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Eliminating Variables in Impression-Taking

Introduction

One of the most frustrating experiences in clinical practice occurs when trying to insert a unit or units of crown and bridgework that, despite fitting accurately on the dies, do not seat, have open contacts or are high in occlusion. This lack of fit often results from distortion or inaccuracies in the impression, some of which may be impossible to see. In addition, the laboratory may be unable to relate the opposing models into accurate occlusion. The process of taking impressions, with its multiple interrelated steps, has many areas where potential discrepancies may be introduced. This article will try to address some of them.

Technical Requirements

To create well-fitting and accurate crown and bridgework, the dental laboratory technician needs:

- rigidity and stability of both the tray and the impression material.
- adequate tooth reduction to satisfy the needs of the tooth being restored but also to address the needs inherent in the type of restoration being fabricated. The dental technician is constantly challenged to create anatomy, colour and contour on dies with insufficient working space.
- accuracy in detail not only of the preparation, but also of the adjacent teeth and opposing arch.
- the ability of the impression to be disinfected without distortion, and to allow for multiple pours.
- an accurate bite registration.

Clinical Requirements

As clinicians, we need an impression material that:

- sets quickly, so as to minimize intra-oral set times.
- has flexible working times depending on the number of units we are trying to impress.
- has no taste, to avoid creating more moisture control problems generated by excess saliva.
- reproduces exact detail, with dimensional stability over time.
- is easy to read, with a colour that will allow us to see if we have adequately captured the preparation (Figure 1).
- is cost effective and allows for a technique with a high predictability of success.
- has a high elastic recovery property to prevent distortion and offers enough flexibility to allow easy removal of the impression from the mouth.

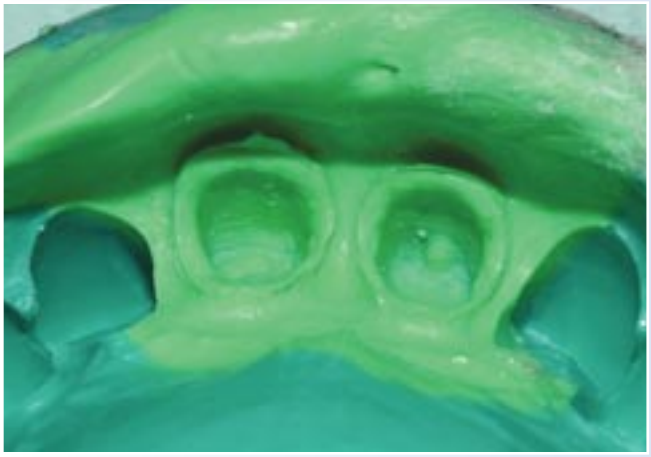

Figure 1.
Easy-to-read coloured material helps to confirm the accuracy of the impression.

Impression Materials

Currently there are many different impression materials available for our selection. Hydrocolloids and polyethers are the only truly hydrophilic impression materials that we have. However, this hydrophilicity, which allows for better adaptation of the material in a moist environment, also may lead to dimensional instability due to absorption and evaporation of moisture. This can create problems with multiple pours and disinfection procedures. Rubber base and condensation silicones are still available, but the vast majority of products on the market today are the addition silicones, also termed polyvinylsiloxanes, (PVS) which have become the most widely used impression materials in restorative dentistry.[1] Over 95 percent of the impressions sent to commercial dental laboratories are polyvinylsiloxanes, and over 80 percent of prosthetic cases submitted to the labs are single units.

Branched Chemistry

PVS materials do not produce a volatile by-product during polymerization and therefore very small dimensional changes occur during setting. The hydrogen gas produced by hydroxide groups in many products can be absorbed by catalysts such as palladium.[2] The polyvinylsiloxanes are inherently hydrophobic, but newer branched chemistry allows for the addition of a grafted surfactant that is uniformly distributed throughout the material for a more uniform wetting ability (Affinity[a]). This has resulted in better dimensional stability in dry, moist and wet conditions.[3] The change from a linear to a branched chemistry has permitted the creation of materials with independent work and set times, and this has reduced the time to achieve full polymerization from over 6 minutes to 4 minutes or less. Newer materials have recently been introduced with even shorter setting times.

Equally important, this branched chemistry has allowed the manufacturers to create unique technique-designed viscosities to complement our impression techniques. For full arch crown and bridge impressions we have light-bodied material with multiple flow choices and a heavy-bodied tray material. For dual arch impressions, tray materials with extremely high stiffness (Inflex[a]) are capable of yielding a tray and an impression that work in synchronicity to eliminate flex and create rigidity. Putty materials with a wash are also available.

Photo courtesy of JCDA????

Figure 2.
Stone models produced from alginate, with "Quick Bite" registration material showing open bite.

Tissue Preparation

It is easier to respect tissue while preparing a tooth than to stop iatrogenically-produced bleeding. This saves a lot of time and frustration, and may help minimize the inherent drawbacks associated with the use of hemostatic agents. Common products currently in clinical practice include aluminum sulphate gels (Tissue Goo[a]), ferric sulphate (Viscostat, Astringedent[b]), aqueous iron (Astringedent X[b]) or aluminum chloride (Ultradent Buffered Aluminum Chloride). We must be aware that aluminum and zinc chloride are caustic to gingival tissues, especially at higher concentrations and may interfere with the surface detail of impression materials. Ferric sulphate, although not damaging to tissues, does not actually shrink the gingiva, and interferes with the surface detail of polyvinylsiloxanes. All astringents negatively affect the bond strengths of adhesives to dentin. Scrubbing the preparation(s) with a cavity cleanser such as Consepsis Scrub[b] — a chlorhexidine antibacterial slurry[4], Prep Quick[b] — a two percent glycolic acid, or Detail[a] — an EDTA-based cleaning gel, may help return the bond strength to normal values and create a clean surface for accurate reproduction. The cleansers also eliminate set inhibition of polyvinylsiloxane impression materials.

Impression Techniques & Bite Registration

Most of us have been taught to take an impression of the prepared teeth with an accurate material and tray of our choice. We routinely obtain an impression of the opposing arch in alginate and pour it up with die stone. Bite registrations are made using one of the many extremely accurate materials available, most of which are PVS. When taking any bite registration, it is imperative that we match the accuracies of the materials we use.[5] However, a major problem may occur when a full-arch bite registration is taken using a material that is more accurate than the stone model produced from an alginate impression. When we articulate the models (Figure 2), here represented as two opposing alginate-produced master casts, the bite created is obviously open and the bite registration does not fit. This false relationship, which also occurs when an alginate-produced stone model opposes a die impression produced from polyvinylsiloxane, inevitably results in hyperocclusion in the final prosthesis.

The dual-arch, all-in-one impression captures the tooth preparation or preparations, opposing arch and bite registration. This method is often easier for the patient, since there is less material, a smaller tray and hopefully less

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Figure 3. Distortion of PVS impression due to inadequate bulk and rigidity of tray.

Figure 4. "Quad Tray Xtreme" metal impression tray.

Figure 5. Plastic tray showing "burn through" of the walls. This creates flex and undesirable rebound during removal.

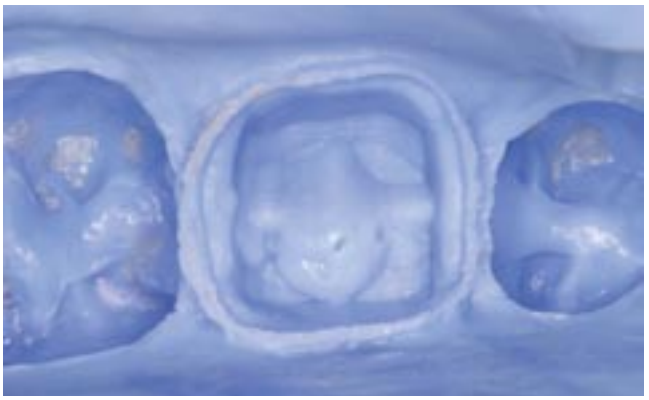

Figure 6. Entire preparation captured in light-bodied material.

chance for gagging. In addition to the obvious economics of reduced impression material usage, there is also the advantage of shorter chair time, since a bite registration and a separate opposing impression are not required.

For the dual-arch technique to be successful a number of factors with respect to the impression tray must be considered:

- The impression tray must be rigid (metal vs. plastic — Figure 3).
- The tray must prevent distortion and have no elastic memory rebound (Quad Tray Xtreme[a] Figure 4). Plastic trays are elastic and will deform under the hydraulic loading pressure of most heavy-bodied polyvinylsiloxanes. Their high side walls and thick retromolar pad areas often create interference with hard and soft tissues creating expansion flex (Figure 5).
- The tray must accommodate all arch forms and be adaptable.

Just as critical however is the rigidity of the impression material. For the dual-arch technique, the impression material selected must:

- have a high rigidity when set, so that it becomes an integral part of the system (Inflex[a]).
- have enough fluid viscosity so that it moves the light body beyond the preparation margins, but does not displace the light-bodied material from the preparation (Figure 6). Many polyvinylsiloxane heavy-bodied materials have too little flow, which results in displacement of the light body and introduces compression flex in the selected tray.
- be rigid enough to to prevent distortion and flex of the final all-in-one unit.

Crowns fabricated from dual-arch impressions have been shown to be equivalent in marginal accuracy and superior occlusally to crowns fabricated from complete arch impressions.[6] The dual-arch impression technique may be one solution to help prevent supra-occlusion in the indirect restoration.[7]

Complications From Latex Gloves

Some compounds used in the vulcanization of latex surgical gloves may interfere with the polymerization of polyvinylsiloxanes and thus contact should be avoided. This is especially true when handling and placing retraction cord, as this effect on polymerization negatively affects the ability to capture the all-important cavosurface margins (Figure 7). The particulate sulphur and sulphur-chloride compounds migrate to the surface and are transferred to the prepared teeth and the adjacent soft tissues as well.[8] If mixing putty by hand, sulphur residue from the gloves poisons the platinum catalyst and decreases the polymerization reaction. Use vinyl or nitrile gloves to eliminate the problem. Residues from acrylics, methacrylates, and petroleum jelly lubricants may also interfere with the setting reaction of the PVS materials and the ability of the material to pick up fine detail. If a temporary prosthesis is fabricated before taking the final impression, it is imperative to clean the tooth preparations before proceeding (Figure 8).

Successful Impressions

The indications of an accurate, high-quality impression are based on the following observations:

- Is there a uniform homogenous mix of materials and are the light and heavy body fully chemically integrated (Figure 9)?
- Was a PVS-specific tray adhesive used, applied thoroughly and allowed to set for at least 15 minutes[9]?
- Is the tray that was used rigid and sturdy? There should be no voids in the impression and no pulls on the margins. Tears or rough surfaces should not be evident. The burn through of heavy-bodied material or of dental structures indicates an inaccurate impression. There should be a uniform bond between the impression material, adhesive and the tray.

This short overview has focused on several factors that are of importance in the impression phase of crown and bridge procedures. However, we must also be aware of the critical role a well-fitting temporary restoration plays in maintaining the position of the contacts and opposing occlusion.

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a) Affinity, Inflex, Tissue Goo, Detail and Quad Tray Xtreme are products manufactured by Clinical Research Dental, London, ON.
b) Viscostat, Astringedent, Astringedent X, Ultradent Buffered Aluminum Chloride, Consepsis Scrub and Prep Quick are products manufactured by UltraDent, Salt Lake City, Utah, USA

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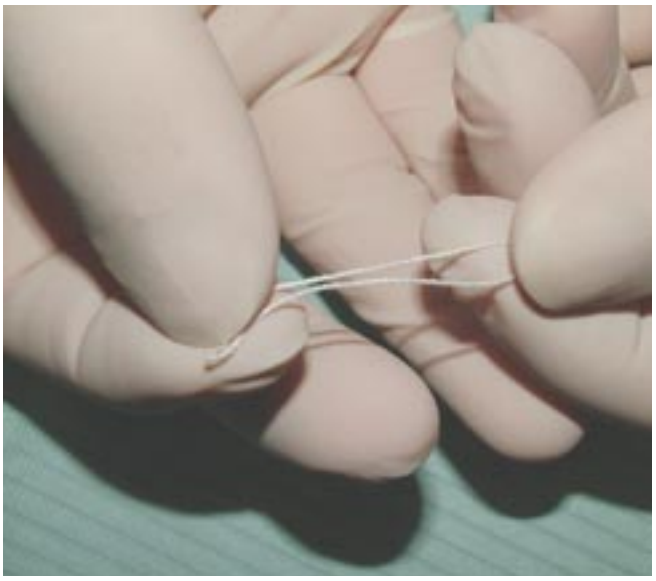

Figure 7. Avoid handling retracton cord with latex gloves.

Figure 8. Preparations should be cleaned after constructing temporary prosthesis, before taking the final impression.

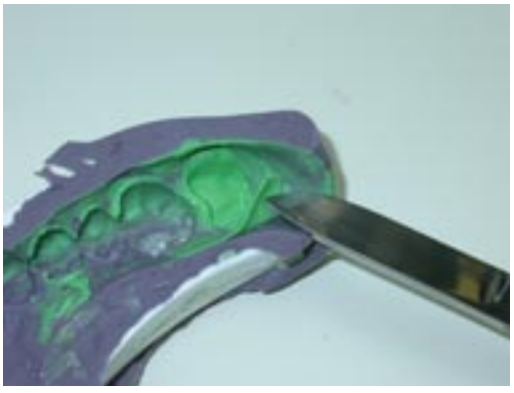

Figure 9. Separation of light and heavy-bodied impression material due to exceeding the working time.