

Optimizing Occlusal Results for Crown and Bridge Prostheses

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When preparing a single-unit crown, or multiple unit bridge, dentists inevitably follow a similar routine. The prepared tooth/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),¹ which accounts for 95% of the impressions sent to the dental laboratory.² 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.³ 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?⁴

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,⁵ why not take the bite registration before the patient is anaesthe-

tized 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.⁶ Furthermore, they are easily distorted on removal from the mouth, in transit, or with temperature changes (Figs. 1 & 2).⁷ The use of resin copings to record centric relation has been described by Anselm Wiskott and Nicholls,⁸ and a comparison between using impression plaster, wax, and Duralay acrylic resin



FIGURE 1—Typical wax bite wafer on a lower model.



FIGURE 2—Side view of Fig. 1 showing obvious distortion of the wax bite registration.



FIGURE 3—This bite registration was trimmed to remove all soft-tissue contacts and interferences.

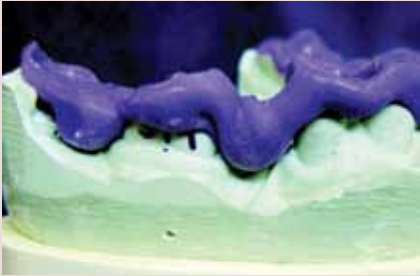


FIGURE 4—In this case, the bite registration does not seat on the model due to undercuts and soft tissue binding.



FIGURE 5—“Donut” bite registration on prepared tooth, extending minimally to adjacent teeth.



FIGURE 6—The highly anatomically detailed vinyl polysiloxane (VPS) bite registration does not fit on a poorly detailed alginate derived stone model.



FIGURE 7—Close up view of an extremely detailed occlusal surface of a mandibular third molar, taken with a PVS bite registration material (Affinity QuickBite — Clinician’s Choice).



FIGURE 8—Same tooth as in Fig. 9 as replicated from an alginate impression. (Note that it does not capture the detailed deep occlusal anatomy.)



FIGURE 9—A lateral (closed) bite registration can be taken if the practitioner uses alginate for the opposing models.

showed that hand articulation was the most accurate method of relating casts to maximum intercuspation.⁹ The use of polyether bite registration materials has been shown to result in vertical discrepancies in the interocclusal relationships of casts.¹⁰ Elastomeric materials may deform¹¹ or distort when pressure is applied during mounting of a case (elastics are often used to hold the casts together), resulting in faulty restorations.¹² 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 durometer of more than 90). When looking at the VPSs; Imprint Bite (3M ESPE), Silagum Automix Bite (DMG America), OBite (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 al¹³ found that these materials presented significantly different polymerization shrinkage kinetics and showed dimensional changes even after the setting time indicated by the respective manufacturers. However, a study by Millstein and Hsu¹⁴ looking at Coe Bite Crème (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 Christensen³ recommends that the interocclusal record be trimmed so as to eliminate all material that touches soft tissue (Fig. 3), that extends to undercuts (Fig. 4), and that extends more than a tooth or two beyond the prepared teeth (Fig.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) 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;¹⁷⁻²¹ if poured up in the office, the quality and dimensional stability of the resulting

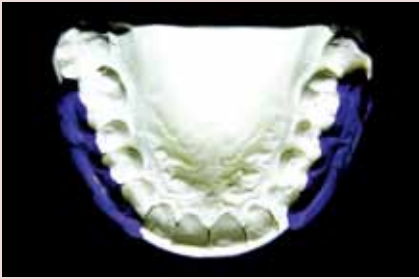


FIGURE 10—The lateral (closed) bite registration, once correctly trimmed, fits on an alginate-derived stone model.



FIGURE 11—Alginate substitute (CounterFIT — Clinician's Choice) shows good detail, even after multiple pour-ups.



FIGURE 12—Models derived from the alginate substitute accurately fit the bite registration.



FIGURE 13—The registered acquired centric is correctly and accurately replicated in the mounted models.



FIGURE 14—In following the correct dual-arch impression technique protocol, the prepared tooth should have teeth with centric stops on either side.



FIGURE 15—A full-quadrant metal tray (such as the Quad-Tray XL (Clinician's Choice)) picks up the cuspid in the impression so that the cuspid (canine) rise occlusion can be replicated in the laboratory.

cast depends on the water/powder mix as well as the method used for mixing of the dental stone;²² 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 non use) 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 (Fig. 6).³⁰ This is due to the inherent mismatch in accuracy of the two 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 (Figs. 7 & 8). If the clinician decides to continue using alginate impressions to generate opposing models,

a lateral closed bite registration is a better choice (Figs. 9 & 10).

ALGINATE SUBSTITUTES

Alginate substitutes 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 (Fig. 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.^{2,32} 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 (Fig. 12). This ensures that the casts will be mounted by the dental technician in maximum intercuspation (Fig. 13), reducing the incidence of high occlusion in the final prosthesis and thus minimizing/eliminating the time 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 tooth/teeth 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 ac-



FIGURE 16—Preparation view of a dual-arch impression taken with a flexible plastic tray; this impression was distorted due to hard-tissue impingement.



FIGURE 17—The opposing side must also be visually checked; tissue contact seen here can cause flex or axial roll.



FIGURE 18—A rigid metal tray with a complementary rigid technique-designed impression material will yield the most accurate models and final prosthesis.

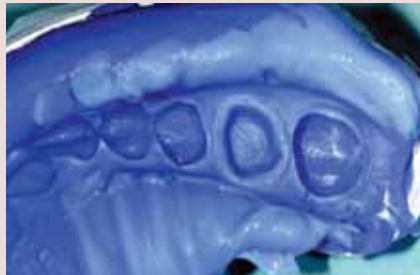


FIGURE 19—A dual-arch impression using a technique-designed stiff (strain in compression: 1.3%) PVS impression material (Inflex — Clinician's Choice).

curate maximal intercusp relationships than mounted casts from full-arch impressions.⁷⁴ 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.³⁵ 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 retro-molar area with no interference to proper closure. With the dual-arch technique, the prepared tooth/teeth should be bordered by intact teeth with centric stops (Figure 14).³⁶ Single-tooth preparations that fit this criteria are indicated, but multiple tooth preparations may be problematic.^{1,37} Since the articulators used for mounting dual-arch impressions are simple hinges (usually flexible plastic), the patient must have a cuspid rise (canine guidance) disclusion, not group function. Therefore, the canine

tooth must be registered in the impression.⁵ This is facilitated by full quadrant metal trays (such as the Quad-Tray XL [CLINICIAN'S CHOICE]) (Fig. 15). Plastic trays can flex, resulting in a distorted impression. Flexure occurs due to the hydraulic pressures of the impression material, tray side walls impinging on hard tissue (Figs. 16 & 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.³⁸⁻⁴⁰ The dual-arch tray must be rigid,⁴¹ making metal trays the tray material of choice. In addition, a complementary rigid (stiff) impression material will increase the chance of overall success with this technique (Figure 18).^{36,38} The ADA, in its review of elastomeric impression materials, recommended an impression material with a strain in compression (stiffness) of less than 2%⁴² 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% (Fig. 19).

CLOSING REMARKS

For predictability in mounting or articulating models, it is prudent to use materials of matching accuracy so that the components 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. **OH**

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