

Ketac™ Nano

Light-Curing Glass Ionomer Restorative



Technical Data Sheet

Indications

- Primary teeth restorations
- Small Class I restorations
- Class III and V restorations
- Transitional restorations
- Laminate/sandwich restorations
- Core build-ups
(> 50% coronal tooth intact)

Shades

Ketac Nano restorative shades were developed to match Filtek™ Supreme Ultra Universal Restorative targets and are available in the following shades:
A1, A2, A3, A3.5, B2

Introduction

Ketac™ Nano Light-Curing Glass Ionomer Restorative and Ketac™ Nano Light-Curing Glass Ionomer Restorative Primer are the latest developments in a long history of glass ionomer technology provided by 3M ESPE to the dental profession. Ketac Nano resin-modified glass ionomer restorative consists of a two-part paste/paste system, utilizing bonded nanoparticle technology, packaged in both the revolutionary, direct-delivery, unit dose Quick Mix Capsule and the Clicker™ Dispenser.

Historically, glass ionomers consisted of a powder and liquid that were mixed either by hand mixing, or in triturated capsules to initiate the acid-base setting reaction of the glass ionomer. Ketac Nano restorative in the novel Quick Mix Capsule is faster, easier and better.



Composition

The first paste/paste resin-modified glass ionomer restorative developed with nanotechnology.

The chemistry of Ketac™ Nano Light-Curing Glass Ionomer Restorative is based on the methacrylate-modified polyalkenoic acid (Vitrebond™ Copolymer—VBCP) first commercialized in Vitrebond™ Resin Modified Glass Ionomer Liner/Base, and subsequently employed in Vitremer™ Restorative/Core Buildup, and other 3M ESPE dental materials.

The filler content of the system consists of an acid-reactive fluoroaluminosilicate glass (FAS) and contains a unique combination of two types of nanofillers and nanoclusters. While nanofillers are primarily discrete, the nanocluster fillers are loosely bound agglomerates of nano-sized zirconia/silica that appear as a single unit, enabling higher filler loading, radiopacity and strength. The filler loading is approximately 69% by weight.

The third necessary component for a glass ionomer restorative is water. This combination of FAS glass, polyalkenoic acid and water in Ketac Nano restorative is responsible for the ionic glass ionomer reaction that takes place slowly over time. The other components include polymerizable methacrylate monomers and photoinitiators, allowing the dentist to cure on demand.

Ketac Nano restorative compositional comparison to Vitremer Restorative/Core Buildup.

Components	Vitremer™ Restorative	Ketac™ Nano Restorative
Aqueous	De-ionized water	De-ionized water
Methacrylate	HEMA	Blend including HEMA
Polyalkenoic Acid	VBCP	VBCP
Glass	FAS	FAS, Nanoparticles and Nanoclusters

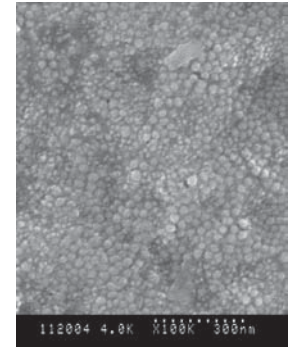


Fig. 1: Ketac™ Nano Light-Curing Glass Ionomer Restorative bonded nanofillers at 100K. Source: Dr. William Douglas and Dr. Daranee Tantibirojn, University of Minnesota

Surface Characteristics

Our knowledge of nanotechnology has led to a quality resin-modified glass ionomer with **unique surface characteristics not typically associated with glass ionomer restorative materials.**

Generally, glass ionomer restoratives can contain a broad range of particle sizes. Filler particle size can influence strength, optical properties and abrasion resistance. By using bonded nanofillers and nanocluster fillers, along with FAS glass, Ketac Nano restorative has improved esthetics and low wear, yet still provides the benefits of glass ionomer chemistry, such as fluoride release. Overall, Ketac Nano restorative exhibits impressive surface characteristics.

Atomic Force Microscopy: 3M Central Research Analytical Laboratory subjected polished samples to a topographical study using AFM (atomic force microscopy). The resulting AFM images are shown in Figure 2. Peaks and valleys on each surface are clearly distinguished by color differences according to the legend. Here, the deep blue represents a valley and the red indicates a peak. This visual clearly shows the different surface roughness of each of these materials.

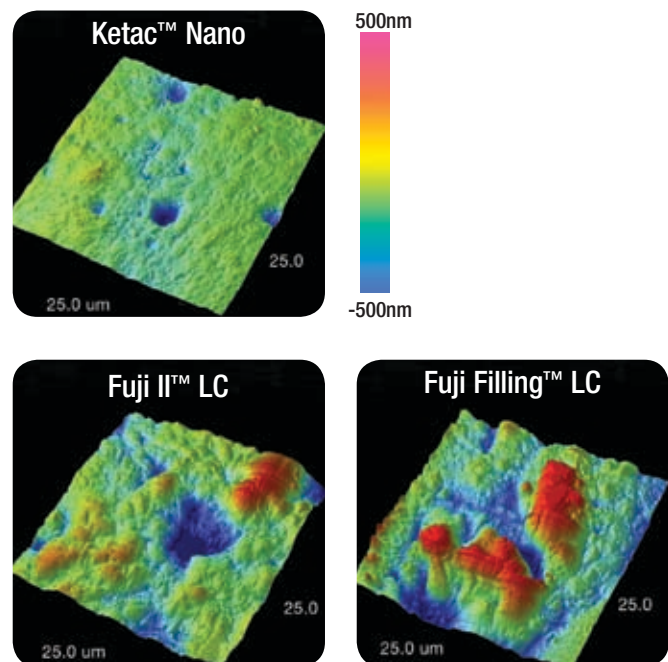


Fig. 2: Surfaces after polishing with a medium-grit disc followed with a two-step, diamond-impregnated, rubberized polishing system.

Surface Roughness: Ra is the universally recognized, and most used, international parameter of surface roughness. It is the arithmetic average deviation of peaks and valleys from the mean line. Rq determines the root-mean-square value of roughness corresponding to Ra. Rq has the greatest value in optical applications where it is directly related to the optical quality of a surface. Ketac Nano restorative roughness values (Fig. 3) provide a quantitative value to the AFM visuals (Fig. 2) taken after polishing.

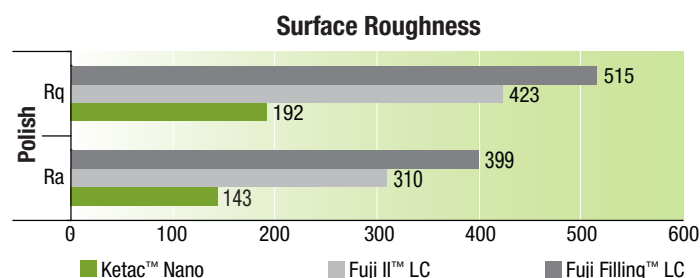


Fig. 3: Ketac™ Nano Light-Curing Glass Ionomer Restorative has smoother surfaces after being subjected to polishing.

Gloss

Along with low surface roughness, another feature for good esthetics is surface gloss.

Directly after polishing, the Ketac Nano restorative surface exhibits a high gloss finish and the practice of applying a surface glaze, as recommended for most glass ionomers, is not required.

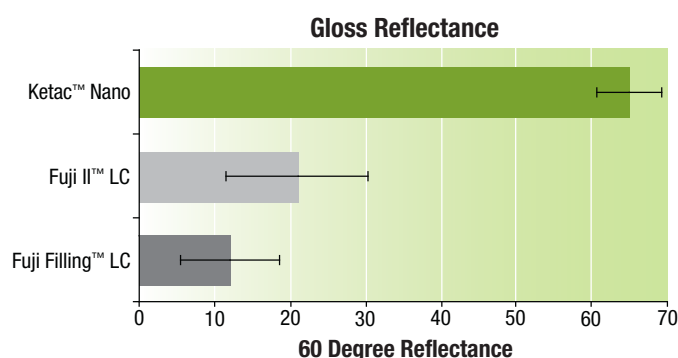
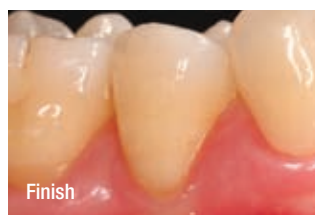


Fig. 4: Rhopoint Novo-Curve gloss reflectance readings.



Fig. 5: Photographic images of reflectance after polishing. All glass ionomers shown are Shade A2.

Clinical results



Photos courtesy of Dr. Gunnar Reich.



Photos courtesy of Dr. Montri Chantaramungkorn.

Fluoride Release

Ketac Nano restorative has high fluoride release.

The Ketac™ Nano Light-Curing Glass Ionomer Restorative Primer layer is extremely hydrophilic and provides ion transport just like 3M™ ESPE™ Vitremer™ Glass Ionomer Restorative Primer. The components of the primer are also key parts of the Ketac Nano restorative paste composition, and are key to promoting adhesion, the glass ionomer reaction, and the resulting fluoride release seen with all true glass ionomer materials. **A study was performed examining the fluoride release of Ketac Nano restorative with and without primer, and data confirms the primer does not inhibit fluoride release.**

Fluoride uptake in enamel has been known to have a caries preventive effect.* Ketac Nano restorative shows a high fluoride release. Additionally, in vitro tests demonstrate an artificial caries inhibition effect, and the ability to recharge the fluoride release.

*CDC MMWR, Recommendations for Using Fluoride to Prevent and Control Dental Caries in the U.S., Aug 2001, Vol 50 No RR-14

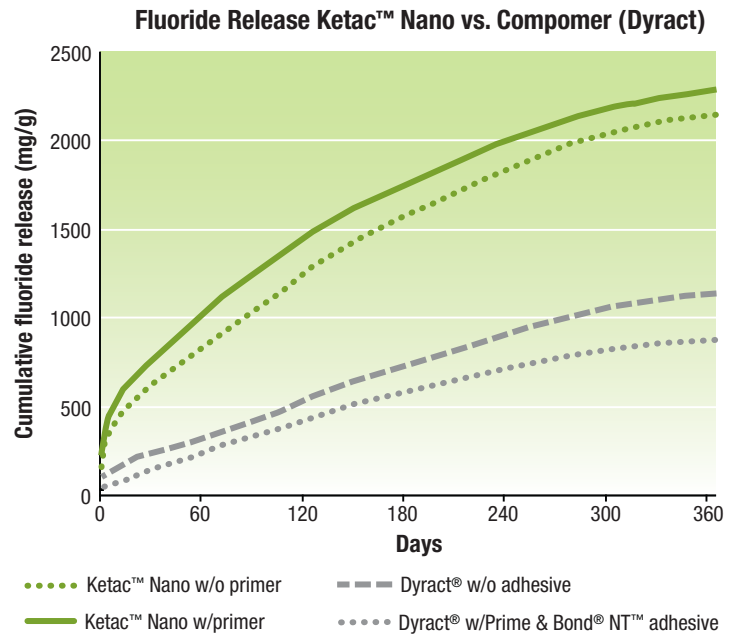


Fig. 6: Cumulative fluoride release with and without Ketac™ Nano Light-Curing Glass Ionomer Restorative Primer compared to a compomer.

Physical Properties

Following are graphs presenting some key properties of Ketac Nano restorative. 3M ESPE applied patented techniques, materials and nanotechnology and designed a paste/paste product with excellent esthetics and low wear, while maintaining the other physical properties of resin-modified glass ionomers.

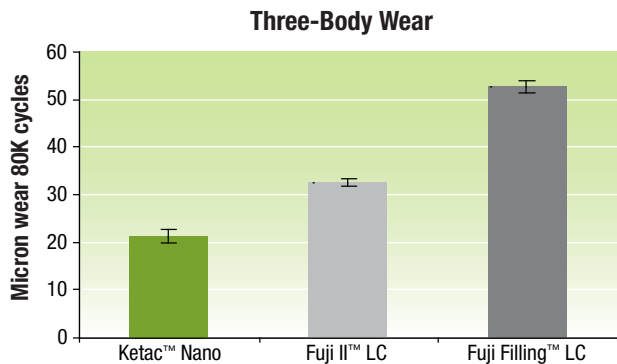


Fig. 7: The measurement of wear is critical as an indicator of longevity in a restoration. In this test, Ketac™ Nano Light-Curing Glass Ionomer Restorative is statistically lower (more wear resistant) than the other resin-modified glass ionomers.

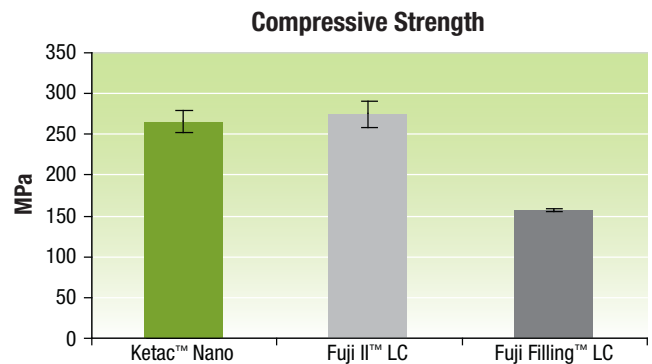


Fig. 8: For compressive strength tests, a sample of material is placed under a load that compresses it at opposite ends. The load tends to compress, or shorten it. Failure is the result of shear and tensile forces.

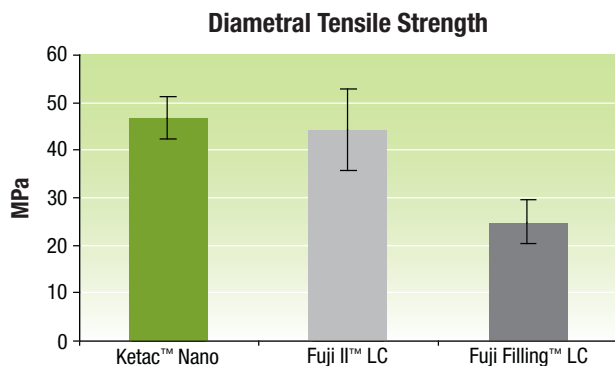


Fig. 9: Diametral tensile strength is measured using a similar test to compressive strength. Forces are applied to the sides of the sample until fracture occurs.

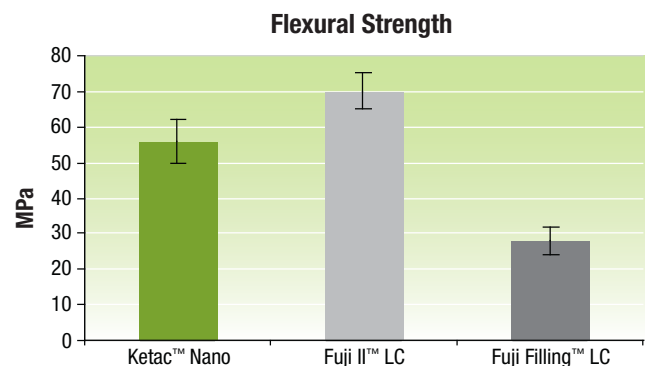


Fig. 10: Flexural strength is measured by using a rod of material that is supported on each end and then applying a load to the center until it breaks.

Quick Mix Capsule

Ketac Nano restorative is now available in a new, revolutionary Quick Mix Capsule that saves time, is easier to prepare and simpler to use.

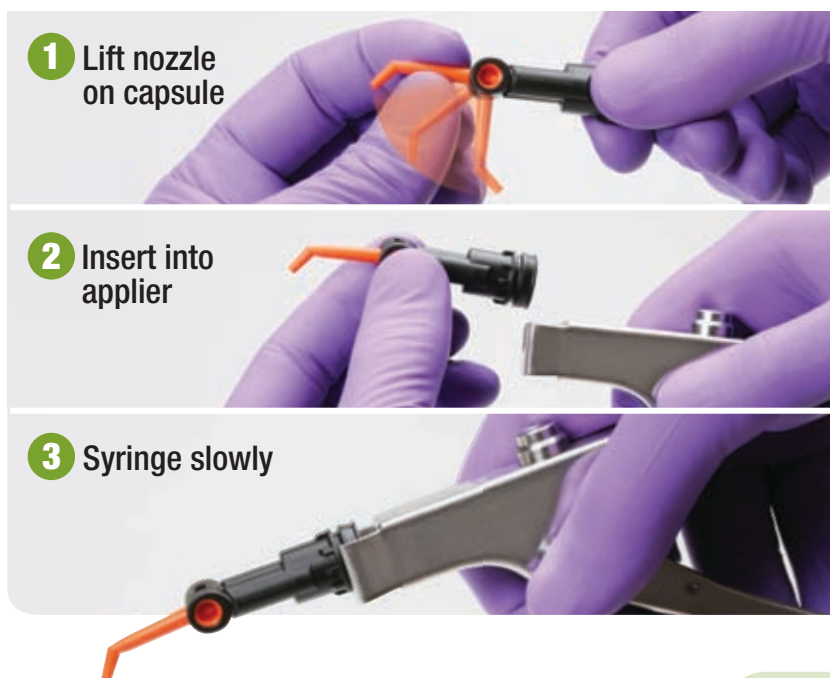
Ketac Nano resin-modified glass ionomer two-part paste is now packaged in a unit-dose static mix capsule. The capsule eliminates any hand-mixing or mixing equipment required for current glass ionomer capsules. Just open the capsule, place into a 3M ESPE capsule applicator, and dispense directly into a preparation.



Easier

The steps needed to prepare a glass ionomer capsule for use are significantly less with the Quick Mix Capsule.

Quick Mix Capsule: 3 Steps



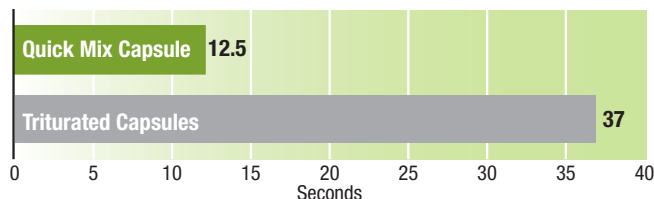
Triturated Capsule: 11 Steps

- 1 Shake capsule to loosen powder
- 2 Depress plunger on capsule
- 3 Insert into activator/applier
- 4 Click once to activate
- 5 Remove from applier/activator
- 6 Insert into mixer
- 7 Mix for 10 seconds
- 8 Remove from mixer
- 9 Insert into applier
- 10 Two clicks to prime
- 11 Syringe slowly

Faster

Dental assistants were able to prepare the Quick Mix Capsule for the dentist three times faster than a triturated capsule.

Capsule Preparation Time



Additional benefits of the Quick Mix Capsule

- Capsule supplies the dentist with the **same amount of restorative material delivered into the preparation** they expect with other glass ionomer capsules.
- Capsule has a **built-in failure mode** in case of misuse. Ketac Nano restorative is designed to escape from the hinged joint of the Quick Mix Capsule if nozzle is not fully opened, or operator dispenses beyond working time.
- **Does not require the use of amalgamator/triturator equipment.** Opens up space in your operatory.
- **Better infection control**, disposable single-use dosage.
- **Faster, easier and less mess** than hand-mix glass ionomer restoratives; no mix pads, spatulas, measuring, mixing or cleanup.
- **Force to dispense is similar to what dentists expect** from their glass ionomer capsules.

Fewer Voids

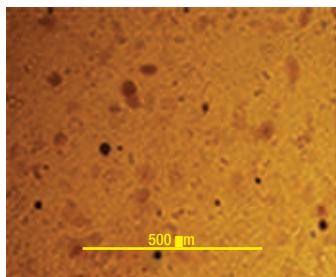
There are fewer voids when dispensed from a Quick Mix Capsule than from a triturated capsule.

Porosity: The porosity of a cured restorative material may lead to reduced physical properties. (John F. McCabe, et al, *Dental Materials* (2004) 20 972-978.) Two different methods were used to evaluate the mixing system-induced voids in glass ionomers; optical microscan and micro-CT scan (a 3-D imaging technique). Also, 60% of dentists (n=120) who used the Quick Mix Capsule in their practice noted fewer voids in their restorations.

Porosity of mixed pastes was quantified using these methods:

Optical microscan: Specimens of each filling material were cast between microscope slides to a thickness of 0.005" after mixed per manufacturer's instructions. Light-cured samples were digitally photographed under high magnification. The two-dimensional void area fraction was quantified using Image-Pro Plus 6.3 image analysis software. A minimum of three images per sample were analyzed.

Ketac™ Nano restorative



Fuji II™ LC

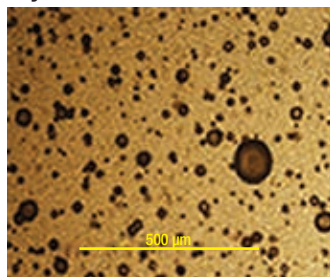


Fig. 11: Comparison of void percentage from image analysis of 2-D micrographs. Voids present as dark brown spots.

Micro-CT scan: Samples were prepared by dispensing the mixed paste directly into plastic tubes and curing them per instructions for use. This was followed by immediate void measurements. Results showed a significant difference between the percentage of voids produced by the Quick Mix Capsule and triturated capsules.

Micro-CT Scans: Yellow = Voids

Ketac™ Nano restorative from the Quick Mix Capsule Fuji II™ LC from a triturated capsule Fuji IX™ from a triturated capsule

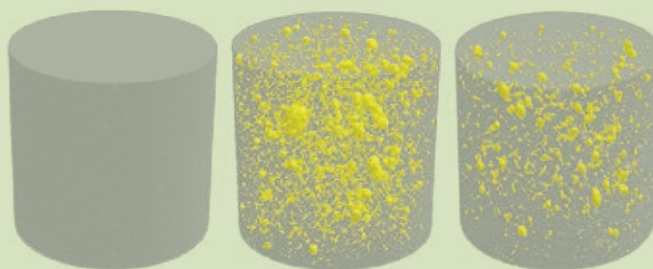


Fig. 12: The micro-CT scan evaluation confirms the optical imaging results that Ketac™ Nano Light-Curing Glass Ionomer Restorative, dispensed via the Quick Mix Capsule, contained significantly lower void content than material dispensed via triturated capsules.

Customer Satisfaction

Clinical procedures can present a number of challenges for a dentist. Choosing materials to achieve a positive outcome for the patient is a priority. Dentists are familiar with the benefits of glass ionomer restoratives, primarily the fluoride release and biocompatibility. Ketac™ Nano Light-Curing Glass Ionomer Restorative makes the decision to incorporate a fluoride-releasing glass ionomer easier, by eliminating the mixing steps and providing a more esthetic glass ionomer.

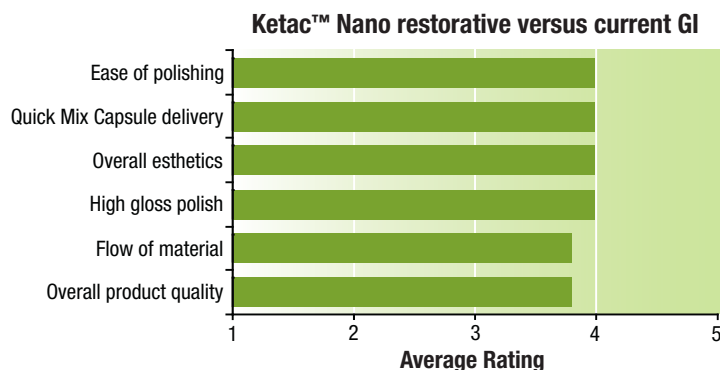


Fig. 13: A clinical survey involving 120 dentists using Ketac™ Nano Light-Curing Glass Ionomer Restorative in the Quick Mix Capsule was conducted in the United States, Germany and Australia. There were high-satisfaction ratings for a number of key attributes, compared to their current glass ionomer restorative.



Fig. 14: In the same clinical survey, most dentists agreed the handling of Ketac™ Nano Light-Curing Glass Ionomer Restorative is rated similar to, or better than, their current glass ionomer restoratives.

Technique Guide

Quick Mix Capsule Tips

- Use capsule within 24 hours of removal from pouch.
- Open nozzle to 180° until it's in a straight line with capsule body.
- Do NOT attempt dispensing at less than 180°.
- Do not re-close after opening.
- Dispense slowly and bleed capsule before dispensing into preparation.
- Subsequent placement of material following initial placements from capsule must be done within 1.5 minutes.
- Using Ketac™ Nano Light-Curing Glass Ionomer Restorative Primer as a wetting agent on placement instruments will aid in minimizing handling concerns.



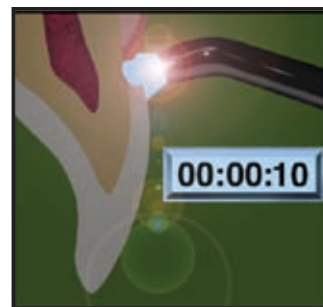
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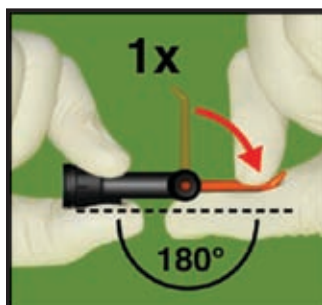
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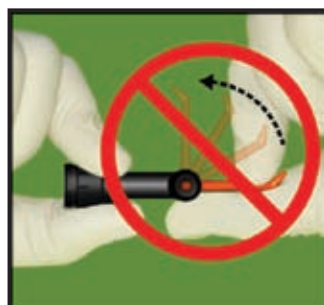
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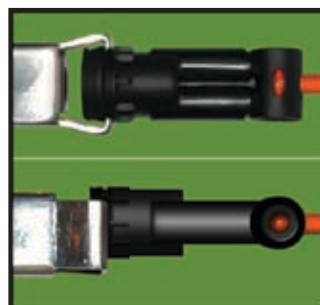
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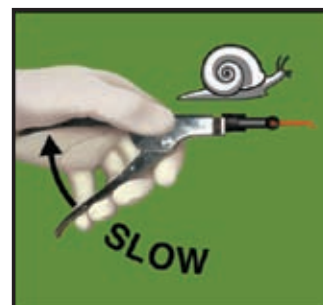
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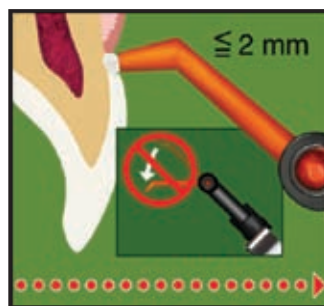
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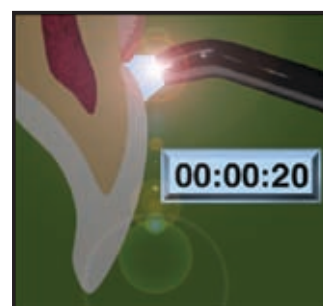
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Testimonials

“In my practice, Ketac Nano is the glass ionomer of choice for patients ranging from pediatric to geriatric.”
















—Dr. Joe Blaes, *Pearls for Your Practice*,
September 2007, *Dental Economics*

“... replicates tooth texture and color at a much higher level than other glass ionomer cements ...”

—Dr. Theodore P. Croll, *The Nano Advantage*,
Renee Knight *Dental Products Report*
Online Edition, 2008

Ketac™ Nano Light-Curing Glass Ionomer Restorative is a fast, easy-to-use, esthetic solution that meets a wide range of indications.

After more than 30 years developing glass ionomer products, 3M ESPE has you covered. Use this handy reference to quickly determine which of the 3M ESPE glass ionomer restoratives will best meet your needs.

Indications									
	Small Class I	Class III	Class V	Minimal Invasive Dentistry (MID)	Primary Teeth	Base Under Composite	Temporary Treatment	Core Build-up	Delivery
RESIN MODIFIED									
Ketac™ Nano	●	●	●	●	●	●	●	●	
Photac™ Fil	●	●	●	●	●		●		
Vitremer™	●	●	●	●	●	●	●	●	
CONVENTIONAL									
Ketac™ Molar Quick	●		●	●	●	●	●	●	
Ketac™ Molar	●		●		●	●	●	●	
Ketac™ Fil Plus	●	●	●	●	●			●	
METAL REINFORCED									
Ketac™ Silver	●		●		●		●	●	



Quick Mix Capsule



Clicker™ Dispenser



Capsule



Powder Liquid

All test data is Internal 3M ESPE unless otherwise noted.

3M ESPE

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