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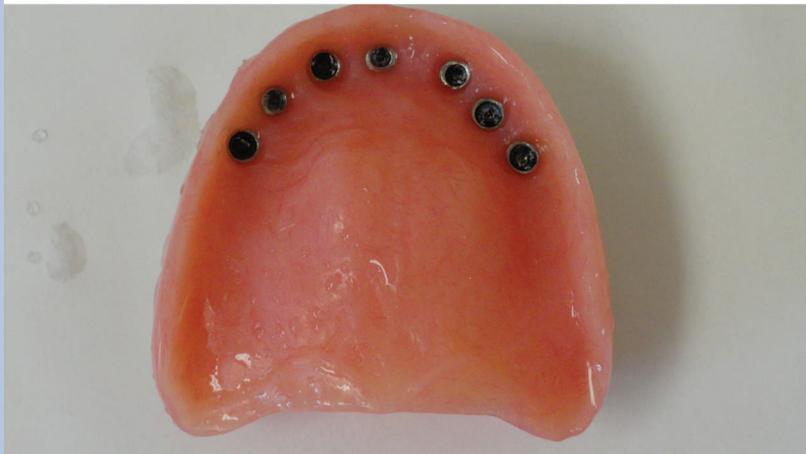
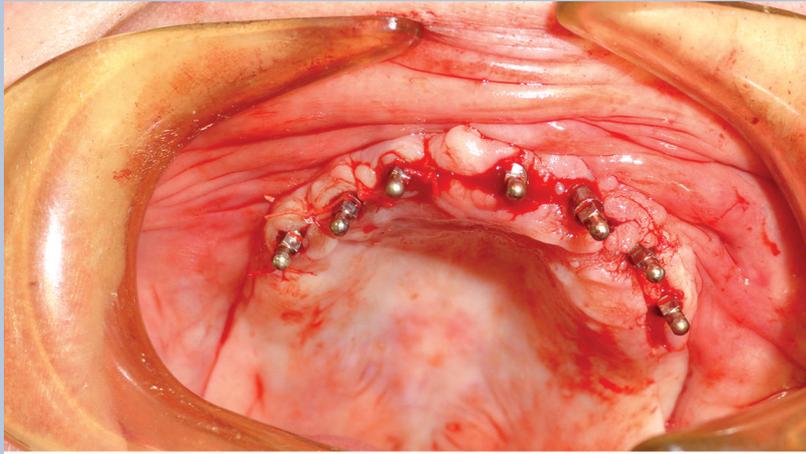
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## Small-Diameter Implant Treatment Plan Revision: Management of Complications

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Implant dentistry has become a predictable discipline for reconstructing the edentulous patient. The edentulous population in the United States will increase over the next 3 decades, and the demand for implant-supported prostheses will rise accordingly.<sup>1</sup> Maxillary and mandibular implant-retained overdentures may serve as an acceptable treatment option for the rehabilitation of the edentulous patient.<sup>2,3</sup> Conventional implants are the primary type and diameter size used in reconstruction, however small-diameter implants (SDI) or mini-dental implants (MDI) may play a role in specific indications.

Survival rates for small-diameter endosseous implants demonstrate a mean success rate of 94%, although complications and failures have been reported.<sup>4,5</sup> Reasons for less than ideal outcomes are poor diagnosis and treatment planning, inadequate bone quality/quantity, implant design, early/late loading, prosthetic design, and biomechanical factors related to implant occlusal concepts.<sup>6</sup>

This case letter describes a mini-implant failure and the subsequent management of complications and oral reconstruction for the edentulous patient with removable overdentures.

Small-diameter implants have received Food and Drug Administration approval for long term use for overdentures, removable partial dentures, and fixed multiunit bridges.<sup>7</sup> Small-diameter implants are a 1-piece, single-stage implant manufactured from titanium alloy. They are composed of an intraosseous, transgingival, and o-ball prosthetic component. It is essential that strict surgical and prosthetic protocols are followed or less than ideal outcomes can be realized.<sup>9</sup>

## CASE HISTORY

A 41-year-old white man presented at a private practice with a concern about the status of his failing MDI.

The patient's medical history revealed (1) gastric bypass surgery, (2) hypertension, and (3) the following medications: testosterone, lisinopril, vitamin D, and vitamin B<sub>12</sub>. The patient reported that 2 years earlier, 5 MDI were placed in the maxilla and 5 in the mandible and immediately loaded. The patient stated that in the maxilla, 2 implants failed, and of the remaining 2, 1 was loose and 1 painful. The patient stated that he was satisfied with the mandibular implants.

A clinical examination revealed 3 SDI present in the maxilla

and 5 SDI in the mandible (Figures 1 and 2). The implant in position No. 9 was mobile, and No. 10 was sensitive to percussion. All tissue proximal to the implants indicated varying degrees of erythema, edema, and bleeding on probing. The mandibular implants were asymptomatic; however, the implant in position No. 24 exhibited severe lingual divergency. The prostheses were removable overdentures with o-ring attachments (Figure 3). The prosthetic occlusion demonstrated anterior tooth contact with bilateral posterior disocclusion in centric relation and a reduced vertical dimension of occlusion with excessive overjet and overbite (Figures 4 through 6). The radiographic survey demonstrated reduced crestal bone levels associated with the mini-implant in the left maxillary incisor position (Nos. 9, 10; Figure 7). On the basis of the clinical and radiological examination, a primary diagnosis was made of peri-implantitis (implants 9 and 10) and a maladaptive occlusal scheme.

Initial therapy focused on the removal of the implant in position No. 9 and the modification of the existing prosthesis to establish a posterior occlusion. Anesthesia was administered, an SDI-specific thumb wrench instrument placed over the prosthetic head, and a reverse manual torque applied in a counterclockwise direction to remove the implant. The residual site was debrided and grafted with a mixture of platelet-rich plasma (PRP) and mineralized irradiated cortical cancellous allograft (Puros, Zimmer, Carlsbad, Calif; Figures 8 and 9). Resin was applied to the occlusal surfaces of the posterior mandibular teeth to establish a bilateral posterior occlusion (Figures 10 and 11).

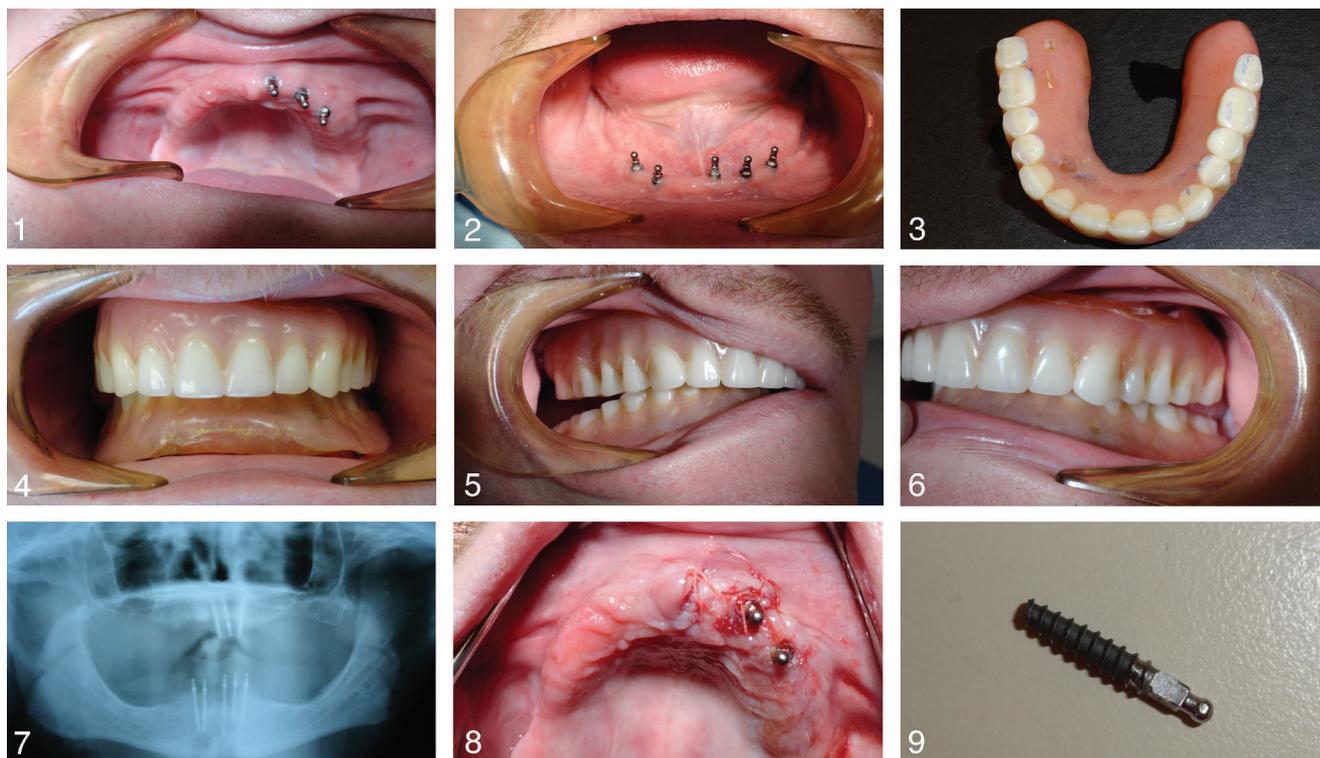
The prosthetic reconstruction was initiated with the fabrication of a maxillary complete denture and a mandibular overdenture. A final mandibular impression using a polyvinylsiloxane material (Imprint III, 3M, St Paul, Minn) placed over the MDI o-ring prosthetic component was performed to capture indirect transfer caps (Figures 12 and 13). A commercial laboratory fabricated an implant working model and a mandibular unibase containing MH2 o-ring housings (Figure 14). A maxillary/mandibular relationship was established, tooth mold (Ivoclar P8), shade (B1) selected, followed by a try-in and final placement (Figures 15 and 16).

The maxillary implant reconstructive surgery was initiated 6 months after the mobile implant was removed (Figures 17 and 18). A 20-mL blood draw from the left medial cubital vein was taken and placed in a single-stage centrifuge. A local anesthetic was delivered, a full mucoperiosteal flap was elevated, and a surgical guide was placed, followed by a 6-mm partial osteotomy created with a 1.1-mm drill. The SDI were autoadvanced with a finger driver, thumb wrench, and ratchet. The implants placed were (5) 2.4 × 13 mm and (1) 2.4 × 10 mm

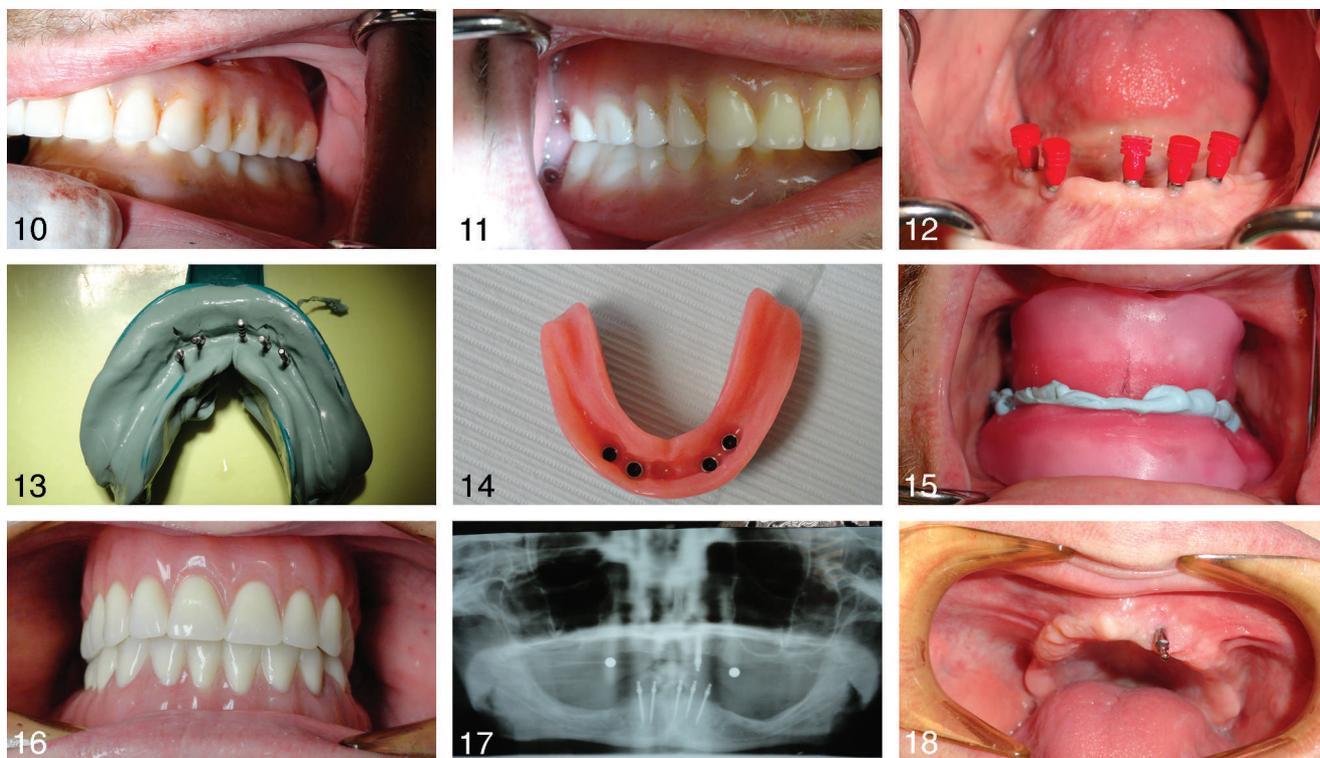
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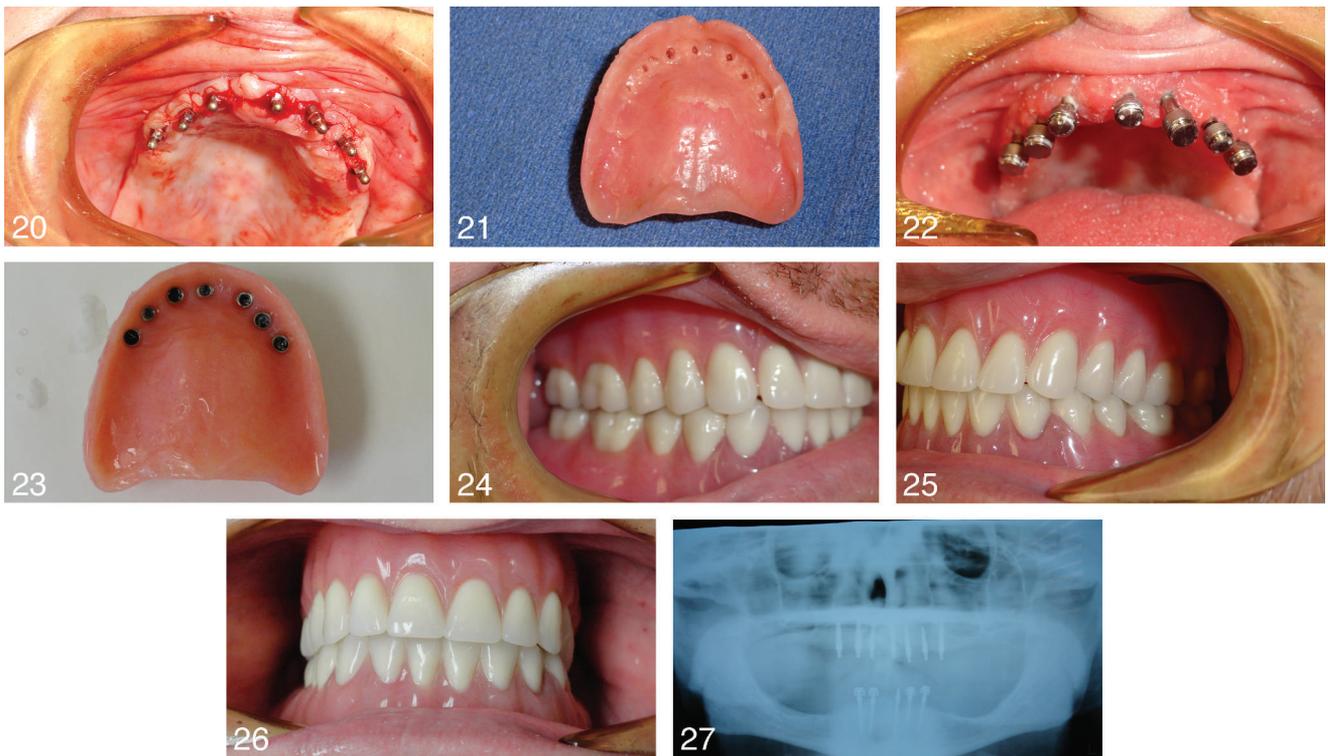
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**FIGURES 1–9.** **FIGURE 1.** Initial intraoral—maxilla. **FIGURE 2.** Initial intraoral—mandible. **FIGURE 3.** Maxillary overdenture—palateless. **FIGURE 4.** Initial intraoral—centric relation. **FIGURE 5.** Initial intraoral—centric relation right. **FIGURE 6.** Initial intraoral—centric relation left. **FIGURE 7.** Initial panoramic radiograph. **FIGURE 8.** Maxilla post MDI removal. **FIGURE 9.** MDI implant 2.4 × 13 mm.



**FIGURES 10–18.** **FIGURE 10.** Centric relation (R)—mandibular resin application. **FIGURE 11.** Centric relation (L)—mandibular resin application. **FIGURE 12.** MDI impression transfers. **FIGURE 13.** Implant analogues/transfers secured in impression material. **FIGURE 14.** Mandibular unibase with MH2 o-rings. **FIGURE 15.** Maxillary/mandibular relationship. **FIGURE 16.** Prosthetic try in. **FIGURE 17.** Panorex—preimplant surgery. **FIGURE 18.** Maxilla—prerevision surgery.



**FIGURES 19–26.** **FIGURE 19.** Maxilla—final implant placement. **FIGURE 20.** Maxillary denture—soft reline. **FIGURE 21.** Maxilla—MH1 housings. **FIGURE 22.** Maxillary overdenture with MH1 housings. **FIGURE 23.** Final prosthesis (RT) centric relation. **FIGURE 24.** Final prosthesis (LT) centric relation. **FIGURE 25.** Final prosthesis—centric relation (facial). **FIGURE 26.** Final Panorex.

(3M ESPE, St. Paul, Minn) distributed anterior to the maxillary sinus (Figure 19). The implant prosthetic o-ball heads were relieved in the undersurface of the maxillary denture and relined with a soft silicone material (Figure 20).

After 6 months, MHI design o-ring housings were placed on the o-ball prosthetic attachments, and a hard composite reline material (Secure, 3M ESPE) was placed around the housings and in denture relief areas (Figures 21 and 22). Vertical dimension, centric relation, and all excursive movements were evaluated (Figures 23 through 26).

#### DISCUSSION

Small-diameter implants have emerged as an alternative for patients with deficient bone and compromised health histories.<sup>10</sup> Research has demonstrated that osseointegration can be achieved with SDI.<sup>11</sup> Strict protocols need to be adhered to however, otherwise complications can develop and jeopardize implant survival. It is difficult to determine whether the failure seen in this clinical case is specific to the surgical aspect or the occlusal scheme. However, it can be hypothesized that variances in recommended implant protocols may have negatively affected the results.

Small-diameter implants consist of a 1-piece design manufactured from titanium alloy (Ti 6Al-4V), which increases the strength of the implant.<sup>12</sup> The absence of a microgap common to a 2-piece design reduces pathogenic microbe colonization.<sup>13</sup> A microthread transgingival design with blasted

osseous threads enhances bone and soft-tissue adherence.<sup>14,15</sup> The o-ball prosthetic design with an o-ring stainless steel housing complex provides retention for the overdenture.<sup>16</sup>

A removable overdenture maxillary treatment plan using SDIs should incorporate several considerations: a minimum of 6 implants with 2.4-mm or greater diameter size and length equal to or exceeding 13 mm.<sup>17</sup> These specifications increase rigid fixation via bone-to-implant contact. Implants are placed anterior to the maxillary sinus in type I, II, or III quality bone. A 6-month nonloading osseointegrative period allows for enhanced mineralization of bone. In light of the results obtained in this case report, the author advocates a delayed healing period as opposed to an immediate load approach. The maxillary overdenture is stabilized and supported by soft tissue and retained by implants.<sup>18</sup> A horseshoe design should be avoided to reduce stress on the implants. The author suggests that if a reduction in the palatal surface is requested, an incremental modification can be achieved after 6 months.

Small-diameter implants in limited situations demonstrate successful results when diagnostic, surgical, and prosthetic protocols are followed. The partial, undersized osteotomy ensures initial rigid fixation in bone. Implant stability is the primary objective at surgical placement. A mucoperiosteal flap or flapless approach can be used. A flapless approach is best achieved with the aid of cone-beam computerized tomography imaging.<sup>19</sup> In this case study, the previous implant surgery was performed flapless without the aid of 3-dimensional imagery. It is possible that the implants may not have been completely placed in bone. A comprehensive treatment plan based on

sound diagnostic criteria can provide crucial information for safe surgical placement and prosthetic reconstruction.<sup>20</sup>

Platelet-rich plasma enhances soft- and hard-tissue development through elevated growth factor concentrations.<sup>21</sup> Growth factors released from platelets expedite healing and reduce pain and infection rates.<sup>22</sup> The main growth factors such as platelet-derived growth factor, transforming growth factor beta-1, epidermal growth factor, and vascular endothelial growth factor, are directly involved in the recruitment, proliferation, and differentiation of cells.<sup>23</sup> Research has demonstrated that healing tissues possess higher levels of growth factor concentrations than chronic nonhealing sites.<sup>24</sup> The author felt it was critical to use PRP in this case to enhance the healing potential.

Implant occlusal principles should be employed with maxillary and mandibular implant retained overdentures. A bilateral balanced occlusion is developed with simultaneous posterior contact during centric relation and lateral excursions. Protrusive movements maintain posterior contact, while non-interfering contacts are achieved with anterior teeth.<sup>25</sup> The forces of occlusion are evenly directed to the alveolar ridges, thereby reducing bone resorption.<sup>26</sup> The author reports that the initial occlusion demonstrated a lack of posterior support with all forces applied to the anterior aspect of the overdenture. This design magnifies the stress applied to the implants, encouraging bone resorption and implant failure.

#### CONCLUSION

For this case report, small-diameter (<3 mm) implant failure was probably due to poor surgical placement, immediate loading, and poor occlusal design. Small-diameter implants have emerged as a possible solution for patients with deficient bone, compromised health histories, and financial limitations. The conservative body of research regarding SDI has emphasized the importance of strict protocols to ensure predictable outcomes. Complications leading to failures or other less than ideal outcomes can lead to undesirable clinical results. A thought-provoking treatment plan revision can salvage cases and meet patient expectations.

#### ABBREVIATIONS

MDI: mini-dental implants  
PRP: platelet-rich plasma  
SDI: small-diameter implants

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