Multimodality Treatment for Rehabilitation of Adult Orthodontic Patient with Complicated Dental Condition and Jaw Relation

Yu-Cheng Liaw[1,2], Shou-Hsin Kuang[1,2], Ya-Wei Chen[1,2], Kai-Feng Hung[1,2], Hsiu-Chin Tsai[3], Shou-Yen Kao[1,2], Jenny Hwai-Jen Fong[1,2]*

[1]Department of Dentistry, Taipei Veterans General Hospital, and [2]National Yang-Ming University School of Dentistry, Taipei, Taiwan, R.O.C., and [3]School of Dentistry, Loma Linda University, California, USA.

A 50-year-old man with severe malocclusion requested comprehensive oral rehabilitation. He presented with retrognathic mandible, anterior deep bite and a gummy smile in the premaxilla, and tenting occlusal plane with severe buccal crossbite of the left maxillary posterior teeth. Inappropriate fixed prostheses spanned the maxilla and the mandible with a class II jaw relationship. A detailed analysis indicated the need for orthodontic treatment, orthognathic surgery, bone graft at the deficient alveolar ridge for implant surgery and a revision of all prostheses. Over a 2-year-period of management, the patient received anterior osteotomy for intrusion of lower anterior teeth, bilateral sagittal splitting osteotomy for mandible advancement and posterior osteotomy for inward upward repositioning of posterior teeth of the left maxilla to correct major jaw deformities. The deficient alveolar ridge in the premaxilla was augmented by autogenous bone graft harvested during the orthognathic surgery. He sequentially had mini-plate and dental implant as anchorage assisting teeth alignment in the mandible. Two 3-fixture-supported implant prostheses were delivered in the premaxilla and the mandible. The improvement in cosmesis, stability and function through treatment and a 2-year clinical follow-up were considered satisfactory. [*J Chin Med Assoc* 2008;71(11):594–600]

Key Words: implant, orthodontics, orthognathic surgery, rehabilitation

Yu-Cheng Liaw and Shou-Hsin Kuang contributed equally to this work.

Introduction

The correction of malocclusion with severe skeletal deformity generally requires surgery combined with orthodontic treatment.[1] Purely camouflage orthodontic treatment or purely prosthodontic treatment may result in an unsatisfactory, unstable and irreversible outcome.[2] Multiple decayed or missing teeth may increase the difficulty and duration of orthodontic treatment due to the lack of appropriate anchorage for tooth movement, especially in adult cases presenting with multiple long-spanned prostheses. Recently, microscrews, miniscrews/plates and dental implants used as anchorage for tooth movement have greatly enhanced the capability and scope of orthodontic treatment.[3,4] In this report, we present a case with multiple skeletal and dental problems including mandibular retrognathism, anterior vertical excess with deep bite and gummy smile, posterior buccal crossbite in the left maxilla, and multiple lost teeth with inappropriate long-span fixed prostheses. The diagnosis and comprehensive treatment of this case are described.

Case Report

Diagnosis and etiology

A 50-year-old male patient visited our outpatient clinic seeking to improve his dental condition and profile. Extraorally, he had a short face, overclosure of lips and left side 5-mm gummy smile in the frontal profile. Lateral profile revealed low angle, mandibular retrognathism

*Correspondence to: Dr Jenny Hwai-Jen Fong, Department of Dentistry, Taipei Veterans General Hospital, 201, Section 2, Shih-Pai Road, Taipei 112, Taiwan, R.O.C.
E-mail: sykao@vghtpe.gov.tw • Received: September 28, 2007 • Accepted: May 29, 2008

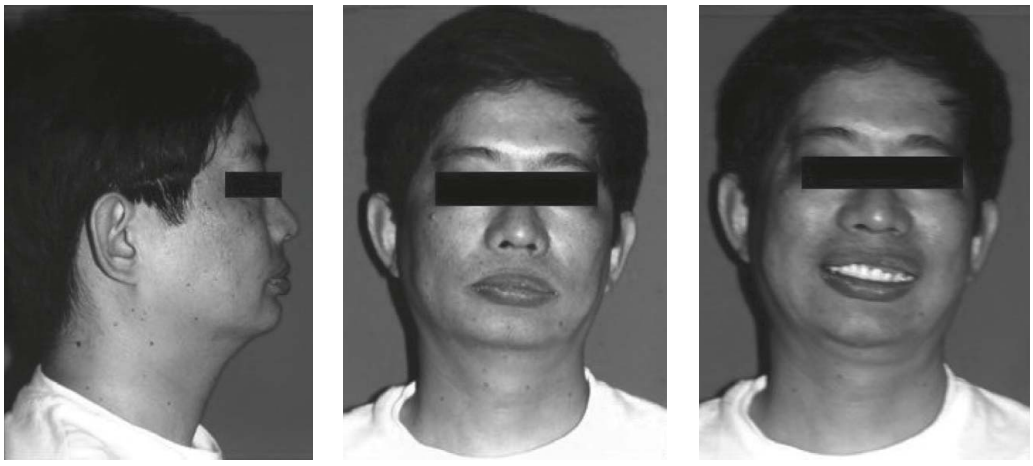

Figure 1. Patient pretreatment.

Figure 2. Intraoral photographs pretreatment.

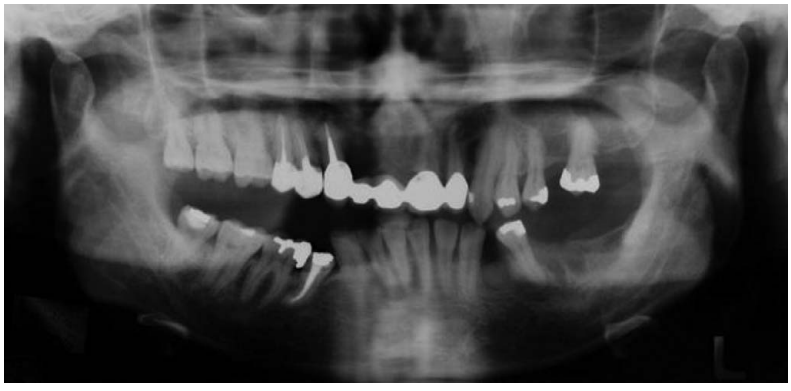

Figure 3. Panoramic radiograph pretreatment.

and bi-lip protrusion (Figure 1). Intraorally, 100% deep overbite, occlusal plane canting, and multiple early missing teeth (teeth numbers: 12, 11, 26, 28, 38, 37, 34, 44) were observed, and a 7-unit fixed prosthesis spanned in the upper arch (Figure 2). The early loss of right maxillary incisors had led to atrophy of the alveolar ridge. Multiple dental caries and old fillings, gingivitis, and tooth stain were present (Figures 2 and 3).

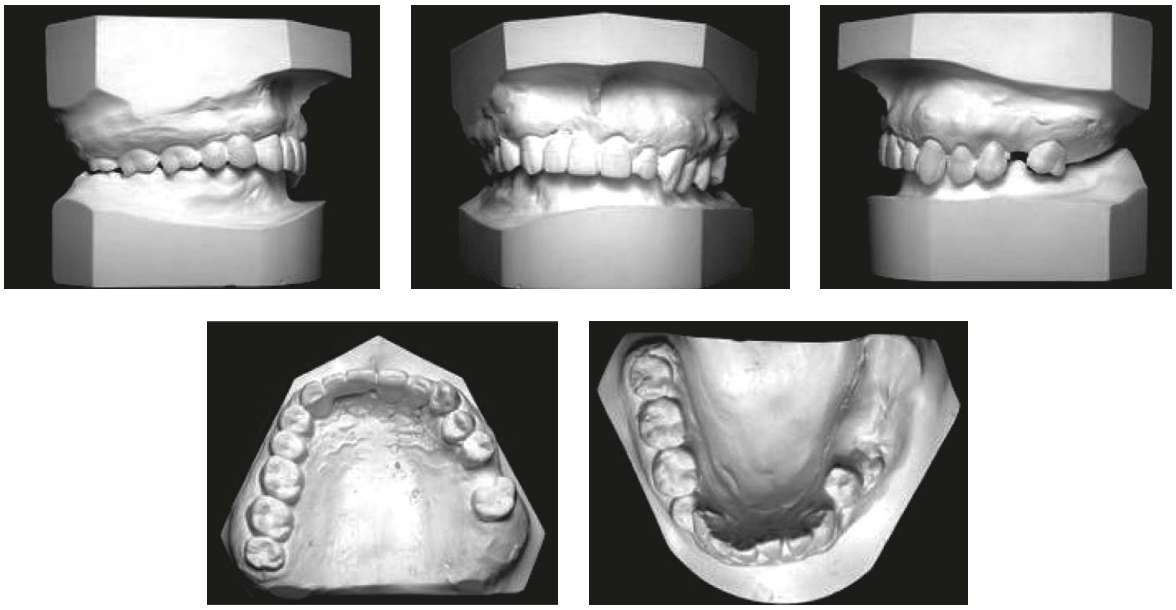

Figure 4. Pretreatment casts.

An asymmetric U-shaped arch in the maxilla and a symmetric ovoid-shaped arch in the mandible were observed (Figure 4). The occlusal relationships between the maxillary and mandibular dentitions were complex. A right-side class I molar, scissor bite in the left side, and bilateral class II canine relations leading to uncoordinated maxillary and mandibular arch form were observed. A 20-mm deep overbite and 5-mm overjet at the anterior dentition were noted. The anterior Bolton ratio was 0.87, and the overall ratio was unpredictable due to early multiple missing teeth, which led to an over-eruption of maxillary teeth and alveolar process with complete buccal crossbite from the left maxillary canine to the 2nd molar (23 to 27) being present. A 7-mm curve of Spee was also observed. The occlusal plane was tenting downward to the left (Figure 2). A complete periodontal probing examination showed deep probing depth (>3 mm) over multiple teeth (18, 17, 14, 13, 23, 25, 27, 47, 48). Mild to moderate gingival recession was also found over the lower anterior teeth area (32, 31, 41, 42). There were several incomplete endodontically treated teeth with apical radiolucency (15, 14, 13, 21, 22, 45).

Cephalometric analysis

The patient's lateral cephalometric radiograph presented a convex profile with lower lip protrusion (lower lip to E-line: 5 mm) (Figure 5). The skeletal pattern was moderate class II (ANB: 6°) with mandibular retrognathism (SNA: 84.3°; SNB: 78.3°; mandible-maxilla length difference: 4.3 mm) and low angle (SN-MP: 24.6°). The upper incisors and lower incisors presented severe retroclination (U1-SN: 82.6°; L1-MP: 83°) and increased interincisor angle (U1-L1: 169.9°) (Table 1).

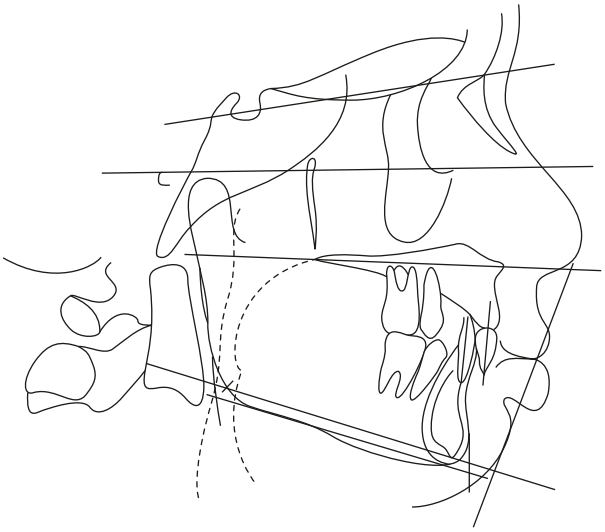

Figure 5. Pretreatment cephalometric tracing.

Problem list

The patient experienced unsatisfactory profiles and presented multiple dental and skeletal problems with uncoordinated intra-arch and inter-jaw relations and malocclusion. Multiple missing teeth led to the focal atrophy of premaxillary alveolar ridge and over-eruption of partial maxillary dentition. These problems required a revision of the current prostheses, re-alignment of the dentition by orthodontic tooth movement, and repositioning of the basal bone by surgery. Multiple

Table 1. Lateral cephalometric data before and after treatment

Reference	Pretreatment	Posttreatment	Mean	SD
Skeletal variables				
SNA	84.3	85	84.9	3.9
SNB	78.3	82*	81.4	3.3
ANB	6	3*	3.5	1.8
BS index, mm	3.4	–11*	–4.9	2.5
Mx. length (Ar-A), mm	100.8	99.5	97.7	3.9
Md. length (Ar-B), mm	105.1	117*	112.3	4.6
Md-Mx. diff., mm	4.3	17.5*	14.6	3.0
Pog-NVert., mm	–4.9	1.5*	–4.2	6.5
LAFH, mm	68.1	74.5*	76.4	3.7
SN-MP	24.6	37.5*	30.9	5.1
Total gonial angle	119.4	144*	123.9	6.9
Dental variables				
U1-SN	82.6	100.5*	106.3	5.6
L1-MP	83	82	93.5	5.7
L1-Apog, mm	7.1	5*	3.6	2.1
U1-L1	169.9	141	129.4	8.1
Soft tissue variables				
NLA	99.3	101	99.1	11.2
Upper lip-E line, mm	3.8	–1*	2.0	1.2
Lower lip-E line, mm	5	4	2.8	1.6

**Representing a significant change between pretreatment and posttreatment data. S = sella; N = nasion; A = point A; B = point B; Mx = maxilla; Md = mandible; Pog = pogonion; LAFH = lower anterior facial high; MP = mandibular plane; U1 = upper incisor long axis; L1 = lower incisor long axis; NLA = nasolabial angle.*

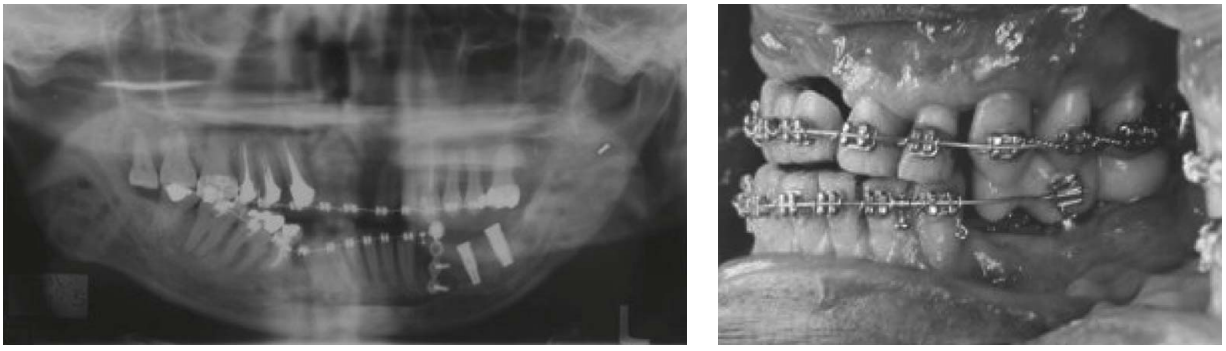

Figure 6. Miniplate and implant as orthodontic anchorage during treatment.

caries required filling. Incomplete pulp sealing needed retreatment. The severely resorbed alveolar ridge in the premaxilla needed bone graft before implant surgery. The patient agreed to a comprehensive multimodality treatment in order to resolve the listed problems.

Treatment objectives

The treatment objectives included the following: (1) to improve soft tissue profile; (2) to correct the anteroposterior, vertical and transverse skeletal discrepancy; (3) to coordinate the arch forms and establish the proper occlusion.

Treatment progress

Different treatment plans, including necessary surgical procedures and potential outcomes or complications were explained to the patient and his family (Figures 6–9). They agreed with the comprehensive approach for oral rehabilitation by orthodontic treatment, orthognathic surgery, bone graft and implant prostheses. In the preparatory phase, the old prostheses were replaced by provisional temporary crowns. Endodontic treatment was performed on teeth numbers 15, 14, 13 and 23. Oral hygiene instruction, ultrasonic scaling and subgingival hand scaling were also given at this stage. Then, the patient was fitted

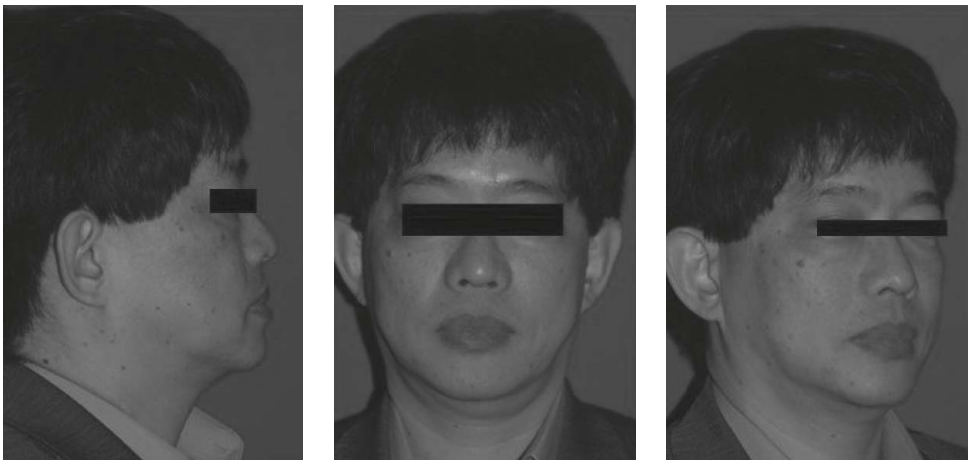

Figure 7. Facial photograph posttreatment.

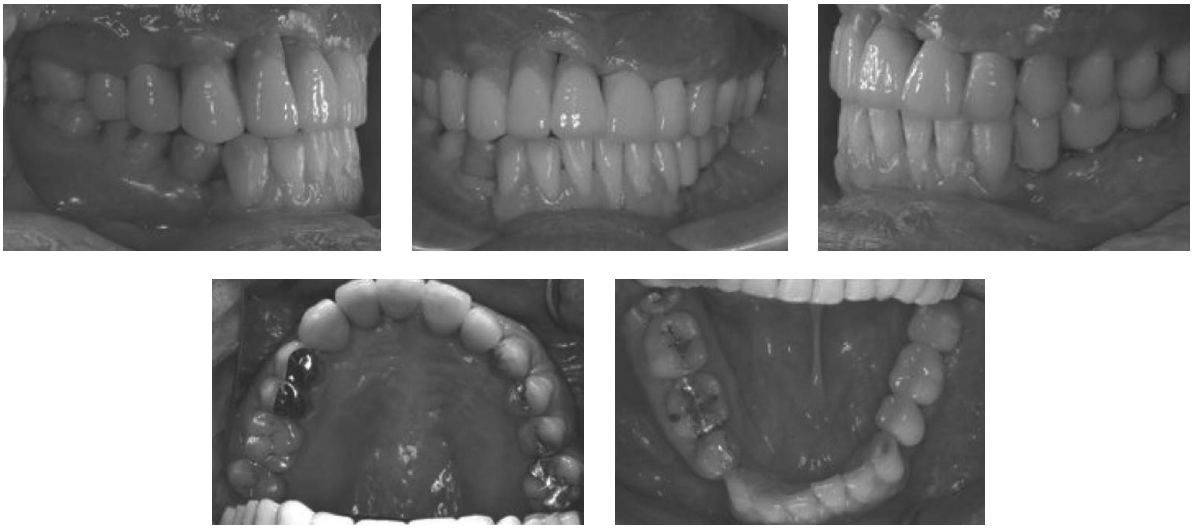

Figure 8. Intraoral photographs posttreatment.

Figure 9. Panoramic radiograph posttreatment.

with braces for the presurgical orthodontic treatment. Left-side space condensation and segmental leveling were performed over the upper dentition. Segmental leveling was also performed over the lower right-side posterior dentition at this stage.

After a 12-month period of orthodontic preparation, the patient was ready for surgery. Under hypotensive general anesthesia, the surgery began with a 5-mm canine-to-canine downward subapical osteotomy in the mandible to straighten the occlusal plane. A posterior

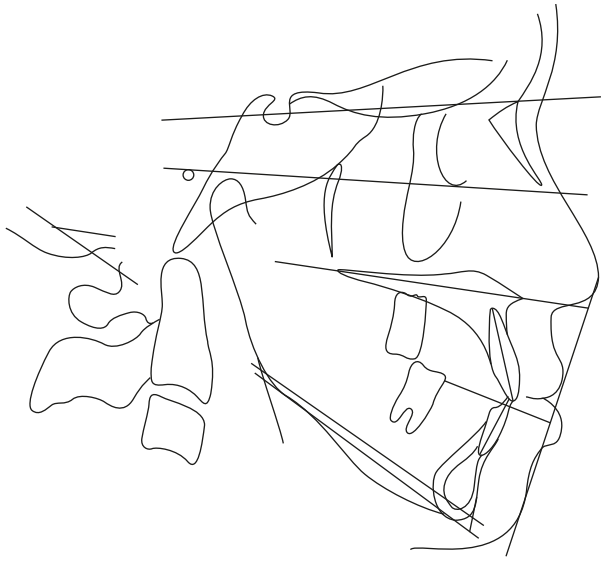

Figure 10. Posttreatment cephalometric tracing.

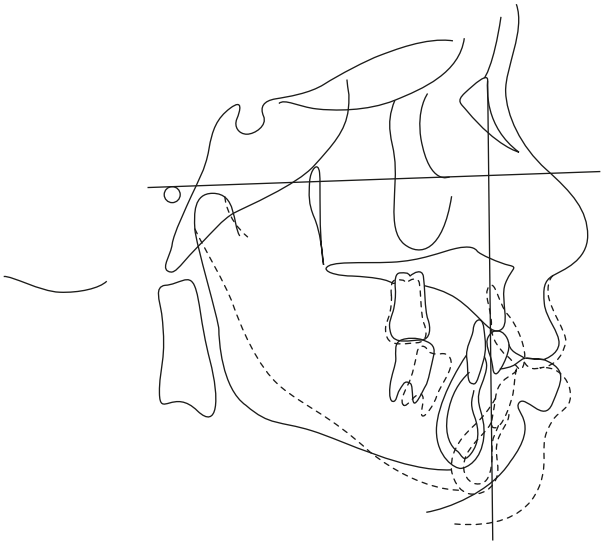

Figure 11. Superimposition of tracings (— pretreatment; ····· posttreatment).

subapical osteotomy was performed from the canine to the first molar in the left maxilla for a 5-mm impaction and lingual translation to correct buccal crossbite. A bilateral sagittal splitting osteotomy (BSSO) was also performed to downward-advance the mandible 5 mm, respectively.[5] Bone fragments were immobilized by biodegradable polymer (INION CPS™, Tampere, Finland) bone plates and screws.[6] The sharp edentulous ridge in the left mandible was trimmed to leave an 8-mm wide superior alveolar table to accommodate the width of the dental implant. A titanium miniplate was fixed at the buccal cortical bone at the 1st premolar area as a future orthodontic anchorage for leveling the lower arch dentition (Figure 6). The premaxillary deficient region was subperiosteally onlay-grafted with about 2 mL of corticocancellous bone chips harvested from the osteotomy and maxillary tuberosity, and covered with a resorbable semipermeable membrane (Gore-Resolut®, W.L Gore & Associates Inc., Flagstaff, AZ, USA) for guided bone regeneration. Two Osseotite™ 3.75 × 13-mm long implants (3I® Implant Innovations Inc., Palm Beach Gardens, FL, USA) were placed in the lower left 2nd premolar and the 1st molar areas (Figure 6).

One month later, the orthodontic treatment was continued. Lower arch dentition was leveled with miniplate anchorage over the tooth 34 area. Three months later, a provisional bridge was placed on top of the fixtures as added orthodontic anchorage. Six months after bone graft in the premaxilla, 23.75 × 3.75 × 15-mm implants were placed. The miniplate as anchorage was removed and an implant was placed in the same position. Vertical elastics were used over the right side and anterior portion to finalize the occlusion. The postsurgical period of orthodontic treatment lasted for about 12 months. By the end of orthodontic treatment, the permanent fixed prostheses were delivered in the maxilla and mandible respectively (Figure 8). Modified removable Hawley retainers with resin splint over anterior teeth segments were used in the maxilla and mandible to maintain the treatment result.

Treatment results

After completion of the treatment, the overjet and overbite had become normal value. The occlusal relationships were Class I canine, CIII molar in the right side and mild Class III canine, molar in the left site. Nearly all skeletal and dental treatment objectives were satisfactorily achieved. Over a 2-year follow-up, the results were considered satisfactory in terms of esthetics, functionality and stability (Figures 7–12).

Discussion

The complexity of the problem list reveals the difficulty of oral rehabilitation for this adult case before tooth movement could be started. The surgico-orthodontics, bone graft for supporting dental implants, and prosthodontic treatments comprised the core of the treatment, which lasted for longer than 2 years. In this patient, the major skeletal problems at multiple locations of both jaws were corrected by orthognathic surgery. These procedures were used to correct over-erupted dentoalveolar processes of the anterior mandible and left maxilla, the excessive curve of Spee, overbite and

Figure 12. Intraoral photographs of posttreatment follow-up.

overjet, maxillary buccal crossbite and the retrognathic mandible at one time. Especially, the BSSO procedure to forward- and downward-reposition the mandible greatly improved the short and retruded lower face. Thus, the presurgical orthodontic preparation was treated segmentally. Owing to multiple lost teeth in both the maxilla and the mandible, the miniplate and dental implants were useful as adjuvant anchorage for tooth movement. This technique has become popular, especially in adult cases with multiple lost teeth.[3,4] The implants in the left edentulous mandible were especially important in leveling and aligning the mandibular arch form and minor tooth movement in finishing the postsurgical orthodontic treatment.

Severe bone resorption was seen in the premaxilla due to trauma or early loss of incisors. It required bone augmentation for appropriate dental implant support.[7,8] Difficulties have been encountered in simultaneously augmenting the width and height of the deficient ridge.[9] An onlay bone graft or guided bone regeneration technique is especially useful to augment the ridge width, but, to some extent, has limited advantages for increasing the ridge height.[10] In this case, the premaxillary region received a subperiosteal tunneling method to accept the bone graft. During the first-stage implant surgery in the premaxilla at 6 months after bone graft, the result was satisfactory. A further increase of the ridge height was unnecessary for this case, since he presented with an initial gummy smile partially due to the overeruption of the alveolar process.

While the treatment goal was largely achieved, the patient did not desire to improve further the vertical height of the anterior maxilla, which was slightly insufficient by a few millimeters at the emergence area of the dental implants. The design of the final prosthesis at the anterior maxilla was accepted by the patient, and further surgical management to improve the bone level or soft tissue management was declined. The improvements in cosmesis of teeth or prostheses, skeletal relations and his profile over a 2-year clinical follow-up were stable and satisfactory. This report denotes the importance of a contemporary multimodality treatment in the oral rehabilitation of cases with complicated dental and skeletal problems.

Acknowledgments

The treatment of this patient and this article were sponsored by grants from Taipei Veterans General Hospital (VGH94C242) and the National Science Council (NSC 94-2314B075), Taipei, R.O.C.

References

1. Proffit WR, White RP. Who needs surgical-orthodontic treatment? *Int J Adult Orthod Orthogn Surg* 1990;5:81–90.
2. Mihalik CA, Proffit WR, Phillips C. Long-term follow-up of Class II adults treated with orthodontic camouflage: a comparison with orthognathic surgery outcomes. *Am J Orthod Dentofacial Orthop* 2003;123:266–78.
3. Umemori M, Sugawara J, Mitani H, Nagasaka H, Kawamaura H. Skeletal anchorage system for open-bite correction. *Am J Orthod Dentofac Orthop* 1999;115:166–74.
4. Odman J, Lekholm U, Jemt T, Branemark PI, Thilander B. Osseointegrated titanium implants: a new approach in orthodontic treatment. *Eur J Orthod* 1988;10:98–105.
5. Booth DF, Dietz V, Gianelly AA. Correction of Class II malocclusion by combined sagittal ramus and subapical body osteotomy. *J Oral Surg* 1976;34:630–4
6. Enislidis G, Lagogiannis G, Wittwer G, Glaser C, Ewers R. Fixation of zygomatic fractures with a biodegradable copolymer osteosynthesis system: short- and long-term results. *Int J Oral Maxillofac Surg* 2005;34:19–26.
7. Keller EE, Tolman DE, Eckert S. Surgical-prosthodontic reconstruction of advanced maxillary bone compromised with autogenous onlay block bone grafts and osseointegrated endosseous implants: a 12-year study of 32 consecutive patients. *Int J Oral Maxillofac Implants* 1999;14:197–209.
8. Kao SY, Yeung TC, Chou IC, Chang CS. Reconstruction of the severely resorbed atrophic edentulous ridge of the maxilla and mandible for implant rehabilitation: report of a case. *J Oral Implantol* 2002;28:128–32.
9. Kao SY, Fong HJJ, Chou SJ, Wu JH, Tu HF, Yeung TC. Segmental osteotomy to reposition multiple osseointegrated dental implants in the anterior maxilla in a trauma patient. *Dental Traumatol* 2007;23:56–9.
10. Astrand P, Nord PG, Branemark PI. Titanium implants and onlay bone graft to the atrophic edentulous maxilla: a 3-year longitudinal study. *Int J Oral Maxillofac Surg* 1996;25:25–9.