

# Solutions for Severely Angulated Implants in the Mandibular Overdenture: A Clinical Report

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#### Abstract

Results of randomized clinical trials have confirmed that implant overdentures provide patients with better outcomes than do conventional complete dentures. Several designs have been introduced for the mandibular implant-retained removable prosthesis. The most commonly used prosthesis design for the mandibular overdenture is two implants in the canine areas with a stud attachment mechanism (i.e., ball attachments). This design is the least expensive, and therefore can service more patients and is now considered to be the "Standard of Care" for the mandibular edentulous patient. Proper treatment planning and execution lead to favorable implant placement and a successful prosthetic restoration and ultimately patient satisfaction; however, implant malposition may occur, which can lead to an unsuccessful prosthesis. This clinical report describes an implant overdenture design used for severely angled implants. Prosthodontic techniques that enabled this patient to have a successful outcome included the use of cast-to attachments and abutments along with a sectional matrix used to locate these components within the bulk of the prosthesis. For this patient the prosthodontic compromises were preferred over another surgical procedure with the additional time, discomfort, increased cost, and possible surgical morbidity. It is important that the patient understand the compromises and potential problems when implant placement is not ideal, especially the potential for implant overload and failure.

The use of dental implants in the rehabilitation of the edentulous mandible has demonstrated a remarkable improvement in the patient's oral health status when compared to conventional complete dentures.<sup>1</sup> Results of randomized clinical trials confirm that implant overdentures provide patients with better outcomes than do conventional complete dentures.<sup>2</sup> Implant overdentures provide greater relief from problems associated with denture wearing in both psychosocial and functional activities than conventional dentures.3 This includes a substantial improvement in perceived oral health status.<sup>4-6</sup> Patients with implant overdentures were more satisfied with the comfort of their dentures, could eat a wide range of food items with less difficulty, and experienced less impact on their daily life than patients with conventional complete dentures.<sup>7,8</sup> Patients rehabilitated with implant mandibular overdentures also demonstrated lower rates of mandibular residual ridge resorption.9 In the mandibular overdenture with two implants, the retention of the prosthesis is provided by the implants, and support is obtained from proper extension over the residual alveolar ridge.<sup>10,11</sup> The use of two implants in the anterior area of the mandible to retain the removable overdenture has been described in the literature as an improved

treatment.<sup>12,13</sup> It is an affordable, reasonable alternative to implant fixed complete dentures, which require a larger number of implants.<sup>8-10</sup>

Several designs have been introduced for the mandibular implant-retained removable prosthesis. A major factor is the number of implants placed and operator preference. Two intraforaminal implants of standard size (4 mm diameter) and a minimum of 8 mm in length are recommended. The distance between the implants should be 15 to 25 mm, depending on the size and curvature of the arch. If two implants are chosen, they are usually placed in either the canine position or lateral incisor position. The implants can be splinted with a clip-bar or single anchors (stud attachments) such as ball and O-ring attachments. If four or more implants can be placed in the mandible, a splinted bar with clips will provide a more stable removable prosthesis. For the patient desiring a totally implant-supported prosthesis, and with four or more implants in the mandible, a fixed prosthesis may be an option, depending on opposing occlusion and the anterior-posterior spread of the implants. Studies have shown that splinting the implants with a bar is not a prerequisite for the long-term survival rate or prognosis of implants in the mandible. In the maxilla with more cancellous bone present, a minimum of four implants evenly distributed and splinted over the anterior arch is recommended.<sup>2</sup> The bar and clip have been shown to provide the most retentive force and fewer complications than stud attachments;<sup>2</sup> however, due to the need to fabricate gold copings and a bar, the bar and clip overdenture is considerably more expensive. Another option for the mandibular overdenture is milled or Electric Discharge Machining (EDM) prosthesis. EDM uses electrical discharges to machine electrically conductive dental alloys and achieves a precise metal-to-metal fit between a fixed, cast gold bar and the understructure of the removable prosthesis. EDM processing techniques are much more expensive and are usually done on four or more implants.

The most commonly used prosthesis for the mandibular overdenture are two implants in the canine areas with a stud attachment mechanism (i.e., ball attachments).<sup>14</sup> This design is the least expensive and therefore can service more patients and is now considered to be the "Standard of Care" for the mandibular edentulous patient.<sup>2</sup>

Proper treatment planning and execution lead to favorable implant placement, a successful prosthetic restoration and ultimately patient satisfaction; however, implant malposition may occur, which can lead to an unsuccessful prosthesis. This can result from poor treatment planning and lack of coordination between the restorative dentist and the surgeon, poor surgical technique, inaccuracies in the surgical guide, failure to use the guide, or the use of an unstable surgical guide.<sup>15</sup>

Malpositioned implants present a challenge to the restoring clinician, and he/she may elect to correct the malposition surgically.<sup>16,17</sup> Problems with attempts to restore severely malpositioned implants are multiple. Often, due to severe labial positioning of the implant, no attached tissue remains on the facial, which can cause eventual peri-implantitis, especially if aggravated by muscle pull or denture border impingement. With minimal interocclusal space, a malpositioned implant will make the prosthesis more susceptible to fracture, especially if placement of an angulated abutment is required, resulting in more vertical height and less acrylic resin coverage. Esthetics can be a major concern if the implant is placed too far facially and interferes with tooth positioning. Comfort can be compromised for the patient when the implant is placed too far buccally or lingually and requires vertical height extension of the acrylic resin, resulting in an uncomfortable bulge in the polished surface.

The restorative dentist must make the ultimate determination on whether it will be possible to fabricate a satisfactory prosthesis that will be structurally sound and provide good function and acceptable esthetics with the existing implant malposition. The best solution may be to bury ("put to sleep") or remove the implant rather than fabricate an unsatisfactory prosthesis. Predictable success with a second surgery must be considered along with possible morbidity and the cost of a second procedure.<sup>15</sup> Despite possible surgical solutions, often the patient does not elect to have another surgery and will request that the implants be used in their existing position if possible. It is important that the resulting compromises in function, esthetics, and comfort are accepted by the patient prior to continuation of treatment. Shor et al<sup>15</sup> presented a prosthetic design of an overdenture for malpositioned implants in the anteroposterior plane. Prosthetic compensations included relocating the attachment mechanism into the bulk of the overdenture with the help of an interconnecting implant bar and a metal reinforcing framework for the overdenture. The purpose of this article is to present another option for correction of an even more severely malpositioned implant on a patient not desiring further surgery. This clinical report describes a patient with two mandibular implants, both with severe anterior inclination, and suggests an alternative prosthetic method to compensate for malpositioned implants.

### **Clinical report**

A 55-year-old Caucasian female patient reported to the West Virginia University School of Dentistry requesting treatment. The patient was totally edentulous, with a severely atrophic maxilla and mandible (Class III Prosthodontic Diagnostic Index for Complete Edentulism classification, American College of Prosthodontists)<sup>18</sup> and two malpositioned dental implants in the anterior mandible. She was referred to the Graduate Prosthodontics Department for restoration of two dental implants in the mandibular arch.

The patient was wearing recently made removable complete maxillary and mandibular dentures with a temporary soft reline material in the mandibular denture and healing abutments on two implants. Examination of the existing dentures revealed a satisfactory design with regard to esthetics, extension, occlusion, and vertical dimension. Therefore, it was decided to use the existing maxillary and mandibular prosthesis. No significant history or contraindications to treatment were found. Two 3.5 mm diameter, 11 mm length implants (SVB10 Zimmer Dental Inc, Carlsbad, CA) had been surgically placed in the area of the mandibular canines. The healing caps in place demonstrated severe anterior inclination with gingival inflammation and little facial attached tissue ( $\sim 1$  mm) (Fig 1). The patient refused further surgical intervention and wanted a prosthesis fabricated on the existing implants if at all possible. The risks were explained verbally to the patient and accepted by signing a statement that the prognosis was guarded. She accepted the risk



Figure 1 The healing caps in place demonstrated severe anterior inclination with gingival inflammation and little facial attached tissue ( $\sim$ 1 mm).



Figure 2 Placement of long impression postpins into the analogs clearly demonstrated the severe anterior inclination of both implants.



Figure 3 The matrix, covering the entire denture, was fabricated and sectioned vertically over the sites of both implants to evaluate space available.



Figure 4 A comparison of vertical attachment heights for different stud attachments available for an externally hexed implant.

of potential implant failure and the potential of compromises in function, esthetics, and comfort.

An open tray, fixture level impression was made using medium and light body poly(vinyl siloxane) impression material (Aquasil Ultra Monophase & Light Viscosity, Dentsply Caulk, Milford, DE) in a custom tray (Fastray autopolymer-



Figure 5 The cast-to Locator was waxed to the cast-to gold abutment, and a surveyor was used to insure parallelism.



Figure 6 The attachments were invested and cast with type IV gold, finished, and polished.



Figure 7 The abutments were inserted and torqued to 20 N/cm.

izing resin, Harry J. Bosworth Company, Skokie, IL). Due to the tissue depth of the implants and the concern for fabricating abutments that would be compatible with the soft tissue profile, it was decided to make a "soft tissue" cast using soft tissue material (Gi-Mask, Coltene Whaledent Inc, Cuyahoga Falls, OH) and type IV stone (Prima-Rock Whip Mix, Louisville, KY). Placement of long impression postpins into the analogs clearly demonstrated the severe anterior inclination of both



Figure 8 The Locator Cap with Black Processing Male was inserted into each Locator Implant Abutment, leaving the White Block-Out spacer beneath.

implants (Fig 2). Angulation was approximately  $55^{\circ}$  from a line perpendicular to the ridge, and conventional abutments could not be used. Observing the poor tissue reaction to the healing abutments also indicated that an angulated abutment would be needed to ensure no tissue impingement. In the laboratory a poly(vinyl siloxane) putty matrix (Aquasil EasyMix Putty, Dentsply Caulk) was fabricated over the denture and indexed to the cast to evaluate the space and required inclination needed to ensure that the attachment placement be within the confines of the denture and acceptable. The matrix, covering the entire denture, was fabricated and sectioned vertically over the sites of both implants to evaluate space available (Fig 3).

A number of possible treatment options and attachments, which would allow the best use of the implants, were considered. Due to the angulation and interocclusal space limitations, copings with a bar were not possible. Standard stud attachment abutments could not be used because of the severe angulation, nor could standard angulated stud abutments, which only allowed angulation variations up to 20°. Alsiyabi et al<sup>19</sup> reviewed possible implant attachments for situations with limited interocclusal space and determined that the Locator attachment (Zest Anchors, Escondido, CA) had the lowest profile. The Locator profile is 3.4 mm on an externally hexed implant and 2.5 mm on



**Figure 10** The gingival tissues responded well to the corrected angulation and appeared healthy with approximately 1 mm of attached mucosa on the facial.

a nonhexed implant.<sup>20</sup> A vertical height comparison of different implant overdenture stud attachments is illustrated in Figure 4. After further analysis of the malposition of the implants on the master cast with the matrix in place, it was decided to use "Cast-to" Locator attachments and "Cast-To" Gold Abutments, Engaging (HLA3G, Zimmer Dental Inc., Carlsbad, CA). The cast-to Locator was waxed to the cast-to gold abutment, and a surveyor was used to ensure parallelism between the two Locators (Fig 5).

The attachments were then invested and cast with type IV gold, finished, and polished (Fig 6). Abutments were inserted and torqued to 20 N/cm (Fig 7), and screw access holes were closed with cotton and Prisma TPH composite resin (Dentsply Caulk). White Block-Out Spacers (Zest order #8519, Zest Anchors) were placed over the head of each Locator Abutment. The Locator Cap with Black Processing Male (Zest order #8519, Zest Anchors) was inserted into each Locator Implant Abutment, leaving the White Block-Out spacer beneath it (Fig 8). A recess was prepared in the mandibular denture to accommodate the protruding Locator Male. It was confirmed that there was no contact between the denture and the Locator patrix retaining cap to ensure complete tissue seating and to ensure space for the addition of acrylic resin (Fig 9).



Figure 9 A recess was prepared in the mandibular denture to accommodate the Locator Male.



Figure 11 Occlusal view of the mandibular denture in place.



Figure 12 Facial view of the denture in full occlusion.

Pink autopolymerizing acrylic resin (Lang Dental Mfg Co., Inc., Wheeling, IL) was used to bond the Locator Denture Cap Male into the denture. After the acrylic resin had cured, the denture was removed, an acrylic bur was used to remove excess acrylic, and the denture base was polished before changing to the final patrix. The Black Processing Male was removed from the metal denture cap using Locator Male Removal Tool (attached to the Locator Core Tool, Zest order #8393, Zest Anchors). The Locator Male Seating Tool (Zest order #8393, Zest Anchors) was used to firmly push a Locator Replacement Male into the metal Denture Cap.

The patient was instructed in the path of insertion, which was now perpendicular to the occlusal plane and ridge and presented no problems. The patient inserted and removed the denture several times at the close of the delivery appointment. The patient reported no problems at the 24-hour postinsertion visit and at the 3-week recall appointment. Despite the facial and gingival position of the screw access areas, the gingival tissues responded well to the corrected angulation and now appeared healthy with approximately 1 mm of attached mucosa on the facial (Fig 10). The screw access holes of the custom abutments were right at the gingival level and would require regular maintenance and follow-up to ensure long-term health. The patient expressed her gratitude for not having to go through another surgery and was very satisfied with the retention, function, and esthetics obtained with the implant-retained mandibular denture (Figs 11, 12).

## Discussion

This clinical report described the prosthetic treatment of severely malpositioned mandibular implants. Even though a successful outcome was accomplished, there are severe limitations to potential success in treating these patients. Informed consent for the prosthesis is critical, and the patient must understand that treatment may not be successful and at best will be a compromise. Overcontouring of the prosthesis is a concern, in addition to compromises in prosthesis strength, esthetics, and function. The use of a sectioned putty matrix was of major value in determining the attachment selection. Besides the use of a cross-sectional matrix used for this patient, facial and lingual matrixes can be very helpful in the fabrication of attachments and bars. The cross-sectional matrix at each implant location enabled the laboratory technician to accurately place the attachment abutment in the bulk of the prosthesis.

A major concern that must be explained to the patient is that with severe angulation, the forces applied to the implant through the attachment will not be in the long axis of the implant and will increase the chances of failure from implant overload or prosthetic failure. The use of a resilient attachment with 180° rotational freedom is recommended to decrease stresses applied to the implant.

Besides being a resilient attachment, a major advantage to the Locator Attachment is the availability of the "cast-to" attachment. The "cast-to" engaging abutment, along with the "cast-to" attachment, allowed for minimum interocclusal space to be used and also enabled both attachments to be placed parallel to each other. When Locator attachments can be aligned close to parallel, then any of the three standard retentive patrixes can be used (up to  $10^{\circ}$  convergence each is allowed). With greater than  $20^{\circ}$  convergence, an "extended range" Locator patrix must be used with less retention.

# Conclusion

This clinical report has described an implant overdenture design for severely angled implants. Prosthodontic techniques that enabled this patient to have a successful outcome included the use of "cast-to" attachments and abutments along with a sectional matrix used to locate these components within the bulk of the prosthesis. For this patient the prosthodontic compromises were preferred over another surgical procedure with the additional time, discomfort, increased cost, and possible surgical morbidity. It is important that the patient understand the compromises and potential problems when implant placement is not ideal, especially the potential for implant overload and failure.

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