in the anchorage unit.[6,13,14] However, closing spaces in two-steps might take a longer treatment time. In addition, when canines are retracted individually they tend to tip and rotate more than when the six anterior teeth are retracted as a single unit.[13-15] Therefore, a modified three-piece base arch was developed for en masse retraction to reduce the treatment time and have a better control over anterior and posterior segments. The cephalometric superimpositions revealed mild restraint in the growth of maxilla and a slight increase in the downward and forward advancement of the mandible [Figure 32]. The maxillary incisors were retracted palatally and intruded. The mandibular molars were slightly extruded and mesially moved. The mandibular incisors were retracted and intruded. The

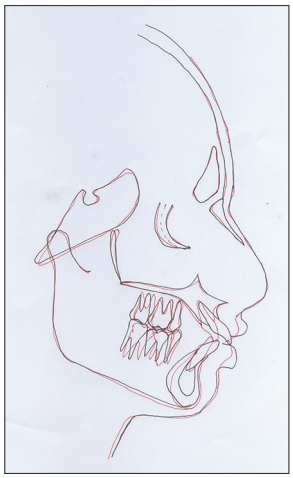

Figure 32: Pretreatment and posttreatment superimposition

end treatment results showed Class I molar and canine relation, ideal overjet and overbite [Figures 25-29], competent lips, and decreased incisal display at rest and smile. The postoperative OPG reveals parallel roots without any significant root resorption of upper anterior teeth [Figure 30]. The postoperative cephalometric values reveal mild restriction in the growth of maxilla, maintaining the mandibular plane angle, decreased interincisal angle, and decreased protrusion of lips [Table 1]. Comparing the pretreatment extraoral photographs [Figures 1-5] with posttreatment extraoral photographs [Figures 25-29], a significant improvement was seen in smile line, smile arc, lip competency, and profile.

Clinical significance

Simultaneous retraction and intrusion with three-piece base arch proves to be an efficient treatment mechanics in terms of time. Unlike the traditional three-piece base arch where a staged retraction in two stages was done, the modified base arch for en masse retraction does not require the canines to be retracted first. Furthermore, since canines receive an intrusion force along with incisor, the roots are placed more in the cancellous bone, and the interference from lower canine in the Class II side is avoided. This accelerates the en masse retraction.

CONCLUSION

A careful combination of treatment planning and biomechanics to correct deep overbite and proclined incisors can help to achieve a desirable esthetic result. The modified three-piece base arch is effective in controlled translation and intrusion of anteriors and would be a preferable mechanotherapy in low angle case with deep bite, proclined anteriors, and Class II canine relationship.

Table 1: Cephalometric values

	Pretreatment	Posttreatment
SNA (°)	86	84
SNB (°)	82	82
ANB (°)	4	2
Angle of convexity (°)	9	4
Wits AO/BO (mm)	2	2
FMA (°)	22	22
SN-GO-GN (°)	24	26
Y axis (°)	59	59
Jarabak's ratio (%)	70.7	72.32
LAFH (mm)	59	61
Gonial angle (°)	120	121
Base plane angle (°)	15	16
U1 to NA angle (°)	40	25
U1 to NA linear (mm)	9	4
U1 to FH (°)	130	118
U1 to SN (°)	126	113
L1 to NB angle (°)	40	26
L1 to NB linear (mm)	8	4
Interincisal angle (°)	96	124
Nasolabial angle (°)	99	105
S line to upper lip (mm)	2	−1
S line to lower lip (mm)	4	0
Lower lip to E-line (mm)	3	1

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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