

Correction of a Class III Malocclusion with All-on-4 Concept Implant Supported Full Mouth Rehabilitation

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INTRODUCTION

Malocclusion is defined as a deviation from ideal. As public awareness continues to grow, the effects of malocclusion on the individual's facial appearance significantly influences their quality of life.¹ Angle classified malocclusion into three categories: Classes I, II, and III. Class II or III types of malocclusion could be a result of either a dental or skeletal deformity or a combination of both.² A skeletal Class III malocclusion can be described as a facial deformity resulting from the forward position of the mandible in relationship to the base of the skull and/or the maxilla. This facial deformity could be the result of mandibular prognathism, maxillary retrognathism, or a combination of both.³ In the United States, a Class III malocclusion is more prevalent in the Hispanic community than the Caucasian or African communities.⁴

In full mouth reconstruction cases, all practitioners are aiming to achieve a normal Class I dental relationship. Vertical dimension of occlusion (VDO) has a substantial impact on the maxillo/mandibular relationship. A collapsed VDO leads to either reduction of the Class II, altering a Class I into a Class III, or accentuating a Class III.⁵ Thus, careful assessment of the VDO is essential to determine the true maxillo/mandibular relationship and plan the corresponding treatment accordingly. It is of paramount importance to establish the correct VDO in the planning phase to determine the alveoplasty required to allow for adequate restorative space.⁶ The prosthesis tissue junction (PTJ) can be defined as the transition of the prosthesis to the gingival tissues. Evaluation of the location of the PTJ, in relation to the patient's smile line, is of paramount significance for the esthetic outcome of the case.⁷ In cases where prosthetic gingiva is planned, if the PTJ becomes visible during certain lip positions, the case could reasonably and justifiably be classified as an esthetic failure. Alveoplasty is an effective treatment modality when PTJ presents an issue.⁷

CASE REPORT

A 76-year-old Hispanic woman presented to the East Carolina University School of Dental Medicine comprehensive care clinic

with a chief complaint of "I cannot wear my upper partial denture, it keeps on breaking." Clinical examination revealed the patient had a reduced VDO, supraeruption of the mandibular teeth, and a lack of restorative space (Figure 1). A profile analysis of the patient's face revealed a skeletal Class III malocclusion (Figures 2 and 3). Clinical examination also revealed the presence of a maxillary implant with a locator attachment present at site #11 and implants at sites #17 and #20 supporting an implant supported fixed partial denture (Figures 4 through 8). Evaluation of the maxillary removable partial denture revealed a fracture in the acrylic at the site of the locator attachment. Tooth #6 was apparently overdentured by the maxillary removable partial denture; however, it was carious and fractured at the gingival level. The patient also reported this fracture and stated it was a recurring problem. Risks, benefits, and alternative treatments were discussed at great length with the patient. The patient opted for maxillary and mandibular All-on-4 concept implant placement,⁸ which was later restored by a titanium/acrylic (hybrid) fixed/detachable implant supported prosthesis.

As with any full mouth reconstruction case, prosthodontic treatment planning always depends on 3 main factors: VDO, centric relation, and the maxillary incisal edge position. After assessment of these 3 factors, a diagnostic cast was fabricated and modified (according to desired alveoplasty), and a denture teeth setup was completed. This diagnostic setup assisted in determining how much alveoplasty was required to achieve a Class I occlusal relationship. The denture setup not only served as a guide but also as the method by which interim dentures were fabricated for the patient to be worn after implant placement and during subsequent healing and integration. The surgical treatment plan included 4 implant bodies placed on each arch to support an implant supported prosthesis. The surgical plan was designed using Siplant-Dentsply Sirona Implant software. The surgery began with the edentulation of the remaining dentition and the removal of implants at sites #11 and #20. An alveoplasty of 3 mm in the maxilla and 8 mm in the mandible was accomplished using a Piezotome Cube Acteon (Figures 9 and 10). Following the alveoplasty, sharp bony ridges were smoothed using a bone file for a smooth contour. Four Zimmer Tapered Screw-Vent (TSV) 4.7 × 10-mm implant bodies were placed in the mandible (Figure 11). The implant bodies were placed straight for sites #22 and #27. Implants at sites #20 and #29 were placed at a 30-degree angle.⁸ This angled placement of the posterior mandibular implants allowed for minimizing the cantilever distally while avoiding the inferior alveolar nerves.⁸ Four

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FIGURES 1–9. **FIGURE 1.** Facial frontal view (preoperative) showing accentuated folds, which is a sign for lack of adequate labial support. **FIGURE 2.** Facial profile view (preoperative) showing collapsed vertical dimension of occlusion. **FIGURE 3.** Closeup, side smile view (preoperative) showing lack of adequate upper lip support. **FIGURE 4.** Intraoral full frontal (preoperative) in maximum intercuspation without the removable partial denture showing lack of restorative space. **FIGURE 5.** Intraoral full frontal (preoperative) in maximum intercuspation with the removable partial denture showing the denture teeth without an ideal setup. **FIGURE 6.** Intraoral right lateral view (preoperative) in maximum intercuspation showing significant Class III malocclusion. **FIGURE 7.** Intraoral left lateral view (preoperative) in maximum intercuspation showing significant Class III malocclusion. **FIGURE 8.** Panoramic radiograph (preoperative) showing significantly pneumatized sinuses, especially the left maxillary sinus. **FIGURE 9.** Mandibular full-thickness flap elevated before mandibular edentulation.

implants were also placed in the maxilla. Site #3 required an internal osteotome sinus graft⁹ of the right maxillary sinus using Bio-Oss Xenograft. A Zimmer TSV 4.7 × 10-mm implant body was simultaneously placed at the site of #3 with the sinus lift. Zimmer TSV implant bodies 4.1 × 10 mm were placed in sites #7 and #10. Because of a lack of alveolar bone height at the site of #14, a lateral window sinus augmentation was completed on the left maxillary sinus. Xenograft Bio-Oss was used for this sinus augmentation, and the window was covered using Biomend extend.¹⁰ The graft material was allowed to heal for 6 months before the placement of a Zimmer TSV 6 × 10-mm implant body at site #14. During the healing phase, the patient was provided with interim complete maxillary and mandibular dentures.

After osseointegration of the implants, second-stage surgery was performed. Straight angled tapered abutments

(ATAs) were delivered for all implants except for sites #20 and #29, which received 30-degree ATAs. All the ATAs torqued to 30 N/cm². Following the abutment level final impressions, jaw relation records, denture teeth setup, and wax try-in, the case was sent to Atlantis Isus hybrid (Dentsply Sirona) for designing and milling of the titanium framework. Once the metal framework was received, it was verified for a passive fit using multiple techniques. The first technique involved direct vision using a sharp explorer to ensure the absence of any discrepancy between the milled framework and ATAs. The second technique used was the Sheffield Test (1 screw test). Last, complete seating of the framework onto the ATAs was confirmed radiographically by obtaining a panoramic radiograph.¹¹ The SR Phonares II (Ivoclar Vivadent) Denture teeth were transferred to the metal framework, and another wax try-in was completed. After esthetic approval by the patient, the



FIGURES 10–17. **FIGURE 10.** Piezotome was used for 10-mm alveoloplasty of the mandibular alveolar ridge to create more restorative space and correction of the Class III malocclusion. **FIGURE 11.** Four Zimmer TSV implants placed in the mandibular arch after 10-mm alveoloplasty. **FIGURE 12.** Full frontal intraoral view (postoperative) in maximum intercuspation showing the maxillary and mandibular screw-retained implant supported fixed prostheses. **FIGURE 13.** Right lateral intraoral view (postoperative) in maximum intercuspation. **FIGURE 14.** Left lateral intraoral view (postoperative) in maximum intercuspation. **FIGURE 15.** Panoramic radiograph (postoperative) showing the maxillary and mandibular implant-supported prostheses. **FIGURE 16.** Facial frontal view (postoperative). **FIGURE 17.** Facial profile view (postoperative) demonstrating restored vertical dimension of occlusion.

case was sent to Drake Dental Laboratory (Charlotte, NC) for processing of the prostheses using original shade acrylic SR Ivocap injection system by Ivoclar Vivadent.

The completed maxillary and mandibular prostheses were inserted, and each screw was torqued to 30 N/cm², after which the occlusion was adjusted and verified. The patient was extremely pleased with the esthetic outcome. Postdelivery instructions were given to the patient, and a follow-up plan was put into place. The patient was scheduled for postdelivery appointments at 1 day, 1 week, 1 month, and 3 months to check and correct any postinsertion problems. The patient was then placed on 6-month recalls for hygiene visits.¹² During the hygiene visits, bitewing radiographs were taken to check for

any alveolar bone loss. The hygiene visits also include removal of the maxillary and mandibular prostheses to check for any peri-implantitis or soft tissue inflammation and to verify the patient's home hygiene measures.

DISCUSSION

An alveoloplasty is more often than not required with the treatment plan of any fixed/detachable implant supported prosthesis. Alveoloplasty is indicated for multiple reasons. The first indication for an alveoloplasty is when more restorative space is required. To be able to fabricate a prosthesis, 15 mm

per arch is necessary.⁶ Lack of adequate space will lead to numerous esthetic and mechanical issues that will compromise the overall prognosis of the treatment.⁶ The second indication for an alveoplasty with an implant hybrid prosthesis is hiding the PTJ or the transition line between the prosthetic gingiva and natural oral mucosa.⁷ Upon smiling, if this PTJ is visible, it would be a major esthetic failure. In some cases, such failure could only be remedied by implant removal and then an alveoplasty, followed by new implant body placement. Correction of cases where implants are placed without alveoplasty, although it was indicated, are traumatic and costly.

For the case presented in this paper, a significant alveoplasty was performed in the mandibular arch after edentulation primarily to gain more restorative space.⁶ The amount of alveoplasty also aided in the creation of the mandibular prosthesis in a proper occlusal relationship with the maxillary prosthesis while maintaining a natural and hygienic pontic surface.⁶ However, before planning for such alveoplasty, assessment of the VDO and centric relation is crucial. VDO assessment was accomplished by the following methods: physiologic rest position, esthetic appearance, and closest speaking space.¹³

The left maxillary sinus was anteriorly pneumatized almost up to the site of #11. This made the placement of the any implants in the posterior left maxilla extremely challenging unless a lateral window sinus graft was performed. Bio-Oss and xenografts, in general, are considered by many studies to be effective choices for sinus lifting.¹⁰ Another factor in the diagnosis that aided in the correction of the Class III occlusal relationship was the fact that the patient presented with a reduced VDO. Posselt's envelope of motion of the mandible demonstrates that when a reduced VDO is opened, the mandible positions itself both inferiorly and posteriorly.¹⁴ The maxillary incisors in the maxillary hybrid prosthesis were set far more facial than the ideal setup. This decision was made to provide adequate lip support and aid in providing an acceptable occlusal relationship with the mandibular incisors (minimal overbite and minimal overjet).

The pontic design chosen for both the maxillary and mandibular prostheses was the modified ridge lap. This design was chosen to allow the patient to perform oral hygiene measures such as flossing underneath the prosthesis using super floss and floss threaders.¹⁵ Milled frameworks for full arch prosthesis are now the gold standard. Many studies have compared milled frameworks to cast frameworks, and the milled frameworks always demonstrated a better passive fit.¹⁶ SR Phonares II (Ivoclar Vivadent) teeth were selected for this case. These teeth provide better mechanical properties and improved esthetics compared with other brands.¹⁷ The implant at site #17, which was supporting the previous fixed prosthesis, was not removed to spare the patient from an additional surgical procedure and because its presence will be inconsequential to the final prosthesis.

CONCLUSION

As demonstrated with the case presented in this paper, the previously placed implants were most likely inserted without an

adequate prosthetic or restorative plan. The removable partial denture that was fabricated for the patient was unsatisfactory because of the lack of restorative space that is essential to deliver a well-functioning and esthetic prosthesis.

With the right case selection, proper treatment planning, and execution, the skeletal Class III malocclusion was corrected. Significant alveoplasty in most hybrid cases is crucial to provide adequate space essential for the prosthesis hardware. Correction of cases with implant bodies placed without providing required space will compromise the esthetics and the overall prognosis of the hybrid cases. In this case, the 8-mm alveoplasty in the mandibular arch allowed correction of the Class III malocclusion without having to fabricate the mandibular prosthesis with an unhygienic tissue surface. In this case, the lack of upper lip support initially was a positive finding, because it indicated that there was space available to set the teeth in a more facial position than the standard maxillary anterior setup (Figures 12 through 17). Comprehensive pretreatment planning as described in this paper demonstrates the criteria necessary to obtain successful results when restoring an All-on-4 concept implant supported full mouth rehabilitation.

ABBREVIATIONS

ATA: angled tapered abutment
PTJ: prosthesis tissue junction
TSV: tapered screw-vent
VDO: vertical dimension of occlusion

NOTE

The authors declare no conflicts of interest.

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