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Case Report

Orthodontic management of a bimaxillary protrusion malocclusion using a continuous T-loop archwire

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ABSTRACT

Bimaxillary protrusion, which is characterised by proclined and protrusive upper and lower incisors, was identified early in the orthodontic profession as a highly unfavourable result of non-extraction treatment. Indeed, it is likely that Charles Tweed's legendary standing in our specialty stems from his effective treatment of bimaxillary protrusion and the subsequent improvements in face aesthetics. The treatment of a young woman with a significant bimaxillary protrusion is described in this case report. To minimise lip procumbency, four first premolars were removed, followed by the en-masse retraction and torque control of upper and lower anterior teeth using a continuous T-Loop archwire. The patient's facial aesthetics improved dramatically. Lip eversion and dentoalveolar protrusion were greatly improved, as was considerable retraction of the upper and lower lips. Mentalis strain was reduced when the lips were retracted, which enhanced chin projection. The dental proclination and facial esthetics were substantially improved.

1. Introduction

Bimaxillary protrusion is a condition marked by increased procumbency of the lips and protruding and proclined upper and lower incisors. African-American[1–4] and Asian[5,6] populations are the most likely to experience it. Bimaxillary protrusion is a complex genesis that includes environmental influences such tongue and lip habits, mouth breathing, and tongue volume in addition to a hereditary component.[7]

The main features of patients presenting bimaxillary protrusion are malocclusion with dentoalveolar flaring of both the maxillary and mandibular anterior teeth that cause protrusion of the lips and produce a convex facial profile. Bimaxillary protrusion is often accompanied by various degrees of lip incompetence (defined as a resting lip separation of more than 4 mm), mentalis strain, gummy smile, and in some cases with anterior open bite.[8]

Conventional orthodontic therapy is a successful treatment option for adults and growing patients with bimaxillary protrusion. Orthognathic surgery is often required for many adult patients in order to get the best possible aesthetic outcome.[9] However, because of the cost,

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the possibility of problems, and the postoperative morbidity, some individuals are resistive to orthognathic surgery.

Many patients choose traditional orthodontic therapy, which involves the retraction and retroclination of the maxillary and mandibular incisors, resulting in a decrease in soft tissue procumbency and convexity of the facial profile, despite the possible aesthetic benefits of surgery. This is most commonly achieved by the extraction of the maxillary and mandibular first premolars followed by the retraction of anterior teeth using maximum anchorage mechanics so that the anterior teeth are maximally retracted using all the extraction space available teeth to a more favorable position within the basal bone. It is rather well accepted by clinicians that the extraction of four first premolars can be effective in the treatment of bimaxillary protrusion.[10–12]

2. Case Report

A review of the patient's medical, dental, and family histories revealed no significant findings. The facial profile was convex, and difficulty with lip closure (lip incompetence) was evident (Figure 1), although no functional problems were apparent. Intra-oral photographs showed an Angle Class I molar relationship with slight mandibular anterior crowding and malocclusion with severe dentoalveolar protrusion. Overjet was 7 mm, overbite was 3.5 mm, and the mandibular dental midline was shifted 1 mm right to the maxillary dental midline. Incisor exposure at rest was 6 mm and excessive circumoral musculature strain was observed on lip closure.

Lateral cephalometric analysis (Figure 2) indicated a slight Skeletal Class II jaw base relationship with an ANB angle of 6° and an average Frankfurt mandibular plane angle (FMA) of 23°. The upper incisors were flared (U1-FH: 121°). Steiner analyses indicated that U1 to NA was 7 mm and that LI to NB was 9 mm, indicating intense labial position of the maxillary and mandibular incisors. Based on these data, the patient was diagnosed as having Angle Class I bimaxillary protrusion with mandibular anterior crowding. Orthopantomogram (OPG) revealed mesio-angular impactions of both the mandibular third molars with no periapical pathologies detected.

2.1. Treatment objectives

The treatment objectives included:

1. To correct the protrusion of the maxillary and mandibular anterior teeth.
2. To achieve an ideal overjet and overbite while maintaining the molar's in neutrocclusion.
3. To reduce lip protrusion, establish lip competency and improve facial aesthetics.

2.2. Treatment options

Based on the post-pubertal age of the patient, three treatment approaches were prescribed and defined to the patient:

1. Surgical: Orthodontic decompensation followed by the orthognathic surgical approach of Lefort I Osteotomy with posterior impaction of the maxilla in combination with BSSO (Bilateral Sagittal Split Osteotomy) or maxillary and mandibular anterior subapical osteotomies (ASOs).
2. Distalization: Orthodontic Camouflage treatment with the surgical extraction of all the third molars followed by the total arch distalization with Infra-zygomatic Crest (IZC) bone screws and mandibular buccal screws (MBS).
3. Premolar Extraction: Orthodontic Camouflage treatment undertaking extraction of four 1st bicuspids and en-masse retraction of the upper and lower anterior segments.

2.3. Treatment plan

For the present case, premolar extractions were performed as the patient did not accept treatment options 1 and 2 owing to their invasiveness and the financial requirements. The primary goal of the treatment plan proposed was to achieve the utmost possible retraction of the maxillary and mandibular arch and its dentition in order to improve the skeletal, dental and soft tissue parameters. Levelling and aligning along with the torque correction of the maxillary and mandibular anterior teeth in addition to anchorage augmentation were the essential part of the overall treatment plan. Furthermore, biomechanical considerations were planned to provide vertical control and execute intrusive mechanics of the anterior segment so as to prevent the extrusion of the incisors during retraction and exacerbation of the gummy smile.

2.4. Treatment progress

Bonding of the dentition was done by using MBT 0.022" × 0.028" slot metal bracket system from 3M™ Unitek™ Gemini. Molar bands were cemented on the upper and lower first molars and bonded buccal tubes were attached to the upper second molars. A soldered transpalatal arch (stainless steel archwire, 0.032-in) was placed on banded 1st molars to enhance the anchorage. Extraction of 14, 24, 34 and 44 was done. Alignment and levelling were carried with 0.012, 0.014, 0.016 and 0.018-in NiTi archwires; and 0.017 x 0.025-in NiTi and stainless steel rectangular archwires. En-masse retraction was performed using the upper and lower continuous T-loop (0.017 × 0.025-inch) TMA archwires with off-centred retraction loop. When a T-loop is placed eccentrically in the space to be closed, the moment, is

higher on the tooth closer to the loop.[13] The T-loops were therefore placed close to the molars for maximum anchorage approximately 3 mm posteriorly in relation to the inter-bracket distance, about 1/3 the distance from canine to molar (keeping a B/L ratio of 0.63) to obtain a moment differential, bypassing the premolar brackets, inserted in the utility arch tube with rigid stabilizing archwires (0.016 × 0.022-inch stainless steel) from second premolar to second molar. Additionally, the anterior and posterior legs of the T-loop were bent 45° to encourage mesial roots movement and extrusion of molars and controlled distal crown tipping and intrusion of anterior teeth. The vertical (extrusive) force along the beta segment were balanced by the occlusal forces.[14] Anterior torque was added to the upper and lower T-loop archwires without having them to be removed from the mouth by making equal "V" bends in the gingival portions of each T-loop on both the sides with an omega-loop-forming plier or a three-pronged plier (Figure 3). The T-loop was activated 3 mm initially and reactivated when a space of 1.5 mm was closed, and this procedure was repeated a couple of times until the extraction space was completely closed in 10 months. After closing spaces, finishing and detailing was done using 0.017 × 0.025 inch TMA archwires to ensure good lingual root torque of the retracted anterior teeth. For occlusal settling, 5/16-in 4.5 oz intermaxillary elastics were used. After 18 months of orthodontic treatment, a Class I molar occlusion with no rotations, crowding or spacing and acceptable overbite and overjet were achieved, with a well-balanced face. All the fixed appliances were removed, and Begg-type retainers were then fabricated for both the arches. A minimum of 1-year retention period and quarterly follow up was counselled to the patient.

Figure 1: Pre-treatment extra-oral and intra-oral records.

The Extraoral photographs demonstrated an acceptable facial balance with improved lip protrusion and an acceptable smile without gingival exposure, while the

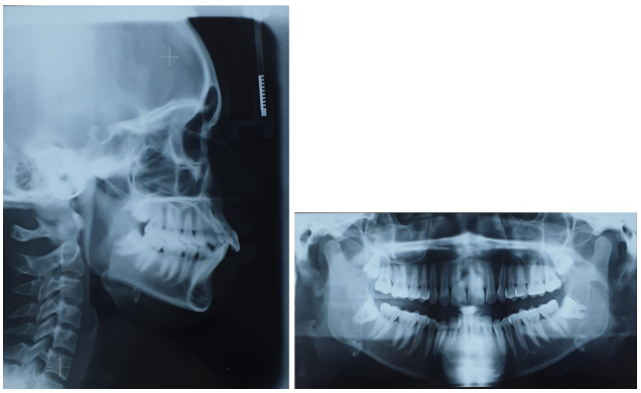

Figure 2: Pre-treatment lateral cephalogram and OPG records.

Figure 3: Treatment mechanics with continuous (0.017× 0.025-inch) TMA T-Loop and mid-treatment records.

Figure 4: Post-treatment extra-oral and intra-oral records.

Intraoral photographs showed acceptable occlusion and proper overbite and overjet, and Class I molar and canine relationships (Figure 4). Panoramic radiography after treatment showed satisfactory root paralleling and no pathological findings (Figure 5). Lateral cephalometric analysis and comparison indicated an improvement in the skeletal, dental and soft tissue parameters as depicted in the Figure 6. A reduction in the sagittal skeletal discrepancy was confirmed by the distal movement of the Point A and a reduction in ANB angle by 3°. Minor reduction in vertical

SKELETAL	MEAN	S.D.
SNA	81.08	3.7
SNB	79.17	3.8
ANB	2.46	1.8
Bjork sum	397.16	3.6
FMA	25	4.0
Gonial angle	124.31	5.4
APDI	85.74	4.0
ODI	72.15	5.5
Combination factor	157.9	6.5
A to N-Perp(FH)	0.4	2.3
B to N-Perp(FH)	-3.5	2.0
Pog to N-Perp(FH)	-1.8	2.5
FH to AB	81	3.0
A-B to mandibular plane	69.3	2.5
Wits appraisal	-0.33	2.7
DENTAL		
Overjet	2	2.0
Overbite	2	2.0
U1 to FH	113.8	6.4
U1 to SN	105.28	6.6
U1 to UOP	55	4.0
IMPA	90	3.5
L1 to LOP	66	5.0
Interincisal angle	128	5.3
Cant of occlusal plane	9.3	3.8
U1 to NA(mm)	4	3.0
U1 to NA(deg)	22	5.0
L1 to NB(mm)	4	2.0
L1 to NB(deg)	25	5.0
Upper incisal display	2.5	1.5
SOFT-TISSUE		
Upper lip to E-plane	0	2.0
Lower lip to E-plane	0	2.0
Nasolabial angle	95	5.0
Extraction Index	153.8	7.8

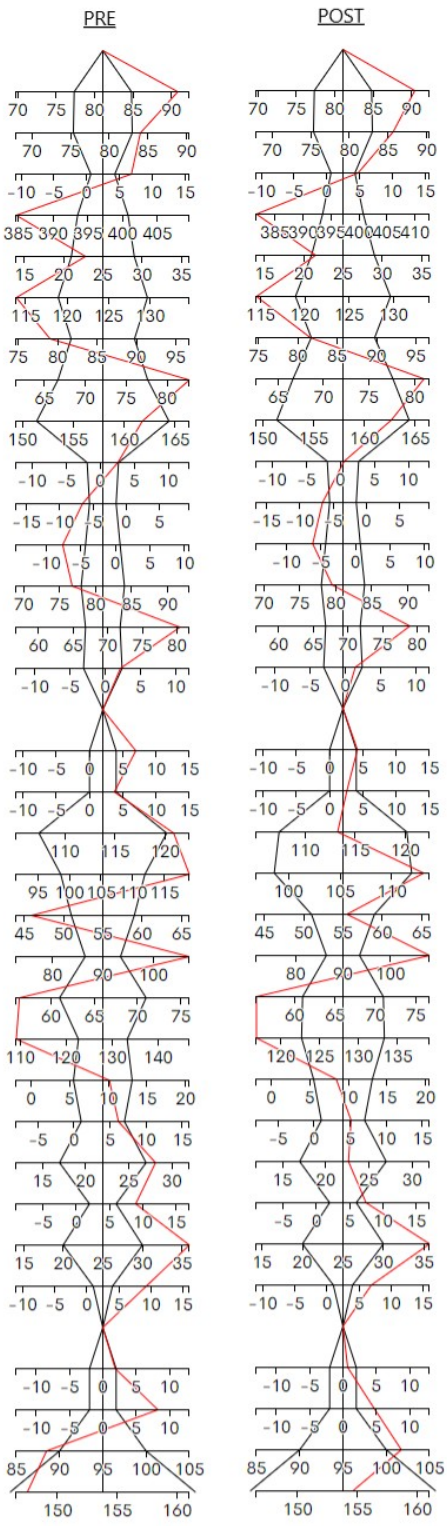

Figure 6: Pre-treatment and post-treatment cephalometric values.

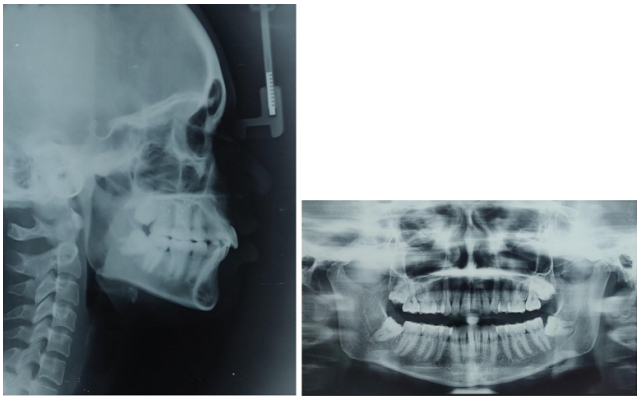

Figure 5: Post-treatment lateral cephalogram and OPG records.

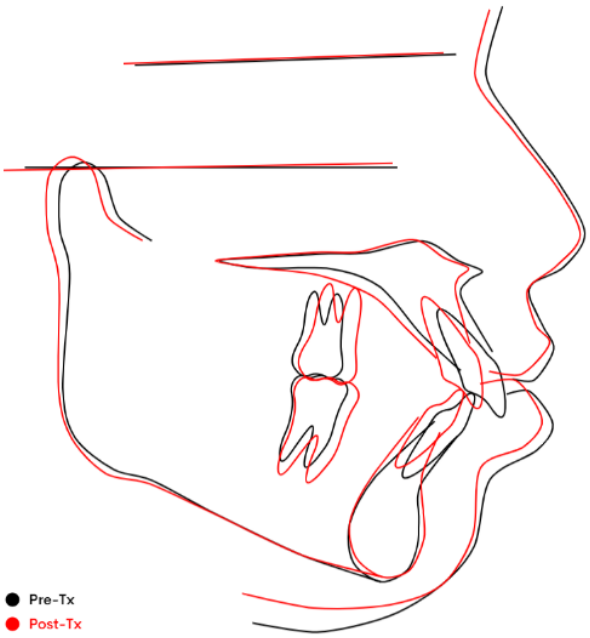

Figure 7: Pre-treatment and post-treatment cephalometric tracing superim position.

angulation confirms the maxillary intrusion and forward auto-rotation of the mandible. Some degree of anchorage burnout within the limits of maximum anchorage (25% loss) was also noticed. Improvement in the axial inclination of upper and lower anterior teeth along with the reduction in the incisor exposure of the maxillary anterior teeth suggests adequate torque control by the continuous T-Loop archwires and can be well appreciated in cephalometric tracing superimposition (Figure 7), respectively.

3. Discussion

Retraction of the incisors and extraction of the premolars are possible ways to accomplish lip procumbency reduction when desired in cases of bimaxillary protrusion, according to Kocadereli's research.[15] Multiple regression analysis has shown that the retraction of both upper and lower incisors by 1 mm results in a 0.44mm retraction of the upper and lower lips.[16] Since mesialization of the posterior section may impair anterior tooth retraction, the orthodontist's primary concern is anchoring maintenance. When supplementary appliances are used to manage anchoring in conjunction with canine retraction, clinicians have recorded mesial molar displacement ranging from 0 to 2.4 mm.[17–20] There has been reports of 1.6 to 4 mm of mesial molar displacement during canine retractions using conventional mechanics when supplementary appliances are not emloyed.[17,21] Adjunctive appliances, including a transpalatal bar, a Nance holding arch, palatal implants, or extraoral traction, are typically required to improve anchoring. Alveolar bone, teeth, dental arches, palatal and mandibular basal bones, differential moment mechanics, Class II elastics, and lip musculature are examples of intraoral sources of anchoring.[18]

Therefore, the need of limiting the mesial mobility of the maxillary and mandibular molars until the crowding and bimaxillary protrusion deemed maximum anchoring essential in this particular case. A transpalatal arch given by Goshgerian was used in our case as it is economical, easy to fabricate, and a reliable method to augment anchorage.[22] Furthermore, maximum anchorage was maintained by applying a larger moment on the anchor teeth. An important attribute of the T-loop is the possibility of obtaining, with different pre-activations or with the eccentric positioning, differential moments or differential forces,[2] to achieve a differential space closure.[13] Positioning the retraction T-loop toward posterior teeth in the en-masse case produces an extrusive force and a greater moment on the posterior teeth. At the same time, it produces an intrusive force and a smaller moment on the anterior teeth. As a result, molars experience extrusion and molar roots tip mesially (molar tip-back enhancing anchorage) and anterior teeth tip distally in a controlled manner. The outcome of this treatment coincides with the findings of Kuhlberg and Priebe who concluded that the force system of off-centred retraction T-looped archwire does predict the tooth movement response.[23] The effect of T-loop placement is similar to that of off-centred V-bends, which also produces a greater moment on the closest tooth.[24]

In the present case, a continuous retraction T-Loop archwire (0.017×0.025-inch) was fabricated from titanium molybdenum alloy (TMA) for en-masse retraction of the upper and lower anterior segments, as it is expected to deliver a lighter force with low load deflection rate. The use of such light force also decreases the risk of root resorption during retraction. In fact, TMA releases 42% less force than stainless steel; thus, normally stainless-steel alloys are not

the first choice for the T-loop.[25] To reduce root resorption, especially during intrusion, only modest pressure should be applied. Burstone states that 20 g of force is advised for anterior tooth intrusion.[26]Moreover, it must be noted that the force systems that are identical in magnitude but opposing in direction are applied to two teeth by a segmental wire. On the other hand, when more than two teeth are connected to an archwire, next to the extraction space, they are impacted by the restrictions of their neighbouring teeth, therefore these two kinds of appliances have different force systems.[27] Also, reactivating the loop too soon will simply cause only the controlled tipping of the teeth; reactivating it too frequently will not be beneficial. It is necessary to permit the M/F ratio to rise in order to generate translation.[28]Notwithstanding its popularity, en-masse retraction using T-loop archwire is a technique-sensitive procedure that necessitates precise bending and T-loop placement in various anchorage preparation conditions. To maintain the necessary kind of anchoring, it may be necessary to fabricate many T-loop archwires and closely monitor the location of the T-loop. In order to reduce the possibility of anchoring loss during treatment, it is crucial to take the precaution of keeping an eye on the T-loop's position and design.

Because no anterior gaps were produced during en-masse retraction, as is typically the case with two-step retraction therapy, the patient experienced better esthetics during the procedure and the treatment took less time overall. There is less room for the tongue when the anterior teeth are retracted. The anterior teeth may relapse as a result of these modifications. Therefore, following the retention period, a re-examination of these patients is required to assess the stable placements of both hard and soft structures.

4. Conclusion

Bimaxillary protrusion is frequently reported in the Asian population. All four first premolars are extracted as part of a traditional orthodontic treatment plan, and the anterior portions are then retracted to lessen dental and soft tissue protrusion. In the presented case, a positive soft tissue response was obtained after the fixed appliance therapy. The patient's profile improved, showing reduced mentalis strain, less lip eversion and protrusion, and less lip procumbency. Because the mandibular and maxillary incisors were up-righted following retraction and space closure, the interincisal angulation greatly improved dentally. When employing continuous loop archwires for en-masse retraction in sliding mechanotherapy, torque management of the incisor's during retraction is crucial since it demands precise loop location and bending to obtain the appropriate moment.

5. Conflict of Interest

None.

6. Source of Funding

None.

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