Using Diagnostic Wax-Ups and Preparation Guides to Facilitate Accurate and Esthetic Diastema Closure and Functional Bite Alteration

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Closing a diastema can be a challenging and difficult task that may find the clinician restoring or working with multiple teeth to ensure the equalization of space, or removing some tooth structure—such as from the distal surface of teeth—to be able to “move” subsequent teeth mesially. Unfortunately, in some instances, dentists may attempt to close diastemas without removing sufficient tooth structure from the surrounding dentition, or without altering or adjusting the gingival zeniths of those teeth. The result could be the creation of an awkward and unwanted triangular appearance of the teeth, or leaving the teeth with an inappropriate width-to-length ratio that compromises their efforts to create the more pleasing and durable smile they may want. To avoid such scenarios, diagnostic wax-ups and preparation guides can be invaluable tools to help ensure esthetic, functional, and restorative success by facilitating and enhancing the treatment planning process.

For example, when closing a diastema and creating the illusion of tooth movement with indirect porcelain/ceramic restorations, it is important for ceramists to be able to “wrap” the porcelain interproximally through the entire thickness of the tooth, as opposed to just halfway through the interproximal space. This need arises from the fact that the darkness of the mouth will create a shadowy effect in the space between the teeth, thereby necessitating thicker ceramic material. As a result, clinicians may need to perform slice preparations on the distal aspects of the selected teeth and, consequently, move the gingival zeniths in a mesial direction to help maintain the proportionality of the teeth.

Such a plan of action may seem to be common sense. However, in the midst of treatment planning, the value of a diagnostic wax-up is the ability to visualize what will be needed to execute a successful clinical and treatment protocol to achieve the desired end result. This article demonstrates the uses of a diagnostic wax-up and preparation guides during the treatment of a patient who presented primarily for esthetic concerns (ie, midline diastema, tooth color, ceramometal crown) and who also required alteration of his bite (ie, changing the end-to-end bite relationship of his anterior teeth to a normal overbite and overjet, with anterior guidance within the patient’s envelope of function).

CASE PRESENTATION

A 47-year-old man presented for consultation because he was unhappy with the appearance of his smile. Specifically, he did not like the midline diastema, the color of his teeth, or the ceramometal crown on tooth No. 9 (Figure 1 and Figure 2). An initial examination was performed that included radiographs and diagnostic records, full-arch polyvinyl siloxane impressions (Aquasil Ultra, DENTSPLY Caulk, Milford, DE), a centric relation bite record, and a facebow transfer (Artex® Facebow, Jensen Industries, North Haven, CT). It was during this examination that it became apparent that the patient demonstrated an end-to-end bite relationship of his anterior teeth (Figure 3); any treatment plan developed would need to alter this relationship to one with a normal overbite and overjet. Multiple photographs showing the teeth in full-facial smile, occlusal (Figure 4 and Figure 5), and retracted views were also obtained. All of this information was forwarded to the laboratory so that the ceramist could create a diagnostic wax-up, putty matrix, and preparation guides.

TREATMENT PLANNING

After the initial examination and after reviewing all of the recorded information, the treatment goals were developed. These included addressing the patient’s concerns and additionally changing the end-to-end bite relationship of his anterior teeth to one with a normal overbite and overjet, with anterior guidance within his envelope of function. Specifically, the diastema would be closed, which required that the size and shape of his teeth be altered, and he would be given a whiter, brighter smile. Therefore, the diagnostic wax-up—and the related clinical tools (eg, putty matrix and preparation guide)—were imperative to the success of the case. The resulting treatment plan called for 10 maxillary and 10 mandibular restorations (ie, teeth Nos. 4 through 13 and 20 through 29 with feldspathic porcelain veneers [Ceramco®, DENTSPLY Prosthetics, Burlington, NJ] and a feldspathic all-porcelain crown on tooth No. 9).

The diagnostic wax-up enabled the preoperative visualization of the proposed changes (Figure 6), as well as the creation of the provisional restorations that would simulate the proposed changes intraorally. To accomplish that, a putty matrix was fabricated (Sil-Tech putty, Ivoclar Vivadent, Alabaster, Alabama).

Figure 1 and Figure 2 Preoperative full-facial and close-up views of the patient and his smile. The midline diastema is obvious, as is the tooth discoloration, particularly of tooth No. 9.

Figure 3 This preoperative retracted view of the patient demonstrates his end-to-end bite relationship. This would be altered to a normal overbite and overjet, with anterior guidance within the patient’s envelope of function.
dent, Amherst, NY) from the diagnostic wax-up. Furthermore, the diagnostic wax-up was used to create incisal reduction and facial reduction preparation guides that aided in ideal tooth preparation (Figure 7A and Figure 7B). Such guides are especially beneficial in a case such as this when a diastema is being closed and a bite is being changed.

**PREPARATION PROTOCOL**

During preparation, a .05-mm depth-cutting bur (843-016, Brasseler USA, Savannah, GA) was used to establish uniform depth of the preparations, after which a 6844-016 bur (Brasseler USA) was used to complete the preparations. All margins were equi-gingival at the facial aspect and slightly subgingival interproximally to allow for the proper emergence profile of the restorations (Figure 8 and Figure 9).

A soft tissue diode laser (Twilight, Biolase Technologies, Irvine, CA) was used to create ideal gingival symmetry and move the gingival zenith in a mesial direction to avoid the appearance of restorations with an excessive mesial-axial inclination and/or an exaggerated triangular shape. The literature has established that if the mesiodistal spaces are not symmetrical and the gingival scallops are not in alignment, the esthetics associated with diastema closure can be compromised (Figure 10).

It is important to note that in cases such as this with a large midline diastema, it is often necessary to reduce the distal aspect of all the anterior teeth slightly to ensure sufficient room for widening each subsequent tooth in a mesial direction, as suggested earlier. When this is not accomplished and space is closed only by adding porcelain to the mesial aspect of the central incisors, it is very difficult to achieve an ideal length-to-width ratio (ie, 75% to 80%); the final result will be teeth that appear too wide and unesthetic.

Rather, in this case a slice preparation in the form of a feather edge was extended in a palatal direction to the mesio-lingual or disto-lingual line angle of the tooth to allow the ceramist to wrap porcelain through the interproximal contact area. When the preparations were completed, they were verified using the preparation guides to ensure proper incisal and facial reduction and sufficient spacing for the diastema closure.

Full-arch polyether impressions (Impregum™, 3M ESPE, St. Paul, MN) were taken along with an occlusal record (Vanilla Bite Registration, Discus Dental, Culver City, CA), stick bite, a facebow transfer (Artex Facebow), and a shade of prepared teeth (stump shade 9). In addition to the preoperative photographs, additional images of the preparations were taken for use by the dental laboratory in fabricating the definitive restorations. A detailed laboratory prescription discussing the goals for the case, the patient’s concerns, and the final desired shade was also sent. Feldspathic porcelain was chosen because the prepared tooth color was fairly light, and powder/liquid ceramics are highly translucent yet very durable when bonded to the tooth; in the hands of a talented ceramist, they can create very natural, life-like esthetics.

**PROVISIONALIZATION**

The provisional restorations were created using a putty matrix of the diagnostic wax-up and a temporary material (Luxatemp®, Zenith DMG, Englewood, NJ) in shade B1. The margins were finished, the gingival embrasures opened, and a blue light curing tip for 5 seconds per tooth. Excess cement was cleaned from the facial and lingual surfaces using dental floss, after which the restorations were carefully removed, and the preparations were cleaned with hydrogen peroxide and disinfected with a chlorhexidine rinse (Consepsis®, Ultradent Products, Inc, South Jordan, UT) in shade +1. Excess cement was then removed interproximally with dental floss, after which the restorations were light-cured for 1 minute each from the facial and lingual surfaces using an LED curing light (bluephase® 16i, Ivoclar Vivadent) in shade +1. Excess cement was then removed interproximally with dental floss, after which the restorations were light-cured for 1 minute each from the facial and lingual surfaces using an LED curing light (bluephase® 16i, Ivoclar Vivadent). The provisional restorations were tried in with water individually and then altogether to evaluate fit, marginal integrity, color, and esthetic integration. After approval from the patient, the restorations were set aside to be etched, rinsed, dried, and silanated in preparation for cementation while the teeth were isolated with a rubber dam.

The restorations were bonded to the teeth using a total-etch technique with a fifth-generation bonding agent (Prime & Bond® NT™, DENTSPLY Caulk) and a light-cured luting cement (Variolink® Veneer, Ivoclar Vivadent) in shade +1. Excess cement was then removed interproximally with dental floss, after which the restorations were light-cured for 1 minute each from the facial and lingual surfaces using an LED curing light (bluephase® 16i, Ivoclar Vivadent).

The interproximal contacts were polished using diamond polishing pastes (Porcelize™, Cosmedent, Chicago, IL) on a felt wheel.
The patient returned for a postoperative follow-up appointment, at which time minor occlusal adjustments were made and the restorations were repolished. The patient was able to function normally, with both lateral and protrusive guidance, was able to speak normally, and stated that he was very happy with the appearance of his smile and his appearance overall. It was determined that the goals of the case had been achieved (Figure 13 through Figure 15).

CONCLUSION
The primary objectives of this case included closing the maxillary midline diastema while maintaining the proportionality of the teeth, thereby ensuring that they would not appear too wide or artificial. Additionally, the crown on tooth No. 9 needed to match seamlessly with the surrounding veneer restorations to restore the patient’s happiness with the color and appearance of his smile. Therefore, a whiter, brighter smile was created for the patient. Finally, the patient’s end-to-end bite was corrected to a proper bite relationship, one with an overbite and overjet and anterior guidance that would give him long-term function. Paramount to the successful completion of this case was proper communication between the dentist and the laboratory technician/ceramist, as well as between the dentist and the patient. To this end, the diagnostic wax-up, preparation guides, and putty matrix used to create the provisional restorations were essential to the communication process, proving instrumental in aiding both dentist-laboratory and dentist-patient communication during the treatment planning stages. By developing an ideal treatment plan with proper communication and execution, the goals of treatment were met and patient satisfaction was achieved.

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REFERENCES