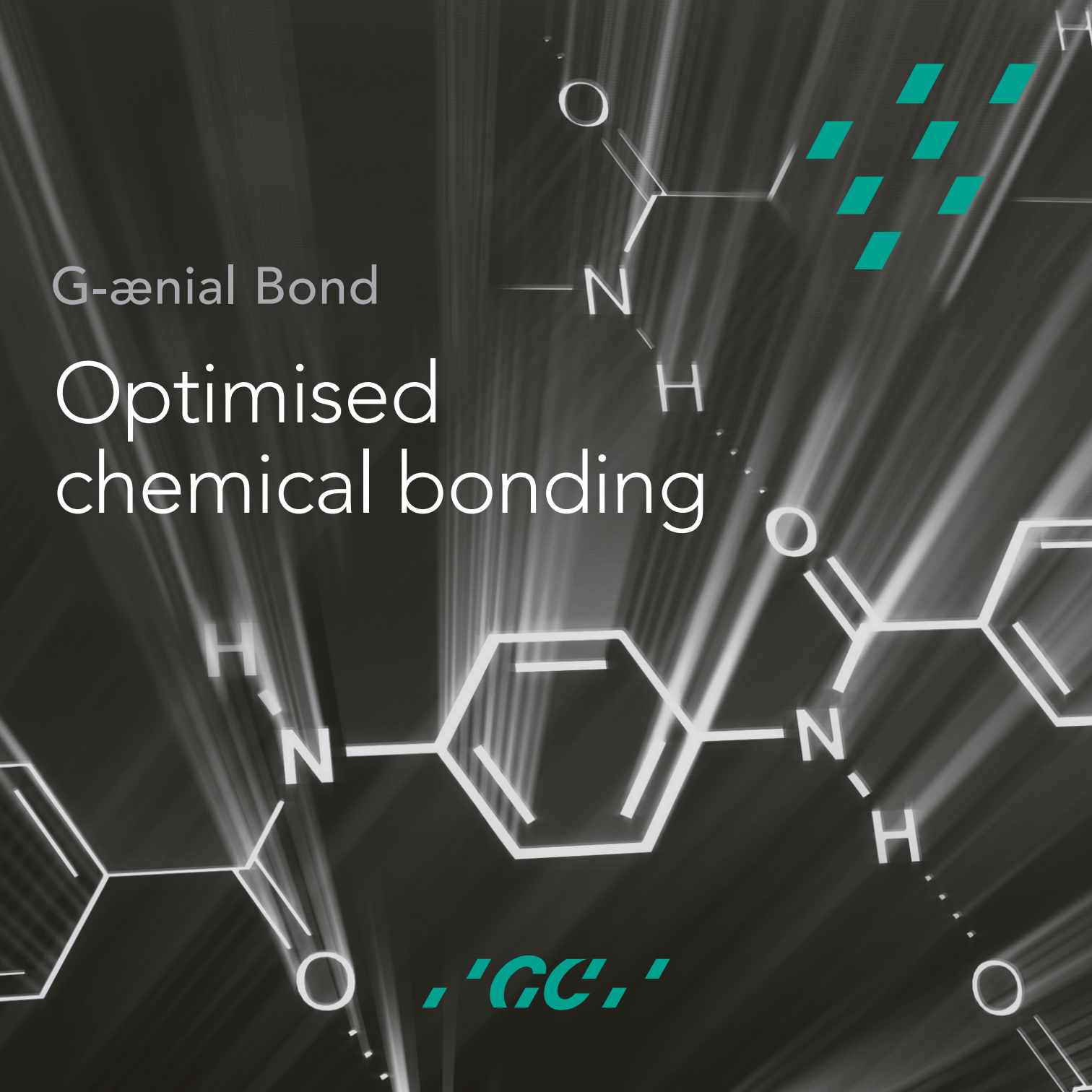

G-ænial Bond
Optimised
chemical bonding

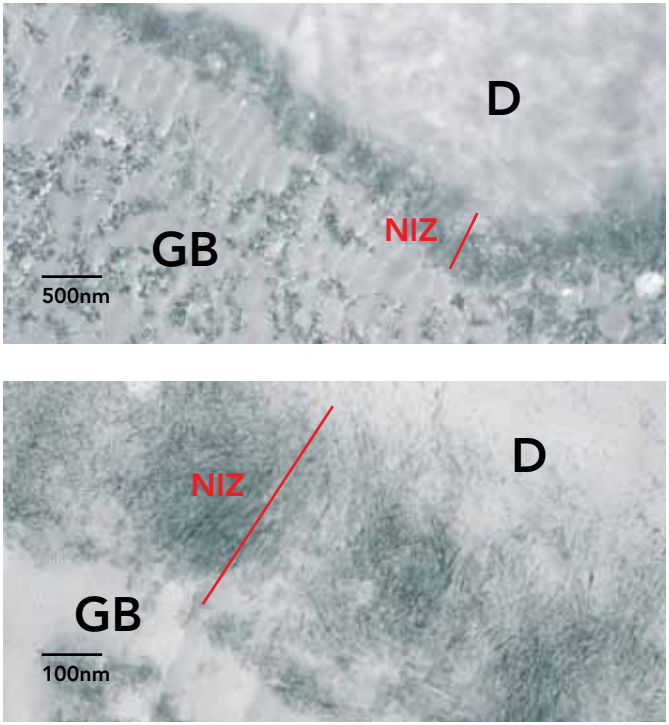
G-ænial Bond – the future is chemical bonding

For many years, dental scientists thought that mechanical retention from a hybrid layer in etched dentine was the key to long term adhesion success. Now we recognise otherwise. The key to strong and durable dentine adhesion is a zone of chemical bonding, called a Nano Interaction Zone (NIZ).

Hybrid layers can produce good initial bond strengths through micromechanical retention, but have proved to degrade over time. A Nano Interaction Zone is a zone of chemical bonding utilising the hydroxyapatite that surrounds collagen to form a strong durable chemical bond.

G-ænial Bond was developed recognising the exceptional clinical trials success of G-BOND – a dentine adhesive which created a 300nm thick NIZ. By refining the synergy of our two clinically proven functional monomers, 4-MET and phosphoric ester monomer, we have now created an even greater zone of optimised chemical bonding – a 500nm thick Nano Interaction Zone.

Chemical bonding = Durable bonding



TEM images of the 500nm thick Nano Interaction Zone (NIZ) showing chemical bonding between G-ænial Bond (GB) and Dentine (D). The Nano Interaction Zone (NIZ) is visualised by demineralising the interface between G-ænial Bond and dentine. The chemical interaction between G-ænial Bond and hydroxyapatite coated collagen is clearly visible.

G-ænial Bond – durable and efficient

Fast application
Total time <30 seconds

No HEMA

Superior bond strengths

Invisible margins

No sensitivity

Matt surface
aids composite placement

Formulated for success:

4-MET Proven chemical bonding

Phosphoric ester monomer Proven chemical bonding

TEGDMA Low viscosity hydrophobic resin

Water Essential to enable demineralisation of the tooth and a predictable chemical reaction

Acetone Evaporates water following successful chemical reaction

The self etch technique. Quick, simple and efficient

There are two ways to apply G-ænial Bond – the self etch technique is shown here, whilst the selective etch technique for enamel is shown overleaf.

1 Apply G-ænial Bond to the tooth surface

2 Leave undisturbed for 10s

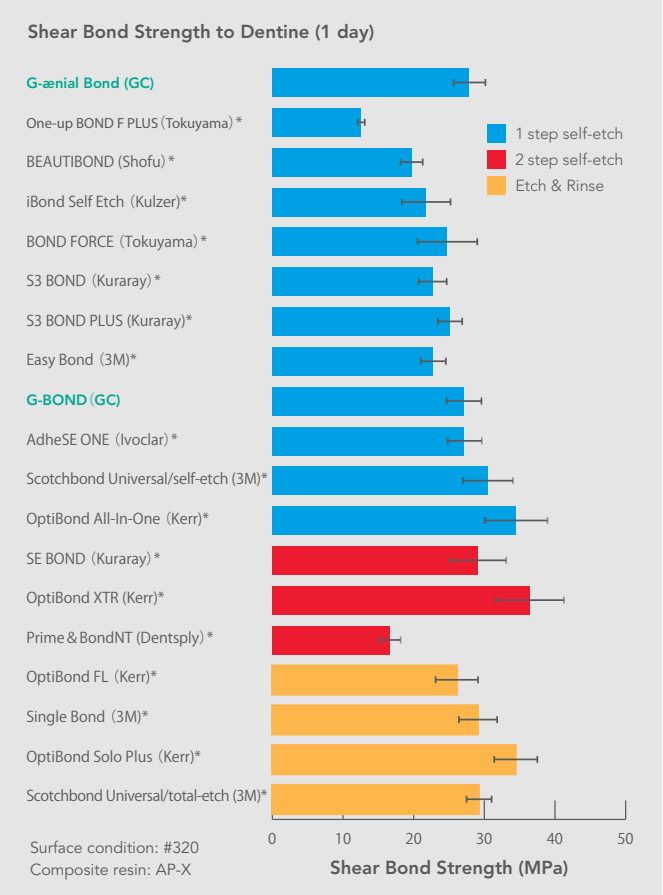
3 Dry thoroughly for 5s under maximum air pressure

4 Light Cure for 10s

Less than 30s

Strong adhesion to dentine

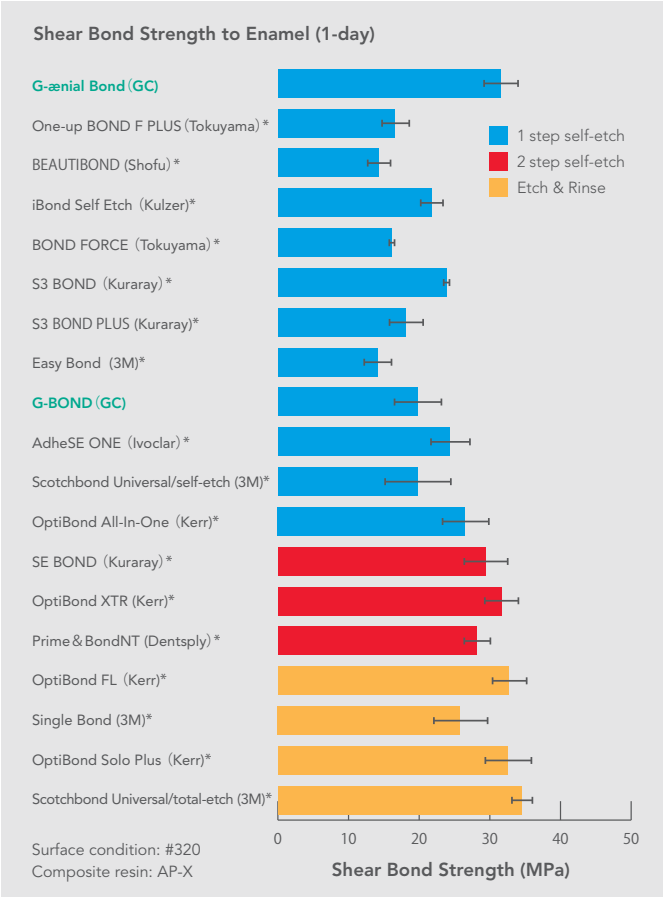
To achieve optimised chemical bonding to dentine, a self etch technique is essential. The balance of functional monomers in G-ænial Bond is designed to solubilise and penetrate variable dentine smear layers and develop a strong Nano Interaction Zone.



R&D Dept. GC Corporation

Strong adhesion to bur-cut enamel (self etch)

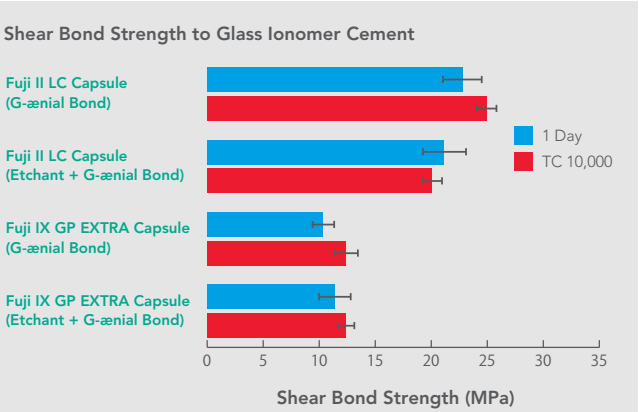
G-ænial Bond has excellent adhesion to prepared enamel, delivering high bond strengths irrespective of the variable smear layers produced by cavity preparation instruments.



R&D Dept. GC Corporation

Strong bonding to glass-ionomer

G-ænial Bond provides a strong chemical bond to a glass ionomer base used in the sandwich (laminate) technique. Acid etching Fuji IX or Fuji II LC (resin reinforced glass ionomer) is optional when using G-ænial Bond. Note: bond strengths below represent cohesive failure within the glass ionomer cement.



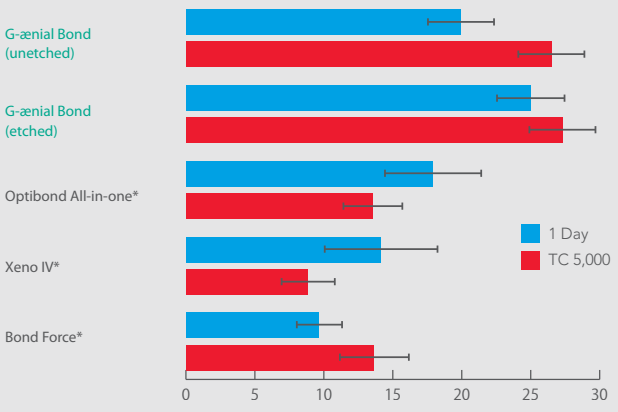
R&D Dept. GC Corporation

* Not Trademarks of GC Corporation

The selective etch technique

The selective etch technique involves etching enamel to enhance micromechanical retention, while maintaining a self-etch approach for optimised chemical bonding to dentine. Selective etch is recommended when additional enamel retention is desired or when bonding to non bur-cut enamel. The recommended etch time is 10 seconds with a 35-40% phosphoric acid gel.

Effect of thermocycling on bond strengths to unground enamel.



Bond Strength to Ground and Unground Enamel of G-ænial Bond. Hirano et al. IADR 2011 abst #3167

Prior to applying G-ænial Bond

Apply phosphoric acid for 10s on enamel surfaces only

Rinse thoroughly for 5s
Dry thoroughly for 5s

The case for etching enamel:
Bonding to enamel presents a number of variables for self-etch materials. Enamel micro-cracks and the level of compaction in smear layers will vary depending on the quality and grit size of cutting instruments. The dense structure of enamel is more difficult than dentine for self etching adhesives to penetrate and their chemical bonding potential will vary depending on the level of carbonated apatite and fluorapatite.

* Not Trademarks of GC Corporation

Clinical Application Benefits

No sensitivity

Immediately following application to exposed dentine, G-ænial Bond will stop fluid movement in the dentine tubules. G-ænial Bond gives you confidence that your bonding procedure won't be a cause of post- operative sensitivity.

Conclusion of Class V Clinical Trial

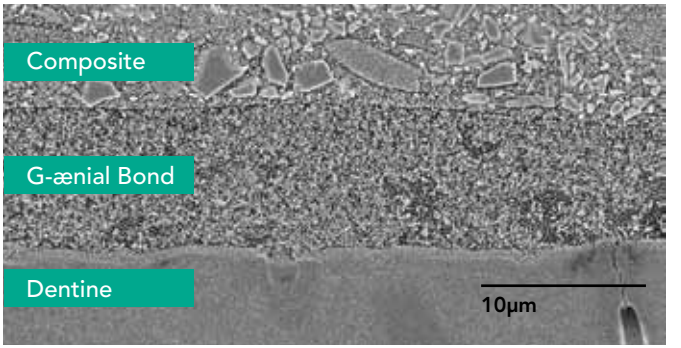
"The combination of G-ænial Bond and Gradia Direct LoFlo resulted in no post-operative sensitivity at 18 months post-placement and the marginal integrity was excellent for all restorations." *Prof M Ferrari, Univ Siena, Italy*

Visible "matt" bond layer aids composite application

After light curing G-ænial Bond, the matt surface identifies exactly where the adhesive has been placed and provides a surface that holds composite to the tooth, giving greater control during manipulation of composite, as shown below.

Invisible Margins

G-ænial Bond has a low film thickness of just 10 microns. This helps ensure aesthetic composite margins and removes the risk of radiolucent zones under composite restorations caused by pooling of bonding agents. This is shown by the radiograph below and the image of the finished restoration.



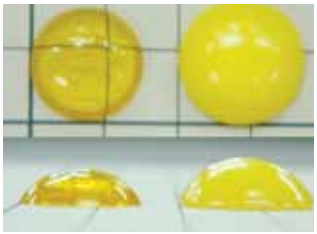
Dr Toshimoto Yamada, Toranomon Hospital

Dr Graeme Milicich

G-ænial Bond contains no HEMA

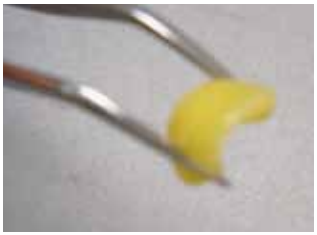
To achieve long term durability, a hydrophobic adhesive is desirable. While the use of HEMA is attractive for manufacturers due to its wetting properties and high early bond strengths, the longer term degradation is cause for concern.

HEMA remains hydrophilic after polymerisation, resulting in water uptake, plasticisation of resin and subsequent degradation over time.



Similar sized samples of polymerised TEGDMA and HEMA have been left in water for 2 weeks. Poly-TEGDMA is hydrophobic, poly-HEMA is hydrophilic. Note swelling of the poly-HEMA.

Poly-TEGDMA remains hard, after 2 weeks water storage.



Poly-HEMA is very soft after 2 weeks water storage.

Why Nano Interaction Zones deliver durability

The Nano Interaction Zone (NIZ) is characterised by the formation of an insoluble calcium salt following the reaction between hydroxyapatite and the functional monomers in G-ænial Bond (4-MET and the phosphoric ester monomer). This NIZ is stronger and more durable than a typical hybrid layer because collagen remains protected by hydroxyapatite.

Hybrid layers degrade

In contrast, a hybrid layer is formed when acid demineralisation of dentine has exposed collagen fibres. This creates a surface layer able to be penetrated by hydrophilic resins. However, this acid insult activates matrix metalloproteinases (MMPs), which are released from the etched dentine and subsequently start degradation of the collagen fibres. This is why the hybrid layer breaks down over time.

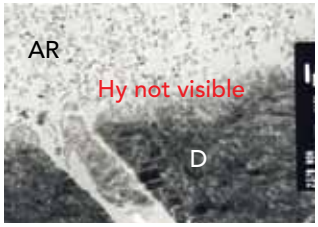
Hydroxyapatite plays an important role in protecting collagen from acid attack. If exposed to acid, collagen fibres release matrix metalloproteinases (MMPs). These host-derived proteases are a group of zinc-and calcium-dependent enzymes that contribute to the breakdown of collagen matrices in the pathogenesis of dentinal caries and periodontal diseases.

Comparison of dentine/adhesive interfacial zones

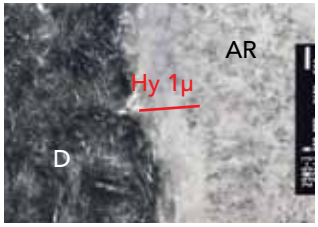
Hybrid Layer

Hybrid layers are characterised by removal of hydroxyapatite and exposure of collagen fibres for mechanical retention.

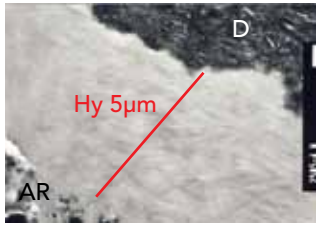
TEM images of non-demineralised specimens (x10,000). *Hy - Hybrid Layer; AR - Adhesive Resin; D - Dentine*



G-ænial Bond – No Hybrid Layer



SE Bond – Some Hybrid Layer

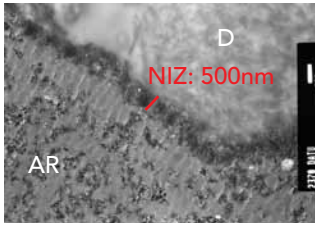


Optibond FL – Hybrid Layer

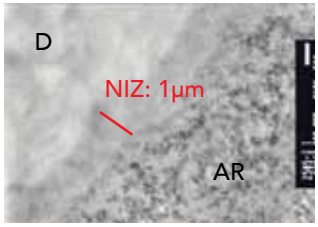
Nano Interaction Zone

The acid resistant Nano Interaction Zone is identified by demineralising the adhesive interface of bonded specimens. The strong NIZ is clearly identified between G-ænial Bond and dentine.

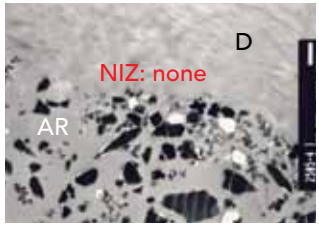
TEM images of demineralised specimens (x10,000).
NIZ - Nano Interaction Zone



G-ænial Bond
– Chemical Bonding



SE Bond
– Some Chemical Bonding

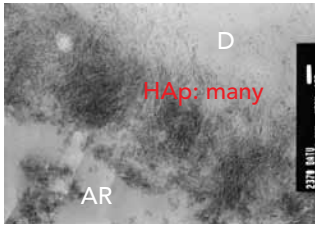


Optibond FL
– No Chemical Bonding

Hydroxyapatite Protecting Collagen

The NIZ has hydroxyapatite still present protecting the collagen fibres and providing calcium for chemical bonding sites.

TEM images of demineralised specimens (x50,000).
HAp - Hydroxyapatite



G-ænial Bond – Hydroxyapatite Protected Collagen

SE Bond – Some Hydroxyapatite Protected Collagen

Optibond FL – No Hydroxyapatite Protected Collagen

Q&A

Q. How many applications can you expect from a 5ml bottle of G-ænial Bond?

A. There are 300 drops of G-ænial Bond in a 5ml bottle.

Q. Why does GC recommend IMMEDIATE application of G-ænial Bond after dispensing?

A. G-ænial Bond is acetone based to provide optimum evaporation of water from tooth surfaces. The acetone component will start evaporating shortly after dispensing, so it is important to apply G-ænial Bond immediately thereafter. This will ensure you have the best possible wetting characteristics and the strongest adhesion.

Q. When drying G-ænial Bond for 5 seconds, how important is it to use MAXIMUM air pressure?

A. A key part of achieving long term durability of dentine adhesion is ensuring no water is left trapped in the bonding agent. Drying G-ænial Bond with MAXIMUM air pressure for 5 seconds will achieve this outcome.

Q. From a clinician's perspective, what are the benefits of air drying under maximum pressure?

A. The instruction is clear and easily reproducible providing a high level of consistency for the bonding procedure. It also results in a consistently low film thickness of bond, which helps create highly aesthetic composite/tooth margins and stops the pooling of bond in line angles of prepared cavities.

Q. The recommended light curing time is 10 seconds. Are there any situations where I should light cure for longer?

A. If the curing light is more than 10mm from bond, then a doubling of curing time is recommended.

Q. Are there any specific recommendations when bonding to glass ionomer cement in the laminate technique?

A. No. G-ænial Bond will chemically bond to any glass ionomer surfaces whether conventional or RRGIC, etched or unetched, freshly set or mature.

Q. Apart from direct placement procedures, what other procedures can I use G-ænial Bond for?

A. Bonding of dual-cured luting and core build-up composites to tooth structure, provided these materials are light-cured.

Q. G-ænial Bond is a refinement of G-BOND technology. How has G-BOND performed in clinical trials?

A. G-BOND has performed extremely well in a number of class V clinical trials. Based on the 5-year clinical trial outcomes from four of these trials, G-BOND is now regarded as the gold standard single bottle adhesive. For more details see www.gcasia.info

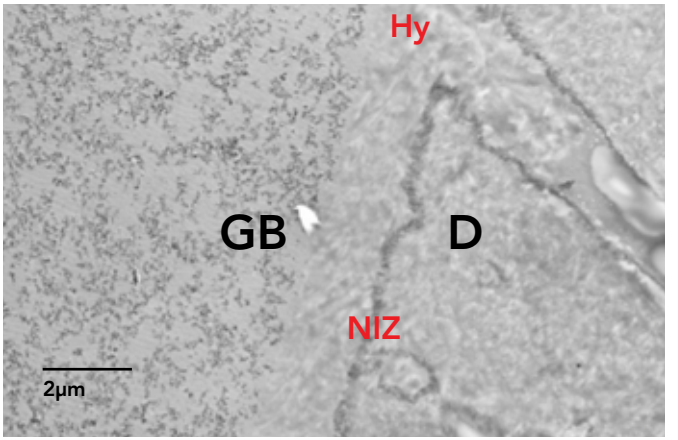
Q. What is the storage requirement and shelf life for G-ænial Bond?

A. During routine use G-ænial Bond doesn't require refrigeration and has a 2-year shelf life. If storing for long periods of time then refrigeration is suggested.

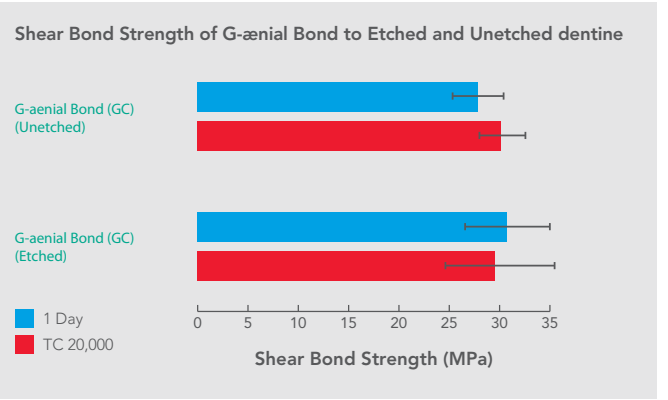
Q. Even with careful placement of phosphoric acid on enamel in the selective etch technique, there is a possibility acid will get onto dentine. How will this affect bond strengths and durability over time?

A. TEM analysis of the interface of G-ænial Bond and etched dentine shows a Nano Interaction Zone is formed at the base of the hybrid layer, which is a good indication that a durable interface has formed. In addition, bond strength testing shows no significant difference between G-ænial Bond applied to etched or unetched dentine. However, we recognise that etching deep vital dentine will result in open tubules with increased water at the adhesive interface, and that collagen in these regions has now been left unprotected by hydroxyapatite and is at greater risk of degradation over time. Residual hydroxyapatite crystals are important to ensure the quality of chemical adhesion and the durability of the bond.

G-ænial Bond and Etched Dentine



TEM image of interface between G-ænial Bond (GB) and Etched Dentine (D). Note: Hybrid Layer (Hy) and Nano Interaction Zone (NIZ).



R&D Dept. GC Corporation

G-ænial Bond

Refill Package contains:
1x 5ml bottle of G-ænial Bond

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