

A review of contemporary impression materials and techniques

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The contemporary restorative dentist has a host of excellent impression materials available for making impressions in fixed prosthodontics, implant dentistry, and operative dentistry. With proper material selection and manipulation, accurate impressions can be obtained for fabrication of tooth- and implant-supported restorations. However, a majority of impressions sent to commercial laboratories for conventional fixed prostheses are deficient in several respects [1,2]. One of the major deficiencies is that the prepared subgingival margins of tooth preparations are frequently inadequately recorded in the impression. This results in a restoration with less than adequate marginal integrity.

A second common deficiency is failure to follow basic principles inherent to the manipulation of impression materials. Stock trays are used extensively, and the importance of control of bulk is ignored. Putty/wash materials also are used extensively, usually in an inappropriate manner, resulting in impressions with less than optimal accuracy.

This situation is not a result of deficiencies in the impression materials but rather is a result of inadequate understanding by operators of the principles of manipulation of impression materials. Many unacceptable impressions are the result of errors in other stages of the restorative procedure, such as improper margin location and overall soft tissue management [3].

This article outlines the ideal properties of impression materials and explains the importance of critical manipulative variables. Available impression materials are analyzed relative to these variables, and several “specialized” impression techniques are described. Special attention is paid to polyvinyl siloxane (PVS) impression materials because they have become the most widely used impression material in restorative dentistry [4].

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A number of ideal properties for impression materials can be identified. These include accuracy, elastic recovery, dimensional stability, flow, flexibility, workability, hydrophilicity, a long shelf-life, patient comfort, and economics. Impression materials vary considerably in relation to these ideal properties, and these differences may provide a basis for the selection of specific materials in specific clinical situations.

Accuracy

There are two aspects to evaluating the accuracy of impression materials. According to American Dental Association specification #19, elastomeric impression materials used to fabricate precision castings must be able to reproduce fine detail of 25 μm or less. All currently available impression materials meet this specification. PVS impression materials are the best in this regard, and reversible hydrocolloid (a water-based impression material) is the worst, although it can meet the 25- μm limit [5]. Differences in detail reproduction are not likely of major clinical consideration because the limiting factor in the system is the ability of gypsum die materials to replicate fine detail. The corresponding specification for gypsum die materials is 50 μm . Most die materials do considerably better than this but fall far short of the impression materials in their ability to reproduce fine detail.

There are significant differences in the ability of various viscosities of impression materials to reproduce fine detail. In general, the lower the viscosity of impression material, the better it records fine detail. The putty materials, in general, cannot reproduce fine detail at the 25- μm level and are required only to record detail of 75 μm [6]. One of the deficiencies of some putty/wash techniques is that, often, critical areas of the tooth preparation, including cervical margins, are recorded in putty material (Fig. 1). This has a deleterious effect on the accuracy of the gypsum die.

A second aspect of accuracy is dimensional accuracy, which is evaluated by measuring tooth-to-tooth distances within the same quadrant and cross arch. There is some evidence that reversible hydrocolloid is slightly superior to the elastomers in this respect [7]. However, it is likely that there are greater differences resulting from the use of different die stones or the manipulation of the gypsum than exist between different types of impression materials.

Most of the impression materials available today provide superb accuracy if they are manipulated correctly. Although PVS materials are likely to be more accurate than other materials, differences in accuracy (assuming correct manipulation) are likely not clinically significant.

Elastic recovery

Impression material needs to be able to flow readily into undercut areas in the mouth, set in that position, and to be able to “rebound” back to its

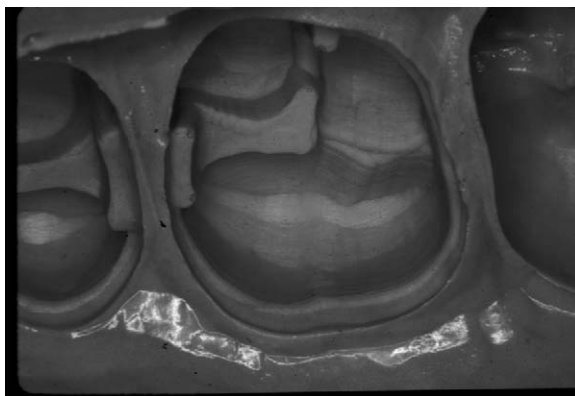


Fig. 1. One deficiency of the putty/wash techniques is that the prepared margins are captured in part with putty material, which is unable to record fine detail 25 μm or less.

original shape when the set impression is removed from the mouth. This process is called elastic recovery. No impression material has 100% elastic recovery, and, for all impression materials, the greater the depth of the undercut, the greater is the permanent distortion of the impression material. PVS impression materials have the best elastic recovery at over 99% elastic recovery with a specific test undercut [8]. This property, coupled with the excellent dimensional stability of PVS materials, makes it the most accurate material for second pours.

The operator need not delay pouring of the impression to allow elastic recovery to occur. Elastic recovery occurs almost instantaneously as the impression is removed from the mouth or the primary cast [8]. An excellent procedure to maximize the elastic recovery of the impression material is to eliminate or block out any undercuts in the tooth preparation before making the impression. This can be accomplished with any of the modified or resin-modified glass ionomer products on the market. Many operators neglect to do this on the premise that the undercuts can be blocked out by the laboratory technician. Although this is possible, this approach forces the impression material to spring out around the undercut and is thus responsible for distortion that could easily be avoided.

Dimensional stability

An ideal impression material would be dimensionally stable over time and thus could be poured at the convenience of the operator. Because there is no by-product to the chemical setting reaction of addition silicones, PVS materials possess ideal dimensional stability. They can be poured at the convenience of the operator and are the impression material of choice if the impression is to be sent to the laboratory where the dentist loses control of

when it is poured. PVS impressions can be poured immediately after removal from the mouth, or hours, days, and even weeks after making the impression.

Other impression materials should be poured within prescribed time limits to obtain maximum accuracy. Water-based impression materials, such as reversible and irreversible hydrocolloid, are composed of 80% water and hence are subject to the phenomena of imbibition (absorption of water) and syneresis (evaporation of water). If either of these phenomena occurs, the impression is distorted. These impressions should be poured up within 10 minutes of removal from the mouth and should not be wrapped in a moist paper towel as seems to be common practice. The impression can easily absorb water from the wet towel and thus distort before pouring.

Condensation silicone impression material produces ethyl alcohol as a by-product of the setting reaction. Polysulfide rubber produces water as a by-product of the setting reaction. These volatile by-products tend to evaporate from the surface of the set impression, resulting in distortion. These impression materials should be poured no more than 30 minutes after removal from the mouth.

Polyether impression materials can absorb water from the atmosphere. Whereas most impression materials shrink over time due to continued polymerization and loss of volatile by-products, polyether materials swell over time due to water sorption [9,10]. Thus, it is recommended that, for maximum accuracy, polyether impression materials be poured within 1 hour of removal from the mouth.

Flow and flexibility

Impression materials need to readily flow into the minute details of the cavity preparations and accurately capture grooves, pinholes, and cervical margin detail. Most commercial products provide light-body or syringe materials for this purpose. These are used with heavy-body or tray materials to provide more rigidity to the impression and to help force the lower viscosity material into the gingival sulcus.

Early versions of light-body materials possessed excellent flow characteristics, but the materials tended to flow off of the prepared tooth with time, which posed problems when attempting to make an impression of several prepared teeth at one time. Most of the newer PVS products and polyethers are thixotropic and stay where they are syringed but flow readily when the heavier body tray materials are placed over the top of them.

Impression materials vary from one another with regard to flexibility. Polyether impression materials tend to be more rigid than the other materials, and this can be a problem when dealing with long, thin preparations of periodontally involved teeth. Fracture of delicate gypsum dies is a common occurrence due to the rigidity of polyether materials. Another

problem related to this rigidity is tearing of the impression material in the gingival sulcus. The tear strength of polyether materials is adequate, but due to the rigidity of the set impression, significant force must be used to remove the impression, and this sometimes exceeds the tear strength of the material. More recent generations of polyether have slightly improved in this regard but are still slightly more rigid than PVS materials.

PVS materials are reasonably stiff but seem to fall below the threshold where problems with fracture of dies are common. Reversible hydrocolloid is the least rigid of all materials and may be the material of choice when making impressions of multiple periodontally compromised teeth.

With certain impressions, such as dual arch impressions, it is advantageous to use a very rigid impression material. Many of the commonly used double-bite trays are somewhat flexible, and a rigid impression material can compensate for this flexibility. Polyether materials, which are thixotropic, work well in these cases, and many of the new PVS materials have specific components to provide the essential rigidity.

Workability

The advent of auto-mix devices for mixing elastomeric impression materials has dramatically improved the workability of these materials. The sophisticated electronic mixing devices (eg, Pentamix; 3M-ESPE, St. Paul, Minnesota) and the simpler mixing guns used by the majority of systems provide a standardized mix with fewer inherent porosities, increased working time, and an economic savings due to less waste of material.

Working times can be varied by the manufacturer, and most auto-mix devices provide materials with standard-set and quick-set capabilities. When using the dual arch technique for a single-crown preparation, the operator may opt for a quick-set material with a short working time. When making a full-arch impression with several prepared teeth, the clinician may choose a material with a longer working time. When making impressions of multiple prepared teeth, the clinician may also opt to refrigerate the low-viscosity material, which increases working time without sacrificing accuracy [11].

Hydrophilicity

Reversible hydrocolloid impression materials are truly hydrophilic and can effectively make accurate impressions in the presence of moisture. The “wet technique” purposefully fills the gingival sulcus with water before making the impression and then relies on the water-loving tendency of the material to flow into the sulcus and capture the prepared subgingival margins in the impression.

Polyether impression materials also are hydrophilic, as witnessed by their tendency to absorb moisture from the atmosphere. However, polyether materials require a dry preparation surface to make an acceptable impression. All rubber-like elastomeric impression materials require a dry field for making impressions.

Most of the manufacturers of the newer PVS impression materials claim their materials are hydrophilic. Although this is technically correct, it is misleading because it implies that excellent impressions can be made in a wet environment, which is not true.

A material can technically be classified as “hydrophilic” if the contact angle that water makes with it is below a specific angle. The original PVS materials were very hydrophobic and produced very high contact angles. Later formulations included nonionic surfactants in the materials, and this improved the wettability and lowered contact angles. Some of the newer PVS materials include technology that grafts the surfactants to the silicone polymer, which further improves wettability and reduces the contact angle. These improvements make it significantly easier to pour PVS materials without incorporating voids, but they do not make it possible to make acceptable impressions in a wet environment.

Shelf-life

The exact shelf-life of impression materials is not known, but it is not advisable to use materials that have passed the expiry date established by the manufacturers. The clinician should become familiar with the code used by the manufacturer of the products being used and insure that current materials are consistently provided. It is arbitrarily suggested that no more than 6 months’ supply of impression material should be kept on hand at any time.

Patient comfort

Contemporary materials are far more patient friendly than the old polysulfide rubber materials or reversible hydrocolloid that had to use bulky water-cooled trays. Contemporary materials are essentially colorless, odorless, and tasteless. The rigidity of polyether materials can be a disadvantage, particularly if the patient has existing fixed prostheses or has multiple open gingival embrasures due to loss of periodontal support. In these situations, it is advisable to use a more flexible material and to block out the undercuts with utility wax before impression making. The use of the dual-arch impression technique, where appropriate, is also pleasant for patients in that it uses a minimal amount of material and avoids the necessity of an opposing arch impression.

When full-arch impressions are indicated, the use of a custom tray is advocated (Fig. 2). Some studies indicate that custom trays are more

accurate than stock trays, but even if both are sufficiently accurate, the level of patient comfort with custom trays is substantially improved. In addition, significantly less material is used, and it has been speculated that the material savings alone plus the reduced number of remakes more than absorb the cost of making the tray [12].

Economic factors

There can be significant differences in the cost of impression materials. Reversible hydrocolloid is less expensive than elastomeric materials, but there are costs associated with conditioning and tempering baths and costs for water-cooled trays. Polyether and PVS materials are similar in cost and are more expensive than competing elastomers. However, it is likely true in most practices that differences in the costs of impression materials are of minimal consequence. Practitioners can reduce costs by using auto-mix devices, by using the dual-arch technique when indicated and custom trays for full-arch impressions, and by reducing the number of remakes.

Principles of impression material manipulation

Proper manipulation of impression materials is probably more important in determining the accuracy of an impression than which type of material is selected. Several manipulative variables are important to obtain maximum accuracy. These include provision of a uniform bulk of material, insuring that the material adequately adheres to the impression tray, pouring the impression at the appropriate time, using the optimum viscosity materials, and adequate mixing and use of proper disinfection procedures.



Fig. 2. Full arch impressions with multiple preparations should be made with custom trays. Use of custom trays provides optimum accuracy, conserves material, and provides patient comfort.

Uniform bulk

All impression materials shrink slightly upon setting. Reversible hydrocolloid material is chilled using water cooler trays, and as the material cools, shrinkage occurs as a thermoplastic event. Elastomeric impression materials set by means of polymerization reactions with monomeric units forming polymer chains. When clinical setting begins, substantial cross-linking of the polymer chains has occurred. With these materials there is a slight amount of polymerization shrinkage. To obtain the most accurate impression, it is imperative to use a relatively uniform amount of bulk in the impression so that there is uniform shrinkage throughout the body of the impression. This shrinkage is counteracted by slight expansion of the gypsum casting material.

Different impression materials require different cross-sectional thicknesses of impression material to provide optimum accuracy. Water-based impression materials, such as reversible and irreversible hydrocolloid, provide maximum accuracy with a cross-sectional thickness of 4 to 6 mm [13]. This thickness is achieved with the use of a properly sized stock tray.

Elastomeric impressions are most accurate when used with a cross-sectional thickness of approximately 2 mm [14]. This thickness is optimally provided with a custom tray. Numerous articles have compared accuracy of impressions made with a custom tray with the accuracy of impressions made with a stock tray [15–24]. Although a few recent studies indicate that impressions for single restorations can be adequately made with PVS impression material in a stock tray, these studies generally demonstrate improved accuracy with custom trays.

The difference in cross-sectional thickness of material in a stock tray is only about 1.5 to 2 mm thicker than that in a custom tray [25]. This mandates precision in fabrication of the custom tray because small differences in cross-sectional thickness can affect accuracy. Custom trays should be constructed on the diagnostic cast using one layer of base plate wax as a spacer. Trays can be fabricated with polymethylmethacrylate (PMM), photo-cure bisacryl materials (Triad; Dentsply International, Milford, Delaware), or PVS putty materials [26]. PMM trays should be fabricated at least 24 hours in advance to insure stability.

Occlusal stops are critical for proper orientation of the tray in the mouth. Three occlusal stops are ideal, with at least one stop posterior to the prepared teeth. Stops should be placed on nonfunctioning cusp tips to minimize distortion in the area of the stops. Stops are prepared by removing the base plate wax from the nonfunctioning cusp tips with a hand instrument. The wax spacer should be covered with tin foil before making the tray to facilitate removal the wax from the tray and to prevent incorporation of a wax residue on the internal surface of the tray due to the inherent exotherm that occurs during the setting reaction of the PMM tray material. This residue can interfere with the proper functioning of tray adhesives.

Adhesion of the impression material to the tray

It is imperative that the impression material adheres to the tray. With proper adherence, the impression material shrinks toward the tray as it polymerizes. This results in a slightly larger die, which is preferable to a smaller die.

Adhesion is achieved through the use of specific chemical tray adhesives. Adhesives must be matched to the impression material and should be painted in a thin layer on the internal of the tray and the tray borders. Painting the adhesive on the tray at least 7 to 15 minutes before making the impression permits formation of adequate bond strength of the material to the tray [27].

Pouring of impression materials

One of the most important manipulative variables with impression materials is the time limit after removal from the mouth to when the impression is poured. Water-based materials should be poured within 10 minutes of removal from the mouth. The major component of these impressions is water, which evaporates at room temperature. This water loss is accompanied by distortion and is minimized by rapid pouring.

Condensation silicones produce ethyl alcohol as a by-product of the setting reaction, and evaporation of the alcohol results in distortion. The identical phenomenon occurs with polysulfide rubber, where the by-product is water. These materials should be poured within 30 minutes for maximum accuracy.

Polyether materials can absorb water from the atmosphere and thus should be poured within 1 hour for maximum accuracy. PVS impression materials are stable because there is no volatile by-product to the reaction and because they do not give off or absorb water. This dimensional stability permits pouring of the impression at the convenience of the operator.

Viscosity control

Elastomeric impression materials are supplied in a number of viscosities, ranging from very low viscosity to very high viscosity putty materials. The main difference between the different viscosities is the amount of inert filler in the material. Two rules of thumb regarding different viscosity materials are (1) the lower the viscosity, the better the fine detail reproduction and (2) the lower the viscosity, the greater the polymerization shrinkage during the setting reaction. Thus, the optimum method of impression making is to use as little low-viscosity material as possible to capture the fine detail of the prepared margin, grooves, box-forms, etc., and the bulk of the impression should be made with high-viscosity material. The heavy-body material helps push the light-body material into the gingival sulcus and results in minimal distortion due to polymerization shrinkage.

Monophasic PVS and polyether materials are supplied by many manufacturers. In theory, such materials do not provide the same level of accuracy as proper use of a combination of low-viscosity/high-viscosity materials, but the actual differences in accuracy are so small that they are likely not clinically significant. The convenience of having to use only one viscosity of materials makes monophasic materials practical.

Adequate mixing

Most elastomeric impression materials are provided as base/catalyst systems. When separate tubes of base and catalyst material are provided, hand mixing is required. Usually, the base and catalyst materials are of contrasting colors, and generally equal lengths of both materials are extruded on the mixing pad. The materials then should be vigorously stropped until a homogeneous material is obtained.

Almost all contemporary impression materials are dispensed using some type of auto-mix system. These systems provide optimum mixing of the material with significantly fewer inherent voids, extend the essential working time of the material, and reduce waste of the material because they are loaded from the dispenser directly into the syringe or tray [28,29].

Disinfection

Microorganisms in the oral cavity can be transmitted from impressions to the dental laboratory [30]. The clinician must disinfect impressions before pouring the cast or sending the impressions to the dental laboratory. An alternative to disinfecting impressions is to use disinfected die stones [31]. This approach avoids potential distortions related to procedures essential for disinfecting impressions.

The first step of any disinfecting technique is to rinse the impression in tap water. This step removes a significant portion of the microorganisms from the impression. Disinfection techniques involve spraying the impressions with disinfection agents or immersion of the impression materials in chemical agents such as sodium hypochlorite [32]. PVS materials are stable in this regard, but special care must be taken with water-based materials and polyethers to insure that adequate immersion times are used to eliminate microorganisms but that extended immersion times are avoided to prevent excess imbibition of the disinfecting solution and distortion of the impression.

PVS impression materials

PVS impression materials have been on the market since the mid-1970s and have garnered the lion's share of the contemporary market. PVS materials have the best fine detail reproduction and elastic recovery of all

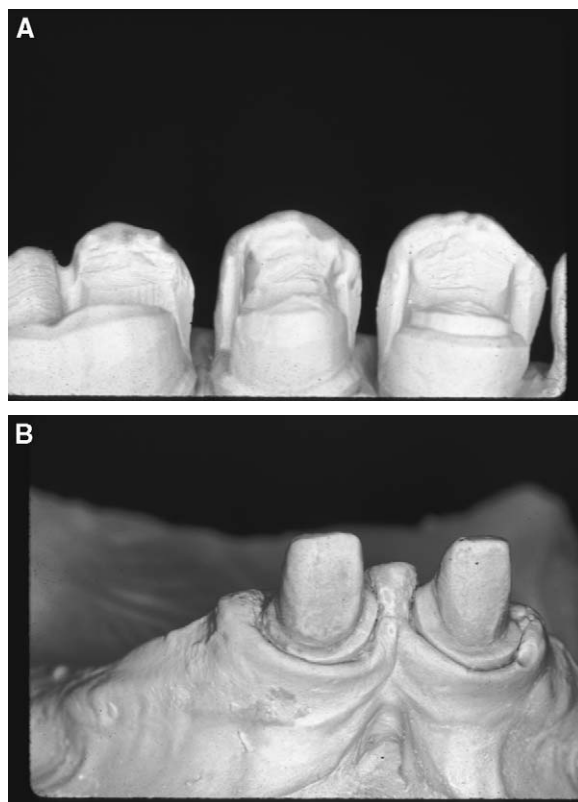


Fig. 3. These casts have unpolymerized impression material on the margins of the preparations as a result of indirect inhibition of polymerization of the PVS material by latex gloves.

available materials. Because there is no by-product to the setting reaction, they possess remarkable dimensional stability and are odorless and tasteless and pleasant for patients. They are provided with a wide variety of viscosities, rigidities, and working and setting times, so they can be used in a variety of clinical situations. There are specific manipulative variables that are important to achieving maximum performance with PVS impression materials.

PVS materials have one disadvantage: PVS materials have a significant interaction with latex. Any contact of unpolymerized PVS material with latex results in inhibition of polymerization of the impression material. This can occur if the clinician mixes putty materials while wearing latex gloves or if latex gloves were worn before mixing [33,34]. Direct inhibition of polymerization also can occur if the impression material is in contact with a rubber dam [35].

Indirect inhibition of polymerization also can occur intra-orally when latex gloves contact tooth preparations and the surrounding periodontal

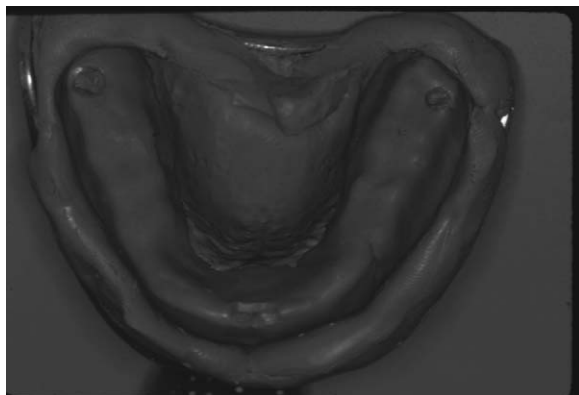


Fig. 4. Custom trays can be fabricated from PMM acrylic resin, light-cured resin, or PVS putty materials.

tissues during tooth preparation and gingival displacement procedures [36–38]. Such inhibition of polymerization is often subtle and limited to small isolated areas of the surface of the impression. It is often not detected with the initial inspection of the impression and may be noticed after only pouring and separation of the gypsum casts (Fig. 3). The presenting signs of inhibited polymerization are a film of unset material in isolated areas or the presence of a sticky, slippery substance on the surface of the impression. It is similar to the feel and appearance of the oxygen-inhibited layer that is seen with photo-cure composite resin restorative materials. Although these isolated areas of inhibited polymerization are subtle and not easy to detect, depending upon their location, they can render the impression unusable.



Fig. 5. Occlusal view of arch requiring impressions of implants and prepared teeth.

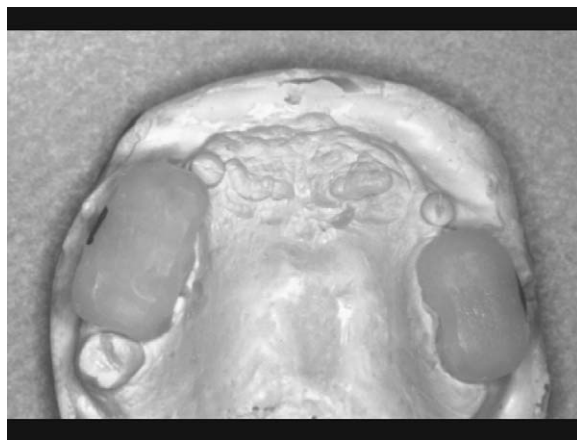


Fig. 6. Custom impression copings on preliminary cast of preparations.

Clinicians must inspect impressions and recovered casts carefully to insure contamination of critical areas has not occurred.

The mechanism of inhibition of polymerization is not known but is thought to result from contamination of the chloroplatinic acid catalyst of the PVS material with unreacted sulfur present in natural latex gloves [39]. Natural latex gloves contain sufficient concentrations of free sulfur for this to occur. Synthetic latex gloves, vinyl gloves, and the powder commonly found on gloves do not cause this inhibition of polymerization.

Sulfur-containing gingival retraction chemicals may contribute to the inhibition of polymerization [40]. Based on available evidence, it seems that contemporary hemostatic agents do not cause inhibition of polymerization

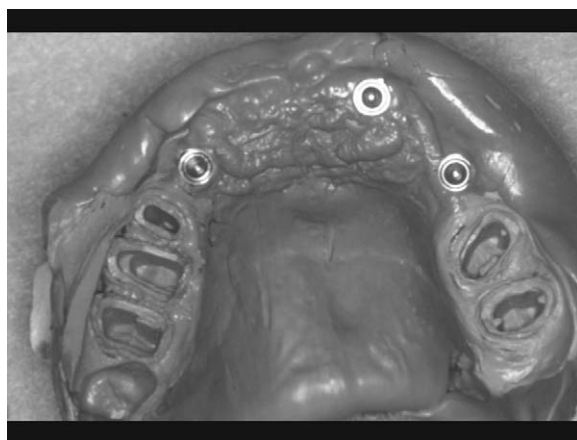


Fig. 7. The segmental impression with tooth preparations and impression copings.



Fig. 8. Arch with resultant definitive restorations on teeth and tissue bar on implants.

of PVS materials. Although clinicians detect such inhibition frequently in areas where gingival retraction was performed, it is likely that this inhibition is the result of contamination with latex gloves during the preparation and retraction procedures [41].

Clinicians should avoid touching tooth preparations and adjacent gingival areas with latex gloves. When this is not avoidable, wearing vinyl gloves over latex gloves is recommended. Once contamination of the preparations has occurred, it is not likely that cleansing with water will adequately remove it. Routine cleansing of tooth preparations with flour of pumice may be indicated before impression making.

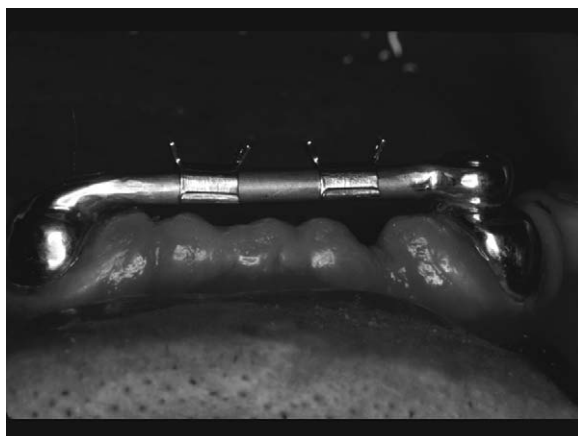


Fig. 9. When radicular attachments are used to retain over-denture bars, impressions of the dowel space may be necessary to fabricate working casts.



Fig. 10. Typical impression for fabrication of indirect dowel cores.

Putty/wash impression techniques

There are three approaches to putty/wash impressions. One approach is appropriate and acceptable, another can provide acceptable impressions but has some potential drawbacks, and a third approach is unacceptable [4].

An excellent technique for putty/wash impressions is to use the putty material to fabricate a custom tray. It is fabricated in the same manner as with PMM materials or light-cure materials. One layer of base plate wax is placed over the diagnostic cast as a spacer, and wax is removed from nonfunctioning cusps to provide occlusal stops. A putty impression is made in a stock tray, and a PVS putty custom tray results (Fig. 4).



Fig. 11. Silver plated cast obtained from the impression in Fig. 10.



Fig. 12. Occlusal view of pontic sites on an uncorrected impression.

A second approach is to use a relieved putty impression. In this technique, a pre-operative putty impression is made intra-orally. Plastic sheets may be placed over the teeth to prevent material from entering gingival embrasures. In the area where the teeth are to be prepared, impression material is removed with a bur or scalpel to provide relief, and the impression is “washed” or relined with low-viscosity PVS impression material.

This approach can be successful, but there are two potential pitfalls. It is difficult to confine the wash materials to the area of the relieved impression, and some wash material enters the unrelieved impression. This results in an

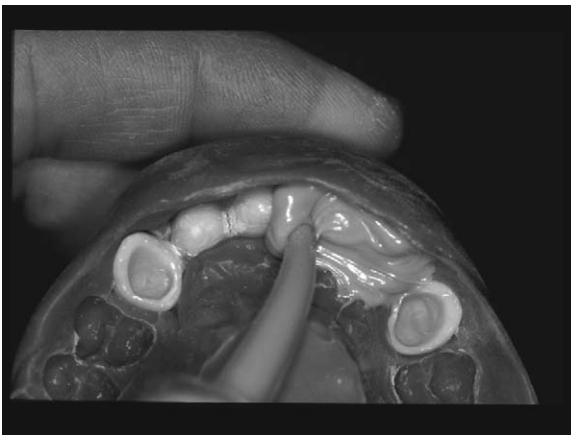


Fig. 13. The corrected impression is made with the provisional restorations seated in the master impression.

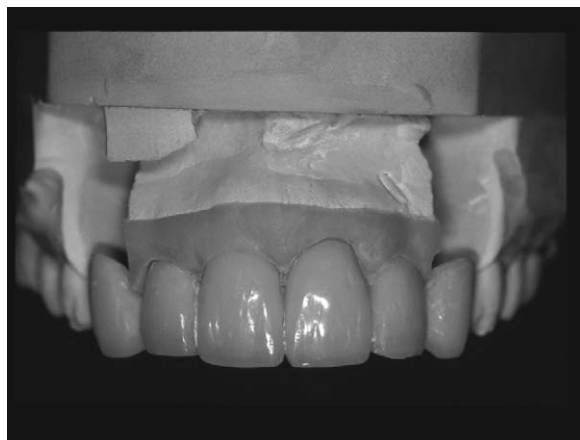


Fig. 14. The provisional restoration indexed to the master cast with corrected pontic contours.

inaccurate occlusal pattern for the resultant cast. Thus, the entire impression, rather than just the relieved area, should be “washed.” This creates the potential problem of hydraulic distortion of the putty material as the impression is seated in the mouth. This is impossible to detect on a clinical level but may have a deleterious effect on the accuracy if the impression and resulting restoration.

The third approach to putty/wash impressions is the so-called “simultaneous” or “squash” technique. With this technique, a stock tray is loaded with putty material, and the syringe material is injected around the prepared tooth or teeth. The tray containing the putty material is squashed over the



Fig. 15. Occlusal view of the pontic sites after the corrected soft-tissue cast is poured against the provisional restoration.



Fig. 16. Occlusal view of the pontic and peri-implant soft tissue to be captured in the impression.

syringe material, and the impression is made with the putty material and the syringe material setting simultaneously. This approach is unacceptable because it is impossible to control the thickness of impression material and excess bulk is used. It is impossible to control what material records the margin detail of the preparation(s). Usually portions of the prepared margin are captured in the putty, and putty materials are essentially deficient in their ability to record marginal detail [6].

It is generally recommended that complete arch impressions should be made wherever possible; however, there are numerous clinical situations where specialized impression techniques can be used to great advantage.

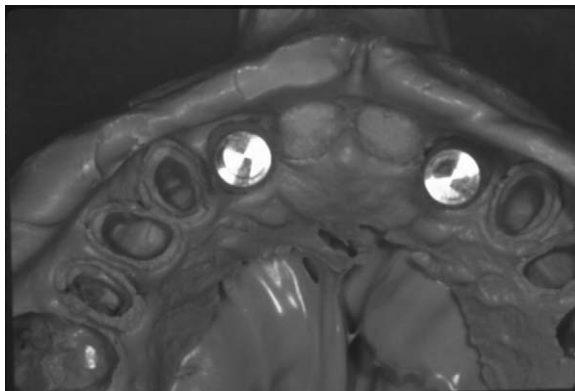


Fig. 17. Impression of the tooth preparations, implant copings, and provisional restorations.

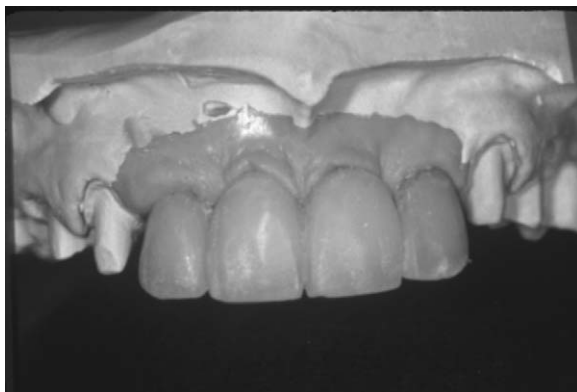


Fig. 18. Provisional restoration with the overimpression removed.

Dual-arch impression technique

When one or two posterior teeth are prepared for indirect restorations, it is often advantageous to consider using the dual arch or double-bite impression technique [26]. This technique captures the prepared teeth, the opposing arch, and the occlusal articulation in maximum intercuspation (MIP) simultaneously. Several studies have demonstrated that this technique, when indicated, can provide a simple but accurate method for fabricating restorations using the conformative maxillo-mandibular relation [42–45].

The dual-arch technique can be used successfully as long as the operator understands the indications and contraindications of the procedure. This technique should be used with a maximum of two prepared teeth. There should be unprepared stops anterior and posterior to the prepared teeth.

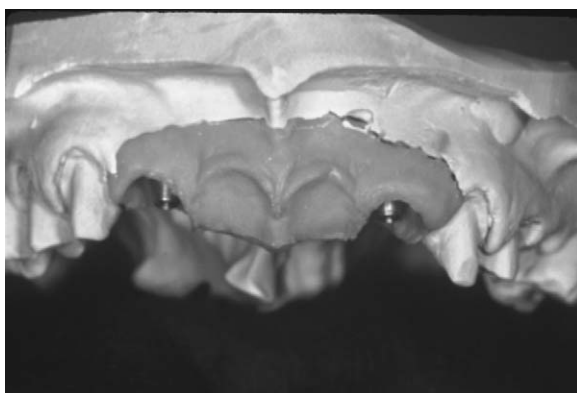


Fig. 19. The soft tissue contours are registered with the modified impression technique.



Fig. 20. Resultant definitive restoration.

The dual-arch technique should be used only with patients that have existing anterior guidance. Because a half-arch impression is used, no recording of the contralateral arch guidance is made. If the patient does not have existing anterior guidance, nonworking (balancing) interferences may be introduced in the new restorations.

For this technique to be successful, the patient must be able to close completely in MIP with the impression tray in place. This should be tested diagnostically before the preparation appointment so a custom tray can be fabricated if the patient cannot close in the correct position. The patient should be instructed to close in MIP with the tray out of the mouth. The operator should visually note the nature of the contact on the contralateral side and verify the patient is in MIP using Mylar shim-stock (Silver Mylar Strips; Du Pont, Wilmington, Delaware). Once this is verified, the dual-arch impression should be placed in position, and the patient should be instructed to again close in MIP. This should be in the identical position to that previously achieved, and this should be confirmed visually and with Mylar strips. Finally, when the tooth or teeth are prepared, Mylar strips on the contra-lateral side should be used as the patient closes into the impression material to confirm the patient has closed in the MIP position.

The presence of third molars, a rapidly ascending ramus, or excess soft tissue distal to the molars often prevents complete closure with the tray in place. The double-bite technique should not be used in these patients.

Rigid metal trays are ideal for this technique (Quad Trays; Clinician's Choice, London, Ontario). Rigid PVS or polyether materials should be used as well. Many plastic-mesh trays are available for this technique, but they should be avoided because they are too flexible. Often the buccal-lingual width of the arch is wider than the trays. The resilient tray flexes outward when the impression is made and rebounds when the impression is removed from the mouth, thus permanently distorting the impression.

The advantages of the dual arch technique include its clinical simplicity and the accurate recording of the MIP position. An additional advantage is that a closed-mouth technique is used that eliminates any mandibular flexure that might be associated with opening [46]. The laboratory procedures associated with the technique are slightly more complicated but can easily be handled once the technique is understood by the dentist and the laboratory technician.

The segmental impression technique

It is frequently necessary to make a simultaneous impression of many prepared teeth. In spite of the improvements in materials and the convenience of auto-mix systems, this can be difficult due to inherent limits in working time and difficulties maintaining moisture control. The segmental impression technique offers a procedure that predictably permits making a successful impression with multiple prepared teeth [47].

The technique can be used with any impression material but is optimally used with auto-mix PVS materials. With this technique, the arch to be impressed is broken down into easily managed segments. This usually is arbitrarily determined as two prepared teeth per segment. Individual custom trays are fabricated on the diagnostic cast for each segment. One millimeter of wax relief is provided, and the trays should extend 3 mm past the gingival margin of the prepared teeth because there are no occlusal stops and because the gingival tissues must prevent over-seating of the trays. These trays may be made using PMM acrylic resin or PVS putty material. They can be made individually or as one tray that is individualized by sectioning with a disc or scalpel. If made of PMM acrylic resin, these trays should be made 24 hours in advance. All of the individual trays must be able to seat simultaneously on the cast.

If PMM trays are used, the appropriate adhesive is applied to the internal of the trays. Conventional gingival displacement procedures are completed. After an appropriate time, low-viscosity material is mixed and loaded into a syringe and one of the segmental trays. Retraction cords are removed from the sulci in the designated segment, impression material is injected around the preparations, and the tray is seated to place. Excess extruded material is removed from around the tray, and the impression material is allowed to set. The tray is not removed. This procedure is repeated with each of the segments until each segmental impression is in place. At this point an over-impression is made with a compatible impression material in a stock tray. This impression is then handled in a conventional manner.

This segmental impression technique has proven useful in extensive cases and when moisture control is difficult in specific patients. It also can be useful when making simultaneous impressions of implants and prepared teeth.

Tooth/implant impressions

Dental implants have become an integral part of restorative dentistry, and frequently impressions for master casts include implants and prepared teeth. In these situations, implant copings can reduce access to the prepared teeth and impede the extrusion of impression material to the margins of the prepared teeth. A useful method to precisely record the detail of the prepared teeth and the implants is to use a combination of custom impression trays to impress the prepared teeth and then place the implant impression copings and make an over-impression of the arch (Fig. 5) [48–51].

With this technique, the teeth must be preliminarily prepared, and a cast of these prepared teeth must be obtained to fabricate the custom impression trays. A wax spacer of approximately 1 mm is placed around the prepared teeth, and PMM acrylic resin custom trays are fabricated with external undercuts to facilitate pick up with an over-impression (Fig. 6). The appropriate impression adhesive is applied to the custom tray(s) internally and externally and allowed to dry. If the margins of the tooth preparations are within 0.5 mm of the gingival margin, no gingival displacement is required. A heavy-bodied PVS impression material is placed in the individual custom tray and is seated over the preparation(s). The heavy-body impression material is allowed to set, and the impression tray is removed and the impression is inspected for completeness and lack of voids. The impression and tray are perforated through the occlusal surface with a #6 round bur. This preliminary impression is then filled with light-body material and replaced over the prepared teeth. The hydraulics of this technique force impression material beyond the prepared subgingival margins. The implant copings are then attached, and an over-impression is made (Figs. 7, 8).

Indirect dowel cores

A frequent clinical finding with endodontically treated teeth is insufficient coronal tooth structure. In these situations, a custom-cast dowel and core restoration are required to obtain adequate resistance, and retention form is required to retain the definitive restoration [52–54]. A direct or an indirect technique can be used to obtain a pattern for the cast dowel and core.

The indirect technique of obtaining dowel patterns is indicated when multiple dowel cores are required or when radicular attachments are to be used (Fig. 9) [55]. One of the difficulties of making impressions of dowel spaces is the entrapment of air in the apical portion of the canal. A predictable technique to consistently and accurately record the canal space is to use a 25-gauge local anesthetic needle as a vent to allow air to escape as the impression material is injected into the dried canal space [56]. The needle is gradually removed while the low-viscosity material is injected into the

canal. An appropriately sized plastic impression dowel that was previously coated with the corresponding impression adhesive is inserted into the canal [27]. The procedure is repeated as necessary with multiple dowels. The impression dowel(s) are then incorporated into an over-impression to obtain a working cast (Figs. 10, 11).

Impressions as a communication aid with dental technicians

Impressions can be valuable tools for communicating soft tissue landmarks to technicians [57]. The pontic form of choice in the esthetic zone is the ovate pontic [58]. Conventional impressions do not transfer the pontic ridge form accurately because the soft tissue loses its morphology shortly after removal of the provisional restoration.

The technique of choice to accurately replicate this soft tissue morphology is to make an additional impression with the provisional restorations in place on the abutment teeth [59]. First, the primary impression of the abutment preparations is made in a conventional manner. Then a second impression is made with the provisional restorations in place. This impression is made with putty viscosity material. This putty impression is removed, and the provisional restorations are inserted into the indentations in the impression. The putty impression with the embedded provisional restorations is then indexed to the working cast, and the residual ridge area is repoured with a soft tissue cast material (Figs. 12–15). The resultant cast can be used by the technician to accurately form the definitive restoration with ovate pontic forms where indicated.

This technique also can be used with implant-supported fixed prostheses. An over-impression that incorporates the provisional restoration can transfer the peri-implant soft tissue contours to the master cast (Fig. 16) [60–63]. When the peri-implant and pontic soft tissue relationships require transfer, the implant supported provisional restoration can be incorporated into the impression, and a soft tissue cast can be poured against the undersurface of the pontics (Figs. 17–19). This accurately transfers the intra-oral soft tissue morphology and allows the technician to fabricate the definitive restoration with defined soft tissue boundaries (Fig. 20) [61].

Summary

Clinicians have an excellent array of impression materials and techniques to use in the fabrication of tooth- and implant-supported restorations. Obtaining maximum accuracy of impressions is critical to the provision of precise restorative dentistry.

Based on the quality of impressions sent to commercial laboratories, it seems that many impressions fall far short of the level of quality made possible by current impression materials. The clinician is urged to review

contemporary principles of impression materials and to make impressions consistent with those principles. Clinicians are also urged to familiarize themselves with the various “specialty” impression techniques available and to use them when indicated.

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