Impressions 101: In Search of the Perfect Impression

Dentists strive for the “perfect impression,” but they constantly deal with several factors that may prevent them from obtaining perfection. Moisture contamination remains atop the list. Despite meticulous preparation, correct delineation of the preparation margins and thorough drying, sulcular fluids, saliva or gingival bleeding can lead to inaccurate detail reproduction, blisters, bubbles or pulls in the impression. The mainly hydrophobic properties of addition-curing silicones are often a limiting factor when trying to achieve dimensionally accurate impressions. New A-Silicone materials displaying an exceptional initial hydrophilicity because of the addition of surface-active tensides have been introduced into the market. Before the release of these products, polyether was the material of choice in borderline cases where moisture control was not totally successful; however, stiffness, difficulty to disinfect and cost have displaced these materials as the dentist’s first choice of impression materials creating the need for new, smart silicone impression materials.

Impression materials have improved but, until recently, were limited in their ability to work in a somewhat moist environment. The properties of the ideal impression material described in the literature are the following:

- An infinite shelf life
- Easy to dispense, proportion and mix.
- Acceptable odor, taste and color
- Suitable working and setting times
- Strength to resist tearing
- Compatible with model and die materials
- Cost effective
- Easy to dispense, proportion and mix
- Easy to clean up
- Facilitate visualization of the finish line
- Allow for multiple die pours
- Facilitate the clinical identification of beginning and end of cure

New correction materials such as Panasil® initial contact light and Panasil® initial contact x-light (Kettenbach) display an especially high initial hydrophilicity, promising optimal flowing properties, even onto the moist tooth surface. Hydrophilicity is attributed to...
optimized flow properties and accurate detail reproduction at the time of clinical application, especially on a wet oral surface.\textsuperscript{3}

A-Silicone materials, because of their high degree of refinement and a low contraction behavior compared to condensation-curing products, are currently still considered the new “gold standard” among impression materials. The hydrophilicity of many A-Silicones is achieved by adding tensides which act as surfactants, eliminating, to a large extent, the hydrophobic nature of silicone.\textsuperscript{4} This “hydrophilication” takes sufficient effect usually some time after the mixing or even after the setting. Often, as a result, the tensides are still not active even during the injection of the impression material.\textsuperscript{5} Panasil\textsuperscript{®} initial contact, because of its initial hydrophilicity, allows high precision impressions even in the presence of moisture. Furthermore, the initial hydrophilic properties are said to be present throughout the entire working time.\textsuperscript{6} Not only its hydrophilicity maintained during all the working time, it also increases in the presence of moisture.

Ever since the first “hydrophilic” polyvinylsiloxane (PVS) was introduced years ago, there has been a race among manufacturers to create products with as much hydrophilicity as found in polyether. Polyether’s chemical makeup allows it to remain moisture tolerant throughout its working and setting time.\textsuperscript{4} During their research, Kettenbach studied the effect of relative humidity on the hydrophilicity of unset elastomeric impression materials. Measurements of the initial water contact angles at different relative humidities were analyzed. Only Panasil\textsuperscript{®} initial contact exceeded the polyether’s initial hydrophilicity (Figure 1). It also demonstrated an increased hydrophilicity with increasing relative humidity. Analyzing the initial contact angles of 1-second-old drops at 20%, 50% and 80% relative humidity, Panasil\textsuperscript{®} initial contact was more hydrophilic than polyether\textsuperscript{3} (Figure 2). What this means to the dentist is that Panasil\textsuperscript{®} initial contact performed better in a moist environment than the previous “gold standard” polyether. Because of this, Panasil\textsuperscript{®} initial contact has been proven to be an excellent alternative to polyethers in high-moisture environments.

Clinical Experience

A restorative rehabilitation course entitled “Full-Mouth Synergy” given by The Aesthetic Masters Group requires participants to prepare and deliver 20 units (10 upper and 10 lower) during a 3-month period (Figure 3). The Group, led by Drs. Mark Montgomery and Ron Ritsco, teaches a very simplified and repeatable technique to restore complex cases using sound occlusal principles creating synergy between proper form and function. Each participant is assigned a clinical instructor who oversees the work as it progressed. The list included a rather esteemed group of pioneers in the field of comprehensive esthetic dentistry. Drs. Debra Gray King of Atlanta, Georgia, Sheldon Seidman of Chicago, Illinois, David Faust of Yardley, Pennsylvania and Chris Hammond of Provo, Utah, guide the students through the process and offer their insights during the clinical phase.

During the diagnostic phase at “Synergy,” open bite apex of force registration was taken using Futar\textsuperscript{®} D Fast bite registration material (Kettenbach) (Figure 4). The material is packaged in a dual-mix syringe, which makes for easy placement. The bright pink color increases its visibility as well. Futar\textsuperscript{®} D Fast is extremely hard once set (Shore-D hardness of 43) and from a clinical standpoint, its hardness was noted when removing it from the mouth. Unlike some of the other bite registration materials, there was very little flexibility when it was completely set.

Full-arch impressions were taken using Panasil\textsuperscript{®} monophase medium (Kettenbach) with Panasil\textsuperscript{®} initial contact as the wash material. Patients commented on how easy the process was and that the material had a rather pleasant taste (Figure 5). During the course, students were given a demonstration of the water droplet test showing the hydrophilicity of different unset PVS impression materials. Impression materials were placed on a metal surface and immediately thinned out. Colored water droplets were added to each unset PVS material. Measurements of the initial water contact angles at different relative humidities were analyzed. Only Panasil\textsuperscript{®} initial contact exceeded the polyether’s initial hydrophilicity (Figure 1). It also demonstrated an increased hydrophilicity with increasing relative humidity. Analyzing the initial contact angles of 1-second-old drops at 20%, 50% and 80% relative humidity, Panasil\textsuperscript{®} initial contact was more hydrophilic than polyether\textsuperscript{3} (Figure 2). What this means to the dentist is that Panasil\textsuperscript{®} initial contact performed better in a moist environment than the previous “gold standard” polyether. Because of this, Panasil\textsuperscript{®} initial contact has been proven to be an excellent alternative to polyethers in high-moisture environments.

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Panasil® initial contact remained intact throughout the setting process. The contact angle of the water droplets on the unset Panasil® initial contact was significantly smaller than the droplets on the unset AFFINIS PVS. The same process was repeated using Panasil® initial contact and Aquasil LV (DENTSPLY Caulk). The same results were noted (Figure 6).

The same process was performed again using Panasil® initial contact x-light and Aquasil. Warm air was blown over both the unset materials containing the water droplets simulating increased relative humidity. When the relative humidity increased the water droplets on the Panasil® initial contact x-light immediately flattened out. At the completion of the setting time for both materials, it was clear that the shape of the water droplets was clearly captured in the Aquasil PVS material. The opposite was true of the Panasil® initial contact x-light. This demonstration clearly shows that the Panasil® initial contact x-light material would be a better performer in a warm, moist environment. If the clinician is not be able to completely create a dry field, then the hydrophilicity of the Panasil® initial contact x-light would help displace the moisture and allow for a more accurate impression.

One month later students returned to begin the preparation phase of the course. Control bites were taken using Futar® D Fast as the teeth were prepared so as to maintain the newly established vertical dimension (Figure 7). Before preparing the teeth, a reduction guide provided by Utah Valley Dental Laboratory was inserted and a full-mouth impression was taken using Panasil® tray fast heavy material (Kettenbach) (Figure 8). This, in essence, created a custom tray to be used later in conjunction with Panasil® initial contact light. The impression phase was accomplished using two different impression techniques—the double-mix and the two-step putty wash.

When the upper arch was fully prepared, the first final impression was taken using the double-mix technique. Panasil® tray fast heavy material was loaded into the tray and Panasil® initial contact light was injected on the preparations. The trays were seated in the patient’s mouth and left to set for 2 minutes. The Panasil® initial contact light flowed very nicely over the prepared teeth with very little slumping. It had good flow properties and was highly thixotropic. The material did not flow off the teeth after its positioning, nor did it flow toward the patient’s throat when the trays were seated.

As was evident when the tray was removed, the Panasil® tray fast heavy material and the Panasil® initial contact light merged seamlessly (Figure 9). Most of the margins were captured in the Panasil® initial contact light material. The vibrant color contrast between the orange colored tray material and the light green light body material made visualizing the margins very easy. Thanks also to the wash material’s high-tear resistance, the reproduced fine structures such as the subgingival preparation margins or interdental septa remained intact after removal of the tray from the mouth (Figure 10).

The second impression was taken using the two-step putty wash technique. Using the custom tray that was created earlier, students injected the Panasil® initial contact light material into the tray (Figure 11). It was not necessary to inject the light body material onto the teeth as the pressure created from seating the tray forced the light body into the sulcular spaces. Upon inspection after removal from the mouth, it was clear that the entire impression of the teeth and sulcular area was captured in the Panasil® initial contact light material (Figure 12). Patients were pleased with the fact that no excess material was extruded down their throats. They also stated that it was “easier” than the first impression. Patients also found that the impression taking stage was easy, thanks to the neutral taste of the material. The short intraoral setting time and the effortless withdrawal of the impression tray were noted as well.

Both techniques proved to be accurate and clinical success was confirmed upon visual inspection of the final restorations on the working model and on the prepared teeth (Figure 13). This confirmed optimal detail, precision and accuracy of the impression material (Figure 14).

Conclusion
In the never-ending quest for the perfect impression material, great developments have been achieved.
In the past, silicones have been known for their poor wettability and high contact angles. The new A-Silicone materials with their updated developments bring us a step closer to the long sought after “perfect impression.” High-tear resistance adds to the already more than ideal properties of these materials to reproduce every detail with practically no distortion. Regardless of the technique, A-Silicone materials provide great hydrophilicity throughout the entire working time, and as a result, allow dentists the accuracy they have come to expect in final impressions.

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Figure Captions

Figure 1: Initial hydrophilicity of several PVS impression materials.

Figure 2: Contact angle measurements of several PVS impression materials with increasing relative humidity.

Figure 3: Preoperative image of patient. Notice the extreme wear and loss of vertical dimension.

Figure 4: Apex of Force bite registration using composite ball technique. Futar D fast was used as the bite registration material.

Figure 5: Diagnostic impressions being taken.

Figure 6: Close up view of water droplets on unset Panasil® initial contact light and Aquasil LV. Notice how the water spreads out on the unset Panasil® initial contact (lower contact angle).
Figure 7: Control bites of anterior prepared teeth using Futar® D Fast. Previously taken posterior control bites have been placed in the patient’s mouth before taking the anterior bite registration.

Figure 8: Image of maxillary final impression using the double-mix impression technique.

Figure 9: Close-up view of marginal detail captured in the final impression.

Figure 10: Removal of reduction stent, which helped create room for the wash material in the created custom tray.

Figure 11: Image of Panasil® initial contact light being loaded into custom tray using the two-step putty-wash technique.

Figure 12: Image of final impression using the two-step putty wash technique. All of the preparation was captured in the Panasil® initial contact light material.

Figure 13: Image of the Empress® restorations (Ivoclar Vivadent, Inc) on the working model. Marginal integrity was confirmed before the seat appointment.

Figure 14: Postoperative image of patient at the seat appointment.
References


5. Roggendorf HC. The combination of Panasil tray soft and Panasil® initial contact- an effective alternative within the double-mix technique. Bonn: Department of Prosthodontics, 2007.


For further information:
KETTENBACH GmbH & Co. KG
Im Heerfeld 7
35713 Eschenburg · Germany
Phone: +49 (0) 2774 7050
Fax: +49 (0) 2774 70533
info@kettenbach.com
www.kettenbach.com