Camouflage treatment of skeletal Class III malocclusion in an adult cleft-palate patient using passive self-ligating system

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This case report describes the successful camouflage treatment to correct a moderate skeletal Class III malocclusion in a 19-year-old male cleft-palate patient. Early closure of the palate produced palatal scar tissue that inhibited midfacial growth, causing maxillary arch deficiency, severe maxillary crowding, and anterior and posterior crossbites. Combined surgical-orthodontic therapy would have been the preferred treatment of choice; however, the patient declined this option because of surgical risks and costs. Therefore, nonextraction camouflage treatment using a passive self-ligating bracket system was used. Treatment aims including expansion of the maxillary arch and correction of the anterior and posterior crossbites were achieved without the use of an additional maxillary arch expander or other auxiliary appliances. This treatment resulted in satisfying facial esthetics and a normal dental occlusion. (Am J Orthod Dentofacial Orthop 2019;155:117-26)

The prevalence of Class III malocclusion has been described from 1% to over 10% depending on sex, age, and ethnic background; the most frequent etiology is a Class III skeletal pattern.[1-3] Skeletal Class III malocclusion can be defined as a skeletal facial disturbance characterized by a retrognathic maxilla, a prognathic mandible, or a combination of both, and over half of patients with a normal or prognathic mandible usually have a maxillary deficiency.[4,5] Patients with cleft lip and palate usually show a tendency toward a skeletal Class III malocclusion because of maxillary deficiency in the sagittal, vertical, and transversal planes; thus, anterior and posterior crossbites are common in those with an isolated cleft palate due to maxillary arch deficiency.[6] Other possible characteristics are steep curve of Spee, ectopically positioned teeth, absence of teeth adjacent to the cleft, and supernumerary teeth.[7]

In nongrowing or adult patients, combined surgical-orthodontic therapy is the preferred treatment of choice to improve facial esthetics. However, due to surgical risks and financial constraints, orthognathic surgery may not always be available. Therefore, camouflage treatment using orthodontic appliances can be considered for a mild or moderate skeletal Class III malocclusion.[5,8] Fixed orthodontic appliances such as a conventional ligation system and a self-ligating system can be used in various cases with their advantages and disadvantages. Sometimes, the use of an additional maxillary expander and other auxiliary appliances are required to correct the maxillary deficiency in skeletal Class III malocclusions, in combination with the fixed orthodontic appliances.

DIAGNOSIS AND ETIOLOGY

The patient was a 19-year-old man, who attended our orthodontic clinic at the dental hospital, Faculty of Dentistry, Universitas Indonesia, in Jakarta, Indonesia. He was concerned about his occlusion and ectopic canines. He had a history of isolated cleft palate and had undergone palatoplasty when he was 1 year-old. Consequently, the tension of the scar contraction in this procedure inhibited the growth of the maxilla in the sagittal, vertical, and transverse planes; therefore, those would play important roles in the etiology of this skeletal Class III malocclusion.[9,10]

The patient had a dolichofacial, proportional but asymmetrical face, and chin deviation toward the left. He had a straight facial profile, competent lips, retrusive upper lip, and protrusive lower lip. The intraoral

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examination showed that all teeth were present except the third molars; he had good oral hygiene, healthy periodontal tissues, and a glass ionomer cement filling on the mandibular right first molar. He had a maxillary arch deficiency, severe maxillary crowding with bilateral ectopic canines, moderate mandibular crowding, anterior crossbite with −2-mm overjet, anterior deepbite with 5-mm overbite, bilateral posterior crossbites involving the premolars, scissorsbite of the right second molars, a steep curve of Spee, Class I canine and molar relationships on the left, and Class III canine and molar relationships on the right. The maxillary dental midline was coincident with the midfacial axis, but the mandibular dental midline deviated 4 mm toward the left (Figs 1 and 2). There was no complaint of pain and restriction during jaw opening and closing, and also there was no anterior functional displacement during jaw closing.

The initial lateral cephalometric radiograph showed a moderate Class III skeletal pattern with a retrognathic maxilla, vertical growth pattern, concave skeletal profile, retroclined maxillary and mandibular incisors, and normal interincisal and nasolabial angles (Table). The posteroanterior cephalometric radiograph showed skeletal asymmetry of the mandible; the right mandibular ramus and corpus were 8 mm longer than the left side, and there was an 8-mm chin deviation toward the left and 9° of occlusal canting. The initial panoramic radiograph showed healthy periodontal tissues, partially erupted maxillary third molars, impacted mandibular third molars, and a restoration on the mandibular right first molar (Fig 3).

TREATMENT OBJECTIVES

The patient's main problems were the moderate Class III skeletal pattern with a retrognathic maxilla, skeletal asymmetry of the mandible, maxillary arch deficiency, severe maxillary crowding, anterior and posterior crossbites, anterior deepbite, steep curve of Spee, scissorsbite of the right second molars, deviation of the mandibular dental midline toward the left, and Class III canine and molar relationships on the right. To improve facial esthetics and achieve an ideal occlusion, the main treatment objectives were to (1) correct the anterior and posterior crossbites to achieve a normal overjet by protracting the maxillary anterior teeth and expanding the maxillary arch, along with relieving the maxillary severe crowding; (2) correct the anterior deepbite to achieve a normal overbite by increasing the vertical dimension and extruding the mandibular premolars in conjunction with correction of the curve of Spee; (3) correct the scissorsbite of the right second molar, (4) correct the mandibular dental midline, and (5) establish Class I canine and molar relationships.

TREATMENT ALTERNATIVES

Based on the comprehensive examination and the diagnosis of this patient, 3 treatment alternatives were considered.

1. An ideal treatment was the combination of orthognathic surgery and orthodontic treatment to improve the patient's facial profile and ensure the stability of results. The combination of surgically assisted rapid maxillary expansion (SARME) and a total LeFort I osteotomy could be the treatment of choice; still, a combination of SARME, rapid maxillary expansion (RME), and facemask therapy could also be considered for a moderate Class III skeletal pattern.[11,12] However, the patient declined this surgical option due to the surgical risks and financial constraints; therefore, nonsurgical orthodontic treatment alternatives were considered.
2. Since the patient had a moderate Class III skeletal pattern with mild facial disturbance, camouflage treatment using fixed orthodontic appliances would be a treatment alternative.[5,8] The extraction of 4 first premolars to relieve the severe crowding and repositioning of the maxillary ectopic canines could be considered. Nevertheless, this treatment was not favorable because it would address the arch length deficiency and might worsen the patient's profile.
3. Another treatment alternative was nonextraction camouflage treatment by expanding the maxillary arch and protracting the maxillary anterior teeth using fixed orthodontic appliances. A conventional ligation system or a self-ligating system could be used to treat this patient. Although some studies have reported that a self-ligating system produced a significant increase in maxillary transverse dentoalveolar width and resulted in greater intermolar width than the conventional ligation system, it might still be controversial.[13,14] All treatment alternatives were discussed with the patient, and he chose the camouflage treatment using a self-ligating system without a maxillary arch expander and other auxiliary appliances.

TREATMENT PROGRESS

The DamonQ passive self-ligating system (0.022 × 0.028-in slot; Ormco, Glendora, Calif) was first bonded to the maxillary teeth. Bite raisers were added to the mandibular posterior teeth, and attachments (buttons)

Fig 1. Pretreatment extraoral and intraoral photographs. The patient had an unattractive smile, maxillary arch deficiency, severe maxillary crowding, anterior and posterior crossbites, and deviation of the mandibular dental midline.

were bonded on the mandibular right and left canines to enable the use of Class III light early elastics (2 oz, 5/16-in; Ormco). In the initial phase, a 0.014-in copper-nickel-titanium archwire was partially ligated to the maxillary lateral incisors and second premolars, and open-coil springs were assembled between the maxillary first premolars and first molars. Overjet became positive (+3 mm) after 4.5 months of treatment, and a 0.016-in copper-nickel-titanium archwire was fully ligated to the maxillary teeth. The appliances were bonded on the mandibular teeth after 6 months of treatment using a 0.014-in copper-nickel-titanium initial archwire. Rectangular copper-nickel-titanium archwires were used on the maxillary and mandibular teeth after 8 months of treatment. Leveling and aligning had been achieved after 15 months of treatment; bite raisers were removed, and Class III elastics were still used.

The working phase began after 19 months of treatment using 0.019 × 0.025-in stainless steel archwires in the maxillary and mandibular teeth, and the mandibular dental midline was corrected using diagonal elastics after 21 months of treatment. The finishing phase began after 23 months of treatment and v-settling elastics and box elastics were used for detailing the occlusion. The appliances were debonded after 26 months of treatment, and a pressure-formed or Essix retainer was used for the stability of results. The impacted mandibular third molars were considered to be extracted later.

TREATMENT RESULTS

The patient's facial esthetics were improved by establishing a more normal soft tissue profile and an attractive smile. The maxillary arch deficiency was corrected, the severe maxillary crowding was relieved, normal overjet

Fig 2. Pretreatment dental casts.

Table. Lateral cephalometric measurements

Parameters	*Norms*	*Initial*	*Predebonding*
Horizontal skeletal parameters			
SNA (°)	81 ± 3	73	75
SNB (°)	78 ± 3	75	76
ANB (°)	3 ± 2	−2	−1
Wits appraisal (mm)	± 1	−12	−2
Facial angle (°)	87 ± 3	82	83
Angle of convexity (°)	0 ± 5	−6	−4
Vertical skeletal parameters			
y-axis (°)	60 ± 4	69	69
SN-MdP (°)	32 ± 3	46	46
SN-MxP (°)	8 ± 3	2	0
MMPA (°)	27 ± 5	43	45
Dental parameters			
Interincisal angle (°)	135 ± 6	140	129
U1-MxP (°)	109 ± 6	102	115
U1- NA (mm)	4 ± 2	3	8
L1-MdP (°)	93 ± 6	75	72
L1- NB (mm)	4 ± 2	5	5
Soft tissue parameters			
Upp lip–E-line (mm)	−1	−3	−1
Low lip–E-line (mm)	−2 ± 2	2	0
Nasolabial angle (°)	115 ± 2	100	95

and overbite (+3 mm) were achieved, and the posterior crossbites and scissorsbite of the right second molar were corrected. A flat curve of Spee was achieved, the maxillary and mandibular dental midlines were coincident, and Class I canine and molar relationships were established. Overall, this camouflage treatment resulted in an ideal occlusion and healthy periodontal tissues with normal pocket depths (1-2 mm) (Figs 4 and 5).

Analysis of the skeletal parameters on the lateral cephalometric radiograph showed improvement of the ANB angle from −2° to −1° and the angle of convexity from −6° to −4°. In addition, there was a significant improvement of the Wits appraisal from −12 to −2 mm. The lower facial height was slightly increased, characterized by increasing the maxillomandibular plane angle (MMPA) from 43° to 45°. Analysis of the dental parameters showed that the maxillary incisor to maxillary plane angle (U1-MxP) increased from 102° to 115°, whereas the mandibular incisor to mandibular plane angle (L1-MdP) reduced from 75° to 72°. Soft tissue parameters showed improvement of the positions of the upper and lower lips (Table; Fig 6).[15,16] The changes in skeletal, dental, and soft tissues were favorable in terms of improving facial esthetics and dental occlusion. Those changes were confirmed by the superimposition of the lateral cephalometric radiograph tracings (Fig 7).

DISCUSSION

The treatment of skeletal Class III malocclusion in adults usually requires a combination of orthognathic surgery and orthodontic treatment. One orthognathic surgery procedure that has been recommended to correct a mild or moderate skeletal Class III malocclusion with maxillary arch deficiency in adults is SARME; sometimes, it can be combined with RME and facemask therapy.[11,12] The main objective of those combined therapies is to establish a normal maxillary arch without dental tipping, although sometimes labial tipping or maxillary

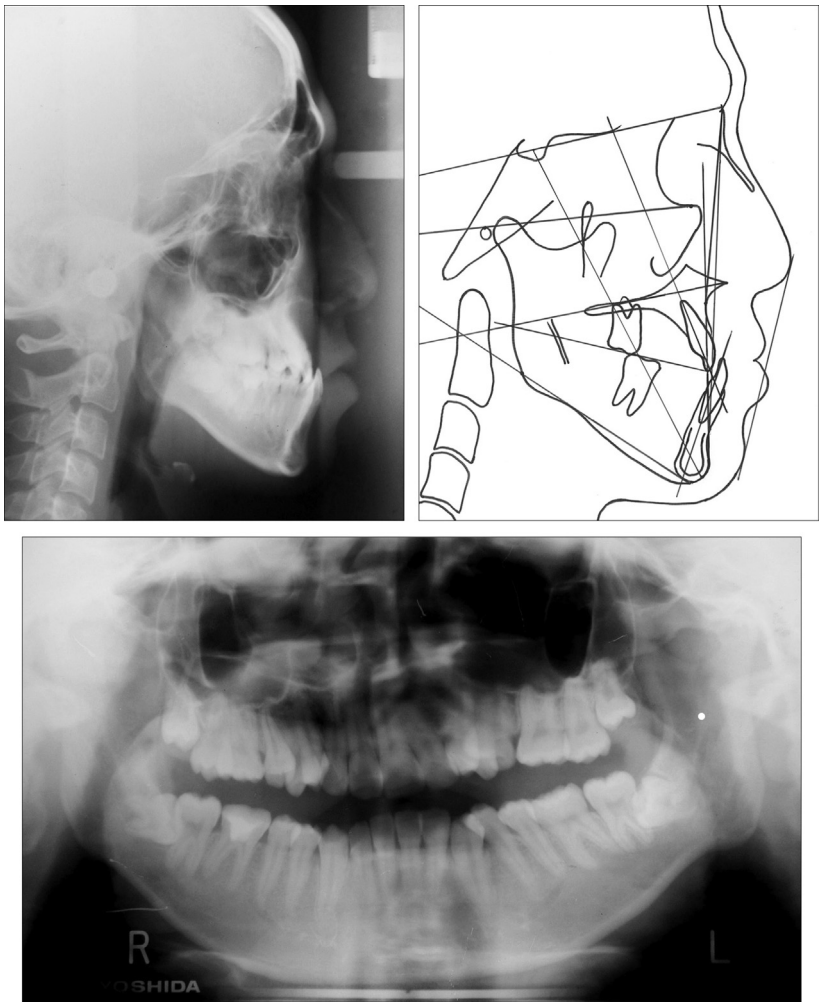

Fig 3. Initial lateral cephalometric radiograph, tracing, and panoramic radiograph.

incisor proclination is found.[17] Rizatto et al[11] reported the treatment success of a 20-year-old woman who had the same characteristics as our patient, treated by SARME followed by RME, facemask, and standard edgewise technique. Those treatments improved the patient's facial profile mainly by maxillary incisor extrusion and proclination with the 2-mm increase in U1-NA. In our camouflage treatment, the facial profile also improved mainly by maxillary incisor proclination with the 5-mm increase in U1-NA without invasive treatment.

The combination of facemask and RME has also been recommended to correct skeletal Class III malocclusions with maxillary arch deficiency and fairly normal mandibles in growing patients.[18,19] The combined orthopedic effects of these appliances would bring the maxilla forward and downward, bring the mandible backward and downward, and in some cases cause maxillary incisor proclination.[17] Sabri,[20] Zhang et al,[21] and Yang et al[22] reported the treatment success of 11- to 13-year-old patients who had the same characteristics as our patient, treated with facemask and RME followed by conventional ligation systems and other auxiliary appliances for 35 to 47 months. Those treatments resulted in skeletal and dental changes including increases in the ANB angle (0°-4.5°) and increases in U1-NA (0.4-8.0 mm). The treatment using a combination of facemask and RME relied on patient cooperation and required long-term stability, so it might increase treatment duration.[20] Our camouflage treatment had satisfying results in a relative shorter treatment time (26 months) with the skeletal and dental changes including the increases in the ANB angle (1°) and U1-NA (5 mm), which improved the patient's profile and dental occlusion.

Some studies have been conducted to elucidate the effectiveness and efficiency of treatment using a passive

Fig 4. Posttreatment extraoral and intraoral photographs. The patient had an attractive smile, normal overjet and overbite, Class I canine and molar relationships, and coincident maxillary and mandibular dental midline.

self-ligating system; however, the results of those studies may still be controversial.[23-27] A retrospective study[24] reported mean reductions of 4 to 7 months in treatment duration and 4 to 7 visits during active treatment with the passive self-ligating system compared with the conventional ligation system, whereas another study[28] stated that the skill, experience, and objectives of the clinician were the main factors that should be considered in influencing the treatment duration. The relatively shorter treatment duration for our patient was probably due using Class III light early elastics and posterior bite raisers, which corrected the sagittal discrepancy from the early stage of treatment and optimize tooth alignment and arch expansion.

The alignment process in this patient was concerning because of the severe maxillary crowding accompanied by bilateral ectopic canines. Authors of a prospective clinical trial found that Damon 2 brackets produced 2.7 times faster alignment for moderate crowding compared with the conventional ligation system, although it was not significant for severe crowding.[29] Other in-vitro studies found that the passive self-ligating system produced greater vertical forces on the ectopic canines but reduced the tipping effect of the adjacent teeth compared with the conventional ligation system.[27,30] Relatively faster alignment might be assigned to the interaction between this system with flexible rectangular copper-nickel-titanium wires that would impact the rotational control from the early stage of treatment.[31] Nevertheless, other studies have found that the passive self-ligating system was neither efficient during tooth alignment nor effective at reducing irregularity compared with the conventional ligation system, so it might not affect treatment duration for relieving initial crowding.[32-35]

Furthermore, an ideal arch form was achieved after dental arch expansion using the passive self-ligating

Fig 5. Posttreatment dental casts.

system (Fig 8). There were a 15-mm increase in maxillary intersecond premolar width, 7-mm increases in maxillary interfirst premolar width and intermolar width, whereas maxillary intercanine width was maintained after treatment. Some studies reported that the passive self-ligating system produced a significant increase in maxillary transverse dentoalveolar width before and after treatment.[13,14] Prospective clinical trials also showed more than 4.5-mm increases in maxillary interpremolar width after treatment using the passive self-ligating system and found that the intermolar width achieved in the passive self-ligating group was 1.5 mm above the value in the conventional ligation system group.[13,29] The passive self-ligating system might induce wider interpremolar and intermolar widths attributed to the combination of lower resistance to sliding and broad copper-nickel-titanium archwires.[23,36-38] Pandis et al[39] confirmed that the mechanism of dental arch expansion might be mostly due to the use of broad copper-nickel-titanium archwires than to the passive self-ligating system. Copper-nickel-titanium archwires with shape memory would distribute continuous forces to the teeth and exert higher forces than other nickel-titanium wires of similar dimensions.[40,41] Moreover, the increase in force level was influenced by the increase in the cross-section of the nickel-titanium thermally active archwires during tooth alignment, and the largest increase was with the passive self-ligating system compared with the conventional ligation system.[42]

This camouflage treatment resulted in a satisfying improvement of patient's facial profile, attributed to the skeletal changes including the 1° increase in ANB angle, 2° increase in the angle of convexity, and the 2° increase in MMPA. The increase of the maxillomandibular plane angle might be attributed to uprighting of the mandibular molars and the slight extrusion of the maxillary molars. Overall, the increases in ANB angle and vertical dimension were favorable for improving the patient's facial profile in this camouflage treatment of a skeletal Class III malocclusion.[43,44] In addition, there was a significant increase in the Wits appraisal (10 mm) that might have been influenced by the change of occlusal plane. This change could be attributed to extrusion of the mandibular premolars in conjunction with correction of the curve of Spee.

Significant dental changes included the 13° increase in the U1-MxP angle and the 3° reduction in the L1-MdP angle, meaning that the maxillary incisor proclination and mandibular incisor retroclination were the strategies to camouflage the skeletal Class III malocclusion to improve smile esthetics and the dental occlusion.[5] Mandibular incisor retroclination in this patient might be attributed to the use of Class III elastics. Moreover, a previous study stated that treatment with the passive self-ligating system resulted in 1.5° less mandibular incisor proclination compared with the conventional ligation system.[45] Another study found no difference in incisor inclination between Class III surgical and camouflage groups after treatment; both showed maxillary incisor proclination and mandibular incisor retroclination.[46] Therefore, camouflage treatment would be successful in

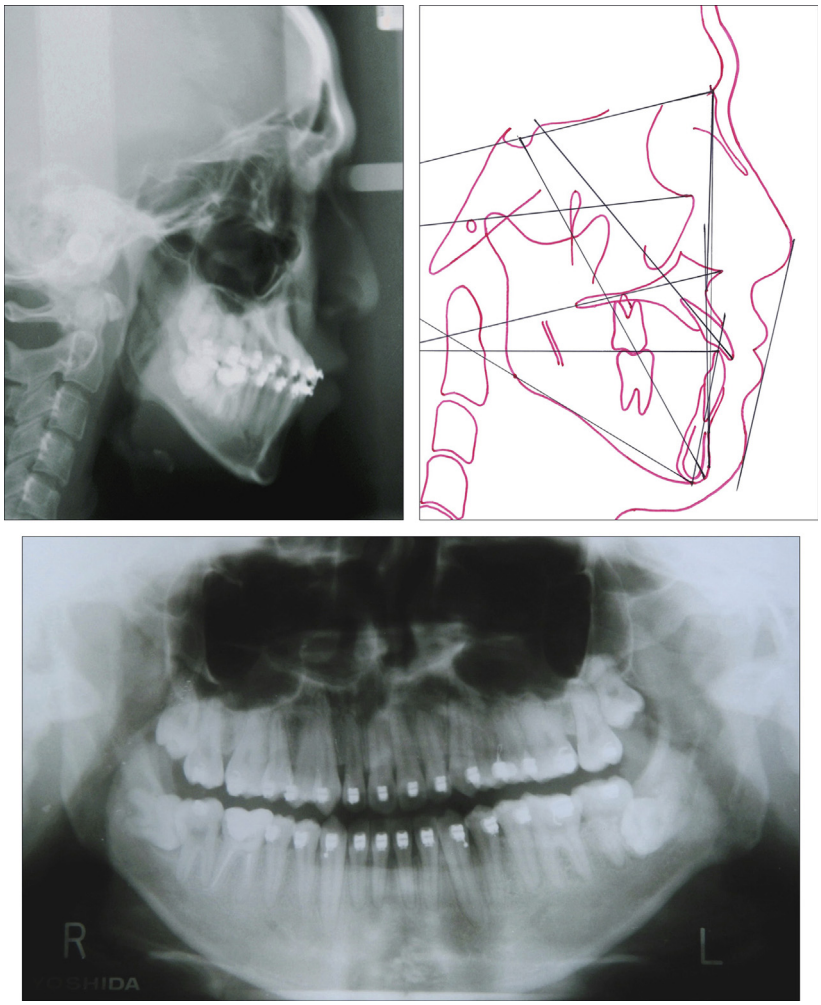

Fig 6. Predebonding lateral cephalometric, tracing, and panoramic radiograph.

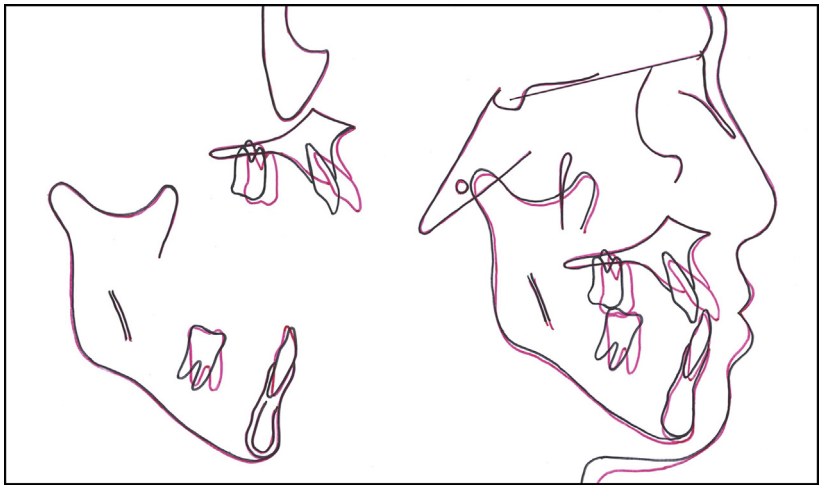

Fig 7. Superimposition of lateral cephalometric tracings on the palatal vault and zygomas, on the inner surface of the mandibular symphysis and outline of the mandibular canal, and on the sella-nasion plane at sella.

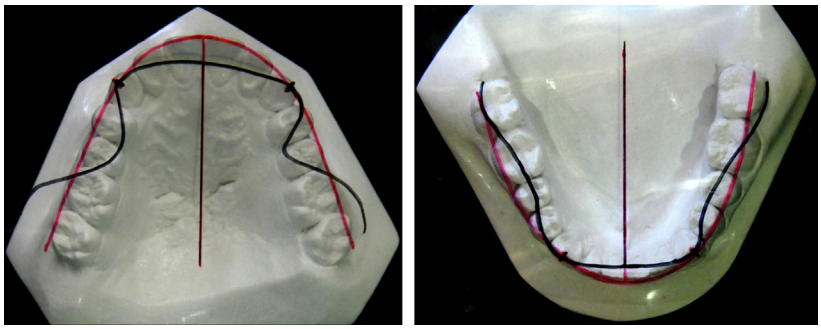

Fig 8. Comparison of the maxillary and mandibular arch form before (*black line*) and after (*red line*) treatment.

various tooth movements without undesirable effects to the periodontal tissues.[44]

Stability of this skeletal Class III camouflage treatment should be considered because of the tendency of relapse. Moreover, there was a limited study about the stability of treatment using the passive self-ligating system compared with the other appliances. Retention was required to maintain the arch width and for tooth alignment; thus, a combination of fixed and removable retainers was recommended for this purpose.[36] However, the pressure-formed or Essix retainer was used in this patient to keep the stability of results. Although previous studies showed that the Essix retainer was more effective in retaining tooth alignment than the Hawley retainer, another systematic review showed no different between the 2 retainers with respect to the changes in intercanine and intermolar widths after orthodontic retention.[47-49] Furthermore, other studies have suggested using a fixed or removable retainer for life to ensure continued satisfactory alignment after treatment.[50,51]

CONCLUSIONS

This camouflage treatment of a skeletal Class III malocclusion in an adult cleft palate patient resulted in satisfying facial esthetics and dental occlusion. The maxillary arch deficiency, severe maxillary crowding, and anterior and posterior crossbites were corrected in a relatively shorter time using the passive self-ligating system without any additional maxillary arch expanders and other auxiliary appliances. However, a future study would be required to determine the effectiveness, efficiency, and stability of this treatment. A long-term retention regimen was suggested for this patient to ensure the long-term stability of the treatment results.

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