Heraeus Kulzer
Mitsui Chemicals Group

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Giving a hand to oral health.

We especially thank **Mark L. Pitel**, DMD for his generosity in allowing us to use not only the title but also the contents from his 2005 textbook “Successful Impression Taking, First Time. Every Time.” and in addition for his overall advice in this project. Dr. Mark Pitel is currently an Associate Clinical Professor and Director of Predoctoral Esthetic Studies at the Columbia University College of Dental Medicine. He also maintains a private clinical practice in Poughkeepsie, New York. Dr. Pitel is an internationally recognized expert and lecturer on topics such as adhesive, cosmetic and laser dentistry, anterior and posterior esthetic restorations and of course impression materials. He has authored or co-authored numerous scientific abstracts and technical papers.

Thank you also to the following experts for their contributions:

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Preface

"Behind the complicated details of the world stand the simplicities."

Graham Greene,
in The Ministry of Fear, 1943

These words, written 60 years ago by a British novelist, have nothing to do with dentistry. Or do they? Today's dentist must deal with a myriad of "complicated details", especially when preparing and placing indirect prosthetic restorations and fixed prostheses. The indirect restorative materials themselves, and the materials used to cement or bond them to teeth, have improved greatly in recent years. But to ensure the success of these complex procedures – whether porcelain veneers, inlays, onlays, crowns, implant-supported restorations, or fixed partial dentures – a series of "simplicities" must be performed and handled correctly.

One of the most critical of these "simplicities" is the impression. Although CAD/CAM devices are available, and almost certainly will be more widely used in the future, most indirect prosthetic restorations today are fabricated by a dental laboratory technician. A good impression duplicates the preparation details accurately and allows the technician to provide a well-fitting, functional and aesthetic restoration.

Modern precision elastomeric impression materials have excellent physical properties. They are accurate, dimensionally stable, generally resistant to tearing, and they reproduce surface details extremely well. Moreover, they are usually mixed with electric or mechanical devices that provide the desired base/catalyst proportion, a homogeneous mix, and minimal air bubble entrapment. Materials are also becoming less hydrophobic, and thus less susceptible to problems caused by oral fluids. Unfortunately, dental technicians report that a large percentage of incoming impressions are poor. These impressions abound with problems such as missing, unclear, or inaccurate margins, bubbles and voids, pulls, and various other distortions.

Such poor impressions are not provide ford intentionally. In fact, on occasion, an "acceptable" impression is the best that can be achieved. However, the prevalence of poor impressions suggests that impression materials are frequently not used properly, nor inspected with enough attention to detail.

Dentists can become frustrated by the difficulties of impression taking and frequently seek out better (read "different") impression materials as potential solutions to their problems. However, whilst important, the choice of an impression material is only one variable in the impression equation.

Even if one of the finest impression materials is used, but used incorrectly, the final result usually will not be satisfactory. As the technical quality of impression materials has improved over the years, the importance of good clinical technique has become more obvious. Proper clinical technique can be the difference between success and failure of any impression. Despite this fact, and because impression materials are viewed as "throw-away" materials (which, of course, is true), dental school curricula and continuing education courses pay scant attention to this important aspect of restorative dentistry. Most practitioners learn their impression-making technique by trial and error. There is nothing wrong with learning by doing, but the informed practitioner can learn more by doing less. The informed practitioner can learn basic information developed by others and use that information to improve his or her impression techniques.

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This informative guide on impression taking provides for a comprehensive over-view of all the background information required, as well as tips and tricks from everyday practice. We would like to express our sincere thanks to all authors for their valuable support. This guide is a joint venture intended to help all dentists take precise impressions first time, every time, avoid time-consuming, expensive adjustments and further perfect the aesthetic and functional qualities of their prosthetic restorations.

Heraeus Kulzer

(Heraeus Kulzer GmbH, Hanau/Germany and
Heraeus Kulzer, Inc., South Bend/USA)

1.

The materials technology of precision impression-taking

Impression materials have come a long way since impressions were first taken by Philip Phaff in 1755. Pfaff described taking impressions with softened wax and constructing models made from plaster of Paris. The table below illustrates the key advances in impression materials technology.
All of these materials are available today, which means that dentists have a wealth of choices. Most dentists tend to develop strong preferences based mainly on the material's handling properties, the consistency of the results in their final impressions or the prosthetic restorations made from them.

However, there are many other factors that may affect material preferences, including:

- the clinician's training
- continuing dental education
- professional experience
- recommendations made by prominent dentists and colleagues
- the types and complexity of the prosthetic restorations placed
- the type and cost of equipment required

No matter which material is preferred, the best and most consistent results are likely to be produced by using the material and technique of choice.

The development of impression materials	
1755	Philip Phaff takes impressions using softened wax and pours models from plaster of Paris
1820	Metal impression trays are introduced in France
1857	The first impression compound is introduced
1925	Hydrocolloid materials
1950	Polysulphides
1955	Condensation-curing silicones (C-silicones)
1965	Polyether
1975	Addition-curing silicones (A-silicones)
1985	Hydrophilic A-silicones

Nowadays, dentists use a wide range of impression taking techniques. To meet these needs, a whole assortment of different materials with different properties is available to operators. The clinician who is aware of these properties can select the most appropriate material for the specific needs of a clinical case. Not only the viscosity, but also other factors influence the choice. For example, some materials exhibit an unpleasant odour or taste. Some have to be poured immediately whereas others require delays in pouring. Some materials are difficult to disinfect or require costly equipment. The advantages and disadvantages of each type of impression material will be identified later in this section.

Various materials with differing properties are available for the different impression techniques

From the practical point of view, impression materials can be classified according to three core characteristics:

- viscosity
- hydrophilicity
- setting time

These properties influence selection of the impression material depending on the indication, type of preparation and impression technique of choice.

Viscosity describes the flow characteristics of an unset impression material. Materials with high viscosity have low flow, whilst those with low viscosity have high flow. Commercially available impression materials vary in viscosity from low to very high.

High viscosity material is only slightly flowable. Low viscosity material is very flowable.

Low viscosity – Type 3

A low viscosity material may be referred to as a light body, syringe or wash material. They are usually able to wet a tooth surface very well and can flow into and record the finest details of a tooth, oral tissue or preparation. They are seldom used as the sole material for an impression. Typically, low viscosity material requires a second, more viscous, material to hydraulically push it towards the tooth and hold it in place whilst it sets.

The so-called light body, syringe or wash materials reproduce even the finest details.

Low viscosity materials are commonly dispensed from the modern automixing syringes, but can still be found in the more traditional paste/ paste tube delivery systems where a base paste is manually mixed with a catalyst paste. An impression syringe, fitted with a finely tapered tip, is often used to precisely distribute the low viscosity material around certain oral areas and to inject the low viscosity material into the interiors of cavity preparations and gingival sulci.

Medium viscosity – Type 2

Medium viscosity materials are very versatile and sometimes referred to as monophase materials. This is because medium viscosity material may be used as the sole material for an impression. Its viscosity is low enough to be loaded into an impression syringe and accurately record fine details, without being so low that it would require an additional supportive or hydraulic material to push it, or hold it, in place.

Medium viscosity materials can be used alone or with wash materials or putties.

Medium viscosity materials can also be used in conjunction with wash materials where they have a hydraulic or supportive function. Medium viscosity impression materials may also be used with higher viscosity or putty materials (refer to type 1) – in this case they are extruded from a syringe.

Type 2 materials can be conveniently dispensed from the mixing tip of automix cartridges or a dynamic mixer right into the impression tray or oral cavity. They are also available in the more traditional paste tubes that are manually mixed and transferred to a tray or impression syringe.

Heavy body or putty materials exert the necessary pressure to force low viscosity wash material onto the surface being impressed.

High viscosity – Type 1

High viscosity impression materials are sometimes referred to as heavy body or tray materials. These materials normally lack sufficient flow to intimately adapt to the interiors of cavity preparations, gingival crevices or other highly detailed tissue surfaces. This means that these materials are almost always used in combination with a wash of another, less viscous, material. In this application, high viscosity material provides for the hydraulic pressure necessary to push the lighter wash materials into good contact with the surface where the impression is being taken.

Since they are not usually able to be dispensed through a syringe, high viscosity materials are exclusively tray materials. Most of the high viscosity materials can still be mixed and dispensed reasonably well from automix or hard cartridges. The physical effort and time required to properly mix and use these materials has driven the development of mechanical mixing devices such as the Heraeus Kulzer Dynamix®.

Very high viscosity materials are often supplied in tubs.

Very high viscosity – Type 0

Very high viscosity materials are also referred to as putty. Like the high viscosity tray materials, they are not syringeable and are used mainly in conjunction with a wash or light-body material. The putty provides for the necessary hydraulic pressure to support the wash material, which records the fine details of the impression.

Putty materials are so viscous that they do not work well with traditional tube delivery or automixing cartridges. They are most often supplied in tubs of base and catalyst pastes. Mixing is accomplished by scooping out an appropriate quantity of each component onto a pad and manually kneading the two pastes until uniformly mixed. It was not until recently that very high viscosity impression materials have been specially formulated for use in mechanical mixing devices. This is not only more convenient in use and time-saving, but also enhances reproducibility thus increasing quality and processing reliability.

ADA specification No. 19 and DIN EN ISO 4823:2000 classify materials according to their viscosities.

The ADA has established an objective numerical standard for impression materials which is used to categorise the viscosity as low, medium, high or very high. This standard is referred to as ADA Specification No. 19. Scientists determine the numerical rating of the viscosity by placing a specific quantity of the material between two glass plates and pressing it into a disk with a standardized weight. The size of the disk, measured in millimetres, provide for the numeric rating and determines the viscosity classification. The DIN EN ISO 4823:2000 European standard also provides viscosity values for classifying impression materials.

Viscosity ratings of impression material

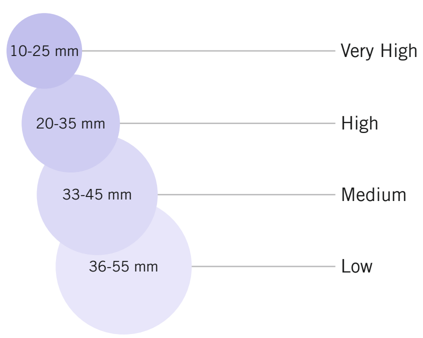


Figure 1: Relative diameters of viscosity consistency disks in millimetres: According to ADA Specification No. 19. (1982)

Viscosity values of impression materials

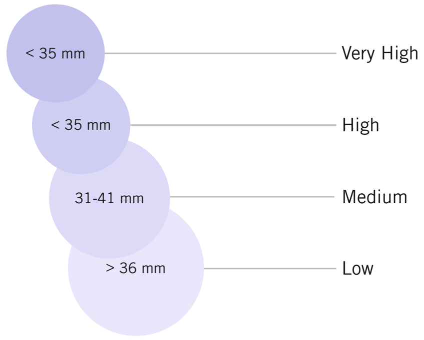


Figure 2: Relative diameters of viscosity consistency disks in millimetres: According to DIN EN ISO 4823:2000

1 2 3 4 5 6 7 8

Impression materials are also characterized by their degree of hydrophilicity, or the material's affinity for moisture. Materials can be identified as:

- hydrophobic
- hydrophilic
- hydroactive

Hydrophobic impression materials are repelled by moisture on the tooth surface.

Hydrophobic

Impression materials that are hydrophobic have a low affinity for, and tend to be repelled by, any moisture present on the teeth or tissue surface. Imagining the way water will bead on a freshly waxed car provides a good analogy for the reaction of hydrophobic materials to a moist environment. Though they will not absorb water, this repellency can mask the surface being impressed, prohibiting intimate contact and reducing the degree of detail that can be recorded. Inaccurate impression detail can then lead to a poorly-fitting final prosthetic restoration. The more moisture present, the worse the result.

Hydrophobic materials:

- provide for poor surface wetting
- record a lower degree of surface detail
- when in contact with water may mask the surface and inhibit intimate contact
- will not absorb water

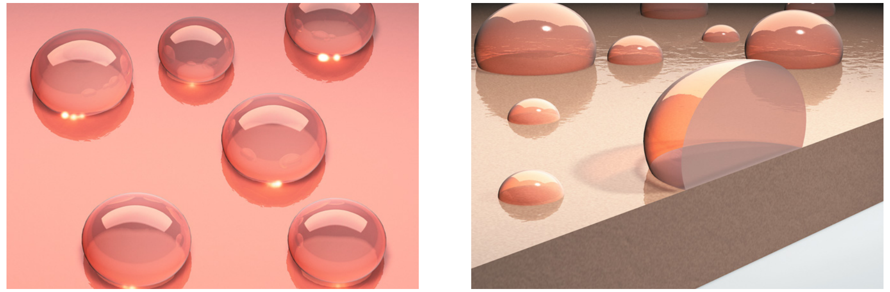


Figure 3: Hydrophobic materials have a low affinity for moisture. Any moisture present on the surface may prevent good contact with impression material.

Hydrophilic

Hydrophilic materials have a high affinity for moisture and are generally considered to be the most ideal for impression taking. Their ability to perform well in moist environments means that they provide for good surface wetting, allowing the material to capture the highest degree of surface detail. However, their ability to absorb water can also cause some dimensional instability, or an alteration of the material's physical properties when an excessive amount of water is present in the mouth such as during disinfection.

Hydrophilic materials also function in moist surroundings but may be rendered inaccurate if exposed to high levels of moisture.

Hydrophilic materials:

- provide for good surface wetting
- allow for a high degree of surface detail
- can be altered by excess moisture rendering them inaccurate

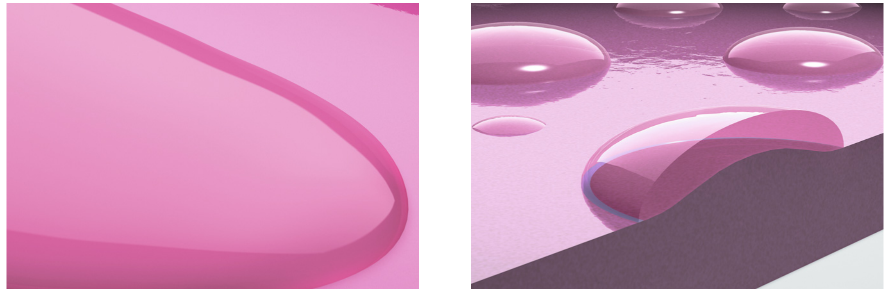


Figure 4: Hydrophilic materials have a high affinity for moisture but can absorb it as well thus rendering them dimensionally inaccurate.

Hydroactive materials combine the advantages of hydrophobic and hydrophilic materials.

Hydroactive (rendered hydrophilic)

Since the 1980s it has been possible to chemically alter some types of materials that are normally hydrophobic and make them more hydrophilic. Material that has undergone this process can be referred to as hydroactive or rendered hydrophilic. They are typically rendered hydrophilic through the addition of surfactants, special molecules with a hydrophobic group at one end of the molecule and a hydrophilic group at the other end. Hydroactive materials have an excellent affinity for moisture, but unlike the true hydrophilic material types, will not absorb it. When rendered-hydrophilic material is placed in contact with moisture, the surfactants react to help it develop intimate contact with the tooth or tissue surface and record excellent surface details. Moisture tends to be displaced from the surface yet is not taken up by the impression material. Thus, the material's properties and dimensional stability are retained.

Hydroactive materials:

- provide for excellent surface wetting
- provide for a high degree of surface detail
- offer dimensional stability
- displace moisture from the tooth and tissue surfaces but without absorbing it

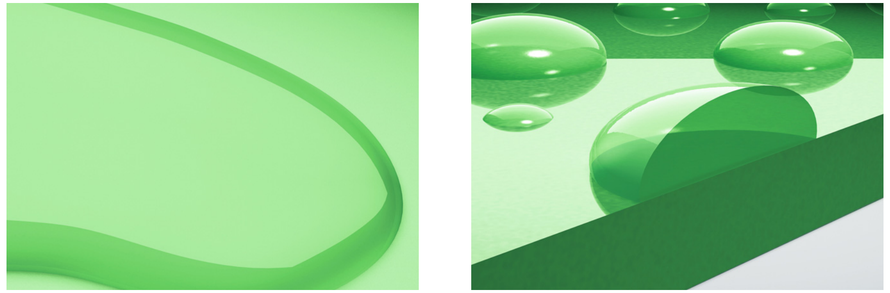


Figure 5: Hydroactive materials are rendered more hydrophilic through the addition of surfactants. This may allow the impression material to contact wet surfaces more intimately. As the moisture is not absorbed, the dimensional stability remains unchanged.

The setting times of elastomeric materials range from two to approx. ten minutes.

Setting time is really the total time that is required from the start of mixing until the impression material has fully set and can be safely removed from the oral cavity without distortion. Within this total time there is a period which is referred to as the working time. The working time is measured from the start of the mix until the point where the material can no longer be safely manipulated without introducing distortion or inaccuracy in the final impression. Thus an impression must be mixed and fully seated in place before the end of the working time. The material is then stabilised in position until fully set. Setting times for elastomeric impression materials range from about one minute for the fast-setting alginates to about 10 minutes for the polysulphides.

Impressiom materials are differentiated and referred to as:

- **slow set**
- **regular set**
- **fast set**

Materials are referred to as being slow set, regular set and fast set. In general, the working time for a material is correlated to the setting time. Thus, a slow-setting material will also have a long working time. Fast-setting materials typically have a short working time. The setting and working times provided by manufacturers for specific products are characteristic values which can be influenced by several variables including ambient temperature, air humidity and mixing technique employed for the material.

When using Heraeus Kulzer Flexitime®, the user can control the setting time.

In 2000 the first variable-set impression material, Flexitime® (Heraeus Kulzer), was introduced. This variable setting time was accomplished by increasing the material's sensitivity to the temperature in the mouth. With Flexitime, the working time and total setting time is variable and under the operator's control. After mixing, the light-body wash has a useful working time of between 1:00 and 2:30 minutes. Final set is reached 2:30 minutes after the impression tray is seated over the wash and thermally activated by the higher intraoral temperature. This achieves a constant intraoral setting time of 2:30 minutes.

1.4 Properties of the various material types

Today dentists have several types of impression materials to choose from, including alginates, reversible hydrocolloids, polysulphides, polyethers, condensation-curing silicones (C-silicones), addition-curing silicones (A-silicones). As technology has advanced, so has the quality and performance of materials. Understanding the differences between the different types of material and the advantages and disadvantages of each will help choose the material that best suits the needs of the case.

1.4.1 Reversible hydrocolloids

When speaking of hydrocolloid, reversible hydrocolloids are generally meant. They were very popular with dentists before the rubber-based elastomeric materials were introduced, but today are used only by less than three percent of practitioners. Reversible hydrocolloids are highly hydrophilic, so they work very well in a wet environment and can record tissue details extremely well. Provided that the impressions are poured immediately after taking the impression, they will result in exceptional accuracy.

As reversible hydrocolloids are thermoplastic, they require special processing equipment.

Unlike alginates, which set irreversibly, reversible hydrocolloids are thermoplastic. This means that at higher temperatures they behave like a viscous solution, but at room temperature will convert reversibly into a semi-solid gel. This temperature change requires the use of specialised equipment. Tempering water baths are used to heat the material to the proper temperature, and water-cooled impression trays reduce the temperature of the material once the impression tray has been positioned in the oral cavity.

Because the material is thermoplastic rather than chemical setting, hydrocolloids allow the operator extended working time if needed. Though hydrocolloid impression material itself is quite economical, the high costs of the equipment and the set-up time needed to use the product have diminished its overall popularity and use.

Hydrocolloids

Advantages	Disadvantages
Very hydrophilic	Technique-sensitive
Pour well	Minimal tear-resistance
No mixing, no waste	Fewer surface details
Very cost-effective in larger amounts	Must be poured immediately
Extended working time	Require expensive equipment
	Impressions can only be poured once
	Difficult to disinfect
	Time-consuming

1.4.2 Polysulphides

Polysulphides are particularly tear-resistant and reproduce surfaces details very accurately.

Polysulphides were the first of the rubber-based elastomeric materials. They have the highest tear-resistance of any elastomeric material. The base material contains a sulphur polymer which gives polysulphides their characteristic bad taste and odour. The catalyst contains lead dioxide which gives it the dark brown colour. Newer polysulphides have switched to peroxide- or copper-containing catalysts, which produce the blue-green colour of some brands.

Polysulphides are not suitable for deep undercuts as they distort easily after setting.

Though they are not highly hydrophilic, polysulphides do offer a reasonably good reproduction of surface detail if used in a dry field. However, due to their low rigidity, they are most accurate when the impressions are taken in a custom tray. When set they are not highly cross-linked and deform easily, so for highest accuracy deep undercuts should be avoided.

Polysulphides are relatively cost-effective and are also antibacterial. This material lacks long-term dimensional stability and should be poured within one hour. In addition, polysulphides have the slowest setting times (8-10 minutes).

Polysulphide rubber

Advantages	Disadvantages
High tear resistance	Unpleasant taste and odour
Good reproduction of detail	Long setting time
Slightly hydrophilic	High distortion
Good wettability	Must be poured within one hour
Kills bacteria	Messy to mix and manipulate
Inexpensive	Short shelf-life

1.4.3 Polyether

Polyether impression materials were first introduced in 1965 as a single-step, medium-viscosity monophase material and have gone on to become one of the most popular elastomeric materials. They offer clinicians many benefits. They are best known for their high hydrophilicity, which allows them to render excellent surface detail and pour easily with gypsums. Most polyethers have a fast setting time and, once set, are dimensionally stable for up to seven days if kept dry. However, storing a set impression in high humidity or for long periods in disinfection solution will lead to distortion.

Polyether materials are precise and usually set rapidly. But they are very stiff.

Polyethers are the most expensive material on the market today and have a bitter taste and odour that many patients find offensive. Polyethers are very stiff, which makes them difficult to mix, handle and clean up, as well as difficult to remove from the mouth. A more flexible version of the original polyether was released in the late 1980s, however the stiffness still makes it a poor choice for impressions of long or periodontally-involved teeth, or if undercuts are involved. Second generation polyethers are now available in a number of different viscosities, expanding the number of impression techniques that can be used.

HINT
Do not leave polyether impressions in high air humidity or for long periods in disinfectant as this will distrort them.

Polyether

Advantages	Disadvantages
Highly accurate	Highest precision only if poured immediately
Adequate tear strength	Usually unpleasant taste and odour
Relatively short working and setting time	Very rigid after setting
Hydrophilic	Sometimes difficult to remove from oral cavity or plaster model
Minimal distortion on withdrawal	Expensive
Acceptable shelf-life	Biocompatibility issues
Impressions can be poured several times	

C-silicones and A-silicones exhibit very different properties.

Silicones are a versatile group of elastomeric impression materials that are available in many different viscosities and setting times. They can be divided into two distinct categories:

- ccondensation-curing silicones, also known as C-silicones,
- addition-curing silicones, referred to as A-silicones.

C- and A-silicones are related through their polysiloxane chemistry, but they have significantly different properties and will be discussed separately.

C-silicones are tear-resistant, crisply detailed and easily processed.

C-silicones are more accurate and much easier to work with than polysulphides. They also have a more pleasant taste and odour, and are far less stiff than polyethers. C-silicones have a high tear-resistance and are highly resistant to deformation. They provide excellent detail and possess a moderate to long setting time which is adjusted via the base/hardener mixing ratio. The setting reaction in C-silicones produces a by-product of volatile alcohol which slowly evaporates from the set impression and reduces dimensional stability. For highest accuracy, impressions should be poured soon after taking. Due to their optimized ingredients, modern C-silicone systems such as Optosil and Xantopren Comfort from Heraeus Kulzer exhibit dimensional stability up to seven days and very good wettability in moist oral conditions.

HINT
C-silicone impressions should be poured soon after taking.

Advantages	Disadvantages
Controllable working and setting times	Technique sensitive
Pleasant odour and non-staining	Time-consuming to mix, handle and clean-up
Adequate tear-resistance	Poor dimensional stability
Easy removal from the mouth	Short shelf-life
Low distortion on removal	

1 2 3 4 5 6 7 8

As A-silicones distort least they are the primary choice for cases with undercuts.

A-silicones are used by the majority of dentists. These materials are also known as vinyl polysiloxanes, or VPS. A-silicones have a more pleasant odour and taste than polysulphides and polyethers. They have the lowest distortion (permanent deformation) of any current impression materials, making them a good choice for undercuts. They generally are not as stiff as polyethers. Their tear-resistance is variable and depends mainly on the viscosity. Low viscosity A-silicones tend to have lower tear-resistance than the C-silicones, whilst the high-viscosity versions have much higher tear-resistance. A-silicones have a different setting mechanism than their C-silicone counterparts and do not release volatile by-products. This means that A-silicones exhibit good dimensional stability and can be poured many weeks after taking the impression.

PLEASE NOTE
A-silicones must not contact sulphur compounds found in, e.g. the powder in latex gloves.

A special consideration with A-silicones is their sensitivity to sulphur compounds. Since sulphur is used in latex glove manufacturing, and is found in some haemostatic agents, the dentist must use caution to avoid contamination, which can inhibit proper setting. Automatic mixing is one of the methods which have a proven track record for enabling the impression tray and syringe to be loaded without touching the impression material.

1.4.4.2 Addition-curing silicones (A-silicones)

Early A-silicones were hydrophobic, similar to the C-silicones. But since 1985 most manufacturers have offered versions to which surfactants were added to make them more hydrophilic. As was addressed in the section on hydrophilicity, these materials are not truly hydrophilic, but are best described as rendered-hydrophilic or hydroactive materials (refer to section 1.3.2). These materials are tolerant of moisture, but the best impressions are still obtained in a dry field. A-silicones can be used with all impression techniques and exhibit fast setting times. With their good dimensional stability, long shelf-life, ease of disinfection and availability in a variety of viscosities and dispensing systems, A-silicones are good candidates for universal impression materials.

A-silicones are suitable for all impression techniques

A-Silicones

Advantages	Disadvantages
Variable set times	Some give off hydrogen as a by-product
Automated mixing devices possible	Hydrophilic, but require a dry field
Adequate tear-resistance	Sensitive to sulphur/latex contamination
Extremely high precision	
Minimal distortion on removal	
Dimensionally stable	
Hydrophilic, very compatible with gypsum	

The type of dispenser influences the quality of mix and processing reliability.

The type of dispensing system influences the type of impression material selected, the mixing quality and processing reliability during impression taking.
There are a number of options for packaging, using and dispensing impression material. Some materials are manufactured in several of these systems. Although clinicians may prefer to purchase their impression material in one particular system, it is worthwhile to be familiar with all types.

They are:

- paste/paste (standard tubes)

- automix cartridge delivery

- putty/putty (standard tubs)

- cartridges for dynamic mixing machines

Some impression materials are available in and dispensed from standard tubes. In this system, a base paste is mixed with a catalyst paste. Base and catalyst are usually significantly different in colour to aid the operator in determining that the material is mixed completely. Paste material from each tube is pressed out volumetrically onto a mixing pad or glass plate and manually mixed with a spatula.

Figure 6: Paste/Paste systems typically consist of a tube of base and a tube of catalyst. Material is dispensed volumetrically onto a mixing pad where it is hand-mixed for use.

Pastes should always be mixed by smearing them out into thin films over the entire pad surface. This process is referred to as stropping or smear mixing. Smear mixing helps avoid incorporating air, which can lead to voids. This process also aids in determining complete mixing. Once properly mixed, the material is transferred to an impression tray or loaded into an impression syringe for clinical use. There are still a few brands of material which utilize paste/ liquid, but these tend to be messy and difficult to assess if the material is completely mixed. Another drawback of this type of delivery system is that the quantity of material actually dispensed is relatively inexact. Even slight variations can impact the set time or physical properties of the set material

HINT

To avoid air voids when mixing, spread a thin coat of pastes over the entire surface of the mixing pad.

1.5.2 Putty/putty mix (standard tubs)

Stiff putties must be kneaded manually.

The very high viscosity materials are also called putty. Putty materials are so viscous that mixing them on a pad with a spatula is impractical or impossible nor can they be mixed mechanically with a static mixer.
Most manufacturers package and sell putties in plastic tubs of base and catalyst. The paste material is dispensed volumetrically onto a pad and must be manually mixed by kneading with the fingers – hence the term putty/ putty mix. It is especially important that the base and catalyst pastes are of significantly different colours so that the user will be able to visually assess that the material has been uniformly mixed. Scoops must always be disinfected after patient use and returned to the appropriate container, or cross contamination may occur. As when mixing two pastes, mixing putties manually may entrap air leading to defective areas in the impression. It is also relatively diffcult to assess the amount of material actually dispensed. Even slight variations can impact the set time or physical properties of the set material.

Figure 7: Due to their very high viscosity, impression putty materials are most often packaged in plastic tubs and dispensed volumetrically with scoops.

1.5.3 Automix cartridges

Automix cartridges function precisely and neatly, mix efficiently and produce minimal waste or air voids.

Automix cartridges have become a popular way to dispense impression materials. The system typically consists of a disposable, double-barrel plastic cartridge which contains the base and catalyst pastes, a disposable static mixing tip which is mounted on the cartridge, and a manually-operated gun which holds the cartridge and forces the material through the mixing tip. As the two unmixed pastes enter the mixing tip from the cartridge, they encounter a plastic insert known as a stator, which blends the material rapidly. It emerges from the other end as a completely mixed material that can be dispensed directly into an impression tray or oral cavity. Automix cartridges allow more accurate dispensing and efficient mixing. They are less messy and less wasteful than paste/paste since the exact quantity that is needed can be dispensed. They also tend to produce significantly fewer air voids. Automix cartridges are most commonly used for low or high viscosity materials. Very high viscosity materials cannot be expressed manually through these cartridges.

Figure 8: A typical automixing cartridge is shown loaded into its dispensing gun.

Dynamic mixing machines are motor-driven and mix materials from 5:1 foil bags or hard cartridges.

A recent addition to the impression material armamentarium is dynamic mixing machines. These are motor-driven mixers that deliver and mix materials from economical 5:1 foil bags or hard cartridges. The system typically consists of a motorized mixing device with two chambers, a hard cartridge with base and catalyst, as well as a disposable dynamic mixing tip.

The filled hard cartridges are loaded into the mixing machine, a fresh dynamic mixing tip placed on the orifice and secured with the fixation ring. When the machine is activated, two powerful pistons push the material from the bulk containers into the dynamic mixing tip. Here it encounters a rapidly moving plastic stator, which mixes the material thoroughly. The mixed material emerges from the other end of the dynamic mix tip and is dispensed directly into the impression tray or syringe for use.

Figure 9: Dynamic mixing machines such as the Dynamix marketed by Heraeus Kulzer have become very popular with practices that often take elastomeric impressions.

1.5.4 Cartrdiges for dynamic mixing machines

Nowadays, dynamic mixers can also be used with very high viscosity putties.

Dynamic mixers can be used for a wide range of viscosities. Since recently they can actually be used for mixing very high viscosity putties from foil bags or hard cartridges. These mixers are particularly useful for tray impression materials which are very difficult to mix manually. As with automix cartridge systems, dynamic mixers ensure that the material is mixed correctly as well as reducing the amount of waste and number of air voids in the impression. Their uniform, consistent quality of mix increases the processing quality regardless of the operator. Dynamic mixers dispense the material precisely and mix it rapidly, thus they save material and time as well as being hygienic in use.

Figure 10: Directly filled hard cartridges are designed to fit into most dynamic mixing machines.

Tray selection

2.

2.1 Clinical diagnosis

Selecting the optimum impression tray is just as specific as diagnosing the actual case.

A complete diagnosis and thorough pre-treatment planning can make all the difference in ensuring an accurate, excellent-quality impression the very first time. It will also help ensure that the overall case is managed successfully and efficiently, resulting in a properly fitting prosthetic restoration. Every case is unique in terms of its complexity, the type and number of prosthetic restorations, tissue quality and aesthetic requirements, so no one tray or technique is suitable for every case.

This section shows how tray selection can affect the outcome of impressions. Those operators who understand their tray choices and the advantages and disadvantages of each choice, as well as other important factors that can significantly impact their impression taking, will be better able to select the best option for a given case

Tray selection guidelines according to indications

Tray type	Indication
Partial-arch or quadrant tray	One or two units
Full-arch stock tray	Three or more units, aesthetic cases, bridgework, implants
Custom tray	Complex procedures, bridgework, implants, edentulous arches

2.2 Tray types and selection criteria

Impression trays differ in size, shape and further design details.

Following diagnosis, selecting the correct tray is the next step in achieving consistent, high-quality impressions. Impression trays come in a variety of sizes, shapes and designs. It is important to select a tray that fits comfortably in the patient's mouth and the tray must always seat passively, without binding on any teeth or alveolar tissues.

The correct tray for a given case fits passively, does not touch the teeth or alveolar tissues and allows adequate space for the impression material.

As almost every case needing an impression has undercuts, it is almost inevitable that the impression material distorts whilst being withdrawn from the oral cavity. If the natural situation in the oral cavity is to be reproduced dimensionally precisely, the deformation must recover. Therefore, the distortion must only take place in the elastic region and never in the plastic or permanently deformed areas. For this reason the impression material must not deform by more than approx. 30–40 percent. A specific example: If a cervical undercut is measured to be one millimetre, the equator of the tooth must be approx. 3 to 4 millimetres from the wall of the tray. Silicones must never be compressed by more than two-thirds of their original length. As the teeth tilt transversely, when selecting a tray particular attention must be paid to the fact that the most severe mandibular undercuts are in the lingual region and the most severe maxillary undercuts in the vestibular region (also refer to section 3.4 for Managing undercuts).

Different tray sizes may have to be tried in until the best size and shape have been found. In addition, the impression tray must match the type of prosthetic restoration being fabricated, the impression material selected and the impression technique in use. Generally speaking, rigid impression trays support the material best and thus reduce the risk of deformation.

The most important types of tray are:

- partial-arch, or quadrant trays,
- full arch stock trays and
- custom trays.

Figures 11–13 (top down): Partial-arch or quadrant tray, full arch stock tray, custom tray

2.2.1 Partial-arch or quadrant trays

As partial-arch trays record only part of the jaw, they can only be used with an open-bite impression technique.

Figure 11: Partial-arch or quadrant trays are especially suited for taking impressions of one or two teeth.

Partial-arch stock trays are appropriate for use in cases with one or two preparations only, just like double-arch trays. These trays are also known as quadrant trays. The term "stock" refers to the fact that these trays are purchased in standard sizes and shapes and are not custom-made for a specific patient. These impression trays record only part of a single arch at a time, such as a quadrant or sextant, and can be used in any area of the mouth. This means that partial-arch trays are suitable only for the open-bite impression technique where the patient's mouth remains open and the impression tray is held in position until the material is set.

Partial-arch trays are popular among many dentists, in part because they require less impression material than full-arch trays and tend to cause less gagging in patients. They are available in metal and plastic, in solid and perforated versions. Metal trays tend to offer better rigidity, but most plastic tray designs are also acceptable. To achieve the highest accuracy and dimensional stability of the set impression, tray adhesive should always be used.

One of the major limitations of this type of tray is the difficulty in accurately mounting and articulating partial-arch models in the dental laboratory. Partial-arch models also cannot accurately reproduce some patient occlusal movements. Prosthetic restorations fabricated from partial-arch impressions may require more clinical adjustments and time to seat them, so the advantages must always be weighed carefully against the possible limitations.

Advantages	Disadvantages
Less material required than with full-arch trays	Cannot accurately reproduce patient movements
Available in metal and plastic	Difficult to articulate accurately
Less likely to cause gagging	Frequently requires more adjustments
	Limited to one or two preparations

2.2.2 Full-arch stock trays

Prosthetic restorations with three or more units require a full-arch tray.

Full-arch trays can be used for any type of case, but are really necessary and ideal for larger cases with three or more units. They are also suitable for aesthetic cases, bridgework or dental implants. Full-arch trays are available in metal and plastic, in perforated and solid materials. As the name implies, impressions recorded in full-arch trays usually capture a full arch of teeth. Like the partial-arch trays, they must be used with an open-bite impression technique. However, full-arch trays tend to provoke gagging and may be less pleasant for patients than other types of tray.

These are also ideal for aesthetically-challenging cases, bridgework and implants.

Full-arch trays require more impression material than partial-arch trays and are perceived by dentists to be more expensive to use. However, they also produce both impressions and models, which can be more accurately articulated and better simulate the movements of the patient's teeth and mouth. This provides the technician with more information, which increases the chances of receiving a prosthetic restoration that fits accurately the first time. This accuracy can ultimately save time and money.

Advantages	Disadvantages
Ideal for multiple-unit cases	Require more material
Provide highly accurate impressions	More difficult to place in the mouth
Provide more information for lab	May be uncomfortable or cause gagging
Fewer adjustments to clinically seat	
Can be used with all materials and techniques	

Although full-arch trays are considered expensive, their high precision often actually saves time and expenditure.

Figure 12: Multiple-unit cases. Implants and bridgework. Veneers and cosmetic cases.

2.2.3 Custom trays

As custom trays are fabricated for a specific case, they provide the most accurate impressions.

They are particularly advisable for multi-unit prosthetic restorations, complex bridgework, partially-dentate and edentulous cases.

IMPORTANT

Custom trays must cure for several hours prior to use.

Like full-arch trays, custom trays can be used for taking any impression. They are best suited for multi-unit aesthetic cases, bridgework, implants or other complex procedures. It is especially helpful to use a custom tray in edentulous cases. Most dental experts agree that custom trays will always produce the most accurate impressions. However, since each one must be custom fabricated by a technician, dental assistant or dentist, they are more time consuming and expensive than other tray types. And, custom trays are almost always made from a working model, which requires a preliminary impression in a stock tray.

As custom trays are used to record a single arch of teeth, they must be used with an open-bite impression technique. Custom trays require less material and produce less waste, so there are some savings in impression material costs. Operators may also save time because the dental restorations fabricated from custom trays often require fewer adjustments.

Custom trays are usually fabricated with self-curing methacrylate acrylics such as Heraeus Kulzer Palatray. Although this material attains initial set within minutes, it continues to cure and shrink slightly for up to nine hours. Ideally, a custom tray should not be used for a few hours in order to compensate for this dimensional change. An alternative is to boil the tray for five minutes or to use one of the newer light-cured plastics, which are more dimensionally stable. Because the peripheries of custom trays are not overextended past anatomical areas, patient comfort is enhanced and gagging reduced.

Advantages	Disadvantages
Most accurate impressions	Require preliminary working mordel
Less material, less waste	Highest laboratory charges
Increased hydraulic pressure	Require extended curing time before use for greatest accuracy
Greater comfort, less gagging	

Figure 13: Custom trays are ideally suited for multiple-unit prosthetic restorations and partially-dentate or edentulous cases.

2.4.4 Using tray adhesive

HINT

Tray adhesive should always be used.

Once the appropriate tray and material for the specific case have been selected, it is essential to consider the use of tray adhesive. Although some trays have perforations, gauze membranes or other features designed to provide mechanical retention of the impression material, tray adhesives are almost always necessary to properly stabilize and bind the material to the tray. The only possible exception to this is reversible hydrocolloid, for which no tray adhesive is available.

Failure to use tray adhesives or using them improperly are common errors that can readily lead to inaccurate impressions and poorly fitting prosthetic restorations. Unless the impression is firmly and uniformly bonded to the underlying tray, it can separate or distort during removal. These defects may be very hard for the clinician to identify.

IMPORTANT

When selecting and using an adhesive, the manufacturer's recommendations and material compatibility should always be taken into account.

Tray adhesives are also material-specific. Therefore, a silicone adhesive should only be used with silicones, a polyether adhesive only with polyether materials and so on. To work properly, tray adhesive must be applied in a thin layer to all areas of the impression tray and permitted to dry according to the manufacturer's instructions before taking the impression.

Figure 14: Tray adhesives are material-specific: The Universal Adhesive for silicones shown here can only be used with addition-curing and condensation-curing silicone impression materials.

3. Important factors for tooth preparation

Planning an impression involves more than just correct tray selection. Adequately preparing the treatment area can help ensure an accurate impression and a properly fitting prosthetic restoration with good aesthetics. When preparing the treatment area it is essential to consider:

- margin design and placement.
- preservation of periodontal health and the biologic width.
- adequate reduction of the tooth.
- limiting undercuts.

Every one of these factors influences the impression. The following details will help in taking the best decision for creating a high-grade impression and carrying out the necessary steps.

Preparation margins may be placed subgingivally, supragingivally or epigingivally.

Supragingival margins are considered functional and biologically superior.

Preparation margins for dental restorations can be placed at three locations:

- subgingivally
- supragingivally
- epigingivally

There is almost universal agreement that margins should never be placed right at the free gingival margin.

Most dental experts feel that supragingival margins offer functional and biologic superiority by permitting better oral hygiene and by not encroaching on the periodontal tissue. Impression taking is greatly simplified with supragingival margins because the need for gingival retraction and haemostasis may be reduced or eliminated. Supragingival margins also allow the clinician to better evaluate the fit of provisional and final prosthetic restorations, and conduct a more thorough examination on recall.

Subgingival margins have customarily been used to produce more aesthetically pleasing prosthetic restorations and to control plaque formation by hiding the margin within the gingival sulcus. When margins are located subgingivally, the clinician must always use caution to avoid injury to the periodontal attachment during tooth preparation or the impression taking sequence. Gingival retraction and haemostasis are usually required to successfully record a subgingival margin in an impression. However, it should be noted that the growing popularity in conservative all-porcelain restorations like laminate veneers, and new aesthetic designs in metal-ceramic restorations (such as porcelain butt margins), have reduced the need to conceal a clinical margin subgingivally.

In addition to the location of the margin, the design of the margin should also be considered when selecting the appropriate impression material. Margin designs can be classified into three types:

- Beveled (e.g. metal crown, where only minimal space is available)
- Chamfer (e.g. metal-ceramic crown)
- Shoulder – 90° or bevelled (e.g. all-ceramic crown)

HINT

When preparing subgingival margins particular attention must be paid to preventing injury to the periodontal attachment

Fig. 15: Subgingival preperation margin

Fig. 16: Supragingival preparation margin

Beveled margins require a tear-resistant impression material such as A-silicone or polyether.

When margins must be located subgingivally, clinicians traditionally tend to prefer slightly chamfered or even beveled marginal designs. Unfortunately, the impression material that extends subgingivally to capture the preparation margin is often also very thin. Impression material with a low tear-resistance, such as reversible hydrocolloid, might not be a good choice to capture such a margin. A better choice would be an A-silicone or polyether. Even with excellent gingival retraction and haemostasis it is difficult to eliminate the moisture, blood and fluids which always occur subgingivally. A hydrophobic impression material might not be a good choice either.

Chamfer or shoulder preparations facilitate precision impression taking but conserve less tooth structure.

Chamfers and shoulders are much easier for the clinician and technician to read, so there is a better chance of achieving good marginal adaptation with the final prosthetic restoration. This is especially true when the margins are located supra-gingivally. These types of margins also allow for a much thicker layer of impression material at the preparation margin, reducing the likelihood that the material will tear or distort when removed from the mouth. However, the preparations for these margins tend to be less conservative of tooth structure, so the need for impression taking must always be balanced with the biologic consequences.

Figure 17: Beveled preparation

Figure 18: Chamfer preparation

Figure 19: Shoulder preparation

Preserving the biologic width is an important factor for periodontal health.

One of the most important factors in the long-term prognosis of a restored tooth is preservation of healthy periodontal tissues. The first principle of periodontal harmony is preservation of the biologic width. Placement and design of the margin of the prosthetic restoration are essential to reaching this goal. Biologic width is defined as the distance from the crest of the alveolar bone to the base of the gingival sulcus. Periodontal experts have established an average healthy biologic width as 2.04 millimeters, which consists of 1.07 mm for the supra-alveolar connective tissue attachment, and 0.97 mm for the junctional epithelium.

Failure to maintain adequate space risks loss of bone and gingival recession.

To maintain the biologic width and periodontal health an additional 1–2 mm of unprepared, sound tooth structure must be allowed above the biologic width. This permits a gingival sulcus of normal depth. So in total, the final prosthetic restoration margin should always be located 3–4 mm from the crestal bone (2.04 mm biologic width, plus 1–2 mm for the gingival sulcus). This can be established or confirmed radiographically. If the final margin of the prosthetic restoration is allowed to encroach on this minimum distance, loss of bone and epithelial attachment, as well as gingival recession are to be expected.

If the minimum space cannot be maintained, additional measures should be taken to enhance the periodontal relationship.

When clinical conditions do not permit the requisite minimum of 3–4 mm of space, auxiliary procedures, such as crown lengthening or orthodontic forced eruption, should be considerd to reestablish a more ideal periodontal relationship.

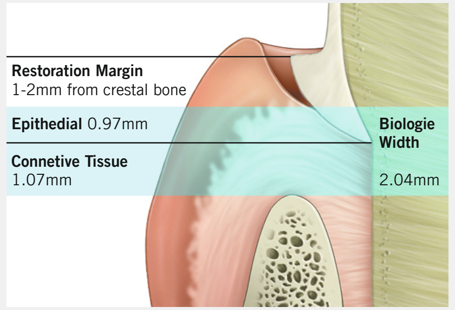


Figure 20: Cross-sectional representation of the periodontal complex graphically demonstrating the biologic width

3.3 Reduction

Inadequate reduction may lead to over-contoured or poorly fitting prosthetic restoration.

Adequate axial and occlusal reduction of the preparation can play an important role in the overall fit, aesthetics and long-term periodontal health of the prosthetic restoration. A minimal thickness (refer to table) of impression material is required to properly capture details of the tooth or tissue without distortion or tearing. For most areas of the impression this will not be an issue.

However, if the margins are located subgingivally, reduction may become important. For example, most rubber elastomeric materials will work properly with a subgingival thickness of only 0.5 mm, but reversible hydrocolloid requires 1.0 mm. Mechanical retraction cannot usually compensate for under-preparation of the tooth. Well known consequences of under-reduction include aesthetically compromised and over-contoured prosthetic restorations. Under-reduction can also lead to poorly fitting prosthetic restorations.

Tray type	Full cast	Metal-ceramic/All-ceramic
Circumferential reduction	0.8 mm	1.2 mm
Incisal reduction	2.0 mm	2.0 mm
Minimum occlusal reduction	1.2 mm	1.5 mm

Figure/Table 21: Guidelines for the reduction of tooth structure for crown preparations

3.4 Managing undercuts

The oral cavity is full of undercut areas that can complicate impression taking. Fully erupted permanent teeth with normal morphology and interdental spaces are good examples of this. The development of elastomeric materials allowed impressions to be removed over undercuts for the first time. However, all materials are not equal in their ability to draw over an undercut and recover without some distortion, or permanent deformation. The greater the percent of distortion, the more inaccurate the final impression, and any models poured from it, will be.

Whilst it may be possible to block out some severe undercuts, it will be impossible to eliminate all of them. The dentist should always be aware of the potential undercuts in the area being impressed, and should select impression materials and techniques which will help address them. A-silicones and C-silicones are the most deformation-resistant materials by far, followed by hydrocolloids, polyethers and polysulphides.

The tear-resistance and stiffness of a particular impression material must also be taken into account. Materials with very high stiffness can be quite difficult to remove from under-cuts. Likewise, materials with low tear-resistance may simply tear instead of springing away from the undercut. Again, a good diagnosis is the best defense. If the area being impressed presents with deep or above-average undercuts, consider blocking out as many as possible and select an elastomeric material better suited for this challenge.

Where unsuitable impression materials are used for impressing undercuts, the impressions will suffer distortion and deformation.

A- and C-silicones are the most distortion-resistant.

HINT

If the case presents with deep or numerous undercuts, as many as possible should be blocked out and an elastomeric, tear-resistant impression material should be used.

Figure 22: Even normal teeth present undercuts, which the impression material must be drawn over without permanent distortion.

Ensure that the impression suffers as little distortion as possible during withdrawal from the mouth.

When withdrawing the impression it is essential to ensure that it is distorted as little as possible. This is usually not easy. Firstly because the upper teeth converge and the lower teeth diverge, and secondly, because the vacuum created during withdrawal is difficult to break. It is therefore usually impossible to avoid rocking the impression or the consequent distortion.

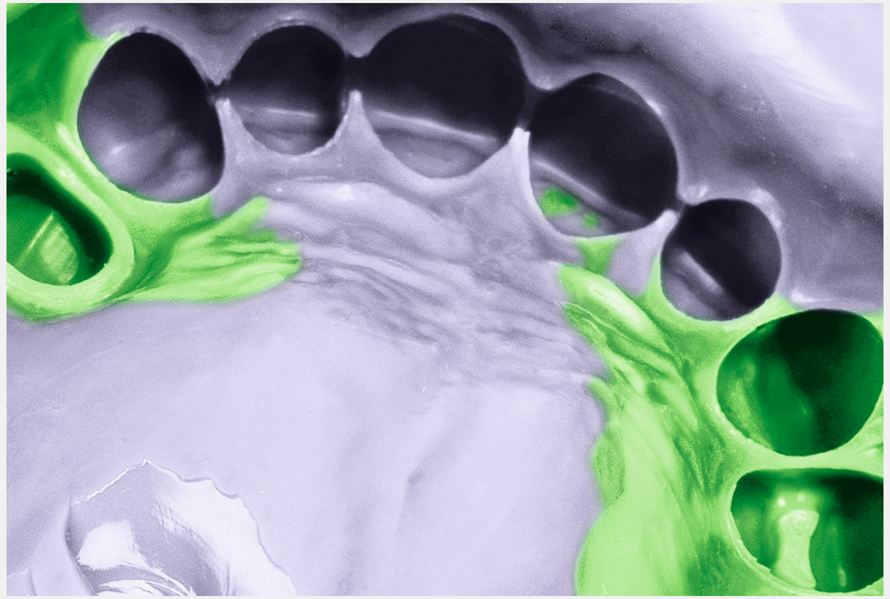
Least distortion is caused by withdrawing the impression parallel to the axes of the preparations.

Techniques for withdrawing the tray yet avoiding distortion in the relevant region (prepared teeth)	
Lower posterior preparations (these teeth tilt lingually)	The impression is first released from the prepared teeth toward the vestibule. The region of rotation is then in the contralateral vestibule.
Upper posterior preparations (these teeth tilt buccally)	The impression is first released from the contralateral vestibule before being withdrawn parallel to the axes of the preparations.
Anterior preparations	The impression is first released bilaterally from the dorsal vestibule before being withdrawn parallel to the axes of the preparations.

If prepared teeth in both halves of the jaw are to be included in the impression, distortion is virtually unavoidable in the relevant area. To keep this to a minimum, a tray which protrudes well beyond the area should be used. This keeps compression to a minimum and prevents plastic, permanent deformation. Due to the anatomy of teeth, elastic, temporary deformation cannot be ruled out completely.

HINT

If the impression is to cover both halves of the jaw, always select a tray which protrudes well beyond the area.



4. Tissue management

Tissue management is certainly one of the most important factors in ensuring a high quality impression and in turn, a properly fitting prosthetic restoration. In this section, various retraction techniques and the advantages and disadvantages of each will be discussed, as well as the importance of achieving excellent haemostasis prior to taking the final impression.

The most important objectives of tissue management are correct retraction and effective haemostasis.

First and foremost, it is important to recognise that retraction and haemostasis are actually two different objectives. Although it may be possible to accomplish both tasks with a single treatment modality, this is not always the case.
Retraction is the temporary displacement of the gingival tissue away from the surface of the tooth to expose a subgingival margin and to make space for impression material to record it. Retraction can also be used prior to preparing the tooth. In this case, retraction serves as a visual aid in establishing an ideal subgingival location for placing a preparation margin. This may help prevent iatrogenic injury to the gingival crevicular tissues, and facilitates preservation of periodontal health and the biologic width.

Depending on case requirements, there are three types of retraction techniques in general use today:

- cord techniques
- electrosurgery
- soft tissue laser

The retraction method used not only depends on the location, quality and condition of the soft tissue and complexity of the case at hand, but also on the personal skill level and preferences of the operator.

The cord-packing technique is the most popular method of retraction and is carried out using a twisted, knitted, woven or braided cord. There are a variety of natural and synthetic fibre types used in manufacturing gingival retraction cords, including wool yarn, cotton and silk. The cords are commercially available in plain versions and impregnated, or pretreated with haemostatic medicaments.
When using a cord packing technique, an appropriately-sized cord is gently placed into the gingival sulcus with the intent of mechanically displacing the soft tissues from the tooth and preparation margin. In general, it's best to use the smallest cord possible since larger cords can sometimes tear delicate gingival tissue, increase haemorrhage and damage the sulcular epithelium. Fortunately, the newer impression materials can capture excellent marginal detail within relatively small gingival spaces.

The cord-packing technique involves displacing the soft tissue from the tooth mechanically with a single or double cord.

Typically, retraction cords are placed after the tooth preparation is completed and then removed immediately before the impression tray is seated. Cords are packed with many different types of hand instruments. The specific instrument that works best depends on the type of cord. For example, a serrated instrument will usually work best with firmer cords and the tightly knitted or braided varieties. The smooth-tipped packers tend to work better with loosely twisted or braided varieties since they are less likely to catch on the fibres and separate them. Cords should always be packed by angling the instrument tip toward the starting point of the cord. Packing away from the starting point tends to dislodge or pull the cord out of the sulcus.

HINT

The tip of the packer should always be angled toward the starting point of the cord.

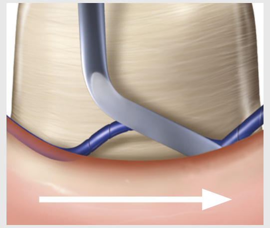


Figure 23: Incorrect: Angling the tip of the cord packing instrument away from the starting point of the cord tends to dislodge it.

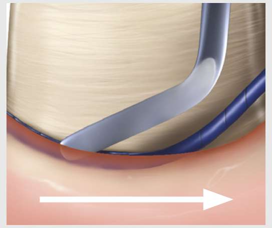


Figure 24: Correct: Always angle the tip of the packing instrument toward the starting point of the cord to facilitate placement.

A single cord should be wrapped around the preparation once or several times, depending on the depth of the sulcus.

The single-cord technique involves the dentist preparing the tooth completely before packing a single cord into the gingival sulcus to achieve retraction. The packed cord is removed just prior to taking the final impression. The single cord can be wrapped around the circumference of the preparation once or several times, depending on the depth of the sulcus. A single wrap is acceptable when the depth of the sulcus is nearly identical to the diameter of the cord. However, a single wrap with a single cord may not produce adequate retraction when the cord diameter is significantly smaller than the depth of the sulcus. This tends to produce teardrop-shaped retraction, which allows the tissue to collapse over the top of the cord or allow only a very thin margin of impression material, which can easily tear on removal. In this case, wrapping the cord multiple times may help achieve proper retraction and compensate for an undersized cord.

An excellent, but more time-consuming, alternative to the single-cord technique is the double-cord technique shown below.

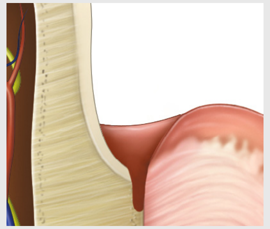


Figure 25: Conventional subgingival location of preparation margin.

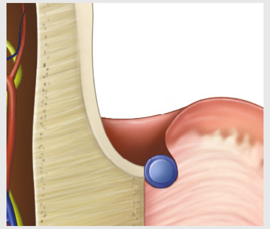


Figure 26: Properly sized and positioned single retraction cord.

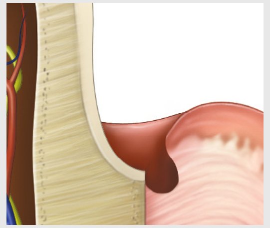


Figure 27: Cord is removed just prior to taking impression, providing good access to margin and adequate space for the impression material.

The double-cord technique is recommended for deeper gingival sulci.

This technique is especially good for impressions of cases where the gingival sulcus is deeper. As its name implies, two cords are used. The first of the two cords is usually smaller and packed into the bottom of the sulcus. It is generally used to help control fluids and haemorrhage, and can be packed before the preparation is completed or after. The first cord may be left in during impression-taking or removed just beforehand. If it is to be left in, it must be located below the preparation margin. The second of the two cords is thicker and packed directly on top of the smaller first cord. This tends to produce V-shaped retraction, which allows better access for the impression material thus providing for an impression margin with greater bulk.

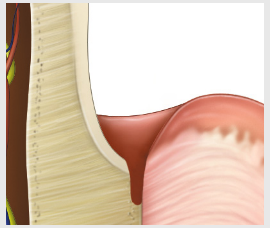


Figure 28: Deeper gingival sulci are better managed with a double-cord technique.

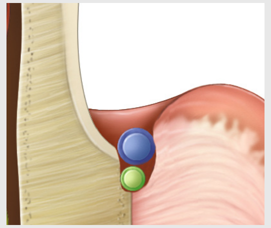


Figure 29: The smaller of the two cords is packed below the preparation margin, whilst a larger cord is packed on top of the first.

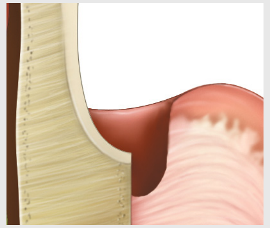


Figure 30: Both retraction cords are usually removed before taking the final impression. Optionally, the smaller cord is temporarily left in while taking the impression.

With all cord techniques, it is extremely important for the dentist to carefully check that all cords, stray fibres, and impression material remnants are completely removed from the gingival sulcus before the patient is dismissed. Residual materials will be treated by the body as foreign objects and can lead to infection, inflammation and other periodontal problems. As with all retraction methods, the operator should always try to expose 0.5–1.0 mm of tooth structure below the finish line of the preparation. This assists the technician in visualizing and creating a prosthetic restoration with a proper emergence profile.

IMPORTANT

With all cord techniques it is extremely important to carefully check that all cords, stray fibres and material remnants have been removed from the gingival sulcus.

When used correctly, electro-surgery achieves excellent gingival retraction and haemostasis.

HINT
Electrosurgery should not be employed in deeper gingival regions where the risk of injury is high.

Electrosurgical retraction – or electrosurgery – works by surgically removing a small portion of the epithelial lining of the gingival sulcus to create space for the impression material. Typically, a thin wire electrode is inserted into the sulcus and an alternating electrical current above 100 kHz is passed through the tip, which simultaneously removes the desired layer of tissue and cauterizes the surgical site. When properly utilized, electrosurgery furnishes excellent retraction, as well as haemostasis, and the epithelial tissues heal rapidly. Electrosurgery can also be a valuable adjunctive treatment modality when retraction cords alone do not seem to be effective.

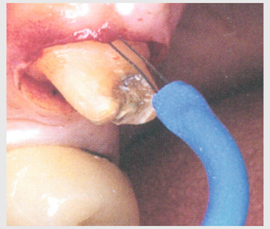


Figure 31: A radiosurgery (electrosurgery) handpiece being used on gingival tissue.

Figure 32: Typical dental electrosurgery unit.

CAUTION
Electrosurgery is contraindicated for patients with heart pacemakers or when gaseous anaesthetics are used.

However, electrosurgery is somewhat technique-sensitive. Some of the significant risks of improper usage include dentinal and cementum burns, and damage to the periodontal attachment. This can ultimately lead to the formation of periodontal defects and gingival recession, which can compromise the aesthetics and longevity of the final prosthetic restoration.
To eliminate the risks, electrosurgery should ideally be avoided in deep gingival areas where visibility is poor and risk of injury to the tooth or other tissues high.
More recently, units operating at frequencies higher than 2000 kHz (radio frequencies) are considered more efficient and safer. These are referred to as radiosurgery devices and should be distinguished from the older electrosurgery units, which operate at lower frequencies. Electrosurgical or radiosurgical techniques are not suitable for use in patients with heart pacemakers, or when gaseous anaesthetics are employed. For these reasons, electrosurgery remains a less popular method of retraction.

Soft tissue lasers are recommended in cases where preparation margins are unexpectedly deep or bleeding is excessive.

Soft tissue lasers create surgical retraction in much the same way as electrosurgery. Lasers are generally considered safer than electrosurgery because they use a high intensity form of light instead of electrical current to remove the tissue. The laser light typically is delivered into the surgical area via a thin glass fiber or fiberoptic bundle.

Lasers tend to produce a more shallow cellular necrotic burn in the tissues adjacent to the epithelial layer, so healing is faster and more predictable than with electrosurgery. Though lasers can also cause burn damage to the dentinal, cemental and attachment tissues, the risks are lower. Lasers are also safe for patients with pacemakers or when gaseous anaesthetics are in use. Depending on the type and wavelength of the laser, they may be either useful or totally ineffective in assisting with haemostasis. Lasers are most often recommended in cases where margins are unexpectedly deep or when there is excessive bleeding.

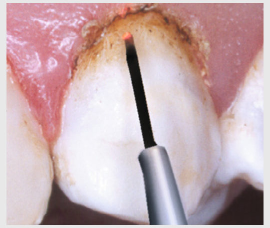


Figure 33: The thin glass filament of an Nd:YAG laser can be a useful retraction tool.

Thorough haemostasis is very important if the impression has to be precise.

Thorough and effective haemostasis is an important part of preparing for an impression since blood and moisture can negatively affect the performance of most impression materials, resulting in a compromised impression.
In dentistry haemostasis is defined as the stopping of undesirable bleeding or blood flow. Related to this is the seepage of blood products, such as gingival crevicular fluids, that also can significantly impair impression taking. Although haemostasis may be related to retraction, this is not always the case. Therefore, retraction and haemostasis should generally be considered as two different tasks.

HINT
Impregnated haemostatic retraction cords release the astringent chemical uniformly.

Whilst some haemostasis can result simply from the pressure of a retraction cord within the gingival sulcus, chemical agents are most often used to improve the haemostatic effects. Likewise, some of the astringent chemicals used for haemostasis will also help in achieving effective retraction. In most cases the chemical haemostatic agents are applied via the retraction cords impregnated with the medicament. However, cords can also be purchased plain and treated chairside with different medicaments right before they are used. The use of impregnated cords may be slightly more expensive, but also assures more exact dosage, or concentration, of chemical.

The most popular types of haemostatic medicaments and their required treatment times are:

Medicament	Concentration	Time
Racemic epinephrine	0.1 % solution	5-10 minutes
Ferric sulphate	0.15 % solution	1-3 minutes
Aluminium sulphate	100 % solution	10-20 minutes
Aluminium chloride	5-10 % solution	10 minutes

4.3 Haemostasis

As with the use of any medication, the operator should be familiar with the risks and benefits of each haemostatic agent. It also is essential to take a good medical history, including a history of any past allergic or adverse reactions to any of the chemical agents or materials. For example, epinephrine should be avoided with patients who report previous sensitivity or may have extensively lacerated tissues. For these patients, use of epinephrine may result in excessive systemic uptake and lead to an adverse syncopal-like reaction called epinephrine syndrome.

Sulphurous medicaments inhibit A-silicones functioning correctly.

The recommended treatment times must not be exceeded.

Certain haemostatic agents may have an impact on the setting reaction of the impression material. For example, it has been reported that the presence of sulphur in aluminum and ferric sulphate can inhibit the setting of some addition-reaction silicone (A-silicone) impression materials. Exceeding the recommended treatment time of any haemostatic agent should be avoided since it can lead to delayed tissue healing, as well as damage to the periodontal attachment.
Mixing of different agents can be synergistic in some cases. This is normally accomplished by dipping a cord impregnated with one medicament into another type of liquid medicament before it is packed. However, epinephrine and ferric III sulphate should never be combined because they generate a dark precipitate that is extremely difficult to remove from the preparation. In addition to being beneficial in retraction, electrosurgery and lasers can also assist in achieving haemostasis where medicaments are contraindicated.

CAUTION
Epinephrine and ferric III sulphate must never be combined.

Impression taking techniques

5.

When it comes to impression taking, selecting the right tray and materials, good sulcus management and thorough preparation will all provide a good start. But the clinical techniques used to take the impression will also have a profound impact on the overall quality of the impression and the fit of the prosthetic restoration.

The simplest way to think about the techniques used in clinical impression taking is to categorize them by the number of materials and the number of steps required to successfully perform them. Typically, multiple material types or combinations of materials may be acceptable for each technique. The generic technique classifications include:

- one material – one step
- two materials – one step
- two materials – two steps

Impression techniques differ in the number of materials used and steps required.

Number of Steps	1 Material	2 Materials
1	**One step** **One material** Monophase technique	**Two step** **Two materials** Double-mix technique (using paste) Sandwich technique (using putty)
2	–	**Two steps** **Two materials** Putty-wash technique

The choice of tray and impression material will have a decisive impact on which technique is most appropriate. However, any of the techniques are capable of producing an excellent impression. Ultimately, the choice will depend on personal preferences and the needs of the specific case.

This technique is the simplest to perform because it uses only a single material in a single step to take the impression. Therefore, the impression material acts simultaneously as both the preliminary and wash material. This is why this technique is referred to as the monophase technique.
A medium viscosity, or monophase, material works best for this technique. Once the base and catalyst are mixed, a portion of the impression material is filled into an impression syringe and the balance of the mix loaded into a suitable tray. The dentist syringes some of the impression material around the preparations and then seats the tray in one simple step. Dentists who prefer using conventional polyether materials often use this method because this material exhibits hydrophilicity and viscosity values which are very well suited to this technique.

The monophase technique involves taking an impression using one material in one single step.

Working steps of the monophase technique

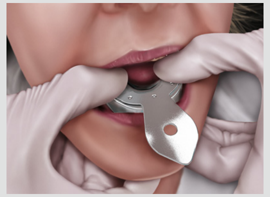
1. The stock tray is first coated with tray adhesive and allowed to dry according to the manufacturer's instructions.
2. The monophase material is loaded into the tray.
3. The material is syringed around the preparation margin and into the sulcus.
4. The impression tray is placed in the patient's mouth.
5. The tray should be inserted slowly to allow the impression material to flow smoothly.
6. The impression is then held in place calmly and without exerting pressure until it sets fully.
7. The impression is then withdrawn from the patient's mouth,
8. before evaluating the finished impression.

HINT

Medium viscosity material, such as conventional polyether, is best suited for this technique.

a.

b.



c.

d.

5 6 7 8

If the preliminary material is a paste, the technique may be referred to as "double-mix". If the preliminary material is a putty, the technique may be referred to as "sandwich".

By definition it requires two different materials, which are individually mixed and then used in a single step to record an impression.

Two materials (wash and preliminary), one step

The most common clinical application is when a low viscosity material is syringed around the preparations and a heavier tray or putty material is immediately seated over the wash before either material has set. When properly used, the two materials blend together seamlessly and are able to accurately record a very high quality final impression. The heavier tray material provides the support and hydraulic pressure for the wash, while the light viscosity wash material records the ultra-fine details of the tissue or preparation. If the tray material used is a paste of medium to high viscosity, the technique may be referred to as "double-mix". If putty is used for the tray material, this is referred to as the "sandwich" technique. The sandwich technique requires a rigid stock tray that will not distort under the pressure of the putty. It is important to distinguish the sandwich technique from the two-step putty/wash technique, which will be discussed next.

HINT

A-silicones are considered ideal for the "double-mix" technique.

The double mix technique is extremely versatile because it will work with almost any type of tray and many different types and viscosities of materials. It is also suitable for almost any clinical situation. Due to the total amount of impression material that must set simultaneously, not all materials work well with the two materials – one-step technique. The most ideal material is considered to be A-silicone and the least desirable is C-silicone.

Working steps for the one-step, two material sandwich technique

1. The stock tray is first coated with tray adhesive and allowed to dry according to the manufacturer's instructions.
2. The putty or heavy body material is mixed and dispensed in the tray (a).
3. A groove is pressed into the material to create space for the teeth.
4. A thin layer of wash material is applied into the groove in the putty, resp., heavy body material (b).
5. The wash material is syringed around the preparation margins and into the sulcus (c).
6. The impression tray is placed in the patient's mouth.
7. The tray should be inserted slowly to ensure that the impression material flows smoothly.
8. The impression is then held in place calmly and without exerting pressure until it sets fully (d).
9. The impression is then removed from the patient's mouth,
10. before evaluating the finished impression (e).

a.

b.

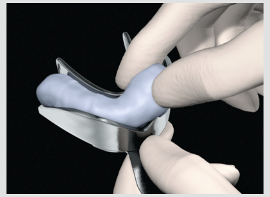
c.

d.

e.

The two-step putty/wash technique is the most common technique requiring two materials and two working steps.

This method also uses two different impression materials, as well as two separate steps. The first step involves taking an initial impression in a stock tray with a high viscosity or putty material. The second step is to take a final impression with a light body, wash material using the initial impression as a type of custom tray. The most commonly recognized example of this method is the two-step putty/wash technique.
Before taking the final impression, the initial impression should always be thoroughly relieved to eliminate any possible undercuts and to create a uniform space for the wash material. To ensure that the putty and wash materials can bond thoroughly, it is essential to clean all contaminants such as blood and saliva from the preliminary impression.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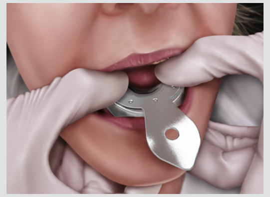
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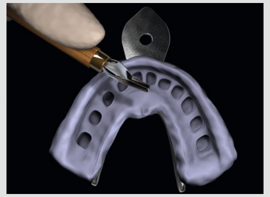
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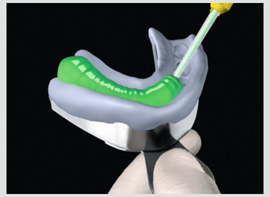
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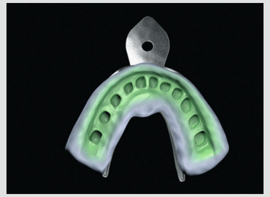

g.

5.4 Two materials, two steps

Working stages for two-step, two material impressions

1. The stock tray is first coated with tray adhesive and allowed to dry according to the manufacturer's instructions.
2. The putty is shaped in the tray (a).
3. A groove is pressed into the putty to create space for the teeth.
4. The impression tray is placed in the patient's mouth and held in position calmly until the intra-oral setting time has elapsed (b).
5. The impression is withdrawn from the mouth and rinsed under running water.
6. The impression peripheries are trimmed, the interdental septae removed and the undercuts eliminated. All areas should be relieved generously. Flat spillways should be cut in the region of the preparation margins (c).
7. The wash material is applied to the putty in the tray (d).
8. The wash material is syringed around the preparation margins and into the sulcus (e).
9. The impression is placed in the patient's mouth.
10. Pressure is exerted briefly to force the impression material to flow.
11. The impression is then held in place calmly and without exerting pressure until it sets fully (f).
12. The impression is then withdrawn from the patient's mouth,
13. before evaluating the finished impression.

IMPORTANT

The preliminary impression must be thoroughly relieved and cleaned prior to taking the wash impression.

6. Infection control

All clinical impressions must be correctly disinfected prior to proceeding with the next step.

CAUTION
Improper disinfection may harm the impression.

For the safety of all dental personnel, and to meet statutory and ethical requirements, all clinical impressions from patients should be properly disinfected before being poured or sent to a dental laboratory. Normal disinfection is a process that chemically or physically destroys viable microorganisms that may be present, but will not completely eliminate spores. High-level disinfection is the elimination of all viable microorganisms and spores.

Due to limitations in the impression materials themselves, it is not normally feasible to autoclave, chemically sterilize or gain high-level disinfection of dental impressions. Improper disinfection can damage the impression material, resulting in an inaccurate model and a poorly fitting prosthetic restoration. Therefore, disinfecting the impression prior to pouring the cast is the only reasonable means of providing a model that may be safely handled by everyone.

After being removed from the mouth, the impression should be rinsed in running water for 15 seconds as recommended by the German Maxillofacial Surgery Association (DGZMK) and the American Dental Association (ADA). This removes plaque, remains of food, saliva and blood as well as reducing the microbial count. Otherwise, these substances would impede contact between the disinfectant and surface of the impression.

HINT
Repeated immersion in disinfectant avoids air bubbles on the impression.

Only immersion solutions should be used for disinfection. For routine disinfection procedures, items should be immersed in disinfectant for 10–15 minutes. It is important that the impression is wetted fully. Immersing the impression in disinfectant repeatedly avoids air bubbles on its surface. In case of increased risk of infection, immersion times of up to one hour are recommended before rinsing off the disinfectant for 15 seconds in running water.

Recommended disinfection procedures:

Disinfection stage	Recommended duration
1. Rinse in running water	15 seconds
2. Immerse in disinfectant	10–15 minutes (where risk of infection is high: max. 60 minutes)
3. Rinse with running water	15 seconds

Apart from these recommendations, the manufacturers' guidelines for disinfecting specific impression materials must be taken into account.

Heraeus Kulzer precision impression materials

7.

7.1.1 Flexitime – Reliable precision – Every time

The VPS precision impression material Flexitime yields compulsory precision and accuracy of impression by balance of clinically relevant physical properties. The innovative setting time concept features flexible working time of 1:00 min – 2:30 min combined with an always short intraoral setting time of 2:30 min. 3 different delivery systems including automatic mixing as well as the concise allrounder system setup with 6 various viscosities enable easy, robust and safe processing of Flexitime. Furthermore, Flexitime attests many years of market experience and is clinically proven. Multiple scientific studies and awards acknowledge Flexitime's reliable quality.

Impression Material / Impression Technique	Indication			
	Crown & Bridge impressions	Inlay- / Onlay-impressions	Transfer-/ Implant impressions	Functional impressions
Flexitime® Easy Putty & Dynamix Putty for **two-step and sandwich impressions** in combination with Light Flow/ Correct Flow/ Medium Flow	● ● ●	● ● ●		
Flexitime® Heavy Tray & Dynamix Heavy Tray for **two step and double-mix impressions** in combination with Light Flow/ Correct Flow/ Medium Flow	● ● ●	● ● ●	●	
Flexitime® Monophase & Dynamix Monophase for **single stage / monophase impressions**	●	●	●	●

We recommend the generalist Flexitime assortment for single-tooth to multiple-unit restorations.
The faster-setting Flexitime Fast & Scan is optimally suited for 1–3 unit impressions.






7.1.2 Provil novo – Your individual selection for precision

The modular system Provil novo is not just remarkable due to its high flexibility and broad spectrum of use. The components are also convincing due to the excellent quality, high degree of comfort and in addition are also perfect for each individual style of working. The modular designed system consists of five ideally matched consistencies, which are formulated as fast set and regular set types and therefore cover all clinical impression situations and techniques.

Impressions Material	Two-Step Impression	Sandwich Impression	Double-Mix Impression	Monophase Impression	Funcional Impression
Provil® novo Putty	●	●			
Provil® novo Putty Soft	●	●			●
Provil® novo Dynamix Putty	●	●			
Provil® novo Monophase			●	●	
Provil® novo Medium	●	●	●		●
Provil® novo Light	●	●			






7.2 C-Silicones
7.2.1 Optosil & Xantopren – The C-Silicones classics

Optosil and Xantopren are reliable for daily use in the dental practice. As a matched system of classical putty and low viscosity materials, they are user friendly and enable precise reproduction of detail.

Impression material Impression technique	Two-Step Impression	Sandwich Impression	Double-Mix Impression
Optosil® P Plus	●	●	
Xantopren® H Heavy			●
Xantopren® L Light	●	●	●
Xantopren® VL Very Light	●		

7.2.2 Optosil & Xantopren – The Comfort System

Easy, secure and fast – the Optosil/Xantopren Comfort system is a further development of the classic Optosil/Xantopren System. Optosil/Xantopren Comfort combine the benefits of A- and C-silicones with those of Polyether in one perfectly matched system.

Impression material Impression technique	Two-Step Impression	Sandwich Impression
Optosil® Comfort Putty	●	●
Xantopren® Comfort Medium	●	●
Xantopren® Comfort Light	●	●

The Dynamix System consists of the Dynamix Cartridge and the functional Dynamix Machine and serves as the base for precise impressions and accurate prosthetics.

	Features	Benefits
Quality and Process Safety	Homogeneous and void-free mixing	Assurance of precision and fitting accuracy
	Consistent quality of mix – independent of operator	Consistently reliable
Savings	Exact dosage of impression material	Material saving
	Fast mixing and precise dosage of material	Time saving and easy to use

Dynamix Machine
The Dynamix Machine offers all the advantages of automatic mixing, with additional functions, that simplify handling and increase safety.

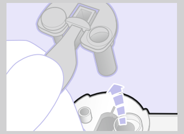
Dynamix Cartridge
The following Heraeus Kulzer precision impression materials are available in Dynamix Cartridges for mixing automatically at a ratio of 5:1 in customery mixing machines such as the Dynamix:

- Flexitime Dynamix Putty
- Flexitime Dynamix Heavy Tray
- Flexitime Dynamix Monophase
- Provil novo Dynamix Putty

The Dynamix Cartridge is ready-to-use and does not have to be activated.

Using the Dynamix Cartridge in the Dynamix Machine

1. Grasp the lug on the cap of the orifices and exert medium force to bend it 90° upwards. Grip the lug between the thumb and index finger and grasp the cartridge with the other hand to remove the cap from the cartridge completely (a).
2. Retract the Dynamix pistons fully, open the cover of the unit and insert the cartridge into the mixer (b; c).
3. Place a Dynamix Mixing Tip over the orifices of the cartridge. If the mixing tip does not fit easily, check that the central internal hexagon of the mixing tip is correctly aligned with the hexagon of the drive shaft (d).
4. If the mixing tip is positioned correctly, push the Dynamix Fixation Ring over the mixing tip to the stop and rotate it ¼ turn clockwise to lock it securely (e; f).
5. It is important to ensure that the Dynamix Fixation Ring is straight and not wedged (g).
6. Close the cover of the Dynamix Machine and operate the feed button to achieve the desired speed or function (impression syringe: normal speed; impression tray: high speed) (h).
7. When using a new cartridge, it is possible that the two pastes will not be extruded uniformly. The impression material should be expressed and discarded until it is coloured uniformly.
8. As soon as the feed button is released, the Dynamix automatically retracts the pistons slightly to prevent the impression material from running.
9. Once the impression tray or elastomer syringe is full, the Dynamix Mixing Tip should be left on the Dynamix Cartridge as an air-proof seal.
10. The Dynamix Fixation Ring can be re-used.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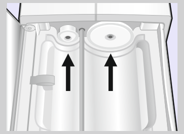
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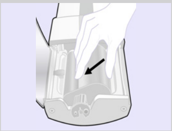
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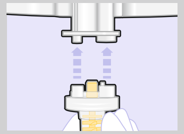
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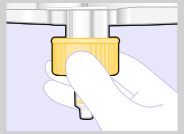
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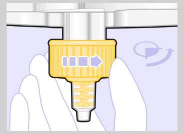
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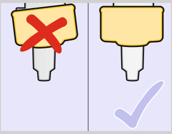
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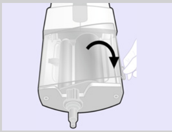
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The following Heraeus Kulzer precision impression materials are available in automix cartridges for mixing automatically:

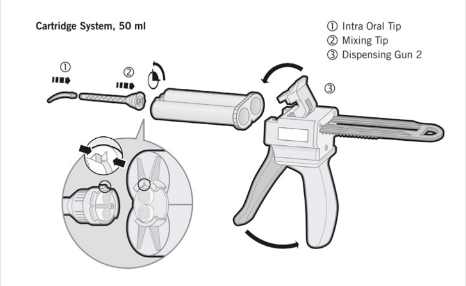
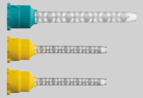


Figure 34: Typical automix system comprising a plastic cartridge containing base and catalyst pastes, a static mixer and dispensing gun.

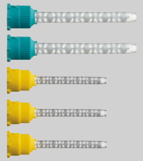
Figure 35: Typical automix system comprising a plastic cartridge containing base and catalyst pastes, a static mixer and dispensing gun.

For 1:1 automatic mixing
in combination with the 1:1 / 2:1 Dispensing Gun and yellow or green Mixing Tips (1:1):

Provil novo
- Provil novo Monophase fast set / regular set
- Provil novo Medium fast set / regular set
- Provil novo Light fast set / regular set

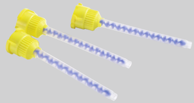


Flexitime
- Flexitime Heavy Tray
- Flexitime Monophase
- Flexitime Medium Flow
- Flexitime Correct Flow
- Flexitime Light Flow



For 4:1 automatic mixing
in combination with the 4:1 Dispensing Gun and yellow Mixing Tip (4:1):

Xantopren
- Xantopren Comfort Medium
- Xantopren Comfort Light



Please note:
To ensure optimally mixed material, always use the correct mixing tip for the specific impression material. The colour-code of the mixing tip and the automix cartridge cap must always be identical. The correct mixing tip is shown on the label of the cartridge. When using a new cartridge, it is possible that the two pastes will not be expressed uniformly. Before using for the first time, a small amount should be expressed, without fitting a mixing tip, and discarded. The impression material is loaded into the tray or filled into the impression syringe directly from the mixer. Alternatively, the correct intraoral tips for the mixing tip can be used for applying the wash material directly into the patient's mouth.

Heraeus Kulzer supplies the following materials for mixing A-silicone putties manually:

- Flexitime Easy Putty
- Provil novo Putty fast set / regular set
- Provil novo Putty soft fast set / regular set

Equal amounts of base and catalyst should be dispensed with the correctly coloured scoops and mixed with the finger tips for 30 seconds until they are coloured homogeneously. The material is then formed into a roll and placed in the tray.

Please note: the lids of the base and catalyst tubs as well as the dispensing scoops must never be interchanged and must only ever be used for the correct components. Should portions of catalyst contaminate the base material, it will harden in these areas.

Heraeus Kulzer supplies the following materials for mixing C-silicone putties manually:

- Optosil Comfort Putty
- Optosil P Plus

These putties are activated by mixing them with:

- Activator Universal Plus Paste

The required amount of base material should be dispensed with the scoop, smoothed and indented with the periphery of an impression tray. A thin string of Activator Universal Plus Paste is dispensed 1.5 to 2 times over the visible tray diameter. The two components are then mixed for 30 seconds with the finger tips before forming the material into a roll and placing it in the tray.

Heraeus Kulzer supplies the following materials for mixing flowable C-silicone in tubes manually:

- Xantopren H green, high viscosity
- Xantopren L blue, low viscosity
- Xantopren VL plus, extra low viscosity

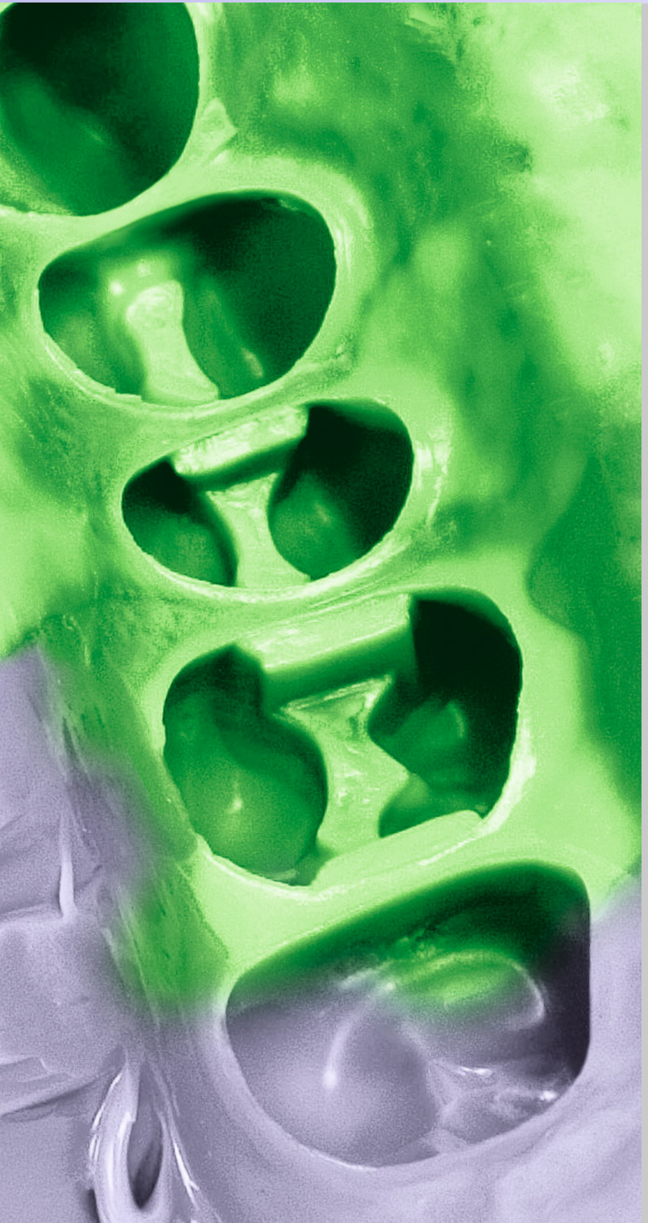
Xantopren H green and L blue are mixed on a mixing pad. The material is dispensed from the tube and the desired amount measured with the scale. Either an equal length of Activator Universal Plus Paste (diameter determined by the tube orifice) or one drop of Activator Universal Plus Liquid per marking on the scale is then dispensed. A spatula is used to mix the two materials by smoothing them out side-to-side for 30 seconds to create a homogeneous mixture. Smoothing the mixture forcefully prevents air bubbles being entrapped.

Xantopren VL plus is dispensed directly into the mixing bowl where it is mixed with Activator universal Plus Liquid. To dispense the amount required for an average impression, fill the bowl to the lower scale. Add 12 drops of Activator universal Plus Liquid and spatulate for 30 seconds.

			Indication			
Type of material	Impression material	Impression technique	Crown & bridge impression	Inlay/Onlay impression	Transfer impression	Implant impression
A-silicone	Flexitime® Easy Putty & Dynamix Putty for two-step and sandwich impressions in combination with Light Flow/ Correct Flow/ Medium Flow	Two-Step Impression Sandwich Impression	● ● ●	● ● ●		
	Flexitime® Heavy Tray & Dynamix Heavy Tray for two step and double-mix impressions in combination with Light Flow/ Correct Flow/ Medium Flow	Two-Step Impression Sandwich Impression	● ● ●	● ● ●	●	
	Flexitime® Monophase & Dynamix Monophase for single stage / monophase impressions	Two-Step Impression Double-Mix Impression	●	●	●	●
A-silicone	Provil® novo Putty with Provil® novo Light	Two-Step Impression Sandwich Impression	●	●		
	Provil® novo Putty soft with Provil® novo Medium	Two-Step Impression Sandwich Impression	●	●		
	Provil® novo Monophase	Monophase Impression	●	●	●	●
C-silicone	Optosil® Comfort Putty with Xantopren® Comfort Medium *or* Xantopren® Comfort Light	Two-Step Impression Sandwich Impression	● ●	● ●		
	Optosil® P Plus with Xantopren® L blau *or* Xantopren® VL plus	Two-Step Impression Sandwich Impression	● ●	● ●		
	Xantopren® H grün with Xantopren® L blau	Double-Mix Impression	●	●		

- We recommend the generalist Flexitime assortment for single-tooth to multiple-unit restorations. The faster-setting Flexitime Fast & Scan is optimally suited for 1–3 unit impressions.

8. Troubleshooting

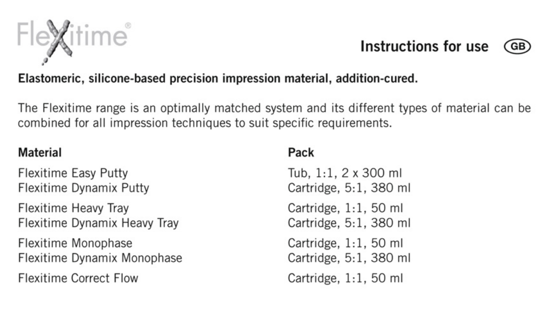


Modern precision impression materials and user-friendly delivery systems provide an excellent basis for attaining dimensionally stable, distortion-free impressions with crisp reproduction of detail. Following the correct procedure when taking an impression is, however, just as important. Even the most experienced practitioner occasionally takes an unsatisfactory impression. This does not have to be the case. Regardless of the impression taking technique and material selected, following a few basic tips can ensure consistently good results.

These tips and hints have been collected and compared compactly and clearly. They are based on the decades of experience gained by Heraeus Kulzer in impression taking techniques and the practical experience of leading universities as well as numerous dental practitioners throughout the world. This proven, practical advice is intended to aid the operator take precise impressions, avoid time-consuming, costly retakes and further perfect the aesthetic and functional qualities of prosthetic restorations.

There are a few typical causes for most of the problems that occur during impression taking. If dentists are aware of these causes and their effect on the impression and know how to avoid them, they will attain superior results as well as save themselves and their patients time and money. The following basic recommendations for attaining good results should simply be regarded as a checklist that can be gone through before taking an impression.

Read the manufacturer's instructions in the instructions for use
It may sound obvious, but some materials require special preparation, handling or conditioning that the clinician may not be familiar with or aware of; this applies in particular if using a material for the first time. Incorrect mixing, removal or storage of the materials can impair the dimensional stability, alter the setting time and chemical structure of the material and generally result in an unsatisfactory impression.


Flexitime®

Instructions for use (GB)

Elastomeric, silicone-based precision impression material, addition-cured.

The Flexitime range is an optimally matched system and its different types of material can be combined for all impression techniques to suit specific requirements.

Material	Pack
Flexitime Easy Putty	Tub, 1:1, 2 x 300 ml
Flexitime Dynamix Putty	Cartridge, 5:1, 380 ml
Flexitime Heavy Tray	Cartridge, 1:1, 50 ml
Flexitime Dynamix Heavy Tray	Cartridge, 5:1, 380 ml
Flexitime Monophase	Cartridge, 1:1, 50 ml
Flexitime Dynamix Monophase	Cartridge, 5:1, 380 ml
Flexitime Correct Flow	Cartridge, 1:1, 50 ml

Adhere to the use-by-date
After the use-by-date, materials may no longer react in accordance with the manufacturer's instructions.

Avoid contaminating the material
All impression materials are sensitive to contamination. This can be caused by a biological source like blood or saliva or other dental materials and products. A-silicones have a highly sensitive reaction to sulphur compounds. These are frequently present in latex gloves and some haemostatic agents. The powder used in powdered gloves contains sulphur.
Just tiny amounts can cause a lot of damage. Even inadvertently touching a tooth or preparation or rolling a retraction cord with latex gloves can transfer chemicals that contain sulphur and this can adversely affect the setting properties of the material.

Moisture and blood can negatively affect both hydrophilic and hydrophobic materials. If moisture comes into contact with hydrophobic materials, it can repel the impression material and cause voids or inaccuracies. Intrinsically hydrophilic materials can absorb water and fluids. This may impair physical properties like tear resistance and also have a detrimental effect on the precision of the finished impression.

- **Use the correct type of impression tray and a correctly fitting tray**
  If the tray is too small, it may come into contact with the patient's teeth or oral tissue during insertion or withdrawal. This results in tears, voids or inaccuracies in the impression. Problems can also arise if the tray is too soft to support the type of material selected.

- **Use the appropriate tray adhesive**
  Maximum precision can only be attained by using a tray adhesive. This ensures that the impression material is retained on the tray during setting and removal from the patient's mouth. This also applies to impression trays with retention aids like perforation. Using the incorrect type of adhesive, too much or too little adhesive or taking the impression before the adhesive has fully set can also distort the impression or result in the material loosening from the tray.

Figure 34: Some materials, such as A-silicone putty, must be hand-mixed without wearing powdered latex gloves to avoid contamination.

Figure 35: Adhesive should also be used for trays with retention aids.

- **Adhere to the manufacturer's recommended working and setting times**
  There are recommended working and setting times for all types of impression materials. A precise impression can only be attained if all the material has been syringed and the impression tray inserted before the end of the working time. The impression must then be held securely in the same position and stabilized until the material sets. Only then can it be safely removed from the mouth. Premature removal would have a detrimental effect on the result. This also applies when partially set material is inserted in the mouth. This can cause defects like voids, separations, flash and distortions. If different materials are used for taking the impression, the working and setting times of all the materials should be correctly coordinated. This avoids poor blending or separation of the materials.

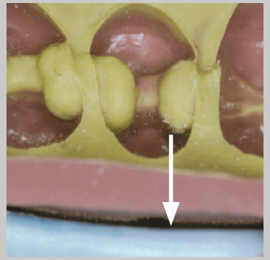


Figure 36: A poor adhesive bond can result in the material loosening from the tray and distortion of the impression.

Voids are probably the most frequent type of deficiency in dental impressions. They generally occur as small or moderately large recesses in the impression. The main causes of voids are:

- incorrect syringe technique, which causes air bubbles or breaks in continuity
- air entrapment in the material during mixing
- contamination of the preparation with blood or saliva
- contamination caused by latex gloves
- contamination caused by dental products, e.g. from the oxygen inhibition layer in composites
- insufficient sulcus retraction

Voids and other types of deficiencies can occur in any section of an impression. If they repeatedly occur at certain sections, there is usually an obvious cause and a way to avoid the problem.

8.3.1 Voids on buccal and lingual surfaces

Voids on buccal and lingual surfaces often occur at the junction between the tray and wash material.

Causes:

- Not enough wash material in the impression: in this case the wash material cannot bond correctly with the higher viscosity tray material and leaves a small gap.
- Exceptionally high ambient temperatures: these can cause premature setting of the wash and/or tray material.
- Shortened working and setting times: this can cause the materials to lose some of their flow properties and render them incapable of bonding together. A typical consequence of this is a small void at the junction of the two layers of material.

Solutions:

- Use adequate wash material during syringing. Ensure that the wash material flows completely around the prepared region so that it reproduces very fine detail.
- On hot days, keep the material cool until it is re-quired for use to ensure the correct working and setting times and viscosity are maintained.
- Completely fill the sulcus and cover the preparation with wash material in a single, continuous working step. When syringing, always keep the intraoral tip in the material to avoid air bubbles.

Figure 37: Voids at the junction between the tray and wash material can be caused by poor coordination of the setting times.

8.3.2 Voids on mesial and distal surfaces

Voids on mesial and distal surfaces, mainly at the junction between the tray material and wash material, occur in particular when the preparation is adjacent to an eden-tulous section of the jaw.

Causes:

- There may not be enough hydraulic pressure to adapt the tray material or wash material adequately or bring it into contact with the proximal surfaces of the preparation or tissue. This results in a void at these surfaces.

Solutions:

- Use a custom tray to confine the material and ensure a more precise shape to fit the mouth.
- Use the sandwich or two-step putty-wash impression technique to ensure correct hydraulic pressure.
- Use an air syringe to adapt the impression material to the proximal surfaces and cover them completely.

Figure 38: A void on mesial or distal surface frequently occurs adjacent to an edentulous section of the jaw.

8.3.3 Multiple voids scattered throughout the impression

A small, localized void can occur due to the causes mentioned above or for some inexplicable reason. Multiple voids in a single impression, on the other hand, indicate an error when mixing or handling the impression material.

Causes:

The material was not mixed or handled according to the instructions for use:

- When loading the impression tray, the mixer was held over it and the material allowed to drop from the syringe into the tray. This can result in air entrapment in several locations.
- Air became trapped during manual mixing of paste-paste material (dynamic mixing increases the quality of the mixture and minimizes the risk of air entrapment).

Solutions:

Multiple voids are easily prevented:

- Always keep the static mixer of the automix cartridge in the dispensed material until the preparation is completely covered or the impression tray is fully loaded.
- When using a dynamic mixer, always keep the dynamic mixer in the tray material when loading the impression tray.
- If possible, fill the impression syringe from a mixing tip from the front with the syringe plunger inserted. This avoids trapping air in the inside of the syringe or between the plunger and impression material. Expel the air from the front of the syringe barrel after attaching the syringe tip.

Figure 39: Multiple voids through-out the impression indicate incorrectly mixed impression material.

8.3.4 Voids in the sulcus area

Fortunately there are only a few causes of voids frequently occurring in the sulcus or at the preparation margins of impressions.

Causes:

- Contamination by moisture or medication
- Inadequate haematosis

Solutions:

- Use the double-cord technique for improved retraction and absorption of moisture.
- Rinse off the retraction agent thoroughly and dry the prepared areas fully.

Figure 40: Localized voids at the margin of the sulcus are an indication of contamination

8.3.5 Voids at a line angle

Voids often occur directly over the edge of a tooth in the form of a line disrupting the continuity of the impression; this virtually always occurs in the wash material. Finning is often produced on the die model when this type of impression is poured:

Causes:

- Incorrect syringe technique: if you start syringing the wash material in the sulcus of an edge, it is difficult to attain a seamless junction when syringing is complete. If a seamless junction is not attained, a void is produced at the edge in the impression that causes finning on the model. If the two ends of the syringe material do not merge properly, a gap is created instead of a seamless junction.

Remedies:

- Always keep the intraoral tip immersed in the material during syringing of the wash material. Apply material liberally at the start of syringing.
- Ensure that the impression is taken quickly in complex cases.

Figure 41: A fin defect can result from a void occurring on a line angle.

Causes:

- Different setting times at the start and finish of syringing: once the initially syringed impression material comes into contact with the naturally warm temperature of the intraoral cavity, it can set more rapidly, particularly on warm days. In complex cases, e.g. with multiple abutment teeth, the initially syringed material may already be partially set before it comes into contact with the material at the finish of syringing. In this case the portions do not merge properly.

Remedies:

- Use slow-setting tray material and wash material with large impressions.
- Cool the impression material before use. This extends the working and setting time.

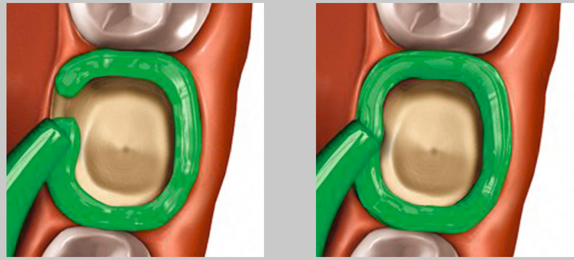


Figure 42: Discontinuity defects, such as line angle voids and fins, can be caused by failure to syringe completely around the circumference of the tooth.

Ledges, or horizontal fins on the impression are the exact opposite of voids: ledge is a positive projection from the surface of the impression into the tooth cavity. This type of impression produces void-like defects in the model. It should be noted that defects resembling ledges can also be the reproduction of actual surface defects, e.g. a gap between the tooth structure and core build-up or post and core.

Causes:

- The impression tray was moved or slipped before the material had completely set: this is the most common cause of flash. This can cause partially set material to overlap and protrude from the surface.
- The set putty impression was incorrectly positioned when the wash impression was taken.

Solutions:

- Block out any actual defect and take the impression again.
- Create more space in the putty for the wash material.
- Prevent movement of the tray while the material is setting.

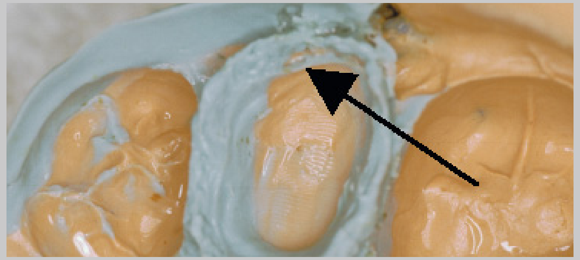


Figure 43: Ledges can be created if the impression is moved before the material is fully set.

Choosing the correct size and fit of the impression tray is just as important for successful impression taking as using the correct type of tray. If the patient's teeth or mucosal tissue comes directly into contact with an impression tray, it can impair the overall accuracy of the impression. This also applies to contact with the set putty in the case of a two-step putty-wash impression.

Causes:

- Incorrect size or shape of tray for the relevant jaw
- Incorrect positioning or insertion of the tray
- Tray inserted too far
- Patient biting on the tray
- Unsuitable tray impression material
- Inadequate cutting back of the putty impression for the wash material

Solutions:

- Use custom trays to fit the shape and size of the jaw exactly.
- Select stock trays prior to impression taking and fit these carefully to ensure they seat passively.
- Practise inserting the tray with the patient before finally taking the impression.
- Use an open mouth impression technique to avoid the patient biting on the tray and inserting the tray too far.

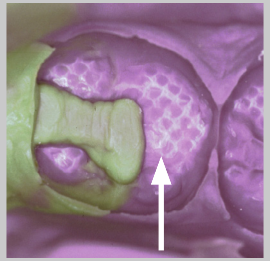


Figure 44: Excessive contact with the wall of the tray results in poorly fitting restorations.

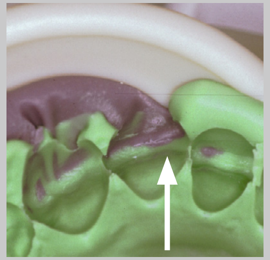


Figure 45: Obvious tooth contact with stock trays should be avoided.

Tearing or breaking off of the impression material results in inaccurate reproduction of the sulcus and surface of the tooth or preparation in the same way as voids and ledges.

Causes:

- The tray was removed before the material had fully set.
- Deep undercuts
- Inadequate retraction: this results in thin margins with low tear resistance.
- Inadequate tooth preparation: this results in thin margins in the impression.
- Contamination by latex gloves or composites
- A material with a low tear resistance was used in a clinical situation that requires a high tear resistance, e.g. in a case with deep undercuts.

Solutions:

Careful, thorough preparation can avoid tearing in the majority of cases:

- Use the double-cord technique to improve retraction and absorb moisture more thoroughly.
- Prepare the tooth adequately.
- Block out deep undercuts.
- Check the use-by-date and setting times of the impression material.
- Do not touch the preparation or materials with latex gloves.
- Use a material with a higher tear resistance.

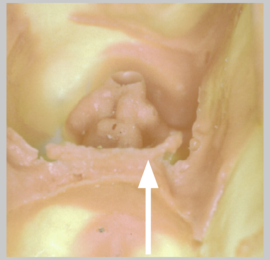


Figure 46: This impression shows obvious signs of tearing on the proximal margin.

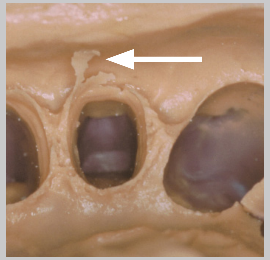


Figure 47: The tear in the interproximal region probably does not affect the impression. The tear on the facial margin, however, impairs the quality of the impression.

The wash material and the tray material do not bond adequately with one another and separate when removing the impression.

Causes:

- The working and setting times of the wash material and tray material were not properly coordinated.
- The wash material had already partially set before the tray was inserted.
- Contamination between the layers, e.g. by blood, saliva or moisture.
- High oral or ambient temperatures: this can accelerate the setting time of a layer.

Solutions:

- Wait until the tray is fully loaded and ready to insert before syringing with intraoral wash material.
- Cool the materials or take the impression at a lower ambient temperature.
- Avoid contamination between the layers.
- Adhere to the recommended working time.
- Keep to the manufacturer's recommended setting time, even though the material feels firm to the touch.

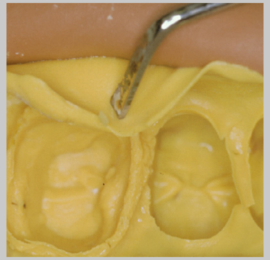


Figure 48: Poor bonding or delamination is virtually always the result of a lack of coordination between the setting times of the tray material and wash material.

Accuracy – the degree to which an impression material can reproduce surface details of the tooth or tissue

Astringents – chemical or medicament materials which tend to temporarily contract or shrink biologic tissues, and reduce secretions and discharge from the tissue; used in impression taking; can be directly applied to tissue or delivered via retraction cords impregnated with the astringent

Dimensional stability – the property of a material which relates to the consistency and constancy of its dimensions when exposed to loading, changes in humidity and/or temperature, or the passage of time

Disinfection – the chemical or physical destruction of all living microorganisms on an impression or object but not the spores

Disinfecting / Hygienic cleaning – measures for reducing the number of bacteria on an impression to a value deemed safe by the standards and requirements of a health authority

Double-cord technique – a gingival retraction technique in which two separate retraction cords are used; the first, usually smaller, cord is placed under the gingival margin to control gingival seepage; the second, somewhat larger, cord is placed above it and removed just before the impression is taken

Elastomeric materials – a lightly cross-linked type of polymeric material that possesses elastic qualities and properties

Gypsum – a powdery material that is mixed with water and used in dentistry to make dental models; gypsum is usually made from a dihydrate form of calcium sulphate which is crushed and heated to remove the water

Haemostasis – the controlling or stopping of bleeding or blood flow

Hydroactive (rendered hydrophilic) – a formerly hydrophobic material that has been rendered hydrophilic through the chemical addition of surfactants so that it performs well in very moist environments

Hydrophilic material – a material with a high affinity for moisture

Hydrophilicity – the measure of a material's affinity for moisture

Hydrophobic material – material that has a low affinity for and is often repelled by moisture

Iatrogenic – an adverse condition, injury or physical harm that has been directly induced in a patient by a dentist's activity or treatment

Line angle – an imaginary line on a tooth used to describe where two major tooth surfaces meet, such as the mesial and buccal line angle

Monophase – referring to an impression material with a suitable viscosity so that it serves well as both the tray and wash material, allowing the impression to be taken in one step with one material

Open-bite impression – an impression recorded of a single arch of teeth or tissue, or portion of a dental arch, whilst the patient holds his mouth in an open position; usually intended to record only the working impression

Oxygen (air) inhibited layer – a thin layer of uncured material that remains on the surface of a dental adhesive or polymer composite resin material due to the competitive inhibition of the setting reaction by oxygen in the air

Retraction – temporarily pushing back the free gingival margin to expose the subgingival area of the tooth or prepared area so that impression material can reach it

Setting time – the time required for a material to solidify, set, polymerize or harden from an initial plastic or liquid state; the setting time includes the working time of the material and does not necessarily indicate the total completion of the chemical reaction, which may continue for long periods of time

Single-cord technique – a method of retraction wherein a single retraction cord is placed into the gingival sulcus just below the gingival margin and removed prior to taking the impression

Sterilisation – the complete destruction and killing of all microorganisms and spores on an impression or other object; may be accomplished through the application of chemical agents or heat

Stropping (smear mixing) – a process in which two viscous pastes are mixed on a flat pad using a spatula

Surfactants – chemicals that are added to or sprayed on impression materials to improve their hydrophilic properties

Syringe material – material with a low or very low viscosity that can be dispensed through a specially adapted impression syringe or delivered directly from automixing cartridges; it is most often used to record the fine details of tissue, cavity preparations and tooth preparations; sometimes referred to as wash material

Tear strength – a measure of the resistance of a dental or impression material to tearing forces; this property is sometimes affected by the rate of loading or how the tearing force is applied

Tempering – the process of cooling a heated material to a temperature that is comfortable and safe to place into the mouth of a patient; usually accomplished with a tempering bath

Thermoplastic – a physical reaction where a material changes reversibly from a gelled solid to a solution due to the application of heat

Thermosetting – a chemical reaction where a material is caused to set or changes irreversibly due to the application of heat (i.e., is set by heat)

Tray material – usually refers to a medium- to heavy-bodied impression material, or material with a medium, high or very high viscosity that is loaded into an impression tray and used to hydraulically push the wash material into contact with the tooth or prepared area being impressed

Viscosity – the resistance a material has to a change in form or ability to flow; this property can be thought of as a kind of internal friction to the material. Low viscosity materials are usually flowable (e.g. light body wash materials) used with high viscosity, firmer materials (e.g. heavy body or putty materials).

Wash material – referring usually to a light-body or low-viscosity impression material that is used to record fine details of an impression; is typically used with tray material (see syringe material)

Working time – the time period during which the impression material may be mixed, loaded into an impression syringe or tray, and placed into the mouth; the time from the beginning of mixing an impression material until the point where its degree of setting prevents it from being safely manipulated without introducing distortion or error in the final impression

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