Nonsurgical treatment of a Class III patient with a lateral open-bite malocclusion

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A 15.3-year-old white girl with a skeletal Class III malocclusion and a severe lateral open bite was treated with conventional orthodontics and directional force mechanics and elastics. She had 5 congenitally missing premolars. The maxillary right canine was ectopically erupted and in contact with the maxillary right first molar. An Angle Class I molar relationship was achieved with canine protected occlusion and incisal guidance. A wrap-around retainer was placed on the maxillary arch and a lingual bonded retainer on the mandibular arch. Treatment time was 38 months. (Am J Orthod Dentofacial Orthop 2011;140:861-8)

Edward H. Angle described a Class III malocclusion as a condition in which the mandibular first molar is positioned mesially to the maxillary first molar.[1] This relationship could include a skeletally recessive maxilla and a normal mandible, a prognathic mandible and a normal maxilla, or a combination of both. This dental relationship could also have a normal maxillary-mandibular relationship. The treatment of choice is normally to correct the faulty skeletal component and the dental malrelationship. A pseudo-Class III can be caused by a forward shift of the mandible to avoid incisal interferences.[2] In the United States, true Class III malocclusions are found in less than 1% of the general population.[3,4]

An open bite with any malocclusion classification is a difficult and complex anomaly to correct. It is particularly troublesome when it is associated with a Class III malocclusion. Open bite can be caused by an abnormal growth pattern, finger sucking, airway obstruction, or tongue posture and function.[5]

Class III malocclusions are difficult for treatment planning. The clinician must choose either a camouflage treatment to mask the Class III malocclusion or a surgical alternative to correct the skeletal imbalance. Certainly, an open bite, whether it is lateral or anterior, complicates the Class III correction. In many instances, it can make the Class III malocclusion worse. What if the patient grows? What if the patient's parents are adamantly opposed to surgery? Can a nonsurgical compromise be accomplished, even if it is not the optimum choice? All these questions must be answered by the clinician in planning treatment to correct the patient's malocclusion.

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DIAGNOSIS AND ETIOLOGY

The patient was a white girl, aged 15.3 years, with an unremarkable medical history. She had a Class III dental malocclusion, a lateral open bite, and a slightly convex facial profile. Her maxilla appeared to be recessive. The maxillary right canine erupted next to the maxillary right first permanent molar. Her chief concerns were "my underbite and my side teeth don't touch." The primary etiology was heredity.

The facial and intraoral photographs (Fig 1) demonstrate a slightly convex facial profile. The patient was able to close her lips without mentalis strain. The maxillary midline was deviated toward her left.

The dental casts (Fig 2) show an Angle Class III occlusion on the left and a Class I dental relationship on the right. The maxillary right canine had erupted ectopically next to the maxillary right first molar and was in an extreme Class III position in relation to the mandibular right canine. The maxillary right deciduous canine was present in the permanent canine position. The maxillary left second deciduous molar was present. The mandibular second deciduous molars were also present. There was a crossbite of the maxillary teeth on the right and a negative overjet of −1 mm. There was 1 mm of mandibular anterior crowding. Lateral open bites of 6 mm on the right and 5 mm on the left were present. The maxillary second molars were not erupted. Her teeth occluded only on the terminal molars. The midlines deviated by 3 mm.

The pretreatment cephalogram and its tracing (Fig 3) showed an ANB angle of 1°. The Wits appraisal of −8 mm

Fig 1. Pretreatment facial and intraoral photographs.

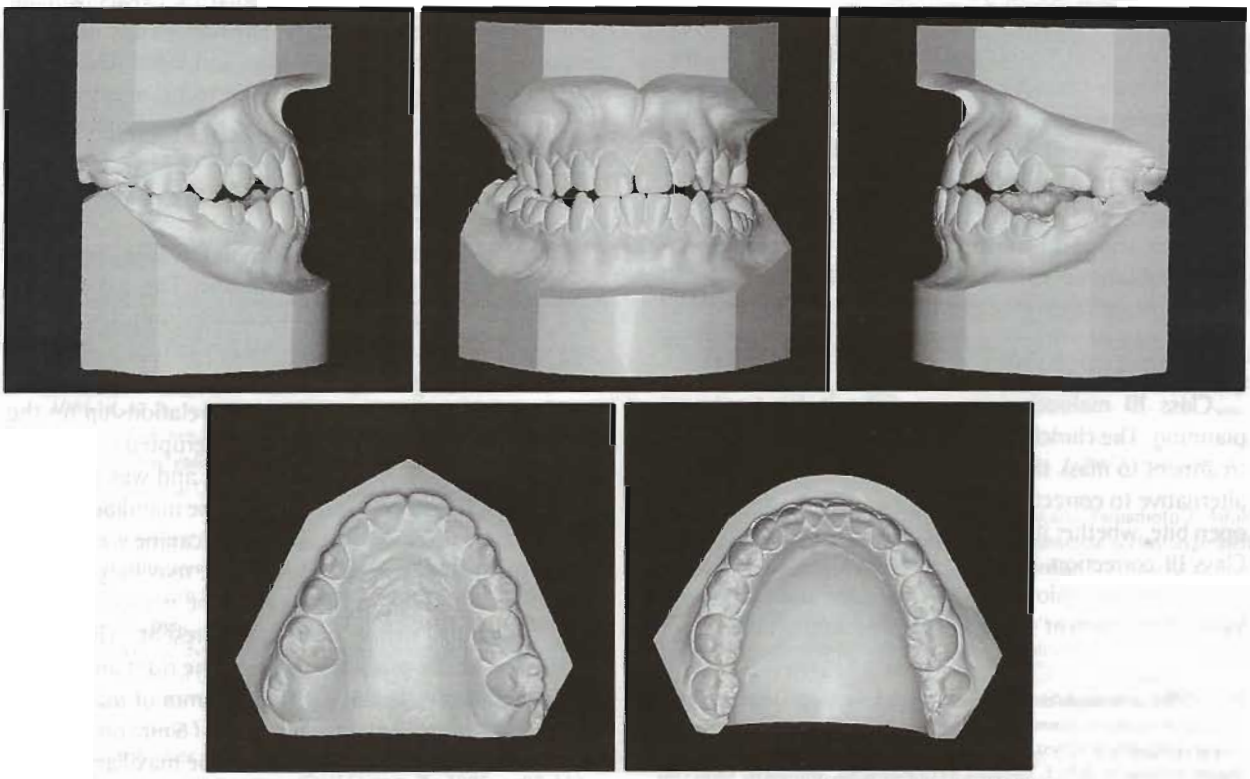

Fig 2. Pretreatment dental casts.

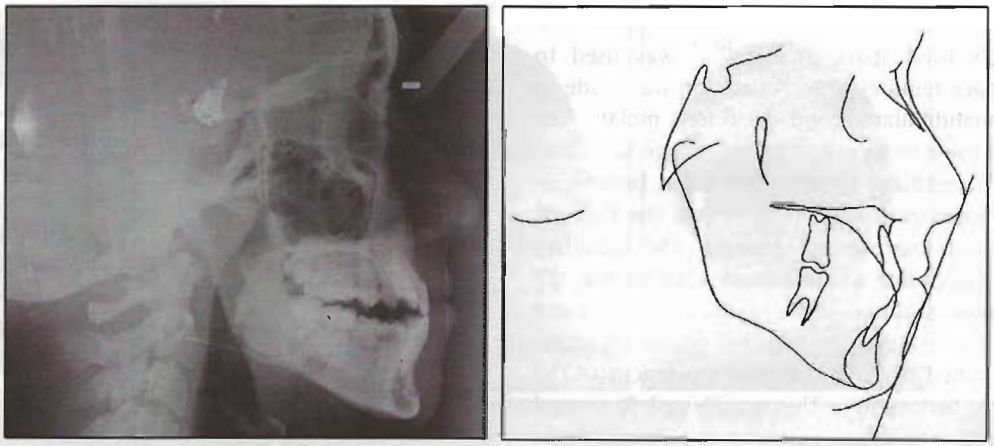

Fig 3. Pretreatment cephalometric radiograph and tracing.

confirmed a skeletal Class III alveolar imbalance.[6,7] The FMA of 30° suggested a vertical skeletal discrepancy. The facial height index (posterior facial height/anterior facial height) of .78 suggested a skeletal deepbite tendency.[8] The Z-angle of 69° confirmed a mildly protruded soft-tissue overlay.[9] The incisors were not in contact. The panoramic radiograph (Fig 4) showed that the maxillary right first and second premolars, the maxillary left second premolar, the mandibular second premolars, and all third molars were congenitally missing. The maxillary left second deciduous molar, the maxillary right deciduous canine, and the mandibular second deciduous molars were present. The maxillary second permanent molars were unerupted.

After the casts, the radiographs, the photos, and the patient were studied, it was decided to approach her problem as a Class III open-bite correction.

Fig 4. Pretreatment panoramic radiograph.

TREATMENT OBJECTIVES

The treatement objectives were to (1) obtain a normal profile line to nose relationship and a normal Z-angle, (2) obtain normal canine and incisal guidance, (3) correct the lateral open bite, (4) correct the Class III dental relationship, (5) place the maxillary right canine in its correct Class I position, (6) place the dental midlines in the middle of the patient's face, and (7) prepare the dentition to be prosthetically restored.

TREATMENT ALTERNATIVES

1. Extract the mandibular left and right deciduous molars and upright the mandibular incisors over basal bone. Extract the maxillary right deciduous canine and move the right permanent canine forward to contact the maxillary right lateral incisor to create space for premolar replacement. The maxillary left second deciduous molar would be left in place to maintain space for an osseointegrated implant crown, and the maxillary left first molar would occlude with the mandibular left second molar in a Class I relationship. The maxillary left second molar would be without an antagonist tooth.
2. Level both arches and maintain all remaining deciduous teeth in their current positions for prosthetic replacements except for the maxillary right deciduous canine. The maxillary right deciduous canine would be extracted to allow the maxillary right permanent canine to be moved mesially to contact the right lateral incisor so that space could be gained for a premolar implant. After leveling and detailing the arches with this plan, a maxillary LeFort impaction and a mandibular setback osteotomy would correct the open bite, the crossbite, and the Class III dental relationship. The patient's parents were adamantly opposed to surgery and the added expense of implants to replace the congenitally missing teeth.

TREATMENT PLAN

Merrifield's total space analysis[10,11] was used to determine space requirements. A decision was made to extract the mandibular second deciduous molars. The extraction of these teeth would provide space to further upright the mandibular incisors over basal bone. This uprighting movement would help correct the Class III appearance and improve the Z-angle. The maxillary right deciduous canine would be extracted so that the maxillary canine could be positioned in its proper place in the arch. The maxillary left second deciduous molar would be retained to prevent mesial movement of the maxillary left first molar. The maxillary left second molar would have no antagonist with this plan.

TREATMENT PROGRESS

All teeth were sequentially banded or bonded with a 0.022-in standard nontorqued, nonangulated edgewise appliance. The 10-2 system of Merrifield[12] was used. A hyrax expander was placed and given 2 turns per day to open the midpalatal suture or to at least gain some expansion to correct the posterior crossbite. Triangular and vertical elastics were used to help control the bite opening that this widening of the palate would create. After 15 days with the expander, the posterior crossbite was corrected, and the appliance was stabilized.

At the same time, the patient was instructed to wear a J-hook straight-pull headgear with the J-hooks placed directly against the mandibular canine brackets to move the mandibular canines and first premolars distally. Mandibular canine and premolar retraction was augmented with elastic power chains. When the canines and first premolars were completely retracted, the mandibular incisors were retracted with a 0.021 × 0.025-in closing-loop archwire. A high-pull J-hook headgear was attached to hooks soldered on the archwire between the mandibular central and lateral incisors. The maxillary expander was left in place for almost 24 months so that it could serve as an anchor unit, while the maxillary right canine was moved mesially with an open coil on the archwire.

Toward the end of treatment, when the maxillary right canine was in its proper position, and the hyrax appliance was removed, the maxillary right first molar remained in a Class III relationship. The space remaining was too large for 1 implant and too small for 2. One implant was placed. After it had integrated, a temporary crown was placed so that the implant could be used to close the excess space and serve as an anchor to bring the maxillary right first molar into a Class I dental relationship.

The patient's mother had unreasonable expectations and objectives during most of the treatment. She absolutely could not accept orthognathic surgery and had to be convinced that an implant was necessary. She agreed only to the implant in the maxillary right quadrant because the tooth was missing. Fortunately, the patient was wonderfully compliant and did not grow. The family was informed that the maxillary left second deciduous molar will need to be replaced eventually by an implant and a crown.

Vertical, triangular, and Class III elastics were used as needed. When a Class I canine relationship was achieved on the right side and the open bite had been corrected, the maxillary right first molar remained in a Class III position. At this time, an implant was inserted to replace the missing maxillary right premolar. Ideal finishing wires stabilized the teeth, while the implant osseointegrated and the occlusion settled. After the implant was integrated, a temporary crown was placed. The implant crown was banded and used to move the right first molar mesially into a Class I position. The maxillary left first molar occluded with the mandibular left second molar in an end-on Class I dental relationship. The maxillary left second molar has no antagonist. A maxillary wrap-around retainer and a mandibular bonded retainer were placed. Total treatment time was 38 months.

TREATMENT RESULTS

The posttreatment facial and intraoral photographs (Fig 5) illustrate the improvement in the patient's profile. Her midlines are coincident and in the center of her face. The posttreatment dental casts and intraoral photos (Fig 6) show a Class I canine occlusion with normal overjet, overbite, and canine and incisal guidance. As planned, the maxillary left first molar occluded with the mandibular left second molar. The maxillary left second molar had no antagonist and will be extracted. The maxillary left second deciduous molar is present and not in occlusion. Eventually, it will be extracted, and an implant and a crown placed. The implant replacing the missing maxillary right premolar has been restored with an implant crown.

The posttreatment cephalometric radiograph and its tracing (Fig 7) illustrate the changes achieved with treatment. The mandibular incisors were further uprighted over basal bone to an IMPA angle of 81°. This uprighting caused the Z-angle to improve to 77°. The FMA angle increased to 34°. The Wits appraisal improved to −2 mm. The facial height index decreased to .67. The posttreatment panoramic radiograph (Fig 8) exhibits no pathology. The maxillary right implant is osseointegrated, and the crown is functional.

Intraoral photographs and dental casts taken 1 year later show the result to be stable (Figs 9 and 10). The maxillary left second molar with no antagonist has been extracted. The maxillary right second molar has settled nicely into occlusion. Slight spaces developed between

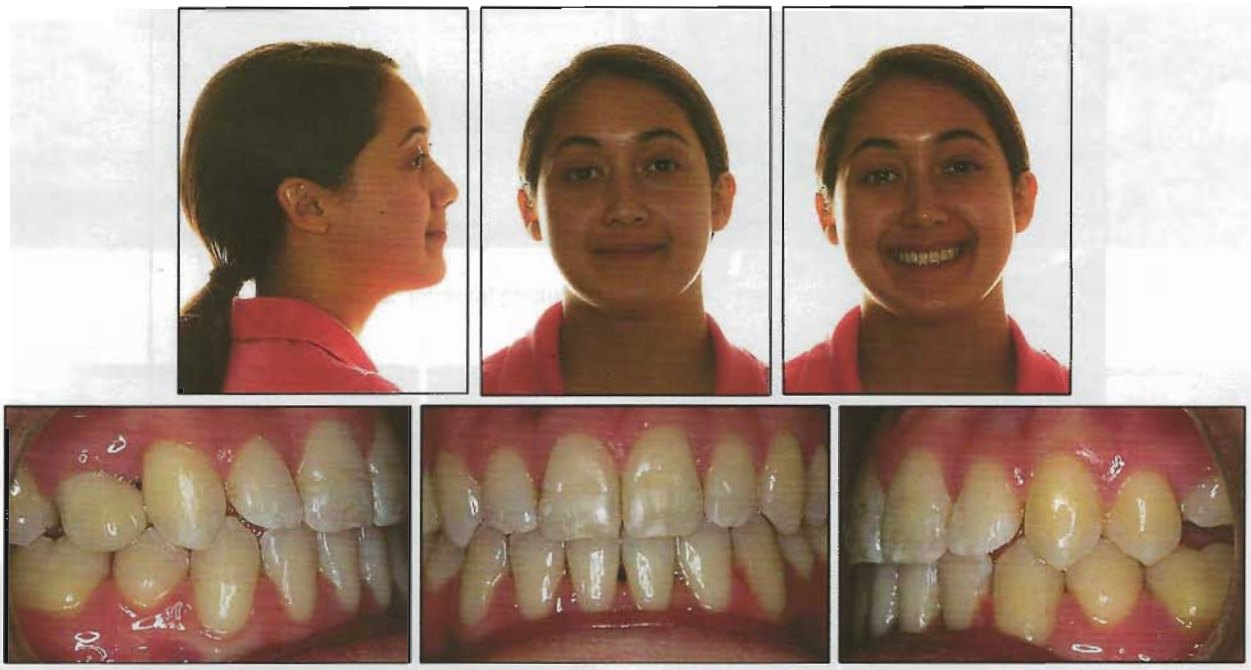

Fig 5. Posttreatment facial and intraoral photographs.

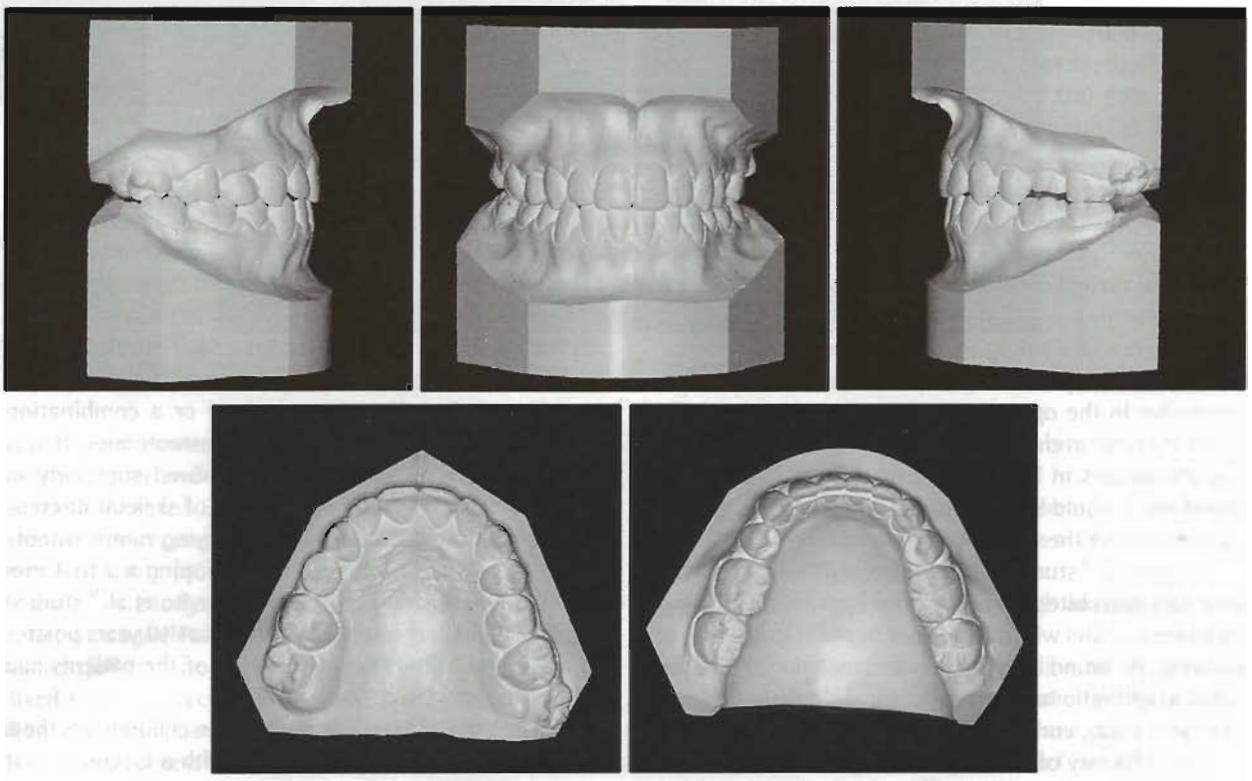

Fig 6. Posttreatment dental casts.

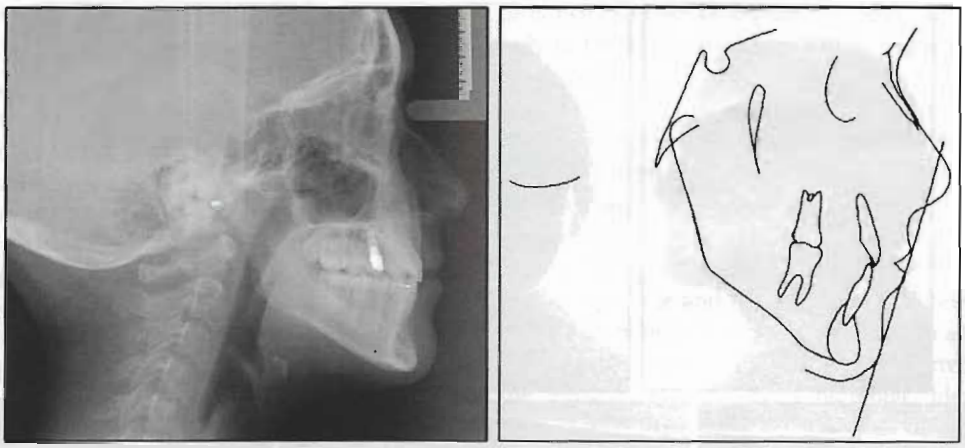

Fig 7. Posttreatment cephalometric radiograph and tracing.

the mandibular first premolars and the canines; these will be closed by the restorative dentist with bonding material. Since the parents did not want the expense of another implant, the maxillary left second deciduous molar was built up with composite and brought into occlusion.

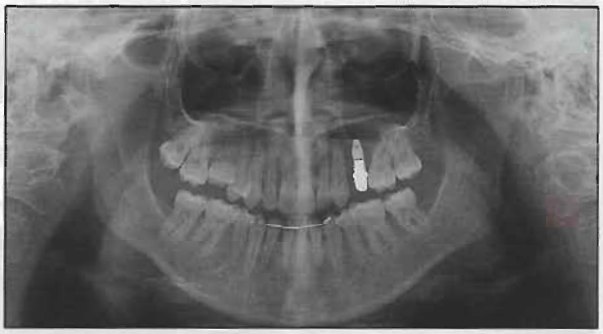

Fig 8. Posttreatment panoramic radiograph.

DISCUSSION

Ellis and McNamara[13] studied the frequency and differences in the dental and skeletal components with and without open bite in a large sample of Class III adults. One-half of the subjects had an anterior open bite. When compared with the nonopen-bite group, significant differences were found: the posterior maxilla exhibited vertical excess in the open-bite group, the maxillary occlusal plane was less steep in the open-bite group, the mandibular occlusal plane and the mandibular plane angle were higher in the open-bite group, and total anterior face height and lower face height were increased in the open-bite group. The mandible was less protrusive in the open-bite group. Their findings indicated that the average Class III open-bite malocclusion has aberrations in both the maxilla and the mandible; therefore, it could require surgical intervention in both jaws to correct the deformity.

Cangialosi[14] studied a large sample of treated patients who had open bites before treatment and compared the treatment results with a sample of treated Class I normal patients. He found a decrease in the posterior to anterior facial height ratio in the open-bite sample. Stuani et al,[15] in a later study, confirmed this finding.

The difficulty of treating an open-bite Class III malocclusion is well recognized. Many would agree that this problem is best treated with a combination of orthodontics and orthognathic surgery. In 1975, Bell[16] showed that a skeletal open bite could be corrected with a LeFort I osteotomy. Denison et al[17] studied the posttreatment stability of open-bite and nonopen-bite LeFort I osteotomies that repositioned the maxilla superiorly. They found more postsurgical decrease in overbite in the open-bite patients. Profitt et al[18] studied 54 patients who had correction of an anterior open bite with maxillary LeFort I osteotomy alone or a combination of LeFort I and mandibular ramus osteotomies. It was found that, when the maxilla is moved superiorly in the treatment of open bite because of skeletal discrepancies with or without an accompanying ramus osteotomy, there is a 10% chance of developing a 2 to 4 mm open bite in the long term. Lopez-Gavito et al[19] studied nonsurgical open-bite malocclusions at 10 years postretention and found that over a third of the patients had a significant relapse.

Correction of maxillary retrusion in children less the 8 years of age can be accomplished with a facemask that uses the forehead and chin as an anchor with elastics attached to either a maxillary splint or an orthodontic appliance. This treatment regimen moves both the teeth and the maxilla forward. After 9 years of age, however,

Fig 9. Intraoral photographs taken 1 year posttreatment.

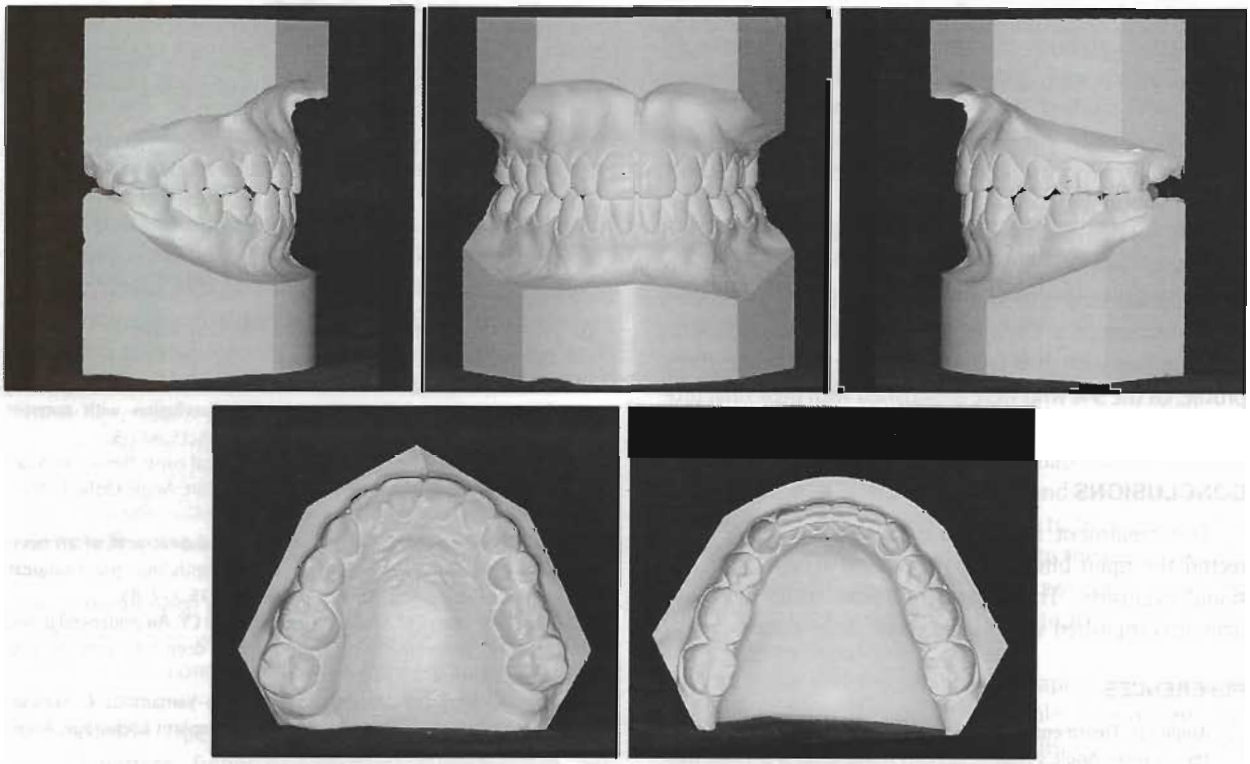

Fig 10. Dental casts taken 1 year posttreatment.

more tooth movement and little skeletal displacement occur.[20] Qazi and Amjad[21] published a case report of a hyperdivergent Class III open bite in a 10-year-old girl with a recessive maxilla, who was treated for 8 months with a protraction facemask that displaced the maxilla anteriorly. Hamamci et al[22] documented an adult with a skeletal Class III and open-bite malocclusion successfully treated without surgical intervention. A fixed edgewise technique, reverse headgear, and Class III and anterior box elastics were used. Saito et al[23] reported the successful nonsurgical treatment of an adult open-bite Class III malocclusion with an edgewise appliance combined with occipital high-pull headgear and Class III elastics. Hans et al,[24] in an evidenced-based approach to treatment of open bite and deep overbite, presented case reports using open-bite strategies that included 4 premolar extractions, 4 first molar extractions, and active vertical corrector therapy. They found that tipping of the anterior teeth was an important contributor to open-bite correction.

Most functional appliances, which are used for early correction of Class III malocclusions, cause the maxillary molars to erupt vertically while holding the mandibular molars in place. The net effect is rotation of the occlusal plane. The rotation of the occlusal plane causes the malocclusion to change from Class III to Class I.[20]

Recently, Sakai et al[25] described the correction of a severe open-bite Class III malocclusion with skeletal miniplate anchorage and mandibular third molar extractions. Weisner[26] described the treatment of an

asymmetric Class III malocclusion with a single miniscrew temporary anchorage device. Several authors have reported closing open bites and correcting Class III malocclusions using temporary anchorage devices or zygomatic anchorage.[27-29]

Implant therapy is highly predictable and successful. Astrand et al[30] studied 48 consecutive patients 20 years after treatment with Branemark-design titanium implant-supported prostotheses (Nobel Biocare AB, Goteborg, Sweden). The survival rate was 99.2%. Kao[31] stated that, although implant success can be rewarding, all parties need to be involved in treatment planning. He stated that poor planning can result in increased surgical needs and costs, and even failure. Klokkevold and Han[32] studied the effects of smoking, diabetes, and periodontitis on implant success rates and found that patients who smoked or had diabetes had a greater risk for failure.

Uslu and Akcam[33] investigated the long-term postretention satisfaction rate among skeletal Class III patients who had received orthodontic treatment without surgery for correction of a Class III malocclusion. Most patients were satisfied with their facial appearance and final esthetic profile. Of the 5% who were dissatisfied with their final profiles, a prognathic mandible was given as the reason.

CONCLUSIONS

This treatment improved the patient's profile, corrected the open bite, and gave her an acceptable functional occlusion. This treatment result could not have been accomplished without excellent patient cooperation.

REFERENCES

1. Angle EH. Treatment of malocclusion of the teeth and fractures of the maxillae, Angle's system. 6th ed. Philadelphia: S. S. White Dental Manufacturing; 1900. p. 5-15.
2. Proffit WR. Contemporary orthodontics. St Louis: C. V. Mosby; 1986. p. 47-9.
3. Kelly JE, Sanchez M, Van Kirk LE. An assessment of the occlusion of the teeth of children. Publication no. (HRA) 74-1612. Washington DC: National Center for Health Statistics, US Public Health Service; 1973.
4. Kelly J, Harvey C. An assessment of the teeth of youths 12-17 years. Publication no. (HRA) 74-1644. Washington DC: National Center for Health Statistics, US Public Health Service; 1977.
5. Sankey WL, Buschang PH, English J, Owen AH. Early treatment of vertical skeletal dysplasia: the hypodivergent phenotype. Am J Orthod Dentofacial Orthop 2000;118:317-27.
6. Jacobson A. The "Wits" appraisal of jaw disharmony. Am J Orthod 1975;67:125-38.
7. Jacobson A. Wits appraisal. In: Jacobson A, editor. Radiographic Cephalometry. Quintessence: Carol Stream, IL; 1995. p. 97-112.
8. Horn AJ. Facial height index. Am J Orthod 1992;101:180-6.
9. Merrifield LL. The profile line as an aid in critically evaluating facial esthetics. Am J Orthod 1966;52:804-22.
10. Merrifield LL. Differential diagnosis with total space analysis. J Charles Tweed Found 1978;6:10-5.
11. Vaden JL, Dale JG, Klontz HA. The Tweed-Merrifield philosophy. In: Graber TM, Vanarsdall RL, editors. Orthodontics: current principles and techniques. St Louis: C. V. Mosby; 1994. p. 627-84.
12. Merrifield LL. Edgewise sequential directional force technology. J Charles Tweed Found 1986;14:22-37.
13. Ellis E 3rd, McNamara JA Jr. Components of adult Class III open-bite malocclusion. Am J Orthod 1984;86:277-90.
14. Cangialosi TJ. Skeletal morphologic features of anterior open bite. Am J Othod 1984;85:28-36.
15. Stuani AS, Matsumoto MA, Stuani MB. Cephalometric evaluation of patients with anterior open-bite. Braz Dent J 2000;11:35-40.
16. Bell WH. Le Fort I osteotomy for the correction of maxillary deformities. J Oral Surg 1975;33:412-26.
17. Denison TF, Kokich VG, Shapiro PA. Stability of maxillary surgery in openbite versus nonopenbite malocclusions. Angle Orthod 1989;59:5-10.
18. Proffit WR, Bailey LJ, Phillips C, Turvey T. Long-term stability of surgical open-bite correction by Le Fort I osteotomy. Angle Orthod 2000;70:112-7.
19. Lopez-Gavito G, Wallen TR, Little RM, Joondeph DR. Anterior open-bite malocclusions: a longitudinal 10-year postretention evaluation of orthodontically treated patients. Am J Othod 1985;87:175-86.
20. Proffit WR. Contemporary orthodontics. St Louis: C. V. Mosby; 1986. p. 382-6.
21. Qazi HS, Amjad AT. Modified maxillary protraction headgear for the correction of Class III skeletal malocclusion with anterior open bite. J Coll Physicians Surg Pak 2005;15:823-5.
22. Hamamci N, Basaran G, Sahin S. Nonsurgical correction of an adult skeletal Class III and open-bite malocclusion. Angle Orthod 2006; 76:527-32.
23. Saito I, Yamaki M, Hanada K. Nonsurgical treatment of an open bite using edgewise appliance combined with high-pull headgear and Class III elastics. Angle Orthod 2005;75:277-83.
24. Hans MG, Teng CM, Liao CC, Chen YH, Yan CY. An evidenced based approach to treatment of open bite and deep bite; case reports. World J Orthod 2007;8:45-64.
25. Sakai Y, Kuroda S, Murshid SA, Takano-Yamamoto T. Skeletal Class III severe openbite treatment using implant anchorage. Angle Orthod 2008;78:157-66.
26. Weisner SM. Treatment of a Class III malocclusion with mandibular asymmetry using a single miniscrew. J Clin Orthod 2009;43:335-41.
27. Seres L, Kocsis A. Closure of severe anterior open bite with zygomatic anchorage. J Craniofac Surg 2009;20:478-82.
28. Keim RG. The latest on skeletal anchorage. J Clin Orthod 2009;43: 289-90.
29. Sugawara Y, Kuroda S, Tamamura N, Takano-Yamamoto T. Adult patient with mandibular protrusion and unstable occlusion treated with titanium screw anchorage. Am J Orthod Dentofacial Orthop 2008;133:102-11.
30. Astrand P, Ahlqvist J, Gunne J, Nilson H. Implant treatment of patients with edentulous jaws: a s0-year followup. Clin Implant Dent Relat Res 2008;10:207-17.
31. Kao RT. Implant treatment planning considerations. J Calif Dent Assoc 2008;36:256-8.
32. Klokkevold PR, Han TJ. How do smoking, diabetes, and periodontitis affect outcomes of implant treatment. Int J Oral Maxillofac Implants 2007;22(Suppl):173-202.
33. Uslu O, Akcam MO. Evaluation of long-term satisfaction with orthodontic treatment for skeletal Class III individuals. J Oral Si 2007;49:31-9.