Using the Master Diagnostic Model™ to Enhance Restorative Success in Implant Treatment

CE 2

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Abstract: *Pretreatment planning is the most important step for definitive diagnosis and treatment. Often, the pretreatment phase consists of a radiograph and study models without confirmation of the patient's jaw relationships and how they affect dentition. The Master Diagnostic Model™ waxing technique confirms jaw relationships and determines which hard and soft tissues should be replaced on the articulated models. In addition, this technique allows the patient to observe and comprehend what the final result will resemble. Documentation of patients with various clinical situations using the Master Diagnostic Model™ technique is presented.*

Learning Objectives:

After reading this article, the reader should be able to:

- describe the Master Diagnostic Model™ waxing technique.
- list the pretreatment planning steps necessary for simple and complex multidisciplinary cases.
- discuss the benefits of the Master Diagnostic Model™ technique in patient education.
- describe how the Master Diagnostic Model™ technique aids in advising patients about their treatment.

From the advent of the Brånemark screw-type implant, submerged implants and their treatment protocol have been well-documented clinical successes.[1,2] Implant therapy continues to evolve into a highly predictable treatment modality for a broader range of patients and case types. Advances in techniques and greater awareness of case uniqueness facilitated the evolution of osseointegration from concept to physiological reality, which further spurred the development of diverse implant fixtures to satisfy esthetic requirements.[3-6] The current state of implantology incorporates a wide spectrum of approaches, techniques, materials, and fixtures to meet individual case requirements and enhance surgical and restorative outcomes. Attention has been directed toward fulfilling functional and esthetic demands.[7-12]

Esthetic requirements among implant cases vary, but neither dentists nor patients favored or tolerated the unsightly high pillars needed to support restorations. The narrow focus on functional restorations was enlarged and reoriented toward both function and esthetic restorations. This expanded focus demanded new thinking about surgical placement techniques to account for esthetic requirements during the healing phase and the final restoration. Because fixtures cannot always be placed where they should from a physiological standpoint, the bone foundation should be reconstructed to accommodate the planned restorations. This requirement led to further developments in surgical bone augmentation procedures using autogenous bone grafts and/or synthetic materials to create ridges of ideal volume, size, and position.[7-12]

Persistent difficulties were encountered because of the inability to maintain patients in a fixed dentate state during the healing phase.[13,14] Clinicians were forced to rely on removable restorations, which created pressure and interfered with tissue remodeling and osseointegration. In cases where fixtures demonstrated incomplete integration or had shifted because of pressure, further surgical intervention delayed initiation of the restorative process. Management of the initial 4- to 6-month healing process was difficult, and with additional surgeries the healing time extended to 1 year or more, which created problems for both the dentist and the patient. When treatment plans were presented, patients were deterred from implant therapy because of prolonged healing periods, the deprivation of normal function, and overall appearance. These were substantial concerns for dentists when they attempted to gain informed consent to proceed with treatment plans.

Figure 1A—Right lateral view of the mounted diagnostic casts.

Figure 1B—Left lateral view of the mounted diagnostic casts showing severe class III jaw relationship.

Figure 1C—Right lateral view of completed MDM™.

Figure 1D—Left lateral view of completed MDM™.

Figure 1E—Heated periodontal probe entering wax to obtain a bone contour thickness measurement.

Figure 1F—Buccal thickness and the amount of bone that needs to be replaced compared to 1E.

Master Diagnostic Model™

Using an approach that allows for the immediate delivery of function and esthetics to implant patients[13-17] has enhanced treatment plan acceptance, patient satisfaction, long-term restorative success, and patients' understanding of their treatment. The approach involves the use of the Master Diagnostic Model™ (MDM™) waxing technique (patented by the author in cooperation with Valley Dental Arts Laboratory of Stillwater, MN).

The MDM™ waxing technique was developed to allow for proper completion of the diagnostic phase in treatment planning for simple and complex implant cases through complete diagnostic waxing of the hard and soft tissues that should be replaced. Treatment planning for implant reconstruction is often considered the most important phase in implant treatment, but it is rarely given the appropriate significance by the implant surgeon. Too often, treatment planning consists only of a panoramic radiograph and study models, the latter of which are provided to the laboratory for surgical stent fabrication. At other times, little or no attention is directed to the proper jaw rela-

Figure 1G—Preoperative panoramic radiograph.

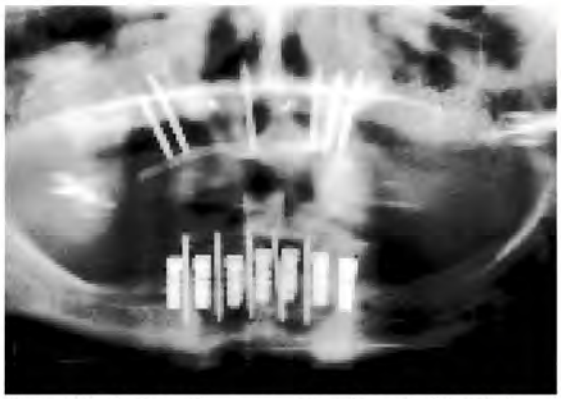

Figure 1H—Postoperative panoramic radiograph after initial surgical procedure.

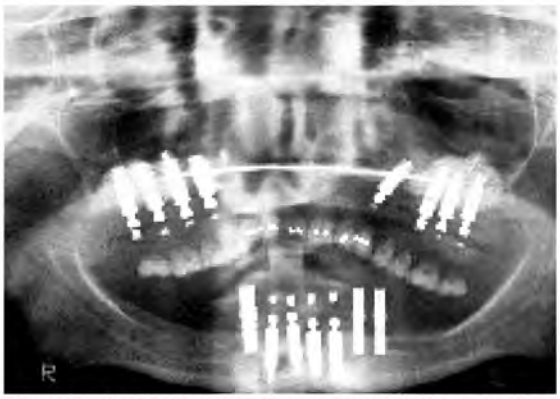

Figure 1I—Final radiograph before seating the final prosthesis.

Figure 2A—Centric view of the pretreatment models mounted after the face-bow transfer.

Figure 2B—Right lateral view of pretreatment models mounted after the face-bow transfer showing severe osseous defects.

Figure 2C—Right lateral view of the diagnostic waxing of the hard and soft tissues that need to be replaced.

tionship before implant placement, thus compromising surgical and prosthetic results. The surgical phase should assume a secondary role in the proposed implant reconstruction, with the reconstructive dentist and the laboratory technician occupying the primary role. Only after the proper sequential diagnostic steps are taken should any implant surgical procedures be initiated.

When a patient presents for a consultation regarding implant therapy, the following steps are performed[18,19]:

1. Complete medical evaluation.
2. Patient questionnaire.
3. Complete dental evaluation.
4. Panoramic radiographs or tomograms (when necessary).
5. Two sets of upper and lower arch impressions.
6. Face-bow transfer using the PROTAR® articulator[a].
7. Bite registration.

The upper and lower impressions, face-bow transfer, and bite registration are sent to the laboratory to mount both sets of casts.

[a]KaVo, Lake Zurich, IL 60047

Figure 2D—Centric view of the diagnostic waxing of the hard and soft tissues that need to be replaced. Note that significant amounts of bone in the maxillary anterior and mandibular anterior sextant need to be replaced.

Figure 2E—Occlusal view of the maxillary model showing the loss in arch form of the edentulous ridge.

Figure 2F—Occlusal view of the completed diagnostic waxing in the maxillary arch. Note the significant bone reconstruction needed buccally and occlusally.

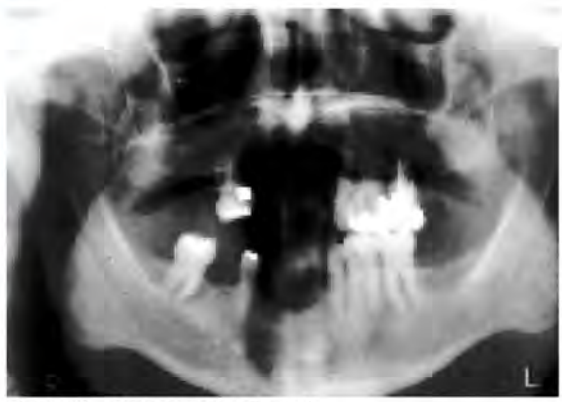

Figure 2G—Pretreatment radiograph.

Figure 2H—Postsurgical panoramic radiograph immediately after initial surgery.

When the lab returns the casts, the final diagnostic steps aid the dentist in properly placing the implants:

1. The patient is provided with a model so that he or she can visualize the completed case.
2. The number of implants to be placed is properly determined.
3. Angulation of implant placement is decided.
4. The need for completed bone replacement procedures before implant placement is determined.
5. The retention of natural teeth and their role in the overall treatment plan is evaluated.
6. The use of temporary or transitional implants is decided.
7. Surgical stents and temporaries are made from the MDM™.
8. The blueprint of the case is provided before surgery.
9. Medical legalities and proper and complete pretreatment planning are accomplished.

After the restorative dentist, surgical dentist, and patient have had a second consultation, a detailed treatment proposal that outlines the steps needed to properly address the case is provided to the dentist and the patient from the surgeon. It is imperative for long-term success that the patient be satisfied—biologically, functionally, and psychologically. The only way to achieve this goal is through proper treatment planning, and the MDM™ diagnostic waxing technique provides patients a visual model of their current pathologic situa-

Figure 2I—Maxillary and mandibular implant-supported, screw-retained, fixed acrylic prosthesis.

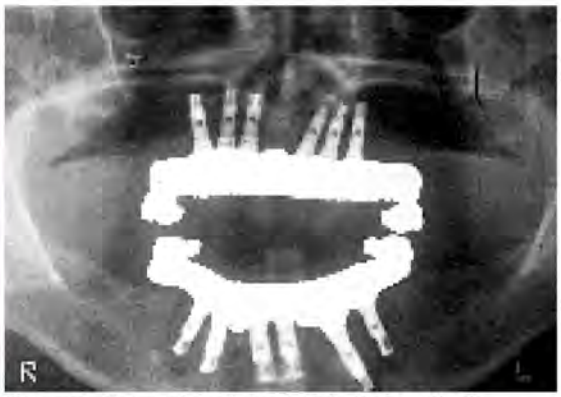

Figure 2J—Panoramic radiograph of the final prosthesis.

Figure 3A—Centric view of pretreatment mounted casts.

Figure 3B—Right lateral view of pretreatment mounted casts showing the severe class III relationship.

tion and compares it to their ideal restored situation. The MDM™ technique allows dentists to determine the correct bone contours necessary to provide patients with the highest possible treatment success rates.

Laboratory Procedures

The first phase in developing the MDM™ uses hydrocolloid to duplicate the study models. The duplicates are then poured in a white die stone, and the original study casts are mounted to the PROTAR™ articulator using the face-bow transfer. The duplicate models are then cross-mounted to the articulator. All alterations are made on the duplicate models.

Conventional wax bite rims and/or bite registration materials establish interarch positions. The dentist gives the technician specific instructions regarding the surgical options, restorative possibilities, and esthetic goals of the case. With this information, the technician develops the optimal hard and soft tissues, tooth lengths, tooth shapes, and anterior arrangement. Special waxes that have a realistic, high-quality appearance were developed for this process (Virtual Way[b]). Tissue shade can vary and tooth color is represented in lighter shades such as A1 or B1 in the Vita® Lumin shade guide[c].

After completion of the model, it is duplicated and two stents are fabricated. The first stent is clear, vacuum-formed, and used to determine optimal implant placement and bone and soft-tissue sites that require augmentation. A periodontal probe is used directly with the model to decide the necessary augmentation. The second stent is a silicon version fabricated of Sil-Tech® putty[d], which develops provisionals quickly. This putty allows the model to be transferred to the provisional restorations. Now, the functional and esthetic aspects of the MDM™ can be verified through the provisionals. After approval by the dentist and patient, a study model of the provisional and the MDM™ are returned to the laboratory for final prosthetic fabrication.

Case Reports

The following cases demonstrate the use of the MDM™ technique for diverse clinical situa-

[b]Launch Dental Products, Long Grove, IL 60047
[c]Vita Zahnfabrik, Germany, dist in US by Vident™, Brea, CA 92621

Figure 3C—Right lateral view of MDM™ showing severe class III relationship and the amount of bone that should have been replaced before the initial implant placement.

Figure 3D—Centric view of MDM™.

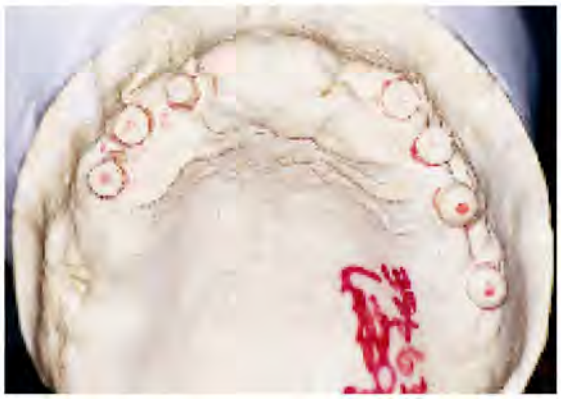

Figure 3E—Occlusal view of pretreatment mounted casts.

Figure 3F—Occlusal view of MDM™ showing the amount of bone needed for buccal-palatal relationship.

tions. The technique was used to determine how much bone was needed, how the occlusal forces would be dissipated, as a guide for preparing the temporaries for the transitional implants, and to give the patients a model of the completely restored facial profile and oral cavity.

Case 1

A 53-year-old woman presented with partial edentulousness and a severely atrophic maxilla in relation to the lower jaw, as evidenced in the right and left lateral views of the casts (Figures 1A and 1B). Using the MDM™ technique, corrected diagnostic models were fabricated to clearly demonstrate the areas of both soft and hard tissue to be replaced before implant surgery or bone regeneration procedures (Figures 1C and 1D). A periodontal probe was heated slightly and pressed through the wax model of the tissue until it touched the stone replica of the bone. This allows for measurement of tissue depth and the amount of bone that needs to be regenerated. It also facilitates the selection of the appropriate technique and material, including tissue augmentation with mesh material, chin grafting procedures, tacking pins for membrane stabilization, and various bone augmentation techniques (Figure 1E).

It was determined that 5 mm to 6 mm of bone needed to be added (Figure 1F). The preoperative panoramic radiograph of the patient showed pneumatized sinuses on both the right and left sides, a resorbed maxilla, tooth loss, and periodontal involvement of the remaining teeth in the lower anterior segment (Figure 1G).

During the initial surgery, implants were placed in the anterior mandible, and bone regeneration procedures were begun (Figure 1H). Surgical procedures involved bilateral sinus elevations in the maxilla, the placement of screws to fixate the chin graft, grafting in the maxillary anterior, and the placement of transitional implants throughout the maxillary anterior to provide immediate occlusion and comfort during the healing phase.

The completed restorations were implant-supported removable overdentures in the maxillary and mandibular arches. A final panorex shows the implant with the final restorations (Figure 1I).

[d]Ivoclar Williams, Amherst, NY 14228

Figure 4A—Right lateral view of edentulous area.

Figure 4B—Left lateral view of edentulous area.

Figure 4C—Pretreatment models. Right lateral view mounted after the face-bow transfer.

Figure 4D—Left lateral view of the pretreatment models.

Case 2

The patient, a nonsmoking man, was an accident victim who had suffered many broken bones throughout the head and facial region. Traumatic insult to his facial area involved bone loss in the maxillary and mandibular anterior regions. A view of articulator-mounted casts (Figure 2A) showed the presence of severe osseous defects with a large defect between the maxillary anterior segment and the mandibular anterior segment, and the relationship of the defects to a preexisting occlusion.

The patient's bite was recreated on the MDM™, and the damaged right lateral area could be clearly seen (Figure 2B). The MDM™ process also demonstrated the patient's centric occlusion and the amount of hard and soft tissue that needed to be replaced (Figure 2C and 2D). An occlusal of the maxillary arch showed the loss of buccal plate and the height of the buccal ridge; further analysis determined the amount of hard and soft tissue that needed to be replaced to restore arch form and function (Figure 2E and 2F). A preoperative panoramic radiographic image (Figure 2G) subsequently revealed severe bone and periodontal involvement of most of the patient's remaining teeth.

The patient's initial surgery consisted of placing permanent implants in the maxillary and mandibular regions, anterior and posterior arches; and transitional implants to facilitate immediate fixed temporization. Bilateral block chin graphs were transposed to the maxillary anterior sextant and fixed with 3 small fixation screws (Figure 2H). Placement of 6 mandibular implants with bone grafting and regeneration in the anterior mandibular area was also completed. Tooth extractions with bone preservation in the extraction sockets, and the placement of transitional implants to aid in the healing phase of therapy completed the surgery. The patient was dismissed in full fixed temporaries that were constructed from the diagnostic waxings provided. Subsequent surgeries have resulted in thorough upper and lower implant reconstruction, which were supported by precision milled meso-structures and screw-retained acrylic restorations. The final clinical appearance is seen in Figure 2I. The final panorex shows implant stability (Figure 2J).

Figure 4E—Diagnostic waxing of the hard and soft tissues that need to be replaced; right lateral view.

Figure 4F—Left lateral view of the diagnostic waxing.

Figure 4G—Occlusal view of the mandibular study model exhibiting knife-edge ridges in the posterior sextants.

Figure 4H—Occlusal view of the diagnostic waxing showing correct relationship between the hard and soft tissues to reconstruct the mandibular posterior sextants.

Case 3

A 51-year-old man presented with failing implant therapy in the maxillary arch. Before surgical correction, an MDM™ was fabricated. The preexisting maxillary anterior conditions and their relationship to the mandibular arch could easily be viewed (Figure 3A). Note the angulation of the implants and the severe buccal and apical resorption of the patient's maxilla (Figure 3B) as a result of excessive cantilevered forces placed on the fixtures, subsequently contributing to premature loss and failure. Figure 3C depicts the right lateral view, and Figure 3D illustrates the centric occlusal position of the patient's bite recreated in wax.

A critical comparison of Figures 3B and 3C reveals that an excessive amount of bone was required to properly restore the osseous structures so dental implants could be successfully accommodated and to establish the proper path of insertion.

The occlusal view of the pretreatment model indicated the patient's existing occlusal status (Figure 3E) and the amount of bone necessary in the buccal-palatal dimension to properly restore occlusion (Figure 3F).

Because of significant cost constraints, the patient elected not to proceed with reconstructive treatment at the time of the consultation. Treatment recommendations will be initiated at a future date.

Case 4

A 63-year-old man presented for implants in the mandibular posterior segments. In a previous consultation with another dentist, the patient was told the only way to reconstruct his lower jaw was to extract all his remaining natural teeth and then place five or six implants in the lower anterior segment. After consultation, an initial exam was completed, impressions were taken, and the models were poured. These steps revealed that tissue needed to be regenerated before the placement of posterior implants. The pretreatment mounted casts from the right lateral and left lateral (Figures 4A and 4B) showed the patient's preclinical occlusal status. Analysis of the patient's condition resulted in the decision to extract teeth Nos. 21 and 29. The mounted models (Figures 4C and 4D) supported this decision.

Recreating the mandibular arch through the MDM™ waxing technique (Figures 4E and 4F) showed the location and indicated the amount of hard and soft tissue that needed to be replaced. An occlusal view of the mandibular arch (Figure 4G) demonstrates the thin bucco-lingual dimension of the posterior mandible, apicocoronal loss, and overall bone loss. The MDM™ showed the patient how the restored mandibular arch with proper tooth form would appear after implant therapy (Figure 4H).

The heated periodontal probe measured and determined the soft tissue that needed to be replaced and the amount of bone required for successful implantation. After review of all the preclinical parameters, the patient underwent tissue regeneration in the areas of teeth Nos. 21 and 29, implant placement, mandibular reconstruction, and bone grafting where the grafts were harvested from the symphesial area.

The patient underwent two surgical procedures, with the initial surgery involving bone regeneration in the posterior mandible and tissue regeneration after extraction of the two teeth. Bone harvesting and the wire mesh technique to regenerate the bucco-lingual dimensions and apical dimensions in the posterior mandibular area were then performed, and transitional implants were used in the posterior mandibular sextants to maintain vertical dimension. The second surgery focused on implantation. After the normal healing phase was observed, healing abutments were placed, and the patient proceeded to an uneventful reconstructive phase.

Conclusion

The use of the MDM™ waxing technique is recommended for all pretreatment planning in simple and complex multidisciplinary reconstructive situations, and the benefits to patient education are invaluable. In addition, the MDM™ technique can be used to determine where appropriate bone contours should be placed before any implant placement is initiated, to measure the bony contours that should be replaced, to create the proper implant angulation, to fabricate surgical stents, to plan for transitional implants and temporaries, and to determine jaw relationships.

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CE 2

Quiz 2

This article provides 1 hour of CE credit from Dental Learning Systems, Co., Inc., in association with the University of Southern California School of Dentistry and the University of Pennsylvania School of Dental Medicine. Record your answers on the enclosed answer sheet or submit them on a separate sheet of paper.

1. **Esthetic requirements among implant cases vary, but neither dentists nor patients favored or tolerated:**
   a. limited shade selection.
   b. angled implants.
   c. lingual inclination.
   d. unsightly high pillars.

2. **Because fixtures cannot always be placed where they should, what should be reconstructed to accommodate the planned restorations?**
   a. remaining teeth
   b. bone foundation
   c. periodontal appearance
   d. frenum muscle pull

3. **Persistent difficulties were encountered because of the inability to maintain patients in what during the healing phase?**
   a. bacterial neutral
   b. pH neutral
   c. fixed dentate state
   d. provisional periodontal health

4. **What created pressure and interfered with tissue remodeling and osseointegration during healing?**
   a. removable restorations
   b. fixed restorations
   c. esthetic restorations
   d. antiallergenic temporaries

5. **Patients were deterred from implant therapy because of:**
   a. prolonged healing periods.
   b. deprivation of normal functioning.
   c. overall appearance.
   d. all of the above

6. **This article uses an approach that allows for what type of delivery of function and esthetics to implant patients?**
   a. immediate
   b. 3 month
   c. 6 month
   d. 1 year

7. **The surgical phase should assume what role in the proposed implant reconstruction?**
   a. primary
   b. secondary
   c. tertiary
   d. equal

8. **A patient is provided a visual model of their current pathologic situation and compares it to their ideal restored situation using:**
   a. computer enhanced photographs.
   b. verbal description.
   c. manufacturers study models.
   d. a diagnostic waxing technique.

9. **In the laboratory procedures, all alterations are made on the:**
   a. master models.
   b. special putty models.
   c. duplicate models.
   d. implant models.

10. **What was heated slightly and pressed through the wax model of the tissue until it touched the stone replica of bone?**
    a. periodontal probe
    b. mesh material
    c. the surgical stent
    d. tacking pins

Please see tester form between pages 84 and 85.