

Prosthodontic and Surgical Management of a Completely Edentulous Patient with a Severe Class III Skeletal Maxillomandibular Relationship: A Clinical Report

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Abstract

This article describes a multidisciplinary approach combining surgical and prosthodontic treatment of a completely edentulous patient who presented with a severe skeletal class III relationship and was diagnosed as American College of Prosthodontists Prosthodontic Diagnostic Index (ACP PDI) class IV. The use of a complete denture serving as diagnostic tool, surgical guide, and definitive restoration is presented. Computer-aided surgical simulation was used to achieve an accurate diagnostic and surgical plan. Maxillary Lefort class I and mandibular sagittal split osteotomy surgical treatment was performed to correct arch discrepancy. The surgical procedure demonstrated a clinically acceptable maxillomandibular relationship and stability. The patient was satisfied with the esthetics and demonstrated improved oral function following prosthesis insertion.

Class III malocclusion is a dentofacial phenotype characterized by negative anterior overjet, which affects 1 to 5% of the US population and up to 23% in Asia.¹ If skeletally severe, then the individual can be handicapped, both functionally and socially.¹ To correct this anomaly, surgical intervention along with adjunctive orthodontics and occlusal adjustment followed by prosthodontic treatment are recommended.² A combination of severe class III skeletal condition and edentulism creates a more challenging situation to treat, such as determining the occlusion, managing the biomechanics, and arranging tooth position for esthetics.³

Preoperative surgical planning is a crucial phase in the treatment plan for a complex multidisciplinary case.^{4,5} Many approaches for surgical planning using computer simulation have been described.⁵⁻⁷ Computer software can be used to predict the surgical outcome and has become an important tool to help with the treatment plan.

This article describes the prosthodontic and surgical management of a completely edentulous and skeletally severe class III condition patient using conventional maxillary and mandibular complete dentures as diagnostic tools and surgical guides in conjunction with a computer software program to predict surgical outcome.

Clinical report

A 32-year-old Hispanic woman with a completely edentulous, maxillary retrognathism and mandibular prognathism condition was referred from Massachusetts General Hospital, Oral Surgery Department to the Harvard School of Dental Medicine, Advanced Prosthodontic Clinic, for comprehensive treatment evaluation. The patient presented with a chief complaint of masticatory dysfunction and esthetic concerns. Medical and dental history suggested the patient was a drug abuser and had been completely edentulous for the last 10 years. Extraoral examination showed that the patient had a prominent chin, concave facial profile, and obtuse nasolabial angle (Fig 1). Intraoral examination revealed moderately resorbed existing alveolar ridges with a severe Angle class III skeletal maxillomandibular relationship (Fig 2A). A panoramic radiograph revealed no pathological condition. Complete edentulism class IV was diagnosed according to the American College of Prosthodontists

Prosthodontic Diagnostic Index.⁸ A mounted maxillomandibular diagnostic cast relationship at the centric relation position confirmed the class III skeletal relationship (Fig 2B).

Maxillary and mandibular custom travs fabricated from light cured composite resin (Triad, Dentsply, York, PA) were border molded with green stick modeling plastic impression compound (Kerr Corp., Orange, CA) and recorded with light-body polysulfide material (Permlastic, Kerr Corp.) with selective pressure technique.⁹ A master cast with type III stone (Microstone, Whip Mix Corp., Louisville, KY) was poured. A centric relation record was made using wax (Aluwax Dental Products Co., Allendale, MI), and a facebow transfer record was obtained. The maxillary and mandibular casts were mounted on a semiadjustable articulator (Whip Mix Corp.). Maxillary and mandibular complete dentures were fabricated using 10° posterior teeth for a more natural appearance (Portrait IPN, Dentsply), and the teeth were arranged in class III canine/molar relationship initially (Fig 3A) with the intent to reposition them into class I canine/molar relationship after surgery. After dentures were processed and inserted, both maxillary and mandibular dentures were duplicated using vinylpolysiloxane impression material (GC America, Alsip, IL) and orthodontic resin (Dentsply Caulk, Milford, DE) as described previously.¹⁰ A mixture of 30% barium sulfate (EZEM, Lake Success, NY) and urethane dimethylacrylate (Triad Gel, Raintree Essix Inc., Metairie, LA) was applied to the facial side of the maxillary and mandibular left central incisors and first molars of the duplicate dentures (Fig 3B), and a cephalometric radiograph was taken to reconfirm the skeletal condition.

A cephalometric analysis (Fig 4A) revealed that the patient had a class III maxillomandibular relationship (ANB: -5.8°), maxillary retrognathia (SNA 77.5°), and mandibular prognathia (SNB: 83.3°). Further analysis using soft-tissue profile simulation software (Dolphin Imaging 11, Chatsworth, CA) was conducted. It was determined that the treatment would be to advance the maxilla 6 mm anteriorly and set the mandible back 4 mm posteriorly to correct the discrepancy and achieve an ideal Angle class I profile (Fig 4B). Duplicated dentures were mounted on a semiadjustable articulator using the plaster mounting index from the previous facebow transfer record. Horizontal and vertical reference lines were marked on the mounting plaster (Fig 5). A surgical model was then constructed according to the determined treatment plan. First, the maxillary cast was separated, moved 6 mm anteriorly, and fixed at the new position. An intermediate interocclusal record (Orthodontic Resin, Dentsply Caulk) was created against the mandible cast. Then the mandibular cast was separated, moved 4 mm posteriorly, and fixed in the new position. The final bite registration record was created with the new maxillary cast position.

The duplicate dentures and the interocclusal records were used to transfer the treatment plan into the actual surgical guide. Preoperatively, stainless steel arch bars (KLS Martin, Jacksonville, FL) were bonded using self-curing acrylic (Dentsply Caulk) to the duplicate dentures. Under general anesthesia, maxillary Lefort I was performed, and the maxillary duplicate denture was ligated to the separated maxilla. The intermediate interocclusal record was used to reposition then fix the maxilla. In a similar sequence, a mandibular bilateral sagittal

split osteotomy was performed, followed by cross-arch duplicate denture ligation. Using stainless steel wires (KLS Martin) on the separated mandible, the mandibular cast was repositioned to the final position against the maxilla using the final interocclusal record, then followed by mandibular fixation. Intermaxillary fixation was placed on the duplicate dentures for a 10-day period after which the fixation was released, and the patient was allowed to function under elastic rubber band (Ormco, Orange, CA) guidance (Fig 6). After the soft tissue matured (4 months postsurgery), definitive complete dentures were fabricated and inserted. Occlusion was adjusted to achieve bilateral balanced occlusion (Fig 7A). A follow-up evaluation was performed 6 months postsurgery. The patient presented with no complaints. The maxillomandibular relationship demonstrated a stable condition. The patient was satisfied with esthetics and demonstrated improved oral functions (Fig 7B). Yearly regular dental recall appointments were suggested for the maintenance phase.

Discussion

A combination of class III skeletal and edentulous conditions resulted in a fairly complex treatment situation. The edentulous patient with a class III skeletal condition frequently places considerable stress and unfavorable leverages on the maxillary basal seat under the complete denture.³ This may cause an excessive resorption of the maxillary residual ridge.³ A multi-disciplinary team approach and the use of advanced diagnostic tools are essential to overcome these issues. Surgical procedures involving either a bilateral sagittal split osteotomy for mandibular setback, a LeFort I maxillary advancement, or a combination of the two procedures along with adjunctive face-lifting procedures to create a more favorable arch alignment and esthetics is recommended.^{2,3} In the literature, the long-term result of these surgical procedures appears to be fairly stable.^{2,11}

The participation of a prosthodontist to fabricate the maxillary and mandibular complete dentures prior to the surgery is mandatory. By having the complete dentures, the skeletal maxillomandibular relationship can be analyzed, and an accurate diagnosis can be determined. In addition, a computer-aided surgical simulation was used. This computer software technology has been used widely to predict orthognathic surgery outcomes, mainly for dentate patients.^{6,7} Soft-tissue surgical simulation can be facilitated by the presence of the duplicate dentures, and the prediction of facial changes can be foreseen. During the surgical procedure, the duplicate dentures can maintain horizontal and vertical jaw relationships, guide the surgeons to establish an ideal maxillomandibular relationship as was planned by cephalometric analysis, and facilitate the intermaxillary fixation process. Without these prostheses, no logical treatment outcome could be predicted and pursued.

In this article, a detailed, comprehensive, and prostheticdriven treatment for a complex PDI completely edentulous class IV patient was presented. A multidisciplinary approach including a surgical team, an orthodontist, and a prosthodontist is an integral part of the treatment. Computer-aided surgical simulation was used to achieve an accurate diagnostic and surgical plan that may lead to an esthetic and functional treatment



Figure 1 Lateral extraoral picture before treatment.



Figure 3 (A) Complete denture teeth arranged in class III canine/molar occlusion. (B) Maxillary and mandibular left incisors and first molars of the duplicated dentures were painted with barium sulfate for cephalometric analysis.



Figure 2 (A) Intraoral pictures of maxillomandibular alveolar anatomical structure and position. (B) Mounted centric relation of diagnostic cast confirmed class III skeletal maxillomandibular relationship.





Figure 4 (A) Cephalometric radiograph before treatment. (B) Cephalometric tracing analysis using Dolphin imaging system. The black lines indicate the patient's existing condition, and the red lines indicate the expected outcome after surgical treatment.



Figure 5 Duplicate dentures were used as a surgical guide for the maxillary Lefort I and mandibular bilateral sagittal split osteotomy surgical procedures.



Figure 6 Cephalometric radiograph after surgical treatment.

outcome. Finally, further recommendation in the course of treatment of this patient should be directed toward dental implant placement. Although implant treatment may require additional surgical intervention and financial burden, implant-supported prostheses have demonstrated superior stability, retention, and patient satisfaction when compared to conventional prostheses alone.^{4,5,12-14}



Figure 7 (A) Intraoral pictures after treatment (class I relationship). (B) Lateral facial profiles after surgery.

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