Optimizing Occlusal Results for Crown and Bridge Prostheses

When preparing a single-unit crown, or multiple-unit bridge, dentists inevitably follow a similar routine. The prepared teeth are impressed in a good quality impression material such as a polyether, or the most widely used impression material, an addition silicone vinyl polysiloxane (VPS), which accounts for 95% of the impressions sent to the dental laboratory. The impressions are taken in a full-arch stock or custom tray, the bite registration is taken after the preparations are completed, and an opposing model is fabricated from alginate to allow mounting of the case in the laboratory. Once the prosthesis is returned to the dental practitioner and inserted; if it is found to be high in occlusion, the dental technician is often blamed for an error in technique. In reality, it is the built-in variability of the above technique sequence and material selection, which is still routinely taught in many dental faculties, that leads to clinical frustration and valuable time wasted in trying to make the unit/units fit. Why is it that a 12 times greater accuracy in the maximal intercuspal position is found with the dual-arch cast?

This article looks at the “normal” sequence described above, identifies the variables, and describes how to minimize them.

**BITE REGISTRATIONS**

Why is it that as dental students we are taught to take the bite registration after tooth preparation and after the patient has been anesthetized? This approach certainly makes sense for extensive restorations, or when involving terminal teeth in the arch as abutments for a multiple-unit restoration. However, if the clinician is preparing a single-unit restoration, which represents the majority of the crown and bridge impressions at dental laboratories, why not take the bite registration before the patient is anesthetized and still has proprioception? In this way, there is an increased likelihood that the casts will be mounted in the patient’s acquired centric. In addition, if the dentition is intact, the working stone model of the single preparation can be easily mounted more accurately using this bite registration.

Bite registration or interocclusal records are taken with many different registration materials in different ways; can the dental laboratory technician actually use them to relate the models in their proper orientation? Laboratories still receive wax bite registrations which are unreliable due to dimensional changes when cooling. Furthermore, they are easily distorted on removal from the mouth, in transit, or with temperature changes (Figures 1 and 2). The use of resin copings to record centric relation has been described by Anselm Wiskott and Nicholls, and a comparison between using impression plaster, wax, and Duralay acrylic resin showed that hand articulation was the most accurate method of relating casts to maximum intercuspation. The use of polyether bite registration materials has been shown to result in vertical discrepancies in the interocclusal relationships of casts. Elastomeric materials may deform or distort when pressure is applied during mounting of a case (elastics are often used to hold the casts together), resulting in faulty restorations.

Of course, VPS impression materials, designed to flex when withdrawing a full tray impression from the mouth, cannot be used! It is critical not only for these bite registration materials to be dimensionally accurate but to be very stiff to resist distortion (such as Affinity QuickBite [CLINICIAN’S CHOICE] that has a durimeter of more than 90). When looking at the VPSs; Imprint Bite (3M ESPE), Silagum Automix Bite (DMG America), O-Bite (DMG America), Blu-Mousse Classic (Parkell), Exabite II (GC America); one polyether, Ramitec (3M ESPE); and one dimethacrylate base material Luxabite (DMG America); Chun, et al. found that these materials presented significantly different polymerization shrinkage kinetics and showed dimensional changes even after the setting time indicated by the respective manufactur-ers. However, a study by Millstein and Hsu looking at Coc Bite Créme (GC America), Blu-Mousse (Parkell), Correct Bite (Pentron Clinical Technologies), Blue Velvet (J. Morita), Memosil D.D. (Heraeus Kulzer), and Ramitec (3M ESPE) showed that all brands were highly accurate and dimensionally stable.

Dr. Gordon Christensen recommends that the interocclusal record be trimmed so as to eliminate all material that touches soft tissue (Figure 3), that extends to undercuts (Figure 4), and that extends more than a tooth or 2 beyond the prepared teeth (Figure 5). However, this advice of having a bite registration material between teeth on one side and not the other, by itself can cause an inaccurate mounting of the opposing models.

**OPPOSING CASTS**

As mentioned earlier, for crown and bridge cases, most dental practitioners take the impression of the opposing arch in alginate. Alginate impressions can contribute significantly to a fixed partial denture (bridge)
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being too high.3 The quality of the alginate is compromised by a myriad of factors that include: the powder-to-liquid ratio is difficult to control which affects flow, resultant accuracy, and working time; the water temperature affects the speed of set and flow characteristics; syneresis (water leaving the gel) continues after the material is set, causing dimensional changes;15 distortion occurs after a short time if the alginate is not poured up immediately;16 the alginate can distort if disinfected;27-29 if poured up in the office, the quality and dimensional stability of the resulting cast depends on the water/powder mix as well as the method used for mixing of the dental stone;30 the stone used in the office is not as accurate as the die stones used in the laboratory; the impression is not stable as it is affected by temperature and humidity;23-25 the type of tray used affects clinical accuracy;26-27 and the use (or nonuse) of adhesives affect the final outcome.28,29

No matter which highly accurate, good flow, stiff, dimensionally stable bite registration material that the clinician uses, the untrimmed bite registration will never fit on models derived from alginate (Figure 6).30 This is due to the inherent mismatch in accuracy of the 2 materials, as the finely detailed occlusal anatomy picked up by high flow VPS bite registration materials is not replicated by alginate, thus not allowing the bite registration to seat accurately on the alginate-derived stone model (Figures 7 and 8). If the clinician decides to continue using alginate impressions to generate opposing models, a lateral closed-bite registration is a better choice (Figures 9 and 10).

**ALGINATE SUBSTITUTES**

Alginate substitutes (Table) are essentially low-cost VPS materials that demonstrate all the favorable characteristics previously demonstrated for materials of the VPS category. Dr. Gordon Christensen31 has described these alginate substitutes as accurate, clean to use, and with no unpleasant taste or odor (Figure 11). In addition, the addition silicones (VPSs) have been shown to be very accurate and dimensionally stable; stable enough to pour after a delay of time or when making additional pours of the same impression.32 Furthermore, VPSs have higher tear strength than alginates (an important feature when they are poured multiple times), and are minimally affected by disinfection techniques.33-34 In using a VPS alginate substitute with a VPS bite registration and a working model derived from a VPS impression, mismatches that occur when using casts derived from alginate impressions can be eliminated (Figure 12). This ensures that the casts will be mounted by the dental technician in maximum intercuspation (Figure 13), reducing the incidence high occlusion in the final prosthesis and thus minimizing/eliminating the time required for rework.

**Table. Representative Alginate Substitutes**

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<tr>
<th>Alginate Substitute</th>
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<tr>
<td>CounterFIT</td>
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<td>Algix</td>
<td>Sultan Healthcare</td>
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<td>Siliglimm</td>
<td>Zenith Dental/DMG</td>
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<td>Status Blue</td>
<td>Zhermack</td>
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<td>Freealign</td>
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required for occlusal adjustments. An added side benefit is that rather than having to pour up the opposing alginate impression in the dental office, this alginate substitute VPS can be shipped along with the impression of the prepared teeth/tooth and bite registration to the dental laboratory. Thus, the time and cost incurred for pouring up the impression in the dental office is removed. This opposing cast fabrication becomes part of the laboratory fee, which more than compensates for the increased cost of taking the impression with an alginate substitute.

**DUAL-ARCH IMPRESSIONS**

It should now be abundantly clear why properly fabricated dual-arch impressions "produce mounted casts with significantly more accurate maxillary and mandibular relationships than mounted casts from full-arch impressions." The dual-arch impression, as an all-in-one technique, is faster, uses less impression material, and is easier for the clinician and the patient. However, to be successful with the dual-arch impression tray, there are strict parameters for its use. The rear bar (connector) of the dual-arch tray must comfortably pass through the interocclusal retraction area with no interference to proper closure. With the dual-arch technique, the prepared teeth should be bordered by intact teeth with centric stops (Figure 14). Single-tooth preparations that fit this criteria are indicated, but multiple tooth preparations may be problematic. Since the articulators used for mounting dual-arch impressions are simple hinges (usually flexible), the patient must have a cuspid rise (canine guidance) discussion, not group function. Therefore, the canine tooth must be registered in the impression. This is facilitated by full-arch metal trays (such as the Quad-Tray XL [CLINICIAN’S CHOICE] (Figure 15)). Plastic trays can flex, resulting in a distorted impression. Flexure occurs due to the hydraulic pressures of the impression material, tray sides walling on hard tissue (Figures 16 and 17), axial roll or vertical flex of the plastic side walls, the action of swallowing by the patient during impression-taking, and elastic rebound upon removal of the impression. The dual-arch tray must be rigid, making metal trays the tray material of choice. In addition, a complementary rigid (stiff) impression material will increase the overall success of this technique (Figure 18). The ADA, in its review of elastomeric impression materials, recommended an impression material with a strain in compression (stiffness) of less than 2% be used for the dual-arch impression technique. Nine of the 10 heavy body impression materials tested in this review did not meet this criterion; only Correct Plus (Pentron Clinical Technologies) was found to have a strain in compression of 1.5%. Another VPS material on the market, Inflex (CLINICIAN’S CHOICE), also especially well-suited for the dual-arch impression technique, has a strain in compression of 1.3% (Figure 19).

**CLOSING REMARKS**

For predictability in mounting or articulating models, it is prudent to use materials of matching accuracy so that the models will work in harmony. To ensure clinical success, use a high-flow, stiff (no bounce) bite registration material; remove soft-tissue interferences; use an alginate substitute for a high quality opposing model resulting in better interdigitation of all of the components; or use an all-in-one dual-arch impression using a metal tray and technique-specific impression material.

The recommendations presented in this article will help the clinician in reducing occlusal adjustments on final crown and bridge prostheses, thus saving time and reducing stress at the delivery appointment.†

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**References**

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