Correction of Bimaxillary Protrusion with Four First Premolar Extractions and T-Loop Mechanics: A Case Report

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ABSTRACT

Bimaxillary protrusion is a condition characterized by proclined upper and lower incisors with an increased prominence of the lips. This is a case of a 18-year-old with bimaxillary protrusion, mild crowding on the maxilla and mandible, and mandibular dental midline shift to the left by 1 mm. The four first premolars were extracted using a pre-adjusted bracket. This bracket had in-built prescriptions of torque, tip, and in-out for orthodontic cases. There were three pre-adjusted orthodontic bracket systems: Andrews, Roth, and MBT. T-loop was also used to achieve controlled space closure. After 26 months of orthodontic treatment, the patient's profile was straighter and a pleasant smile was achieved at the end of treatment.

Keywords: bimaxillary protrusion, frictionless mechanics, extraction, space closure

INTRODUCTION

Bimaxillary protrusion is a condition characterized by proclined upper and lower incisors with an increased prominence of the lips. It is a malocclusion frequently encountered in persons of American-African descent and Asian populations.[1] Because of the negative perception of protrusive dentition and lips in most cultures, many patients with bimaxillary protrusion seek orthodontic care to decrease this protrusion.[2] The etiology of bimaxillary protrusion is multifactorial involving genetic and environmental. The environmental factors include mouth breathing, tongue thrusting habit, and tongue volume.[3]

When bimaxillary protrusion occurs in a Class I malocclusion the overjet is increased because of the angulation of the incisors. Management is difficult because both upper and lower incisors need to be retroclined to reduce the overjet.[4] This can be achieved by the extraction of the first four premolar teeth to achieve normal overjet, and followed by retraction of anterior teeth. Therefore, the goal of these treatment plans was also to gain a satisfactory facial profile.[5] The retraction of anterior teeth during space closure can be achieved by two mechanisms (a) friction (sliding) mechanics and (b) frictionless (loop) mechanics. Various loops are used in frictionless mechanics such as T-loop, vertical loop, boot loop, teardrop loop, delta loop, omega loop, and mushroom loop.[1]

This case report used T-loop for frictionless mechanics because it is simple, economic, easy to fabricate, and easy to activate.[1] The T-loop described by Burstone and

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subsequently refined or modified is a simple and effective device for controlled space closure. The main principle of loop design is increased stiffness of the wire on anchorage side of the spring.[6] The T-loop has been proposed to control anchorage movement during space closure because it has differential moments between anterior and posterior segments. The desired tooth movement can be obtained by modifying the angulation of the pre-activation bends, the dimensions of the springs, and the position of the T-loop.[7] The main characteristic of the T-loop is the possibility of obtaining, with different pre-activations or with the irregular positioning of the spring, differential moments or forces to achieve controlled space closure.[8]

CASE REPORT

A Javanese 18-year-old woman came to the Orthodontic Clinic at the Faculty of Dental Medicine Universitas Airlangga Dental Hospital with concerns on her protrusion teeth that affected her confidence when smiling. The profile photographs taken before treatment showed a symmetric face. Her facial profile was convex. The lips were incompetent (Figure 1). The intraoral examination showed bimaxillary protrusion and mandibular dental midline shift to the left by 1 mm with normal overjet and overbite. The degree of crowding on maxilla and mandible were mild. Her oral hygiene and periodontal tissues were good. All teeth were present (Figure 2).

The lateral cephalometric analysis showed a pattern of skeletal Class I malocclusion with SNA 78° and SNB 75° considered as smaller than normal range for both, convex skeletal profile, proclined maxillary and mandible incisors, and high angle face pattern. A panoramic radiograph showed impacted mandible third-molars (Figure 3). According to the patient, her father had a similar convex profile with protrusion teeth and the patient did not have bad habits from earlier anamnesis that could affect this case.

The treatment objectives were to improve the occlusion, including correction of the bimaxillary protrusion as well as the mandible midline shift and to achieve an ideal profile with competent lip. The ideal treatment for bimaxillary protrusion was extraction of the four first premolars with mini screws (Temporary Anchorage Devices / TADs) for maximum anchorage. However, patient refused to have TADs application as she was afraid that she would not feel comfortable with the procedure. She chose to have frictionless mechanic instead, which was T-loop for space closure after four first premolar extractions.

Treatment Planning and Treatment Progress

In this case, the pre-orthodontic treatment was extraction of the four first premolars. The patient had a bimaxillary protrusion with anterior mild crowding. By extracting the four first premolars before bracket bonding, the extraction space was used to correct bimaxillary protrusion and retract both anterior maxilla and mandible.

The treatment used the preadjusted technique with MBT 0.022 and buccal tubes on four first molars. The first step progressed as alignment and leveling with 0.012, 0.014, 0.016 NiTi followed by 0.016 x 0.016, and 0.016 x 0.022 NiTi for three months. The second steps were four canine retraction using elastomeric chains with 0.016 x 0.016 SS and V-stop added on mesial four first molars. Uprighting on the second molar mandibular was not done due to the

Figure 1. Pre-treatment extraoral photographs. Facial photos of **(A)** frontal view at rest, **(B)** during smiling, and **(C)** lateral view.

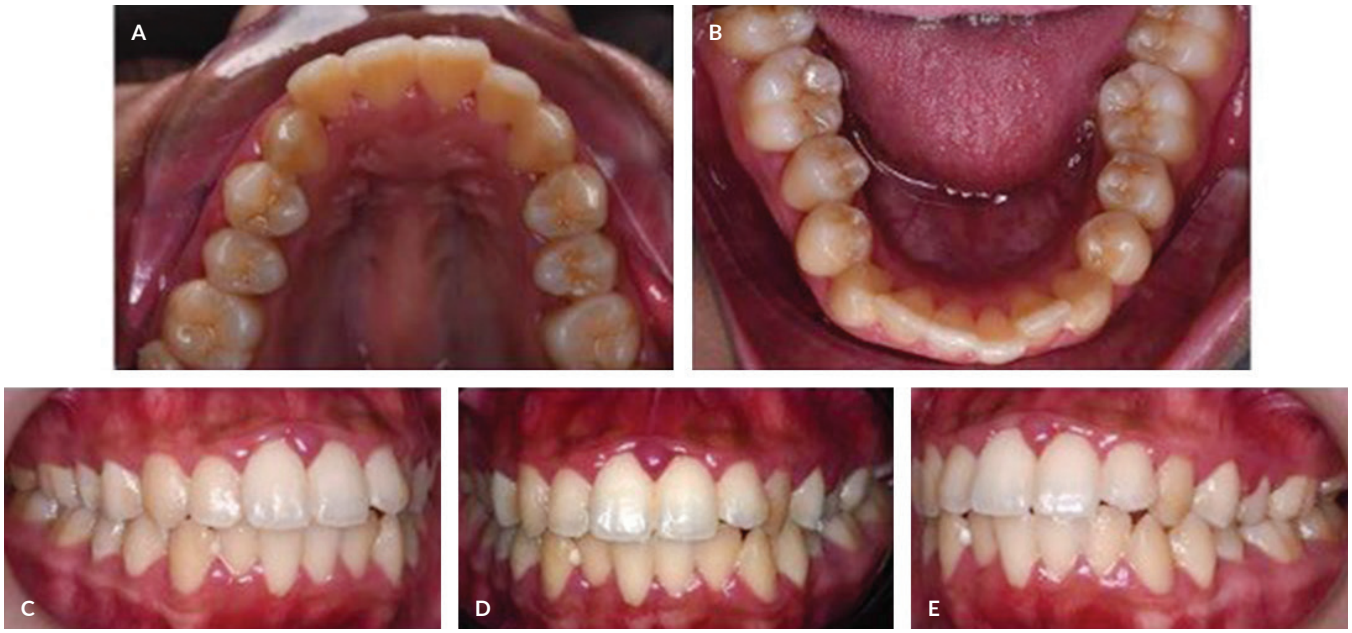

Figure 2. Pre-treatment intraoral photographs. Intraoral view of **(A)** upper occlusal, **(B)** lower occlusal, **(C)** right lateral, **(D)** frontal, and **(E)** left lateral

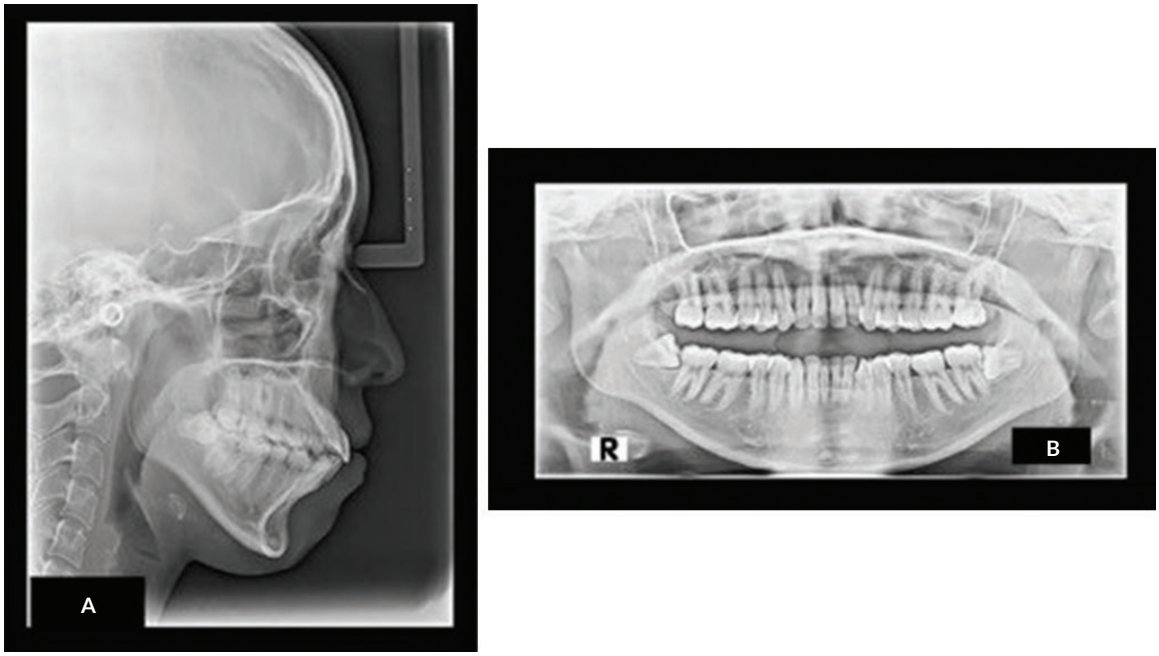

Figure 3. Initial **(A)** lateral cephalometric and **(B)** panoramic radiographs.

impacted 38 and 48. Impacted 38 and 48 molars needed to be removed, but due to the COVID-19 pandemic, patient refused to do odontectomy and will do it once the pandemic conditions are safe. This canine retraction was achieved in seven months. The third step was anterior retraction with 0.017 x 0.025 using frictionless mechanic, which was T-loop on the maxilla and mandible (Figure 4). The last step was arch compatibility.

Results of Orthodontic Treatment

After 26 months of orthodontic treatment with a control appointment every three weeks, the brackets and buccal tubes were debonded and clear retainers were used for stability on both upper and lower arches. The patient also had received informed consent and agree to the publication regarding the photograph from this case. A straighter soft tissue profile and a pleasant smile were

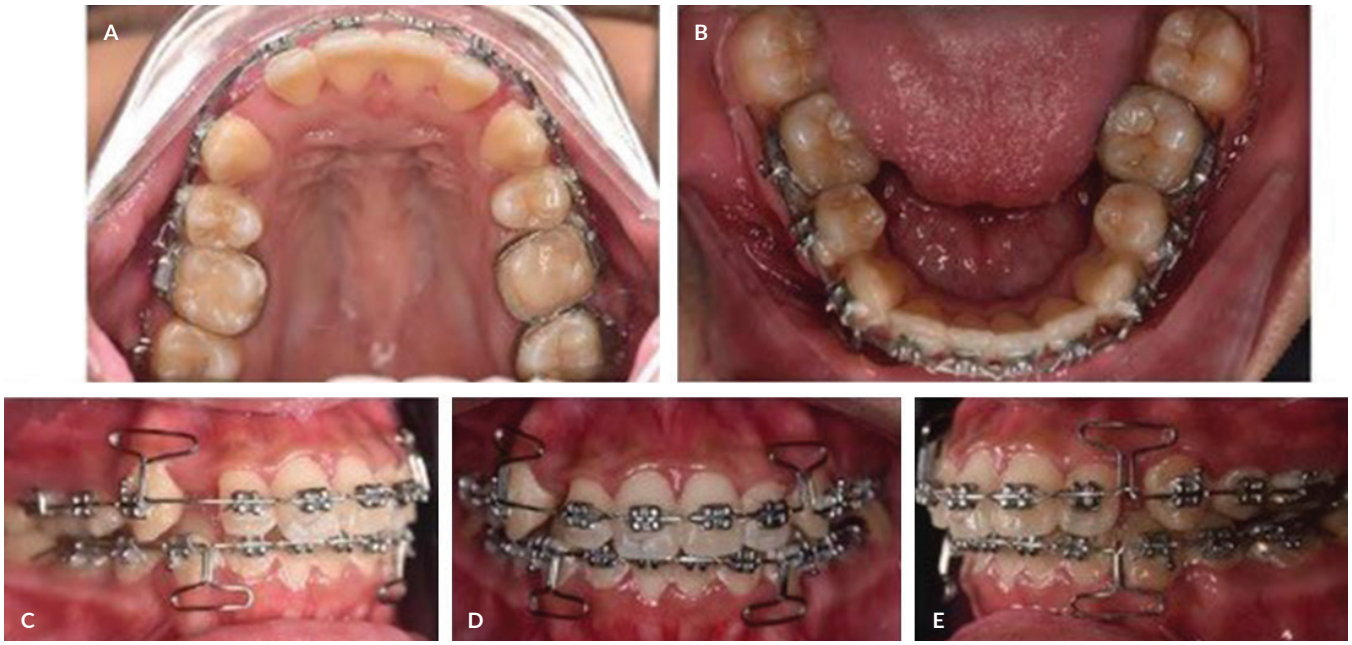

Figure 4. Canine retraction using T-loop. Intraoral view of **(A)** upper occlusal, **(B)** lower occlusal, **(C)** right lateral, **(D)** frontal, and **(E)** left lateral.

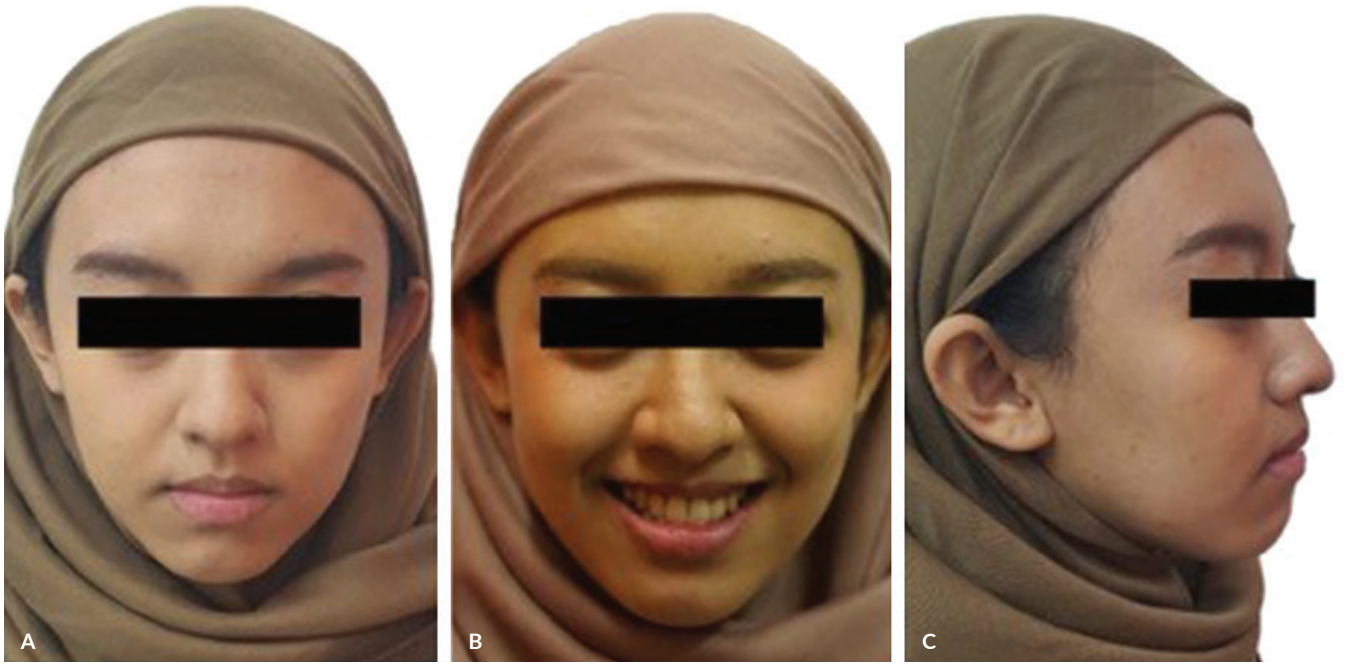

Figure 5. Post-treatment extraoral photographs. Facial photos of **(A)** frontal view at rest, **(B)** during smiling, and **(C)** lateral view.

achieved at the end of the treatment (Figure 5). An ideal overjet and overbite were obtained. Six keys of Andrews were achieved. Bimaxillary protrusion and mandible midline shift were also corrected (Figure 6). A lateral cephalometric radiograph showed changes in skeletal, dental, and soft tissue parameters and revealed satisfactory result of tooth paralleling (Figure 7).

DISCUSSION

According to Ardani (2020), skeletal Class I malocclusion is common among the Javanese population.[9] Meanwhile, bimaxillary protrusion is common in Asian population. In this case, the patient presented with incompetent lips caused by bimaxillary protrusion. Previous research from

Figure 6. Post-treatment intraoral photographs. Intraoral view of **(A)** upper occlusal, **(B)** lower occlusal, **(C)** right lateral, **(D)** frontal, and **(E)** left lateral.

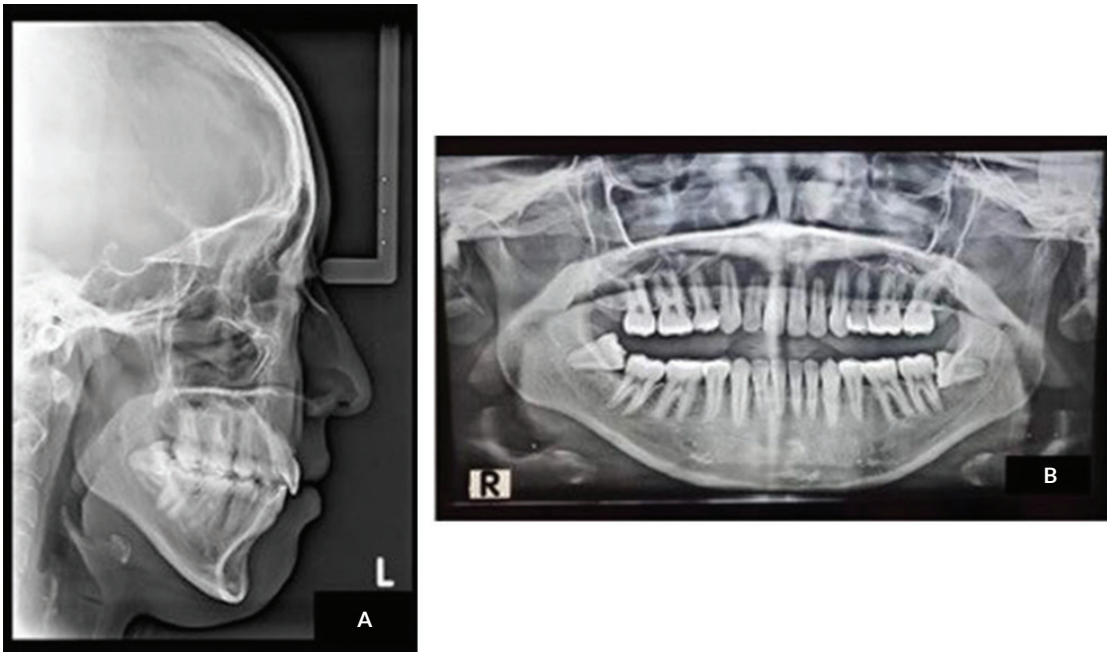

Figure 7. Post-treatment **(A)** lateral cephalometric and **(B)** panoramic radiographs.

Kocadereli in 2002, found that if a decrease of lip protrusion is advantageous, extracting premolars and retracting incisors is a possible option to achieve this objective. The treatment goal is to achieve an ideal occlusion.[1,10]

For the pre-orthodontic treatment, extraction of the four first premolars were done because the relation for first molar and canine were both Class I malocclusion angle. The next step was space closure. Space closure is one of the most complex steps in orthodontic treatment. The biomechanical basis of space closure allow the orthodontist to establish anchorage and treatment options. Frictionless mechanic was chosen and T-loop was used for this case.[11] The T-loop has been acknowledged as an effective spring to obtain controllable tooth movement between the anterior and posterior segments. Even though TADs have been broadly used for anchorage auxiliaries, there are uncertain

factors such as anatomical limitation and the probability of failure especially for this bimaxillary protrusion case. It needs different mechanics to improve the occlusion and achieve an ideal profile with competent lips, as well as to avoid deep bite.[7] Meanwhile, a sliding mechanic tends to make anchorage loss. Therefore, T-loop was chosen because this case did not use lingual arch as anchorage enhancement.[12] When space is to be closed symmetrically, 0.017 x 0.025 T-loop is used. Before the T-loop is inserted, it needs to be pre-activated as follows, curvature is bent in the occlusal part of the spring. The part of the spring may deform during activation and needs to be overbent and followed by a trial activation. The T-loop on the template was rechecked, which was a guide for the required angulation (Figure 8).[13]

When the 0.017 x 0.025 spring is activated, the T-loop will be centered between the buccal and anterior segment. When reactivation is needed, both of the anterior and posterior arms can be shortened if the T-loop is to be centered. For the anterior retraction, torque was added to control apex movement. The intrusion was not performed because the overbite was normal. The pre-activated loop is important especially when maxilla and mandibular retraction were needed. When the T-loop is activated, the orthodontist has three control variables that regulate tooth movement: (1) the moment-to-force ratio (M/F), (2) the force and moment magnitudes, and (3) the consistency of these forces.

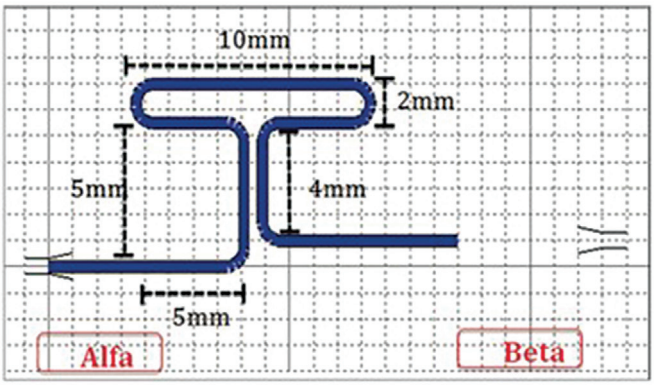

Figure 8. T-loop characteristics, according to Burstone (Viecilli, 2018).[8]

The M/F ratio forms the tooth movement, which is the location of the center rotation. The force-moment magnitudes and forces consistency determined the quantitative clinical response. A T-loop without pre-activation created a low M/F ratio that is less than the vertical dimension of the T-loop.[14]

Analysis from lateral cephalometric radiograph is shown in Table 1. The angle of convexity showed improvement from -2˚ to 0˚ and the interincisal angle was also improved from 97˚ to 132˚. Dental parameters showed that the upper incisor to NA line angle and lower incisor to NB line angle

Table 1. Cephalometric analysis pre-treatment and post-treatment

Measurement	Mean	SD	Pre-treatment	Post-treatment
Horizontal Skeletal				
SNA (°)	82	2	78	78
SNB (°)	80	2	75	74
ANB (°)	3	2	3	4
Angle of convexity	0	5	9	5
Mandibular plane angle	24	5	35	35
Facial Axis	-3.65	3.6	-5.8	-5.8
Vertical Skeletal				
Y-axis (°)	60	6	69	68
Anterior Dental				
Interincisal angle (°)	135	10	97	132
U1-palatal plane (°)	109	6	129	130
L1-mandibular plane (°)	90	4	83	84
I-NA angle	22	10	36	18
I-NB angle	25	7	44	25
Tweed Analysis				
FMA	25	10	36	37
FMIA	65	10	38	59
IMPA	90	5	106	84
Soft Tissue				
Upper lip-E line (mm)	1	2	2	2
Lower lip-E line (mm)	0	2	1	1

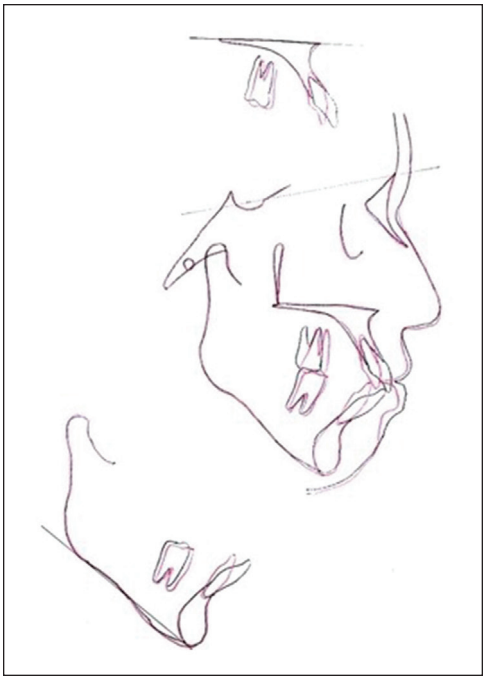

Figure 9. Superimposition of lateral cephalometric on pre- *(black)* and post-treatment *(red)*. Note changes in maxilla and mandibular incisor angulation and the lip position.

decreased from 36˚ to 18˚ and 44˚ to 25˚, indicating that the occlusal plane was improved. Tweed analysis showed significant change in IMPA from 106˚ to 84˚. Soft tissue parameters showed that the positions of upper and lower lip positions were also improved and confirmed in lateral cephalometric superimposition (Figure 9). The overall result showed an improvement of the occlusion, including correction of the bimaxillary protrusion as well as mandible midline shift, and an ideal profile with a competent lip.

CONCLUSION

Bimaxillary protrusion is a complex case. This case showed that Angle Class I malocclusion with bimaxillary protrusion that results in incompetent lips treated with fixed orthodontic appliance and extraction of four premolars generated a great outcome. Appliance and assessment selections are needed in this case; in particular, bracket prescription, wires, techniques for leveling-aligning as well as T-loop preactivated-activated, and anchorage. These are important to obtain an optimal result.

It is indicated that an appropriate treatment plan should be taken into consideration to provide good progress. The treatments of choice should be agreed between the orthodontist and patient to achieve esthetic and functional objectives.

Statement of Authorship

All authors contributed in the collection of data and analysis and approved the final version submitted.

Author Disclosure

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REFERENCES

1. Pratik P. Class I Bimaxillary proclination treated with tear drop loop – a case report. Indian J Appl Res. 2016 May; 6(5):237-40.
2. Halwa HK, Yadav SK, Dutta K, Gupta SK, Shrestha R, Shah AK. Bimaxillary protrusion – a case report. J Univers Coll Med Sci. 2019; 7(19):70-3.
3. Yumna Q, Fehmi M, Mohd T, Sanjeev KV. Management of bimaxillary protrusion in hyperdivergent case; a case report. Int J Contemp Med. 2018 Mar; 5(3):C1-C3.
4. Mitchell L, Littlewood SJ, Nelson-Moon ZL. An Introduction to Orthodontics, 4th Ed. Oxford: Oxford University Press. 2013; pp. 111.
5. Kasmawaricin, Harahap N, Oeripto A. Lower facial height and soft tissue changes in bimaxillary protrusion cases. Sci Dent J. 2019 Jan; 3(1):1-7.
6. Chaudhari AR, Kishore MSV, Reddy SK, Patil C, Shetty KS, Ansari S. T-Loop position and anchorage control: a finite element study. J Ind Orthod Soc. 2013; 47(4):171-7.
7. Choi YJ, Chung CJ, Choy K, Kim KH. Absolute anchorage with universal T-Loop mechanics for severe deepbite and maxillary anterior protrusion and its 10-year stability. Angle Orthod. 2010; 80:771-82.
8. Viecilli AF, Freitas MPM. The T-Loop in details. Dental Press J Orthod. 2018 Jan-Feb; 23(1):108-17.
9. Ardani IGAW, Pratiknjo IS, Djaharu'ddin I. Correlation between dentoalveolar heights and vertical skeletal patterns in class I malocclusion in ethnic Javanese. Eur J Dent. 2020 Oct; 15(2):210-5.
10. Kocadereli I. Changes in soft tissue profile after orthodontic treatment with and without extractions. Am J Orthod Dentofacial Orthop. 2002; 122:67-72.
11. Ribeiro GLU, Jacob HB. Understanding the basis of space closure in orthodontics for a more efficient orthodontic treatment. Dental Press J Orthod. 2016 Mar-Apr; 21(2):115-25.
12. Joshi HN, Soni JS, Shah M, Mann S, Taluja RH, Taluja S. Modified T-Loop for high labially placed maxillary canine – a case report. Biosci Biotechnol Res Commun. 2021 May; 14(6):33-5.
13. Burstone CJ, Steenbergen EV, Hanley KJ. Modern Edgewise Mechanics and The Segmented Arch Technique. California: Ormco Corporation. 1995; pp. 50-52.
14. Castro SMD, Moreira R, Braga AC, Ferreira AP, Pollmann MC. Effect of activation and preactivation on the mechanical behavior and neutral position of stainless steel and beta-titanium T-loops. Korean J Orthod. 2015 Jul; 45(4):198-208.